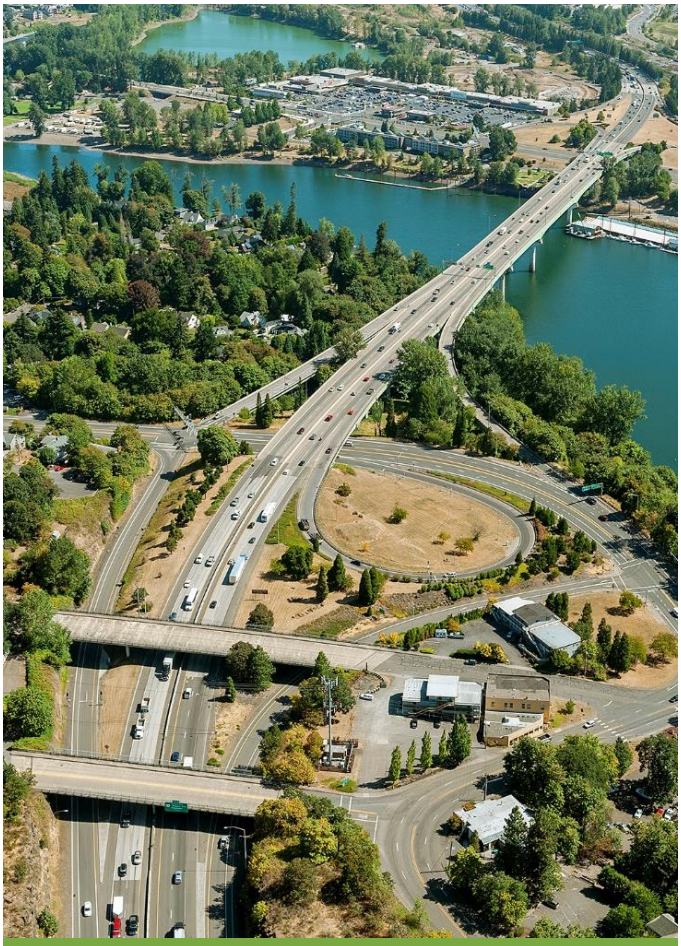
Attachment C(1). Stormwater Report



Preliminary Stormwater Report

ODOT | K19786 I-205: I-5 – OR 213, Phase 1

Combined I-205 Freeway Widening and Abernethy Bridge Project

ODOT EA: PE003013
HDR Project # 10063137

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Prepared by: Cory Gieseke, PE – HDR

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Acronyms

ADT	average daily traffic
bgs	below ground surface
BMP	Best Management Practice
cfs	cubic feet per second
CIA	contributing impervious area
DDE	dichloro-2,2-bis(p-chlorophenyl) ethylene
DDT	dichlorodiphenyltrichloroethane
ft/s	feet per second
HSG	Hydrologic Soil Groups
in/hr	inches per hour
MP	mile post
NAVD88	North American Vertical Datum of 1988
NB	northbound
NRCS	Natural Resources Conservation Service
ODOT	Oregon Department of Transportation
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
project	I-205: I-5 – OR 213, Phase 1
ROW	right-of-way
SB	southbound
STA	Station
SWMACC	Surface Water Management Agency of Clackamas County
USGS	U.S. Geological Survey

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1 Introduction

1.1 Purpose

This report provides a water quality impact assessment and post-construction stormwater management plan for the I-205: I-5 – OR 213, Phase 1 (project). The report summarizes the project stormwater management plan and discusses minimization of water quality impacts.

1.2 Project Description

This project is located on I-205 from mile post (MP) 8.71 to MP 10.24 in Clackamas County, Oregon.

Main components of the project include:

- Reconstructing the I-205 southbound (SB) auxiliary lane from the OR 99E exit ramp to the OR 43 entrance ramp (across the Abernethy Bridge)
- Reconstructing and extending the I-205 northbound (NB) auxiliary lane from the OR 43 entrance ramp to the OR 99E exit ramp (across the Abernethy Bridge)
- Constructing the NB auxiliary lane from OR 99E entrance ramp to OR 213 exit ramp
- Adjusting the OR 99E interchange ramp geometries to conform to the additional freeway lanes
- Modifying the OR 43 interchange by consolidating the entrance and exit ramps and removing the existing OR 43 NB entrance ramp that connects to the Abernethy Bridge
- Widening and seismically retrofitting the following bridges:
    - I-205 over Willamette River (Abernethy Bridge) – MP 9.03
    - I-205 SB Connector #2 to OR 43 (West Linn interchanges) – MP 9.14
    - I-205 NB Connector #1 to OR 99E (Oregon City interchange) – MP 9.30
    - I-205 over Main Street (Oregon City) – MP 9.51

2 Stormwater Design Requirements

The project will be designed to meet stormwater management design standards outlined in Oregon Department of Transportation's (ODOT) *Hydraulics Manual* (2014), Oregon City Public Works *Stormwater and Grading Design Standards* (2019), or City of Portland *Stormwater Management Manual (2016)*, as amended and adopted by the City of West Linn and the requirements in the City of West Linn Public Works *Design Standards* (2010). In the event design standards are different for the two agencies in overlapping coverage areas, the most conservative standard will be used. The following sections address preliminary water quality and quantity control design criteria.

2.1 Water Quality Standards

Stormwater treatment within ODOT's right-of-way (ROW) is required to meet water quality control standards (ODOT 2014). The project water quality goal is met if "…treatment is provided for all of the runoff generated by the Water Quality Design Storm from the contributing impervious area (CIA) using Best Management Practices (BMPs) that utilize infiltration, media filtration, or vegetative filtration." The project's CIA consists of all impervious surfaces within the project limits and impervious surfaces owned or operated by ODOT outside the project limits that drain to the project via direct flow or discrete conveyance.

Stormwater quality treatment facilities will be designed based on a water quality design flow rate and volume. Per the City of West Linn and Oregon City, the water quality design storm is 0.83 and 1.0 inch, respectively. However, ODOT's *Hydraulics Manual*s water quality design storm is one-half of the 2-year, 24-hour storm event, or 1.22 inches. Water quality facilities will be designed using the ODOT water quality design storm of 1.22 inches. Table 1 provides additional project design rainfall depths.

Table 1. Design Rainfall Depth

Return Interval	Rainfall Depth ODOT (inches)[1]	Rainfall Depth West Linn (inches)[2]	Rainfall Depth Oregon City (inches)[3]
Water Quality	1.22	0.83	1.0
2	2.44	2.4	2.8
10	3.28	3.4	3.5
25	3.82	3.9	4.0
50	4.17	N/A	4.4
100	4.65	4.4	4.5

[1] ODOT Hydraulics Manual Chapter 7 Appendix H, Oregon 24-Hour Precipitation Maps
[2] City of Portland Stormwater Management Manual Appendix A, Table A-1
[3] Oregon City Stormwater and Grading Design Standards Chapter 5, Table 5-2

2.1.1 Target Pollutant Removal

Pollutants of concern typically expected in highway runoff are sediment, nutrients, oil and grease, polycyclic aromatic hydrocarbons (PAH), and particulate and dissolved metals (such as copper and lead). Because I-205 has a high average daily traffic (ADT), high pollutant loads and concentrations are expected.

2.1.2 Receiving Waterbodies

The proposed receiving waterbody is the Willamette River. Table 2 lists the beneficial uses and water quality impairments for the receiving waterbody.

Table 2. Receiving Waters Beneficial Uses and Water Quality Impairments

Waterbody	Beneficial Uses[1]	Listed Water Quality Impairments[2]
Willamette River	Public/private/industrial water supply, irrigation, livestock watering, fish and aquatic life, wildlife and hunting, fishing, boating, water contact recreation, aesthetic quality, hydropower, commercial navigation and transportation	aldrin, chlorophyll a, chlordane, DDE, DDT, dieldrin, dioxin, e coli, hexachlorobenzene, iron, lead, manganese, mercury, PCB, pentachlorophenol, polynuclear aromatic hydrocarbons, temperature

[1] Section 401 Water Quality Certification Post-Construction Stormwater Management Plan Submission Guidelines, Appendix 3 Designated Beneficial Uses(Oregon Department of Environmental Quality [DEQ] 2018)

[2] Water Quality Assessment – Oregon's 2012 Integrated Report Assessment Database and 303(d) List (DEQ 2014)

DDE=Dichloro-2,2-bis(p-chlorophenyl) ethylene

DDT=Dichlorodiphenyltrichloroethane

PCB=Polychlorinated Biphenyls

2.2 Water Quantity Standards

2.2.1 Detention

ODOT requires detention when one of the following criteria is met (ODOT 2014):

- Required by a local jurisdiction
- Drainage deficiencies, such as flooding, have been documented
- Discharge into an intermittent or perennial waterbody with an upstream drainage basin less than 100 square miles
- Uncontrolled peak post-construction discharge rate during the design storm increases 0.5 cubic feet per second (cfs) or more
- Total contributing area after the proposed development is 0.25 acres or more

ODOT detention guidelines are in place to reduce streambed and bank impacts to the receiving streams. The project should not increase peak flows or duration of flows for a recurrence interval that corresponds to a flow resulting in sediment transport. ODOT defines sediment transport flows from a lower end of 42 percent of the 2-year event to an upper threshold of the 10-year event for incised streams or bank overtopping for minimally incised streams.

ODOT does not require detention if the site discharges into a waterbody with an upstream drainage basin greater than 100 square miles.

Oregon City uses the same flow control guidelines as ODOT, and exempts systems that discharge directly to the Clackamas River, Willamette River, and Abernethy Creek from flow control.

The City of West Linn requires the post-project runoff from a 2-year, 24-hour storm event to be less than or equal to one-half the runoff from a 2-year, 24-hour storm for pre-development conditions. The facilities must also control the post-development peak flows

from the 5-, 10-, and 25-year, 24-hour storm to the predevelopment 5-, 10-, and 25-year, 24-hour design storm events. Systems that discharge stormwater runoff directly into the Willamette River or through a conveyance system that has adequate capacity to convey the 10-year storm event to the Willamette River are exempt from detention requirements.

2.2.2 Infiltration Design Standards

The City of West Linn and Oregon City stormwater design guidance materials both recommend the use of infiltration as a stormwater treatment and disposal technique above other methods. Both the City of Portland *Stormwater Management Manual*, as modified by the City of West Linn and the Oregon City Public Works *Stormwater and Grading Design Standards* state that infiltration may not be required if site conditions make infiltration infeasible. Examples include:

- The site has seasonally high groundwater of less than 5 feet below the lowest elevation of the infiltration facility,
- The site has low infiltration rates of less than 2.0 inches per hour,
- The facility would be located on fill, and
- The site is located near steep slopes or does not meet slope setbacks.

Infiltration testing is discussed in Section 3.1.1; none of the tests had infiltration rates above 2.0 inches per hour. Because of the low onsite infiltration rates, infiltration will not be utilized as a treatment and disposal technique. Infiltration will be allowed to the extent that passive infiltration occurs. Because the proposed stormwater facilities are flow-through treatment facilities, very little to zero infiltration is anticipated to occur.

3 Existing and Proposed Conditions

3.1 Existing Conditions

The project is located along the existing I-205 corridor, between the Park Place Interchange and West A Street. The roadway topography varies between flat and 3 percent slopes and generally slopes downhill in a west to east direction. The embankment side slopes range from flat to retaining walls. The roadway surface is located in both cut and fill sections in relation to the adjacent ground. In general, the northern side of the highway is at a higher elevation than the southern side. Elevations along the project range from 50 to 160 feet.

3.1.1 Geotechnical Investigations

Soils within the project area generally consist of the Hydrologic Soil Groups (HSG) C and D, with a few pockets of HSG B. The entire Natural Resources Conservation Service (NRCS) Soil Survey Report can be found in Appendix A (NRCS 2017).

In-situ infiltration tests were completed in several locations throughout the project. Locations of the tests are shown in the Stormwater CIA Exhibit (Appendix B) and summarized in Table 3. Multiple tests were conducted at each location. The average

infiltration rates during the August 2018 geotechnical investigation ranged from 0.24 inches per hour (in/hr) to 1.44 in/hr.

Table 3. In-Situ Infiltration Test Results

Designation	Approximate Depth (feet)	Infiltration Testing Method	Final Infiltration Rate for each Trial (inches/hour)			Average Infiltration Rate (inches/hour)
			1	2	3	
INF19786-11	2.0	Open Pit Falling Head Test	0.72	0.36	0.36	0.48
INF19786-12	2.0	Open Pit Falling Head Test	1.44	0.72	1.44	1.20
INF19786-13	3.0	Open Pit Falling Head Test	1.44	1.44	1.44	1.44
INF19786-14	3.5	Open Pit Falling Head Test	1.44	0.72	1.44	1.20
INF19786-15	2.0	Open Pit Falling Head Test	0.36	0.00	0.36	0.24

Groundwater wells were installed in October of 2017 and November of 2018, and elevations of seasonal groundwater levels have been measured periodically since installation. The piezometers were installed near the west and east ends of the Abernethy Bridge. See Table 4 for measured seasonal high groundwater elevations and Appendix A for locations of wells. For locations not in the vicinity of the test wells, the U.S. Geological Survey (USGS) groundwater elevation maps are referenced for approximate groundwater elevations (USGS 2009). The portion of the project located within West Linn will have groundwater located between 60 and 70 feet below ground surface (bgs). The portion of the project located in Oregon City will have groundwater located between 12 and 20 feet bgs.

Table 4. Measured Seasonal High Groundwater Elevations

Facility Number	Anticipated Seasonal High Groundwater Elevation (NAVD88) (feet)
TB19786-01	13.8
TB19786-09	27.4
TB19786-30B	17.5
TB19786-32	17.6
TB19786-40	26.1
TB19786-44	36.5

3.2 Existing Facilities

The existing project area consists of approximately 22 acres of CIA, including pavement, gravel shoulders, overpasses that drain to the project, and bridges.

The existing stormwater management features only consist of conveyance systems; there are no existing water quality facilities within the project footprint. The existing conveyance systems will be utilized to the extent feasible; however, incorporating new water quality facilities and providing a conveyance system that meets current design standards will require construction of additional conveyance networks.

3.3 Pre-development Conditions

The City of West Linn water quantity design criteria requires the post-project runoff from a 2-, 10-, and 25-year, 24-hour storm event be less than or equal to the runoff from the corresponding storm event for pre-development conditions. ODOT and Oregon City water quantity design criteria require the duration of peak flow rates from post-development conditions to be less than or equal to the duration of peak flow rates from pre-development conditions for all peak flows between 42 percent of the 2-year peak flow rate up to the 10-year peak flow rate. Pre-development refers to what the landscape was before any human alterations took place. To compare pre-development conditions to post-project discharge values, the assumed undisturbed project area is a forest or woods in good hydraulic condition.

3.4 Proposed Conditions

The proposed changes to existing conditions that could potentially affect water quality or hydrology include widening the roadway surface an additional travel lane in both directions and, to a lesser extent, removing and relocating existing bridges and ramps. The proposed project area will consist of 26.6 acres of CIA. The additional travel lanes will not change existing roadway drainage patterns. In some areas along the project, drainage ditches will be replaced with closed conduit conveyance systems due to lack of available space. To meet the stormwater design criteria, water quality facilities are proposed along the length of the project and a water quality/detention facility is proposed at one location. These facilities are generally located in areas with adequate available ROW to construct and safely maintain the facilities following ODOT guidelines.

Drainage curbs and inlets will be utilized to the extent practicable to capture only runoff from the roadway surface and not capture or convey runoff from non-roadway surfaces to water quality facilities. This will help reduce the required amount of ROW for the overall water quality facilities footprints.

4 Preliminary Stormwater Recommendation

The project has been divided into basins based on topography and the proposed conveyance system. Appendix B provides a map of basin and facility locations. Table 5 provides a summary of proposed drainage basins.

Table 5. Basin Summary

Basin	Treatment Facility	Treated CIA (acres)	Untreated CIA (acres)	Offset Treatment Impervious Area (acres)	Comments
10	1	1.065	0	0	—
20	2	3.080	0	0	—
30	3	2.179	0	0	—
0S-31	3	0	0	1.652	—
40	4	0.396	0	0	—
41	4	4.560	0	0	—
42	4	0.698	0	0	—
43	4	0.338	0	0	—
50	5	0.719	0	0	—
51	5	0.578	0	0	—
52	5	3.570	0	0	—
53	—	0	0.273	0	Not feasible to provide treatment due to maintenance access concerns and lack of elevation to convey to proposed regional facilities.
60	6	2.299	0	0	—
61	6	0.474	0	0	—
62	6	2.315	0	0	—
63	6	0.123	0	0	—
64	—	0	0.592	0	Not feasible to provide engineered treatment due to lack of suitable ROW and proximity to Willamette River. Non-engineered dispersion is expected to occur before runoff reaches receiving water.

Basin	Treatment Facility	Treated CIA (acres)	Untreated CIA (acres)	Offset Treatment Impervious Area (acres)	Comments
70	7	0.287	0	0	—
71	7	0.333	0	0	—
72	7	0.556	0	0	—
80	8	1.953	0	0	—
90	9	0.134	0	0	—
Totals		**25.658**	**0.865**	**1.652**	**—**

For the basins where treatment is proposed, the runoff is conveyed to a water quality facility for treatment. The facilities are sized using guidelines from ODOT's *Hydraulics Manual* (2014) based on the volumetric flow rate expected to result from the water quality storm event in the corresponding basins. Flow rate calculations for each basin can be found in Appendix C. Key design considerations for the biofiltration swales included a minimum residence time of 9 minutes and a maximum velocity of 3 feet per second (ft/s) in a 25-year storm event. Swale and bioslope sizing calculations are included in Appendix D. The bioretention pond was sized to infiltrate the water quality storm event and provide enough detention to achieve an outflow rate during the 10-year storm equal to the preconstruction outflow rate. Inflow and outflow hydrographs for the proposed detention facility are provided in Appendix C. The bioslope and stormwater planter were sized to infiltrate the peak flows anticipated during the water quality storm event.

Table 6 details the stormwater management facilities and includes a description, specifications, and maintenance considerations for each facility.

Table 6. Stormwater Management Facility Summary

Facility	Treated Area (Acres)	Description	Specifications	Maintenance
1	1.065	Combination biofiltration swale/detention pond located between Station (STA) "L" 663+47 and STA "L" 665+04. The pond receives runoff from Basin 10 via sheet flow and conveyance in an existing ditch, and outfalls to a tributary to Abernethy Creek (Appendix B).	Bottom width is 10 feet and bottom length is 157 feet. Stormwater pretreatment will be accomplished by sheet flow over vegetation. A 6-inch perforated drain pipe with a slope of 0.5% will be installed in granular drain backfill material to prevent standing water conditions due to the low infiltration rate. Planting will be accomplished with an 18-inch layer of water quality mix and seeding (Appendix B). See Basin 1 in Appendix C for design flow rates.	Routine maintenance for detention ponds such as mowing, debris removal, and sediment removal. Maintenance access to the facility will be from the shoulder of I-205 NB.
2	3.080	Bioslope located between STA. "L" 665+00 and STA. "L" 684+00. The Bioslope receives runoff from Basin 20 via sheet flow. The bioslope outfalls to an existing roadside ditch, which is connected to the Clackamas River via an existing stormwater conveyance system (Appendix B).	The length of roadway treated by the bioslope is 1,900 feet. The width is 4.5 feet. One foot of ecology mix soil will be used to treat the runoff. A 12- inch perforated drain pipe located in an 24-inch layer of granular backfill material will be used to drain the bioslope (Appendix B).	Routine maintenance for bioslopes such as debris and sediment removal. Maintenance access to the facility will be from the I-205 NB shoulder.
3	3.831	Biofiltration swale located between STA "L" 689+24 and STA "L" 691+59. The swale receives runoff from Basin 30 via the proposed pipe network, which utilizes existing pipes and structures where possible, and outfalls to an existing system leading to Clackamas River (Appendix B).	Bottom width is 6 feet and bottom length is 235 feet. Pretreatment will be accomplished using a pollution control manhole upstream of the swale. There will be a rock basin flow spreader at the swale inlet and additional flow spreaders at 50-foot intervals. Planting will be accomplished with an 18-inch layer of water quality mix and seeding (Appendix B). See Basin 3 in Appendix C for design flow rates.	Routine maintenance for swales such as mowing, debris removal, and sediment removal. Maintenance access to the facilities will be via an access road to be constructed in ODOT ROW from Main Street.
4	5.992	Biofiltration swale located between STA "99E2" 109+30 and STA "99E2" 111+03. Runoff from Basins 40, 41, 42, and 43 is collected and piped to the low end of the I-205 SB on-ramp from OR 99E. After treatment, the proposed network connects to an existing system that outfalls to the Willamette River (Appendix B).	Bottom width is 20 feet total, divided into two 10-foot-wide sections with a center flow separator, and bottom length is 180 feet. Pretreatment will be accomplished using a pollution control manhole upstream of the swale. There will be a rock basin flow spreader at the swale inlet and additional flow spreaders at 50-foot intervals. Planting will be accomplished with an 18-inch layer of water quality mix and seeding (Appendix B). See Basin 4 in Appendix C for design flow rates.	Routine maintenance for swales such as mowing, debris removal, and sediment removal. Maintenance access to the facilities will be via an access road from 99E.
5	4.867	Biofiltration swale located between STA "99E2" 114+47 and STA "99E2" 115+86. Runoff from Basins 50, 51, and 52 is collected and piped under the on- and off-ramps connecting I-205 NB to OR99E. The conveyance system consolidates at the low end of the off-ramp prior to the swale inlet. After treatment, the proposed network connects to an existing system that outfalls to the Willamette River (Appendix B).	Bottom width is 14 feet and bottom length is 150 feet. Pretreatment will be accomplished using a pollution control manhole upstream of the swale. There will be a rock basin flow spreader at the swale inlet and additional flow spreaders at 50-foot intervals. A sub-surface drain pipe is required because the bottom slope is less than 1.5%. Planting will be accomplished with an 18-inch layer of water quality mix and seeding (Appendix B). See Basin 5 in Appendix C for design flow rates.	Routine maintenance for swales such as mowing, debris removal, and sediment removal. Maintenance access to the facilities will be via an access road from 99E.
6	5.211	Biofiltration swale located between STA "OR43" 10+52 and STA "OR43" 8+97. Runoff from Basins 60, 61, 62, and 63 is conveyed to the swale via a pipe network. After treatment, the proposed system outfalls to the Willamette River at a proposed riprap pad underneath Abernethy Bridge (Appendix B).	Bottom width is 40 feet total, divided into four 10-foot-wide sections with flow separators, and bottom length is 250 feet. Pretreatment will be accomplished using a pollution control manhole upstream of the swale. Planting will be accomplished with an 18-inch layer of water quality mix and seeding. See Basin 6 in Appendix C for design flow rates. The swale is designed to treat runoff from offsite area and future development.	Routine maintenance for swales such as mowing, debris removal, and sediment removal. Maintenance access to the facilities will be via an access road to be constructed in ODOT ROW underneath Abernethy Bridge.
7	1.176	Biofiltration swale located between STA "OR43" 9+55 and STA "OR43" 12+30. Runoff from Basin 72 is captured and conveyed via a ditch to a ditch inlet at the high end of the I-205 NB off-ramp to OR43. The stormwater is conveyed through the proposed pipe network and picks up flow from Basins 70 and 71. A flow splitter manhole diverts the volumetric flow rate generated by the water quality storm event in Basins 70, 71, and 72 to the swale. After treatment, the proposed system outfalls to the Willamette River at a proposed riprap pad underneath Abernethy Bridge (Appendix B).	Bottom width is 30 feet total, divided into three 10-foot-wide sections with flow separators, and bottom length is 210 feet. Pretreatment will be accomplished using a pollution control manhole upstream of the swale. There will be a rock basin flow spreader at the swale inlet and additional flow spreaders at 50-foot intervals. A sub-surface drain pipe is required because the bottom slope is less than 1.5%. Planting will be accomplished with an 18-inch layer of water quality mix and seeding (Appendix B). See Basin 7 in Appendix C for design flow rates. The swale is designed to treat runoff from offsite area and future development.	Routine maintenance for swales such as mowing, debris removal, and sediment removal. Maintenance access to the facilities will be from the OR43 on-ramp to I-205 NB shoulder.
8	1.953	Biofiltration swale located between STA "E3" 737+51 and STA "E3" 738+64. Runoff from Basin 80 is conveyed to the swale in a pipe network. The swale is sized to treat runoff from improvements further upstream, as well as some of the offsite flow from a large residential area. After treatment, the proposed system outfalls to the Willamette River at a proposed riprap pad underneath Abernethy Bridge (Appendix B).	Bottom width is 55 feet total, divided into five 11-foot-wide sections with flow separators, and bottom length is 142 feet. Pretreatment will be accomplished using a pollution control manhole upstream of the swale. There will be a rock basin flow spreader at the swale inlet. A sub-surface drain pipe is required because the bottom slope is less than 1.5%. Planting will be accomplished with an 18-inch layer of water quality mix and seeding (Appendix B). See Basin 8 in Appendix C for design flow rates. The swale is designed to treat runoff from offsite area and future development.	Routine maintenance for swales such as mowing, debris removal, and sediment removal. Maintenance access to the facilities will be from the OR43 on-ramp to I-205 NB shoulder.
9	0.134	Stormwater planter located behind curbline of proposed on-street parking spaces and sidewalk in John Storm Park. Runoff from Basin 90 is conveyed via sheet flow and curb drops. The stormwater planter is sized to treat runoff from the proposed impervious area from the new parking. After treatment, the proposed facility connects to an existing stormwater network and discharges into the Willamette River (Appendix B).	Bottom width is 6 feet and bottom length is 20 feet. The primary outlet will be a perforated sub drain. There will be a high flow outlet located above the water quality treatment depth. Curb cuts and splash pads will be the primary inlets to the facility.	Routine maintenance for stormwater planters such as weed, debris, and sediment removal. Maintenance access to the facilities will be from the shoulder of Clackamette Drive.

4.1 Future Build-out Accommodation

Water quality facilities 6, 7, and 8 are sized to incorporate additional flows from an adjacent proposed project (I-205: I-5 to OR213, Phase 2 Section). The adjacent proposed project footprint does not have enough available space to construct water quality facilities. Therefore, the I-205: I-5 to OR213, Phase 1 Section Project is being designed to divert runoff for the water quality storm event from the adjacent project into the proposed conveyance system and treatment facilities located at the OR 43 interchange.

4.2 Groundwater Considerations

Stormwater facilities were designed to not infiltrate in areas with high groundwater tables. Table 7 summarizes the anticipated seasonal high groundwater elevations at each facility and whether or not a liner is proposed for each water quality facility. It is proposed that Facilities 2 and 6 have impermeable membranes for structural purposes as both facilities are located on fill. Because the groundwater elevation was obtained from the USGS Depth to Groundwater maps and the anticipated close proximity of the groundwater to the facility invert, an impermeable membrane is proposed for Facility 3 to prevent migration to the groundwater.

Table 7 Water Quality Facility Depth to Groundwater

Facility ID	Facility Invert Elevation	Anticipated High Seasonal Groundwater Elevation	Depth to Groundwater	Impermeable Liner
WQF #1	48.5	33.7*	14.8*	No
WQF #2	Varies	Varies	Varies	Yes
WQF #3	35.0	29.3*	5.7*	Yes
WQF #4	43.8	17.5	26.3	No
WQF #5	52.9	17.5	35.4	No
WQF #6	105.8	36.5	69.3	Yes
WQF #7	118.7	66.2*	52.5*	No
WQF #8	142.8	74.3*	68.5*	No
WQF #9	37.9	17.6	20.3	No

***** Groundwater elevation from USGS Depth to Groundwater Interactive Maps (USGS)

4.3 Planting Plan

The stormwater facilities will be planted in accordance to ODOT standard practices. Vegetation will be established prior to operation. Permanent seeding should be performed March 1 through May 15 and September 1 through October 31. The seeding mix proposed for the vegetated water quality facility bottoms and sides is shown in Table 8.

Table 8. Water Quality Facility Seeding

Common Name	Botanical Name	Pounds per Acre
California Oatgrass	*Danthonia californica*	5
Tufted Hairgrass	*Deschampsia cespitosa*	4
Slender Hairgrass	*Deschampsia elongata*	4
Red Fescue	*Festuca rubra var. rubra*	10
Meadow Barley	*Hordeum brachyantherum*	10
Dense Sedge	*Carex densa*	1
Slough Sedge	*Carex obnupta*	1
Slender Rush	*Juncus patens*	0.5
Spreading Rush	*Juncus tenuis*	0.5
Broadleaf Lupine	*Lupinus latifolius*	0.25
Graceful Cinquefoil	*Potentilla gracilis*	0.25

4.4 Maintenance Plan

4.4.1 Responsible Party

ODOT staff will provide oversight during project construction to ensure that the water quality and stormwater management elements of the project are properly constructed following project plans and specifications. Vegetation will be established prior to use. Planting should take place from March 1 through May 15 or September 1 through October 31. During this post-construction period, ODOT construction inspection staff will conduct inspections to determine if the water quality and stormwater management swales are vegetated according to specifications and treatment needs. After construction, ODOT maintenance staff will review the facilities at intervals sufficient to ensure continued functioning as designed.

4.4.2 Routine Maintenance Actions

As part of the final plans package, templates for each stormwater facility will be provided. After the facilities have been constructed, a comprehensive Operations and Maintenance Manual will be completed by ODOT staff for each facility using standards described in the ODOT Hydraulics Manual. Appendix E provides tables of routine maintenance for the applicable stormwater facilities.

4.4.3 Maintenance Activity Schedule

Maintenance activities will follow the schedule outline in the tables provided in Appendix E as well as the maintenance schedules determined by ODOT District 2B.

4.5 Downstream Analysis

The project proposes to connect and discharge stormwater into existing drainage systems owned and maintained by Oregon City. A downstream analysis was completed for both drainage systems that the project proposes to connect. Both existing stormwater systems were found to have adequate capacity and no improvements downstream of the project are proposed. Appendix F summarizes the methodology and the results of the downstream analysis.

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Appendix A. NRCS Soil Survey Report, Draft Infiltration Testing Memo, and Groundwater Well Locations

United States Department of Agriculture

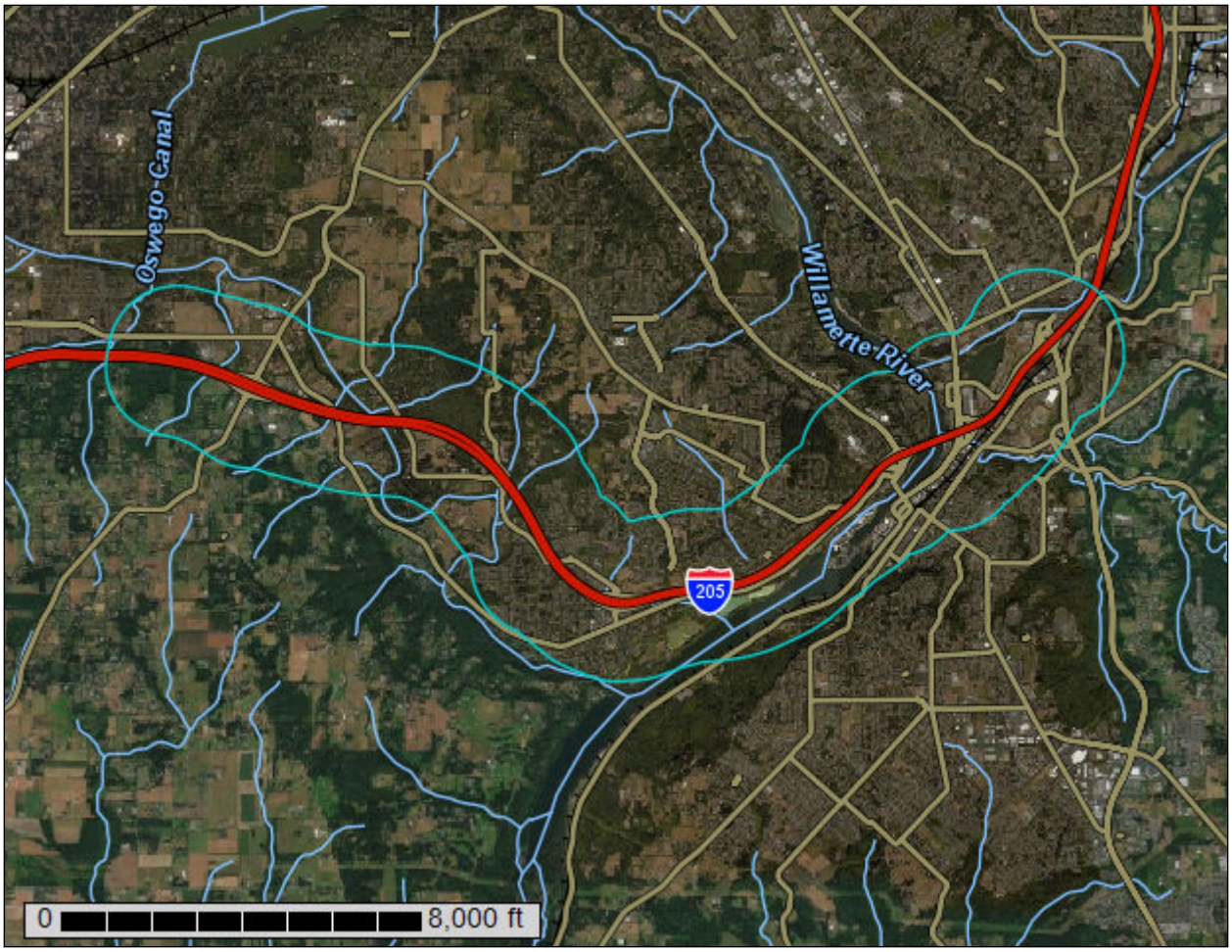
NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Clackamas County Area, Oregon

I-205 Abernethy to Stafford Widening



August 8, 2017

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

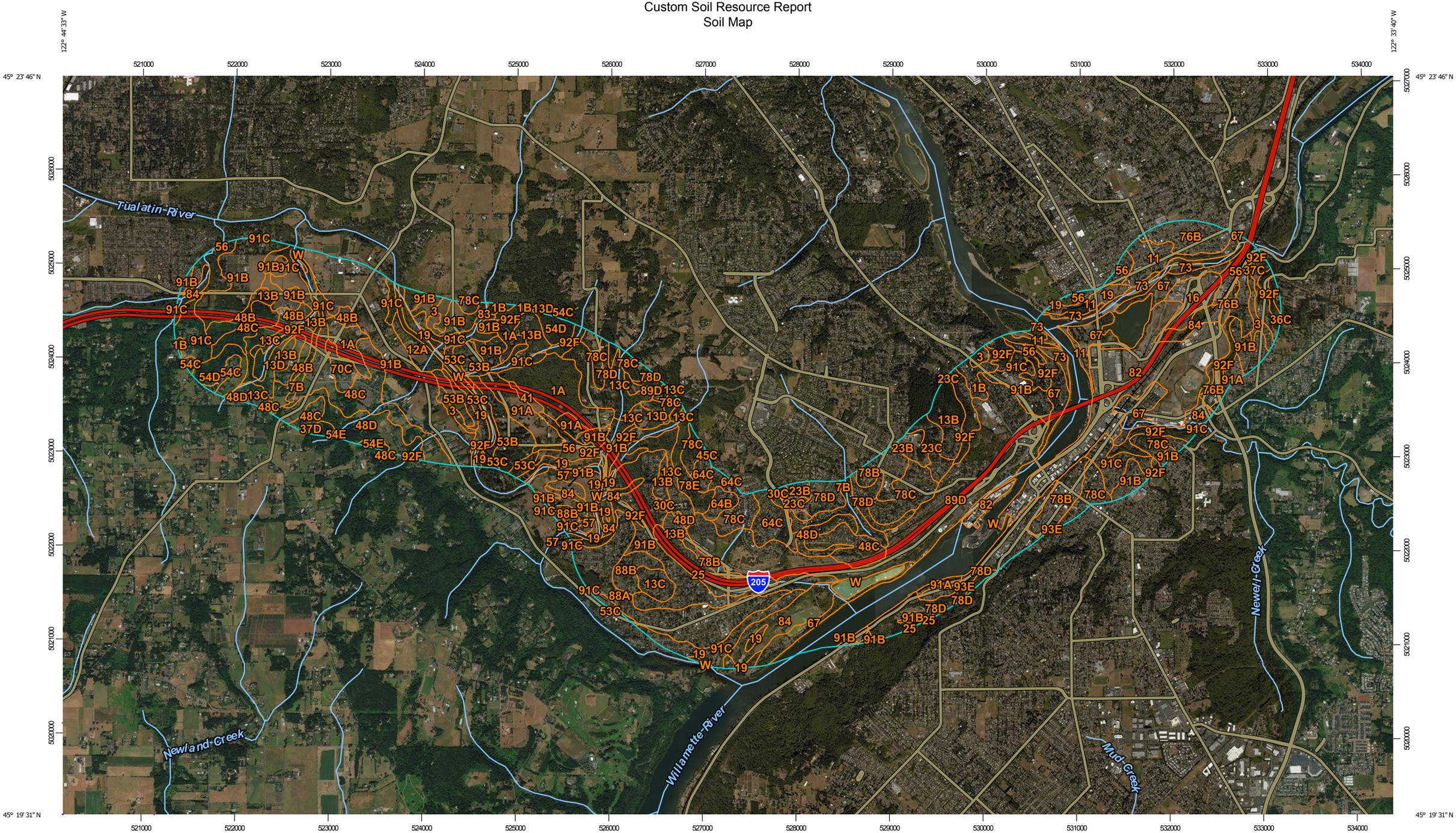
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.



Map Scale: 1:38,300 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 500 1000 2000 3000

Feet: 0 1500 3000 6000 9000

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 Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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.

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 11, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—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.

Map Unit Legend

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1A	Aloha silt loam, 0 to 3 percent slopes	161.9	2.7%
1B	Aloha silt loam, 3 to 6 percent slopes	34.9	0.6%
3	Amity silt loam	51.2	0.8%
7B	Borges silty clay loam, 0 to 8 percent slopes	47.0	0.8%
11	Camas gravelly sandy loam	78.0	1.3%
12A	Canderly sandy loam, 0 to 3 percent slopes	29.1	0.5%
13B	Cascade silt loam, 3 to 8 percent slopes	130.4	2.2%
13C	Cascade silt loam, 8 to 15 percent slopes	134.6	2.2%
13D	Cascade silt loam, 15 to 30 percent slopes	53.4	0.9%
16	Chehalis silt loam	50.7	0.8%
19	Cloquato silt loam	113.2	1.9%
23B	Cornelius silt loam, 3 to 8 percent slopes	30.8	0.5%
23C	Cornelius silt loam, 8 to 15 percent slopes	48.2	0.8%
25	Cove silty clay loam	63.3	1.0%
30C	Delena silt loam, 3 to 12 percent slopes	9.9	0.2%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	0.0	0.0%
37C	Helvetia silt loam, 8 to 15 percent slopes	51.0	0.8%
37D	Helvetia silt loam, 15 to 30 percent slopes	7.9	0.1%
41	Huberly silt loam	8.3	0.1%
45C	Jory silty clay loam, 8 to 15 percent slopes	0.7	0.0%
48B	Kinton silt loam, 3 to 8 percent slopes	67.3	1.1%
48C	Kinton silt loam, 8 to 15 percent slopes	247.5	4.1%
48D	Kinton silt loam, 15 to 30 percent slopes	125.4	2.1%
53B	Latourell loam, 3 to 8 percent slopes	94.8	1.6%

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
53C	Latourell loam, 8 to 15 percent slopes	37.2	0.6%
54C	Laurelwood silt loam, 8 to 15 percent slopes	16.3	0.3%
54D	Laurelwood silt loam, 15 to 30 percent slopes	62.1	1.0%
54E	Laurelwood silt loam, 30 to 60 percent slopes	6.5	0.1%
56	McBee silty clay loam	74.6	1.2%
57	McBee variant loam	35.5	0.6%
64B	Nekia silty clay loam, 2 to 8 percent slopes	17.7	0.3%
64C	Nekia silty clay loam, 8 to 15 percent slopes	61.0	1.0%
67	Newberg fine sandy loam	189.0	3.1%
70C	Powell silt loam, 8 to 15 percent slopes	23.5	0.4%
73	Riverwash	39.8	0.7%
76B	Salem silt loam, 0 to 7 percent slopes	89.8	1.5%
78B	Saum silt loam, 3 to 8 percent slopes	110.0	1.8%
78C	Saum silt loam, 8 to 15 percent slopes	229.2	3.8%
78D	Saum silt loam, 15 to 30 percent slopes	157.1	2.6%
78E	Saum silt loam, 30 to 60 percent slopes	39.9	0.7%
82	Urban land	363.1	6.0%
83	Wapato silt loam	6.5	0.1%
84	Wapato silty clay loam	146.1	2.4%
88A	Willamette silt loam, wet, 0 to 3 percent slopes	192.6	3.2%
88B	Willamette silt loam, wet, 3 to 7 percent slopes	42.8	0.7%
89D	Witzel very stony silt loam, 3 to 40 percent slopes	439.2	7.3%
91A	Woodburn silt loam, 0 to 3 percent slopes	88.6	1.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	779.4	12.9%
91C	Woodburn silt loam, 8 to 15 percent slopes	283.3	4.7%
92F	Xerochrepts and Haploxerolls, very steep	287.0	4.7%
93E	Xerochrepts-Rock outcrop complex, moderately steep	115.8	1.9%

Clackamas County Area, Oregon (OR610)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
W	Water	477.5	7.9%
Totals for Area of Interest		**6,050.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Clackamas County Area, Oregon

1A—Aloha silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 223l
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Aloha and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aloha

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 51 inches: silt loam
H3 - 51 to 80 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 3 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

1B—Aloha silt loam, 3 to 6 percent slopes

Map Unit Setting

National map unit symbol: 223m
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Aloha and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aloha

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 51 inches: silt loam
H3 - 51 to 80 inches: silt loam

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None

Available water storage in profile: High (about 11.9 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 3 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

3—Amity silt loam

Map Unit Setting

National map unit symbol: 2247
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Amity and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Amity

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 22 inches: silt loam
H2 - 22 to 62 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Dayton

Percent of map unit: 3 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

7B—Borges silty clay loam, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2277
Elevation: 250 to 1,400 feet
Mean annual precipitation: 48 to 65 inches
Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 140 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Borges and similar soils: 80 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Borges

Setting

Landform: Depressions on terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 18 inches: silty clay loam
H2 - 18 to 45 inches: silty clay
H3 - 45 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Delena

Percent of map unit: 6 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

11—Camas gravelly sandy loam

Map Unit Setting

National map unit symbol: 2231
Elevation: 100 to 1,500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Camas and similar soils: 80 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Camas

Setting

Landform: Flood plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 10 inches: gravelly sandy loam
H2 - 10 to 17 inches: gravelly sandy loam
H3 - 17 to 60 inches: stratified extremely gravelly coarse sand to very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 9 to 17 inches to strongly contrasting textural stratification
Natural drainage class: Excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Frequent
Frequency of ponding: None
Available water storage in profile: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Wapato

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

12A—Canderly sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2232
Elevation: 120 to 250 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Canderly and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canderly

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 7 inches: sandy loam
H2 - 7 to 46 inches: sandy loam
H3 - 46 to 60 inches: stratified gravelly sand to coarse sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.4 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Hydric soil rating: No

13B—Cascade silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2234
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Cascade and similar soils: 80 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cascade

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Interfluve, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 21 inches: silt loam
H3 - 21 to 60 inches: silty clay loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 30 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)

Hydric soil rating: No

Minor Components

Delena

Percent of map unit: 3 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

13C—Cascade silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2235
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cascade and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cascade

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Crest, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material

Typical profile

H1 - 0 to 11 inches: silt loam
H2 - 11 to 21 inches: silt loam
H3 - 21 to 60 inches: silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 30 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None

Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

13D—Cascade silt loam, 15 to 30 percent slopes

Map Unit Setting
National map unit symbol: 2236
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Cascade and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cascade

Setting
Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Crest, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material

Typical profile
H1 - 0 to 11 inches: silt loam
H2 - 11 to 21 inches: silt loam
H3 - 21 to 60 inches: silty clay loam

Properties and qualities
Slope: 15 to 30 percent
Depth to restrictive feature: 20 to 30 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.0 inches)

Interpretive groups
Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: C
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

16—Chehalis silt loam

Map Unit Setting

National map unit symbol: 223g
Elevation: 50 to 1,200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Chehalis and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chehalis

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 44 inches: silty clay loam
H3 - 44 to 60 inches: stratified fine sandy loam to silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

Minor Components

Wapato

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

19—Cloquato silt loam

Map Unit Setting

National map unit symbol: 223k
Elevation: 50 to 1,200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Cloquato and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cloquato

Setting

Landform: Flood plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 15 inches: silt loam
H2 - 15 to 42 inches: silt loam
H3 - 42 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

Minor Components

Wapato

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Aquolls

Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

23B—Cornelius silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 223r
Elevation: 250 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Cornelius and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cornelius

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material

Typical profile

H1 - 0 to 16 inches: silt loam

H2 - 16 to 34 inches: silty clay loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 30 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 27 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Delena

Percent of map unit: 3 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

23C—Cornelius silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 223s
Elevation: 250 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cornelius and similar soils: 80 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cornelius

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Interfluve, base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 34 inches: silty clay loam
H3 - 34 to 60 inches: silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 30 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 27 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Delena

Percent of map unit: 4 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

25—Cove silty clay loam

Map Unit Setting

National map unit symbol: 223y

Elevation: 100 to 1,500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Cove and similar soils: 85 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cove

Setting

Landform: Flood plains
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 7 inches: silty clay loam
H2 - 7 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Wapato

Percent of map unit: 5 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Conser

Percent of map unit: 4 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Concord

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

30C—Delena silt loam, 3 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2248
Elevation: 250 to 1,400 feet
Mean annual precipitation: 48 to 65 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 140 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Delena and similar soils: 80 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Delena

Setting

Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty alluvium

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 25 inches: silty clay loam
H3 - 25 to 60 inches: silty clay loam

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 20 to 30 inches to fragipan
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C/D
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Borges

Percent of map unit: 8 percent
Landform: Depressions on terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

36C—Hardscrabble silt loam, 7 to 20 percent slopes

Map Unit Setting

National map unit symbol: 224k
Elevation: 150 to 600 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hardscrabble and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hardscrabble

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve

Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Clayey alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 14 inches: silty clay loam
H3 - 14 to 60 inches: clay

Properties and qualities

Slope: 7 to 20 percent
Depth to restrictive feature: 12 to 24 inches to abrupt textural change
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

37C—Helvetia silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 224m
Elevation: 250 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Helvetia and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Helvetia

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed old alluvium

Typical profile

H1 - 0 to 14 inches: silt loam

H2 - 14 to 21 inches: silty clay loam
H3 - 21 to 40 inches: silty clay
H4 - 40 to 60 inches: silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Delena

Percent of map unit: 2 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

37D—Helvetia silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 224n
Elevation: 250 to 500 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Helvetia and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Helvetia

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed old alluvium

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 21 inches: silty clay loam
H3 - 21 to 40 inches: silty clay
H4 - 40 to 60 inches: silty clay loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained >15% Slopes (G002XY003OR)
Hydric soil rating: No

41—Huberly silt loam

Map Unit Setting

National map unit symbol: 224s
Elevation: 150 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Huberly and similar soils: 85 percent
Minor components: 7 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Huberly

Setting

Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 15 inches: silt loam
H2 - 15 to 24 inches: silt loam
H3 - 24 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 30 inches to fragipan
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 0 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Dayton

Percent of map unit: 5 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Delena

Percent of map unit: 2 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

45C—Jory silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 224y
Elevation: 250 to 1,200 feet
Mean annual precipitation: 50 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Jory and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Jory

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium

Typical profile

H1 - 0 to 13 inches: silty clay loam
H2 - 13 to 60 inches: silty clay

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

48B—Kinton silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2256
Elevation: 250 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Kinton and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kinton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 15 inches: silt loam
H2 - 15 to 35 inches: silt loam
H3 - 35 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 30 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 27 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Delena

Percent of map unit: 3 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

48C—Kinton silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2257
Elevation: 250 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Kinton and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kinton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 15 inches: silt loam
H2 - 15 to 35 inches: silt loam
H3 - 35 to 60 inches: silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 30 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 27 to 37 inches
Frequency of flooding: None

Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups
Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Delena
Percent of map unit: 3 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

48D—Kinton silt loam, 15 to 30 percent slopes

Map Unit Setting
National map unit symbol: 2258
Elevation: 250 to 1,400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Kinton and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kinton

Setting
Landform: Hillslopes
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile
H1 - 0 to 15 inches: silt loam
H2 - 15 to 35 inches: silt loam

H3 - 35 to 60 inches: silt loam

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 30 to 40 inches to fragipan
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 27 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained >15% Slopes (G002XY003OR)
Hydric soil rating: No

Minor Components

Delena

Percent of map unit: 2 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

53B—Latourell loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 225k
Elevation: 50 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Latourell and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Latourell

Setting

Landform: Terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 15 inches: loam
H2 - 15 to 48 inches: loam
H3 - 48 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Hydric soil rating: No

53C—Latourell loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 225l
Elevation: 50 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Latourell and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Latourell

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 15 inches: loam
H2 - 15 to 48 inches: loam

H3 - 48 to 60 inches: gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

54C—Laurelwood silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 225p
Elevation: 200 to 1,500 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Laurelwood and similar soils: 85 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Laurelwood

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material over older clayey material

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 18 inches: silty clay loam
H3 - 18 to 46 inches: silty clay loam
H4 - 46 to 60 inches: silty clay

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches

Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups
Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

Minor Components

Aqualfs
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

54D—Laurelwood silt loam, 15 to 30 percent slopes

Map Unit Setting
National map unit symbol: 225q
Elevation: 200 to 1,500 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Laurelwood and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Laurelwood

Setting
Landform: Hillslopes
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Base slope, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material over older clayey material

Typical profile
H1 - 0 to 10 inches: silt loam
H2 - 10 to 18 inches: silty clay loam
H3 - 18 to 46 inches: silty clay loam
H4 - 46 to 60 inches: silty clay

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

54E—Laurelwood silt loam, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 225r
Elevation: 200 to 1,500 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 51 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Laurelwood and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Laurelwood

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Side slope, head slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Silty material over older clayey material

Typical profile

H1 - 0 to 10 inches: silt loam
H2 - 10 to 18 inches: silty clay loam
H3 - 18 to 46 inches: silty clay loam
H4 - 46 to 60 inches: silty clay

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained

Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 11.4 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

56—McBee silty clay loam

Map Unit Setting
National map unit symbol: 225t
Elevation: 50 to 1,200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition
Mcbee and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcbee

Setting
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile
H1 - 0 to 15 inches: silty clay loam
H2 - 15 to 48 inches: silty clay loam
H3 - 48 to 60 inches: clay loam

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 11.6 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Wapato

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Aquolls

Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

57—McBee variant loam

Map Unit Setting

National map unit symbol: 225v
Elevation: 50 to 1,200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Mcbee, variant, and similar soils: 90 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Mcbee, Variant

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 28 inches: loam

H2 - 28 to 60 inches: clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: B/D
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Wapato

Percent of map unit: 3 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

64B—Nekia silty clay loam, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2268
Elevation: 250 to 1,200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Nekia and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Nose slope, crest, interfluve

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from basalt

Typical profile

H1 - 0 to 19 inches: silty clay loam
H2 - 19 to 39 inches: clay
H3 - 39 to 43 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

64C—Nekia silty clay loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2269
Elevation: 250 to 1,200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Nekia and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Nose slope, crest, interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from basalt

Typical profile

H1 - 0 to 19 inches: silty clay loam

H2 - 19 to 39 inches: clay
H3 - 39 to 43 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

67—Newberg fine sandy loam

Map Unit Setting

National map unit symbol: 226g
Elevation: 30 to 1,200 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Newberg and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newberg

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 14 inches: fine sandy loam
H2 - 14 to 23 inches: fine sandy loam
H3 - 23 to 42 inches: fine sand
H4 - 42 to 60 inches: extremely gravelly sand

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.1 inches)

Interpretive groups
Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Wapato
Percent of map unit: 2 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Aquolls
Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

70C—Powell silt loam, 8 to 15 percent slopes

Map Unit Setting
National map unit symbol: 226m
Elevation: 250 to 1,400 feet
Mean annual precipitation: 50 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Powell and similar soils: 85 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Powell

Setting
Landform: Terraces
Landform position (three-dimensional): Riser

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty material over old silty alluvium

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 15 inches: silt loam
H3 - 15 to 60 inches: silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 15 to 23 inches to fragipan
Natural drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 15 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.3 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Delena

Percent of map unit: 3 percent
Landform: Terraces, hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve, riser
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

73—Riverwash

Map Unit Composition

Riverwash: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Riverwash

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear

Across-slope shape: Linear

Typical profile

H1 - 0 to 60 inches: stratified sand to gravel

Properties and qualities

Slope: 0 to 3 percent
Natural drainage class: Well drained
Depth to water table: About 0 to 24 inches
Frequency of flooding: Frequent

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Yes

76B—Salem silt loam, 0 to 7 percent slopes

Map Unit Setting

National map unit symbol: 226y
Elevation: 200 to 650 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Salem and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salem

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 24 inches: gravelly clay loam
H3 - 24 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

78B—Saum silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2271
Elevation: 250 to 800 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Saum and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Material silty and colluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 26 inches: silty clay loam
H3 - 26 to 50 inches: gravelly silty clay loam
H4 - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

78C—Saum silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2272
Elevation: 250 to 800 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Saum and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Material silty and colluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 26 inches: silty clay loam
H3 - 26 to 50 inches: gravelly silty clay loam
H4 - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

78D—Saum silt loam, 15 to 30 percent slopes

Map Unit Setting

National map unit symbol: 2273
Elevation: 250 to 800 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Saum and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Material silty and colluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 26 inches: silty clay loam
H3 - 26 to 50 inches: gravelly silty clay loam
H4 - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 15 to 30 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

78E—Saum silt loam, 30 to 60 percent slopes

Map Unit Setting

National map unit symbol: 2274
Elevation: 250 to 800 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Saum and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Saum

Setting

Landform: Hillslopes
Landform position (two-dimensional): Footslope, backslope
Landform position (three-dimensional): Head slope, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Material silty and colluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 26 inches: silty clay loam
H3 - 26 to 50 inches: gravelly silty clay loam
H4 - 50 to 54 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 60 percent
Depth to restrictive feature: 40 to 60 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Hydric soil rating: No

82—Urban land

Map Unit Setting

National map unit symbol: 227g
Elevation: 50 to 400 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

83—Wapato silt loam

Map Unit Setting

National map unit symbol: 227h
Elevation: 100 to 1,500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Wapato and similar soils: 90 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wapato

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 41 inches: silty clay loam
H3 - 41 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water storage in profile: High (about 9.7 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Cove

Percent of map unit: 6 percent
Landform: Flood plains
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

84—Wapato silty clay loam

Map Unit Setting

National map unit symbol: 227j
Elevation: 100 to 1,500 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

Wapato and similar soils: 85 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wapato

Setting

Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 18 inches: silty clay loam
H2 - 18 to 45 inches: silty clay loam
H3 - 45 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water storage in profile: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Cove

Percent of map unit: 6 percent
Landform: Flood plains
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Humaquepts

Percent of map unit: 4 percent
Landform: Flood plains
Hydric soil rating: Yes

88A—Willamette silt loam, wet, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 227q

Elevation: 150 to 350 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Willamette, wet, and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Willamette, Wet

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 30 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

88B—Willamette silt loam, wet, 3 to 7 percent slopes

Map Unit Setting

National map unit symbol: 227r
Elevation: 150 to 350 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Willamette, wet, and similar soils: 85 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Willamette, Wet

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 14 inches: silt loam
H2 - 14 to 60 inches: silty clay loam

Properties and qualities

Slope: 3 to 7 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 30 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

89D—Witzel very stony silt loam, 3 to 40 percent slopes

Map Unit Setting

National map unit symbol: 227s
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Witzel and similar soils: 80 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Witzel

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Interfluve, nose slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from basalt

Typical profile

H1 - 0 to 4 inches: very stony silt loam
H2 - 4 to 16 inches: very stony silty clay loam
H3 - 16 to 20 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 40 percent
Depth to restrictive feature: 12 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)
Hydric soil rating: No

91A—Woodburn silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 227y
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodburn and similar soils: 85 percent
Minor components: 6 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodburn

Setting

Landform: Terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 38 inches: silty clay loam
H3 - 38 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 3 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Dayton

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Aquolls

Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

91B—Woodburn silt loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 227z
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodburn and similar soils: 90 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodburn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 38 inches: silty clay loam
H3 - 38 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 2 percent
Landform: Swales on terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Aquolls

Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

Dayton

Percent of map unit: 1 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

91C—Woodburn silt loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2280
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Woodburn and similar soils: 90 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodburn

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Stratified glaciolacustrine deposits

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 38 inches: silty clay loam
H3 - 38 to 60 inches: silt loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Dayton

Percent of map unit: 2 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Aquolls

Percent of map unit: 1 percent
Landform: Flood plains
Hydric soil rating: Yes

92F—Xerochrepts and Haploxerolls, very steep

Map Unit Setting

National map unit symbol: 2281
Elevation: 50 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition

Xerochrepts and similar soils: 50 percent
Haploxerolls and similar soils: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xerochrepts

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 48 inches: gravelly clay loam
H3 - 48 to 60 inches: very cobbly clay loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 8.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Haploxerolls

Setting

Landform: Terraces
Landform position (three-dimensional): Riser
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Colluvium derived from igneous rock

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 60 inches: very gravelly loam

Properties and qualities

Slope: 20 to 60 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: About 36 to 48 inches
Frequency of flooding: None

Frequency of ponding: None
Available water storage in profile: High (about 12.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Hydric soil rating: No

93E—Xerochrepts-Rock outcrop complex, moderately steep

Map Unit Setting
National map unit symbol: 2282
Elevation: 100 to 500 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Not prime farmland

Map Unit Composition
Xerochrepts and similar soils: 60 percent
Rock outcrop: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Xerochrepts

Setting
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Colluvium derived from andesite and/or basalt

Typical profile
H1 - 0 to 26 inches: gravelly loam
H2 - 26 to 30 inches: unweathered bedrock

Properties and qualities
Slope: 0 to 30 percent
Depth to restrictive feature: 10 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s

Hydrologic Soil Group: C
Hydric soil rating: No

Description of Rock Outcrop

Typical profile

R - 0 to 60 inches: unweathered bedrock

Properties and qualities

Slope: 0 to 30 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Water

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: Yes

Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

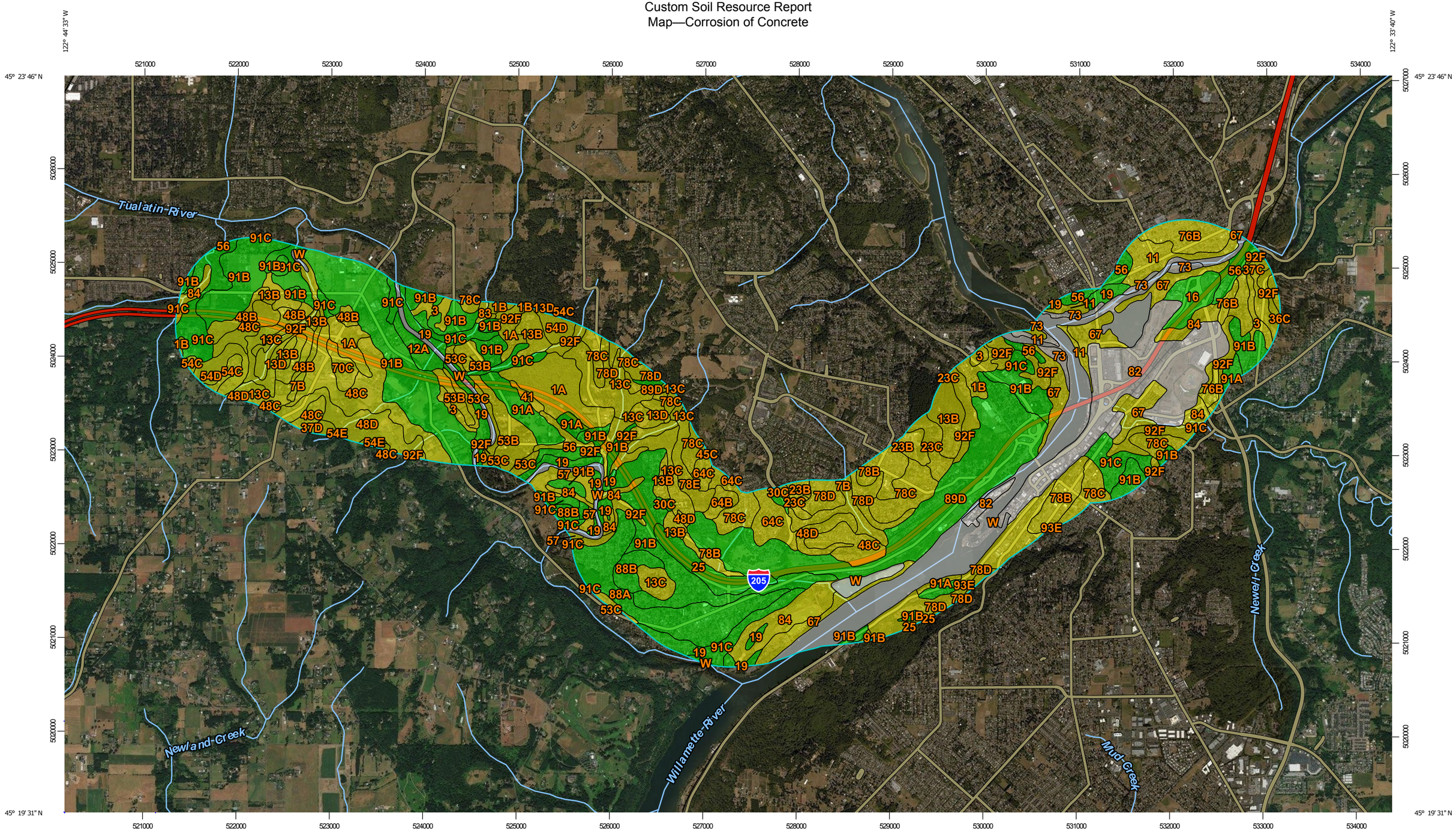
Building Site Development

Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

Corrosion of Concrete

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."



Map Scale: 1:38,300 if printed on B landscape (17" x 11") sheet.

N

Meters
0 500 1000 2000 3000

Feet
0 1500 3000 6000 9000

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

High

Moderate

Low

Not rated or not available

Soil Rating Lines

High

Moderate

Low

Not rated or not available

Soil Rating Points

High

Moderate

Low

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.

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 11, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—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.

Table—Corrosion of Concrete

Corrosion of Concrete— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1A	Aloha silt loam, 0 to 3 percent slopes	Moderate	161.9	2.7%
1B	Aloha silt loam, 3 to 6 percent slopes	Moderate	34.9	0.6%
3	Amity silt loam	Moderate	51.2	0.8%
7B	Borges silty clay loam, 0 to 8 percent slopes	Moderate	47.0	0.8%
11	Camas gravelly sandy loam	Moderate	78.0	1.3%
12A	Canderly sandy loam, 0 to 3 percent slopes	Low	29.1	0.5%
13B	Cascade silt loam, 3 to 8 percent slopes	Moderate	130.4	2.2%
13C	Cascade silt loam, 8 to 15 percent slopes	Moderate	134.6	2.2%
13D	Cascade silt loam, 15 to 30 percent slopes	Moderate	53.4	0.9%
16	Chehalis silt loam	Low	50.7	0.8%
19	Cloquato silt loam	Low	113.2	1.9%
23B	Cornelius silt loam, 3 to 8 percent slopes	Moderate	30.8	0.5%
23C	Cornelius silt loam, 8 to 15 percent slopes	Moderate	48.2	0.8%
25	Cove silty clay loam	Low	63.3	1.0%
30C	Delena silt loam, 3 to 12 percent slopes	Low	9.9	0.2%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	High	0.0	0.0%
37C	Helvetia silt loam, 8 to 15 percent slopes	Moderate	51.0	0.8%
37D	Helvetia silt loam, 15 to 30 percent slopes	Moderate	7.9	0.1%
41	Huberly silt loam	Moderate	8.3	0.1%
45C	Jory silty clay loam, 8 to 15 percent slopes	Moderate	0.7	0.0%
48B	Kinton silt loam, 3 to 8 percent slopes	Moderate	67.3	1.1%
48C	Kinton silt loam, 8 to 15 percent slopes	Moderate	247.5	4.1%
48D	Kinton silt loam, 15 to 30 percent slopes	Moderate	125.4	2.1%
53B	Latourell loam, 3 to 8 percent slopes	Moderate	94.8	1.6%

Corrosion of Concrete— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
53C	Latourell loam, 8 to 15 percent slopes	Moderate	37.2	0.6%
54C	Laurelwood silt loam, 8 to 15 percent slopes	Moderate	16.3	0.3%
54D	Laurelwood silt loam, 15 to 30 percent slopes	Moderate	62.1	1.0%
54E	Laurelwood silt loam, 30 to 60 percent slopes	Moderate	6.5	0.1%
56	McBee silty clay loam	Low	74.6	1.2%
57	McBee variant loam	Moderate	35.5	0.6%
64B	Nekia silty clay loam, 2 to 8 percent slopes	Moderate	17.7	0.3%
64C	Nekia silty clay loam, 8 to 15 percent slopes	Moderate	61.0	1.0%
67	Newberg fine sandy loam	Moderate	189.0	3.1%
70C	Powell silt loam, 8 to 15 percent slopes	Moderate	23.5	0.4%
73	Riverwash		39.8	0.7%
76B	Salem silt loam, 0 to 7 percent slopes	Moderate	89.8	1.5%
78B	Saum silt loam, 3 to 8 percent slopes	Moderate	110.0	1.8%
78C	Saum silt loam, 8 to 15 percent slopes	Moderate	229.2	3.8%
78D	Saum silt loam, 15 to 30 percent slopes	Moderate	157.1	2.6%
78E	Saum silt loam, 30 to 60 percent slopes	Moderate	39.9	0.7%
82	Urban land		363.1	6.0%
83	Wapato silt loam	Moderate	6.5	0.1%
84	Wapato silty clay loam	Moderate	146.1	2.4%
88A	Willamette silt loam, wet, 0 to 3 percent slopes	Low	192.6	3.2%
88B	Willamette silt loam, wet, 3 to 7 percent slopes	Low	42.8	0.7%
89D	Witzel very stony silt loam, 3 to 40 percent slopes	Low	439.2	7.3%
91A	Woodburn silt loam, 0 to 3 percent slopes	Low	88.6	1.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	Low	779.4	12.9%
91C	Woodburn silt loam, 8 to 15 percent slopes	Low	283.3	4.7%
92F	Xerochrepts and Haploxerolls, very steep	Moderate	287.0	4.7%

Corrosion of Concrete— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
93E	Xerochrepts-Rock outcrop complex, moderately steep	Moderate	115.8	1.9%
W	Water		477.5	7.9%
Totals for Area of Interest			**6,050.5**	**100.0%**

Rating Options—Corrosion of Concrete

Aggregation Method: Dominant Condition

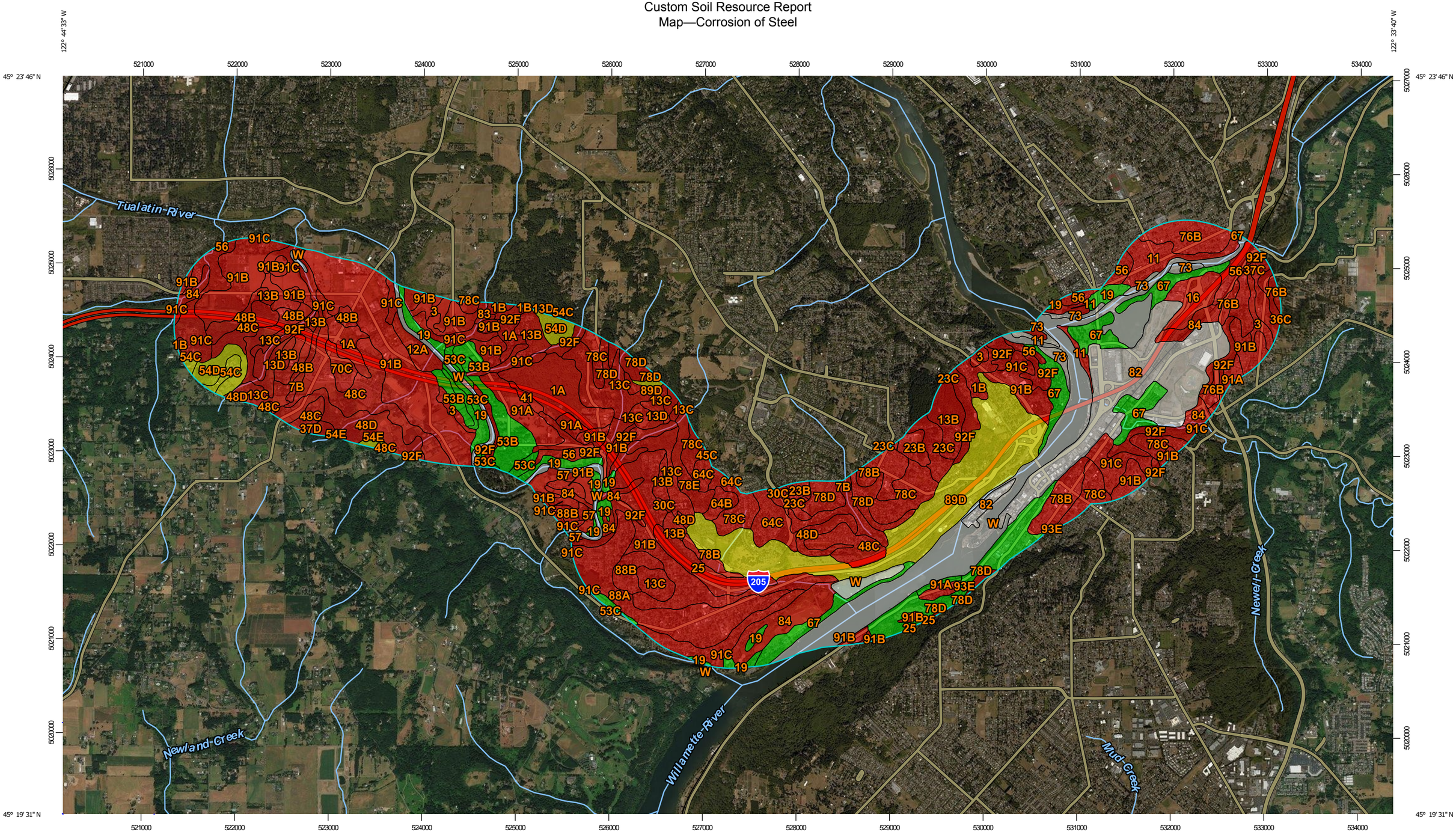
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Corrosion of Steel

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."



Map Scale: 1:38,300 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 500 1000 2000 3000

Feet: 0 1500 3000 6000 9000

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

High

Moderate

Low

Not rated or not available

Soil Rating Lines

High

Moderate

Low

Not rated or not available

Soil Rating Points

High

Moderate

Low

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.

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)

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Soil Survey Area: Clackamas County Area, Oregon
Survey Area Data: Version 11, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—Sep 13, 2016

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Table—Corrosion of Steel

Corrosion of Steel— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1A	Aloha silt loam, 0 to 3 percent slopes	High	161.9	2.7%
1B	Aloha silt loam, 3 to 6 percent slopes	High	34.9	0.6%
3	Amity silt loam	High	51.2	0.8%
7B	Borges silty clay loam, 0 to 8 percent slopes	High	47.0	0.8%
11	Camas gravelly sandy loam	High	78.0	1.3%
12A	Canderly sandy loam, 0 to 3 percent slopes	High	29.1	0.5%
13B	Cascade silt loam, 3 to 8 percent slopes	High	130.4	2.2%
13C	Cascade silt loam, 8 to 15 percent slopes	High	134.6	2.2%
13D	Cascade silt loam, 15 to 30 percent slopes	High	53.4	0.9%
16	Chehalis silt loam	High	50.7	0.8%
19	Cloquato silt loam	Low	113.2	1.9%
23B	Cornelius silt loam, 3 to 8 percent slopes	High	30.8	0.5%
23C	Cornelius silt loam, 8 to 15 percent slopes	High	48.2	0.8%
25	Cove silty clay loam	High	63.3	1.0%
30C	Delena silt loam, 3 to 12 percent slopes	High	9.9	0.2%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	High	0.0	0.0%
37C	Helvetia silt loam, 8 to 15 percent slopes	High	51.0	0.8%
37D	Helvetia silt loam, 15 to 30 percent slopes	High	7.9	0.1%
41	Huberly silt loam	High	8.3	0.1%
45C	Jory silty clay loam, 8 to 15 percent slopes	High	0.7	0.0%
48B	Kinton silt loam, 3 to 8 percent slopes	High	67.3	1.1%
48C	Kinton silt loam, 8 to 15 percent slopes	High	247.5	4.1%
48D	Kinton silt loam, 15 to 30 percent slopes	High	125.4	2.1%
53B	Latourell loam, 3 to 8 percent slopes	Low	94.8	1.6%

Corrosion of Steel— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
53C	Latourell loam, 8 to 15 percent slopes	Low	37.2	0.6%
54C	Laurelwood silt loam, 8 to 15 percent slopes	Moderate	16.3	0.3%
54D	Laurelwood silt loam, 15 to 30 percent slopes	Moderate	62.1	1.0%
54E	Laurelwood silt loam, 30 to 60 percent slopes	Moderate	6.5	0.1%
56	McBee silty clay loam	High	74.6	1.2%
57	McBee variant loam	High	35.5	0.6%
64B	Nekia silty clay loam, 2 to 8 percent slopes	High	17.7	0.3%
64C	Nekia silty clay loam, 8 to 15 percent slopes	High	61.0	1.0%
67	Newberg fine sandy loam	Low	189.0	3.1%
70C	Powell silt loam, 8 to 15 percent slopes	High	23.5	0.4%
73	Riverwash		39.8	0.7%
76B	Salem silt loam, 0 to 7 percent slopes	High	89.8	1.5%
78B	Saum silt loam, 3 to 8 percent slopes	High	110.0	1.8%
78C	Saum silt loam, 8 to 15 percent slopes	High	229.2	3.8%
78D	Saum silt loam, 15 to 30 percent slopes	High	157.1	2.6%
78E	Saum silt loam, 30 to 60 percent slopes	High	39.9	0.7%
82	Urban land		363.1	6.0%
83	Wapato silt loam	High	6.5	0.1%
84	Wapato silty clay loam	High	146.1	2.4%
88A	Willamette silt loam, wet, 0 to 3 percent slopes	High	192.6	3.2%
88B	Willamette silt loam, wet, 3 to 7 percent slopes	High	42.8	0.7%
89D	Witzel very stony silt loam, 3 to 40 percent slopes	Moderate	439.2	7.3%
91A	Woodburn silt loam, 0 to 3 percent slopes	High	88.6	1.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	High	779.4	12.9%
91C	Woodburn silt loam, 8 to 15 percent slopes	High	283.3	4.7%
92F	Xerochrepts and Haploxerolls, very steep	High	287.0	4.7%

Corrosion of Steel— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
93E	Xerochrepts-Rock outcrop complex, moderately steep	Low	115.8	1.9%
W	Water		477.5	7.9%
Totals for Area of Interest			**6,050.5**	**100.0%**

Rating Options—Corrosion of Steel

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Water Management

Water Management interpretations are tools for evaluating the potential of the soil in the application of various water management practices. Example interpretations include pond reservoir area, embankments, dikes, levees, and excavated ponds.

Subsurface Water Management, Outflow Quality

The ratings for Subsurface Water Management, Outflow Quality are based on the soil properties that affect the capacity of the soil to convey surface and subsurface water and on the properties that affect water quality. The properties that affect the conveyance and water quality include salinity, sodicity, soil reaction, soil taxonomic great group placement, gypsum content, shrink-swell potential, soil saturation, and surface erosion.

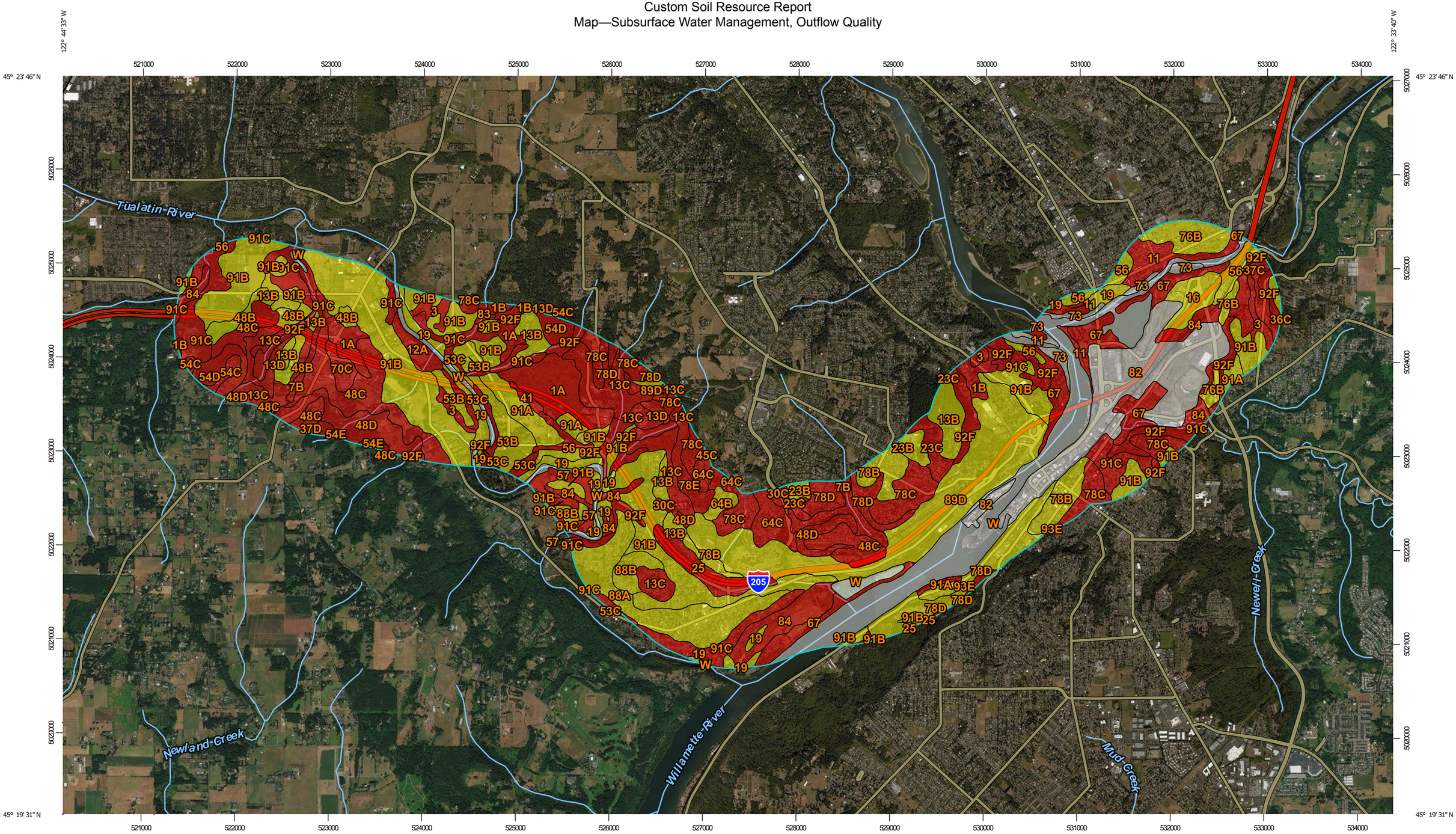
The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor water quality can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as that listed for the map unit. The percent composition of each component in a particular map unit is given so that the user will realize the percentage of each map unit that has the specified rating.

A map unit may have other components with different ratings. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Map—Subsurface Water Management, Outflow Quality



Map Scale: 1:38,300 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 500 1000 2000 3000

Feet: 0 1500 3000 6000 9000

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

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Lines

Very limited

Somewhat limited

Not limited

Not rated or not available

Soil Rating Points

Very limited

Somewhat limited

Not limited

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

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Source of Map: Natural Resources Conservation Service
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Tables—Subsurface Water Management, Outflow Quality

Subsurface Water Management, Outflow Quality— Summary by Map Unit — Clackamas County Area, Oregon (OR610)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
1A	Aloha silt loam, 0 to 3 percent slopes	Very limited	Aloha (85%)	Pesticide and nutrient movement (1.00)	161.9	2.7%
			Huberly (3%)	Pesticide and nutrient movement (1.00)		
			Dayton (2%)	Pesticide and nutrient movement (1.00)		
1B	Aloha silt loam, 3 to 6 percent slopes	Very limited	Aloha (85%)	Pesticide and nutrient movement (1.00)	34.9	0.6%
				Water Erosion (0.46)		
			Huberly (3%)	Pesticide and nutrient movement (1.00)		
			Dayton (2%)	Pesticide and nutrient movement (1.00)		
3	Amity silt loam	Very limited	Amity (85%)	Pesticide and nutrient movement (1.00)	51.2	0.8%
			Dayton (3%)	Pesticide and nutrient movement (1.00)		
			Huberly (2%)	Pesticide and nutrient movement (1.00)		
7B	Borges silty clay loam, 0 to 8 percent slopes	Very limited	Borges (80%)	Pesticide and nutrient movement (1.00)	47.0	0.8%
				Water Erosion (0.12)		
			Delena (6%)	Pesticide and nutrient movement (1.00)		

Subsurface Water Management, Outflow Quality— Summary by Map Unit — Clackamas County Area, Oregon (OR610)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
				Water Erosion (1.00)		
11	Camas gravelly sandy loam	Very limited	Camas (80%)	Pesticide and nutrient movement (1.00)	78.0	1.3%
			Wapato (2%)	Pesticide and nutrient movement (1.00)		
12A	Canderly sandy loam, 0 to 3 percent slopes	Very limited	Canderly (90%)	Pesticide and nutrient movement (1.00)	29.1	0.5%
13B	Cascade silt loam, 3 to 8 percent slopes	Somewhat limited	Cascade (80%)	Pesticide and nutrient movement (0.99)	130.4	2.2%
				Water Erosion (0.12)		
13C	Cascade silt loam, 8 to 15 percent slopes	Very limited	Cascade (80%)	Water Erosion (1.00)	134.6	2.2%
				Pesticide and nutrient movement (0.99)		
13D	Cascade silt loam, 15 to 30 percent slopes	Very limited	Cascade (80%)	Water Erosion (1.00)	53.4	0.9%
				Pesticide and nutrient movement (0.99)		
16	Chehalis silt loam	Somewhat limited	Chehalis (85%)	Pesticide and nutrient movement (0.22)	50.7	0.8%
19	Cloquato silt loam	Somewhat limited	Cloquato (85%)	Pesticide and nutrient movement (0.22)	113.2	1.9%
23B	Cornelius silt loam, 3 to 8 percent slopes	Somewhat limited	Cornelius (85%)	Pesticide and nutrient movement (0.71)	30.8	0.5%
				Water Erosion (0.12)		
23C	Cornelius silt loam, 8 to 15 percent slopes	Very limited	Cornelius (80%)	Water Erosion (1.00)	48.2	0.8%
				Pesticide and nutrient movement (0.71)		

Subsurface Water Management, Outflow Quality— Summary by Map Unit — Clackamas County Area, Oregon (OR610)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
			Delena (4%)	Pesticide and nutrient movement (1.00)		
				Water Erosion (1.00)		
25	Cove silty clay loam	Very limited	Cove (85%)	Pesticide and nutrient movement (1.00)	63.3	1.0%
			Wapato (5%)	Pesticide and nutrient movement (1.00)		
			Conser (4%)	Pesticide and nutrient movement (1.00)		
			Concord (2%)	Pesticide and nutrient movement (1.00)		
			Dayton (1%)	Pesticide and nutrient movement (1.00)		
30C	Delena silt loam, 3 to 12 percent slopes	Very limited	Delena (80%)	Pesticide and nutrient movement (1.00)	9.9	0.2%
				Water Erosion (0.90)		
			Borges (8%)	Pesticide and nutrient movement (1.00)		
				Water Erosion (0.04)		
36C	Hardscrabble silt loam, 7 to 20 percent slopes	Very limited	Hardscrabble (85%)	Pesticide and nutrient movement (1.00)	0.0	0.0%
				Water Erosion (1.00)		
				Too acid (0.04)		
37C	Helvetia silt loam, 8 to 15 percent slopes	Very limited	Helvetia (85%)	Water Erosion (1.00)	51.0	0.8%
				Pesticide and nutrient movement (0.14)		

Subsurface Water Management, Outflow Quality— Summary by Map Unit — Clackamas County Area, Oregon (OR610)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
			Delena (2%)	Pesticide and nutrient movement (1.00)		
				Water Erosion (1.00)		
37D	Helvetia silt loam, 15 to 30 percent slopes	Very limited	Helvetia (85%)	Water Erosion (1.00)	7.9	0.1%
				Pesticide and nutrient movement (0.14)		
41	Huberly silt loam	Very limited	Huberly (85%)	Pesticide and nutrient movement (1.00)	8.3	0.1%
			Dayton (5%)	Pesticide and nutrient movement (1.00)		
			Delena (2%)	Pesticide and nutrient movement (1.00)		
				Water Erosion (1.00)		
45C	Jory silty clay loam, 8 to 15 percent slopes	Very limited	Jory (90%)	Water Erosion (1.00)	0.7	0.0%
				Pesticide and nutrient movement (0.00)		
48B	Kinton silt loam, 3 to 8 percent slopes	Somewhat limited	Kinton (85%)	Pesticide and nutrient movement (0.71)	67.3	1.1%
				Water Erosion (0.42)		
48C	Kinton silt loam, 8 to 15 percent slopes	Very limited	Kinton (85%)	Water Erosion (1.00)	247.5	4.1%
				Pesticide and nutrient movement (0.71)		
			Delena (3%)	Pesticide and nutrient movement (1.00)		
				Water Erosion (1.00)		

Subsurface Water Management, Outflow Quality— Summary by Map Unit — Clackamas County Area, Oregon (OR610)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
48D	Kinton silt loam, 15 to 30 percent slopes	Very limited	Kinton (85%)	Water Erosion (1.00)	125.4	2.1%
				Pesticide and nutrient movement (0.71)		
			Delena (2%)	Pesticide and nutrient movement (1.00)		
				Water Erosion (1.00)		
53B	Latourell loam, 3 to 8 percent slopes	Somewhat limited	Latourell (90%)	Water Erosion (0.42)	94.8	1.6%
				Pesticide and nutrient movement (0.22)		
53C	Latourell loam, 8 to 15 percent slopes	Very limited	Latourell (85%)	Water Erosion (1.00)	37.2	0.6%
				Pesticide and nutrient movement (0.22)		
54C	Laurelwood silt loam, 8 to 15 percent slopes	Very limited	Laurelwood (85%)	Water Erosion (1.00)	16.3	0.3%
				Pesticide and nutrient movement (0.00)		
54D	Laurelwood silt loam, 15 to 30 percent slopes	Very limited	Laurelwood (80%)	Water Erosion (1.00)	62.1	1.0%
				Pesticide and nutrient movement (0.00)		
54E	Laurelwood silt loam, 30 to 60 percent slopes	Very limited	Laurelwood (80%)	Water Erosion (1.00)	6.5	0.1%
				Pesticide and nutrient movement (0.00)		
56	McBee silty clay loam	Somewhat limited	McBee (85%)	Pesticide and nutrient movement (0.82)	74.6	1.2%
57	McBee variant loam	Very limited	McBee, Variant (90%)	Pesticide and nutrient movement (1.00)	35.5	0.6%

Subsurface Water Management, Outflow Quality— Summary by Map Unit — Clackamas County Area, Oregon (OR610)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
			Wapato (3%)	Pesticide and nutrient movement (1.00)		
64B	Nekia silty clay loam, 2 to 8 percent slopes	Somewhat limited	Nekia (80%)	Water Erosion (0.08)	17.7	0.3%
				Pesticide and nutrient movement (0.00)		
64C	Nekia silty clay loam, 8 to 15 percent slopes	Very limited	Nekia (80%)	Water Erosion (1.00)	61.0	1.0%
				Pesticide and nutrient movement (0.00)		
67	Newberg fine sandy loam	Very limited	Newberg (85%)	Pesticide and nutrient movement (1.00)	189.0	3.1%
			Wapato (2%)	Pesticide and nutrient movement (1.00)		
70C	Powell silt loam, 8 to 15 percent slopes	Very limited	Powell (85%)	Pesticide and nutrient movement (1.00)	23.5	0.4%
				Water Erosion (1.00)		
			Delena (3%)	Pesticide and nutrient movement (1.00)		
				Water Erosion (1.00)		
73	Riverwash	Not rated	Riverwash (100%)		39.8	0.7%
76B	Salem silt loam, 0 to 7 percent slopes	Somewhat limited	Salem (85%)	Pesticide and nutrient movement (0.22)	89.8	1.5%
				Water Erosion (0.12)		
78B	Saum silt loam, 3 to 8 percent slopes	Somewhat limited	Saum (80%)	Water Erosion (0.42)	110.0	1.8%
				Pesticide and nutrient movement (0.22)		

Subsurface Water Management, Outflow Quality— Summary by Map Unit — Clackamas County Area, Oregon (OR610)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
78C	Saum silt loam, 8 to 15 percent slopes	Very limited	Saum (80%)	Water Erosion (1.00)	229.2	3.8%
				Pesticide and nutrient movement (0.22)		
78D	Saum silt loam, 15 to 30 percent slopes	Very limited	Saum (80%)	Water Erosion (1.00)	157.1	2.6%
				Pesticide and nutrient movement (0.22)		
78E	Saum silt loam, 30 to 60 percent slopes	Very limited	Saum (80%)	Water Erosion (1.00)	39.9	0.7%
				Pesticide and nutrient movement (0.22)		
82	Urban land	Not rated	Urban land (100%)		363.1	6.0%
83	Wapato silt loam	Very limited	Wapato (90%)	Pesticide and nutrient movement (1.00)	6.5	0.1%
			Cove (6%)	Pesticide and nutrient movement (1.00)		
84	Wapato silty clay loam	Very limited	Wapato (85%)	Pesticide and nutrient movement (1.00)	146.1	2.4%
			Cove (6%)	Pesticide and nutrient movement (1.00)		
			Humaquepts (4%)	Pesticide and nutrient movement (1.00)		
88A	Willamette silt loam, wet, 0 to 3 percent slopes	Somewhat limited	Willamette, wet (85%)	Pesticide and nutrient movement (0.64)	192.6	3.2%
88B	Willamette silt loam, wet, 3 to 7 percent slopes	Somewhat limited	Willamette, wet (85%)	Pesticide and nutrient movement (0.64)	42.8	0.7%
				Water Erosion (0.36)		
89D	Witzel very stony silt loam, 3 to	Somewhat limited	Witzel (80%)	Water Erosion (0.68)	439.2	7.3%

Subsurface Water Management, Outflow Quality— Summary by Map Unit — Clackamas County Area, Oregon (OR610)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
	40 percent slopes			Pesticide and nutrient movement (0.22)		
91A	Woodburn silt loam, 0 to 3 percent slopes	Somewhat limited	Woodburn (85%)	Pesticide and nutrient movement (0.96)	88.6	1.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	Somewhat limited	Woodburn (90%)	Pesticide and nutrient movement (0.96)	779.4	12.9%
				Water Erosion (0.12)		
91C	Woodburn silt loam, 8 to 15 percent slopes	Very limited	Woodburn (90%)	Water Erosion (1.00)	283.3	4.7%
				Pesticide and nutrient movement (0.96)		
			Dayton (2%)	Pesticide and nutrient movement (1.00)		
92F	Xerochrepts and Haploxerolls, very steep	Very limited	Xerochrepts (50%)	Water Erosion (1.00)	287.0	4.7%
				Pesticide and nutrient movement (0.14)		
			Haploxerolls (35%)	Water Erosion (1.00)		
				Pesticide and nutrient movement (0.48)		
93E	Xerochrepts-Rock outcrop complex, moderately steep	Somewhat limited	Xerochrepts (60%)	Water Erosion (0.72)	115.8	1.9%
				Pesticide and nutrient movement (0.00)		
W	Water	Not rated	Water (100%)		477.5	7.9%
Totals for Area of Interest					**6,050.5**	**100.0%**

Subsurface Water Management, Outflow Quality— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Very limited	2,732.4	45.2%
Somewhat limited	2,437.8	40.3%

Subsurface Water Management, Outflow Quality— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Null or Not Rated	880.4	14.5%
Totals for Area of Interest	**6,050.5**	**100.0%**

Rating Options—Subsurface Water Management, Outflow Quality

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

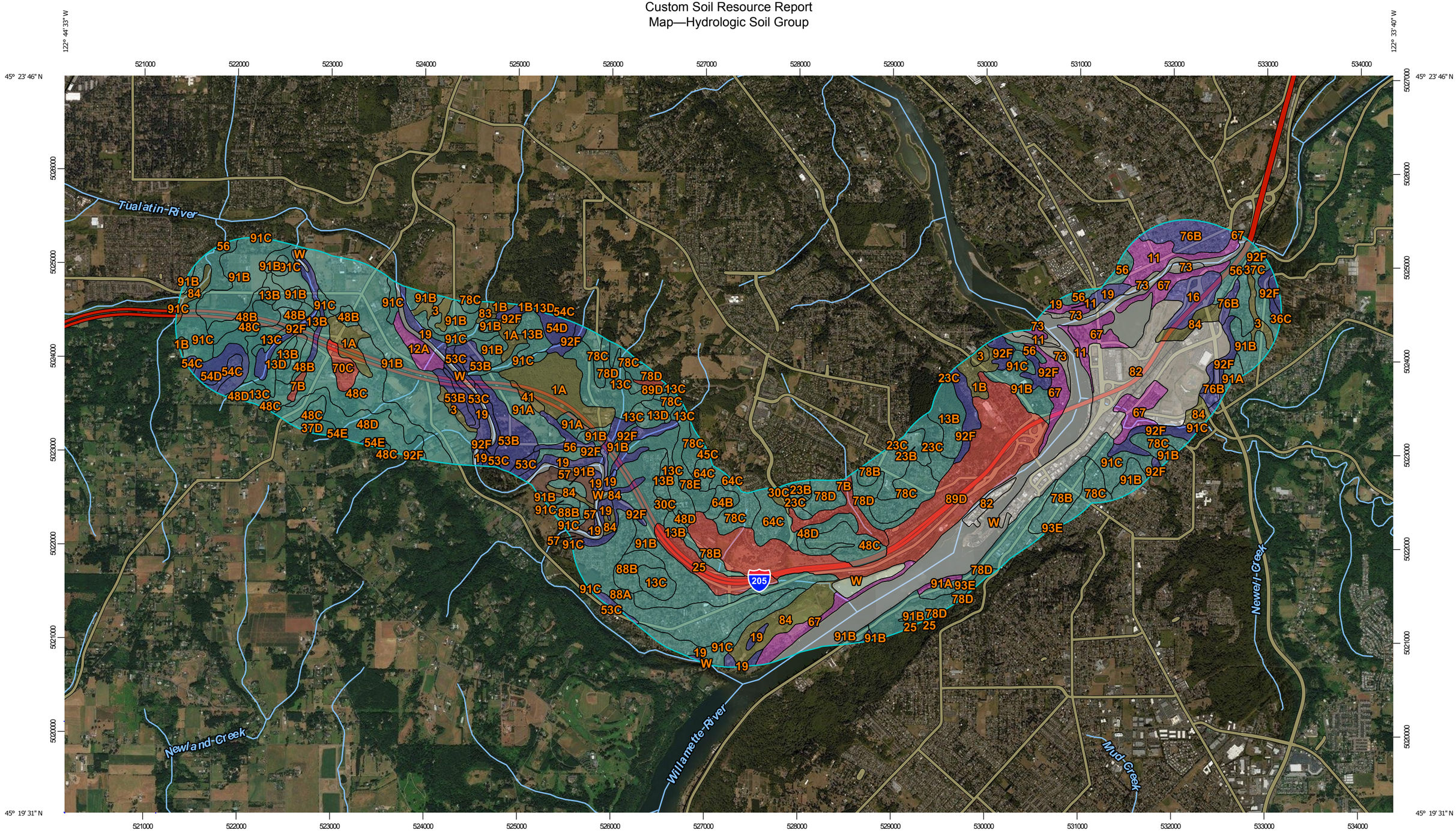
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.



Map Scale: 1:38,300 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 500 1000 2000 3000

Feet: 0 1500 3000 6000 9000

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.

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 11, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—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.

Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1A	Aloha silt loam, 0 to 3 percent slopes	C/D	161.9	2.7%
1B	Aloha silt loam, 3 to 6 percent slopes	C/D	34.9	0.6%
3	Amity silt loam	C/D	51.2	0.8%
7B	Borges silty clay loam, 0 to 8 percent slopes	D	47.0	0.8%
11	Camas gravelly sandy loam	A	78.0	1.3%
12A	Canderly sandy loam, 0 to 3 percent slopes	A	29.1	0.5%
13B	Cascade silt loam, 3 to 8 percent slopes	C	130.4	2.2%
13C	Cascade silt loam, 8 to 15 percent slopes	C	134.6	2.2%
13D	Cascade silt loam, 15 to 30 percent slopes	C	53.4	0.9%
16	Chehalis silt loam	B	50.7	0.8%
19	Cloquato silt loam	B	113.2	1.9%
23B	Cornelius silt loam, 3 to 8 percent slopes	C	30.8	0.5%
23C	Cornelius silt loam, 8 to 15 percent slopes	C	48.2	0.8%
25	Cove silty clay loam	D	63.3	1.0%
30C	Delena silt loam, 3 to 12 percent slopes	C/D	9.9	0.2%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	D	0.0	0.0%
37C	Helvetia silt loam, 8 to 15 percent slopes	C	51.0	0.8%
37D	Helvetia silt loam, 15 to 30 percent slopes	C	7.9	0.1%
41	Huberly silt loam	C/D	8.3	0.1%
45C	Jory silty clay loam, 8 to 15 percent slopes	C	0.7	0.0%
48B	Kinton silt loam, 3 to 8 percent slopes	C	67.3	1.1%
48C	Kinton silt loam, 8 to 15 percent slopes	C	247.5	4.1%
48D	Kinton silt loam, 15 to 30 percent slopes	C	125.4	2.1%
53B	Latourell loam, 3 to 8 percent slopes	B	94.8	1.6%

Hydrologic Soil Group— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
53C	Latourell loam, 8 to 15 percent slopes	B	37.2	0.6%
54C	Laurelwood silt loam, 8 to 15 percent slopes	B	16.3	0.3%
54D	Laurelwood silt loam, 15 to 30 percent slopes	B	62.1	1.0%
54E	Laurelwood silt loam, 30 to 60 percent slopes	B	6.5	0.1%
56	McBee silty clay loam	C	74.6	1.2%
57	McBee variant loam	B/D	35.5	0.6%
64B	Nekia silty clay loam, 2 to 8 percent slopes	C	17.7	0.3%
64C	Nekia silty clay loam, 8 to 15 percent slopes	C	61.0	1.0%
67	Newberg fine sandy loam	A	189.0	3.1%
70C	Powell silt loam, 8 to 15 percent slopes	D	23.5	0.4%
73	Riverwash		39.8	0.7%
76B	Salem silt loam, 0 to 7 percent slopes	B	89.8	1.5%
78B	Saum silt loam, 3 to 8 percent slopes	C	110.0	1.8%
78C	Saum silt loam, 8 to 15 percent slopes	C	229.2	3.8%
78D	Saum silt loam, 15 to 30 percent slopes	C	157.1	2.6%
78E	Saum silt loam, 30 to 60 percent slopes	C	39.9	0.7%
82	Urban land		363.1	6.0%
83	Wapato silt loam	C/D	6.5	0.1%
84	Wapato silty clay loam	C/D	146.1	2.4%
88A	Willamette silt loam, wet, 0 to 3 percent slopes	C	192.6	3.2%
88B	Willamette silt loam, wet, 3 to 7 percent slopes	C	42.8	0.7%
89D	Witzel very stony silt loam, 3 to 40 percent slopes	D	439.2	7.3%
91A	Woodburn silt loam, 0 to 3 percent slopes	C	88.6	1.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	C	779.4	12.9%
91C	Woodburn silt loam, 8 to 15 percent slopes	C	283.3	4.7%
92F	Xerochrepts and Haploxerolls, very steep	B	287.0	4.7%

Hydrologic Soil Group— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
93E	Xerochrepts-Rock outcrop complex, moderately steep	C	115.8	1.9%
W	Water		477.5	7.9%
Totals for Area of Interest			**6,050.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Hydrologic Soil Group

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:

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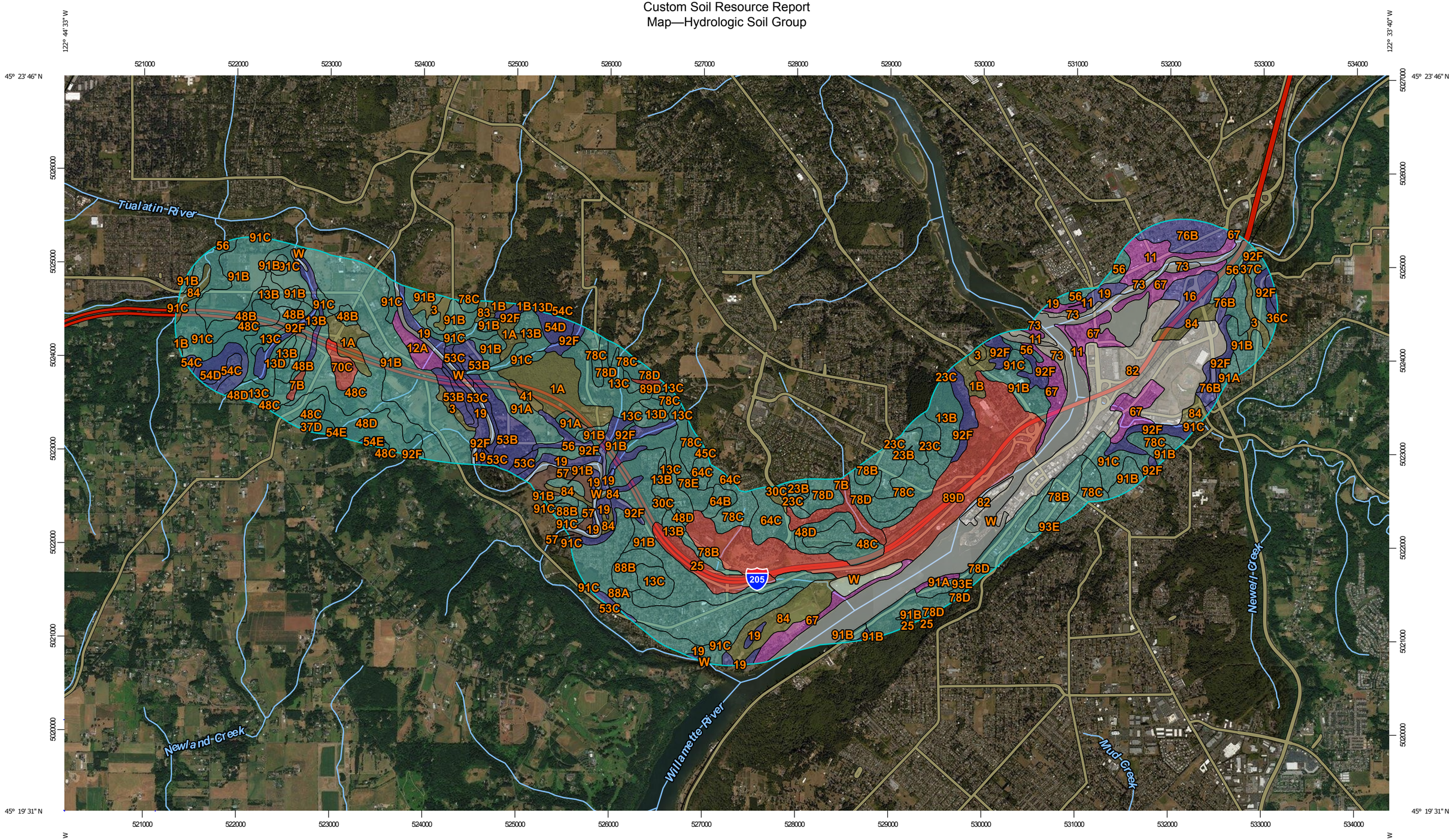

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N

Meters: 0 500 1000 2000 3000

Feet: 0 1500 3000 6000 9000

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

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Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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Web Soil Survey URL:
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12A	Canderly sandy loam, 0 to 3 percent slopes	A	29.1	0.5%
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13C	Cascade silt loam, 8 to 15 percent slopes	C	134.6	2.2%
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16	Chehalis silt loam	B	50.7	0.8%
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23B	Cornelius silt loam, 3 to 8 percent slopes	C	30.8	0.5%
23C	Cornelius silt loam, 8 to 15 percent slopes	C	48.2	0.8%
25	Cove silty clay loam	D	63.3	1.0%
30C	Delena silt loam, 3 to 12 percent slopes	C/D	9.9	0.2%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	D	0.0	0.0%
37C	Helvetia silt loam, 8 to 15 percent slopes	C	51.0	0.8%
37D	Helvetia silt loam, 15 to 30 percent slopes	C	7.9	0.1%
41	Huberly silt loam	C/D	8.3	0.1%
45C	Jory silty clay loam, 8 to 15 percent slopes	C	0.7	0.0%
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54E	Laurelwood silt loam, 30 to 60 percent slopes	B	6.5	0.1%
56	McBee silty clay loam	C	74.6	1.2%
57	McBee variant loam	B/D	35.5	0.6%
64B	Nekia silty clay loam, 2 to 8 percent slopes	C	17.7	0.3%
64C	Nekia silty clay loam, 8 to 15 percent slopes	C	61.0	1.0%
67	Newberg fine sandy loam	A	189.0	3.1%
70C	Powell silt loam, 8 to 15 percent slopes	D	23.5	0.4%
73	Riverwash		39.8	0.7%
76B	Salem silt loam, 0 to 7 percent slopes	B	89.8	1.5%
78B	Saum silt loam, 3 to 8 percent slopes	C	110.0	1.8%
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84	Wapato silty clay loam	C/D	146.1	2.4%
88A	Willamette silt loam, wet, 0 to 3 percent slopes	C	192.6	3.2%
88B	Willamette silt loam, wet, 3 to 7 percent slopes	C	42.8	0.7%
89D	Witzel very stony silt loam, 3 to 40 percent slopes	D	439.2	7.3%
91A	Woodburn silt loam, 0 to 3 percent slopes	C	88.6	1.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	C	779.4	12.9%
91C	Woodburn silt loam, 8 to 15 percent slopes	C	283.3	4.7%
92F	Xerochrepts and Haploxerolls, very steep	B	287.0	4.7%

Hydrologic Soil Group— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
93E	Xerochrepts-Rock outcrop complex, moderately steep	C	115.8	1.9%
W	Water		477.5	7.9%
Totals for Area of Interest			**6,050.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

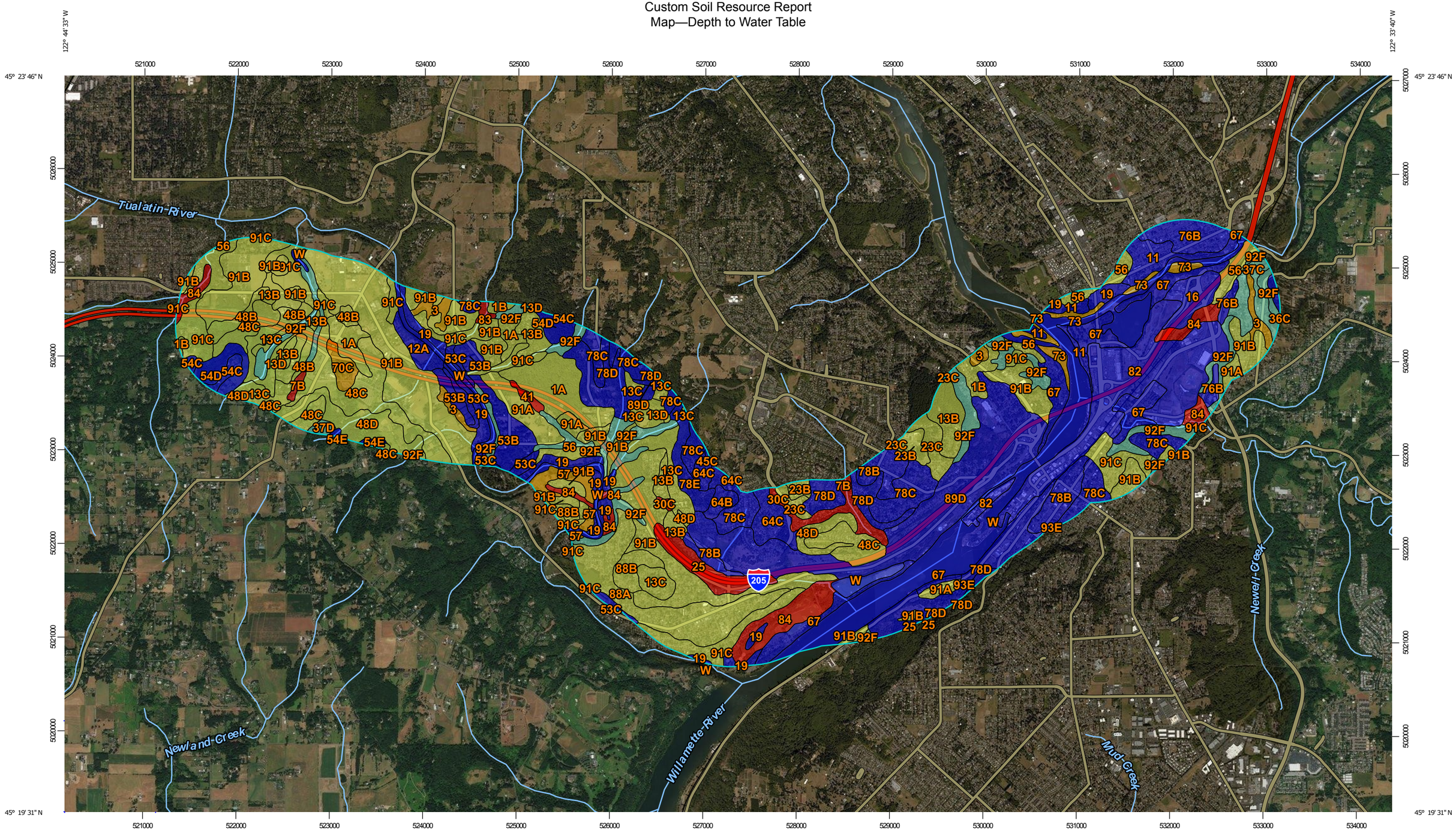
Water Features

Water Features include ponding frequency, flooding frequency, and depth to water table.

Depth to Water Table

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.



Map Scale: 1:38,300 if printed on B landscape (17" x 11") sheet.

N

Meters: 0 500 1000 2000 3000

Feet: 0 1500 3000 6000 9000

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

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Lines

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

Not rated or not available

Soil Rating Points

0 - 25

25 - 50

50 - 100

100 - 150

150 - 200

> 200

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.

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 11, Sep 16, 2016

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 8, 2010—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.

Table—Depth to Water Table

Depth to Water Table— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
1A	Aloha silt loam, 0 to 3 percent slopes	54	161.9	2.7%
1B	Aloha silt loam, 3 to 6 percent slopes	54	34.9	0.6%
3	Amity silt loam	31	51.2	0.8%
7B	Borges silty clay loam, 0 to 8 percent slopes	8	47.0	0.8%
11	Camas gravelly sandy loam	>200	78.0	1.3%
12A	Canderly sandy loam, 0 to 3 percent slopes	>200	29.1	0.5%
13B	Cascade silt loam, 3 to 8 percent slopes	61	130.4	2.2%
13C	Cascade silt loam, 8 to 15 percent slopes	61	134.6	2.2%
13D	Cascade silt loam, 15 to 30 percent slopes	61	53.4	0.9%
16	Chehalis silt loam	>200	50.7	0.8%
19	Cloquato silt loam	>200	113.2	1.9%
23B	Cornelius silt loam, 3 to 8 percent slopes	86	30.8	0.5%
23C	Cornelius silt loam, 8 to 15 percent slopes	86	48.2	0.8%
25	Cove silty clay loam	15	63.3	1.0%
30C	Delena silt loam, 3 to 12 percent slopes	23	9.9	0.2%
36C	Hardscrabble silt loam, 7 to 20 percent slopes	31	0.0	0.0%
37C	Helvetia silt loam, 8 to 15 percent slopes	137	51.0	0.8%
37D	Helvetia silt loam, 15 to 30 percent slopes	137	7.9	0.1%
41	Huberly silt loam	23	8.3	0.1%
45C	Jory silty clay loam, 8 to 15 percent slopes	>200	0.7	0.0%
48B	Kinton silt loam, 3 to 8 percent slopes	86	67.3	1.1%
48C	Kinton silt loam, 8 to 15 percent slopes	86	247.5	4.1%
48D	Kinton silt loam, 15 to 30 percent slopes	86	125.4	2.1%
53B	Latourell loam, 3 to 8 percent slopes	>200	94.8	1.6%

Depth to Water Table— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating (centimeters)**	**Acres in AOI**	**Percent of AOI**
53C	Latourell loam, 8 to 15 percent slopes	>200	37.2	0.6%
54C	Laurelwood silt loam, 8 to 15 percent slopes	>200	16.3	0.3%
54D	Laurelwood silt loam, 15 to 30 percent slopes	>200	62.1	1.0%
54E	Laurelwood silt loam, 30 to 60 percent slopes	>200	6.5	0.1%
56	McBee silty clay loam	76	74.6	1.2%
57	McBee variant loam	31	35.5	0.6%
64B	Nekia silty clay loam, 2 to 8 percent slopes	>200	17.7	0.3%
64C	Nekia silty clay loam, 8 to 15 percent slopes	>200	61.0	1.0%
67	Newberg fine sandy loam	>200	189.0	3.1%
70C	Powell silt loam, 8 to 15 percent slopes	38	23.5	0.4%
73	Riverwash	31	39.8	0.7%
76B	Salem silt loam, 0 to 7 percent slopes	>200	89.8	1.5%
78B	Saum silt loam, 3 to 8 percent slopes	>200	110.0	1.8%
78C	Saum silt loam, 8 to 15 percent slopes	>200	229.2	3.8%
78D	Saum silt loam, 15 to 30 percent slopes	>200	157.1	2.6%
78E	Saum silt loam, 30 to 60 percent slopes	>200	39.9	0.7%
82	Urban land	>200	363.1	6.0%
83	Wapato silt loam	0	6.5	0.1%
84	Wapato silty clay loam	8	146.1	2.4%
88A	Willamette silt loam, wet, 0 to 3 percent slopes	92	192.6	3.2%
88B	Willamette silt loam, wet, 3 to 7 percent slopes	92	42.8	0.7%
89D	Witzel very stony silt loam, 3 to 40 percent slopes	>200	439.2	7.3%
91A	Woodburn silt loam, 0 to 3 percent slopes	64	88.6	1.5%
91B	Woodburn silt loam, 3 to 8 percent slopes	64	779.4	12.9%
91C	Woodburn silt loam, 8 to 15 percent slopes	64	283.3	4.7%
92F	Xerochrepts and Haploxerolls, very steep	137	287.0	4.7%

Depth to Water Table— Summary by Map Unit — Clackamas County Area, Oregon (OR610)				
Map unit symbol	**Map unit name**	**Rating (centimeters)**	**Acres in AOI**	**Percent of AOI**
93E	Xerochrepts-Rock outcrop complex, moderately steep	>200	115.8	1.9%
W	Water	>200	477.5	7.9%
Totals for Area of Interest			**6,050.5**	**100.0%**

Rating Options—Depth to Water Table

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Beginning Month: January

Ending Month: December

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SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

August 22, 2018

Mr. Steve Drahota
HDR, Inc.
1001 SW 5th Avenue, Suite 1800
Portland, Oregon 97204

RE: DRAFT PRELIMINARY INFILTRATION TESTING RESULTS MEMORANDUM CLACKAMAS COUNTY, OREGON

Dear Mr. Drahota:

This letter report summarizes results of infiltration testing performed by Shannon & Wilson, Inc. (Shannon & Wilson), to support design of stormwater management facilities for the I-205: Stafford Road to OR99E Corridor Widening Project. The project area is shown on the Vicinity Map, Figure 1. We understand the Oregon Department of Transportation (ODOT) is planning to widen the Interstate-205 (I-205) corridor from Stafford Road to OR99E. This project will widen I-205 to three lanes northbound and three lanes southbound from Stafford Road to OR213. We also understand the project will include proposed facilities such as detention ponds and swales which will be deeper than 3 feet.

To assist HDR, Inc. (HDR), for the design of the proposed stormwater management facilities, Shannon & Wilson is providing geotechnical field explorations and infiltration testing services. Our services were performed in accordance with the scope of services defined in the HDR Subconsultant Task Order No.10063137-001, dated June 14, 2018.

INFILTRATION TESTING

Shannon & Wilson is currently performing a subsurface investigation for Amendment 3 at the project site. As part of the ongoing subsurface investigation, we completed 15 infiltration tests. Approximate locations of the infiltration test sites are shown on the Site and Exploration Plan, Figure 2. A Shannon & Wilson representative was on site to perform each infiltration test.

Infiltration Testing

Infiltration tests were conducted in accordance with the procedures described in the Infiltration Testing Guide, of the *Stormwater Standards, Clackamas County Stormwater Service District No.*

DRAFT

1(E.2.2). Infiltration tests must be performed at the base of the proposed facilities, which is anticipated to be approximately six feet. As shown in Table 1 below, nine of the holes were excavated to less than 3.5 feet. At these locations, we encountered refusal conditions after several attempts due to gravels, cobbles, and boulders, at or near the surface.

The test hole was advanced using a gasoline-powered auger and hand tools. A 6-inch-diameter PVC casing was embedded into the underlying soil to perform the Encased Falling Head Test method. This method is not appropriate in gravelly soils or conditions in which a good seal with the casing cannot be established. In these cases, the Open Pit Falling Head Test method was followed.

The excavated hole was then filled with clean water a minimum of 12 inches deep, and this depth was maintained for at least 4 hours to presoak the native material. After the presaturation period, the holes were refilled with water to 6 inches (12 inches for Open Pit Falling Head Test Method) and the drawdown time was measured. Measurements were made every 10 minutes for one hour in faster draining soils, or 20 minutes for two hours in slower draining soils.

The process of refilling the hole and taking measurements (a trial) is repeated until the change in measured infiltration rate between two successive trials is no more than five percent. At least three trials were conducted for each test.

The infiltration test results of all infiltration tests are presented on Figures 3 through 17.

RESULTS

According to the *Stormwater Standards, Clackamas County Stormwater Service District No. 1(E.2.2),* the final infiltration rates were calculated using the following standard calculation. The calculation is performed for each water level drop and is outlined below:

= (Drop in water level/Time interval) x conversion

= 0.055ft/20min x (12in/ft) x (60min/hr)

= 1.98 inches per hour

Field-measured infiltration rates in the final test of each trial for each test location are provided in Table 1 below.

DRAFT

TABLE 1
INFILTRATION TESTING SUMMARY

Designation	Approximate Depth (feet)	Infiltration Testing Method	Final Infiltration Rate (inches/hour) for each Trial		
			1	2	3
INF19786-01	5.0	Encased Falling Head Test	0.06	0.00	0.00
INF19786-02	5.5	Encased Falling Head Test	0.72	0.36	0.72
INF19786-03	5.5	Encased Falling Head Test	0.09	0.18	0.0
INF19786-04	6	Encased Falling Head Test	1.44	1.44	0.72
INF19786-05	5.25	Encased Falling Head Test	0.00	0.00	0.00
INF19786-06	2.5	Open Pit Falling Head Test	0.36	0.17	0.36
INF19786-07	5.5	Encased Falling Head Test	0.72	0.72	0.72
INF19786-08	2.0	Open Pit Falling Head Test	1.44	1.44	1.44
INF19786-09	2.0	Open Pit Falling Head Test	3.60	3.60	2.88
INF19786-10	2.0	Open Pit Falling Head Test	2.88	2.88	2.88
INF19786-11	2.0	Open Pit Falling Head Test	0.72	0.36	0.36
INF19786-12	2.0	Open Pit Falling Head Test	1.44	0.72	1.44
INF19786-13	3.0	Open Pit Falling Head Test	1.44	1.44	1.44
INF19786-14	3.5	Open Pit Falling Head Test	1.44	0.72	1.44
INF19786-15	2.0	Open Pit Falling Head Test	0.36	0.00	0.36

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LIMITATIONS

Shannon & Wilson has prepared this report in a professional manner, using a level of skill and care normally exercised for similar projects under similar conditions by reputable and competent geotechnical consultants currently practicing in the area, and in accordance with the terms and conditions set forth in our proposal. The facts and conditions referenced in this report may change over time, and the conclusions set forth herein are applicable to the facts and conditions

as described only at the time of this report. Conclusions were made within the operative constraints of the scope, budget, and schedule for this project. We believe that the conditions stated here are factual, but no guarantee is made or implied. This report is for the exclusive use of HDR, Inc. We have prepared an enclosure, "Important Information About Your Geotechnical/Environmental Report," to help you and others understand the use and limitations of our reports.

Sincerely,

SHANNON & WILSON, INC.

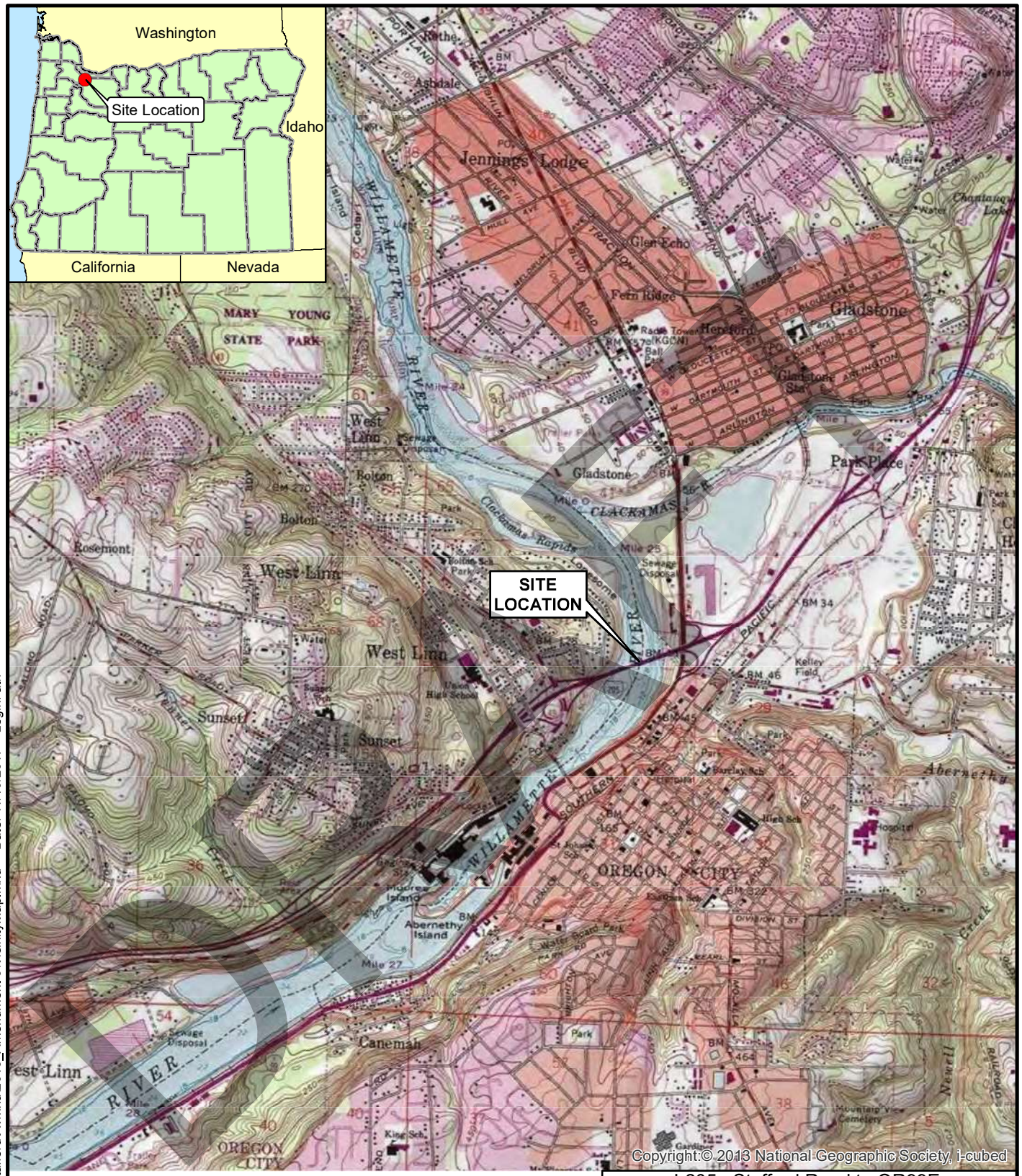
Cody Sorensen, CEG
Senior Engineering Geologist

Christina Villeneuve, GIT
Staff Geologist

CLV:NMV/mmm

Enc: Figure 1: Vicinity Map
Figure 2: Site and Exploration Plan
Figures 3 through 17: Infiltration Test Results
Important Information About Your Geotechnical/Environmental Report

DRAFT



0 0.25 0.5 1

Scale in Miles

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

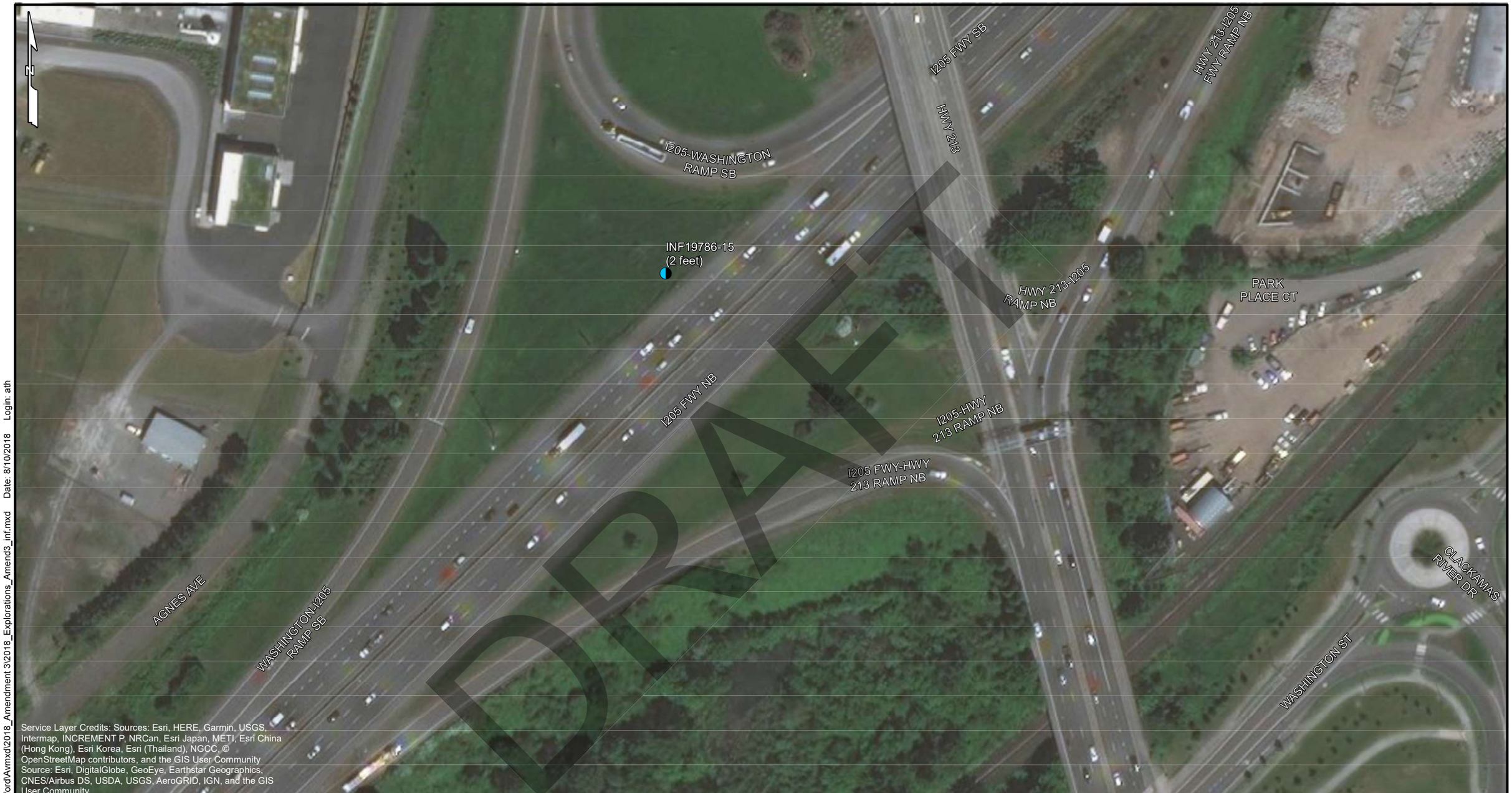
VICINITY MAP

August 2018 24-1-04165-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\VicinityMap.mxd Date: 11/15/2017 Login: ath



LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200

Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

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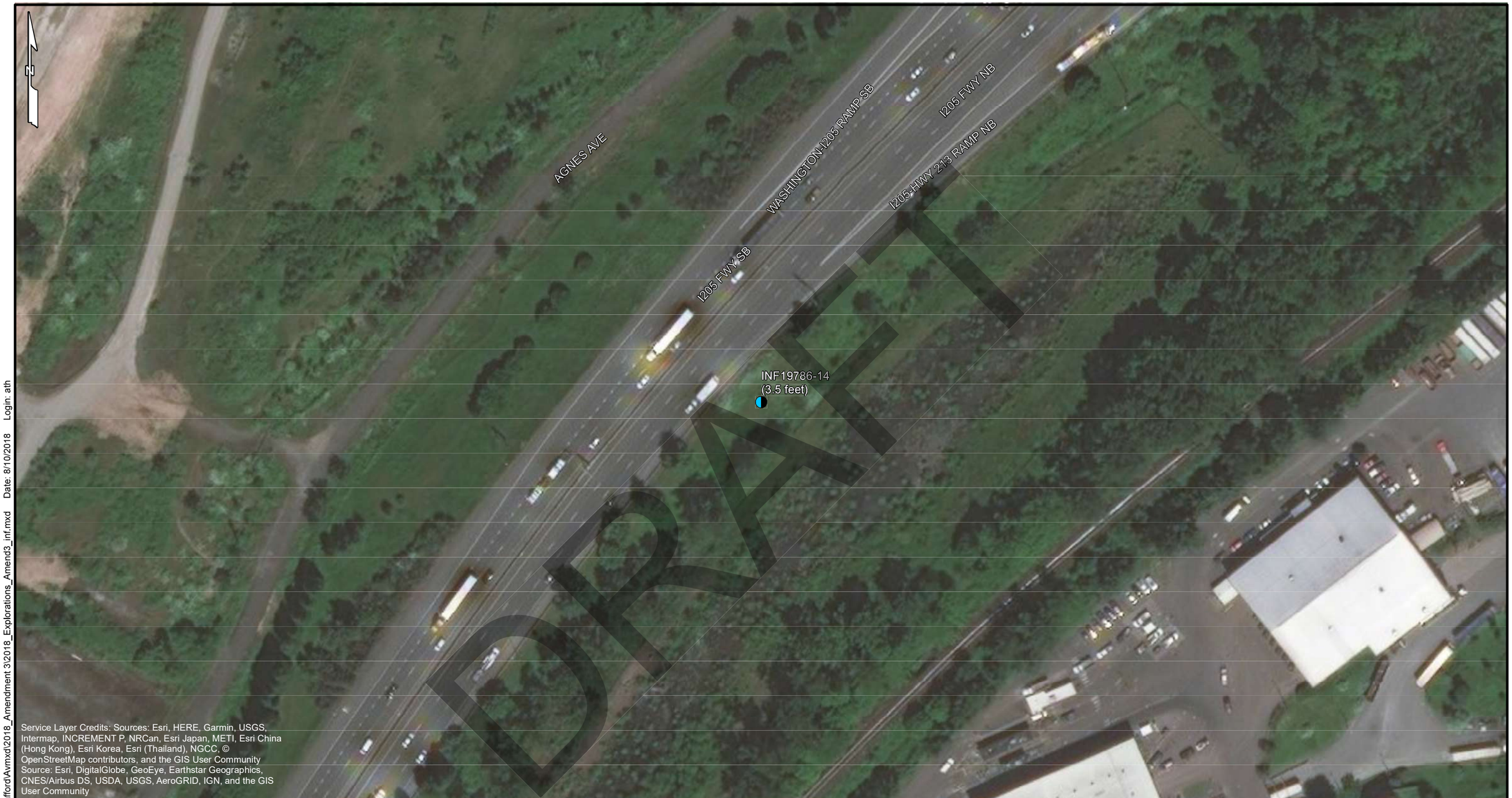
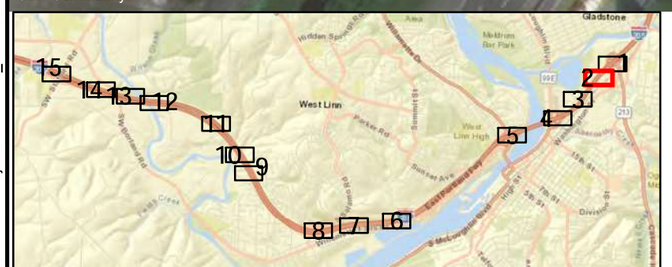
FIG. 2
Sheet 1 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath





LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

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FIG. 2
Sheet 2 of 15

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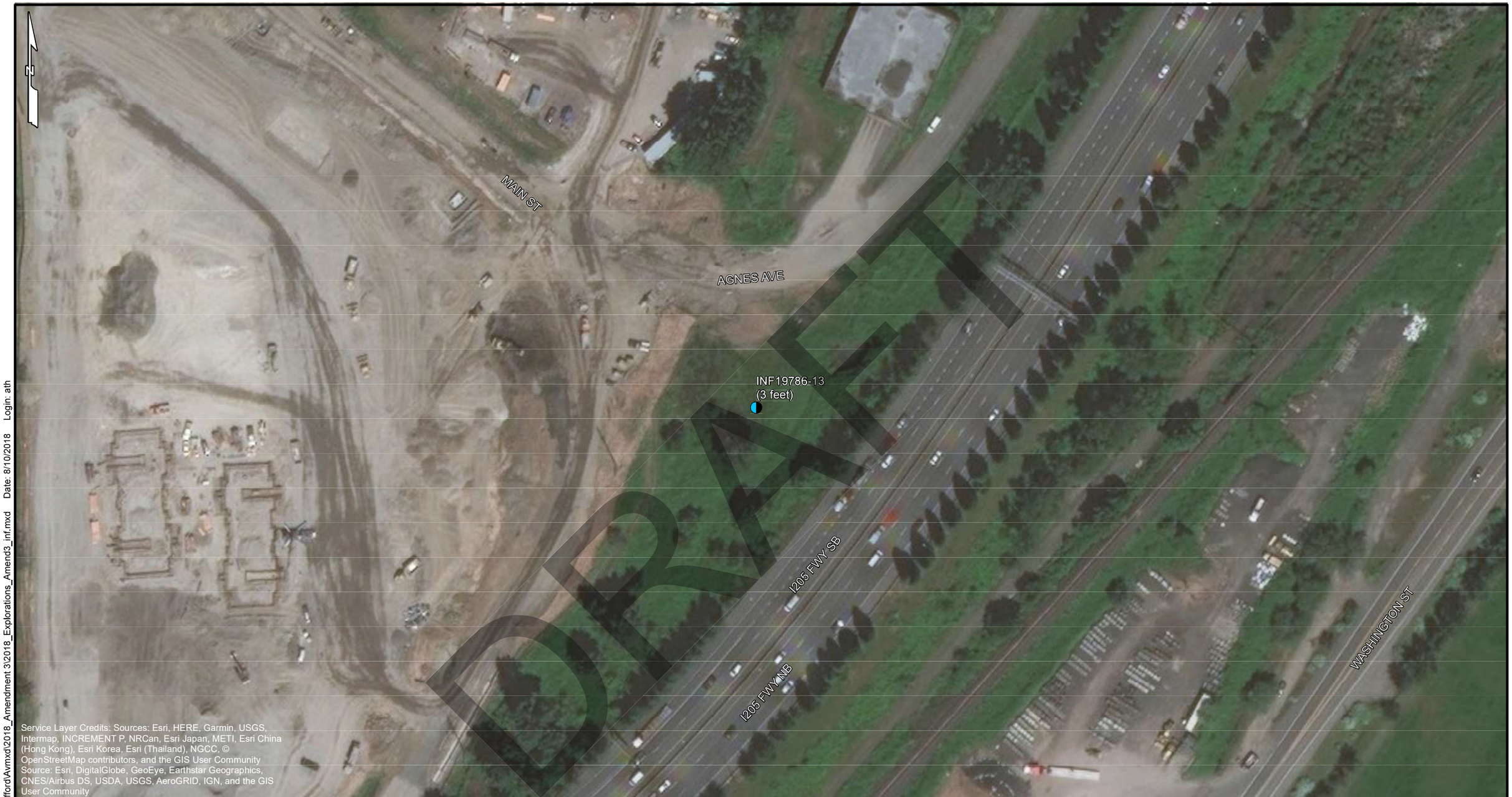

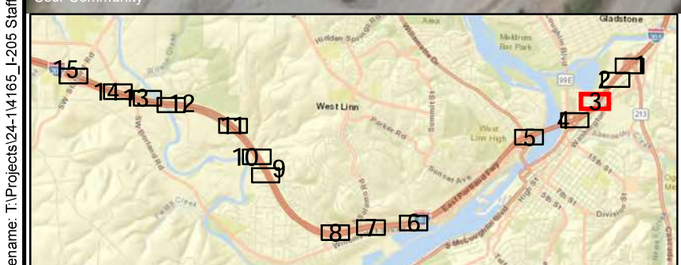

LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

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FIG. 2
Sheet 3 of 15

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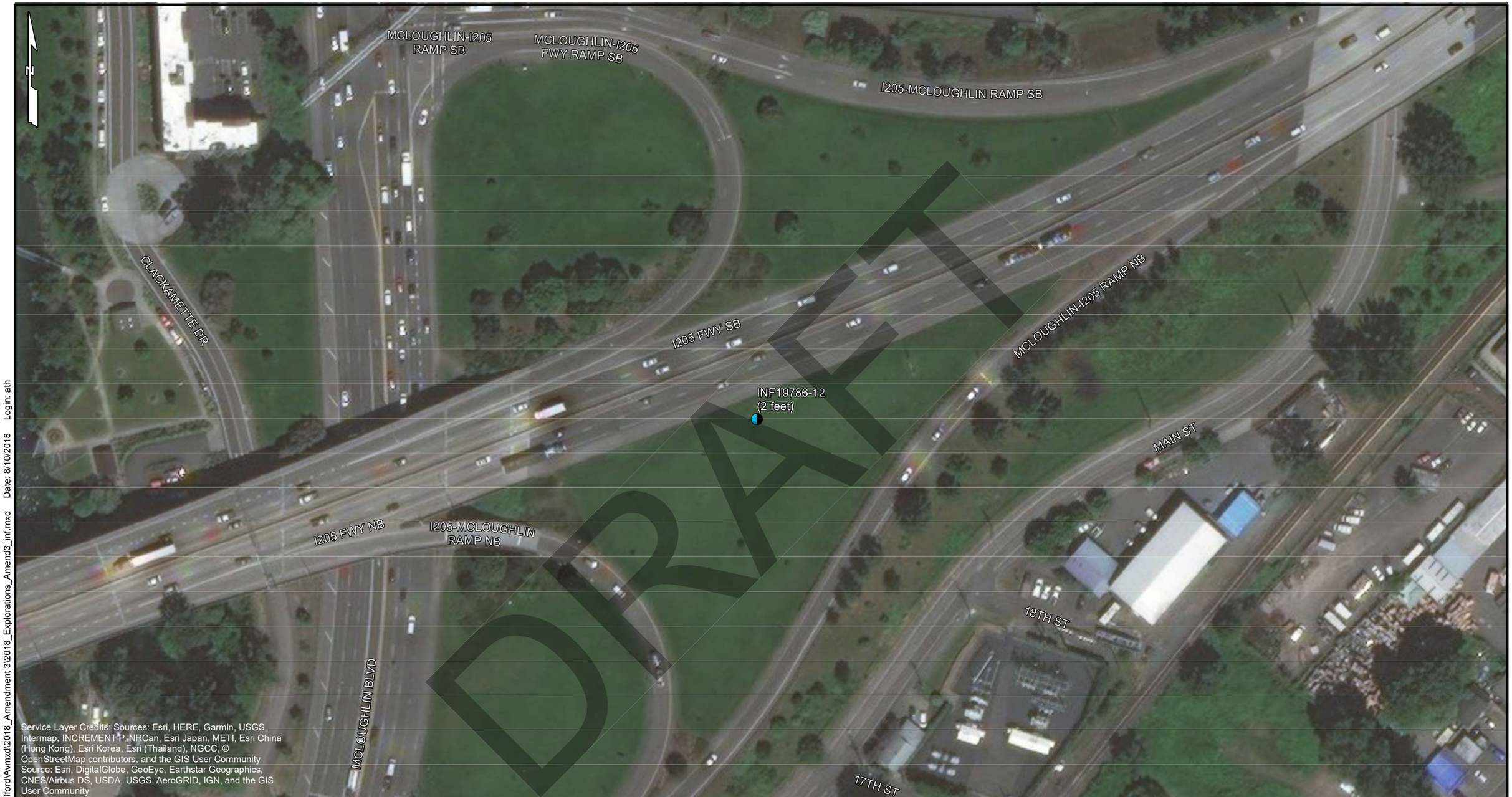

LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

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FIG. 2
Sheet 4 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath

LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

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FIG. 2
Sheet 5 of 15

Filename: T:\Projects\24-114165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath

LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

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FIG. 2
Sheet 6 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

INF19786-15A
(Final Depth)
Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 7 of 15

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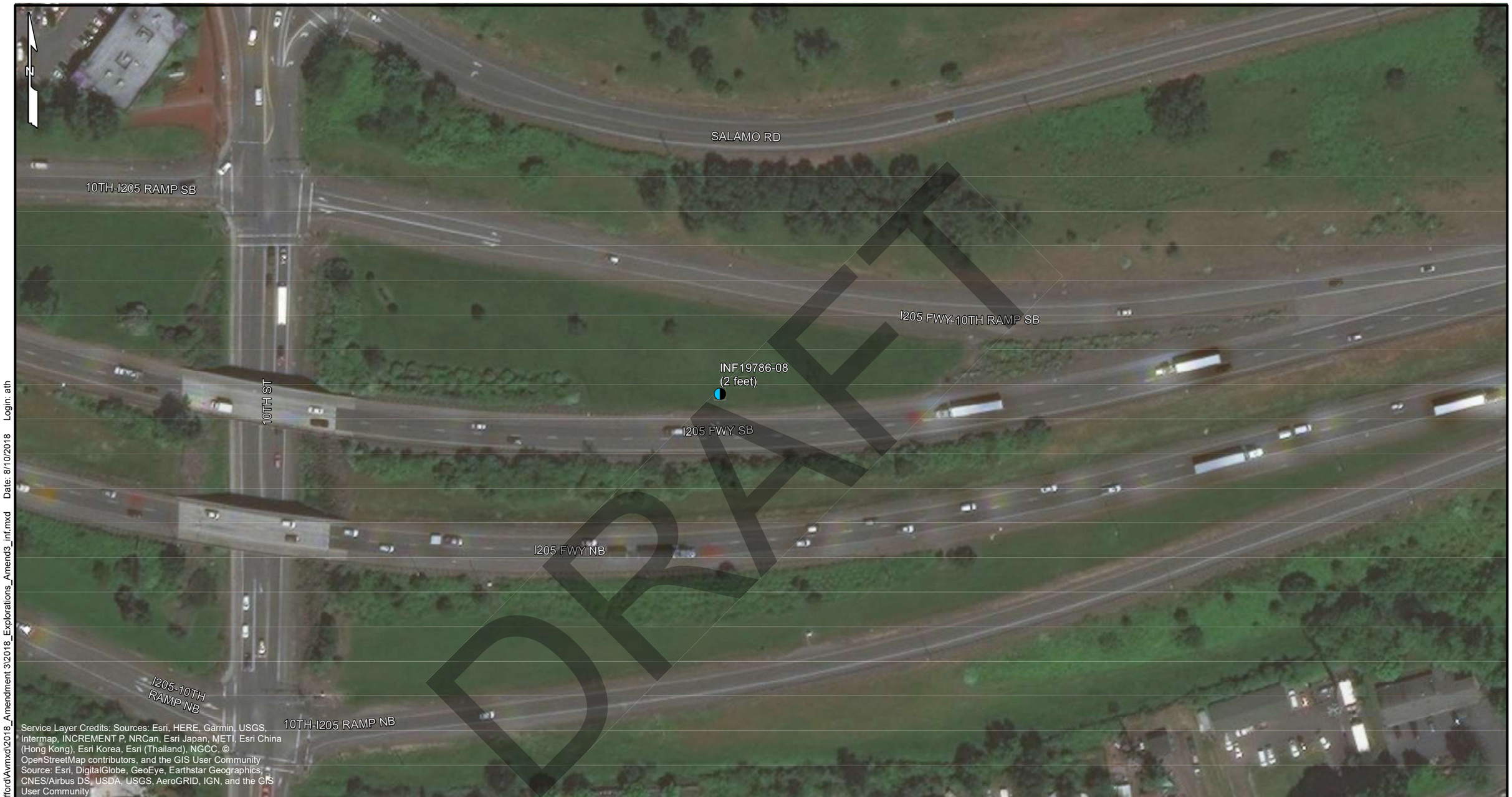

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

INF19786-15A
(Final Depth)
Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

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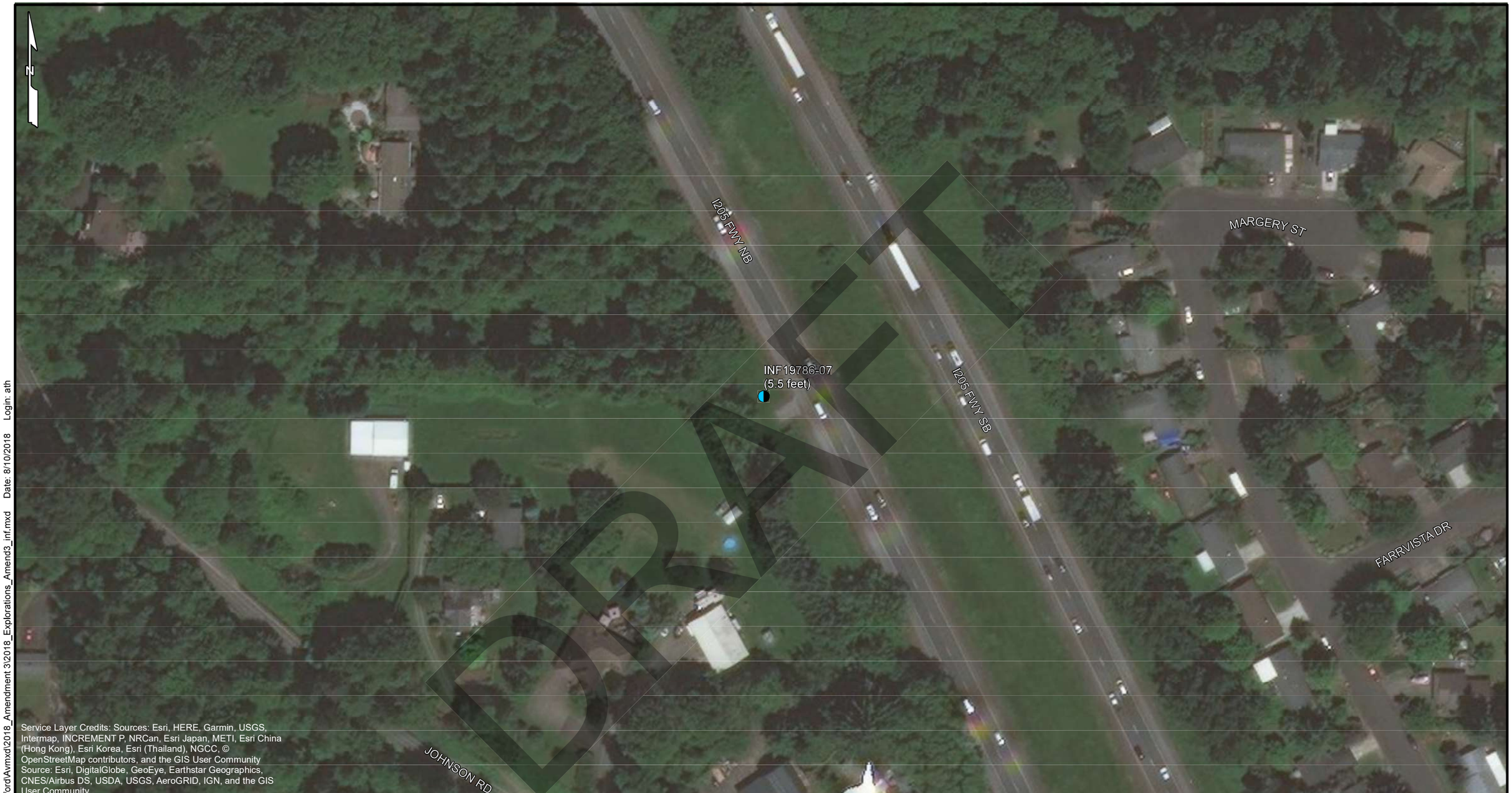
FIG. 2
Sheet 8 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath



LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 9 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath

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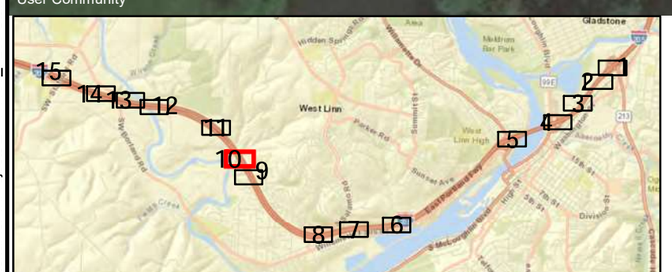
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



LEGEND

INF19786-15A
(Final Depth)
Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

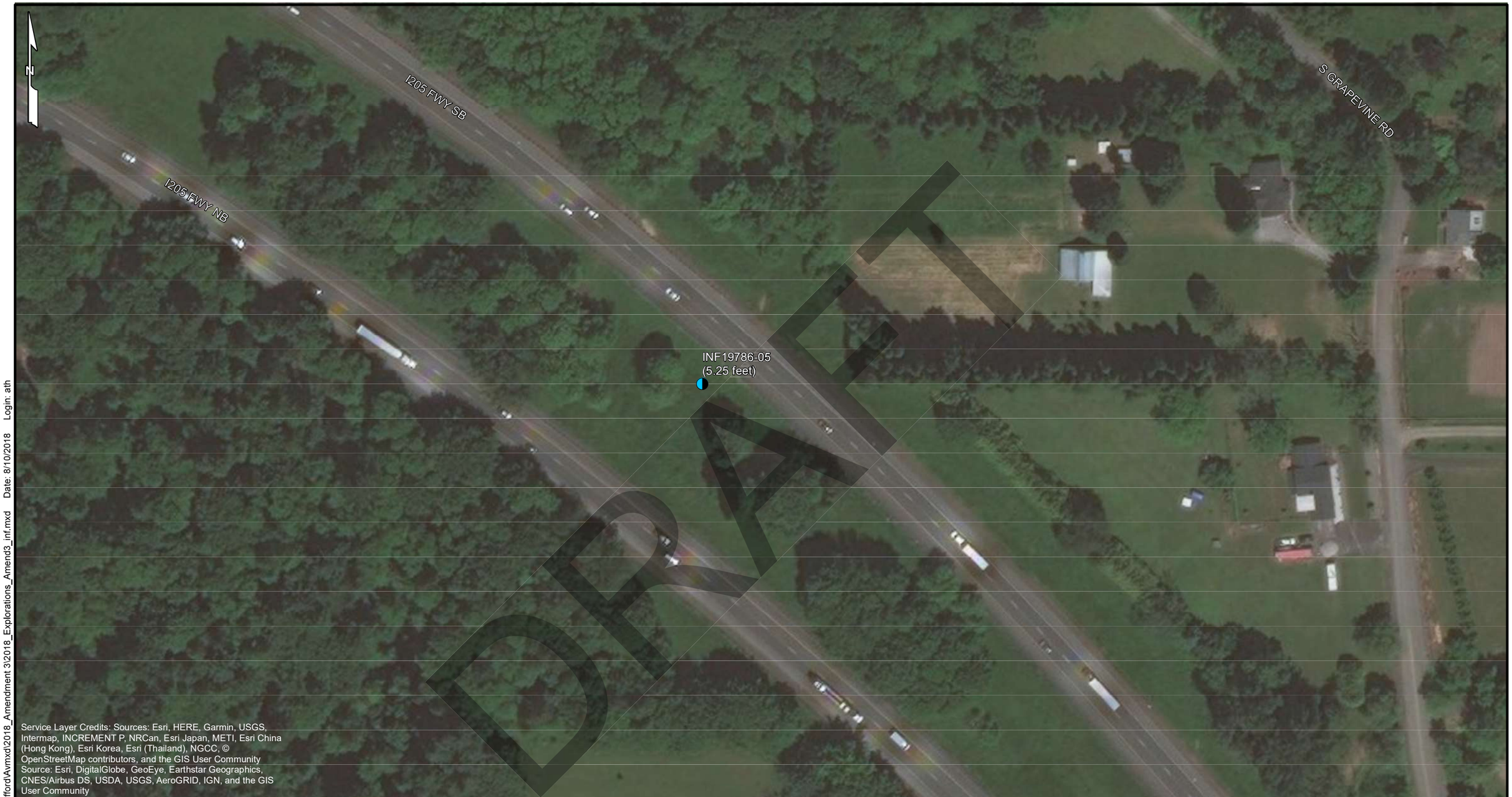
EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 10 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

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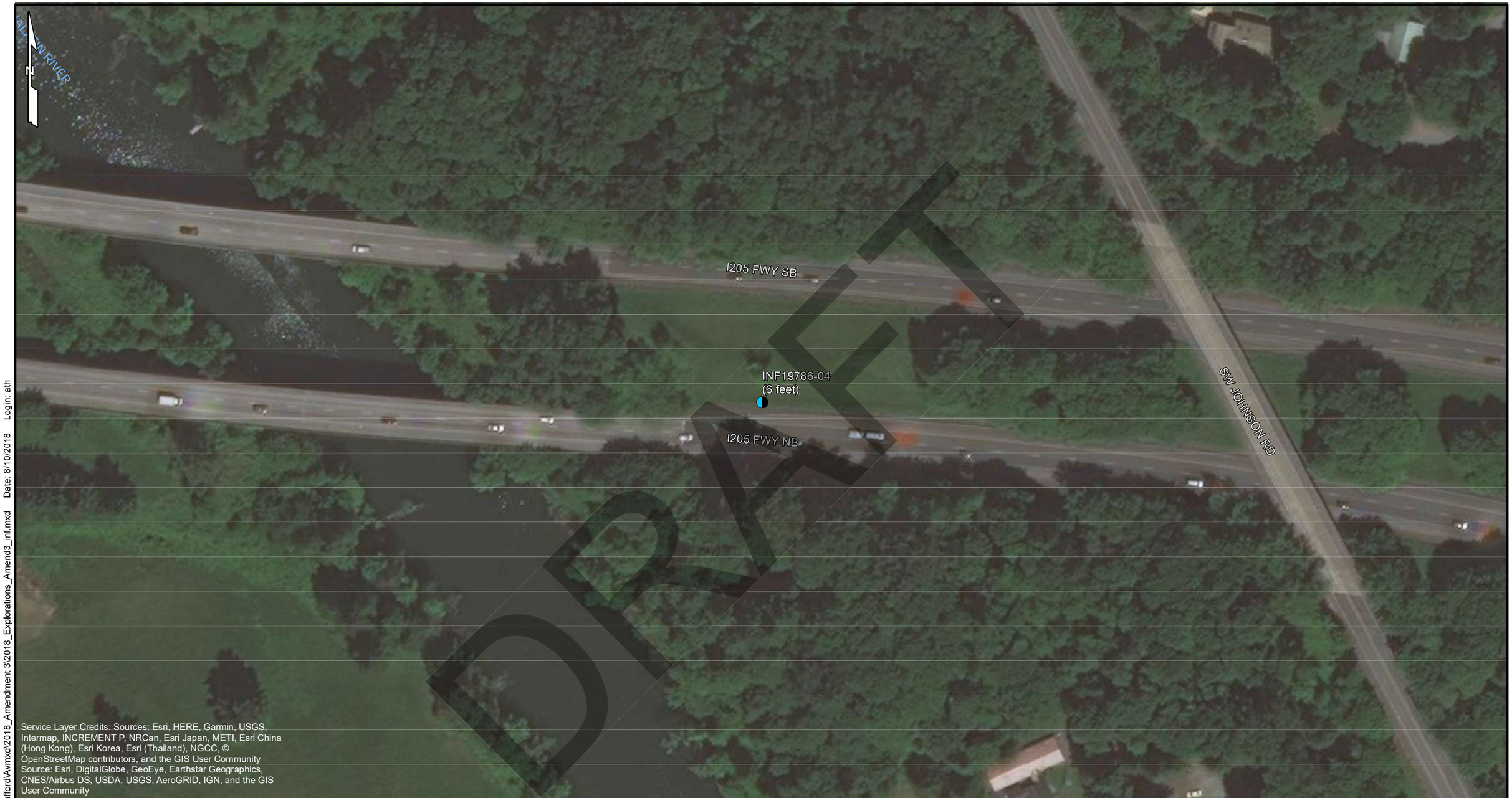
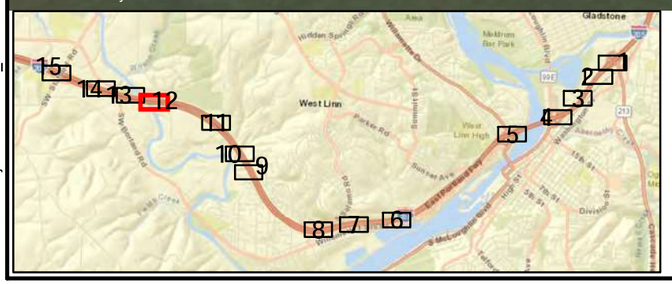
FIG. 2
Sheet 11 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



LEGEND

INF19786-15A
(Final Depth)
Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

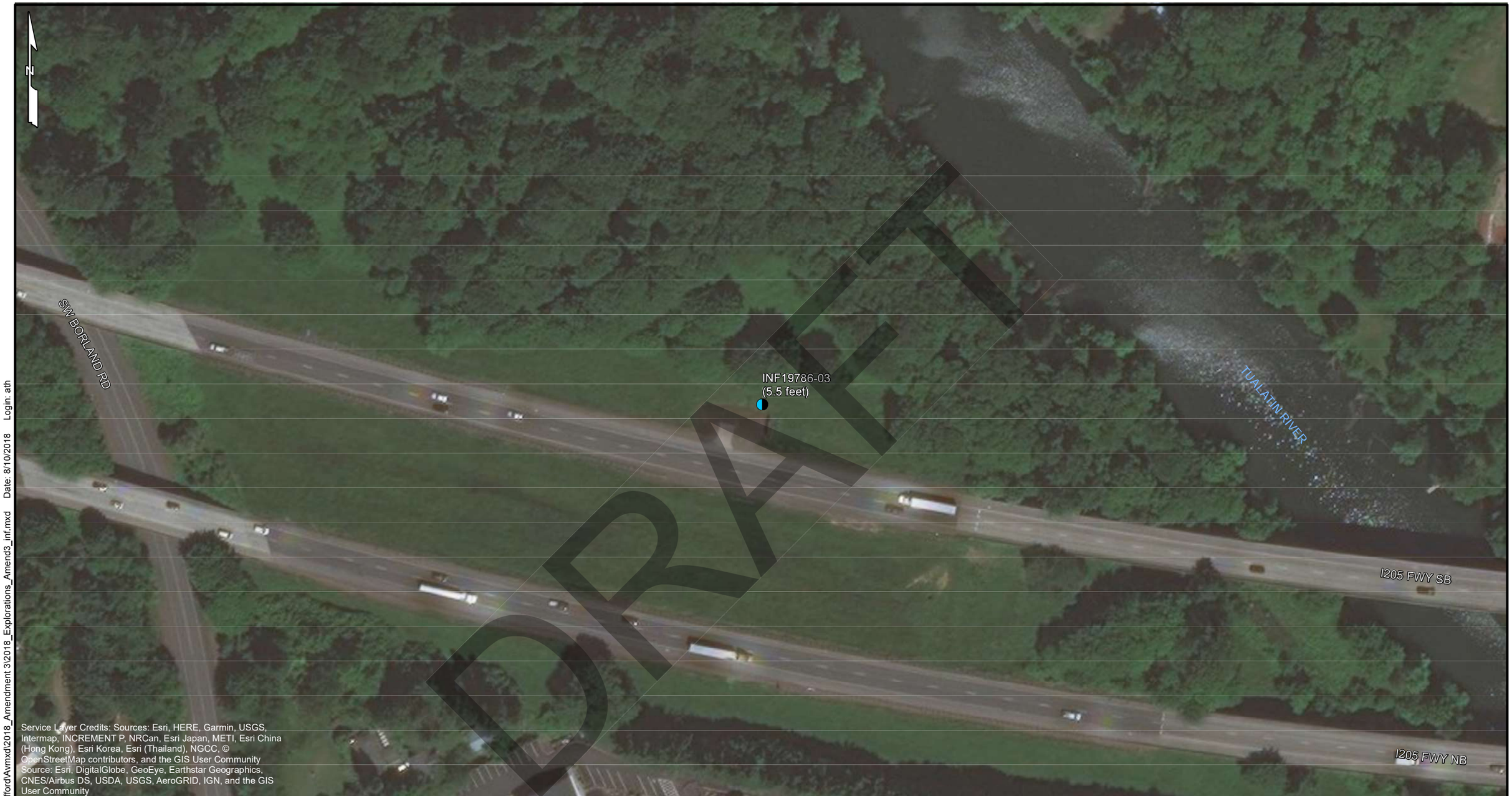
EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 12 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

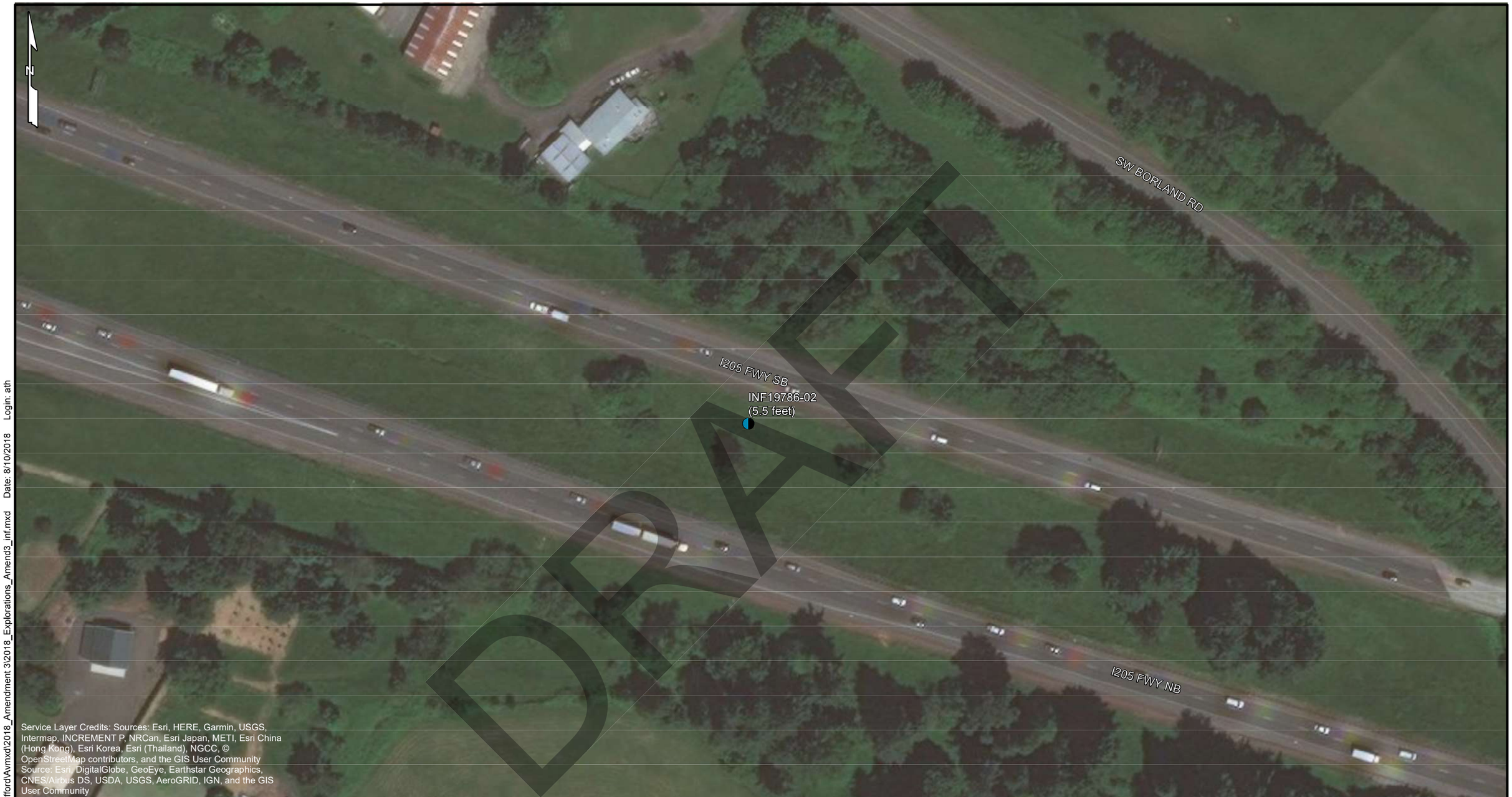
EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 13 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath



LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

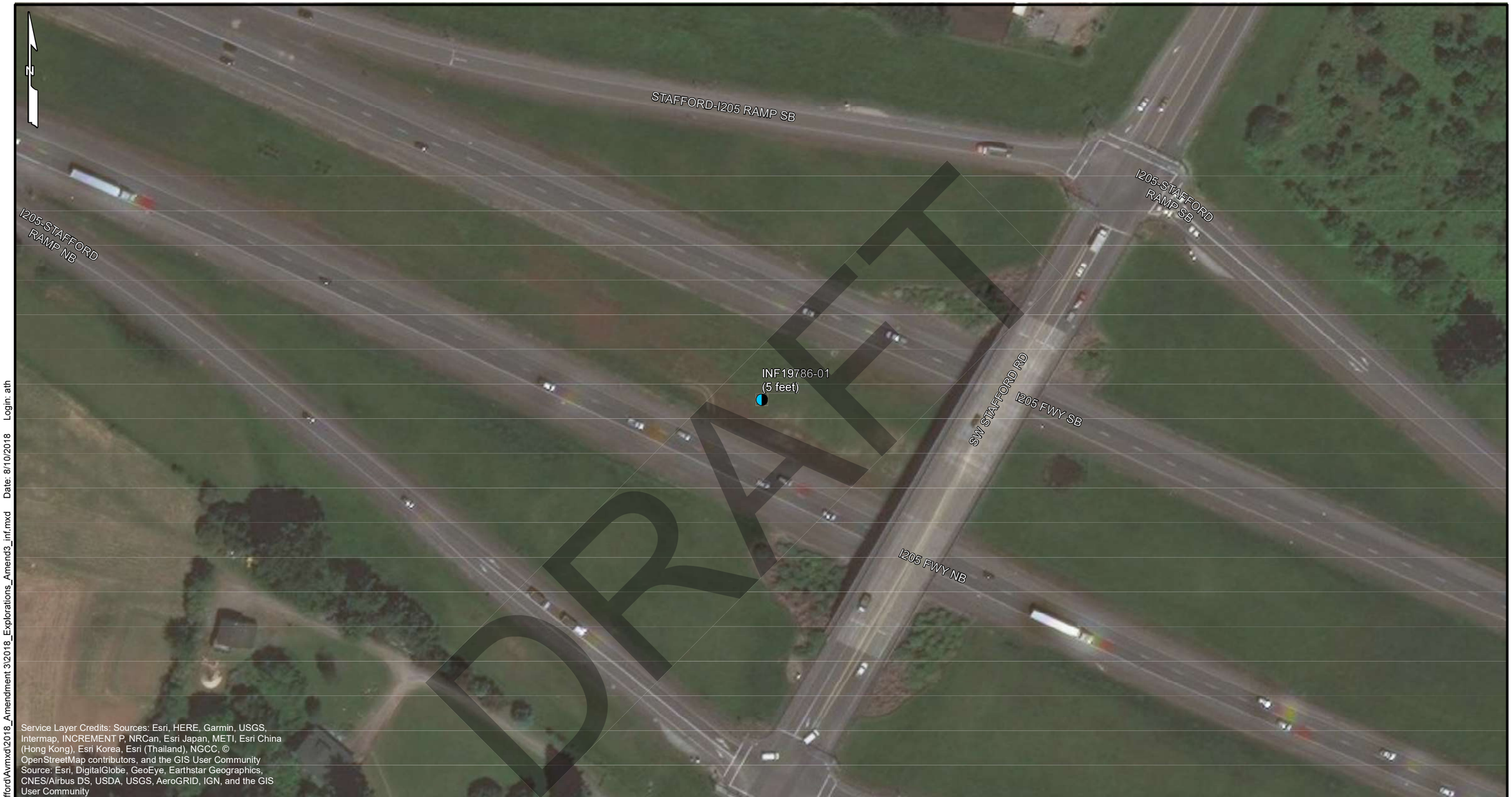
EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 14 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath



LEGEND

INF19786-15A
(Final Depth)

Approximate Infiltration Location

0 50 100 200
Scale in Feet

N

I-205: Stafford Road to OR99E
Corridor Widening
Clackamas County, Oregon

EXPLORATION PLAN
INFILTRATION TESTING

August 2018 24-1-04165-006

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2
Sheet 15 of 15

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\2018_Amendment 3\2018_Explorations_Amend3_inf.mxd Date: 8/10/2018 Login: ath

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/6/2018

Location: I-205 northbound median mile marker 3.0		**Test Hole Number:** INF19786-01
Depth to bottom of hole: 5.0 feet	**Diameter of hole:** 6 inches	**Test method:** Encased Falling Head Test

Depth (feet):	**Soil Texture:**
0 - 2.0	Sandy SILT; ML; Light brown; Moist
2.0 - 5.0	Silty SAND; SM; Brown; Nonplastic fines; Moist; Fine to medium sand

Presaturation Start Time: 8:00 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Drop in water level - Corrected (feet):	Infiltration rate (inches per hour):	Remarks:
12:00	0	5.40	-	-	-	Trial #1
12:20	20	5.40	0.00	0.01	0.06	
12:40	20	5.40	0.00			
13:00	20	5.40	0.00			
13:20	20	5.40	0.00			
13:40	20	5.40	0.00			
14:00	20	5.41	0.01			
14:00	0	5.40		-	-	Trial #2
14:20	20	5.40	0.00	0.00	0.00	
14:40	20	5.40	0.00			
15:00	20	5.40	0.00			
15:20	20	5.40	0.00			
15:40	20	5.40	0.00			
16:00	20	5.40	0.00			
16:00	0	5.40		-	-	Trial #3
16:20	20	5.40	0.00	0.00	0.00	
16:40	20	5.40	0.00			
17:00	20	5.40	0.00			
17:20	20	5.40	0.00			
17:40	20	5.40	0.00			
18:00	20	5.40	0.00			

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-01

August 2018 24-1-04165-006

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FIG. 3

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/9/2018

Location: I-205 southbound median mile marker 3.5		**Test Hole Number:** INF19786-02
Depth to bottom of hole: 5.5 feet	**Diameter of hole:** 6 inches	**Test method:** Encased Falling Head Test
Depth (feet):	**Soil Texture:**	
0 -5.5	SILT with trace sand; ML; Brown; Nonplastic fines; Moist	
Presaturation Start Time:	8:15 AM	

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Drop in water level - Corrected (feet):	Infiltration rate (inches per hour):	Remarks:
12:02	0	5.45	-	-	-	Trial #1
12:12	10	5.46	0.01	0.01	0.72	
12:22	10	5.47	0.01	0.01	0.72	
12:32	10	5.48	0.01	0.01	0.72	
12:42	10	5.48	0.00	0.01	0.36	
12:52	10	5.49	0.01			
13:02	10	5.50	0.01	0.01	0.72	
13:06	0	5.45	-	-	-	Trial #2
13:26	20	5.47	0.02		0.72	
13:46	20	5.48	0.01		0.36	
14:06	20	5.50	0.02		0.72	
14:26	20	5.52	0.02		0.72	
14:46	20	5.54	0.02		0.72	
15:06	20	5.55	0.01		0.36	
15:10	0	5.45	-	-	-	Trial #3
15:30	20	5.47	0.02		0.72	
15:50	20	5.49	0.02		0.72	
16:10	20	5.50	0.01		0.36	
16:30	20	5.52	0.02		0.72	
16:50	20	5.54	0.02		0.72	
17:10	20	5.56	0.02		0.72	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-02

August 2018 24-1-04165-006

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FIG. 4

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/10/2018

Location: I-205 southbound shoulder mile marker 4.0		**Test Hole Number:** INF19786-03
Depth to bottom of hole: 5.5 feet	**Diameter of hole:** 6 inches	**Test method:** Encased Falling Head Test

Depth (feet):	**Soil Texture:**
0 - 2.0	SILT; ML; Light brown; Moist
2.0 - 5.5	Sandy SILT; ML; Brown; Nonplastic fines; Moist; Fine to medium sand

Presaturation Start Time: 8:09 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Drop in water level - Corrected (feet):	Infiltration rate (inches per hour):	Remarks:
12:00	0	5.97	-	-	-	Trial #1
12:20	20	5.97	0.00	0.01	0.36	
12:40	20	5.98	0.01	0.01	0.36	
13:00	20	5.99	0.01	0.01	0.36	
13:20	20	5.99	0.00	0.01	0.09	
13:40	20	5.99	0.00			
14:00	20	6.00	0.01			
14:00	0	5.97	-	-	-	Trial #2
14:20	20	5.97	0.00	0.01	0.09	
14:40	20	5.97	0.00			
15:00	20	5.98	0.01			
15:40	20	5.99	0.00	0.01	0.18	
16:00	20	6.00	0.01			
16:00	0	5.97	-	-	-	Trial #3
16:20	20	5.97	0.00	0.01	0.09	
16:40	20	5.97	0.00			
17:00	20	5.98	0.01			
17:40	20	5.99	0.01	0.01	0.18	
18:00	20	5.99	0.00	0.00	0.00	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-03

August 2018 24-1-04165-006

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FIG. 5

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/11/2018

Location: I-205 northbound median mile marker 4.1		**Test Hole Number:** INF19786-04
Depth to bottom of hole: 6.0 feet	**Diameter of hole:** 6 inches	**Test method:** Encased Falling Head Test

Depth (feet):	**Soil Texture:**
0 - 1.5	Sandy SILT; ML; Light brown; Moist
1.5 - 6.0	Silty SAND; ML; Light brown; Moist; Fine to medium sand

Presaturation Start Time: 8:07 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Infiltration rate (inches per hour):	Remarks:
12:02	0	6.14	-	-	Trial #1
12:12	10	6.15	0.01	0.72	
12:22	10	6.17	0.02	1.44	
12:32	10	6.19	0.02	1.44	
12:42	10	6.20	0.01	0.72	
12:52	10	6.22	0.02	1.44	
13:02	10	6.24	0.02	1.44	
13:03	0	6.14	-	-	Trial #2
13:13	10	6.15	0.01	0.72	
13:23	10	6.16	0.01	0.72	
13:33	10	6.18	0.02	1.44	
13:43	10	6.19	0.01	0.72	
13:53	10	6.21	0.02	1.44	
14:03	10	6.23	0.02	1.44	
14:05	0	6.14	-	-	Trial #3
14:15	10	6.16	0.02	1.44	
14:25	10	6.17	0.01	0.72	
14:35	10	6.19	0.02	1.44	
14:45	10	6.20	0.01	0.72	
14:55	10	6.22	0.02	1.44	
15:05	10	6.23	0.01	0.72	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-04

August 2018 24-1-04165-006

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FIG. 6

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/12/2018

Location: I-205 southbound median mile marker 4.7		**Test Hole Number:** INF19786-05
Depth to bottom of hole: 5.25 feet	**Diameter of hole:** 6 inches	**Test method:** Encased Falling Head Test

Depth (feet):	**Soil Texture:**
0 - 0.5	SILT; ML; Light brown; Moist
0.5 - 5.25	SILT with some sand; ML; Light brown; Moist

Presaturation Start Time: 8:17 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Drop in water level - Corrected (feet):	Infiltration rate (inches per hour):	Remarks:
12:00	0	6.04	-	-	-	Trial #1
12:20	20	6.04	0.00	0.00	0.00	
12:40	20	6.04	0.00			
13:00	20	6.04	0.00			
13:20	20	6.04	0.00			
13:40	20	6.04	0.00			
14:00	20	6.04	0.00			
14:00	0	6.04	-	-	-	Trial #2
14:20	20	6.04	0.00	0.01	0.09	
14:40	20	6.04	0.00			
15:00	20	6.04	0.00			
15:20	20	6.05	0.01			
15:40	20	6.05	0.00	0.00	0.00	
16:00	20	6.05	0.00			
16:00	0	6.04	-	-	-	Trial #3
16:20	20	6.04	0.00	0.00	0.00	
16:40	20	6.04	0.00			
17:00	20	6.04	0.00			
17:20	20	6.04	0.00			
17:40	20	6.04	0.00			
18:00	20	6.04	0.00			

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-05

August 2018 24-1-04165-006

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FIG. 7

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/16/2018

Location: I-205 northbound median mile marker 5.4		**Test Hole Number:** INF19786-06
Depth to bottom of hole: 2.5 feet	**Diameter of hole: 8** inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0 - 1.0	SILT; ML; Light brown; Moist
0.5 - 2.5	SILT with trace sand and gravel, with cobbles; ML; Light brown; Moist
2.5	Silty GRAVEL with Cobbles; GM; Refusal

Presaturation Start Time: 8:20 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Drop in water level - Corrected (feet):	Infiltration rate (inches per hour):	Remarks:
11:24	0	4.01	-	-	-	Trial #1
11:44	20	4.01	0.00	0.02	0.24	
12:04	20	4.01	0.00			
12:24	20	4.03	0.02			
12:44	20	4.03	0.00	0.02	0.36	
13:04	20	4.05	0.02			
13:24	20	4.06	0.01	0.01	0.36	
13:25	0	4.01	-	-	-	Trial #2
13:45	20	4.01	0.00	0.01	0.17	
14:05	20	4.02	0.01			
14:25	20	4.03	0.01	0.01	0.36	
14:45	20	4.04	0.01	0.01	0.36	
15:05	20	4.04	0.00	0.01	0.17	
15:25	20	4.05	0.01			
15:26	0	4.01	-	-	-	Trial #3
15:46	20	4.02	0.01	0.01	0.36	
16:06	20	4.02	0.00	0.01	0.17	
16:26	20	4.03	0.01			
16:46	20	4.03	0.00	0.01	0.17	
17:06	20	4.04	0.01			
17:26	20	4.05	0.01	0.01	0.36	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-06

August 2018 24-1-04165-006

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FIG. 8

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/13/2018

Location: I-205 northbound shoulder mile marker 5.5		**Test Hole Number:** INF19786-07
Depth to bottom of hole: 5.5 feet	**Diameter of hole:** 6 inches	**Test method:** Encased Falling Head Test
Depth (feet):	**Soil Texture:**	
0 - 5.5	Sandy SILT; ML; Light brown; Moist	
Presaturation Start Time:	8:40 AM	

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Drop in water level - Corrected (feet):	Infiltration rate (inches per hour):	Remarks:
12:00	0	5.91	-	-	-	Trial #1
12:10	10	5.93	0.02	0.02	1.44	
12:20	10	5.93	0.00	0.01	0.36	
12:30	10	5.94	0.01			
12:40	10	5.96	0.02	0.02	1.44	
12:50	10	5.97	0.01	0.01	0.72	
13:00	10	5.98	0.01	0.01	0.72	
13:01	0	5.91	-	-	-	Trial #2
13:11	10	5.92	0.01	0.01	0.72	
13:21	10	5.93	0.01	0.01	0.72	
13:31	10	5.94	0.01	0.01	0.72	
13:41	10	5.95	0.01	0.03	2.15	
13:51	10	5.97	0.02	0.02	0.72	
14:01	10	5.97	0.00			
14:02	0	5.91	-	-	-	Trial #3
14:12	10	5.92	0.01	0.01	0.72	
14:22	10	5.93	0.01	0.01	0.72	
14:32	10	5.94	0.01	0.01	0.72	
14:42	10	5.96	0.02	0.02	1.44	
14:52	10	5.97	0.01	0.01	0.72	
15:02	10	5.98	0.01	0.01	0.72	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-07

August 2018 24-1-04165-006

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FIG. 9

DRAFT

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/19/2018

Location: I-205 southbound median mile marker 6.5		**Test Hole Number:** INF19786-08
Depth to bottom of hole: 2.0 feet	**Diameter of hole:** 10 inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0.0 - 0.5	SILT; ML; Light brown; Moist
0.5-2.0	SILT with trace sand and gravel, with cobbles; ML; Light brown; **Moist**
2.0	Silty GRAVEL with Cobbles; ML; Refusal

Presaturation Start Time: 8:25 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Infiltration rate (inches per hour):	Remarks:
12:01	0	3.81	-	-	Trial #1
12:11	10	3.83	0.02	1.44	
12:21	10	3.87	0.04	2.88	
12:31	10	3.90	0.03	2.16	
12:41	10	3.92	0.02	1.44	
12:51	10	3.94	0.02	1.44	
13:01	10	3.96	0.02	1.44	
13:02	0	3.83	-	-	Trial #2
13:12	10	3.86	0.03	2.16	
13:22	10	3.89	0.03	2.16	
13:32	10	3.91	0.02	1.44	
13:42	10	3.93	0.02	1.44	
13:52	10	3.95	0.02	1.44	
14:02	10	3.97	0.02	1.44	
14:04	0	3.83	-	-	Trial #3
14:14	10	3.85	0.02	1.44	
14:24	10	3.87	0.02	1.44	
14:34	10	3.89	0.02	1.44	
14:44	10	3.92	0.03	2.16	
14:54	10	3.93	0.01	0.72	
15:04	10	3.95	0.02	1.44	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-08

August 2018 24-1-04165-006

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FIG. 10

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/17/2018

Location: I-205 northbound median mile marker 7.0		**Test Hole Number:** INF19786-09
Depth to bottom of hole: 2.0 feet	**Diameter of hole:** 12 inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0.0 - 0.5	SILT; ML; Light brown; Moist
0.5-2.0	Gravelly SILT with some sand, with cobbles; ML; Light brown; **Moist**
2.0	Silty GRAVEL with Cobbles; GM; Refusal

Presaturation Start Time: 9:00 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Infiltration rate (inches per hour):	Remarks:
13:00	0	3.43	-	-	Trial #1
13:10	10	3.64	0.21	15.12	
13:20	10	3.75	0.11	7.92	
13:30	10	3.83	0.08	5.76	
13:40	10	3.91	0.08	5.76	
13:50	10	3.97	0.06	4.32	
14:00	10	4.02	0.05	3.60	
14:34	0	3.44	-	-	Trial #2
14:44	10	3.59	0.15	10.80	
14:54	10	3.69	0.10	7.20	
15:04	10	3.77	0.08	5.76	
15:14	10	3.84	0.07	5.04	
15:24	10	3.90	0.06	4.32	
15:34	10	3.95	0.05	3.60	
15:37	0	3.42	-	-	Trial #3
15:47	10	3.57	0.15	10.80	
15:57	10	3.67	0.10	7.20	
16:07	10	3.74	0.07	5.04	
16:17	10	3.81	0.07	5.04	
16:27	10	3.87	0.06	4.32	
16:37	10	3.91	0.04	2.88	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-09

August 2018 24-1-04165-006

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FIG. 11

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/20/2018

Location: I-205 southbound shoulder mile marker 7.2		**Test Hole Number:** INF19786-10
Depth to bottom of hole: 2.0 feet	**Diameter of hole:** 14 inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0.0 - 2.0	GRAVEL with some silt and sand, with Cobbles; GP-GM; Light brown, Moist
2.0	GRAVEL with Cobbles; Refusal

Presaturation Start Time: 9:20 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Infiltration rate (inches per hour):	Remarks:
13:01	0	3.88	-	-	Trial #1
13:11	10	3.99	0.11	7.92	
13:21	10	4.06	0.07	5.04	
13:31	10	4.12	0.06	4.32	
13:41	10	4.18	0.06	4.32	
13:51	10	4.22	0.04	2.88	
14:01	10	4.26	0.04	2.88	
14:03	0	3.88	-	-	Trial #2
14:13	10	3.98	0.10	7.20	
14:23	10	4.04	0.06	4.32	
14:33	10	4.10	0.06	4.32	
14:43	10	4.14	0.04	2.88	
14:53	10	4.19	0.05	3.60	
15:03	10	4.23	0.04	2.88	
15:05	0	3.82	-	-	Trial #3
15:15	10	3.93	0.11	7.92	
15:25	10	4.01	0.08	5.76	
15:35	10	4.07	0.06	4.32	
15:45	10	4.11	0.04	2.88	
15:55	10	4.16	0.05	3.60	
16:05	10	4.20	0.04	2.88	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-10

August 2018 24-1-04165-006

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FIG. 12

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/23/2018

Location: I-205 northbound beneath east Abernethy Bridge abutment mile marker 8.9		**Test Hole Number:** INF19786-11
Depth to bottom of hole: 2.0 feet	**Diameter of hole:** 14 inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0.0 - 1.5	GRAVEL with some silt and sand, with Cobbles; GP-GM; Light brown, Moist
1.5-3.0	SILT with some sand and gravel, with Cobbles; ML, Light brown, Moist
3.0	GRAVEL and Cobbles; Refusal

Presaturation Start Time: 9:05 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Drop in water level - Corrected (feet):	Infiltration rate (inches per hour):	Remarks:
13:00	0	4.44	-	-	-	Trial #1
13:10	10	4.45	0.01	0.01	0.72	
13:20	10	4.45	0.00	0.01	0.36	
13:30	10	4.46	0.01			
13:40	10	4.46	0.00	0.02	0.72	
13:50	10	4.48	0.02			
14:00	10	4.49	0.01	0.01	0.72	
14:02	0	4.43	-		-	Trial #2
14:22	20	4.45	0.02		0.72	
14:42	20	4.47	0.02		0.72	
15:02	20	4.48	0.01		0.36	
15:22	20	4.49	0.01		0.36	
15:42	20	4.51	0.02		0.72	
16:02	20	4.52	0.01		0.36	
16:04	0	4.44	-		-	Trial #3
16:24	20	4.46	0.02		0.72	
16:44	20	4.47	0.01		0.36	
17:04	20	4.49	0.02		0.72	
17:24	20	4.50	0.01		0.36	
17:44	20	4.51	0.01		0.36	
18:04	20	4.52	0.01		0.36	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-11

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FIG. 13

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/24/2018

Location: I-205 northbound shoulder mile marker 9.4		**Test Hole Number:** INF19786-12
Depth to bottom of hole: 2.0 feet	**Diameter of hole:** 10 inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0.0 - 2.0	SILT; ML; Light brown, Moist
2.0	BASALT fragments and GRAVEL; GP; Refusal

Presaturation Start Time: 8:05 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Infiltration rate (inches per hour):	Remarks:
11:31	0	4.01	-	-	Trial #1
11:41	10	4.03	0.02	1.44	
11:51	10	4.06	0.03	2.16	
12:01	10	4.08	0.02	1.44	
12:11	10	4.11	0.03	2.16	
12:21	10	4.14	0.03	2.16	
12:31	10	4.16	0.02	1.44	
12:32	0	4.01	-	-	Trial #2
12:42	10	4.03	0.02	1.44	
12:52	10	4.05	0.02	1.44	
13:02	10	4.08	0.03	2.16	
13:12	10	4.10	0.02	1.44	
13:22	10	4.13	0.03	2.16	
13:32	10	4.14	0.01	0.72	
13:33	0	4.01	-	-	Trial #3
13:33	10	4.03	0.02	1.44	
13:33	10	4.06	0.03	2.16	
14:03	10	4.08	0.02	1.44	
14:13	10	4.10	0.02	1.44	
14:23	10	4.12	0.02	1.44	
14:33	10	4.15	0.02	1.44	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-12

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FIG. 14

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/25/2018

Location: I-205 southbound south of Agnes Avenue mile marker 9.7		**Test Hole Number:** INF19786-13
Depth to bottom of hole: 3.0 feet	**Diameter of hole:** 10 inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0.0 - 3.0	SILT with some sand and gravel; ML; Light brown, Moist
3.0	GRAVEL and Cobbles; Refusal

Presaturation Start Time: 7:55 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Infiltration rate (inches per hour):	Remarks:
11:30	0	3.86	-	-	Trial #1
11:40	10	3.89	0.03	2.16	
11:50	10	3.92	0.03	2.16	
12:00	10	3.95	0.03	2.16	
12:10	10	3.97	0.02	1.44	
12:20	10	3.99	0.02	1.44	
12:30	10	4.01	0.02	1.44	
12:31	0	3.85	-	-	Trial #2
12:41	10	3.88	0.03	2.16	
12:51	10	3.91	0.03	2.16	
13:01	10	3.94	0.03	2.16	
13:11	10	3.96	0.02	1.44	
13:21	10	3.98	0.02	1.44	
13:31	10	4.00	0.02	1.44	
13:32	0	3.86	-	-	Trial #3
13:32	10	3.89	0.03	2.16	
13:32	10	3.92	0.03	2.16	
14:02	10	3.94	0.02	1.44	
14:12	10	3.97	0.03	2.16	
14:22	10	3.99	0.02	1.44	
14:32	10	4.01	0.02	1.44	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-13

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FIG. 15

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/26/2018

Location: I-205 northbound shoulder mile marker 10.0		**Test Hole Number:** INF19786-14
Depth to bottom of hole: 3.5 feet	**Diameter of hole:** 8 inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0.0 - 2.0	SILT with some gravel, ML, Brown, Moist
2.0-3.5	SILT with some gravel, with Cobbles; trace organics, ML, Dark brown, Moist
3.5	GRAVEL with Cobbles; Refusal

Presaturation Start Time: 9:12 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Infiltration rate (inches per hour):	Remarks:
13:00	0	3.78	-	-	Trial #1
13:10	10	3.82	0.04	2.88	
13:20	10	3.86	0.04	2.88	
13:30	10	3.89	0.03	2.16	
13:40	10	3.91	0.02	1.44	
13:50	10	3.93	0.02	1.44	
14:00	10	3.95	0.02	1.44	
14:01	0	3.82	-	-	Trial #2
14:11	10	3.84	0.02	1.44	
14:21	10	3.87	0.03	2.16	
14:31	10	3.88	0.01	0.72	
14:41	10	3.90	0.02	1.44	
14:51	10	3.92	0.02	1.44	
15:01	10	3.93	0.01	0.72	
15:02	0	3.81	-	-	Trial #3
15:12	10	3.82	0.01	0.72	
15:22	10	3.84	0.02	1.44	
15:32	10	3.87	0.03	2.16	
15:42	10	3.89	0.02	1.44	
15:52	10	3.90	0.01	0.72	
16:02	10	3.92	0.02	1.44	

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INFILTRATION TEST RESULTS
INF19786-14

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FIG. 16

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Job #:	24-1-04165-006
Field Rep.:	PJS
Date	7/16/2018

Location: I-205 southbound shoulder mile marker 10.1		**Test Hole Number:** INF19786-15A
Depth to bottom of hole: 2.0 feet	**Diameter of hole:** 10 inches	**Test method:** Open Pit Falling Head Test

Depth (feet):	**Soil Texture:**
0 - 2.0	SILT with some sand and gravel, with Cobbles; ML; Light brown; Moist
2.0	GRAVEL with Cobbles; Refusal

Presaturation Start Time: 8:30 AM

Time:	Time Interval (minutes):	Measurement (feet):	Drop in water level (feet):	Drop in water level - Corrected (feet):	Infiltration rate (inches per hour):	Remarks:
11:30	0	3.98	-		-	Trial #1
11:50	20	3.99	0.01		0.36	
12:10	20	4.00	0.01		0.36	
12:30	20	4.01	0.01		0.36	
12:50	20	4.03	0.02		0.72	
13:10	20	4.04	0.01		0.36	
13:30	20	4.05	0.01		0.36	
13:31	0	3.98	-	-	-	Trial #2
13:51	20	3.99	0.01	0.01	0.36	
14:11	20	4.01	0.02	0.02	0.72	
14:31	20	4.02	0.01	0.01	0.36	
14:51	20	4.03	0.01	0.02	0.36	
15:11	20	4.04	0.01			
15:31	20	4.04	0.00	0.00	0.00	
15:32	0	3.98	-		-	Trial #3
15:52	20	3.99	0.01		0.36	
16:12	20	4.00	0.01		0.36	
16:32	20	4.01	0.01		0.36	
16:52	20	4.02	0.01		0.36	
17:12	20	4.03	0.01		0.36	
17:32	20	4.04	0.01		0.36	

I-205: Stafford Road to OR99E Corridor Widening
Clackamas County, Oregon

INFILTRATION TEST RESULTS
INF19786-15

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FIG. 17

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IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

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CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

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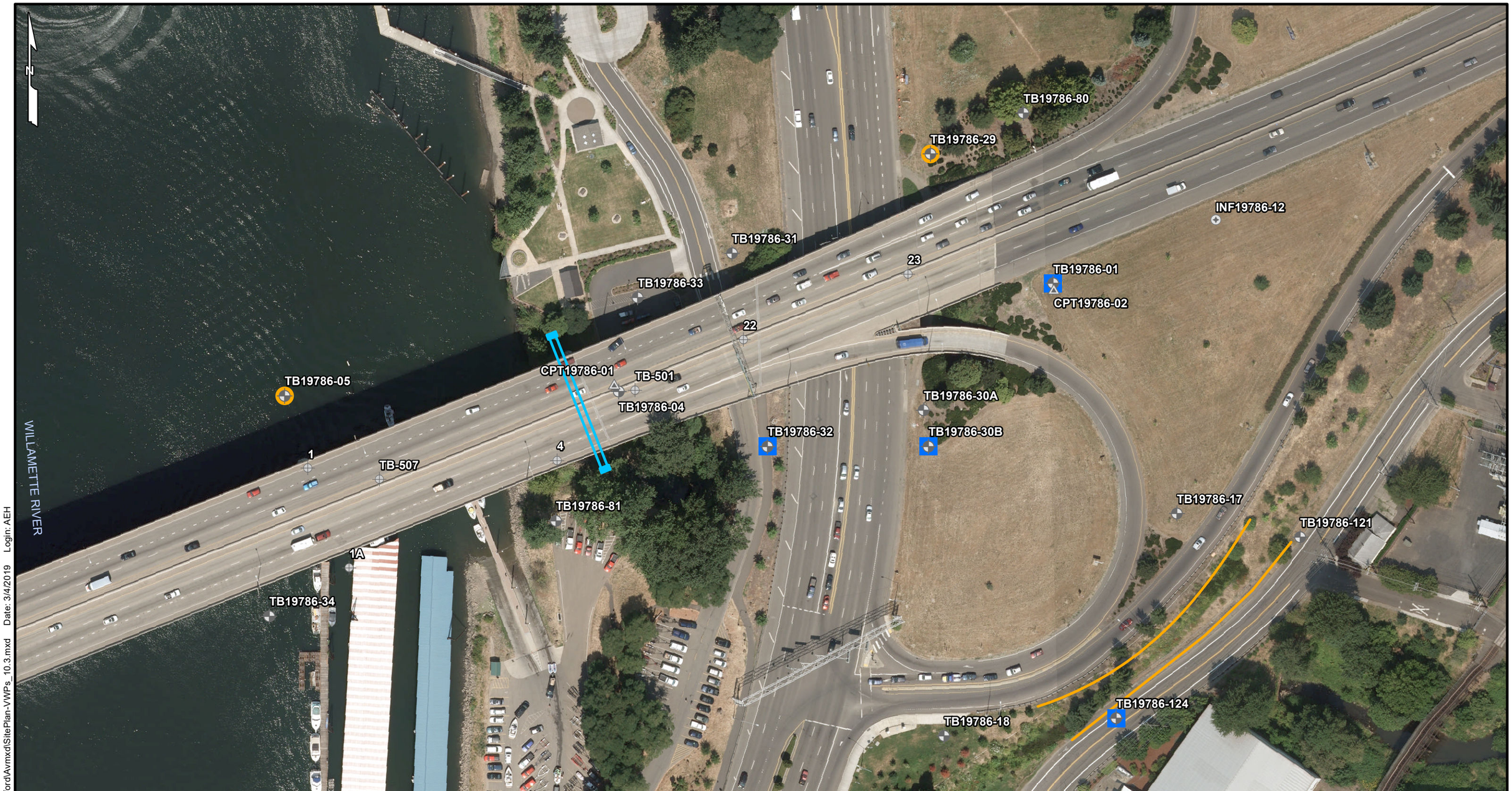

LEGEND

- Boring (Shannon & Wilson, 2017-2019)
- CPT (Shannon & Wilson, 2017)
- Historic Boring (ODOT or Dames & Moore)
- Infiltration Test (Shannon & Wilson, 2017)
- Vibrating Wire Piezometer
- Shear Wave Velocity Profile
- Proposed Retaining Wall
- Proposed Sound Wall
- Proposed Traffic Sign

0 50 100 200
Scale in Feet

NOTES

1. Locations of proposed features from files downloaded from ProjectWise: TN_K19786_OBEC_snd_bas_01.dgn, TN_K21400_OBEC_snd_bas_01.dgn, TN_K21401_OBEC_snd_bas_01.dgn, R_K19786_rtw_bas_01.dgn, and R_K21401_rtw_bas_01.dgn, on December 10, 2018, file R_K19786_QEI_bas_03.dgn, on December 26, 2018, and file R_K21401_OBEC_bas_01.dgn, on December 31, 2018.

I-205: Stafford Road to OR99E Widening
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SITE AND EXPLORATION PLAN

March 2019 24-1-04165

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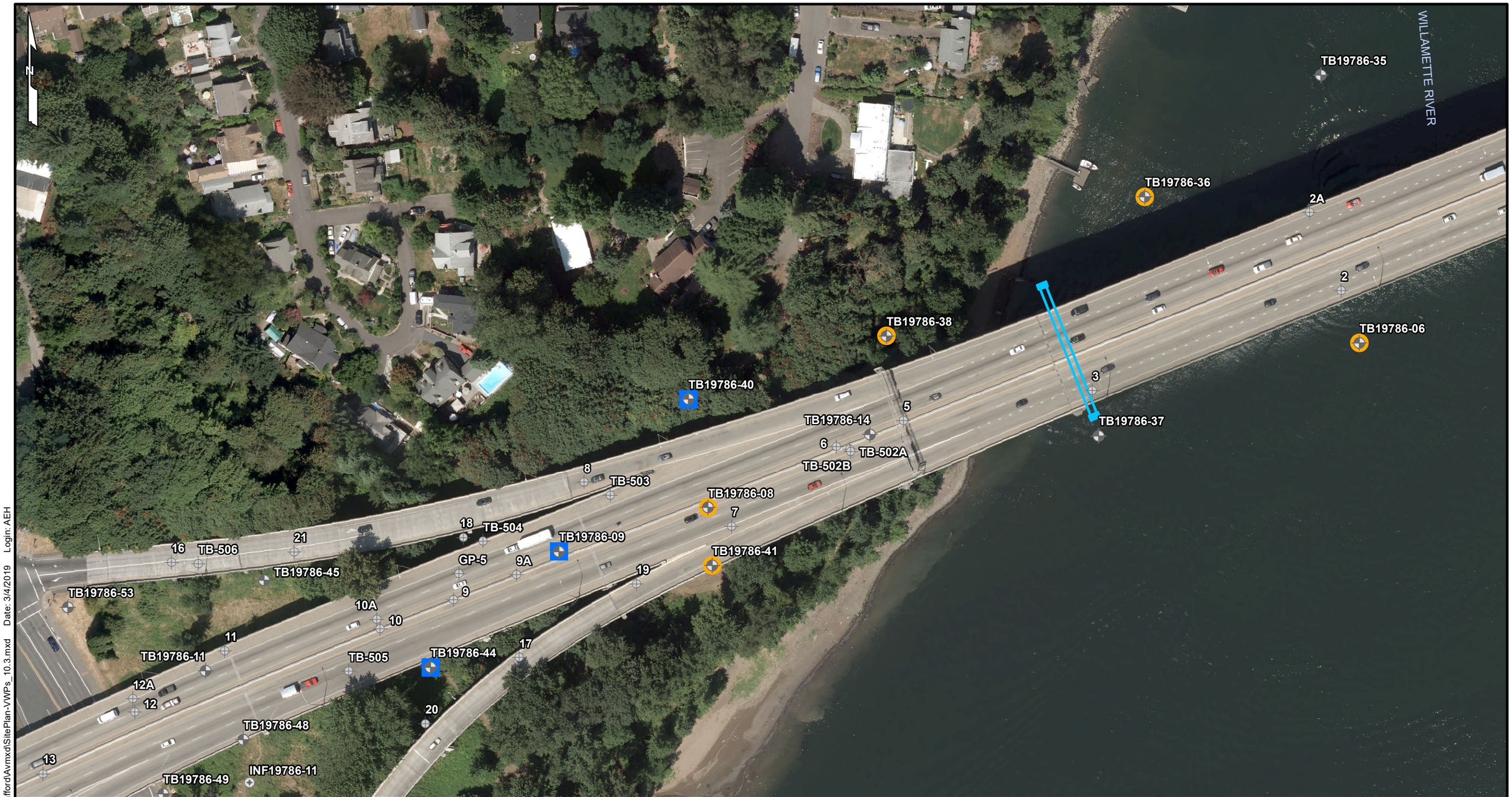
FIG. 1
Sheet 1 of 4

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\SitePlan-VWPs_10.3.mxd Date: 3/4/2019 Login: AEH



LEGEND

- Boring (Shannon & Wilson, 2017-2019)
- CPT (Shannon & Wilson, 2017)
- Historic Boring (ODOT or Dames & Moore)
- Infiltration Test (Shannon & Wilson, 2017)
- Vibrating Wire Piezometer
- Shear Wave Velocity Profile
- Proposed Retaining Wall
- Proposed Sound Wall
- Proposed Traffic Sign

0 50 100 200
Scale in Feet

NOTES

1. Locations of proposed features from files downloaded from ProjectWise: TN_K19786_OBEC_snd_bas_01.dgn, TN_K21400_OBEC_snd_bas_01.dgn, TN_K21401_OBEC_snd_bas_01.dgn, R_K19786_rtw_bas_01.dgn, and R_K21401_rtw_bas_01.dgn, on December 10, 2018, file R_K19786_QEI_bas_03.dgn, on December 26, 2018, and file R_K21401_OBEC_bas_01.dgn, on December 31, 2018.

I-205: Stafford Road to OR99E Widening
Clackamas County, Oregon

SITE AND EXPLORATION PLAN

March 2019 24-1-04165

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 1
Sheet 2 of 4

Filename: T:\Projects\24-1\4165_I-205 Stafford\Avmxd\SitePlan-VWPs_10.3.mxd Date: 3/4/2019 Login: AEH

Appendix B. Contributing Impervious Area, Impervious Surface Area, and Water Quality Facility Figures

Existing FEMA 100 Year Floodplain Boundary

Willamette River

Subbasin 61
CIA = 0.474 acres

Subbasin 70
CIA = 0.287 acres

Prop. Water Quality Swale for CIA "80" treatment.

Subbasin 80
CIA = 1.953 acres

Subbasin 60
CIA = 2.299 acres

Subbasin 41
CIA = 4.560 acres

Subbasin 52
CIA = 3.570 acres

"L" 730+00

"L" 725+00

"L" 720+00

"L" 735+00

"L" 740+00

"L" 745+00

Ditch

WQF #8

WQF #7

WQF #6

Prop. outlet to Willamette River

BH.# INF19786-11

Prop. Water Quality Swale for CIA "60", "61", "62" and "63" treatment.

Prop. Water Quality Swale for CIA "70", "71" and "72" treatment.

Subbasin 71
CIA = 0.333 acres

Subbasin 63
CIA = 0.123 acres

Subbasin 72
CIA = 0.556 acres

Subbasin 62
CIA = 2.315 acres

Subbasin 64
CIA = 0.592 acres

Edge of Water

Existing FEMA 100 Year Floodplain Boundary

Legend

- Existing Pipe
- Bioslope
- Wetland Boundary
- Proposed Pipe
- CIA basin
- Proposed Inlet
- Non-triggered treated areas
- Proposed Manhole
- Conveyance Direction
- Not Treated CIA
- Surface Flow
- Water quality swale boundary
- Combination detention pond/ water quality swale boundary

Total Treated CIA - 25.658 Acres

Total Not Treated CIA - 0.847 Acres

Total Offset Treatment CIA - 1.652 Acres

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PORTLAND, OR 97204-1134
503.423.3700

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

STORMWATER CIA EXHIBIT

SHEET NO. 1A

Edge of Water

Willamette River

Prop. Water Quality Swale for CIA "40", "41", "42" and "43" treatment.

Existing FEMA 100 Year Floodplain Boundary

Extg. outfall to Clackamas River

BH.# INF19786-13

Prop. Water Quality Swale for CIA "30" and "OS-31" treatment.

Subbasin 43
CIA = 0.338 acres

Subbasin OS-31
CIA = 1.652 acres

Prop. stormwater planter for CIA "90" treatment.

Subbasin 40
CIA = 0.396 acres

Extg. outfall to Willamette River

Subbasin 90
CIA = 0.134 acres

Subbasin 42
CIA = 0.698 acres

Subbasin 41
CIA = 4.560 acres

Extg. outlet pipe to Willamette River

Subbasin 20
CIA = 3.080 acres

Subbasin 30
CIA = 2.179 acres

Subbasin 52
CIA = 3.570 acres

Abernethy Creek

Subbasin 53
CIA = 0.273 acres

Prop. Water Quality Swale for CIA "50", "51" and "52" treatment.

BH.# INF19786-12

Subbasin 50
CIA = 0.719 acres

Subbasin 51
CIA = 0.578 acres

WQF #9

WQF #4

WQF #3

WQF #5

"L" 715+00

"L" 710+00

"L" 705+00

"L" 700+00

"L" 695+00

"L" 690+00

Legend

- Wetland Boundary
- CIA basin
- Non-triggered treated areas
- Not Treated CIA
- Water quality swale boundary
- Bioslope
- Existing Pipe
- Proposed Pipe
- Proposed Inlet
- Proposed Manhole
- Conveyance Direction
- Surface Flow
- Combination detention pond/ water quality swale boundary
- Existing FEMA 100 Year Floodplain Boundary

Total Treated CIA - 25.658 Acres

Total Not Treated CIA - 0.847 Acres

Total Offset Treatment CIA - 1.652 Acres

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STORMWATER CIA EXHIBIT

SHEET NO. 2A

Edge of Water

Clackamas River

Extg. outfall to Clackamas River

Existing FEMA 100 Year Floodplain Boundary

Subbasin 10
CIA = 1.065 acres

BH.# INF19786-15

BH.# INF19786-13

BH.# INF19786-14

WQF #1

WQF #2

WQF #3

Water Quality Facility #1
Prop. Bioretention Facility and Detention Pond for CIA "10" treatment.

Subbasin 20
CIA = 3.080 acres

Water Quality Facility #2
Prop. Bioslope for CIA "20" treatment.

Legend

- Wetland Boundary
- CIA basin
- Non-triggered treated areas
- Not Treated CIA
- Water quality swale boundary
- Bioslope
- Existing Pipe
- Proposed Pipe
- Proposed Inlet
- Proposed Manhole
- Conveyance Direction
- Surface Flow
- Combination detention pond/ water quality swale boundary
- Existing FEMA 100 Year Floodplain Boundary

Total Treated CIA - 25.658 Acres

Total Not Treated CIA - 0.847 Acres

Total Offset Treatment CIA - 1.652 Acres

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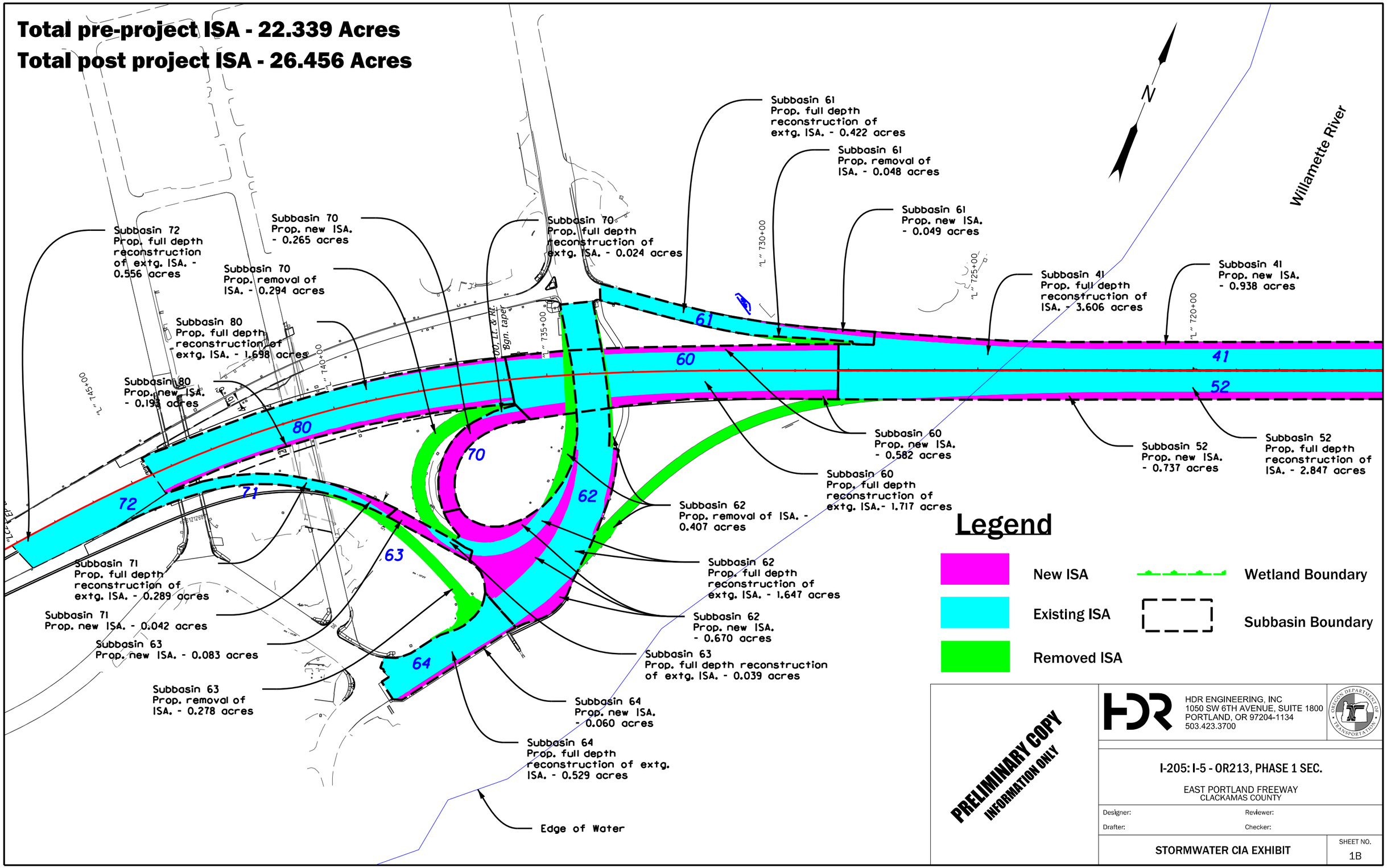
STORMWATER CIA EXHIBIT

SHEET NO. 3A

Rotation: 44.768° Scale: 1"=200'

Total pre-project ISA - 22.339 Acres

Total post project ISA - 26.456 Acres



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CLACKAMAS COUNTY

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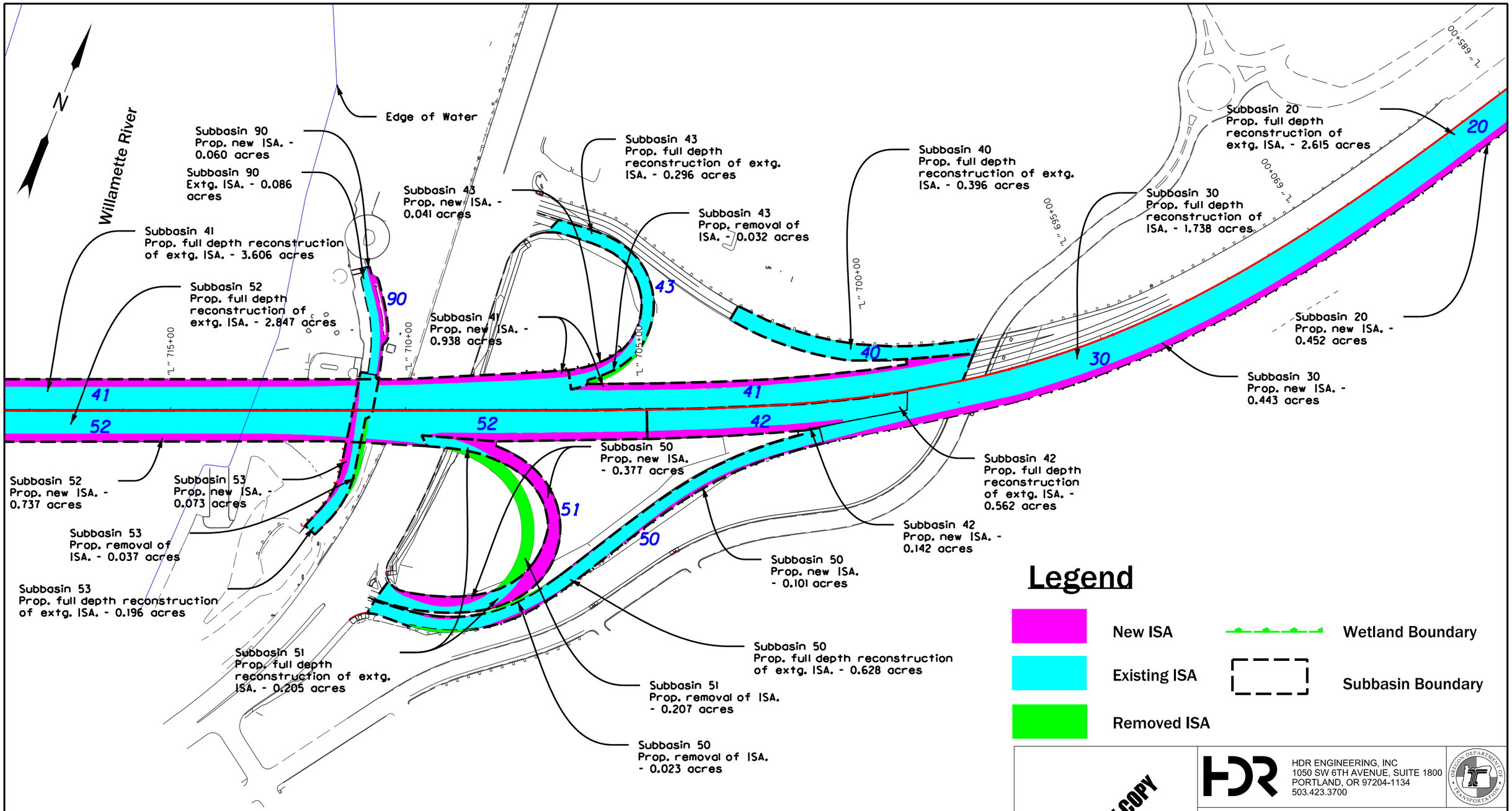
STORMWATER CIA EXHIBIT

SHEET NO. 1B

Rotation: 21.7268° Scale: 1"=200'



Legend

- New ISA
- Existing ISA
- Removed ISA
- Wetland Boundary
- Subbasin Boundary

Total pre-project ISA - 22.339 Acres

Total post project ISA - 26.456 Acres

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CLACKAMAS COUNTY

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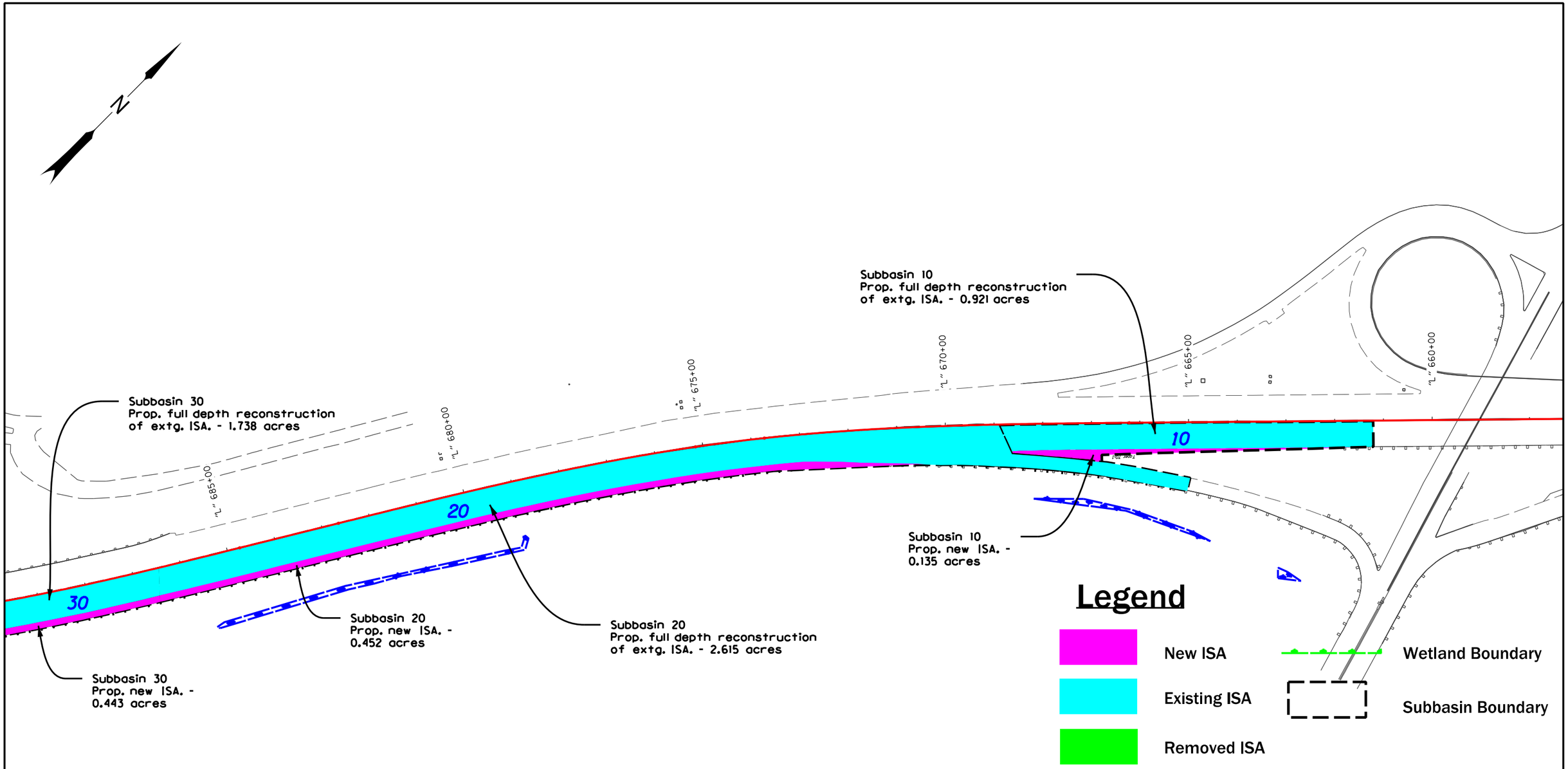
STORMWATER CIA EXHIBIT

SHEET NO. 2B

Rotation: 21.7268° Scale: 1"=200'



Total pre-project ISA - 22.339 Acres

Total post project ISA - 26.456 Acres

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CLACKAMAS COUNTY

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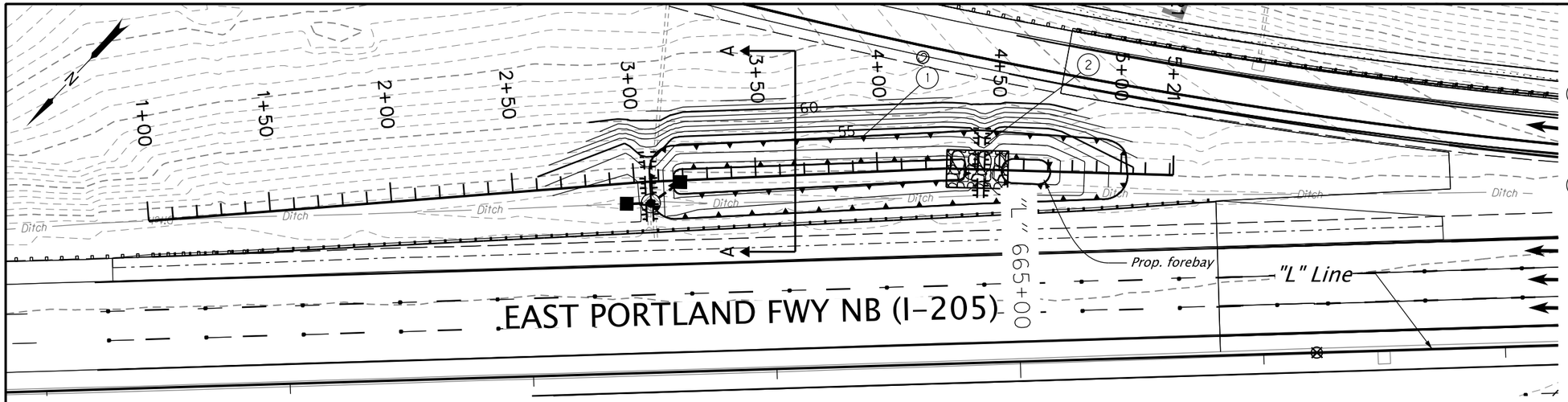
STORMWATER CIA EXHIBIT

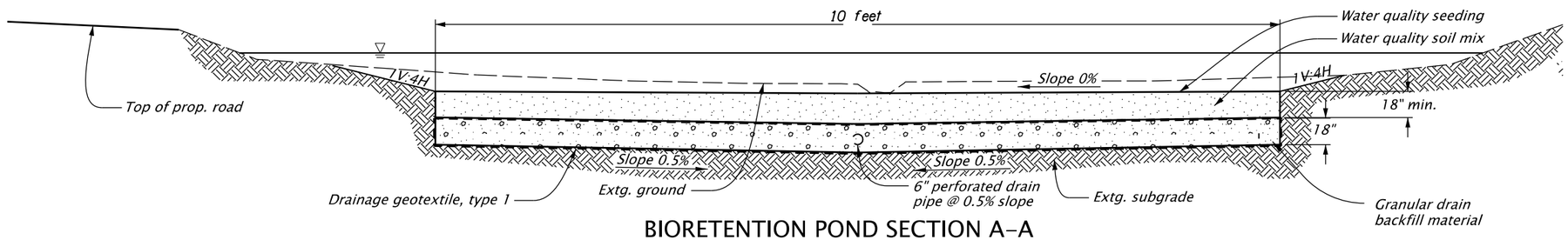
SHEET NO. 3B

Rotation: 44.768° Scale: 1"=200'



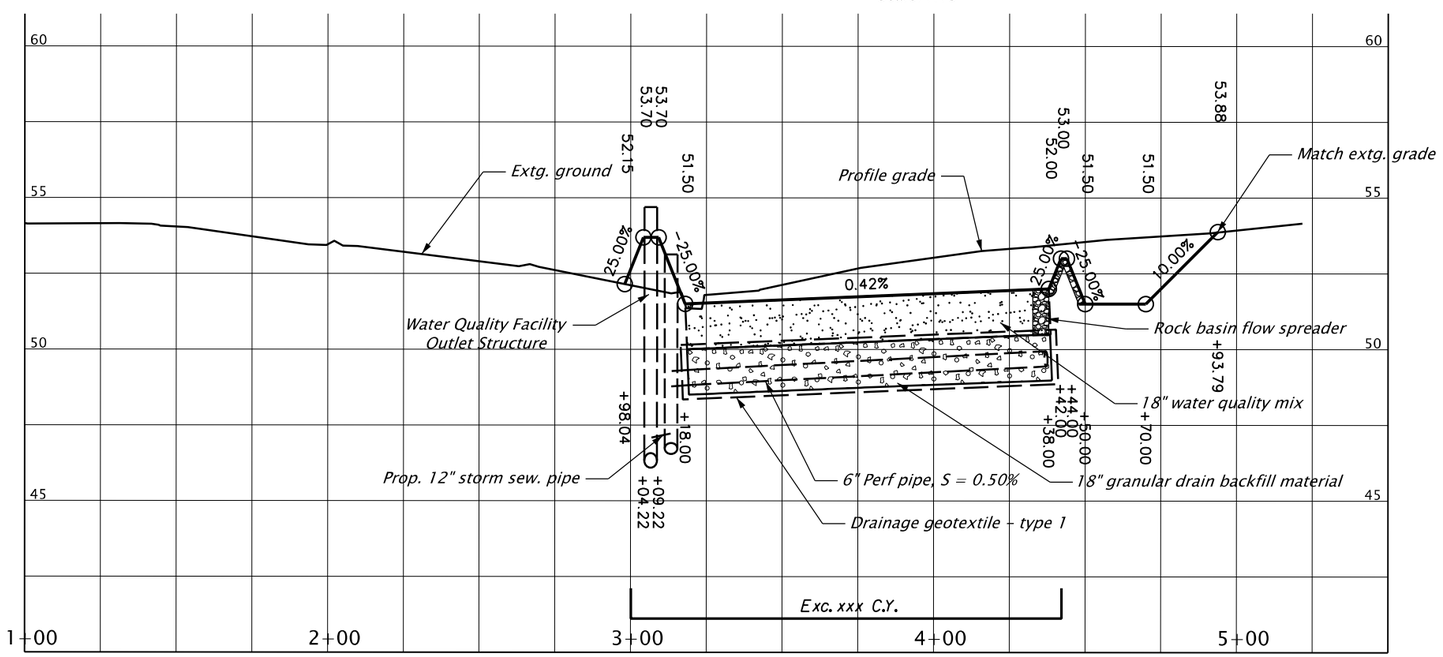
1 Sta. 3+09.86 to Sta. 4+10.05 = Sta. "L" 664+49.08, 81.53' Lt. to Sta. "L" 663+49.06, 84.27' Lt.
Const. biorention pond
(For details, see sht. HAxx)

2 Sta. 4+50.00, 0.00'
Const. forebay berm
(For details, see sht. HAxx)



BIORETENTION POND SECTION A-A

Scale: NTS



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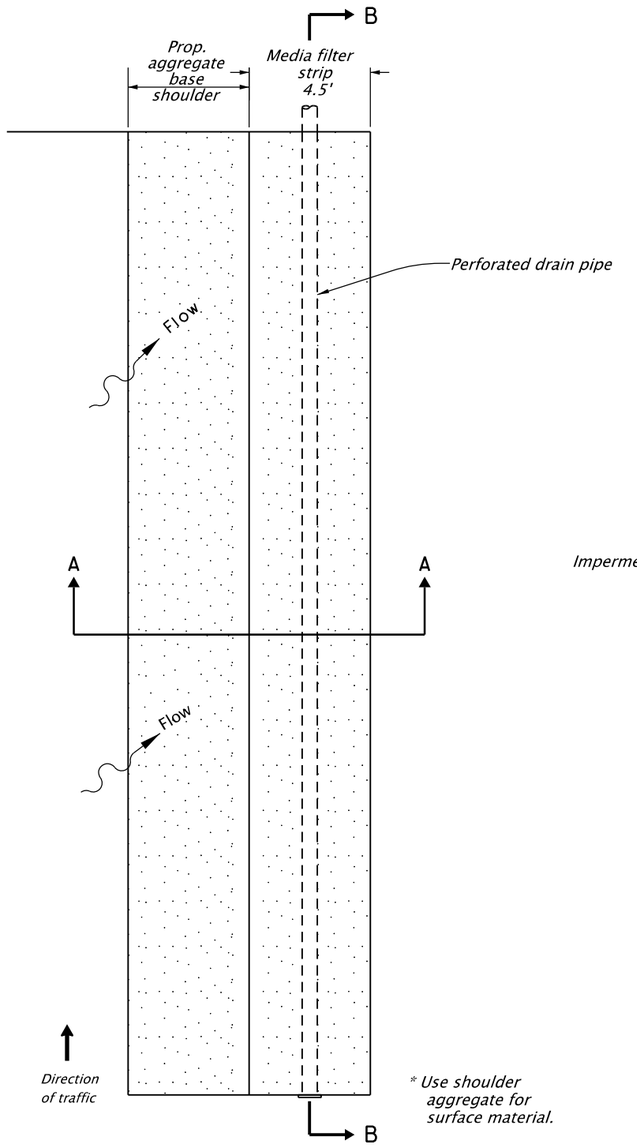
WATER QUALITY PLAN AND PROFILE

SHEET NO.
HA01

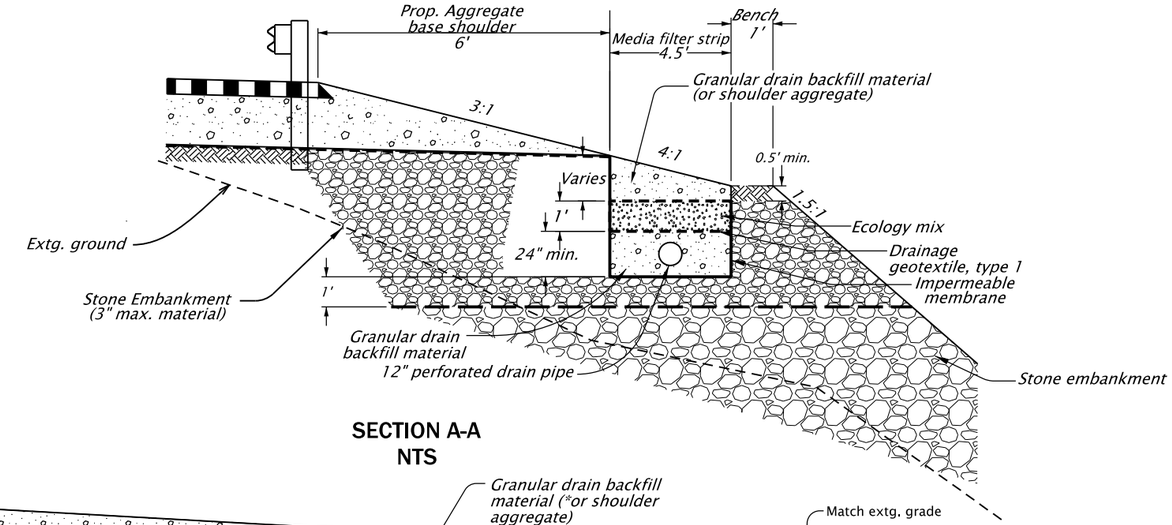
Rotation: 223.5514° Scale: 1"=50'
Vertical Scale: 1:10

BIOSLOPE
STA. "L" 665+00 TO STA. "L" 684+00

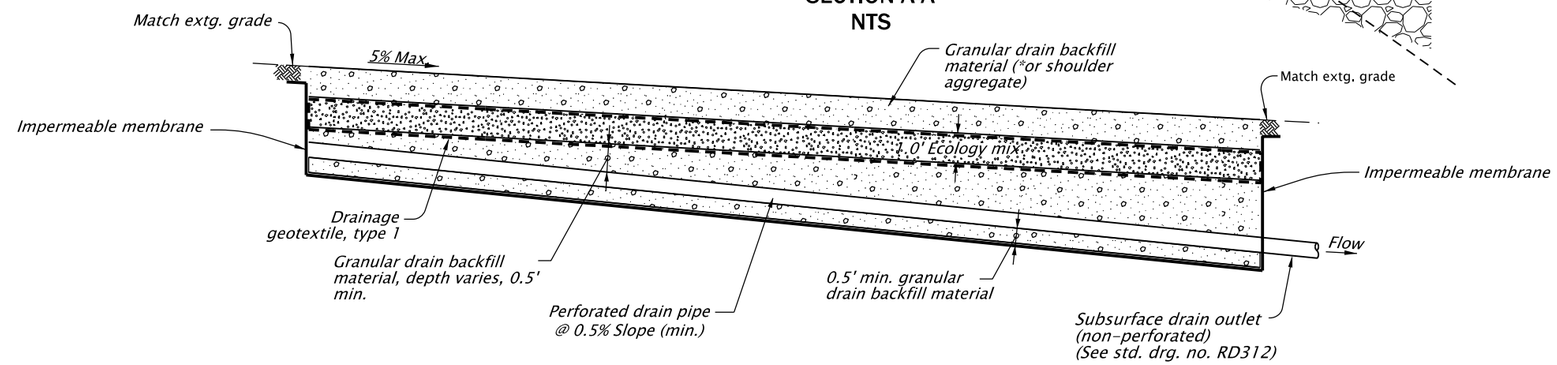


* Use shoulder aggregate for surface material.

PLAN
NTS



SECTION A-A
NTS



SECTION B-B
NTS

DFI#XXXXXX

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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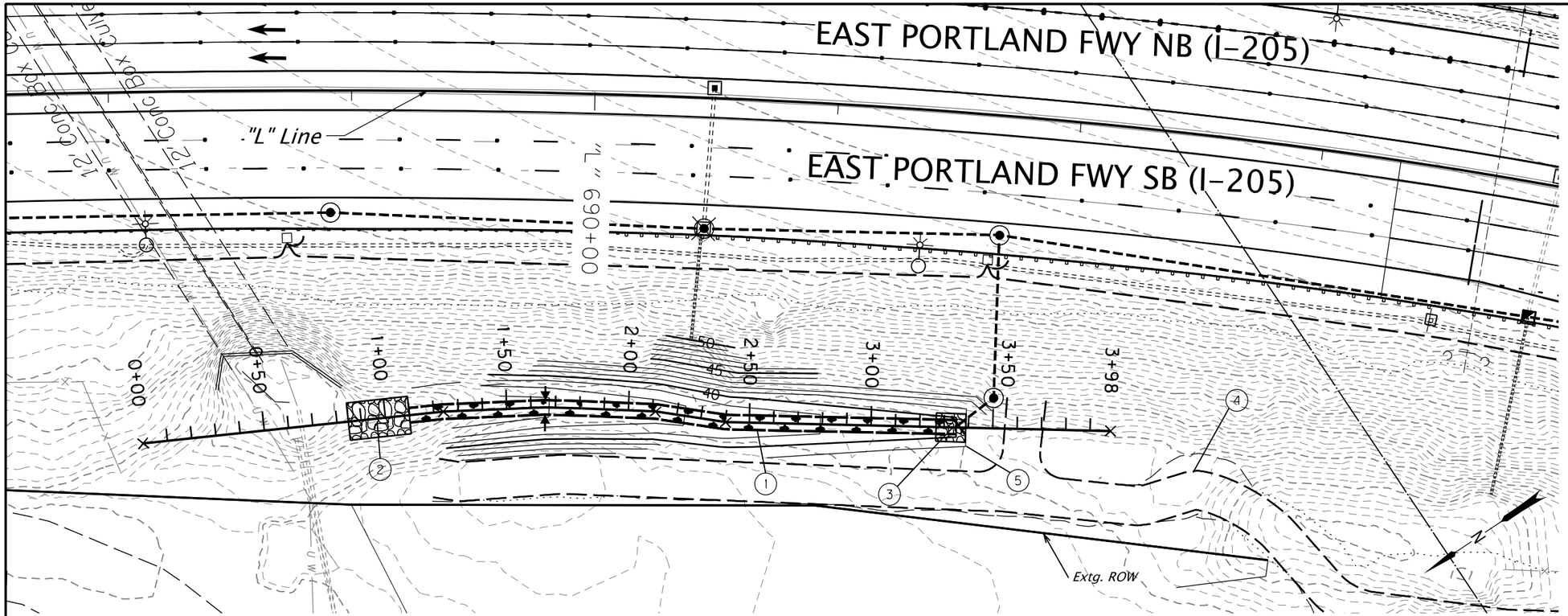
Drafter:	Checker:

WATER QUALITY DETAILS

SHEET NO.
HA02

FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 0° Scale: 1"=60'



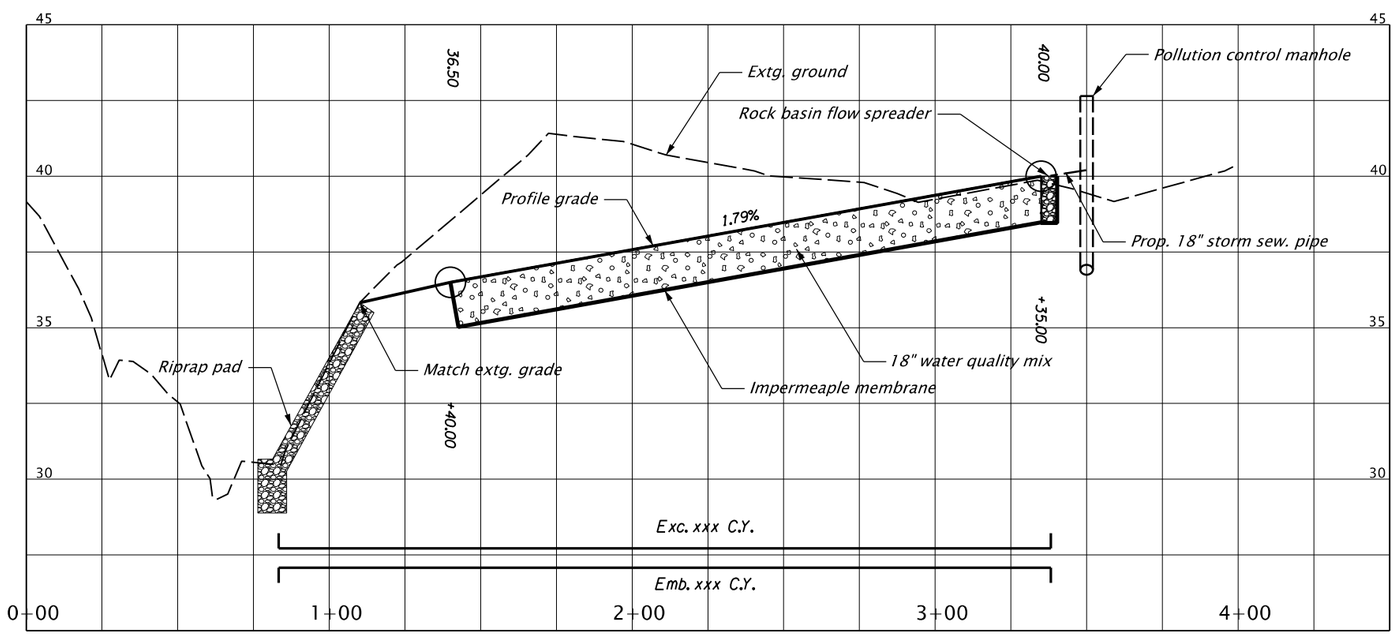
1. Sta. 1+09.97 to Sta. 3+34.91 = Sta. "L" 691+58.97, 128.64' Rt. to Sta. "L" 689+24.75, 133.18' Rt.
   Const. biofiltration swale
   (For details, see sht. HAxx)

2. Sta. 0+97.37, 0.00'
   Const. riprap pad
   Loose riprap (class 50) - 5.0 tons
   (See drg. no. RD317)

3. Sta. 3+33.58, 0.00'
   Const. rock basin flow spreader
   (For details, see sht. HAxx)

4. Sta. XX+XX.XX
   Const. maintenance access road
   (For details, see sht. HAxx)

5. Sta. XX+XX.XX
   Const. biofiltration swale berm
   (For details, see sht. HAxx)



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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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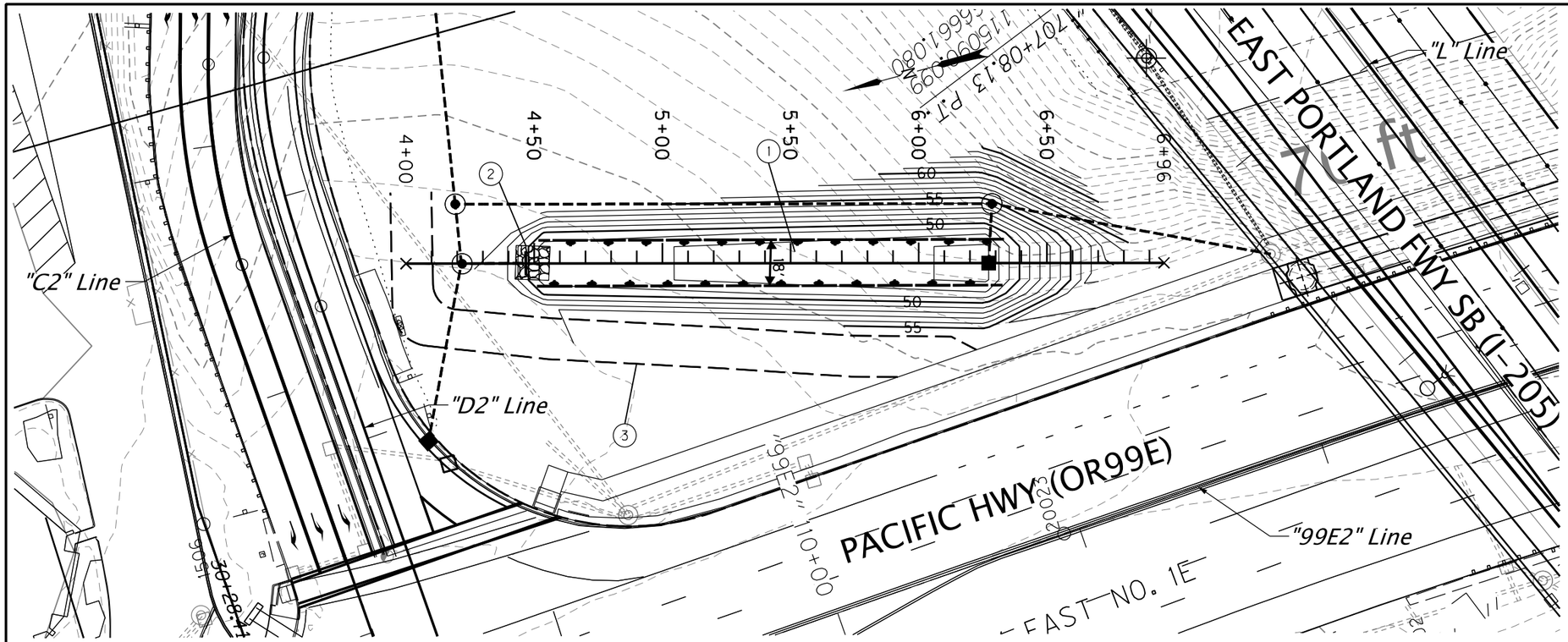
WATER QUALITY PLAN AND PROFILE

SHEET NO. HA03

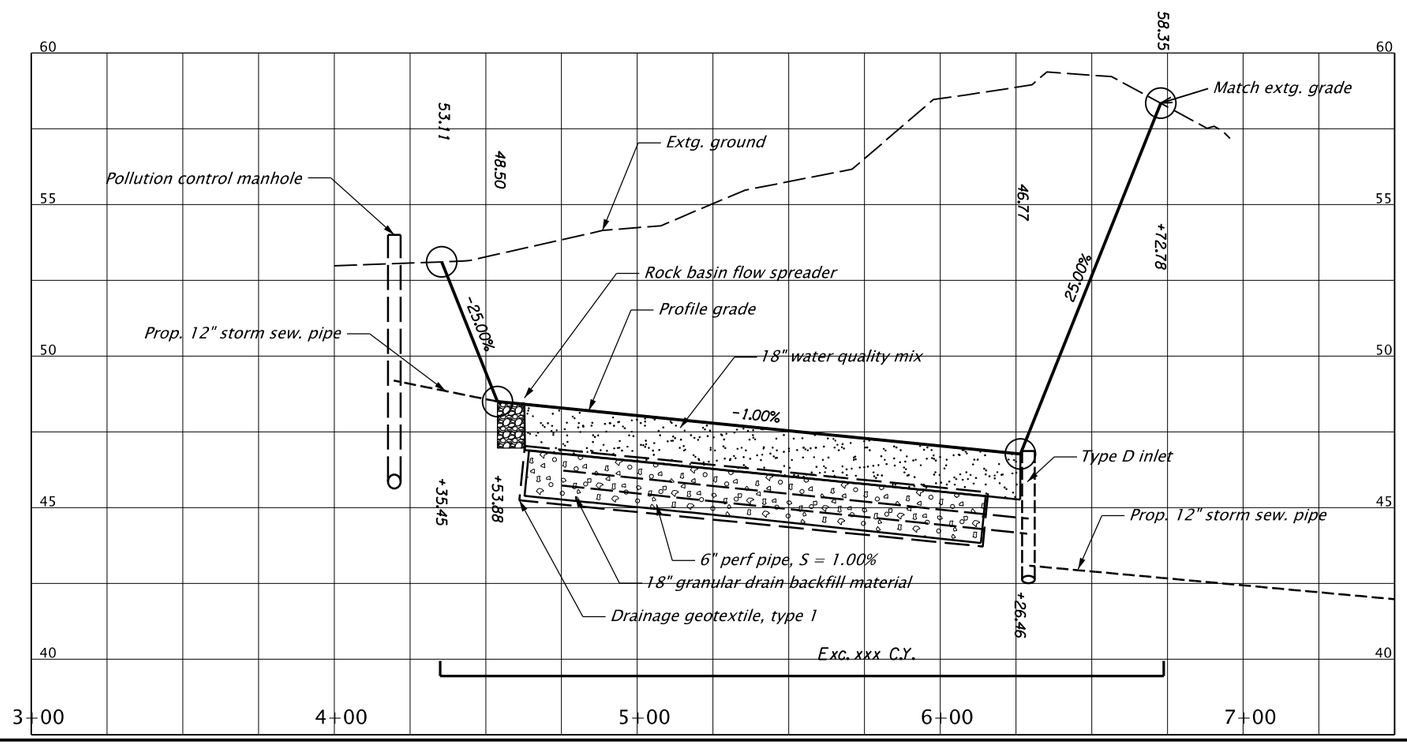
Rotation: 236.1297° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 4+50.41 to Sta. 6+34.91 = Sta. "99E2" 109+34.68, 167.57' Lt. to Sta. "99E2" 111+06.11, 107.62' Lt.
   Const. biofiltration swale
   (For details, see sht. HAxx)

2. Sta. 4+48.95, 0.00'
   Construct rock basin flow spreader
   (For details, see sht. HAxx)

3. Sta. XX+XX.XX
   Construct maintenance access road
   (For details, see sht. HAxx)



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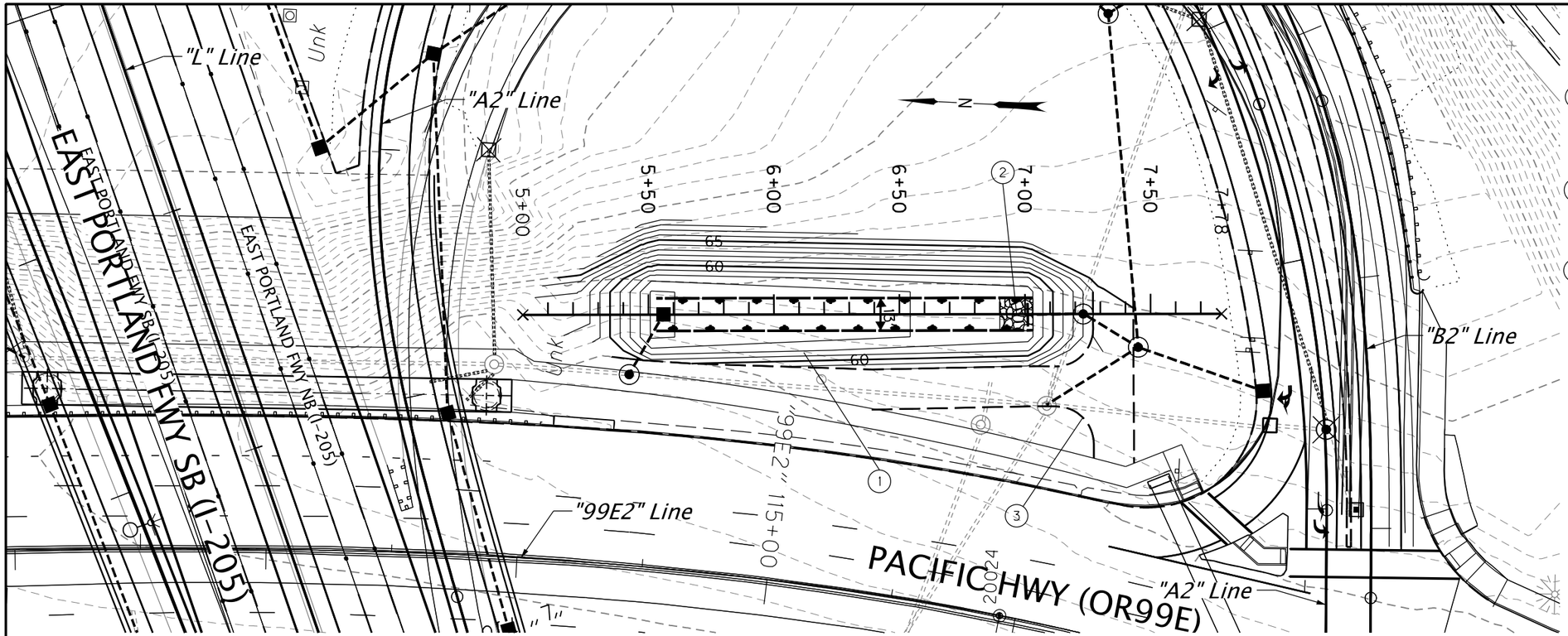
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

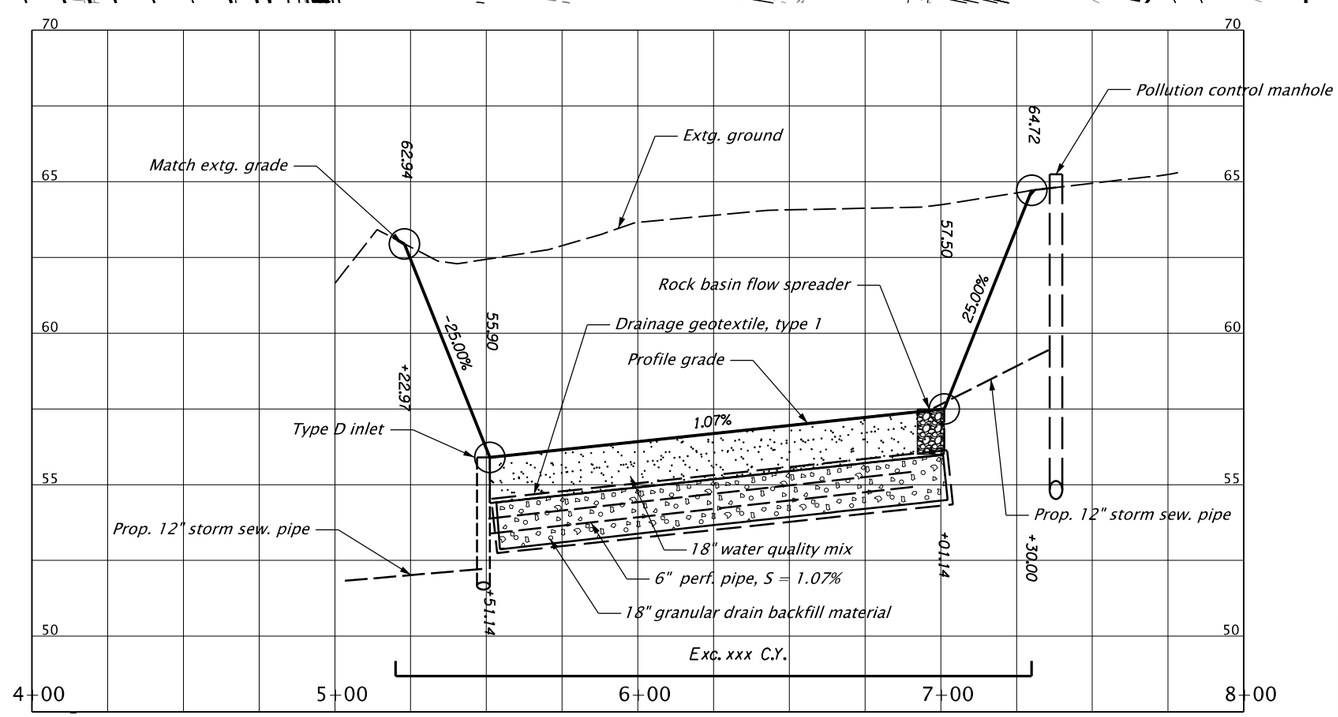
WATER QUALITY PLAN AND PROFILE

SHEET NO. HA04

Rotation: 254.7731° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 7+03.50 to 5+52.97 = Sta. "99E2" 115+84.70, 120.53' Lt. to Sta. "99E2" 114+47.00, 100.54' Lt.
   Construct biofiltration swale
   (For details, see sht. HAxx)
2. Sta. 6+95.86, 0.00'
   Construct rock basin flow spreader
   (For details, see sht. HAxx)
3. Sta. XX+XX.XX
   Construct maintenance access road
   (For details, see sht. HAxx)



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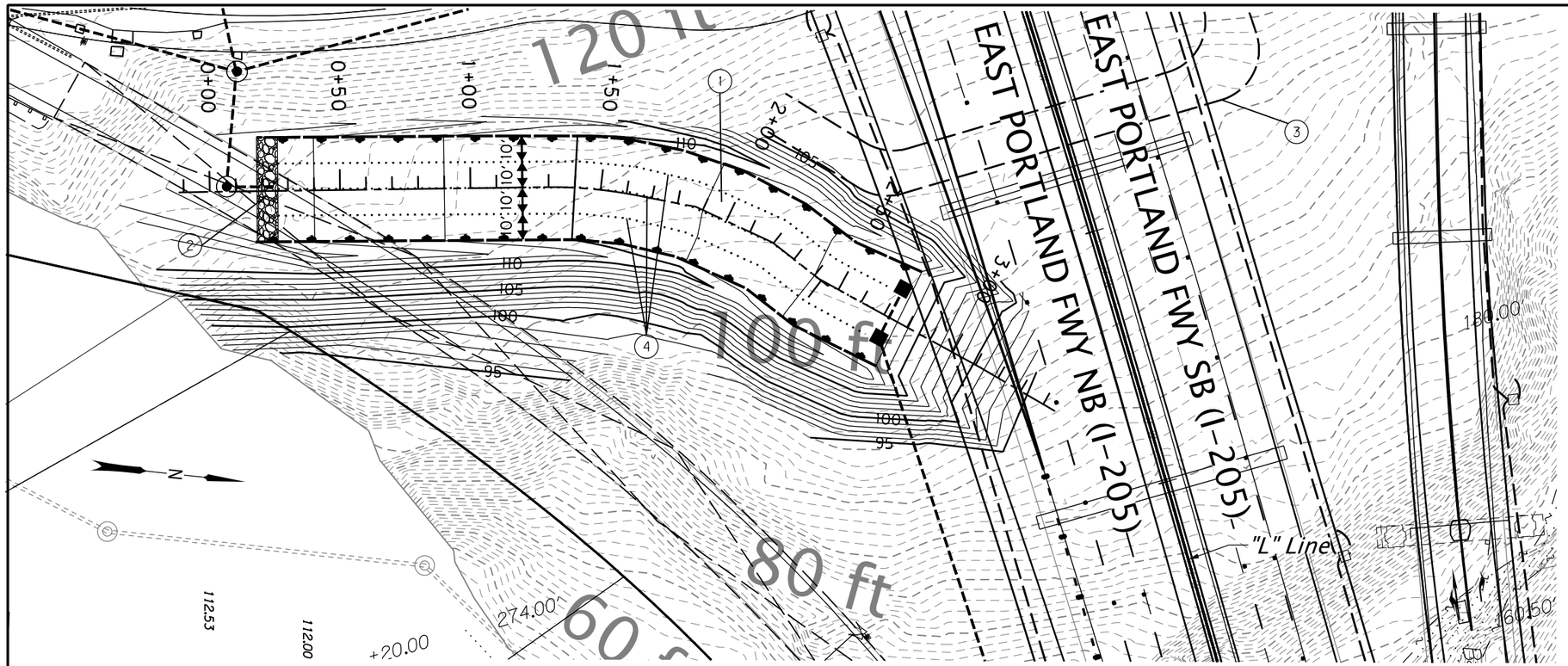
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer:	Reviewer:
Drafter:	Checker:

WATER QUALITY PLAN AND PROFILE

SHEET NO. HA05

Rotation: 272.7106° Scale: 1"=50'
Vertical Scale: 1:10

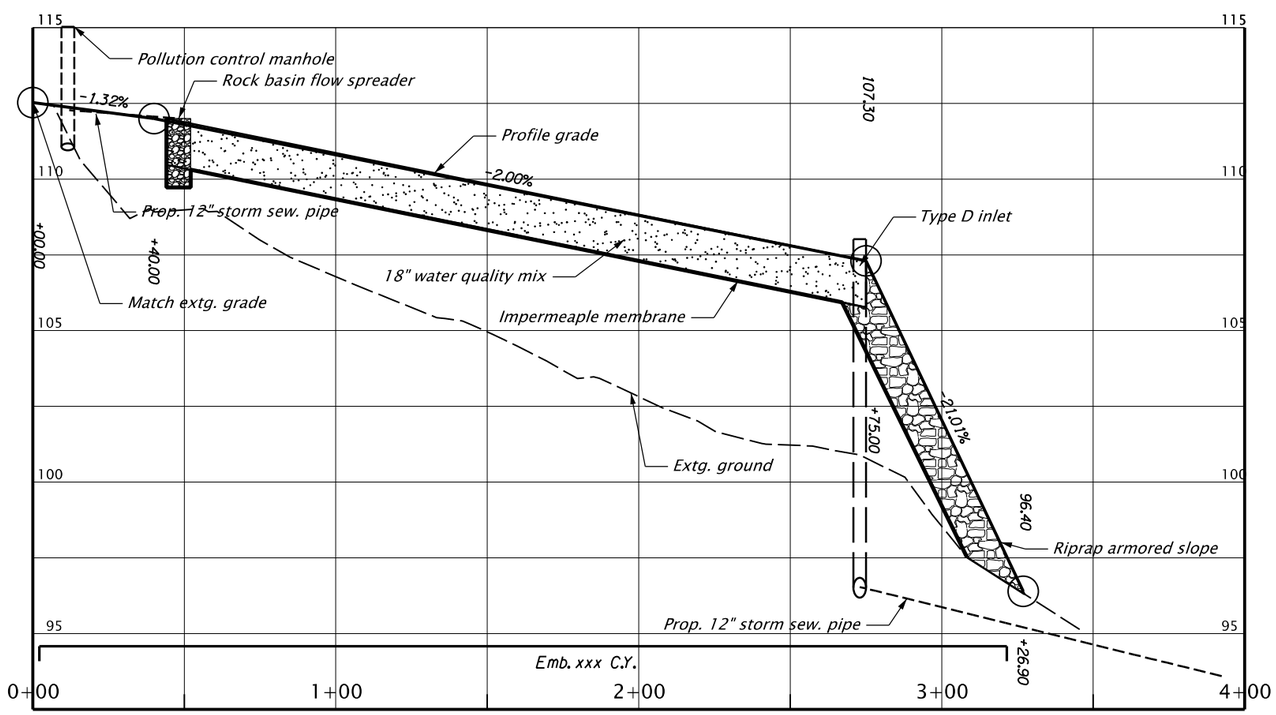


1. Sta. 0+31.89 to Sta. 2+48.39 = Sta. "OR43" 10+59.46, 110.66' Lt. to Sta. "OR43" 8+78.88, 209.80' Lt.
   Construct biofiltration swale
   (For details, see sht. HAxx)

2. Sta. 0+37.15, 2.22' Lt.
   Construct rock basin flow spreader
   (For details, see sht. HAxx)

3. Sta. XX+xx.xx
   Construction maintenance access road
   (For details, see sht. HAxx)

4. Construct biofiltration swale divider
   (For details, see sht. HAxx)



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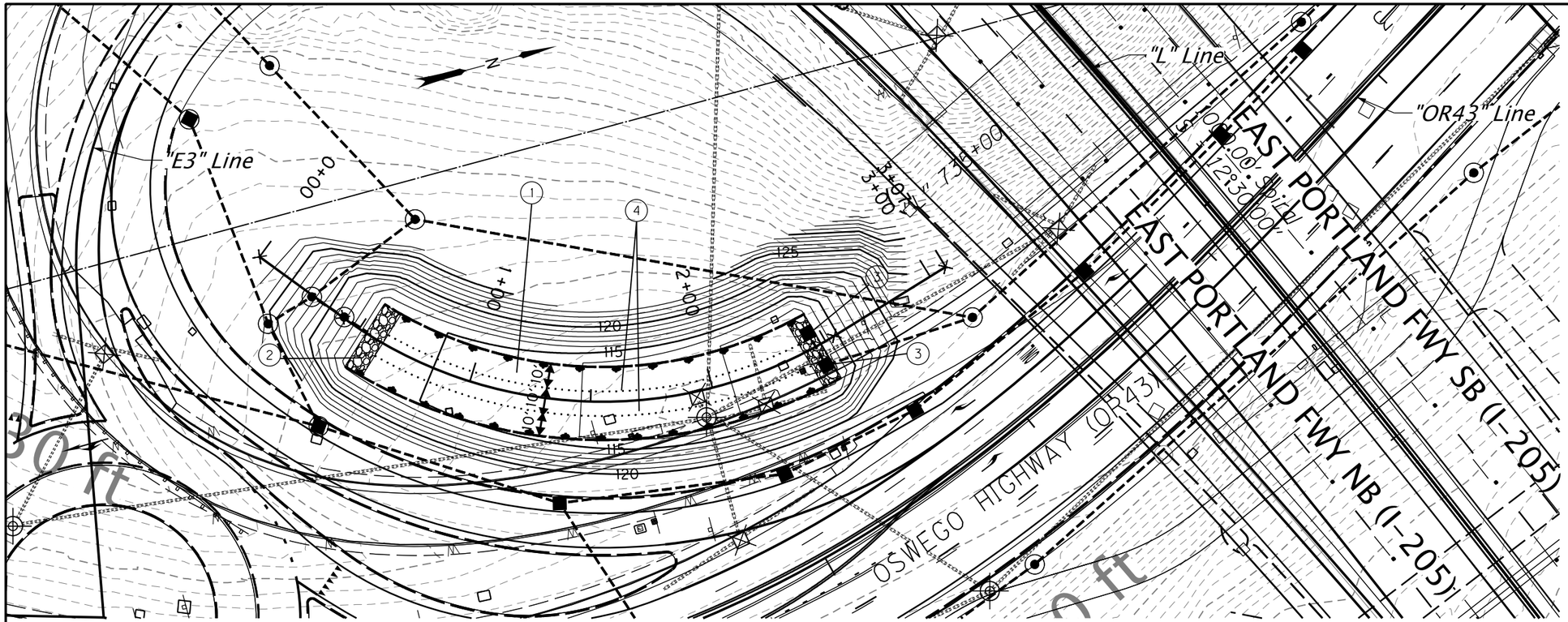
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

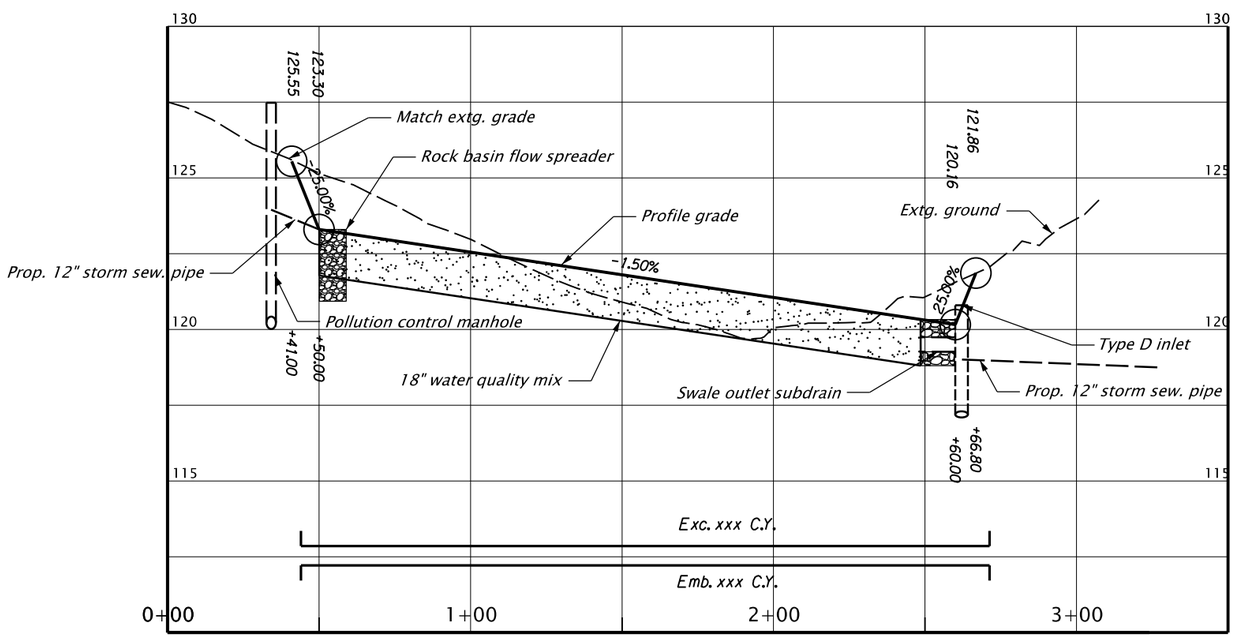
WATER QUALITY PLAN AND PROFILE

SHEET NO.
HA06

Rotation: 96.0998° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 0+54.22 to 2+55.48 = Sta. "E3" 740+37.28, 107.23' Lt. to Sta. "OR43" 9+52.79, 60.58' Rt. Construct 30' wide biofiltration swale (For details, see sht. HAxx)
2. Sta. 0+58.54 Construct rock basin flow spreader (For details, see sht. HA10)
3. Sta. 2+60.28 Construct rock basin flow spreader (For details, see sht. HA10)
4. Construct biofiltration swale divider (For details, see sht. HAxx)



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OREGON DEPARTMENT OF TRANSPORTATION

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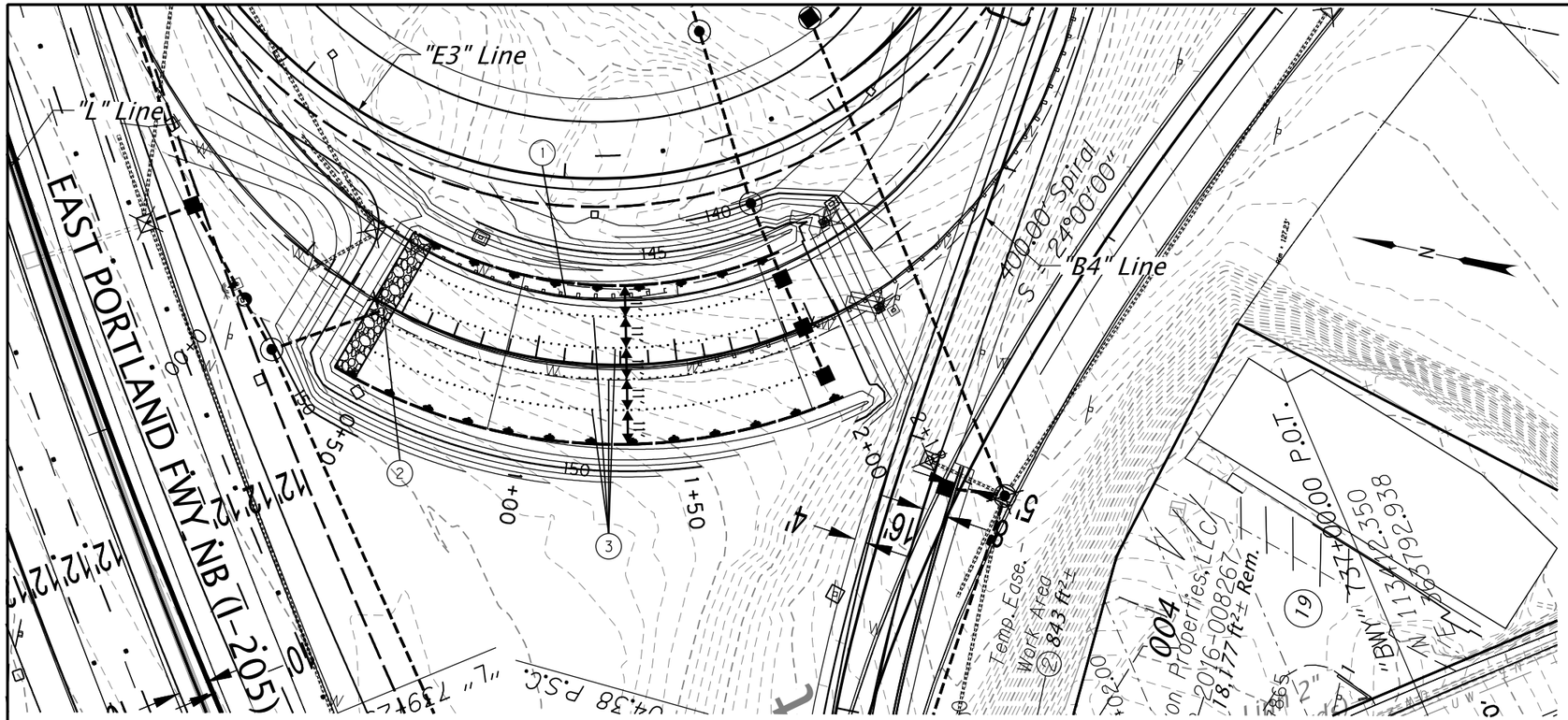
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

WATER QUALITY PLAN AND PROFILE

SHEET NO. HA07

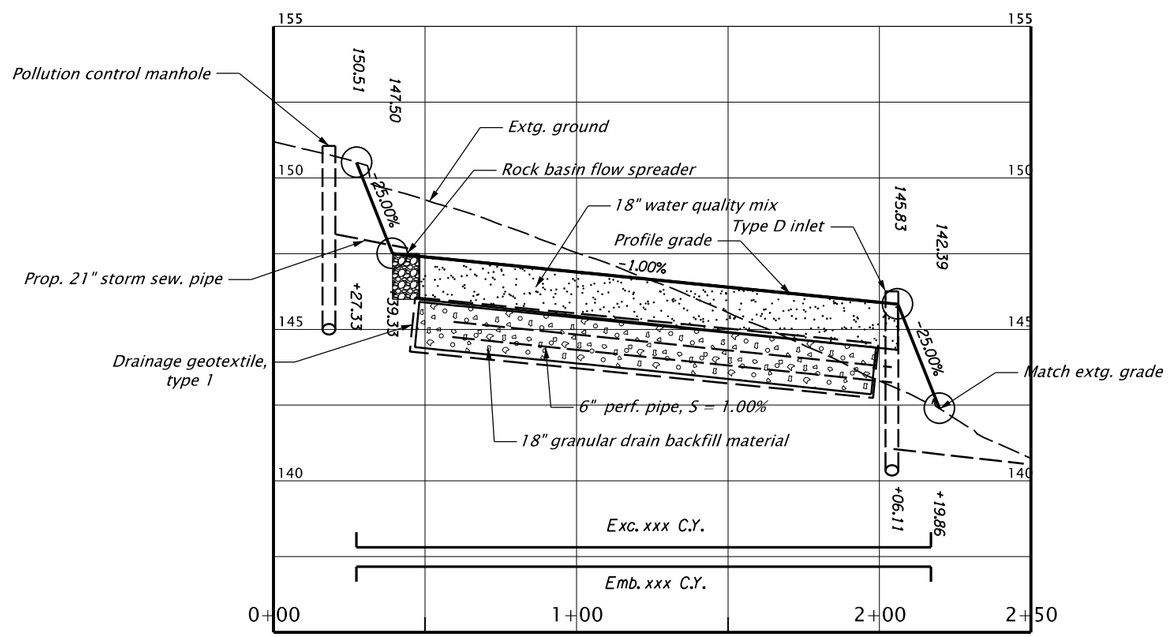
Rotation: 75.0253° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 0+39.24 to Sta. 1+98.79 = Sta. "E3" 737+52.57, 56.87' Rt. to Sta. "E3" 738+66.37, 64.42' Rt.
   Construct biofiltration swale
   (For details, see sht. HAxx)

2. Sta. 0+44.18, 0.00'
   Construct rock basin flow spreader
   (For details, see sht. HAxx)

3. Construct biofiltratoin swale divider
   (For details, see sht. HAxx)



DFI no. ######

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INFORMATION ONLY

HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

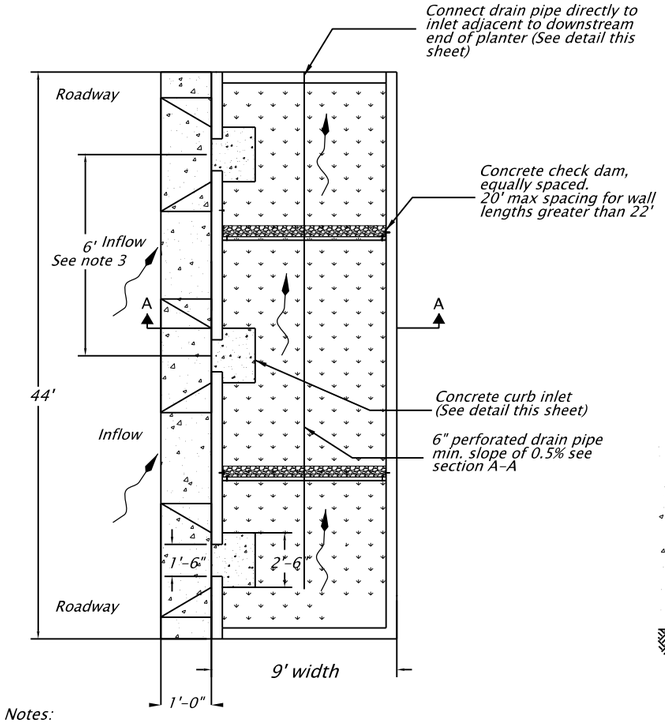
Designer: Reviewer:
Drafter: Checker:

WATER QUALITY PLAN AND PROFILE

SHEET NO.
HA08

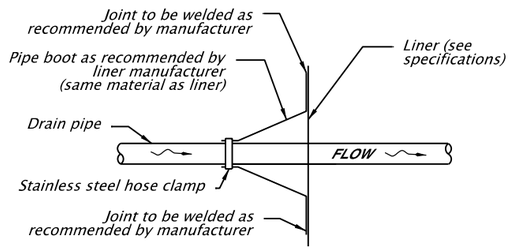
Rotation: 281.7947° Scale: 1"=50'
Vertical Scale: 1"=5'

S T O R M W A T E R P L A N T E R

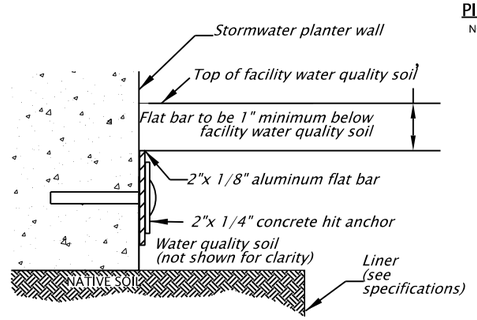


Notes:
1. Match longitudinal slope of planter to slope of the road.
2. If less than 18" is between splash pad and planter end wall, extend pad to wall.
3. Install inlets (6' on center) on all sides of facility that are adjacent to parking lot.

PLAN VIEW

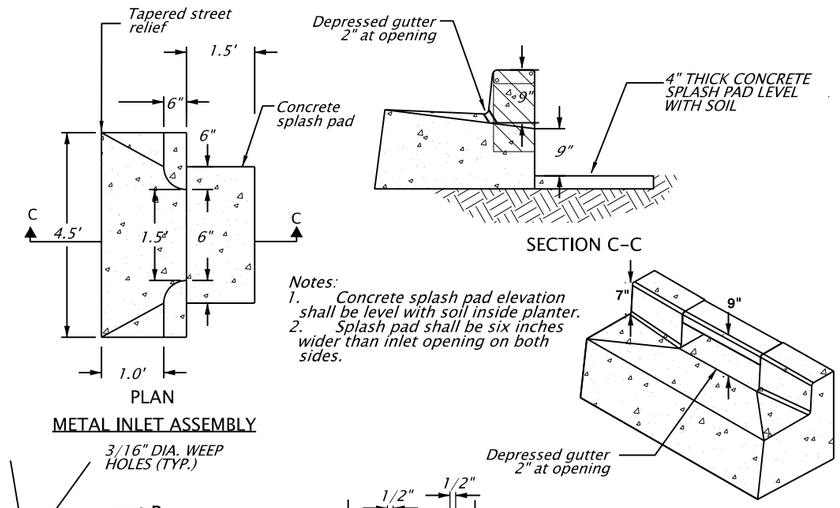


PIPE BOOT
NOT TO SCALE



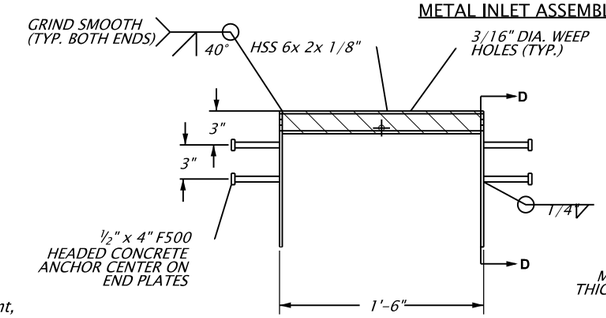
Notes:
1. Adhere liner to concrete with top coat tc moldable sealant, or approved equal.
2. Liner to extend from top of water quality soil to the bottom of excavation.
3. 3" of concrete is required on all sides of attachment. Adjust sidewalk depth as necessary.
4. Secure liner to concrete with 2" aluminum flat bar, placed as directed (around entire facility).
5. Attach flat bar with concrete hit anchors, 24" o.c.
6. Trim excess liner to the top of the flat bar.

LINER ATTACHMENT DETAIL
NOT TO SCALE

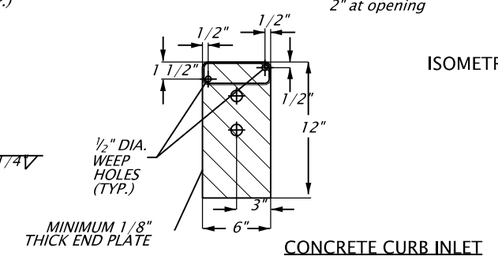


Notes:
1. Concrete splash pad elevation shall be level with soil inside planter.
2. Splash pad shall be six inches wider than inlet opening on both sides.

METAL INLET ASSEMBLY

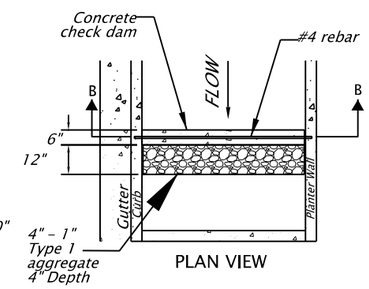


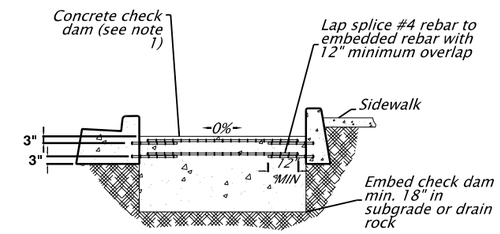
ELEVATION



SECTION D-D

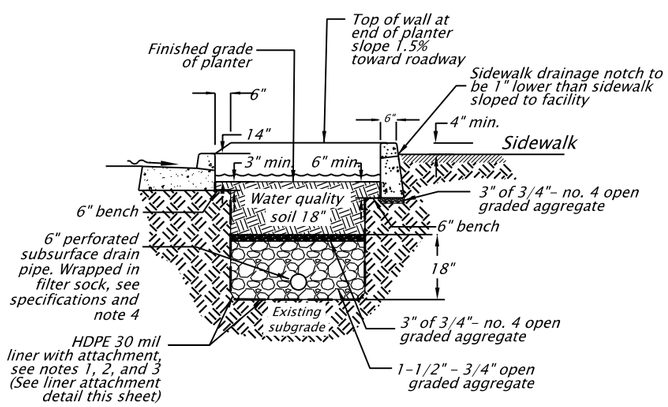
CONCRETE CURB INLET
NOT TO SCALE





Notes:
1. Top of dam elevation to be 2" lower than upstream curb depression elevation.
2. Concrete to be 3,000 psi.
3. Embed #4 rebar 3" into curb and planter wall.

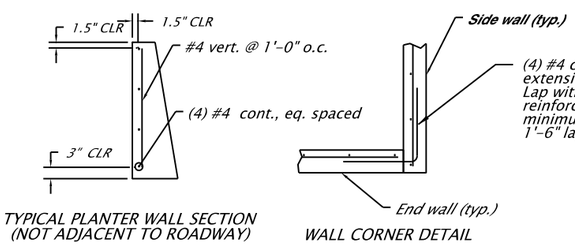
CONCRETE CHECK DAM
NOT TO SCALE



Notes:
1. Partial or full liner required. See stormwater planter table (this sheet) for requirement.
2. Partial liner located along side of planter adjacent to roadway.
3. Full liner located along all sides of planter.
4. Drain pipe only required for fully lined planters.
5. Scarify the native soil 12" following the initial excavation and before installing water quality soil and rock.

SECTION A-A

STORMWATER PLANTER DETAIL
NOT TO SCALE



TYPICAL PLANTER WALL SECTION (NOT ADJACENT TO ROADWAY)

WALL CORNER DETAIL

Notes:
1. Top of planter walls to be 4" higher than adjacent sidewalk.
2. Bottom of planter walls to be 6" below top of water quality soil.

PLANTER WALL
NOT TO SCALE

DFI no. ######

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OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

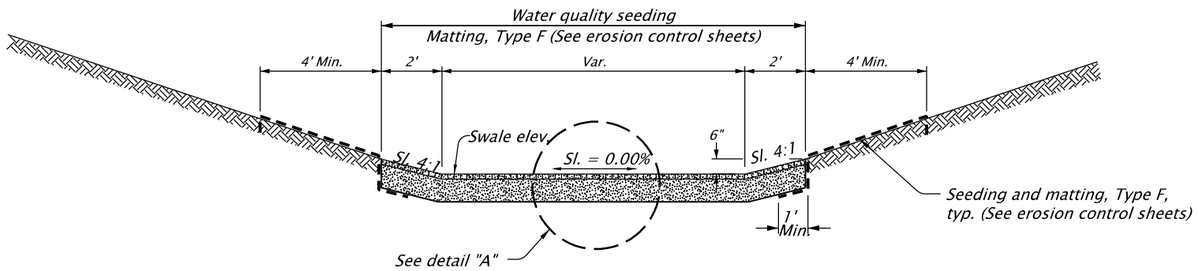
Designer: Reviewer:
Drafter: Checker:

WATER QUALITY DETAILS

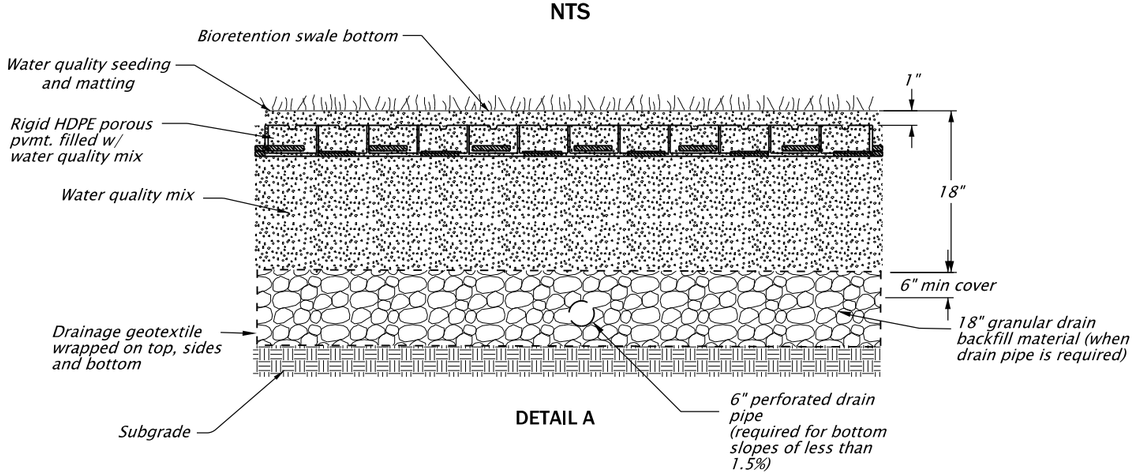
SHEET NO. HA09

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

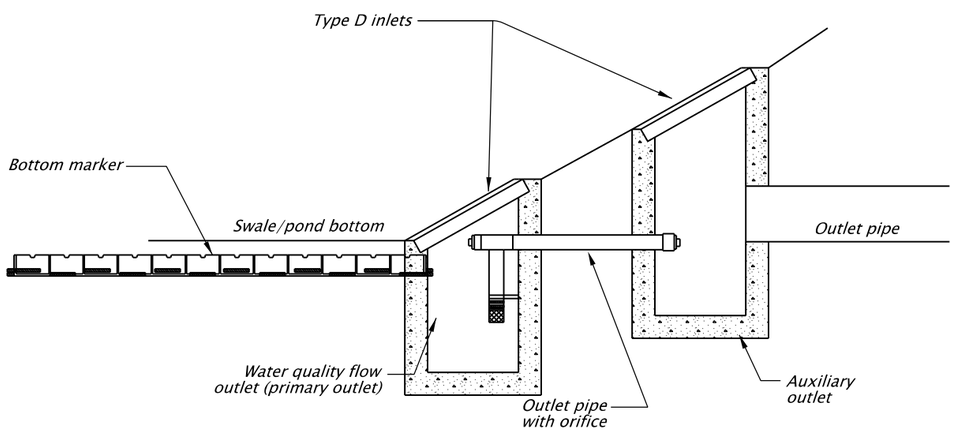
Rotation: 0° Scale: 1"=60'



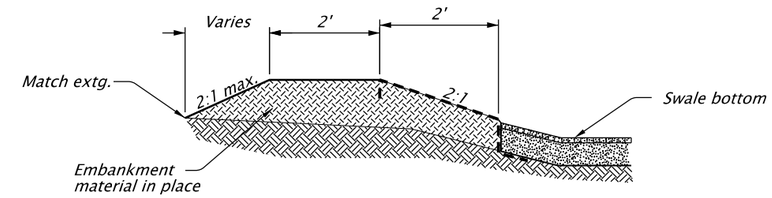
BIORETENTION SWALE
NTS



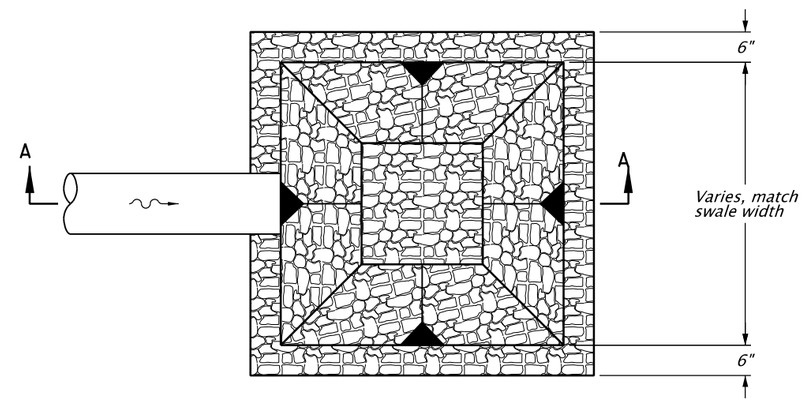
DETAIL A



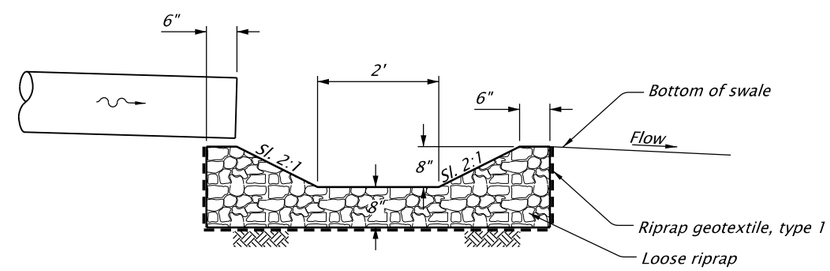
WATER QUALITY FACILITY OUTLET STRUCTURE
NTS



BIORETENTION SWALE BERM
NTS



ROCK BASIN FLOW SPREADER
NTS



SECTION A-A

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503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

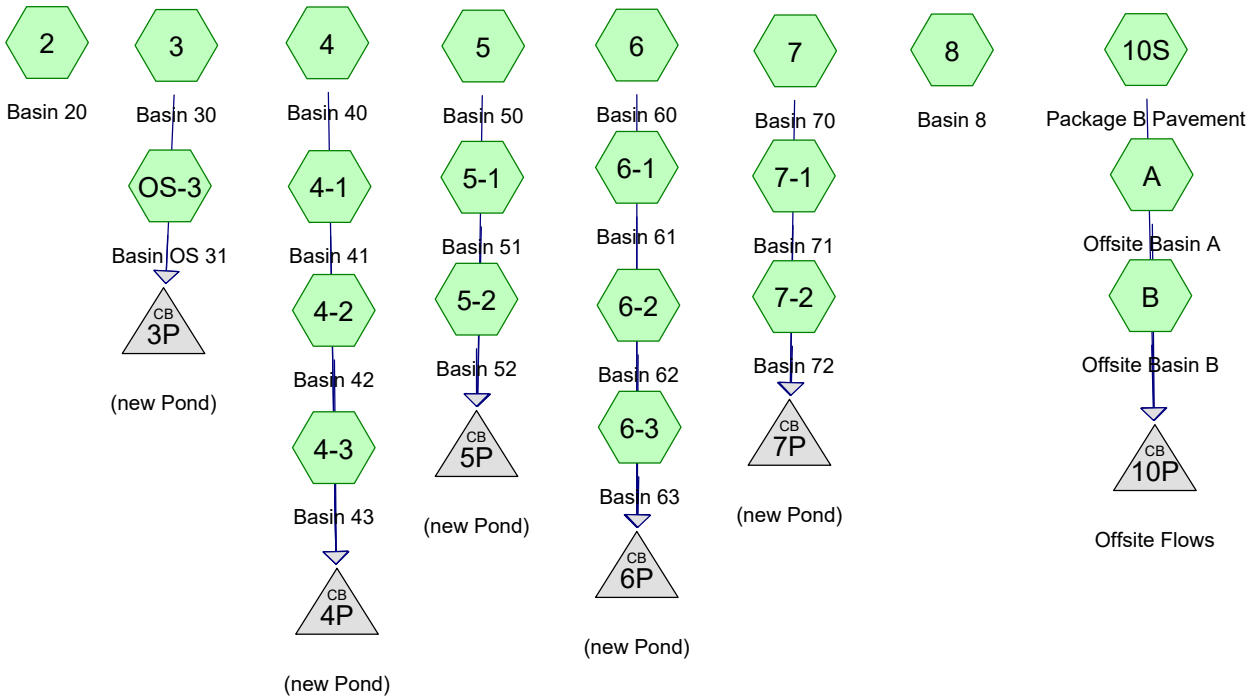
Designer:	Reviewer:
Drafter:	Checker:

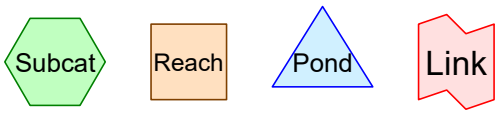
WATER QUALITY DETAILS

SHEET NO.
HA10

Rotation: 0° Scale: 1"=60'

Appendix C. Hydrology Calculations





Drainage Diagram for Abernethy Basins
Prepared by HDR, Printed 3/28/2019
HydroCAD® 9.10 s/n 04284 © 2010 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
111.160	83	1/4 acre lots, 38% imp, HSG C (A, B)
24.458	98	(2, 3, 4, 4-1, 4-2, 4-3, 5, 5-1, 5-2, 6, 6-1, 6-2, 6-3, 7, 7-1, 7-2, 8)
17.417	98	Paved roads w/curbs & sewers, HSG B (10S, OS-3)

Time span=0.00-40.00 hrs, dt=0.01 hrs, 4001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2: Basin 20 Runoff Area=3.080 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=2.36 cfs 0.782 af

Subcatchment3: Basin 30 Runoff Area=2.179 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=1.67 cfs 0.553 af

Subcatchment4: Basin 40 Runoff Area=0.396 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.30 cfs 0.101 af

Subcatchment4-1: Basin 41 Runoff Area=4.560 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=3.49 cfs 1.158 af

Subcatchment4-2: Basin 42 Runoff Area=0.698 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.53 cfs 0.177 af

Subcatchment4-3: Basin 43 Runoff Area=0.338 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.26 cfs 0.086 af

Subcatchment5: Basin 50 Runoff Area=0.719 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.55 cfs 0.183 af

Subcatchment5-1: Basin 51 Runoff Area=0.578 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.44 cfs 0.147 af

Subcatchment5-2: Basin 52 Runoff Area=3.570 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=2.74 cfs 0.907 af

Subcatchment6: Basin 60 Runoff Area=2.299 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=1.76 cfs 0.584 af

Subcatchment6-1: Basin 61 Runoff Area=0.474 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.36 cfs 0.120 af

Subcatchment6-2: Basin 62 Runoff Area=2.315 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=1.77 cfs 0.588 af

Subcatchment6-3: Basin 63 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.09 cfs 0.031 af

Subcatchment7: Basin 70 Runoff Area=0.287 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.22 cfs 0.073 af

Subcatchment7-1: Basin 71 Runoff Area=0.333 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.26 cfs 0.085 af

Subcatchment7-2: Basin 72 Runoff Area=0.556 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=0.43 cfs 0.141 af

Subcatchment8: Basin 8 Runoff Area=1.953 ac 100.00% Impervious Runoff Depth=3.05"
Tc=12.0 min CN=0/98 Runoff=1.38 cfs 0.496 af

Subcatchment10S: Package B Pavement Runoff Area=15.765 ac 100.00% Impervious Runoff Depth=3.05"
Tc=15.0 min CN=0/98 Runoff=10.77 cfs 4.003 af

SubcatchmentA: Offsite Basin A Runoff Area=19.530 ac 38.00% Impervious Runoff Depth=1.83"
Tc=20.0 min CN=74/98 Runoff=6.61 cfs 2.985 af

SubcatchmentB: Offsite Basin B Runoff Area=91.630 ac 38.00% Impervious Runoff Depth=1.83"
Tc=60.0 min CN=74/98 Runoff=20.05 cfs 14.005 af

SubcatchmentOS-3: Basin OS 31 Runoff Area=1.652 ac 100.00% Impervious Runoff Depth=3.05"
Tc=5.0 min CN=0/98 Runoff=1.27 cfs 0.419 af

Pond 3P: (new Pond) Peak Elev=0.77' Inflow=2.94 cfs 0.973 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=2.94 cfs 0.973 af

Pond 4P: (new Pond) Peak Elev=0.96' Inflow=4.59 cfs 1.522 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=4.59 cfs 1.522 af

Pond 5P: (new Pond) Peak Elev=0.86' Inflow=3.73 cfs 1.236 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=3.73 cfs 1.236 af

Pond 6P: (new Pond) Peak Elev=0.89' Inflow=3.99 cfs 1.323 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=3.99 cfs 1.323 af

Pond 7P: (new Pond) Peak Elev=0.44' Inflow=0.90 cfs 0.299 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=0.90 cfs 0.299 af

Pond 10P: Offsite Flows Peak Elev=2.84' Inflow=36.77 cfs 20.993 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=36.77 cfs 20.993 af

Summary for Subcatchment 2: Basin 20

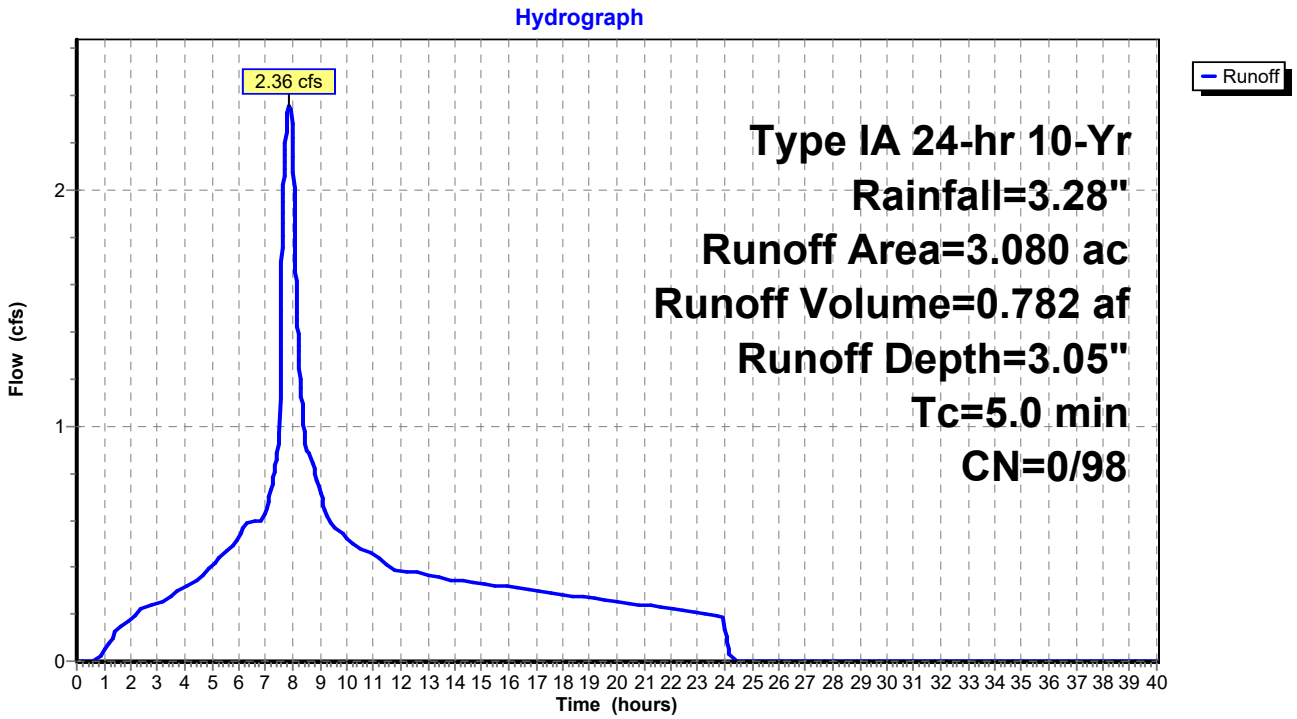
Runoff = 2.36 cfs @ 7.88 hrs, Volume= 0.782 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	3.080	98	
	3.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Basin 20



Summary for Subcatchment 3: Basin 30

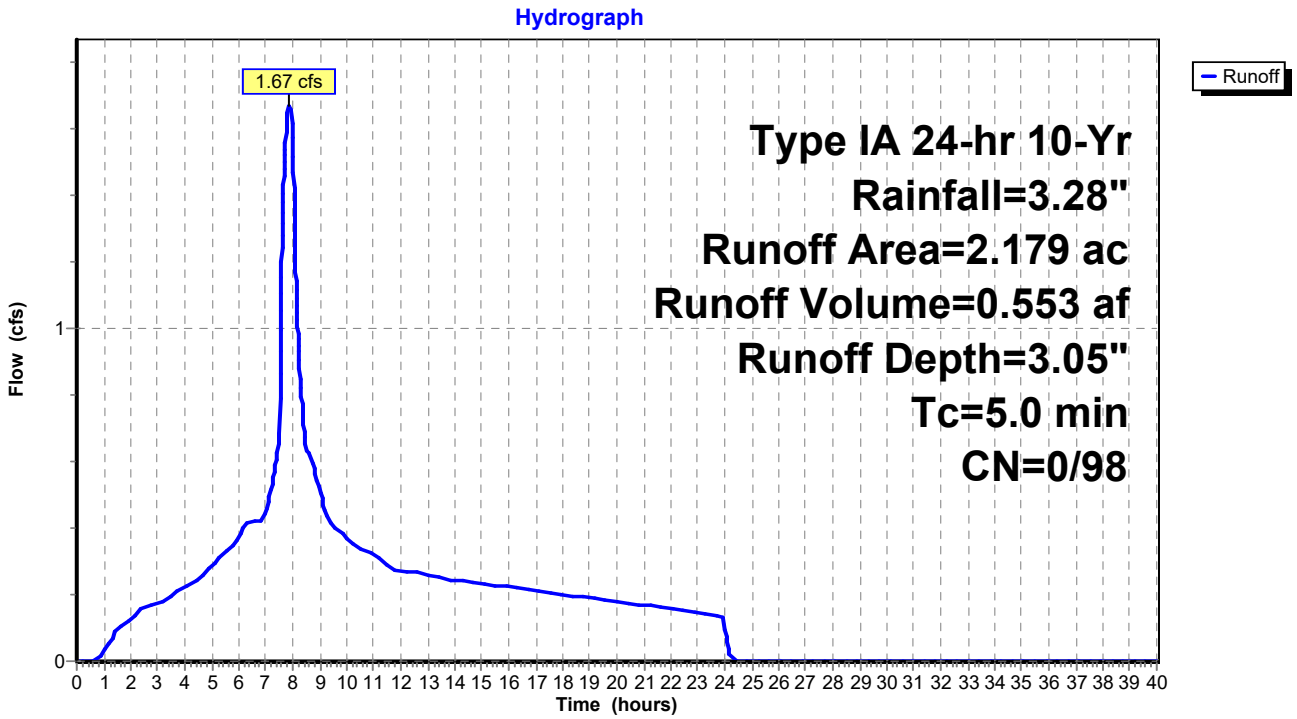
Runoff = 1.67 cfs @ 7.88 hrs, Volume= 0.553 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	2.179	98	
	2.179	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Basin 30



Summary for Subcatchment 4: Basin 40

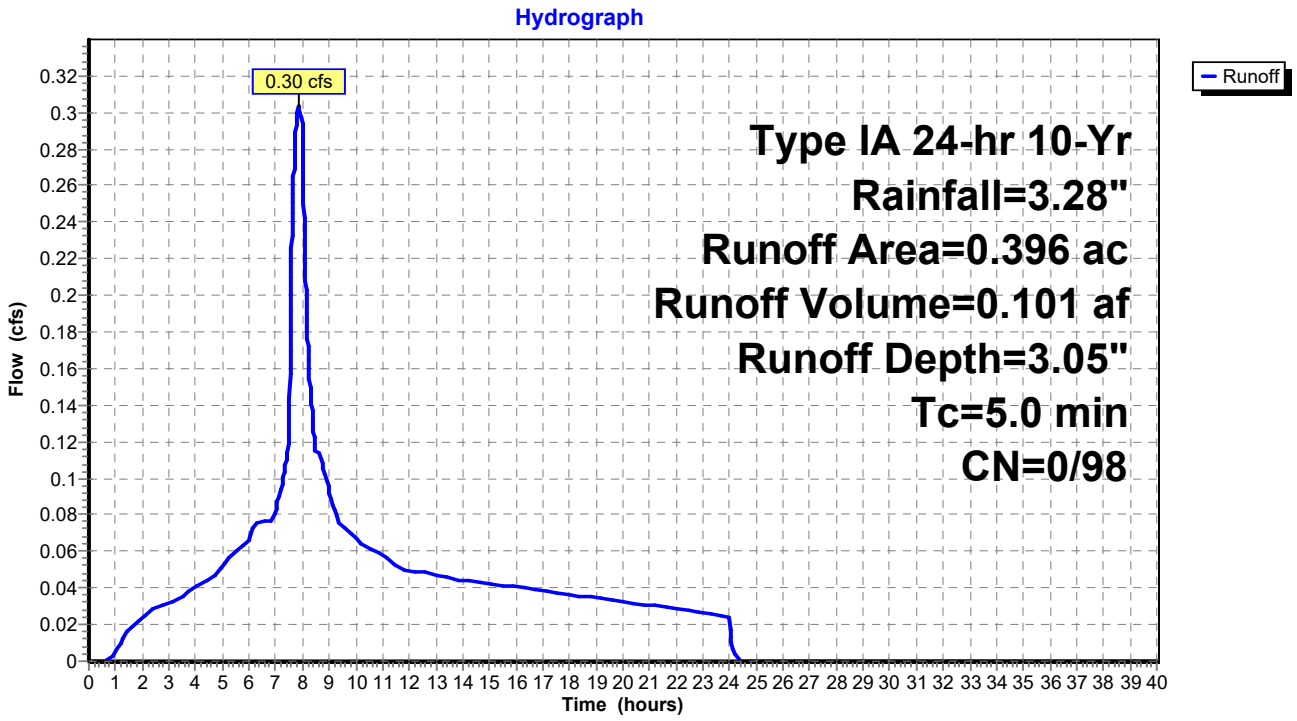
Runoff = 0.30 cfs @ 7.88 hrs, Volume= 0.101 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.396	98	
	0.396	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: Basin 40



Summary for Subcatchment 4-1: Basin 41

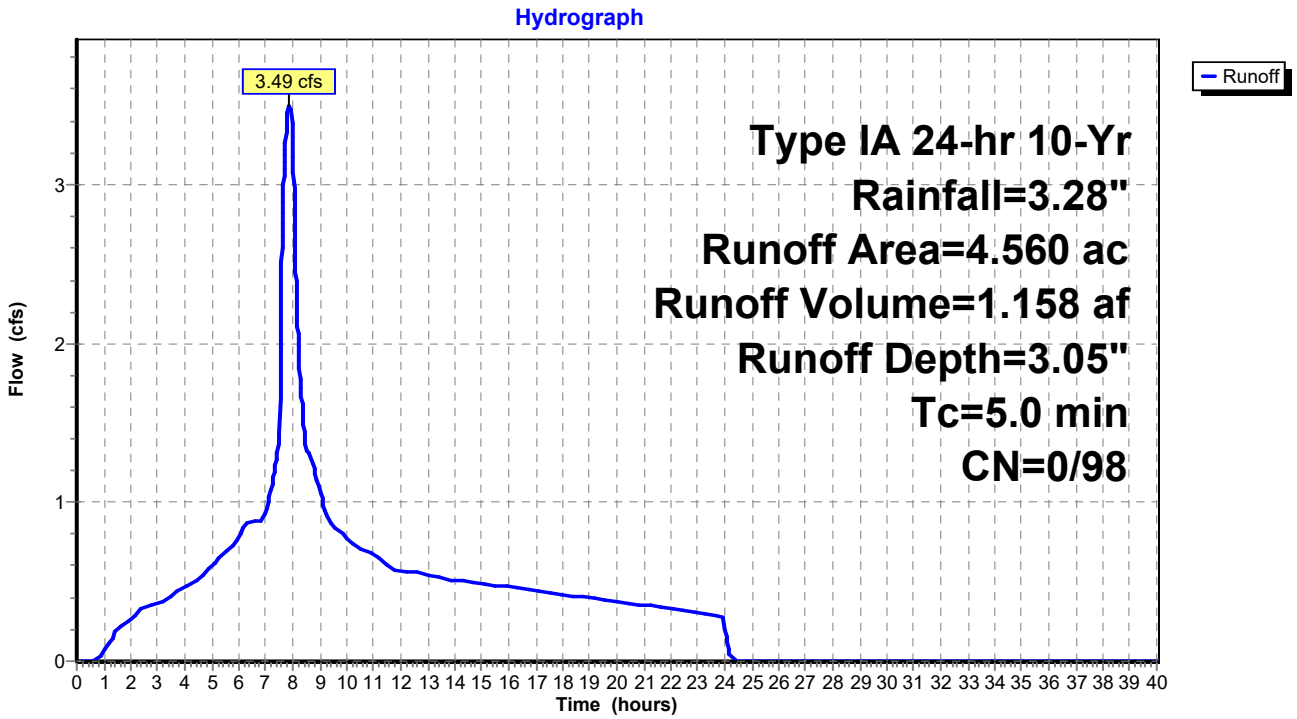
Runoff = 3.49 cfs @ 7.88 hrs, Volume= 1.158 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	4.560	98	
	4.560	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-1: Basin 41



Summary for Subcatchment 4-2: Basin 42

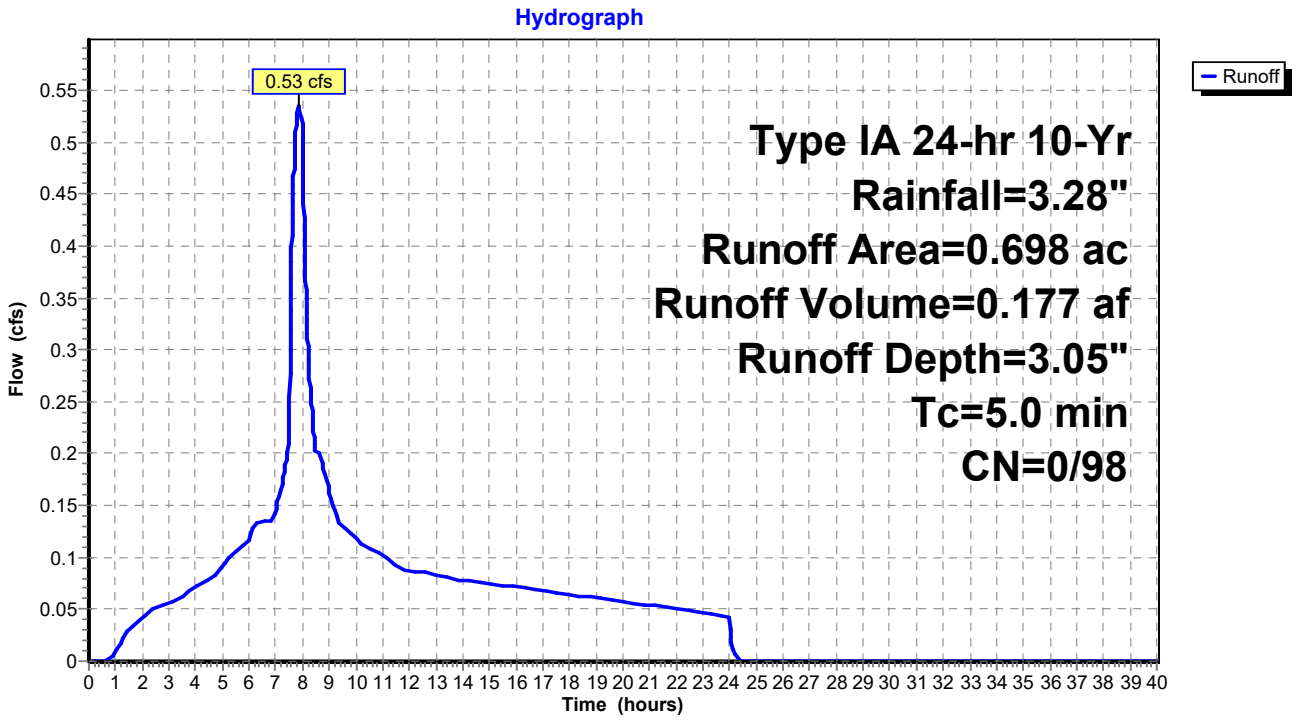
Runoff = 0.53 cfs @ 7.88 hrs, Volume= 0.177 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.698	98	
	0.698	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-2: Basin 42



Summary for Subcatchment 4-3: Basin 43

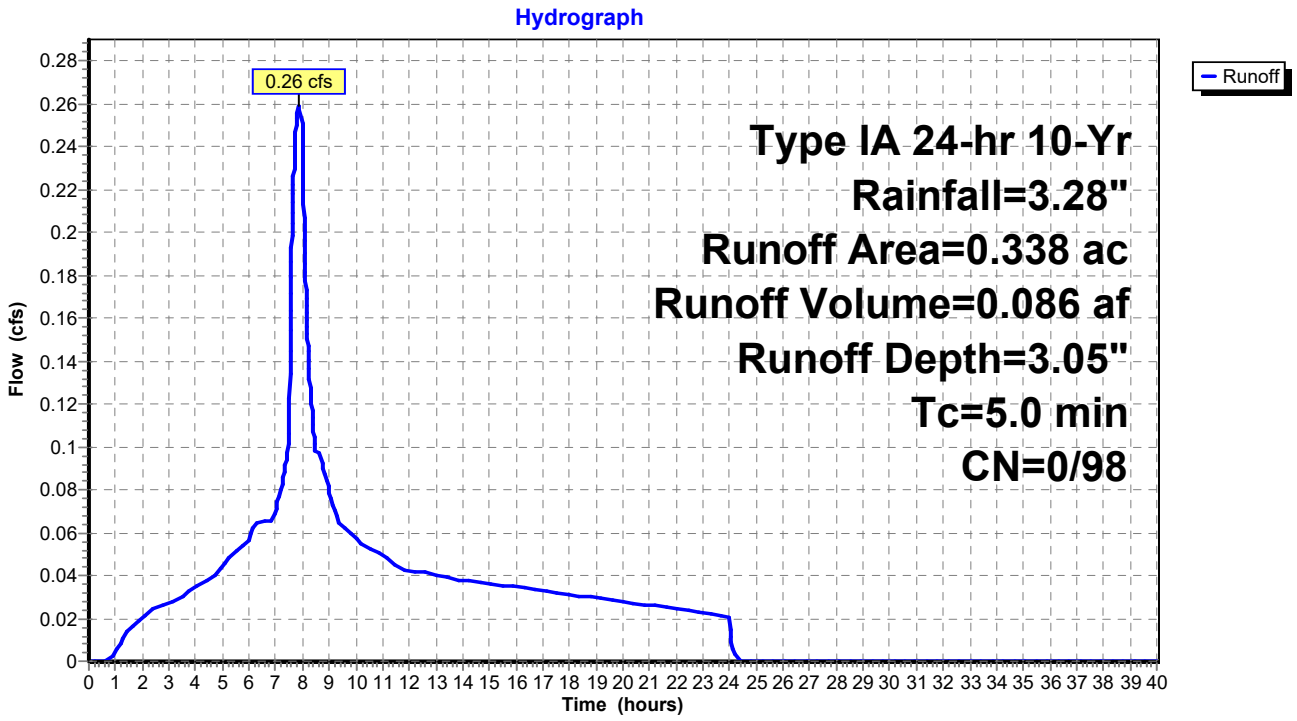
Runoff = 0.26 cfs @ 7.88 hrs, Volume= 0.086 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.338	98	
	0.338	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-3: Basin 43



Summary for Subcatchment 5: Basin 50

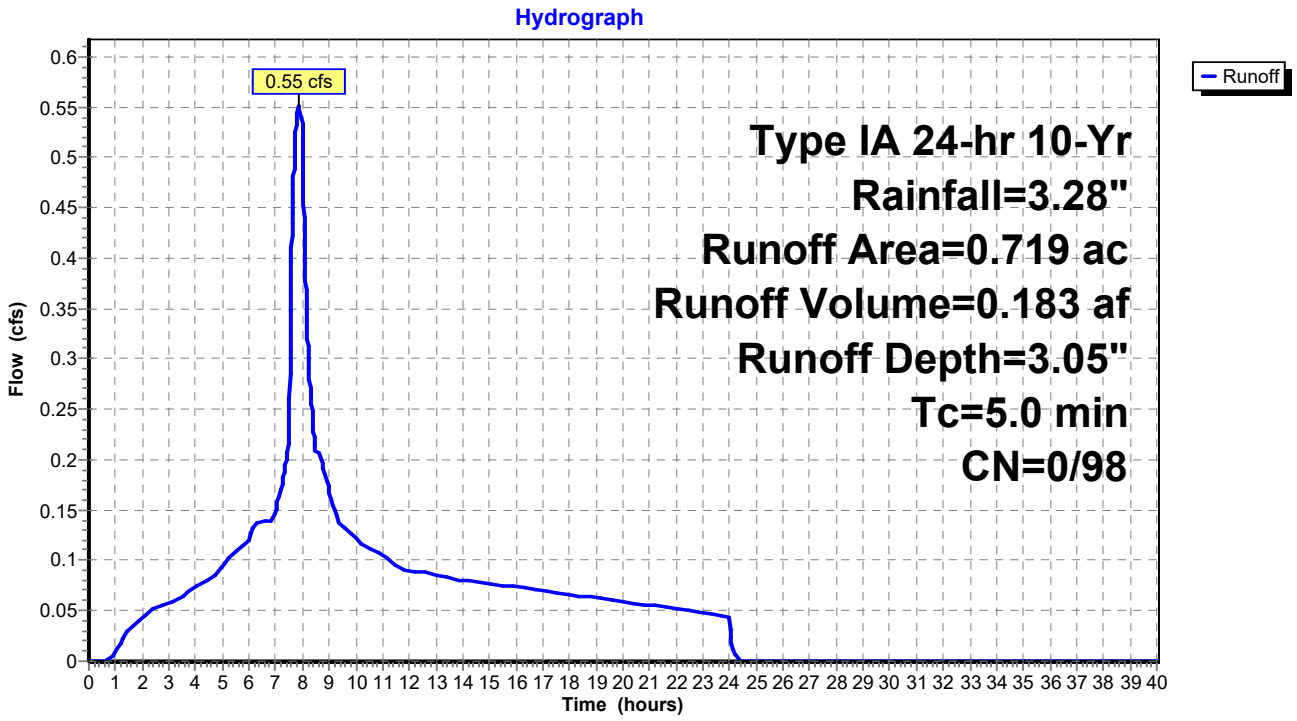
Runoff = 0.55 cfs @ 7.88 hrs, Volume= 0.183 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.719	98	
	0.719	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: Basin 50



Summary for Subcatchment 5-1: Basin 51

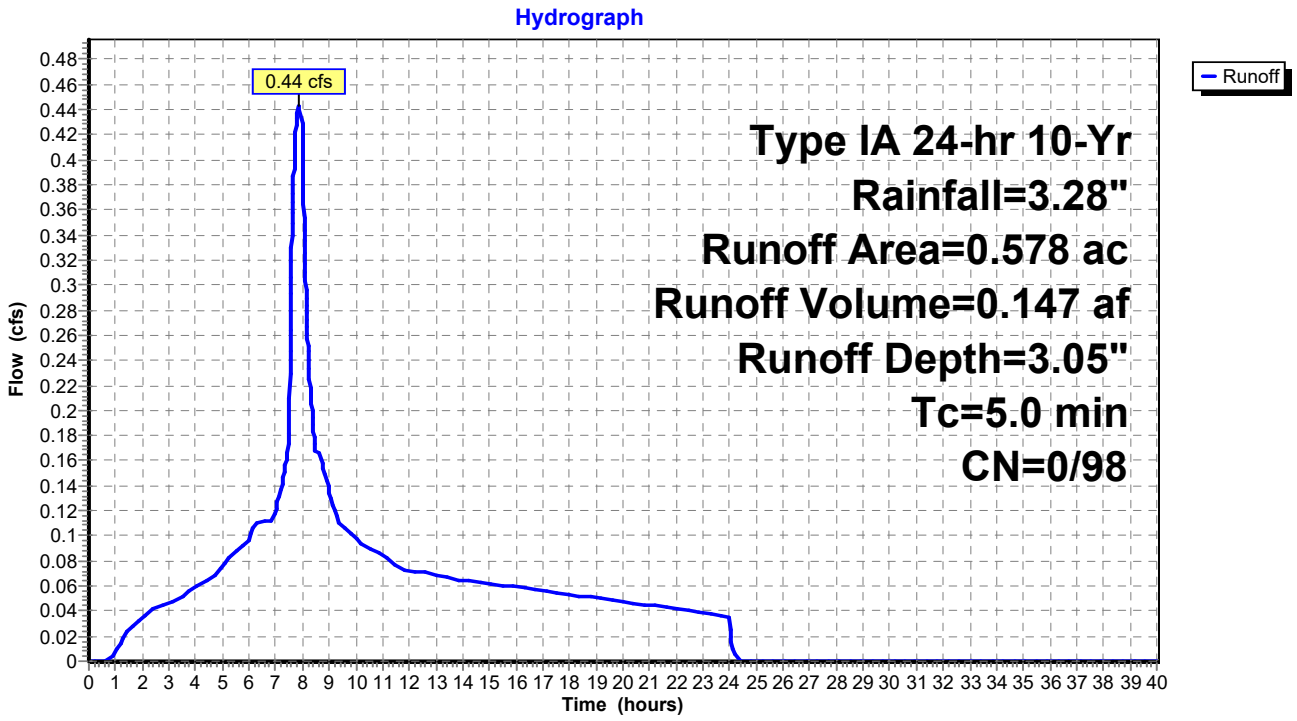
Runoff = 0.44 cfs @ 7.88 hrs, Volume= 0.147 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.578	98	
	0.578	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5-1: Basin 51



Summary for Subcatchment 5-2: Basin 52

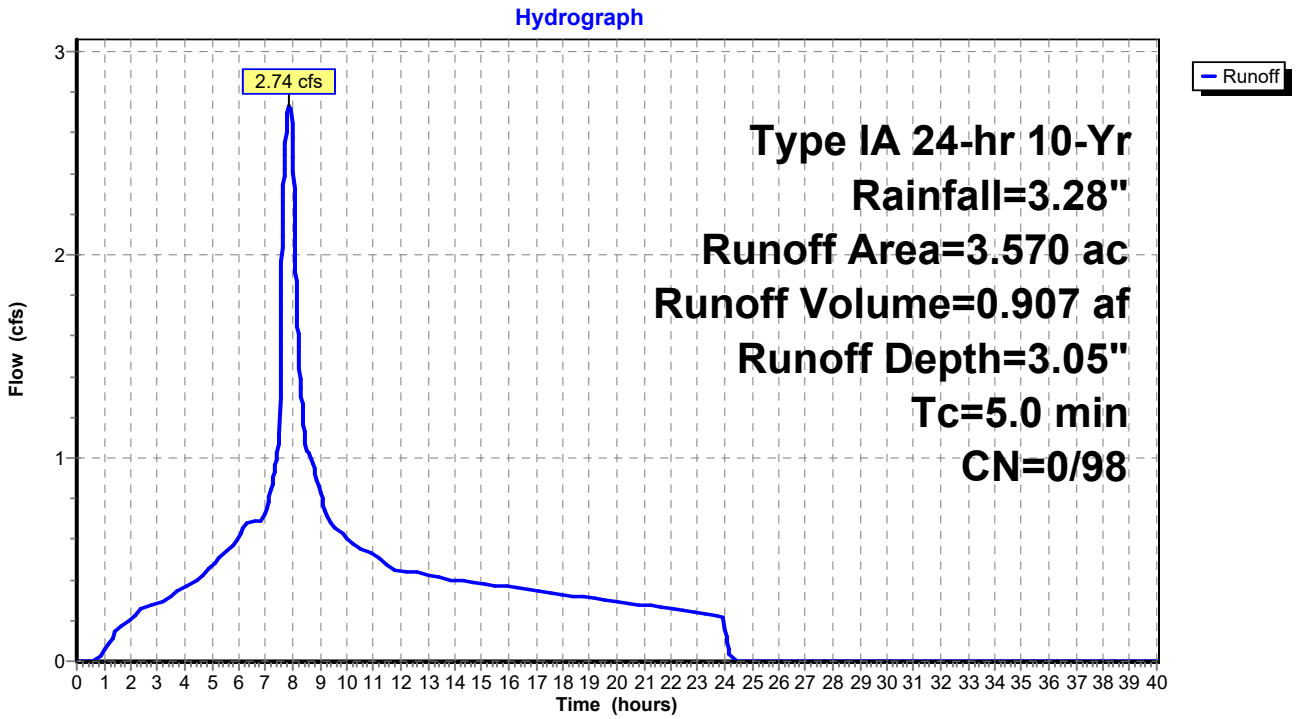
Runoff = 2.74 cfs @ 7.88 hrs, Volume= 0.907 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	3.570	98	
	3.570	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5-2: Basin 52



Summary for Subcatchment 6: Basin 60

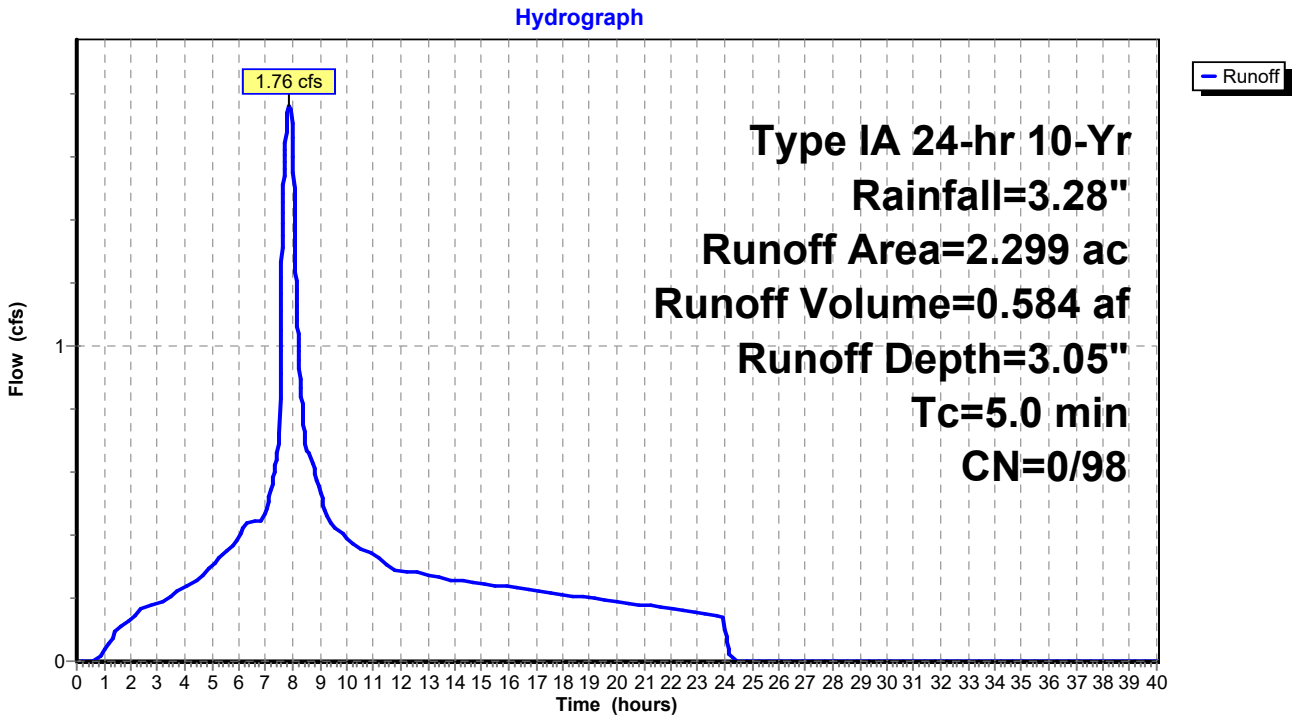
Runoff = 1.76 cfs @ 7.88 hrs, Volume= 0.584 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	2.299	98	
	2.299	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6: Basin 60



Summary for Subcatchment 6-1: Basin 61

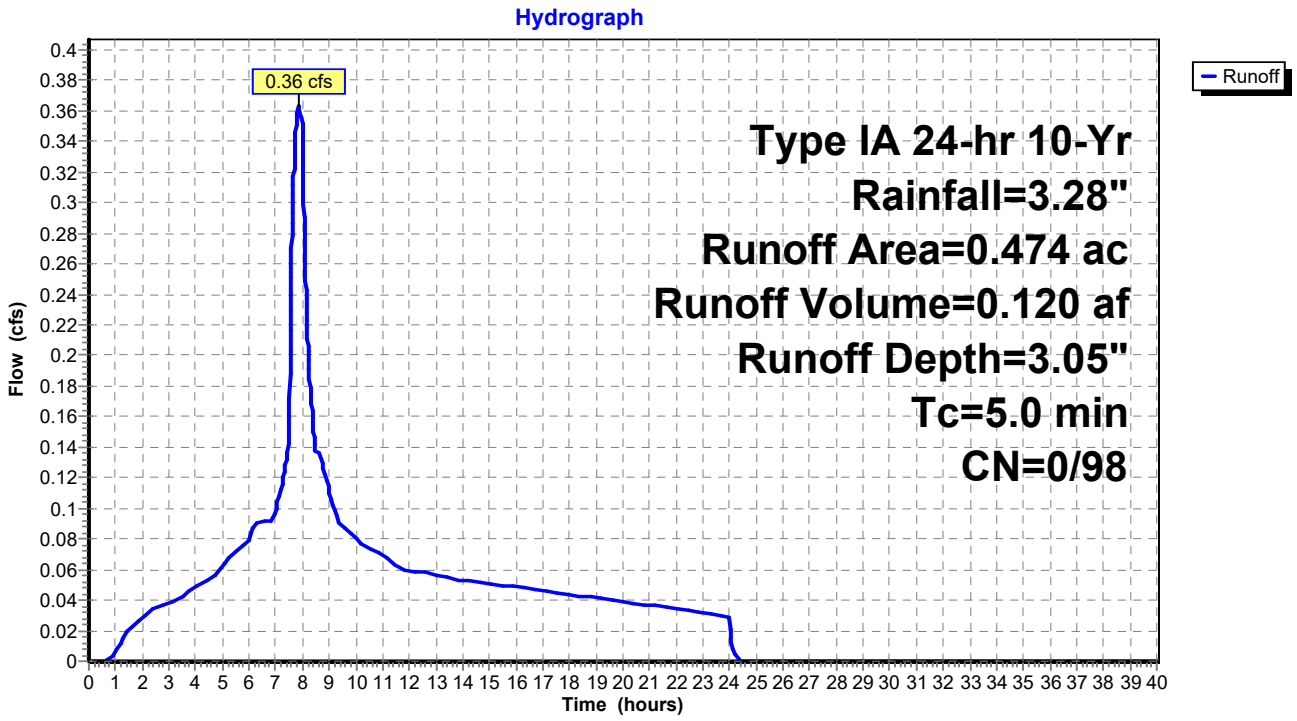
Runoff = 0.36 cfs @ 7.88 hrs, Volume= 0.120 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.474	98	
	0.474	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-1: Basin 61



Summary for Subcatchment 6-2: Basin 62

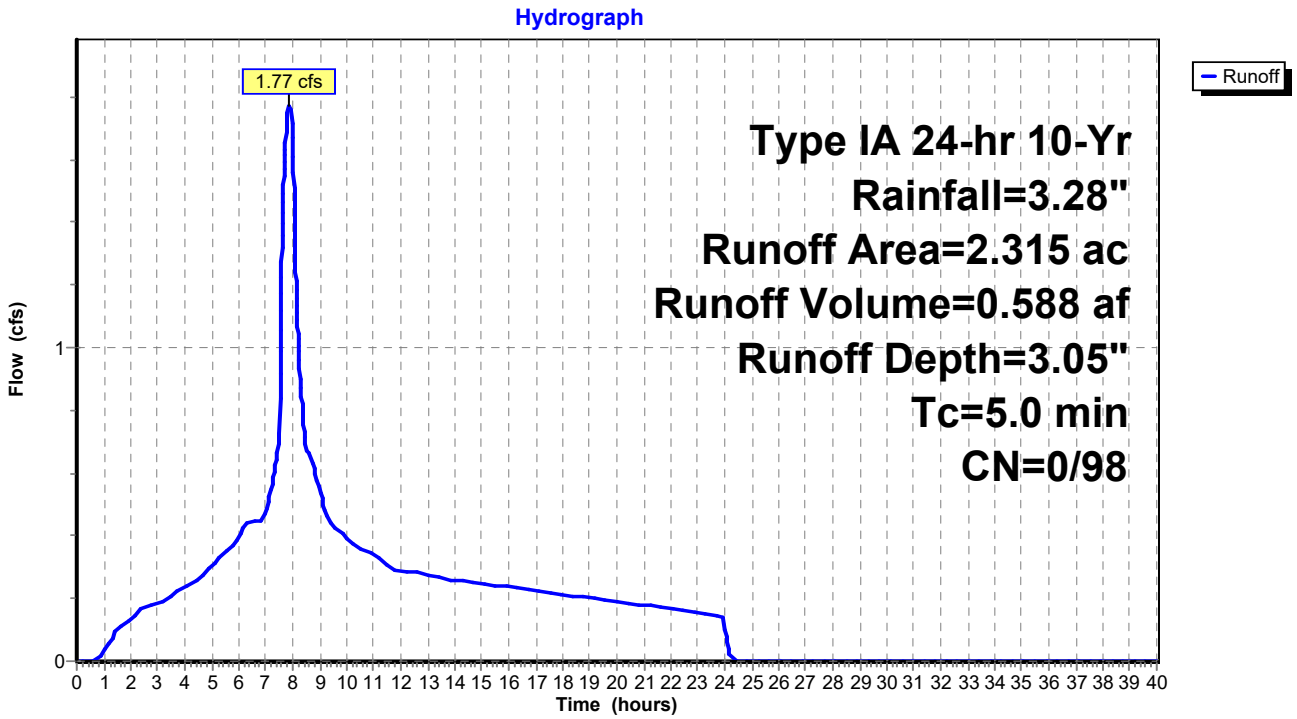
Runoff = 1.77 cfs @ 7.88 hrs, Volume= 0.588 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	2.315	98	
	2.315	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-2: Basin 62



Summary for Subcatchment 6-3: Basin 63

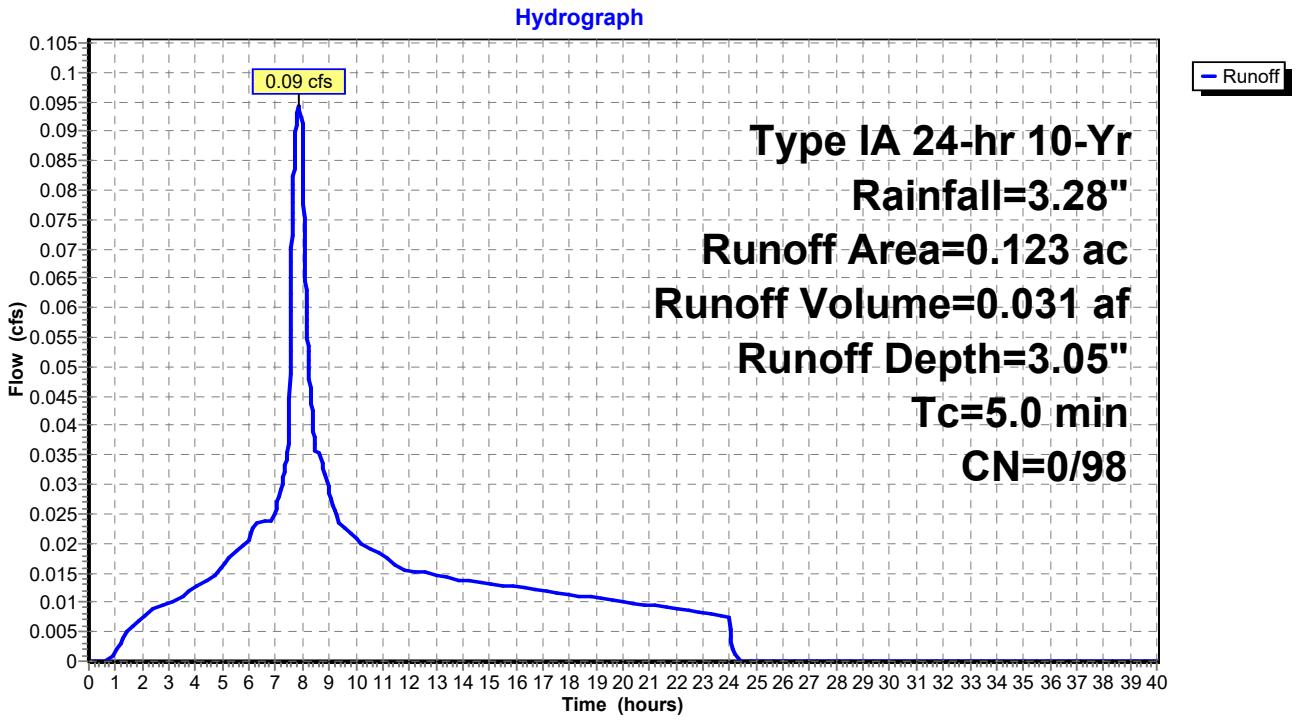
Runoff = 0.09 cfs @ 7.88 hrs, Volume= 0.031 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.123	98	
	0.123	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-3: Basin 63



Summary for Subcatchment 7: Basin 70

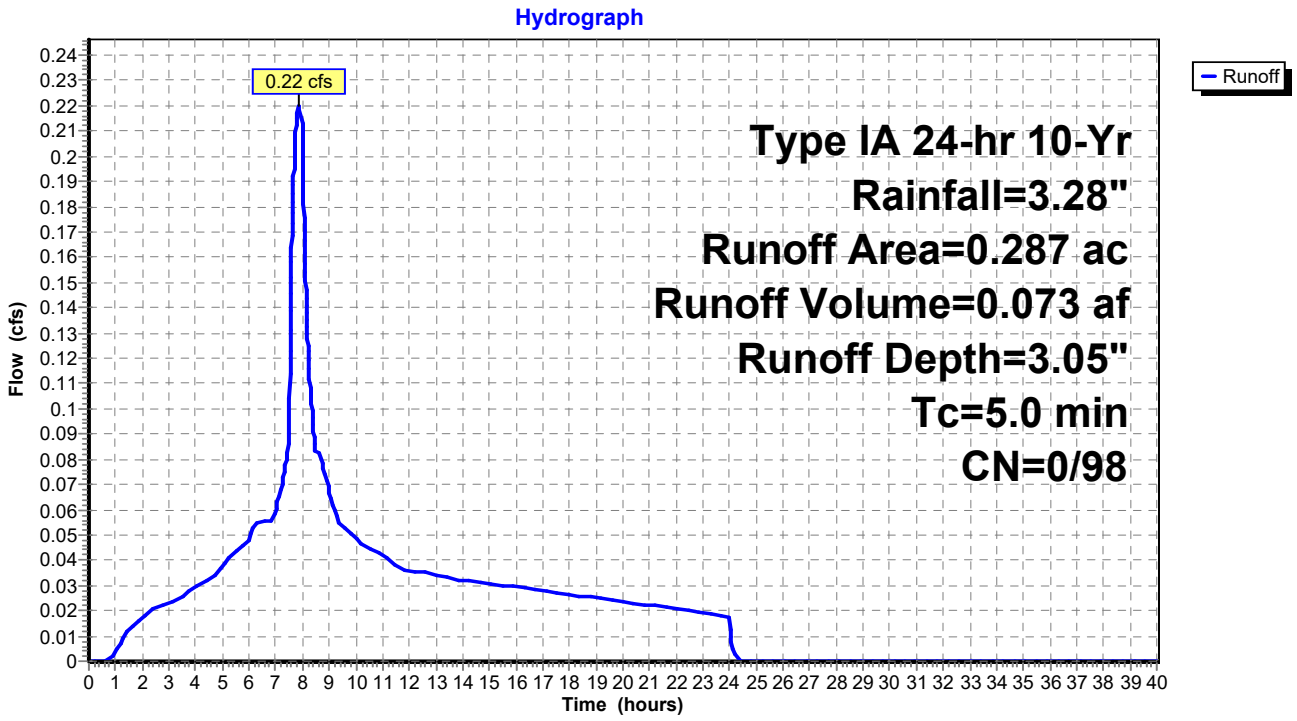
Runoff = 0.22 cfs @ 7.88 hrs, Volume= 0.073 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.287	98	
	0.287	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7: Basin 70



Summary for Subcatchment 7-1: Basin 71

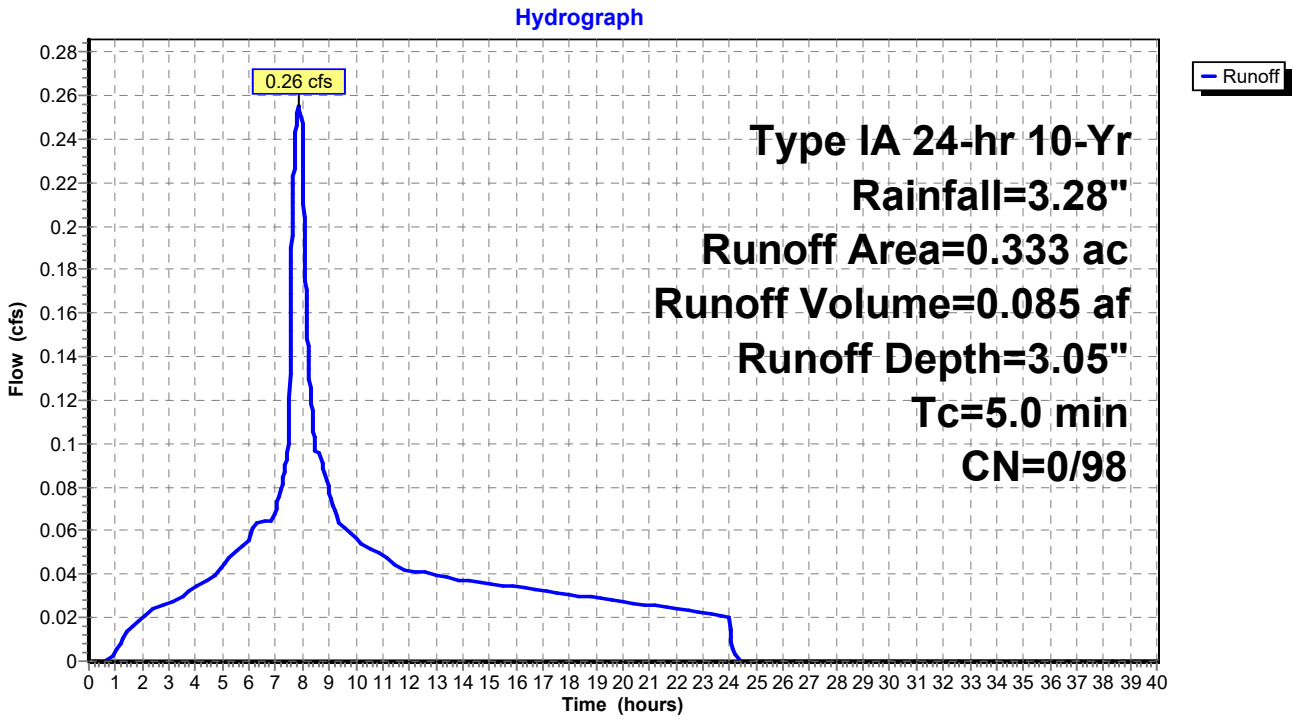
Runoff = 0.26 cfs @ 7.88 hrs, Volume= 0.085 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.333	98	
	0.333	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7-1: Basin 71



Summary for Subcatchment 7-2: Basin 72

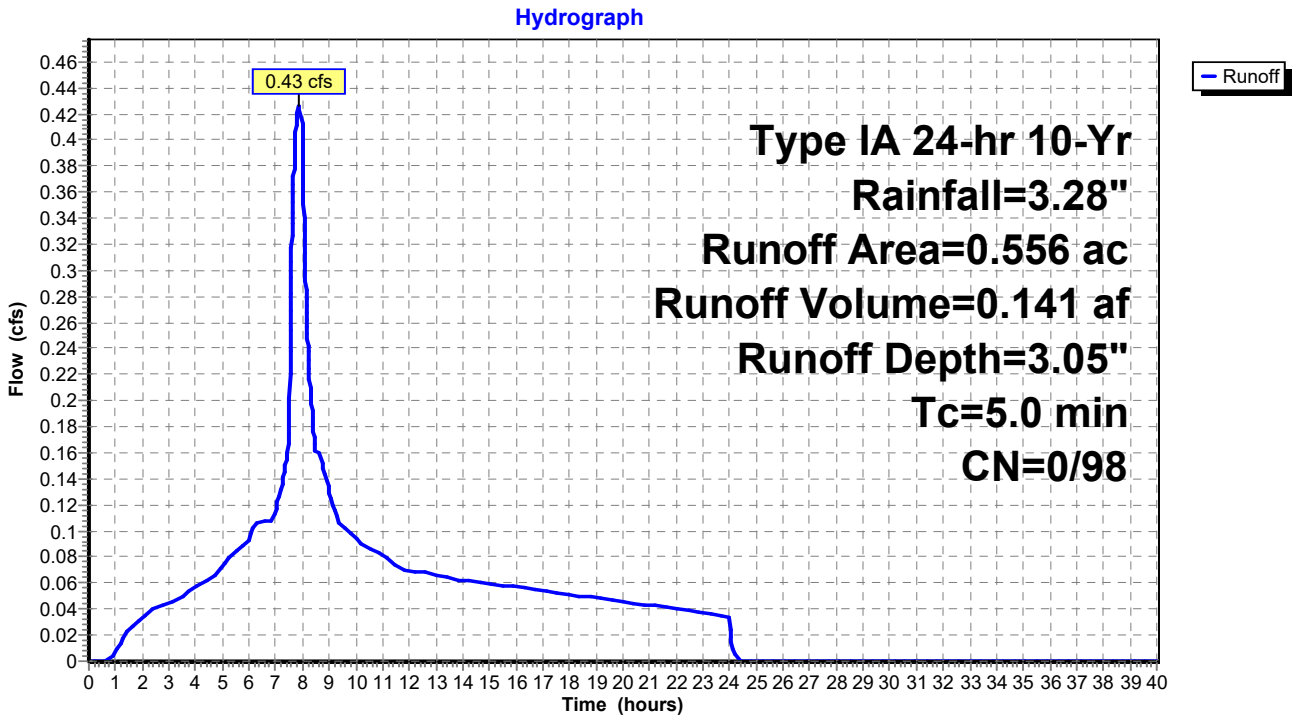
Runoff = 0.43 cfs @ 7.88 hrs, Volume= 0.141 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	0.556	98	
	0.556	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7-2: Basin 72



Summary for Subcatchment 8: Basin 8

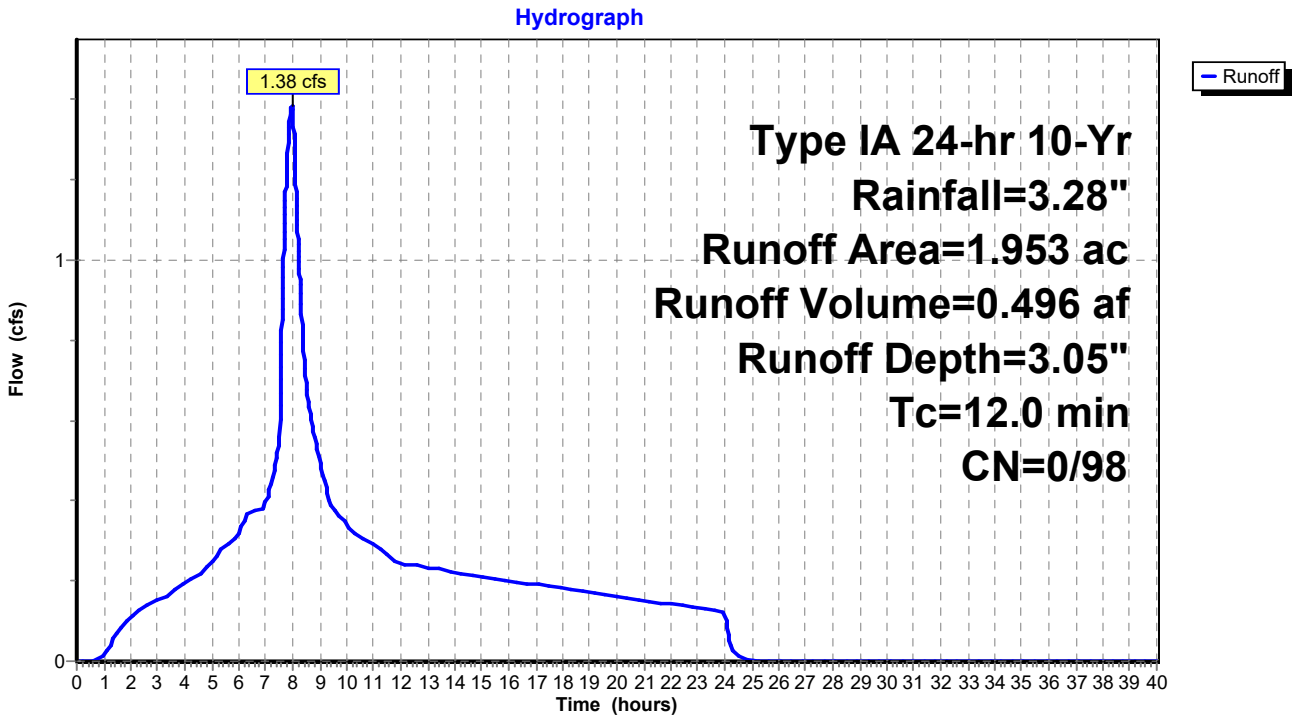
Runoff = 1.38 cfs @ 7.99 hrs, Volume= 0.496 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

	Area (ac)	CN	Description
*	1.953	98	
	1.953	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, 8C**

Subcatchment 8: Basin 8



Summary for Subcatchment 10S: Package B Pavement

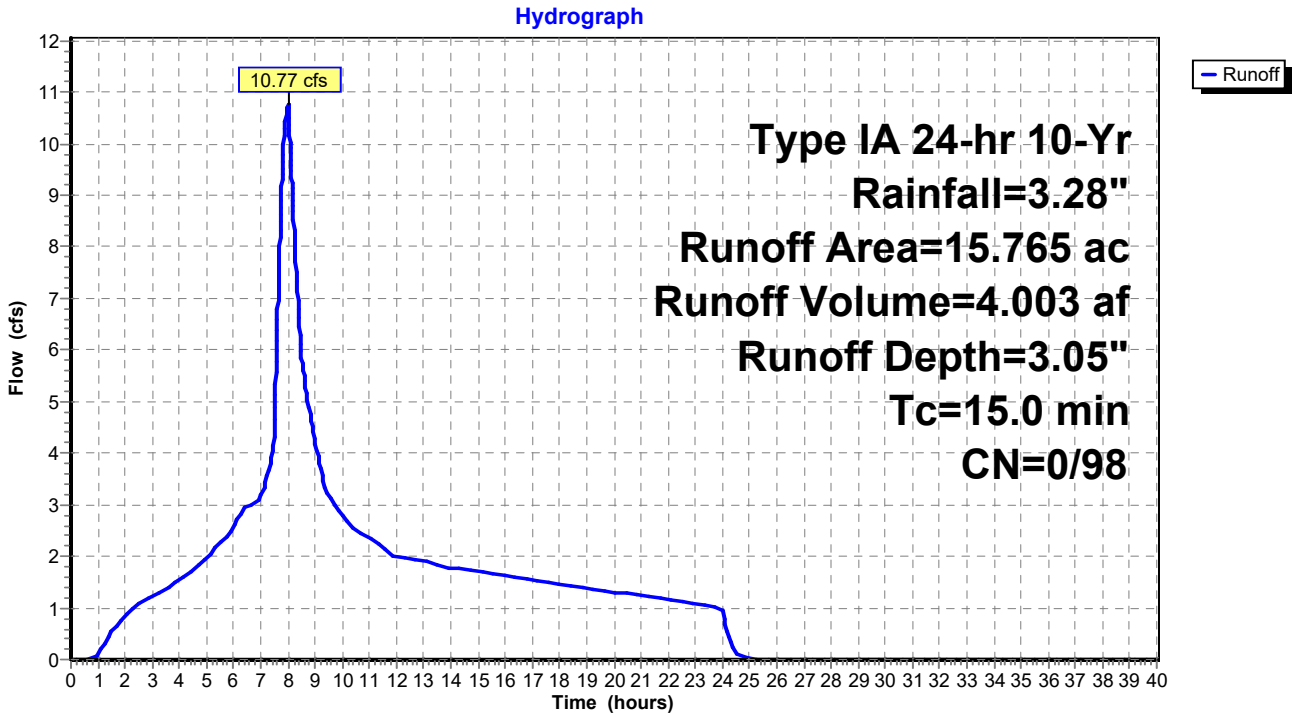
Runoff = 10.77 cfs @ 8.00 hrs, Volume= 4.003 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

Area (ac)	CN	Description
2.296	98	Paved roads w/curbs & sewers, HSG B
2.629	98	Paved roads w/curbs & sewers, HSG B
2.078	98	Paved roads w/curbs & sewers, HSG B
2.195	98	Paved roads w/curbs & sewers, HSG B
3.686	98	Paved roads w/curbs & sewers, HSG B
0.913	98	Paved roads w/curbs & sewers, HSG B
1.968	98	Paved roads w/curbs & sewers, HSG B
15.765	98	Weighted Average
15.765	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment 10S: Package B Pavement



Summary for Subcatchment A: Offsite Basin A

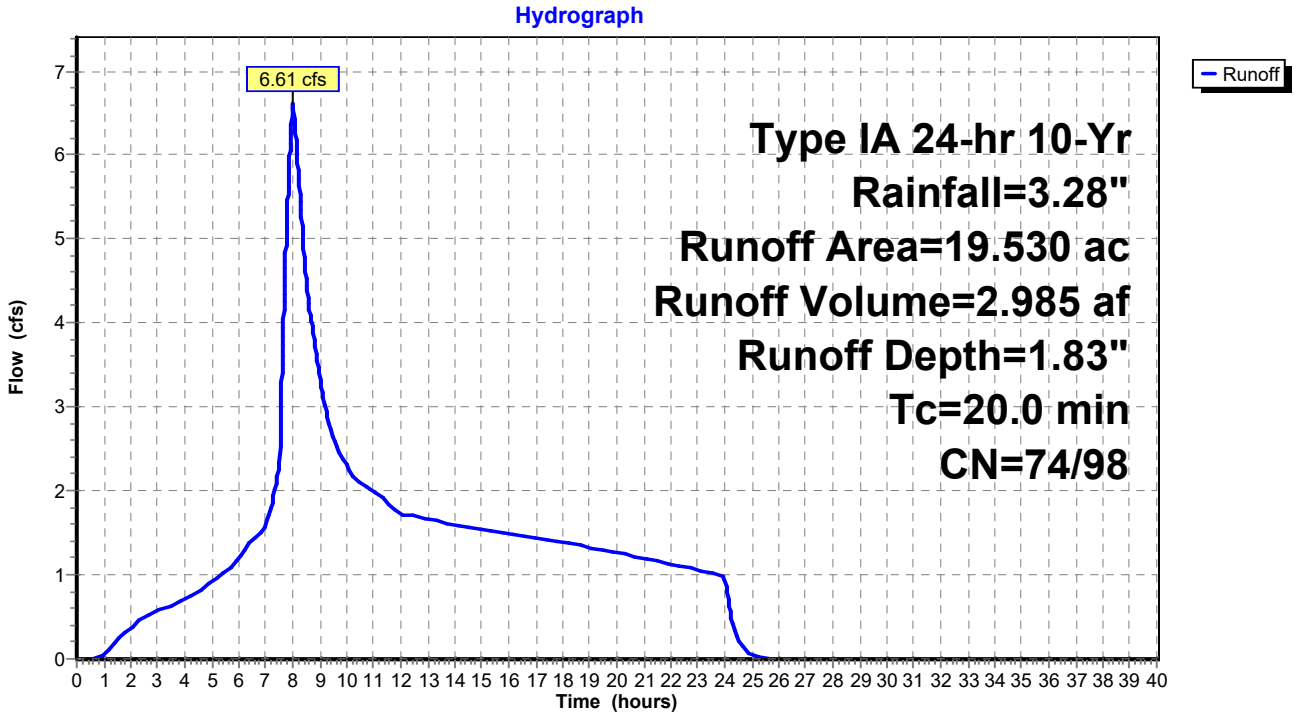
Runoff = 6.61 cfs @ 8.01 hrs, Volume= 2.985 af, Depth= 1.83"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

Area (ac)	CN	Description
19.530	83	1/4 acre lots, 38% imp, HSG C
12.109	74	62.00% Pervious Area
7.421	98	38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry, Rough estimate based on SCF formula**

Subcatchment A: Offsite Basin A



Summary for Subcatchment B: Offsite Basin B

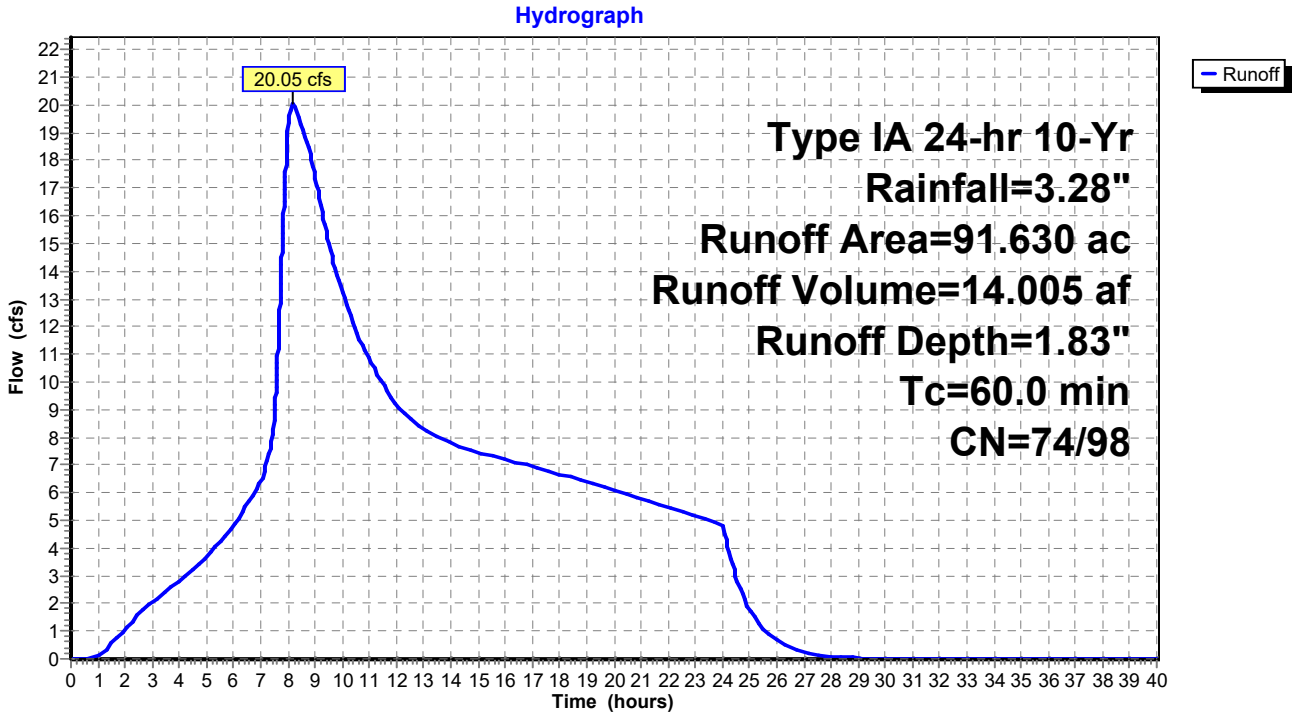
Runoff = 20.05 cfs @ 8.20 hrs, Volume= 14.005 af, Depth= 1.83"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

Area (ac)	CN	Description
91.630	83	1/4 acre lots, 38% imp, HSG C
56.811	74	62.00% Pervious Area
34.819	98	38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
60.0					**Direct Entry, Rough estimate based on SCF formula**

Subcatchment B: Offsite Basin B



Summary for Subcatchment OS-3: Basin OS 31

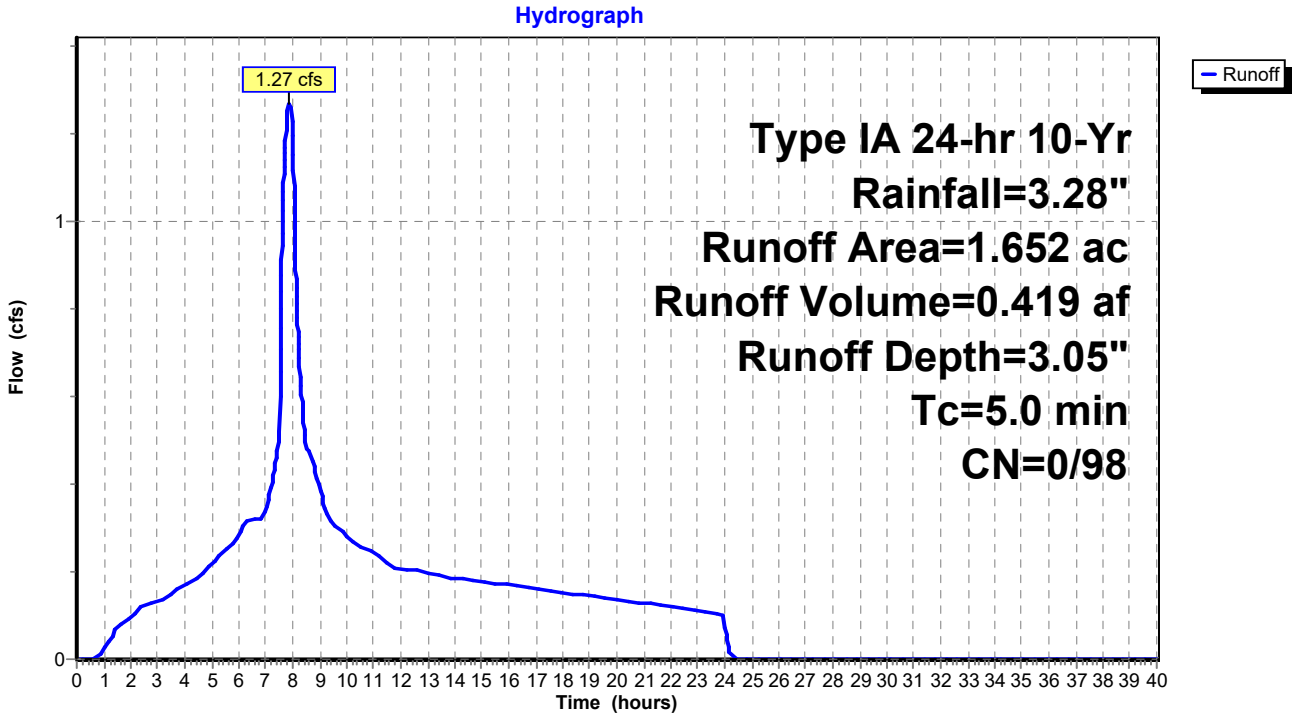
Runoff = 1.27 cfs @ 7.88 hrs, Volume= 0.419 af, Depth= 3.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-Yr Rainfall=3.28"

Area (ac)	CN	Description
1.652	98	Paved roads w/curbs & sewers, HSG B
1.652	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment OS-3: Basin OS 31



Summary for Pond 3P: (new Pond)

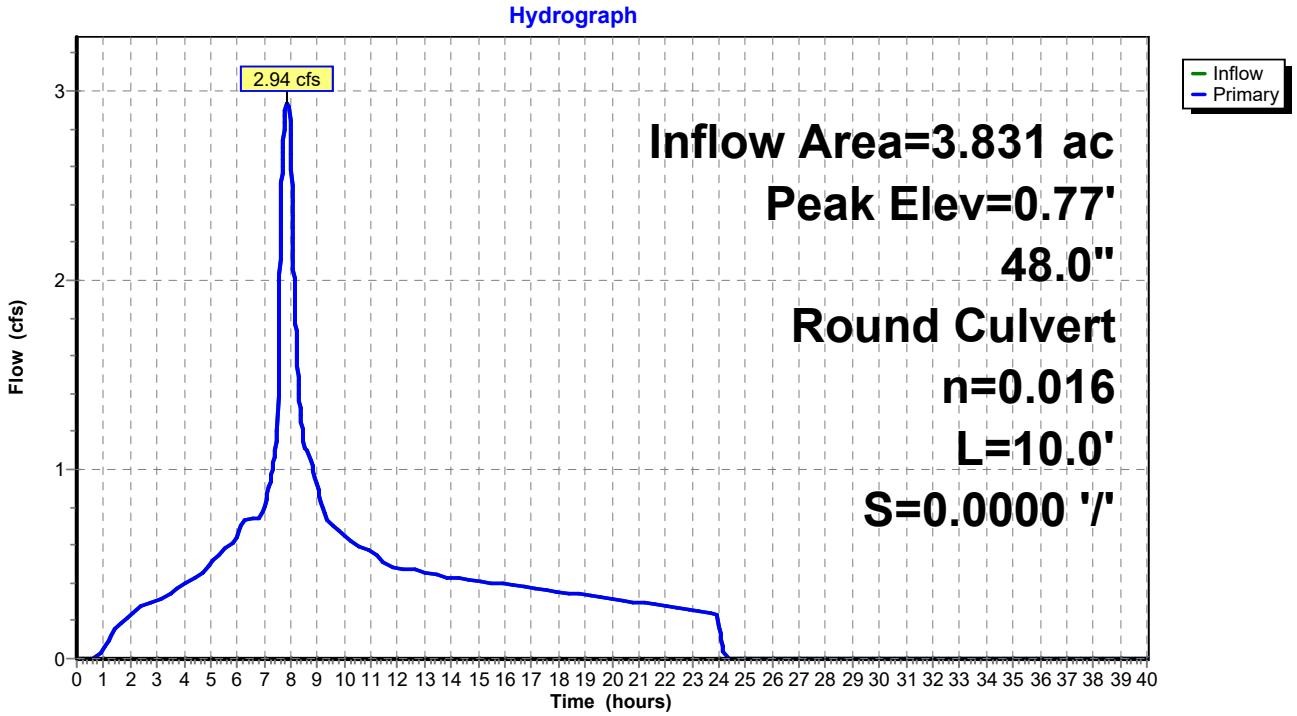
Inflow Area = 3.831 ac,100.00% Impervious, Inflow Depth = 3.05" for 10-Yr event
Inflow = 2.94 cfs @ 7.88 hrs, Volume= 0.973 af
Outflow = 2.94 cfs @ 7.88 hrs, Volume= 0.973 af, Atten= 0%, Lag= 0.0 min
Primary = 2.94 cfs @ 7.88 hrs, Volume= 0.973 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.77' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=2.93 cfs @ 7.88 hrs HW=0.77' (Free Discharge)
└**1=Culvert** (Barrel Controls 2.93 cfs @ 2.63 fps)

Pond 3P: (new Pond)



Summary for Pond 4P: (new Pond)

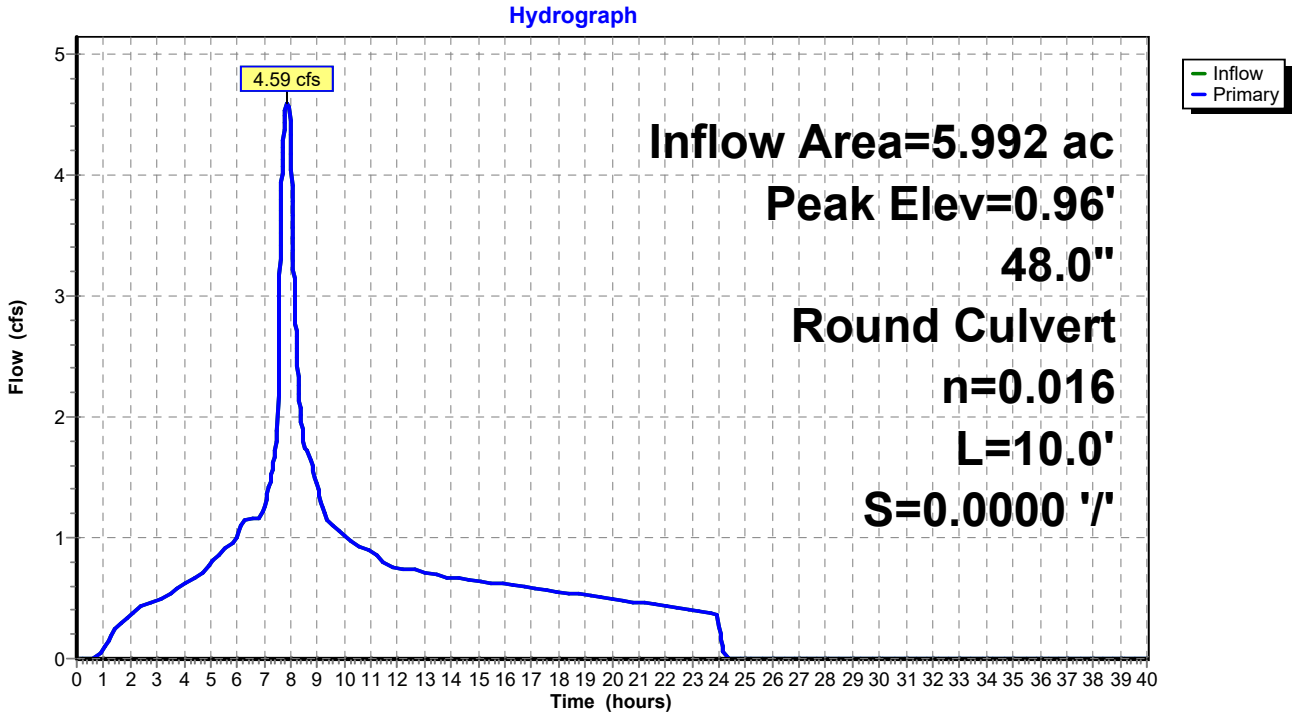
Inflow Area = 5.992 ac,100.00% Impervious, Inflow Depth = 3.05" for 10-Yr event
Inflow = 4.59 cfs @ 7.88 hrs, Volume= 1.522 af
Outflow = 4.59 cfs @ 7.88 hrs, Volume= 1.522 af, Atten= 0%, Lag= 0.0 min
Primary = 4.59 cfs @ 7.88 hrs, Volume= 1.522 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.96' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=4.59 cfs @ 7.88 hrs HW=0.96' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.59 cfs @ 2.99 fps)

Pond 4P: (new Pond)



Summary for Pond 5P: (new Pond)

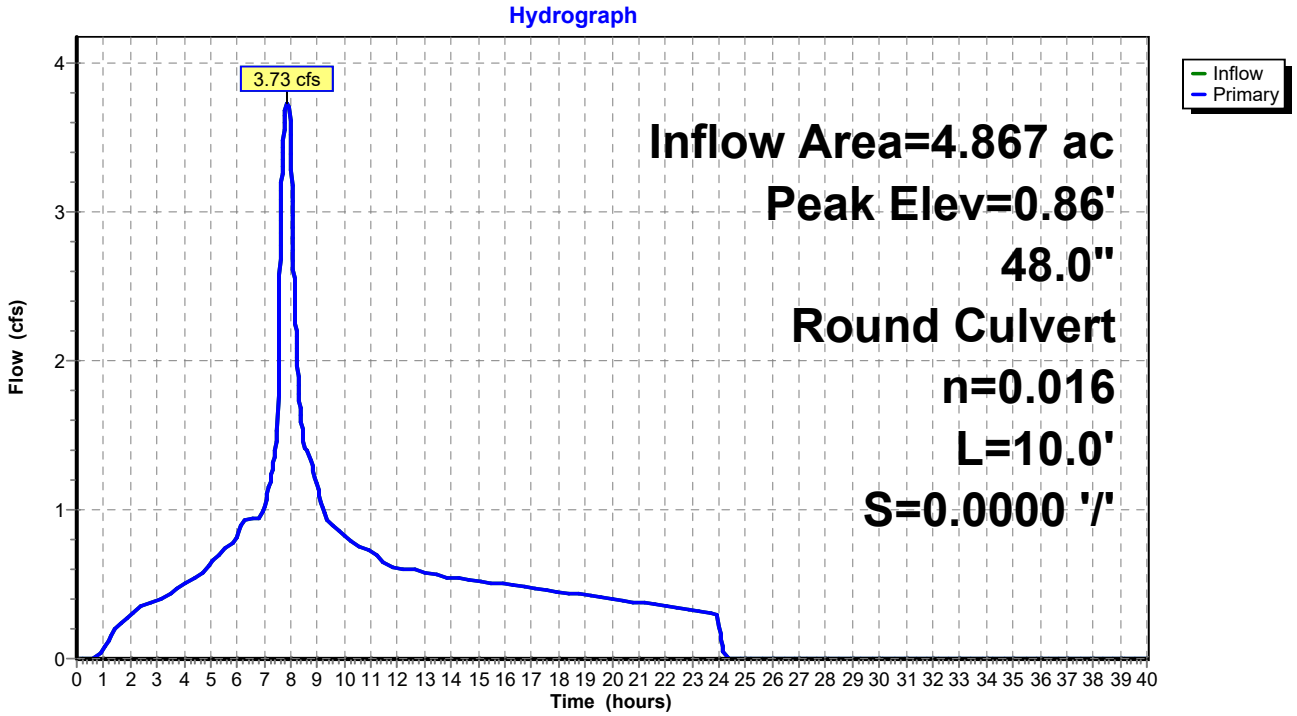
Inflow Area = 4.867 ac,100.00% Impervious, Inflow Depth = 3.05" for 10-Yr event
Inflow = 3.73 cfs @ 7.88 hrs, Volume= 1.236 af
Outflow = 3.73 cfs @ 7.88 hrs, Volume= 1.236 af, Atten= 0%, Lag= 0.0 min
Primary = 3.73 cfs @ 7.88 hrs, Volume= 1.236 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.86' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=3.73 cfs @ 7.88 hrs HW=0.86' (Free Discharge)
└**1=Culvert** (Barrel Controls 3.73 cfs @ 2.82 fps)

Pond 5P: (new Pond)



Summary for Pond 6P: (new Pond)

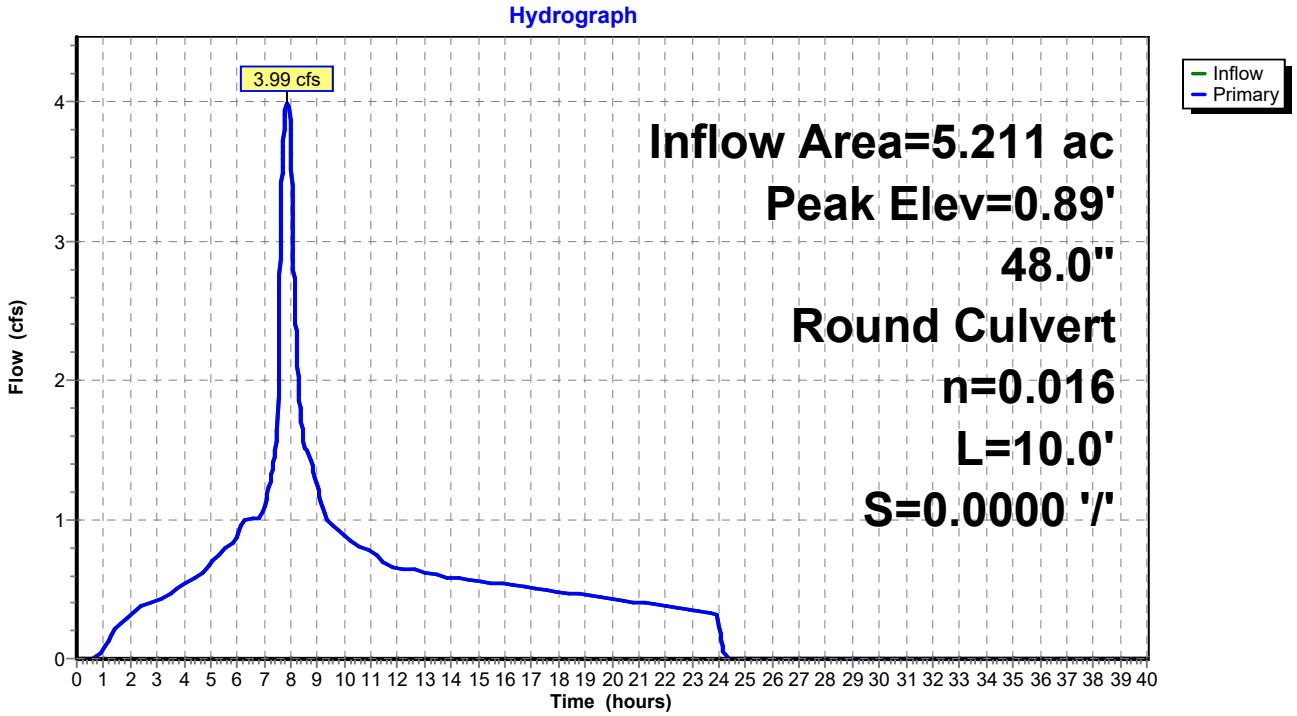
Inflow Area = 5.211 ac,100.00% Impervious, Inflow Depth = 3.05" for 10-Yr event
Inflow = 3.99 cfs @ 7.88 hrs, Volume= 1.323 af
Outflow = 3.99 cfs @ 7.88 hrs, Volume= 1.323 af, Atten= 0%, Lag= 0.0 min
Primary = 3.99 cfs @ 7.88 hrs, Volume= 1.323 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.89' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=3.99 cfs @ 7.88 hrs HW=0.89' (Free Discharge)
└**1=Culvert** (Barrel Controls 3.99 cfs @ 2.87 fps)

Pond 6P: (new Pond)



Summary for Pond 7P: (new Pond)

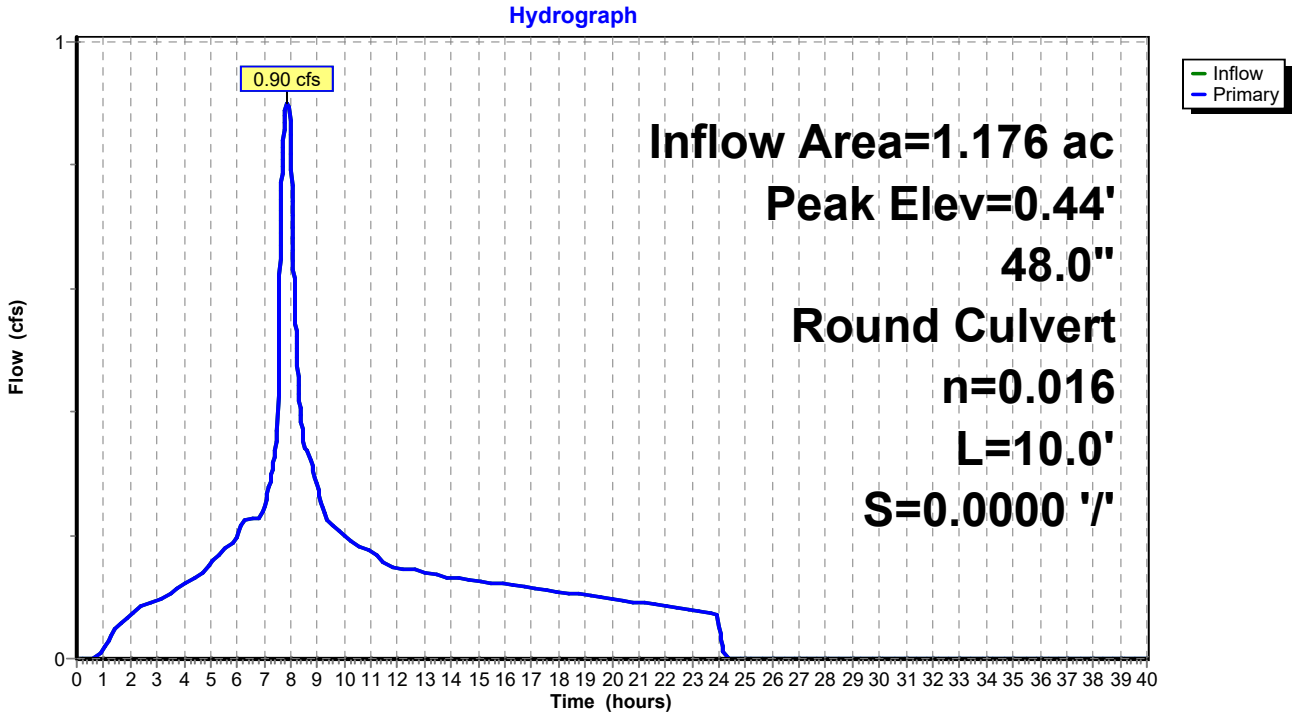
Inflow Area = 1.176 ac,100.00% Impervious, Inflow Depth = 3.05" for 10-Yr event
Inflow = 0.90 cfs @ 7.88 hrs, Volume= 0.299 af
Outflow = 0.90 cfs @ 7.88 hrs, Volume= 0.299 af, Atten= 0%, Lag= 0.0 min
Primary = 0.90 cfs @ 7.88 hrs, Volume= 0.299 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.44' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=0.90 cfs @ 7.88 hrs HW=0.44' (Free Discharge)
└─**1=Culvert** (Barrel Controls 0.90 cfs @ 1.84 fps)

Pond 7P: (new Pond)



Summary for Pond 10P: Offsite Flows

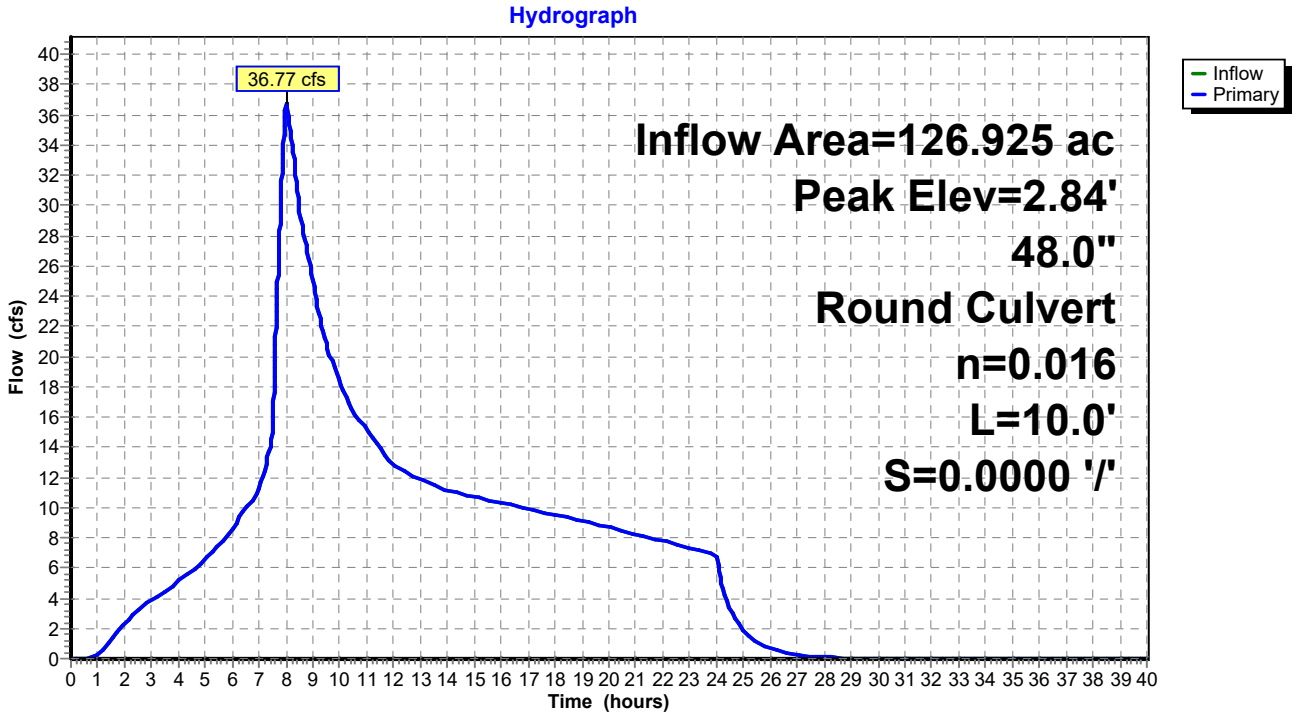
Inflow Area = 126.925 ac, 45.70% Impervious, Inflow Depth = 1.98" for 10-Yr event
Inflow = 36.77 cfs @ 8.01 hrs, Volume= 20.993 af
Outflow = 36.77 cfs @ 8.01 hrs, Volume= 20.993 af, Atten= 0%, Lag= 0.0 min
Primary = 36.77 cfs @ 8.01 hrs, Volume= 20.993 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 2.84' @ 8.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=36.77 cfs @ 8.01 hrs HW=2.84' (Free Discharge)
└**1=Culvert** (Barrel Controls 36.77 cfs @ 5.40 fps)

Pond 10P: Offsite Flows



Time span=0.00-40.00 hrs, dt=0.01 hrs, 4001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2: Basin 20 Runoff Area=3.080 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=2.76 cfs 0.920 af

Subcatchment3: Basin 30 Runoff Area=2.179 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=1.95 cfs 0.651 af

Subcatchment4: Basin 40 Runoff Area=0.396 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.36 cfs 0.118 af

Subcatchment4-1: Basin 41 Runoff Area=4.560 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=4.09 cfs 1.363 af

Subcatchment4-2: Basin 42 Runoff Area=0.698 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.63 cfs 0.209 af

Subcatchment4-3: Basin 43 Runoff Area=0.338 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.30 cfs 0.101 af

Subcatchment5: Basin 50 Runoff Area=0.719 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.64 cfs 0.215 af

Subcatchment5-1: Basin 51 Runoff Area=0.578 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.52 cfs 0.173 af

Subcatchment5-2: Basin 52 Runoff Area=3.570 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=3.20 cfs 1.067 af

Subcatchment6: Basin 60 Runoff Area=2.299 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=2.06 cfs 0.687 af

Subcatchment6-1: Basin 61 Runoff Area=0.474 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.43 cfs 0.142 af

Subcatchment6-2: Basin 62 Runoff Area=2.315 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=2.08 cfs 0.692 af

Subcatchment6-3: Basin 63 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.11 cfs 0.037 af

Subcatchment7: Basin 70 Runoff Area=0.287 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.26 cfs 0.086 af

Subcatchment7-1: Basin 71 Runoff Area=0.333 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.30 cfs 0.099 af

Subcatchment7-2: Basin 72 Runoff Area=0.556 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=0.50 cfs 0.166 af

Subcatchment8: Basin 8 Runoff Area=1.953 ac 100.00% Impervious Runoff Depth=3.59"
Tc=12.0 min CN=0/98 Runoff=1.62 cfs 0.584 af

Subcatchment10S: Package B Pavement Runoff Area=15.765 ac 100.00% Impervious Runoff Depth=3.59"
Tc=15.0 min CN=0/98 Runoff=12.60 cfs 4.711 af

SubcatchmentA: Offsite Basin A Runoff Area=19.530 ac 38.00% Impervious Runoff Depth=2.27"
Tc=20.0 min CN=74/98 Runoff=8.38 cfs 3.696 af

SubcatchmentB: Offsite Basin B Runoff Area=91.630 ac 38.00% Impervious Runoff Depth=2.27"
Tc=60.0 min CN=74/98 Runoff=25.41 cfs 17.342 af

SubcatchmentOS-3: Basin OS 31 Runoff Area=1.652 ac 100.00% Impervious Runoff Depth=3.59"
Tc=5.0 min CN=0/98 Runoff=1.48 cfs 0.494 af

Pond 3P: (new Pond) Peak Elev=0.83' Inflow=3.44 cfs 1.145 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=3.44 cfs 1.145 af

Pond 4P: (new Pond) Peak Elev=1.04' Inflow=5.38 cfs 1.790 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=5.38 cfs 1.790 af

Pond 5P: (new Pond) Peak Elev=0.93' Inflow=4.37 cfs 1.454 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=4.37 cfs 1.454 af

Pond 6P: (new Pond) Peak Elev=0.97' Inflow=4.67 cfs 1.557 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=4.67 cfs 1.557 af

Pond 7P: (new Pond) Peak Elev=0.47' Inflow=1.05 cfs 0.351 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=1.05 cfs 0.351 af

Pond 10P: Offsite Flows Peak Elev=3.22' Inflow=45.61 cfs 25.749 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=45.61 cfs 25.749 af

Summary for Subcatchment 2: Basin 20

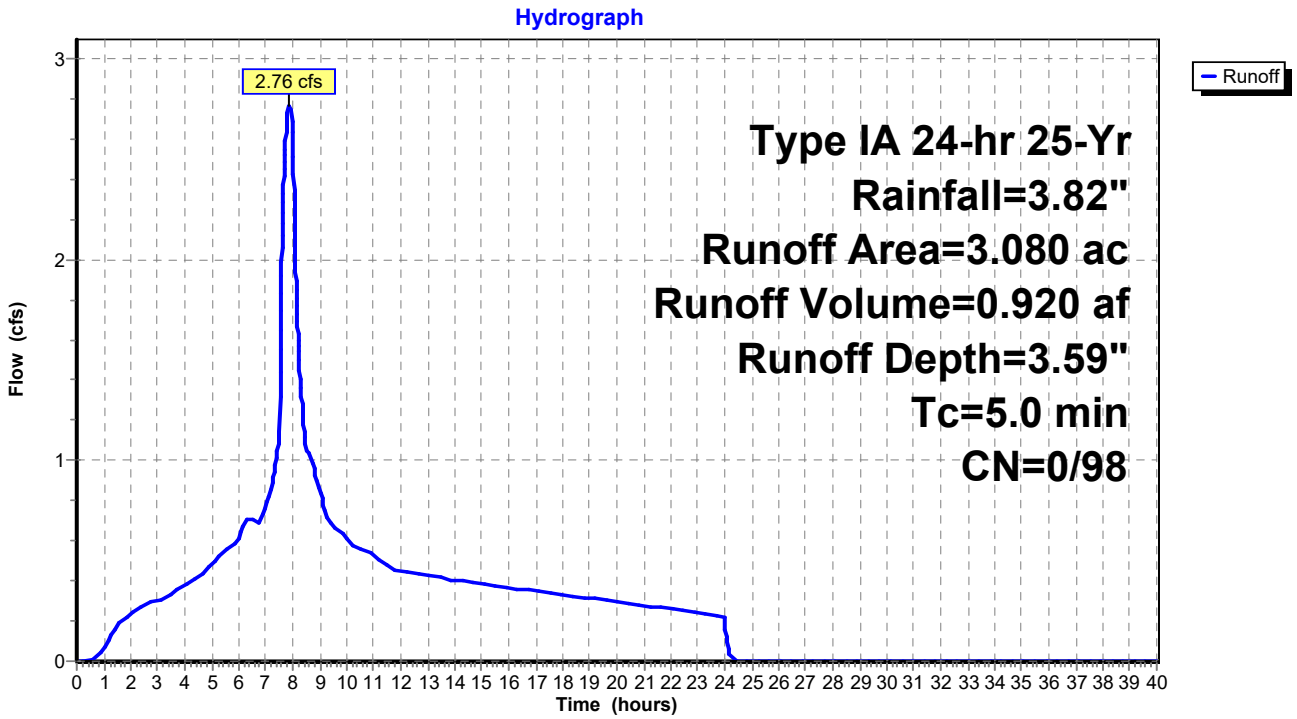
Runoff = 2.76 cfs @ 7.88 hrs, Volume= 0.920 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	3.080	98	
	3.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Basin 20



Summary for Subcatchment 3: Basin 30

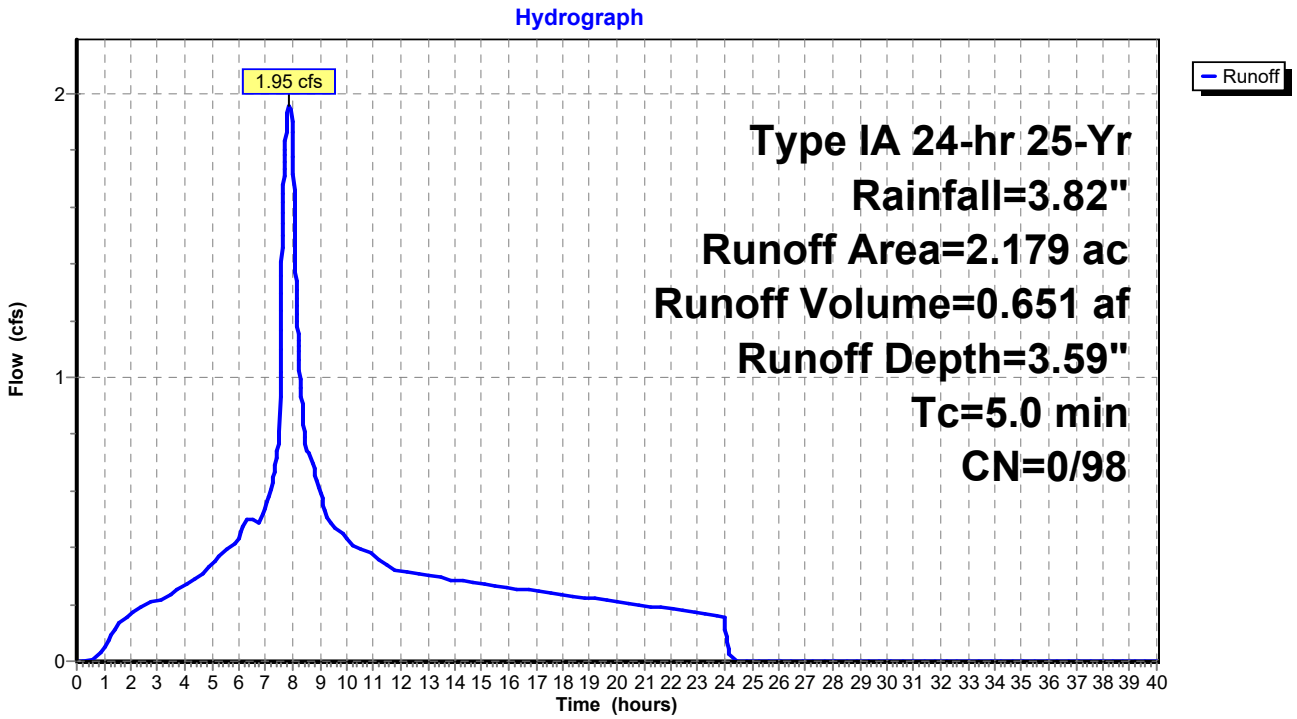
Runoff = 1.95 cfs @ 7.88 hrs, Volume= 0.651 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	2.179	98	
	2.179	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Basin 30



Summary for Subcatchment 4: Basin 40

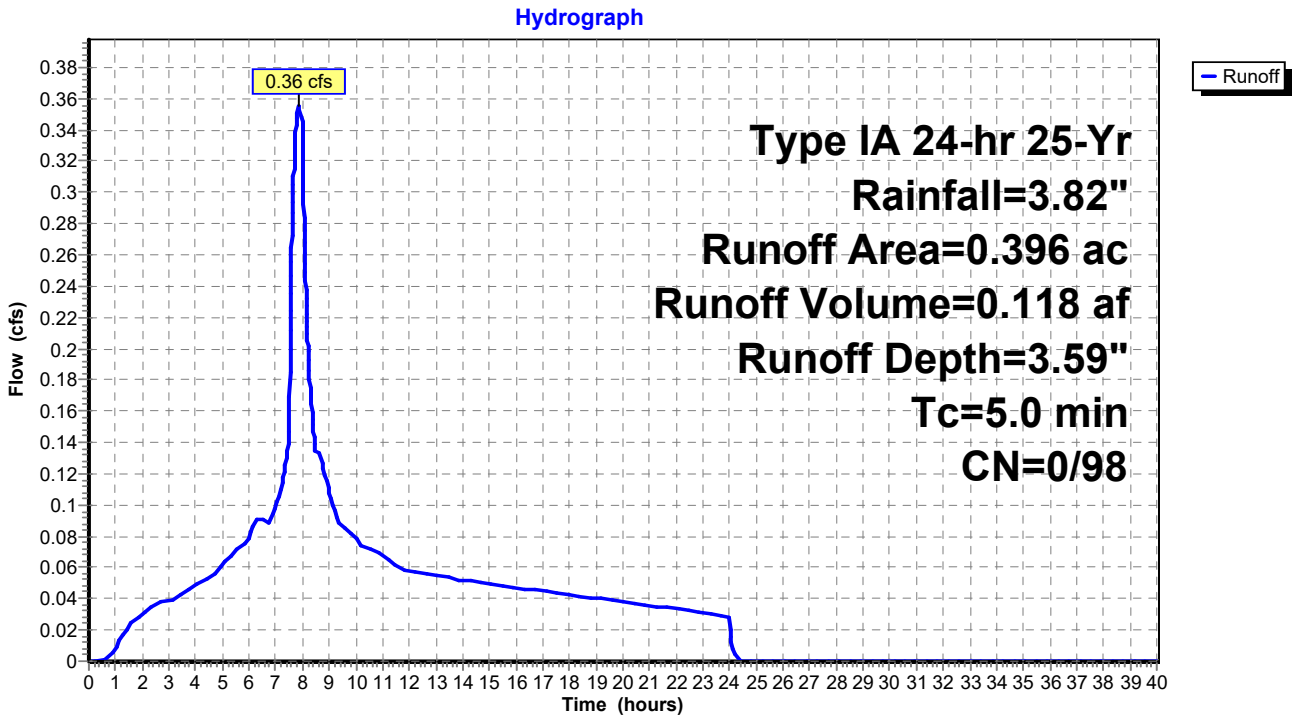
Runoff = 0.36 cfs @ 7.88 hrs, Volume= 0.118 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.396	98	
	0.396	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: Basin 40



Summary for Subcatchment 4-1: Basin 41

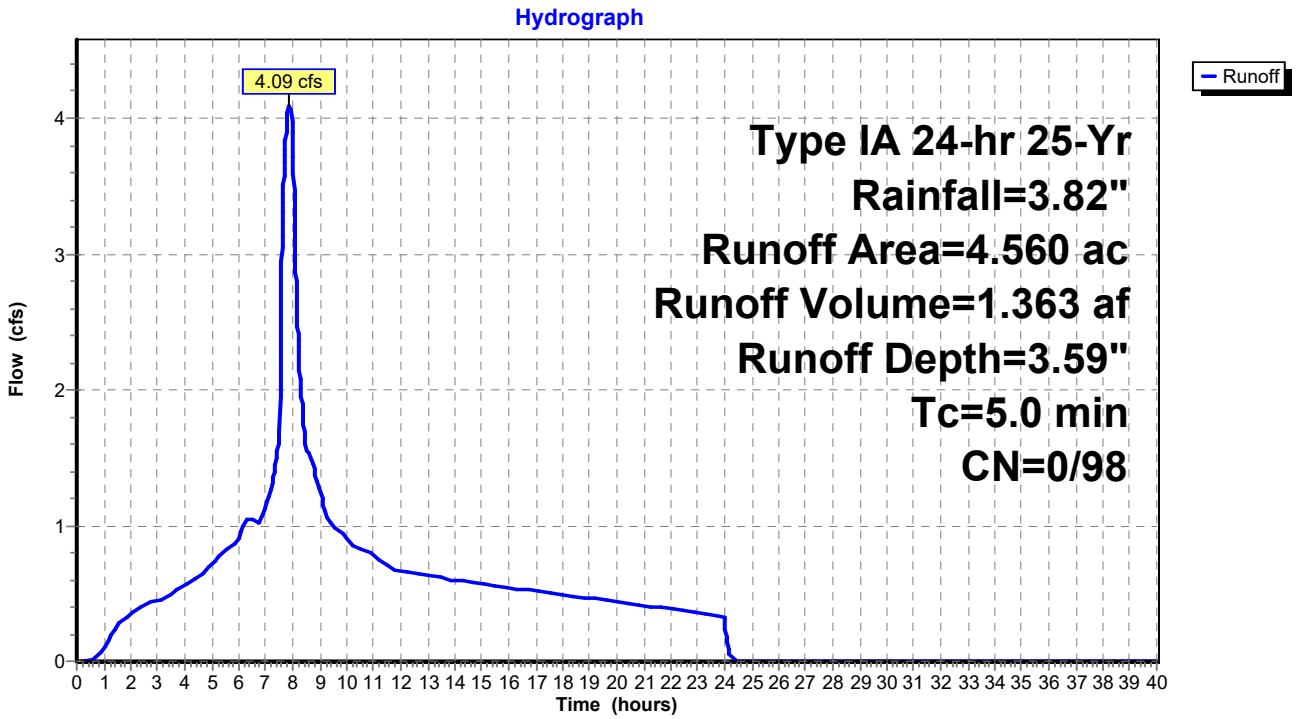
Runoff = 4.09 cfs @ 7.88 hrs, Volume= 1.363 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	4.560	98	
	4.560	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-1: Basin 41



Summary for Subcatchment 4-2: Basin 42

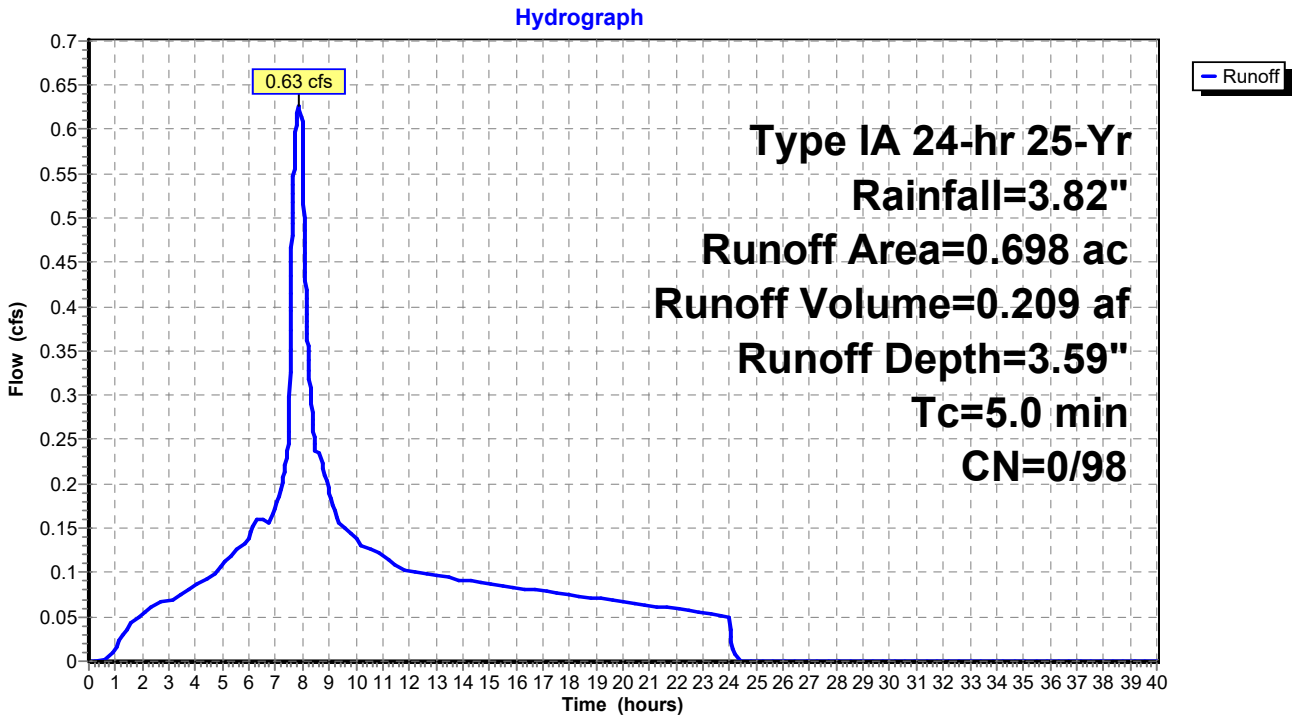
Runoff = 0.63 cfs @ 7.88 hrs, Volume= 0.209 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.698	98	
	0.698	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-2: Basin 42



Summary for Subcatchment 4-3: Basin 43

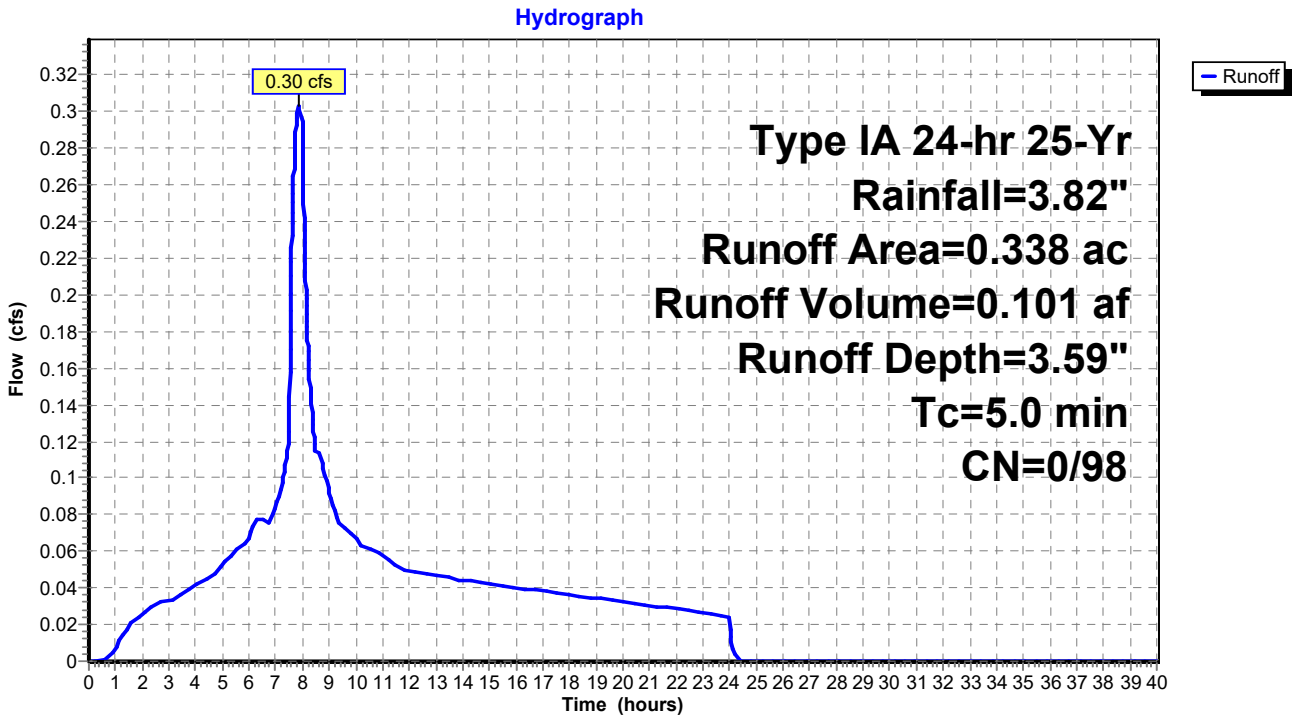
Runoff = 0.30 cfs @ 7.88 hrs, Volume= 0.101 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.338	98	
	0.338	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-3: Basin 43



Summary for Subcatchment 5: Basin 50

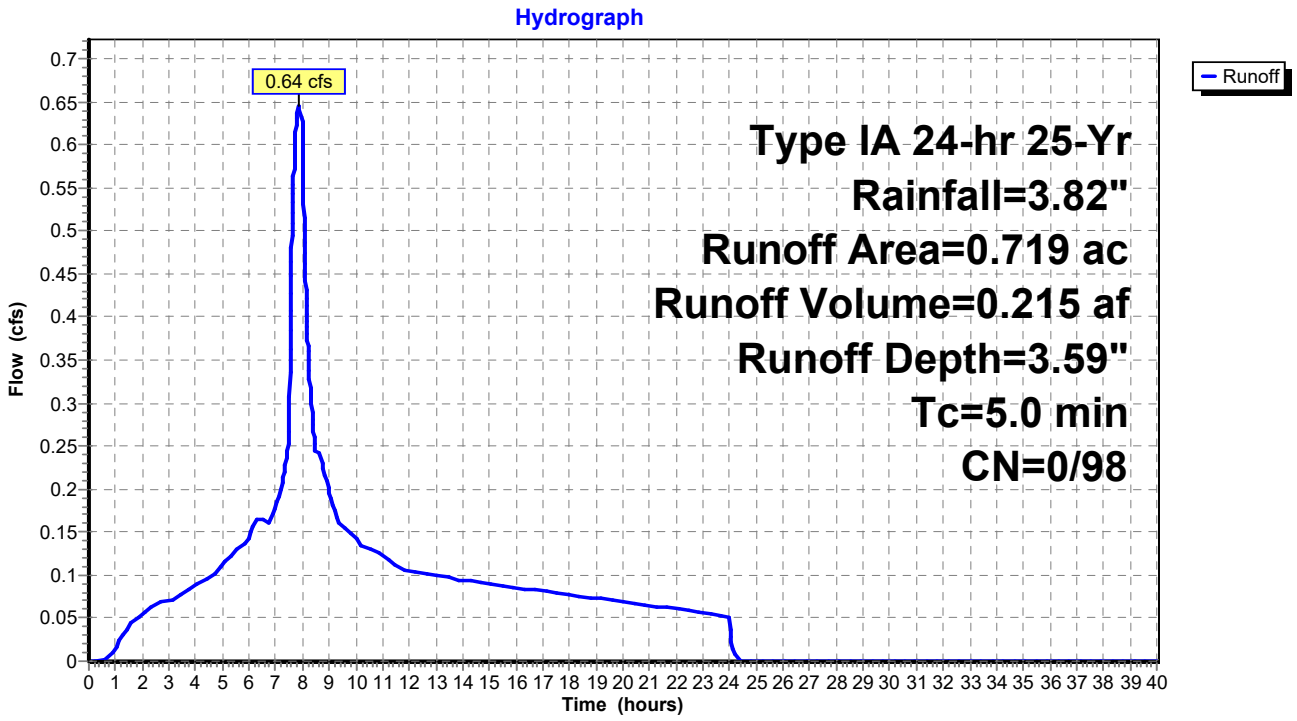
Runoff = 0.64 cfs @ 7.88 hrs, Volume= 0.215 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.719	98	
	0.719	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: Basin 50



Summary for Subcatchment 5-1: Basin 51

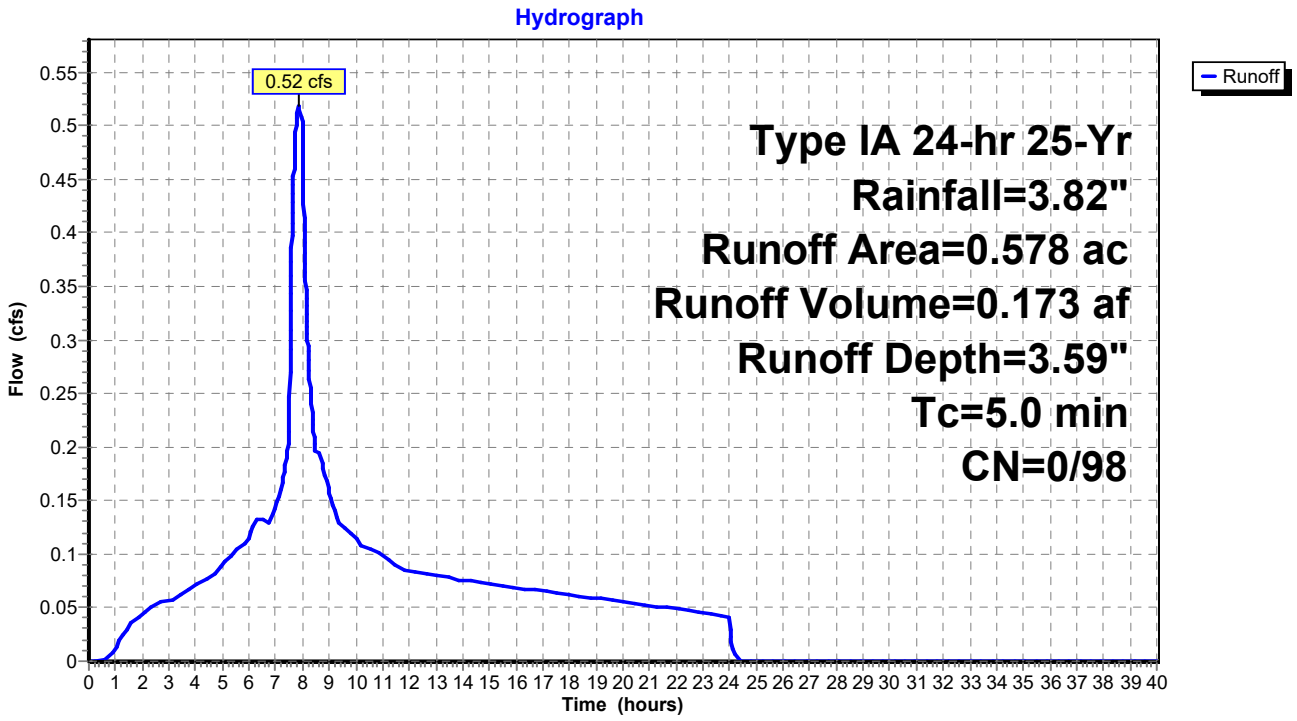
Runoff = 0.52 cfs @ 7.88 hrs, Volume= 0.173 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.578	98	
	0.578	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5-1: Basin 51



Summary for Subcatchment 5-2: Basin 52

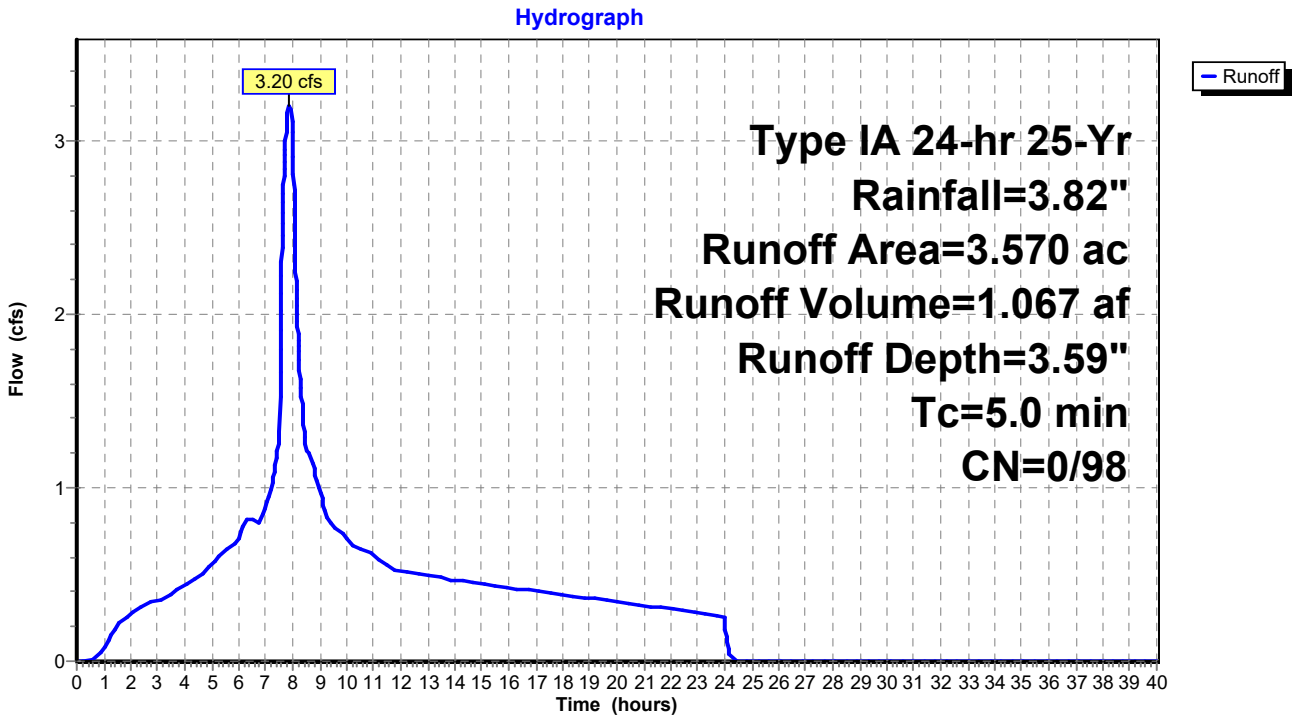
Runoff = 3.20 cfs @ 7.88 hrs, Volume= 1.067 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	3.570	98	
	3.570	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5-2: Basin 52



Summary for Subcatchment 6: Basin 60

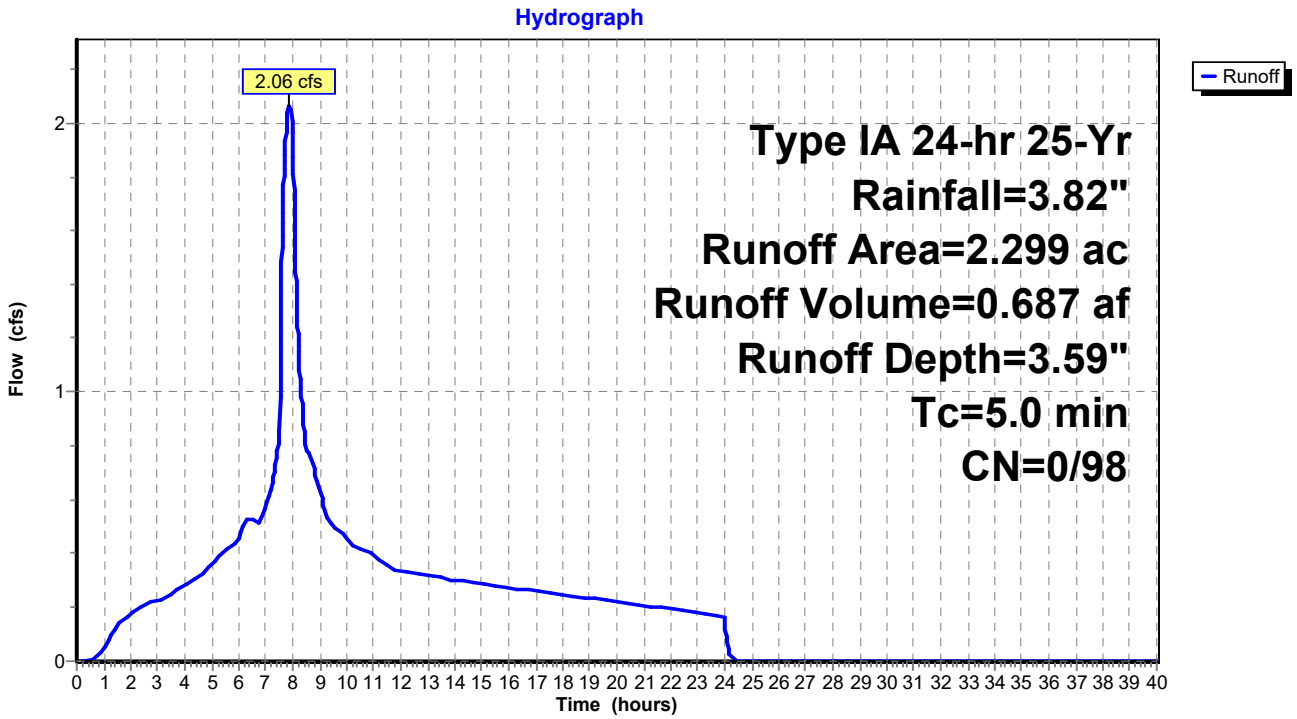
Runoff = 2.06 cfs @ 7.88 hrs, Volume= 0.687 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	2.299	98	
	2.299	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6: Basin 60



Summary for Subcatchment 6-1: Basin 61

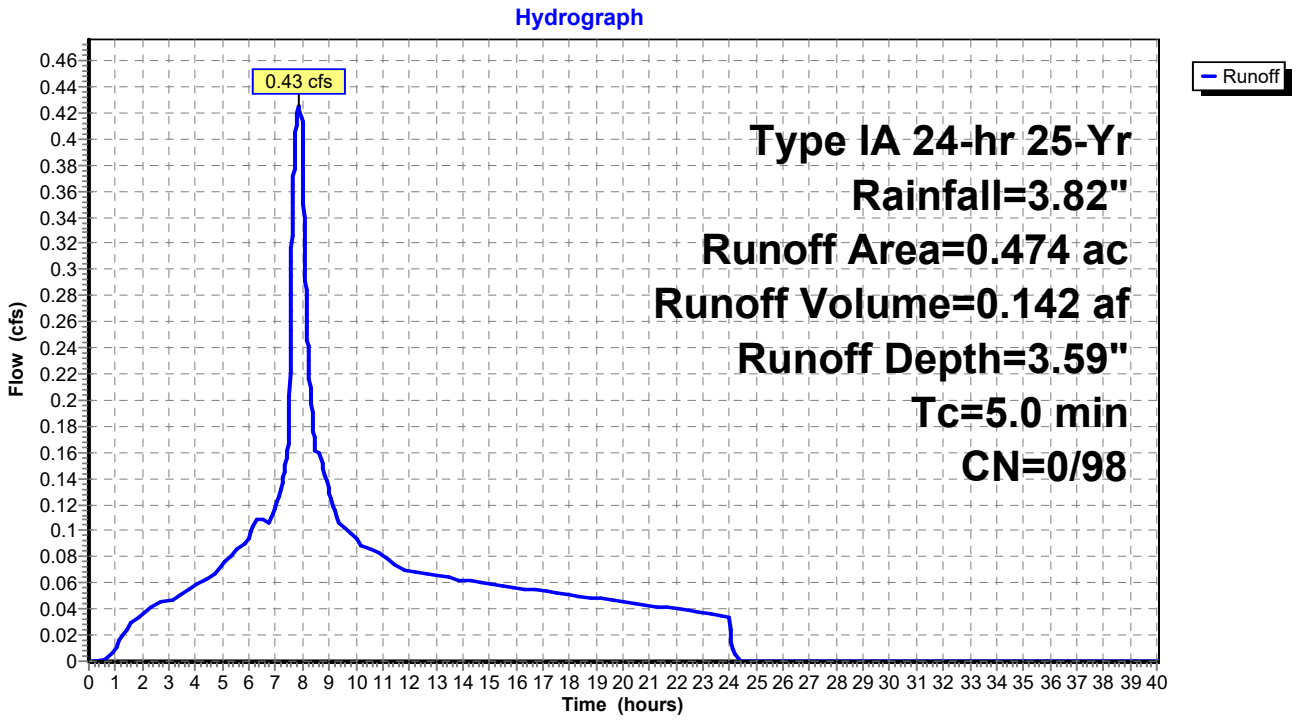
Runoff = 0.43 cfs @ 7.88 hrs, Volume= 0.142 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.474	98	
	0.474	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-1: Basin 61



Summary for Subcatchment 6-2: Basin 62

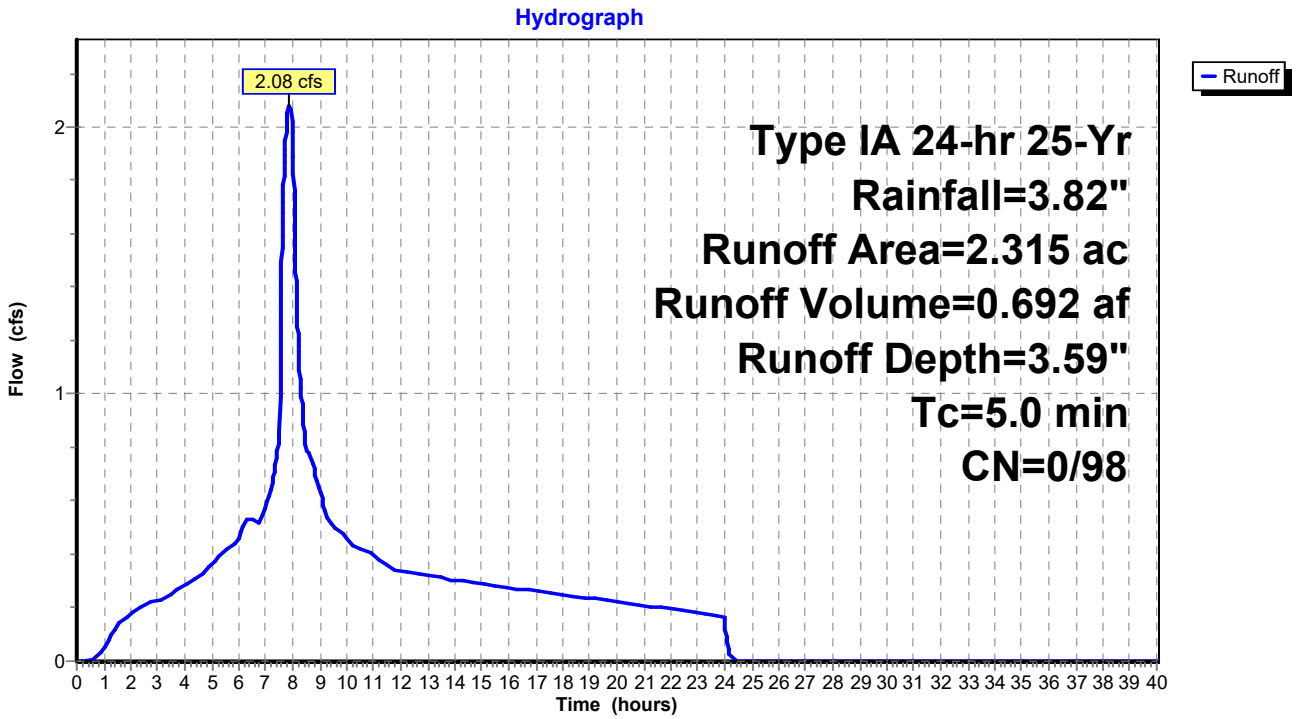
Runoff = 2.08 cfs @ 7.88 hrs, Volume= 0.692 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	2.315	98	
	2.315	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-2: Basin 62



Summary for Subcatchment 6-3: Basin 63

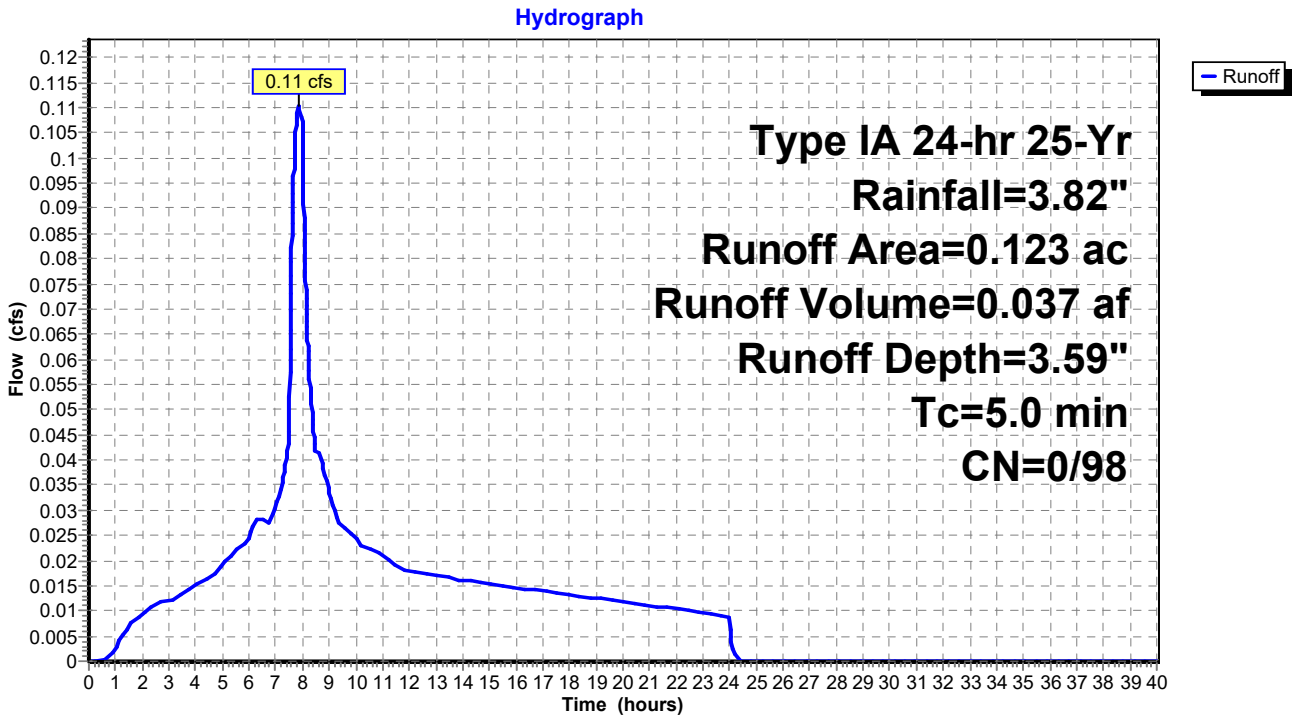
Runoff = 0.11 cfs @ 7.88 hrs, Volume= 0.037 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.123	98	
	0.123	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-3: Basin 63



Summary for Subcatchment 7: Basin 70

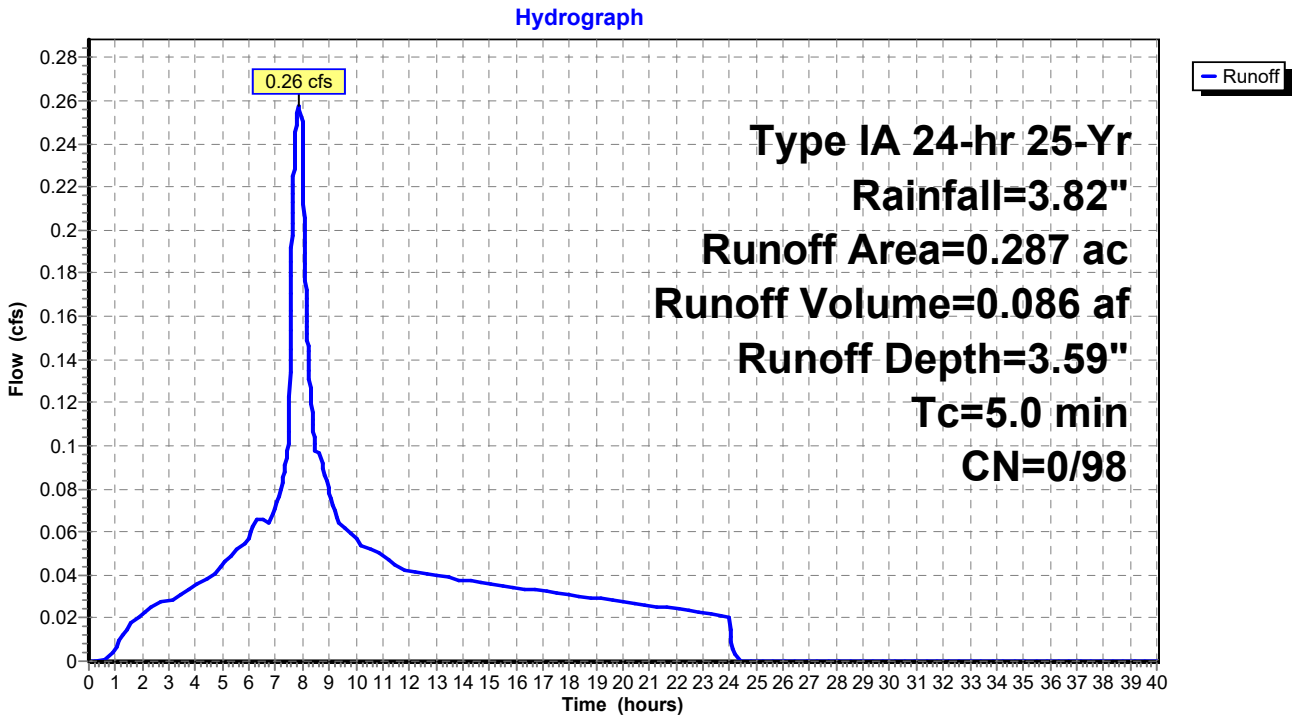
Runoff = 0.26 cfs @ 7.88 hrs, Volume= 0.086 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.287	98	
	0.287	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7: Basin 70



Summary for Subcatchment 7-1: Basin 71

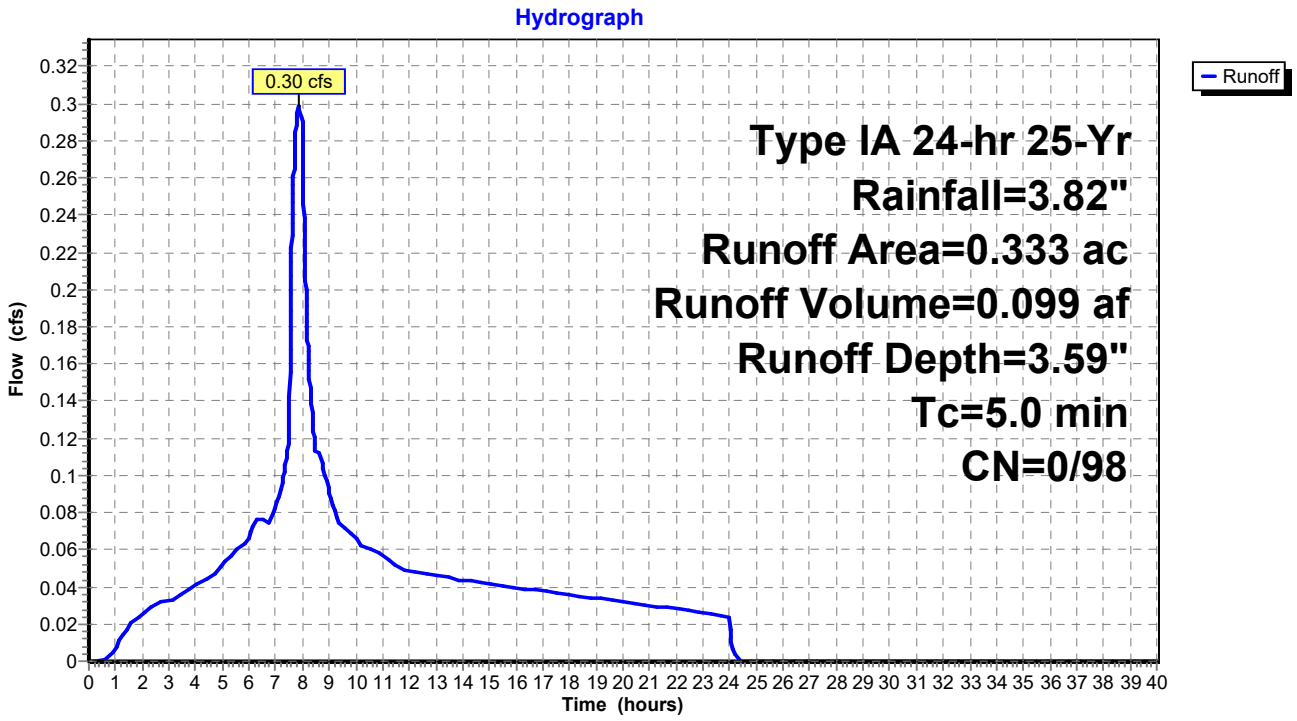
Runoff = 0.30 cfs @ 7.88 hrs, Volume= 0.099 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.333	98	
	0.333	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7-1: Basin 71



Summary for Subcatchment 7-2: Basin 72

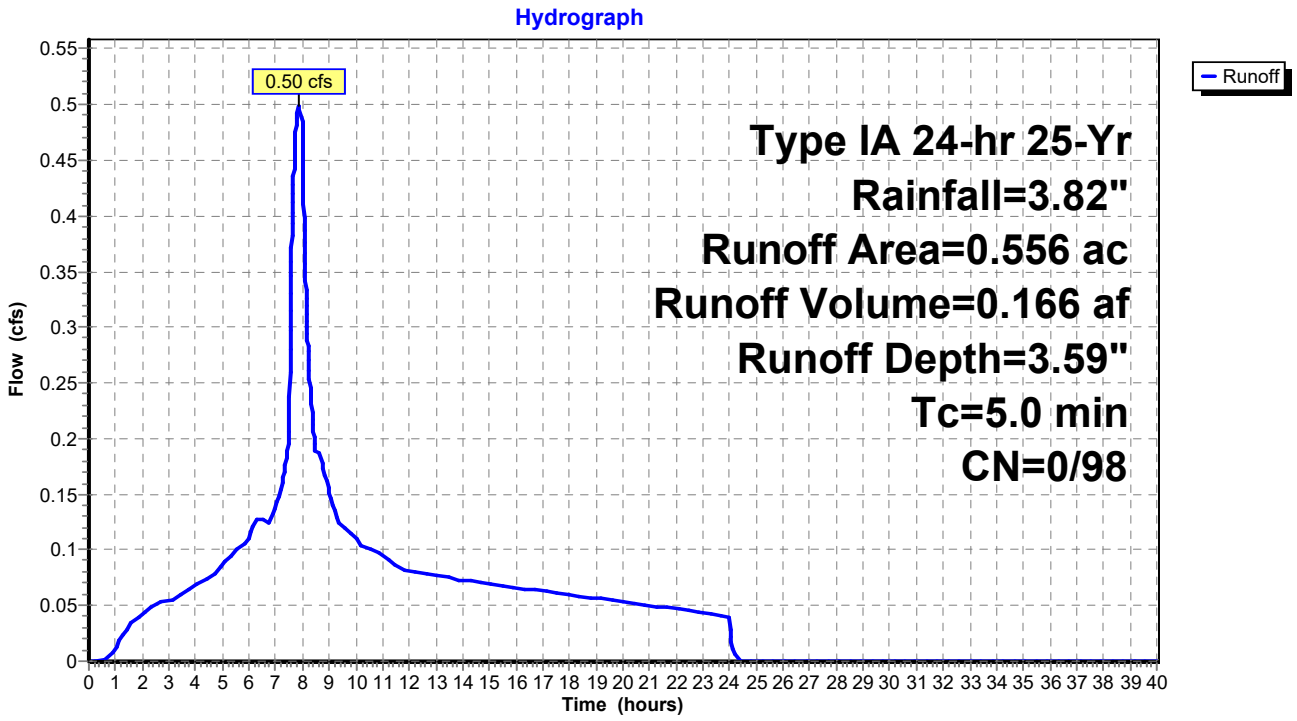
Runoff = 0.50 cfs @ 7.88 hrs, Volume= 0.166 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	0.556	98	
	0.556	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7-2: Basin 72



Summary for Subcatchment 8: Basin 8

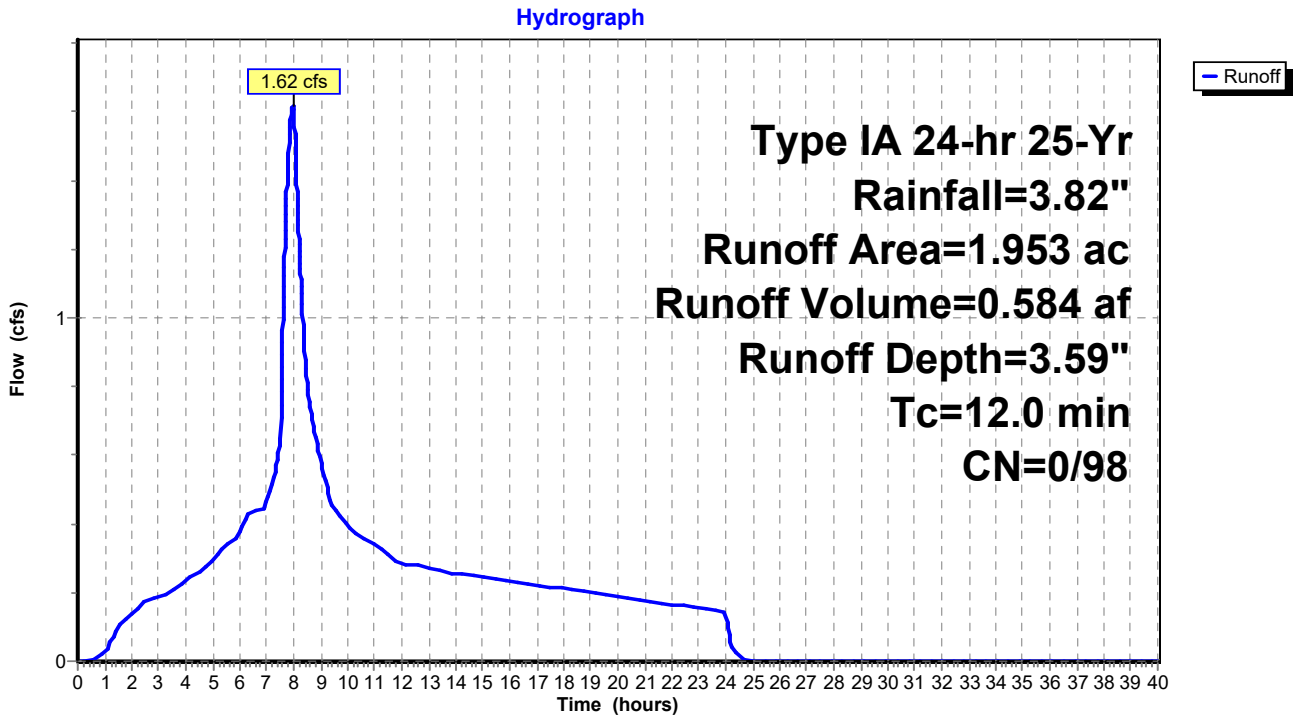
Runoff = 1.62 cfs @ 7.99 hrs, Volume= 0.584 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

	Area (ac)	CN	Description
*	1.953	98	
	1.953	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, 8C**

Subcatchment 8: Basin 8



Summary for Subcatchment 10S: Package B Pavement

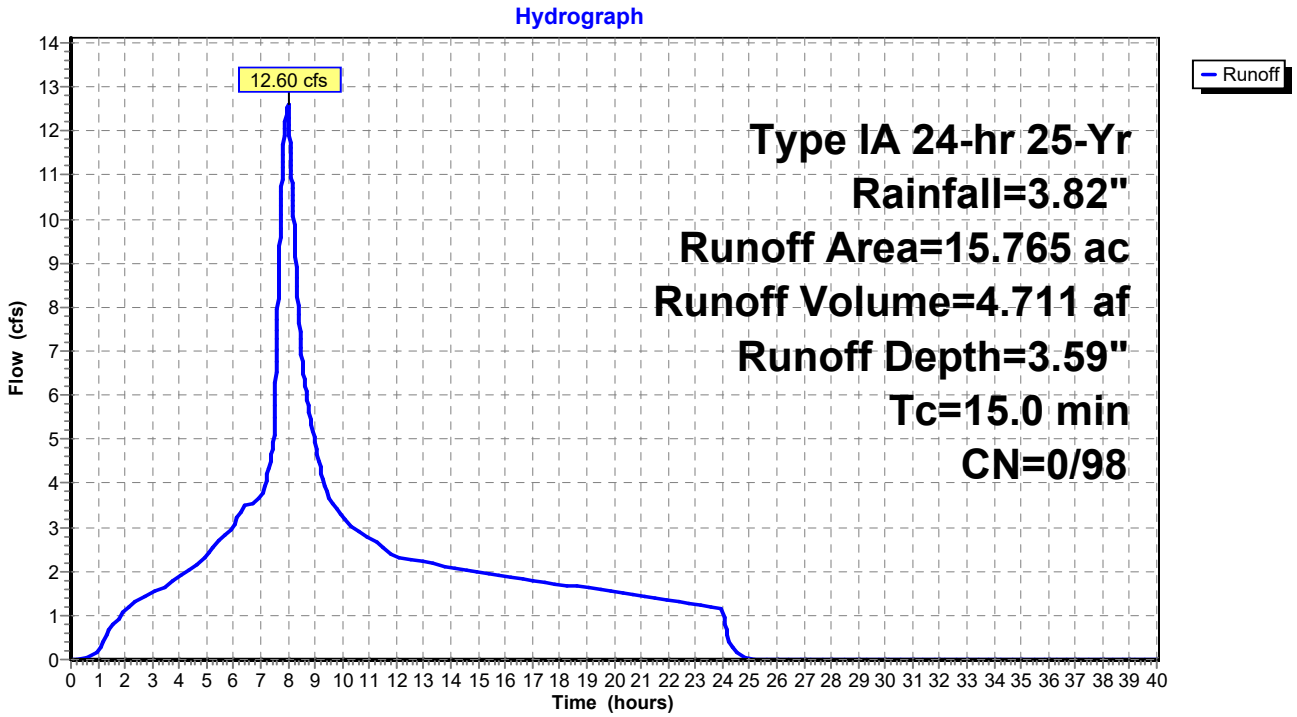
Runoff = 12.60 cfs @ 8.00 hrs, Volume= 4.711 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

Area (ac)	CN	Description
2.296	98	Paved roads w/curbs & sewers, HSG B
2.629	98	Paved roads w/curbs & sewers, HSG B
2.078	98	Paved roads w/curbs & sewers, HSG B
2.195	98	Paved roads w/curbs & sewers, HSG B
3.686	98	Paved roads w/curbs & sewers, HSG B
0.913	98	Paved roads w/curbs & sewers, HSG B
1.968	98	Paved roads w/curbs & sewers, HSG B
15.765	98	Weighted Average
15.765	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment 10S: Package B Pavement



Summary for Subcatchment A: Offsite Basin A

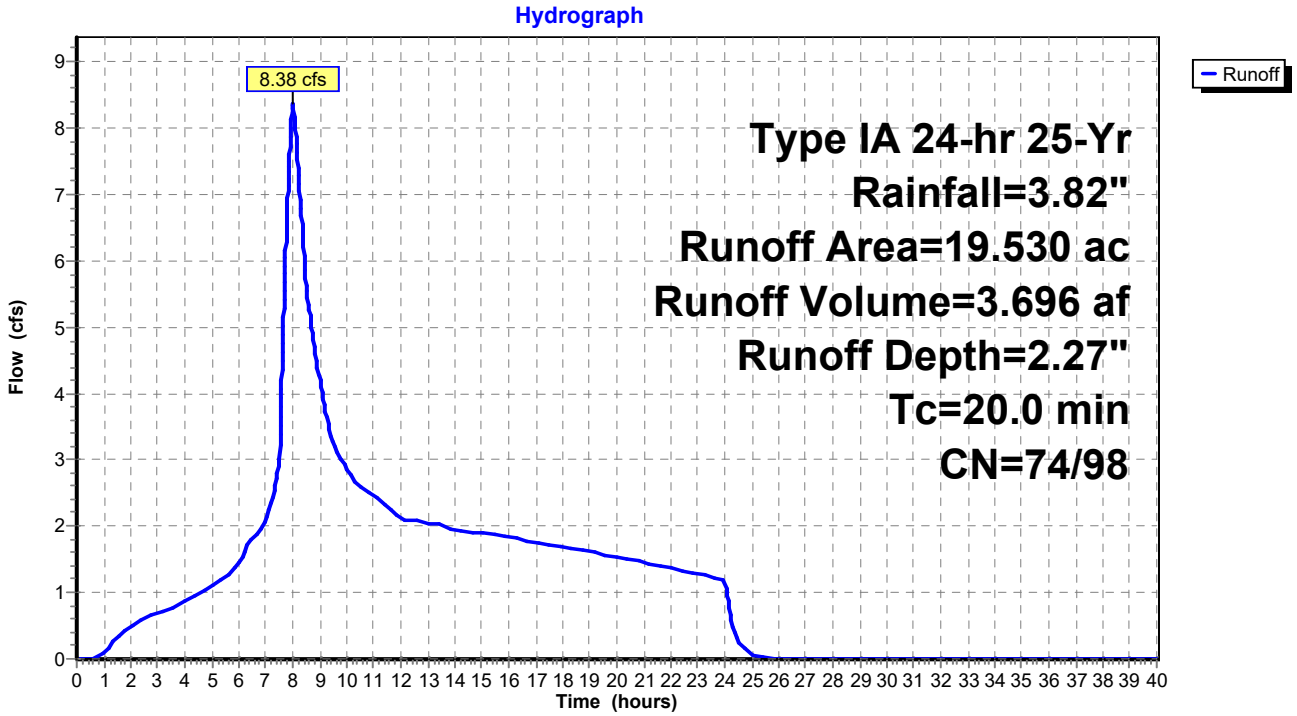
Runoff = 8.38 cfs @ 8.01 hrs, Volume= 3.696 af, Depth= 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

Area (ac)	CN	Description
19.530	83	1/4 acre lots, 38% imp, HSG C
12.109	74	62.00% Pervious Area
7.421	98	38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry, Rough estimate based on SCF formula**

Subcatchment A: Offsite Basin A



Summary for Subcatchment B: Offsite Basin B

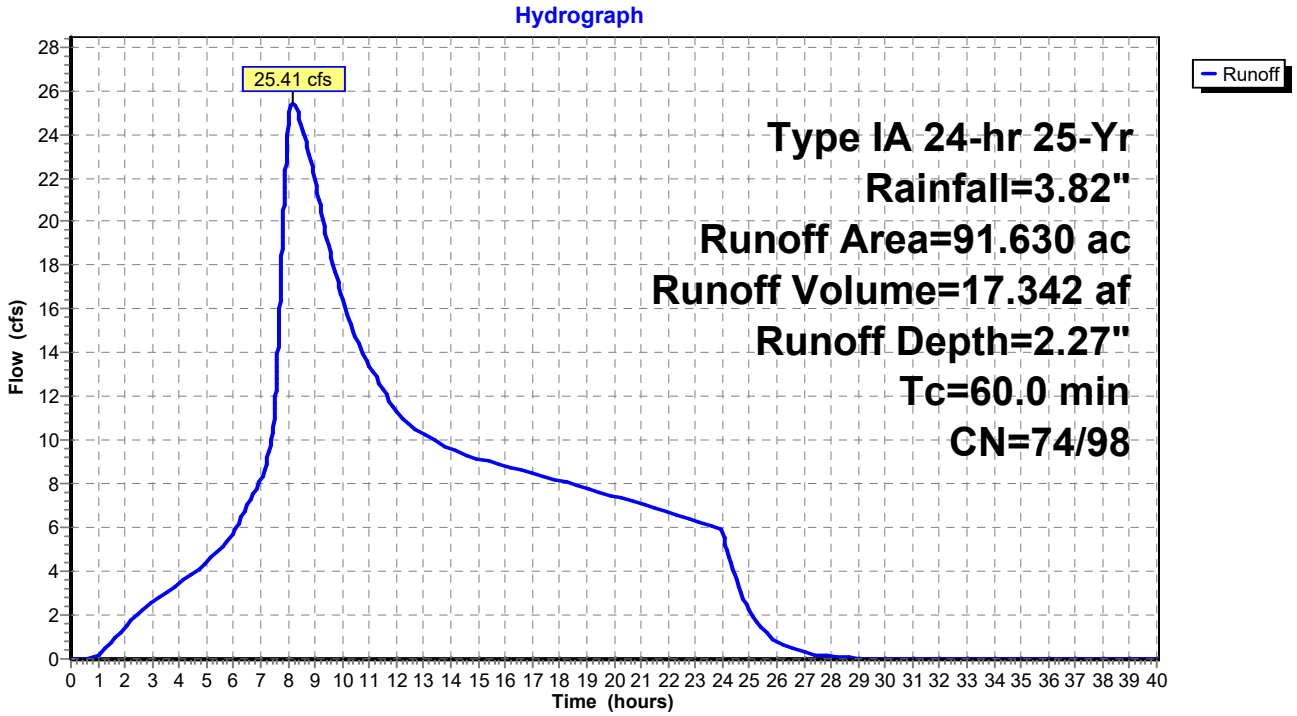
Runoff = 25.41 cfs @ 8.20 hrs, Volume= 17.342 af, Depth= 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

Area (ac)	CN	Description
91.630	83	1/4 acre lots, 38% imp, HSG C
56.811	74	62.00% Pervious Area
34.819	98	38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
60.0					**Direct Entry, Rough estimate based on SCF formula**

Subcatchment B: Offsite Basin B



Summary for Subcatchment OS-3: Basin OS 31

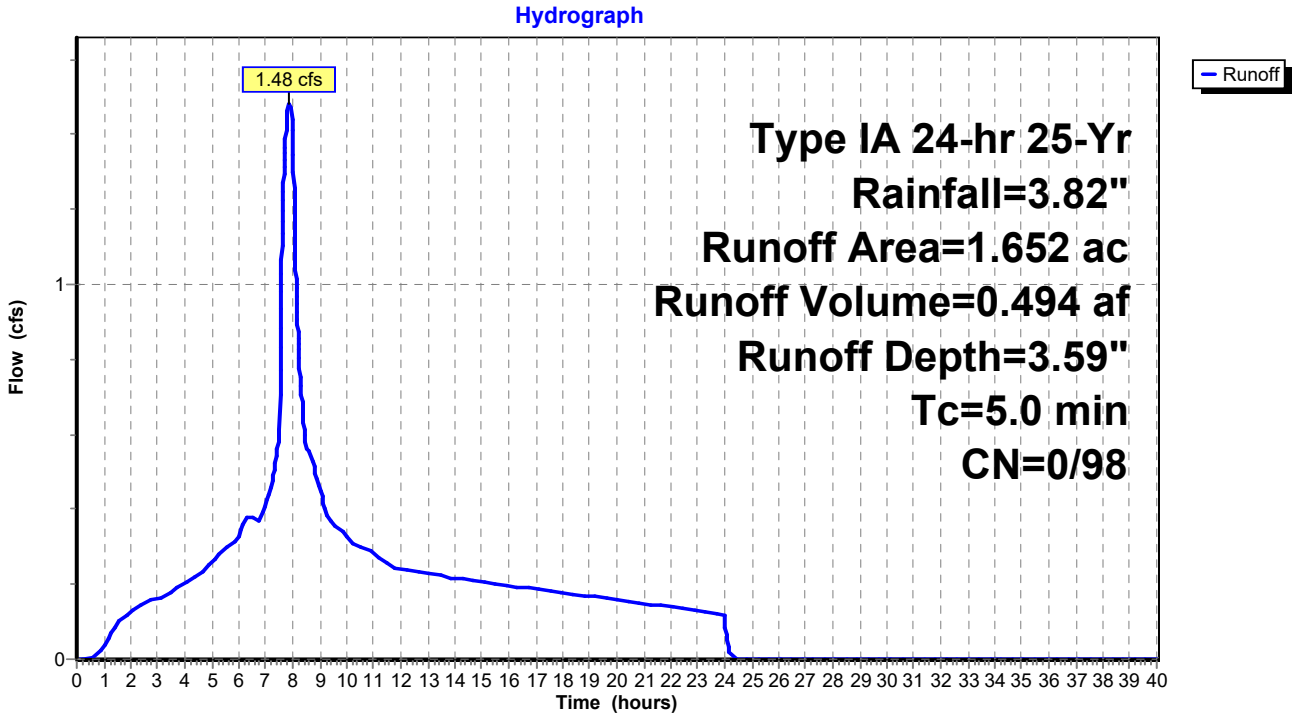
Runoff = 1.48 cfs @ 7.88 hrs, Volume= 0.494 af, Depth= 3.59"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=3.82"

Area (ac)	CN	Description
1.652	98	Paved roads w/curbs & sewers, HSG B
1.652	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment OS-3: Basin OS 31



Summary for Pond 3P: (new Pond)

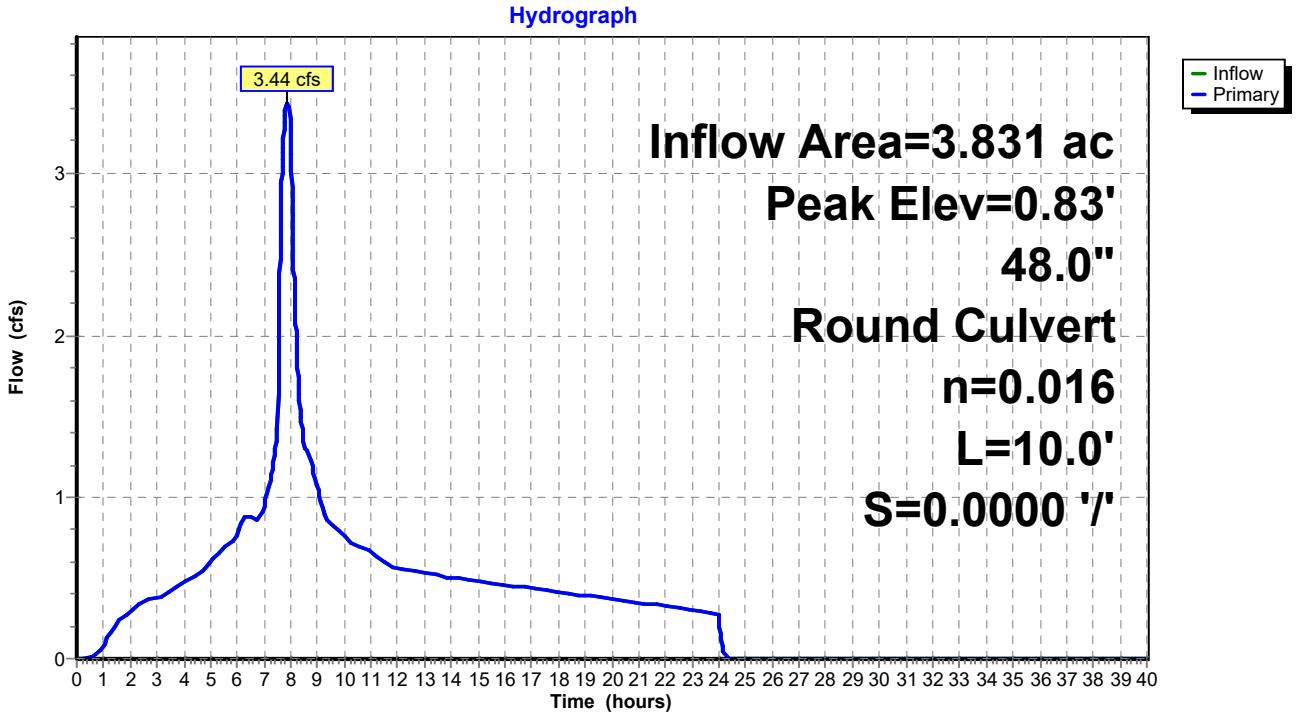
Inflow Area = 3.831 ac,100.00% Impervious, Inflow Depth = 3.59" for 25-Yr event
Inflow = 3.44 cfs @ 7.88 hrs, Volume= 1.145 af
Outflow = 3.44 cfs @ 7.88 hrs, Volume= 1.145 af, Atten= 0%, Lag= 0.0 min
Primary = 3.44 cfs @ 7.88 hrs, Volume= 1.145 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.83' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=3.43 cfs @ 7.88 hrs HW=0.83' (Free Discharge)
└─**1=Culvert** (Barrel Controls 3.43 cfs @ 2.75 fps)

Pond 3P: (new Pond)



Summary for Pond 4P: (new Pond)

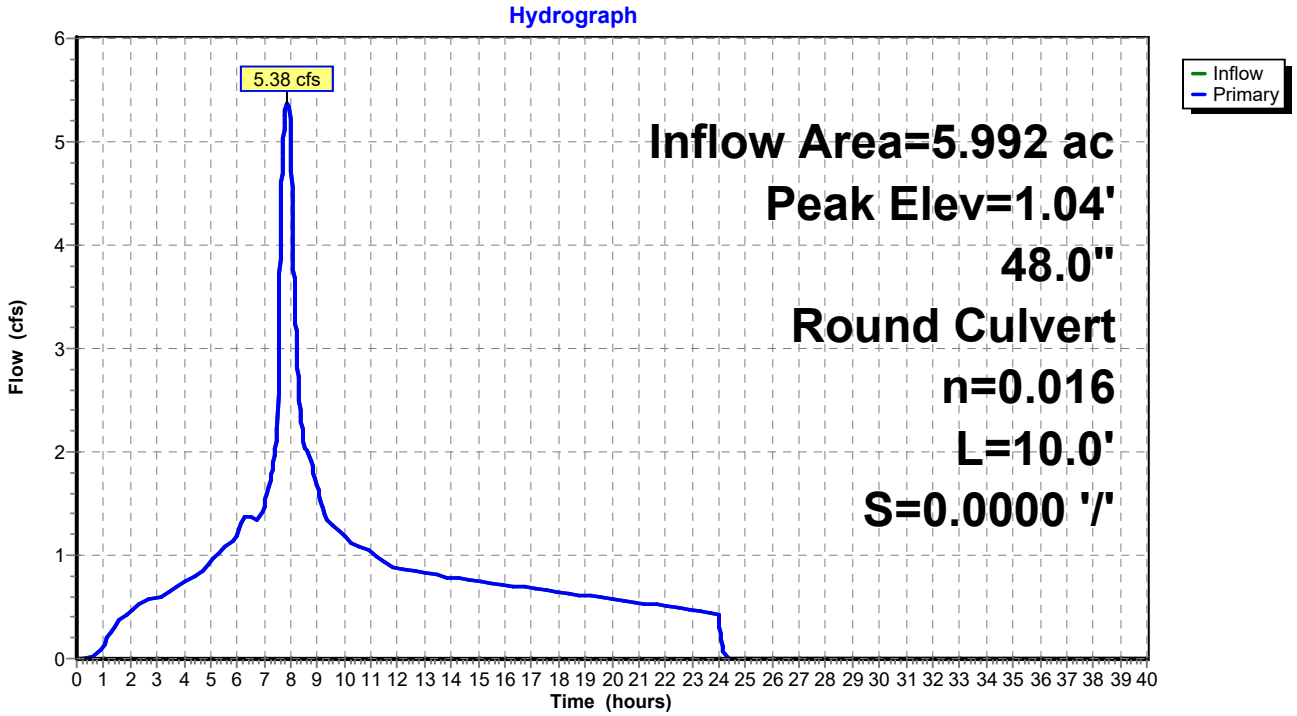
Inflow Area = 5.992 ac,100.00% Impervious, Inflow Depth = 3.59" for 25-Yr event
Inflow = 5.38 cfs @ 7.88 hrs, Volume= 1.790 af
Outflow = 5.38 cfs @ 7.88 hrs, Volume= 1.790 af, Atten= 0%, Lag= 0.0 min
Primary = 5.38 cfs @ 7.88 hrs, Volume= 1.790 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 1.04' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=5.37 cfs @ 7.88 hrs HW=1.04' (Free Discharge)
└**1=Culvert** (Barrel Controls 5.37 cfs @ 3.13 fps)

Pond 4P: (new Pond)



Summary for Pond 5P: (new Pond)

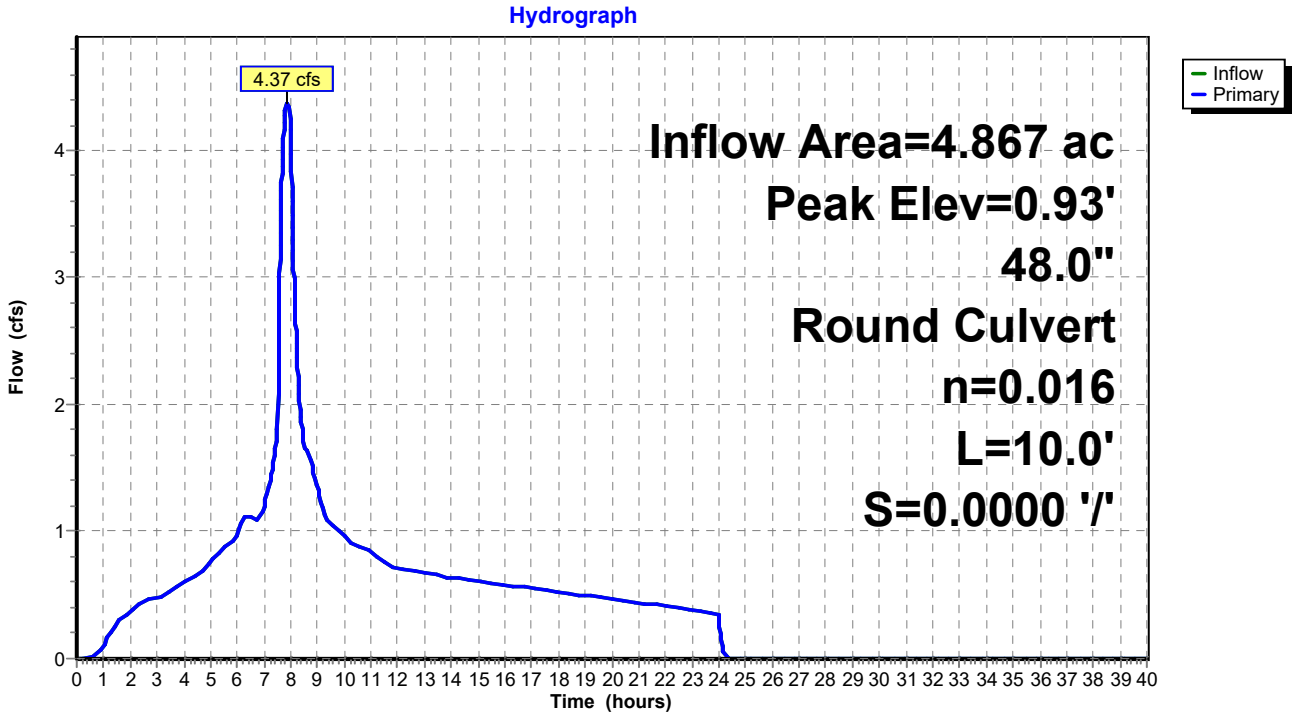
Inflow Area = 4.867 ac,100.00% Impervious, Inflow Depth = 3.59" for 25-Yr event
Inflow = 4.37 cfs @ 7.88 hrs, Volume= 1.454 af
Outflow = 4.37 cfs @ 7.88 hrs, Volume= 1.454 af, Atten= 0%, Lag= 0.0 min
Primary = 4.37 cfs @ 7.88 hrs, Volume= 1.454 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.93' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=4.36 cfs @ 7.88 hrs HW=0.93' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.36 cfs @ 2.95 fps)

Pond 5P: (new Pond)



Summary for Pond 6P: (new Pond)

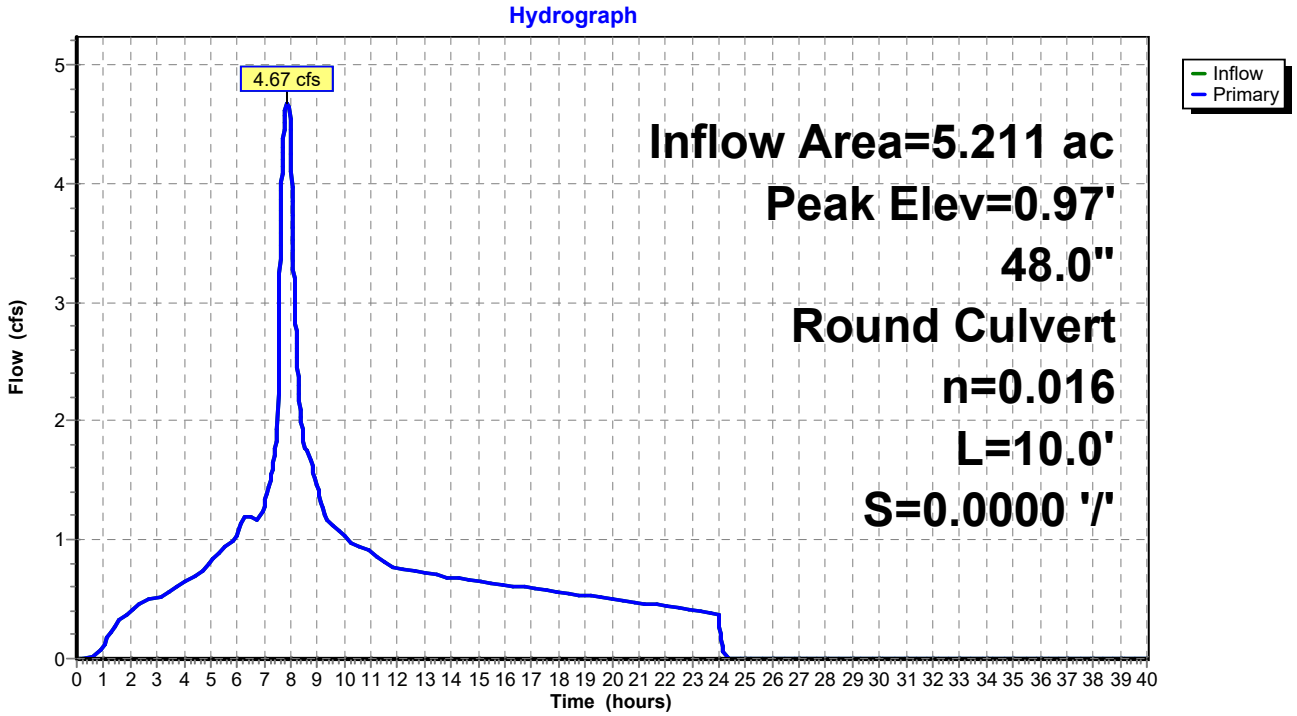
Inflow Area = 5.211 ac,100.00% Impervious, Inflow Depth = 3.59" for 25-Yr event
Inflow = 4.67 cfs @ 7.88 hrs, Volume= 1.557 af
Outflow = 4.67 cfs @ 7.88 hrs, Volume= 1.557 af, Atten= 0%, Lag= 0.0 min
Primary = 4.67 cfs @ 7.88 hrs, Volume= 1.557 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.97' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=4.67 cfs @ 7.88 hrs HW=0.97' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.67 cfs @ 3.01 fps)

Pond 6P: (new Pond)



Summary for Pond 7P: (new Pond)

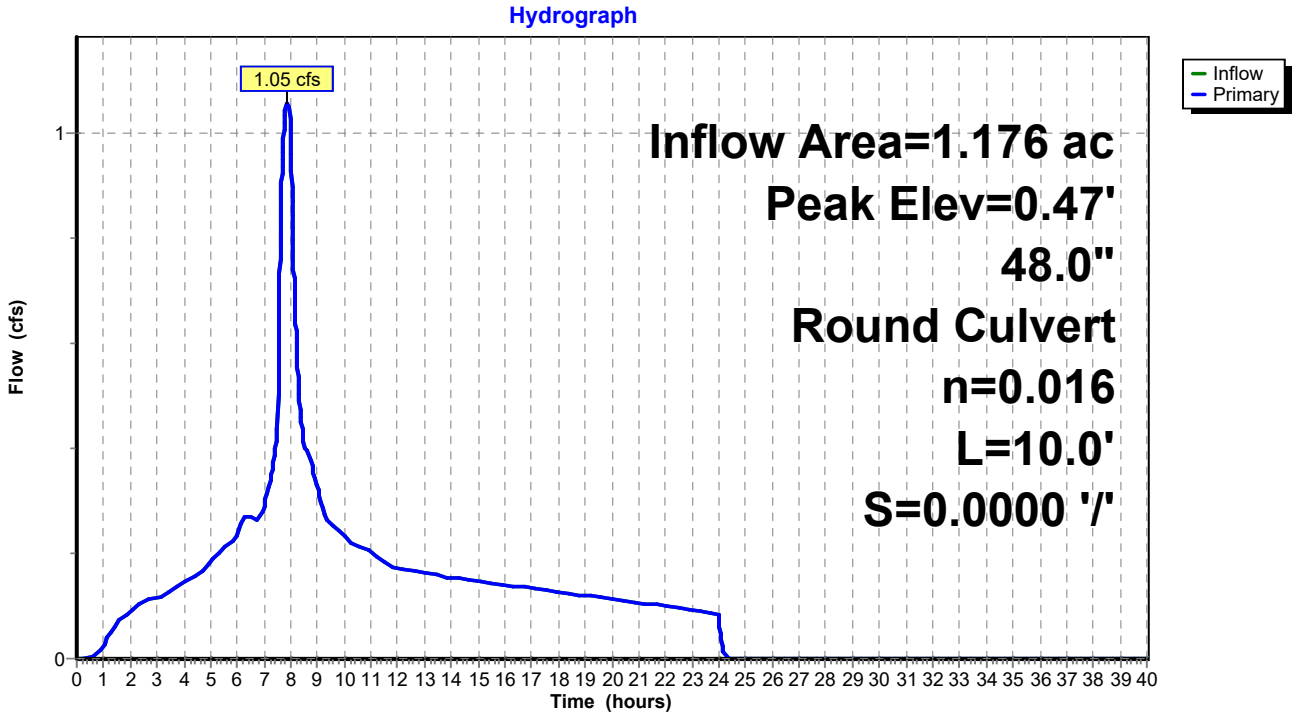
Inflow Area = 1.176 ac,100.00% Impervious, Inflow Depth = 3.59" for 25-Yr event
Inflow = 1.05 cfs @ 7.88 hrs, Volume= 0.351 af
Outflow = 1.05 cfs @ 7.88 hrs, Volume= 0.351 af, Atten= 0%, Lag= 0.0 min
Primary = 1.05 cfs @ 7.88 hrs, Volume= 0.351 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.47' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=1.05 cfs @ 7.88 hrs HW=0.47' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.05 cfs @ 1.93 fps)

Pond 7P: (new Pond)



Summary for Pond 10P: Offsite Flows

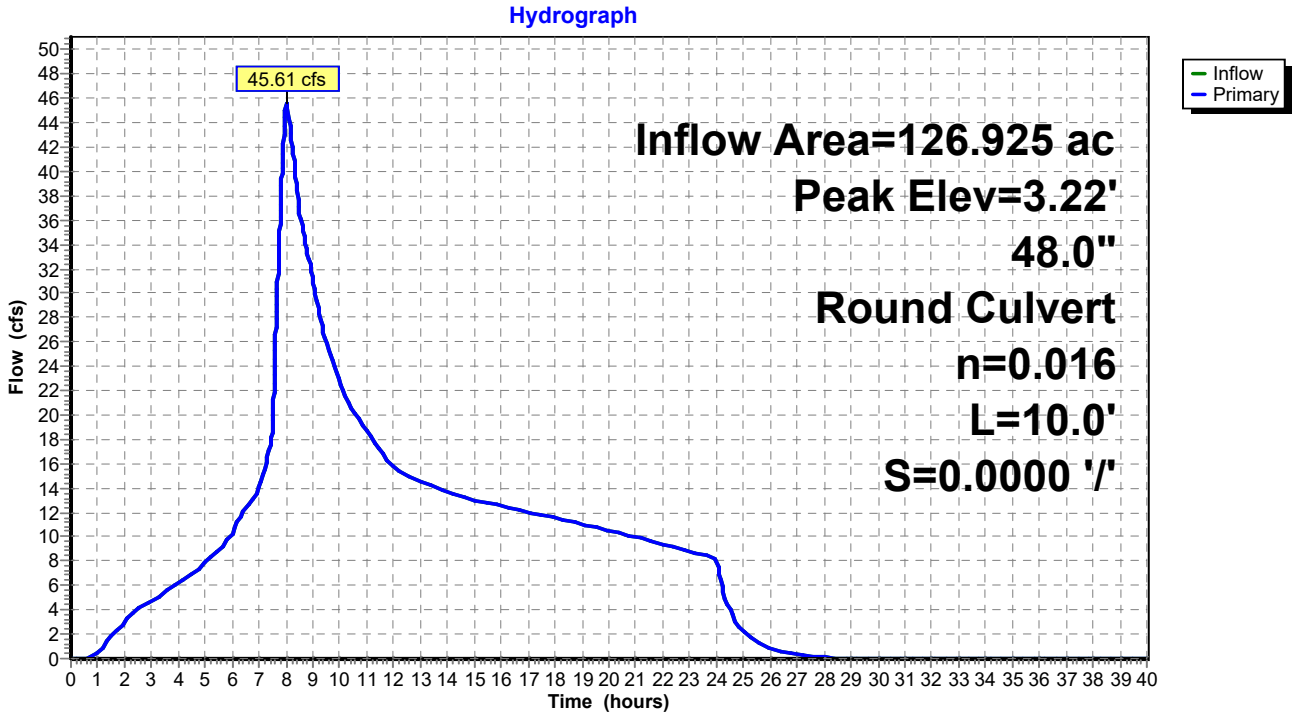
Inflow Area = 126.925 ac, 45.70% Impervious, Inflow Depth = 2.43" for 25-Yr event
Inflow = 45.61 cfs @ 8.01 hrs, Volume= 25.749 af
Outflow = 45.61 cfs @ 8.01 hrs, Volume= 25.749 af, Atten= 0%, Lag= 0.0 min
Primary = 45.61 cfs @ 8.01 hrs, Volume= 25.749 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 3.22' @ 8.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=45.60 cfs @ 8.01 hrs HW=3.22' (Free Discharge)
└─**1=Culvert** (Barrel Controls 45.60 cfs @ 5.75 fps)

Pond 10P: Offsite Flows



Time span=0.00-40.00 hrs, dt=0.01 hrs, 4001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2: Basin 20 Runoff Area=3.080 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=3.38 cfs 1.133 af

Subcatchment3: Basin 30 Runoff Area=2.179 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=2.39 cfs 0.801 af

Subcatchment4: Basin 40 Runoff Area=0.396 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.43 cfs 0.146 af

Subcatchment4-1: Basin 41 Runoff Area=4.560 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=5.00 cfs 1.677 af

Subcatchment4-2: Basin 42 Runoff Area=0.698 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.77 cfs 0.257 af

Subcatchment4-3: Basin 43 Runoff Area=0.338 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.37 cfs 0.124 af

Subcatchment5: Basin 50 Runoff Area=0.719 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.79 cfs 0.264 af

Subcatchment5-1: Basin 51 Runoff Area=0.578 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.63 cfs 0.213 af

Subcatchment5-2: Basin 52 Runoff Area=3.570 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=3.92 cfs 1.313 af

Subcatchment6: Basin 60 Runoff Area=2.299 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=2.52 cfs 0.846 af

Subcatchment6-1: Basin 61 Runoff Area=0.474 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.52 cfs 0.174 af

Subcatchment6-2: Basin 62 Runoff Area=2.315 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=2.54 cfs 0.851 af

Subcatchment6-3: Basin 63 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.13 cfs 0.045 af

Subcatchment7: Basin 70 Runoff Area=0.287 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.31 cfs 0.106 af

Subcatchment7-1: Basin 71 Runoff Area=0.333 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.37 cfs 0.122 af

Subcatchment7-2: Basin 72 Runoff Area=0.556 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=0.61 cfs 0.205 af

Subcatchment8: Basin 8 Runoff Area=1.953 ac 100.00% Impervious Runoff Depth=4.41"
Tc=12.0 min CN=0/98 Runoff=1.98 cfs 0.718 af

Subcatchment10S: Package B Pavement Runoff Area=15.765 ac 100.00% Impervious Runoff Depth=4.41"
Tc=15.0 min CN=0/98 Runoff=15.42 cfs 5.799 af

SubcatchmentA: Offsite Basin A Runoff Area=19.530 ac 38.00% Impervious Runoff Depth=2.97"
Tc=20.0 min CN=74/98 Runoff=11.24 cfs 4.837 af

SubcatchmentB: Offsite Basin B Runoff Area=91.630 ac 38.00% Impervious Runoff Depth=2.97"
Tc=60.0 min CN=74/98 Runoff=34.16 cfs 22.694 af

SubcatchmentOS-3: Basin OS 31 Runoff Area=1.652 ac 100.00% Impervious Runoff Depth=4.41"
Tc=5.0 min CN=0/98 Runoff=1.81 cfs 0.608 af

Pond 3P: (new Pond) Peak Elev=0.92' Inflow=4.20 cfs 1.409 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=4.20 cfs 1.409 af

Pond 4P: (new Pond) Peak Elev=1.15' Inflow=6.58 cfs 2.204 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=6.58 cfs 2.204 af

Pond 5P: (new Pond) Peak Elev=1.03' Inflow=5.34 cfs 1.790 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=5.34 cfs 1.790 af

Pond 6P: (new Pond) Peak Elev=1.07' Inflow=5.72 cfs 1.917 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=5.72 cfs 1.917 af

Pond 7P: (new Pond) Peak Elev=0.52' Inflow=1.29 cfs 0.433 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=1.29 cfs 0.433 af

Pond 10P: Offsite Flows Peak Elev=3.80' Inflow=59.87 cfs 33.330 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=59.87 cfs 33.330 af

Summary for Subcatchment 2: Basin 20

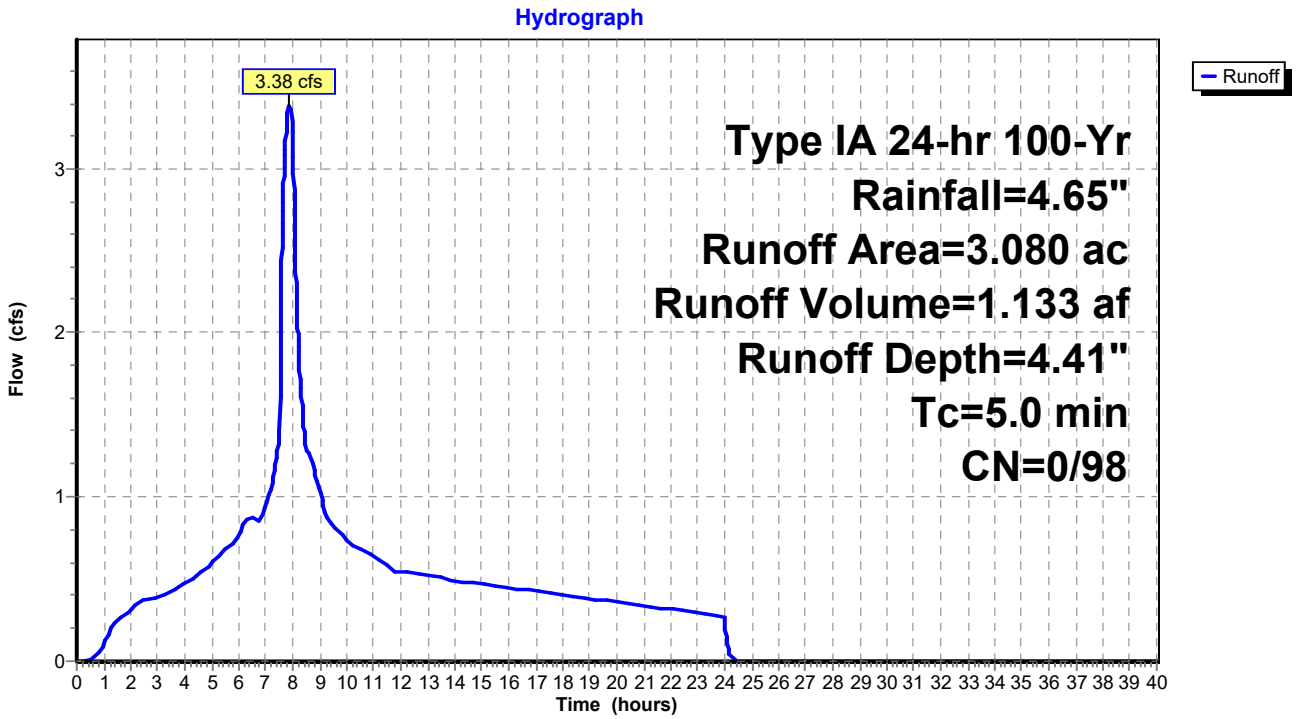
Runoff = 3.38 cfs @ 7.88 hrs, Volume= 1.133 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	3.080	98	
	3.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Basin 20



Summary for Subcatchment 3: Basin 30

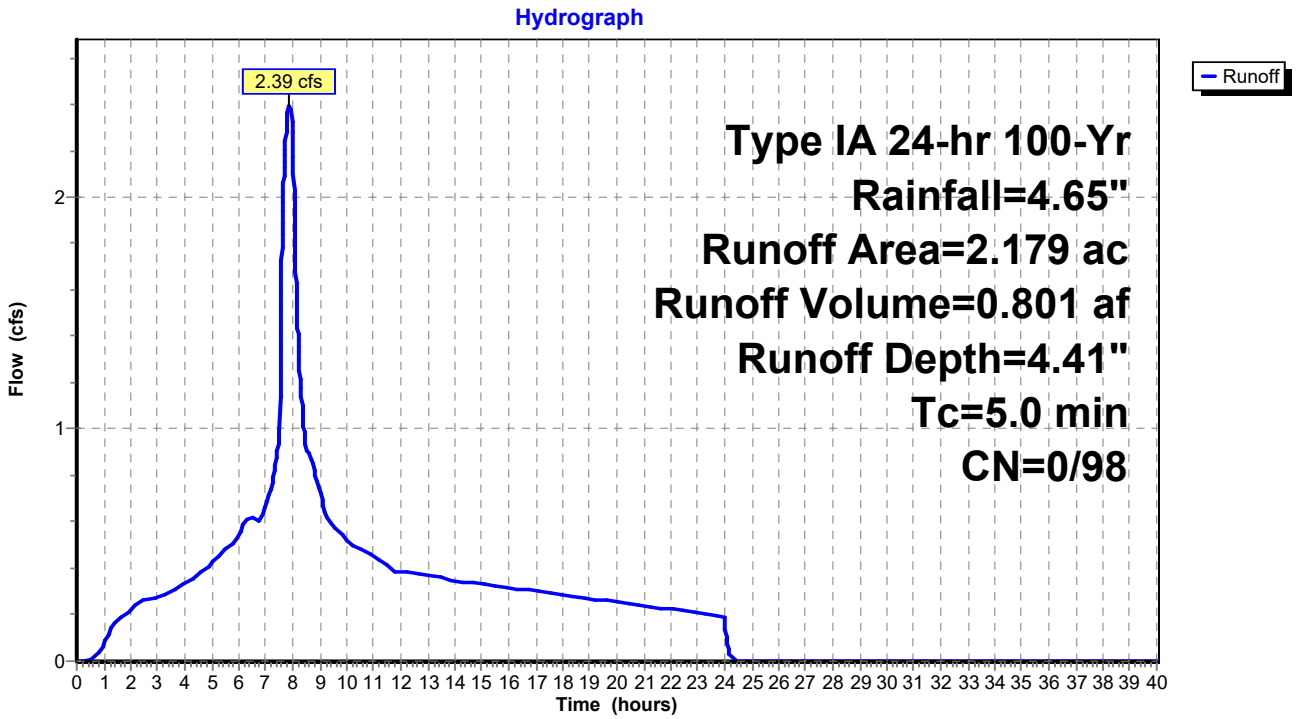
Runoff = 2.39 cfs @ 7.88 hrs, Volume= 0.801 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	2.179	98	
	2.179	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Basin 30



Summary for Subcatchment 4: Basin 40

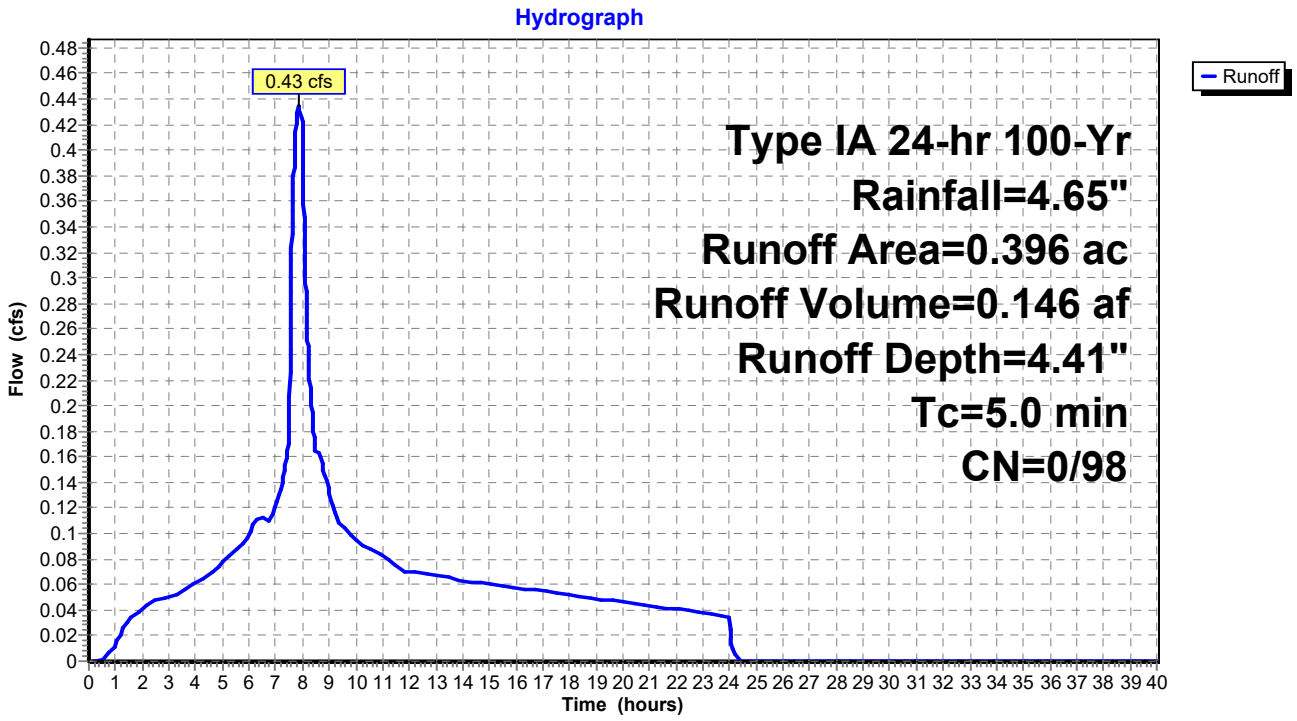
Runoff = 0.43 cfs @ 7.88 hrs, Volume= 0.146 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.396	98	
	0.396	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: Basin 40



Summary for Subcatchment 4-1: Basin 41

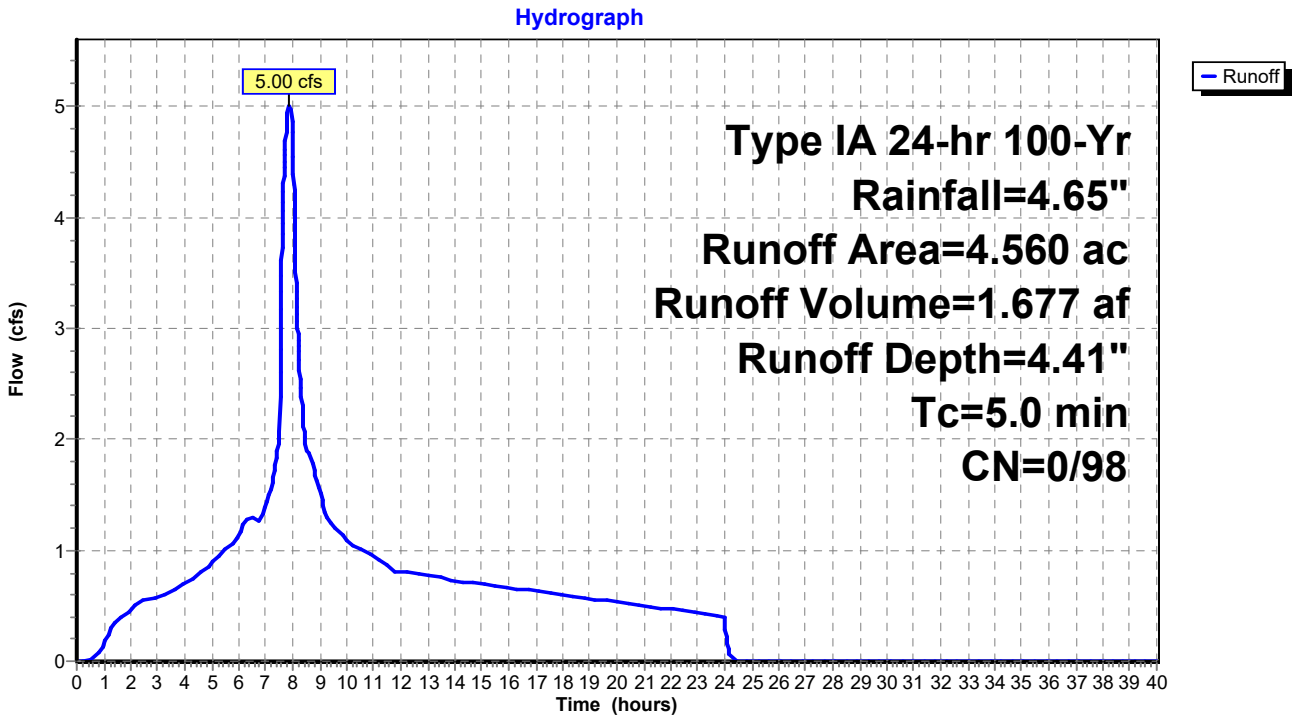
Runoff = 5.00 cfs @ 7.88 hrs, Volume= 1.677 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	4.560	98	
	4.560	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-1: Basin 41



Summary for Subcatchment 4-2: Basin 42

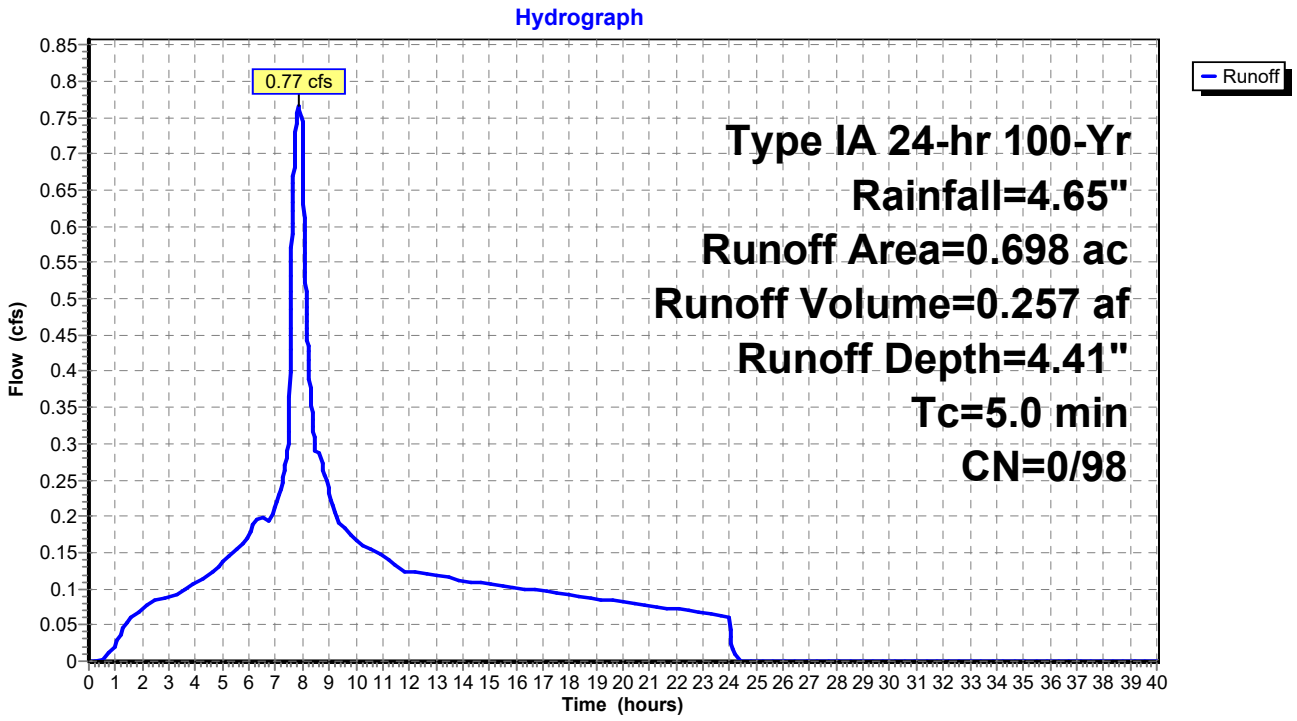
Runoff = 0.77 cfs @ 7.88 hrs, Volume= 0.257 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.698	98	
	0.698	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-2: Basin 42



Summary for Subcatchment 4-3: Basin 43

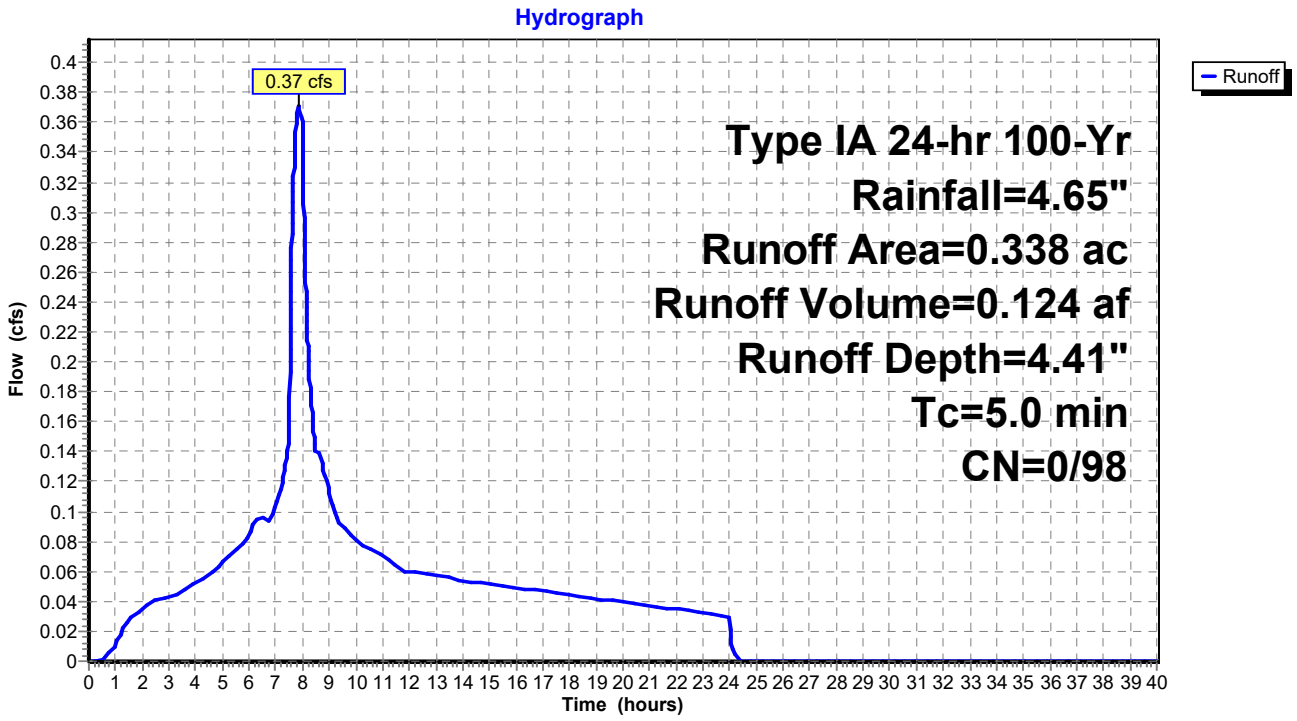
Runoff = 0.37 cfs @ 7.88 hrs, Volume= 0.124 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.338	98	
	0.338	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-3: Basin 43



Summary for Subcatchment 5: Basin 50

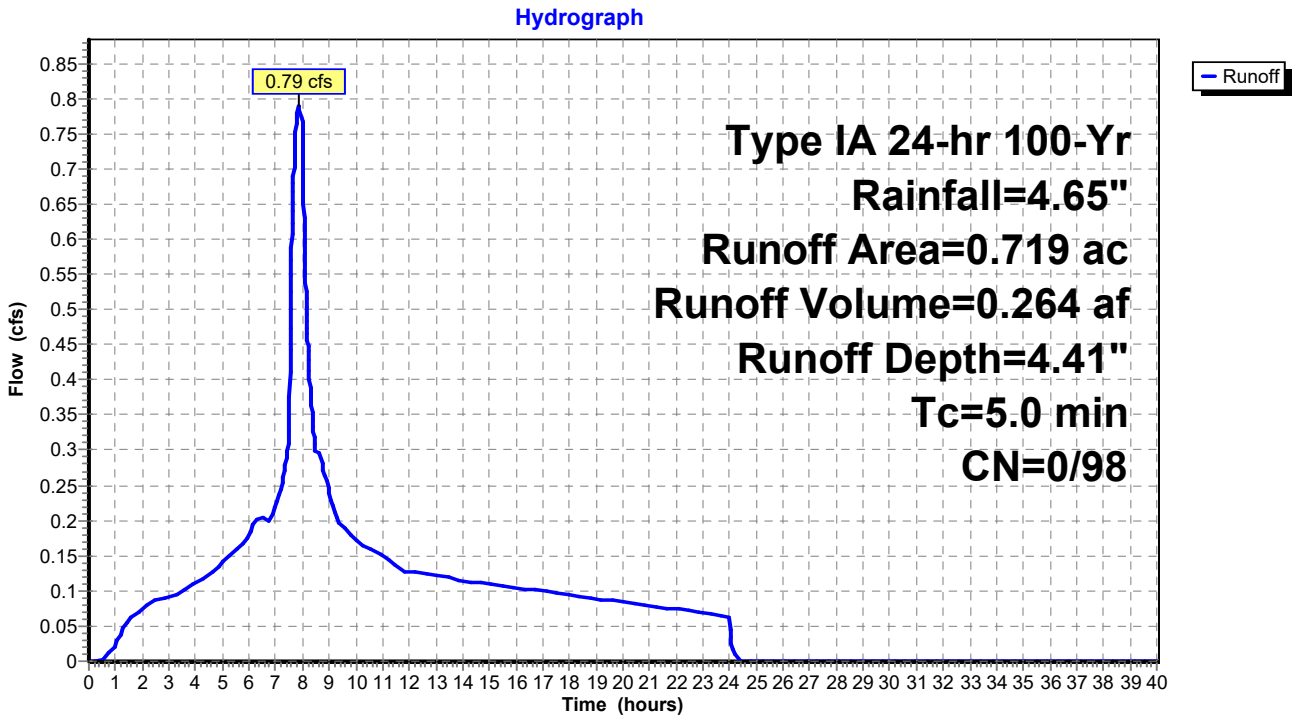
Runoff = 0.79 cfs @ 7.88 hrs, Volume= 0.264 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.719	98	
	0.719	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: Basin 50



Summary for Subcatchment 5-1: Basin 51

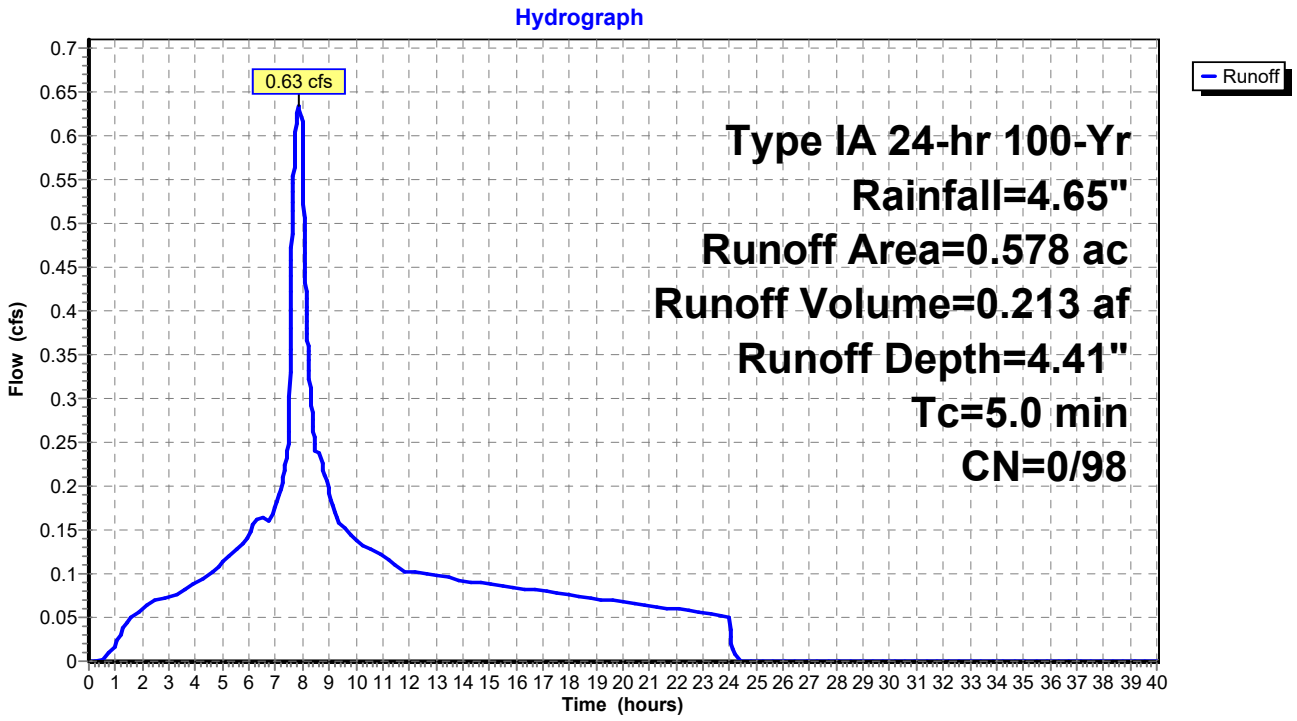
Runoff = 0.63 cfs @ 7.88 hrs, Volume= 0.213 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.578	98	
	0.578	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5-1: Basin 51



Summary for Subcatchment 5-2: Basin 52

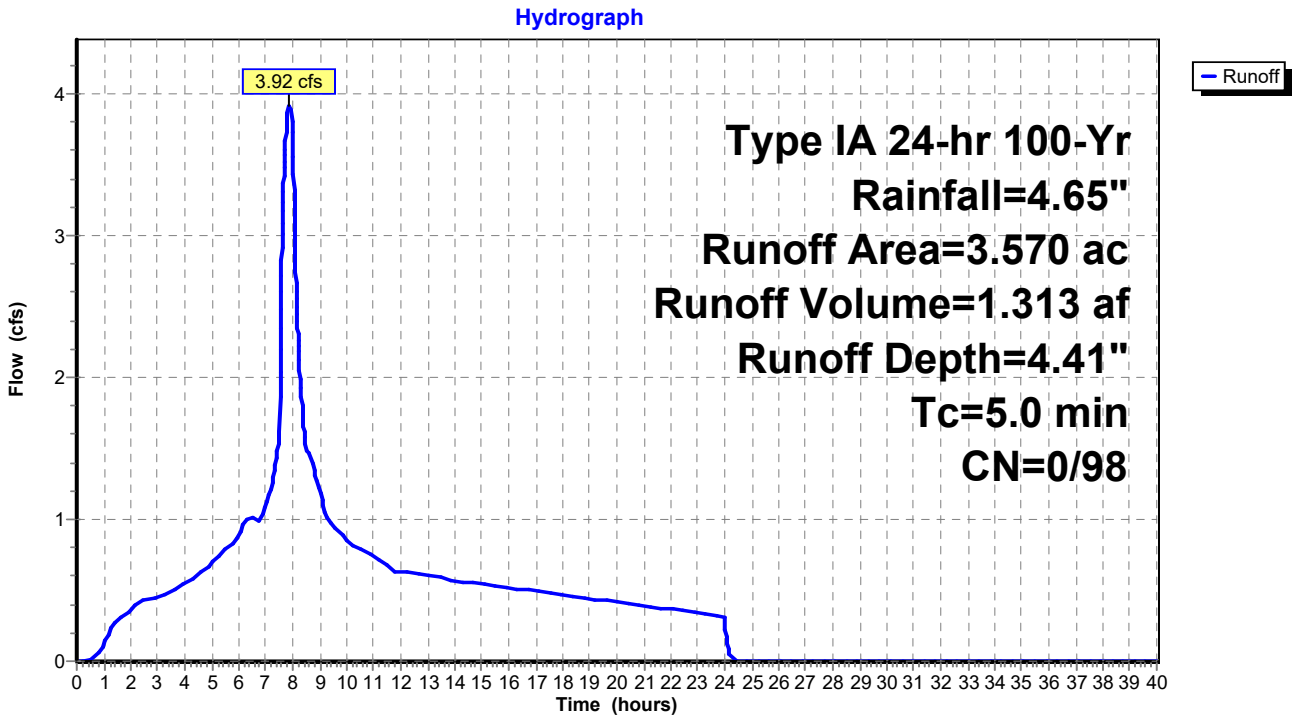
Runoff = 3.92 cfs @ 7.88 hrs, Volume= 1.313 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	3.570	98	
	3.570	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5-2: Basin 52



Summary for Subcatchment 6: Basin 60

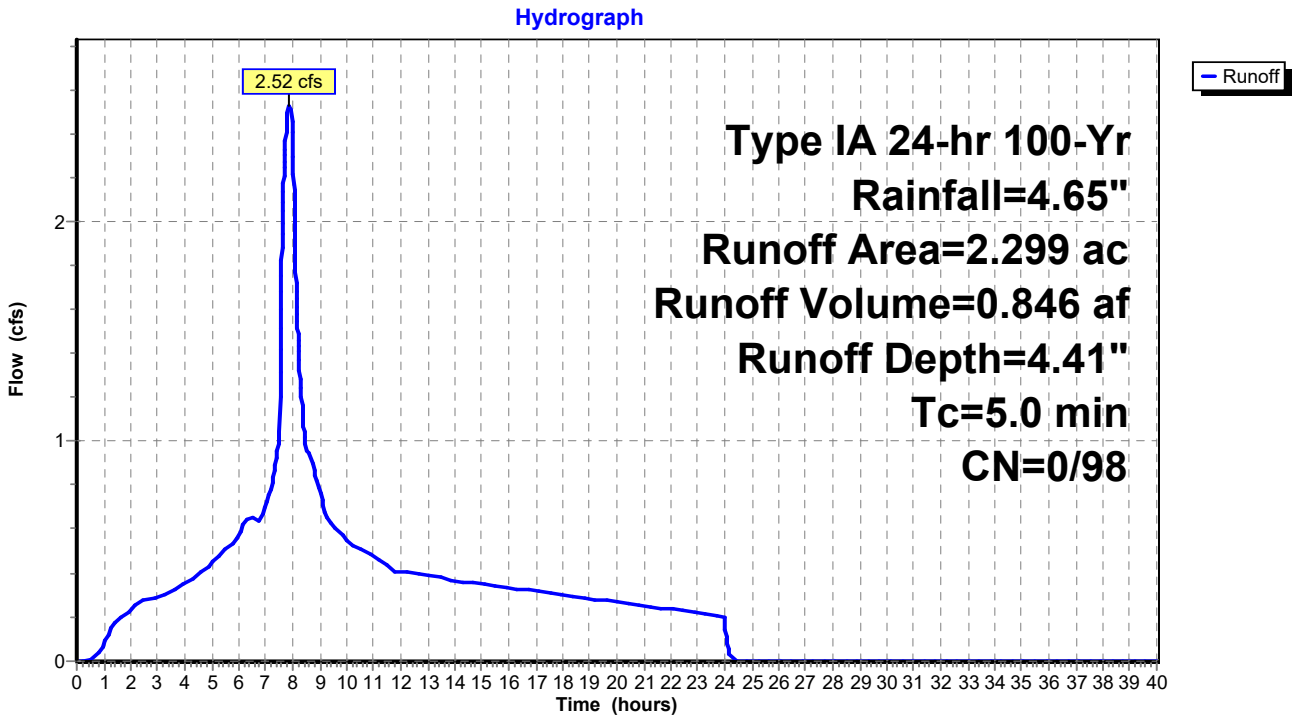
Runoff = 2.52 cfs @ 7.88 hrs, Volume= 0.846 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	2.299	98	
	2.299	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6: Basin 60



Summary for Subcatchment 6-1: Basin 61

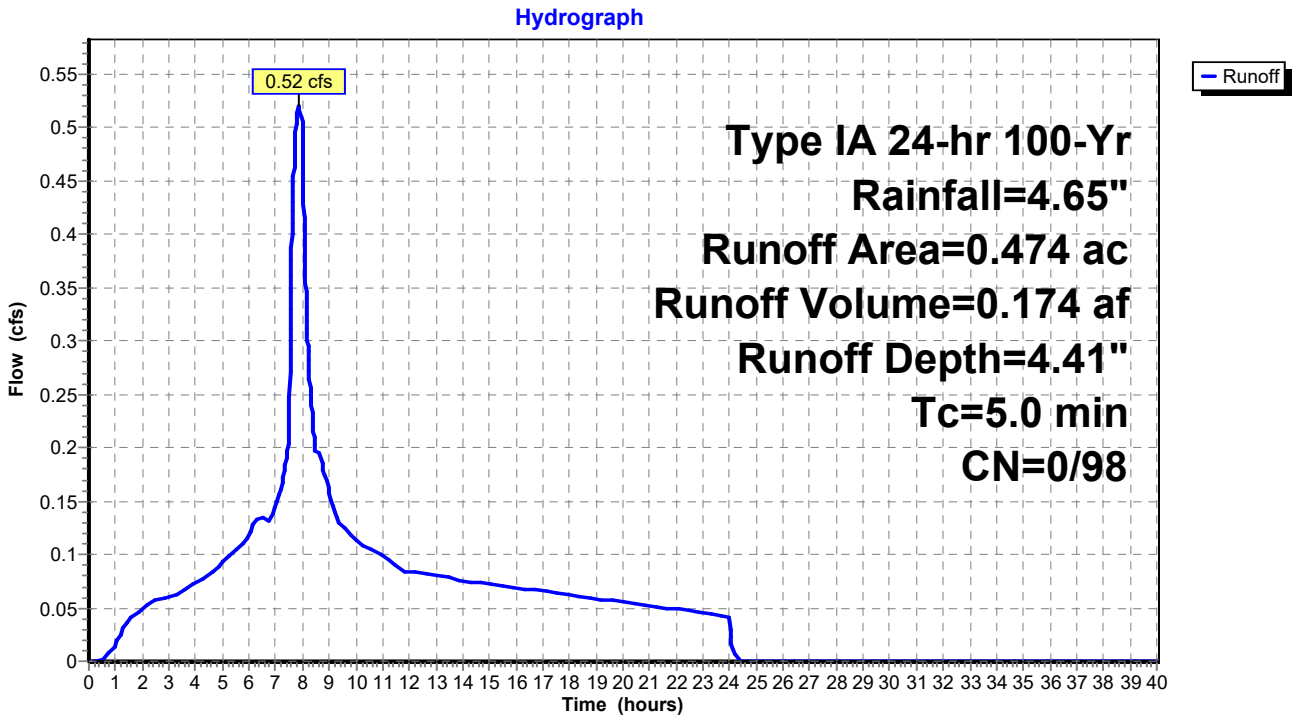
Runoff = 0.52 cfs @ 7.88 hrs, Volume= 0.174 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.474	98	
	0.474	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-1: Basin 61



Summary for Subcatchment 6-2: Basin 62

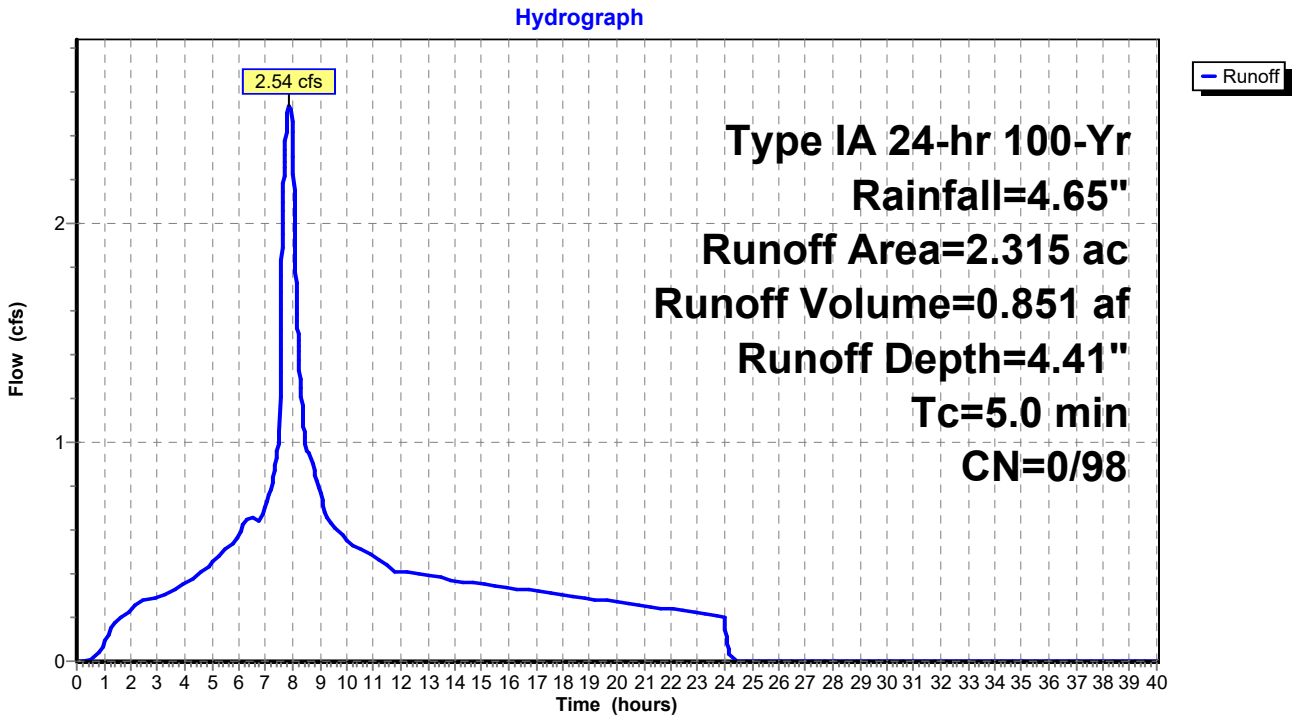
Runoff = 2.54 cfs @ 7.88 hrs, Volume= 0.851 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	2.315	98	
	2.315	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-2: Basin 62



Summary for Subcatchment 6-3: Basin 63

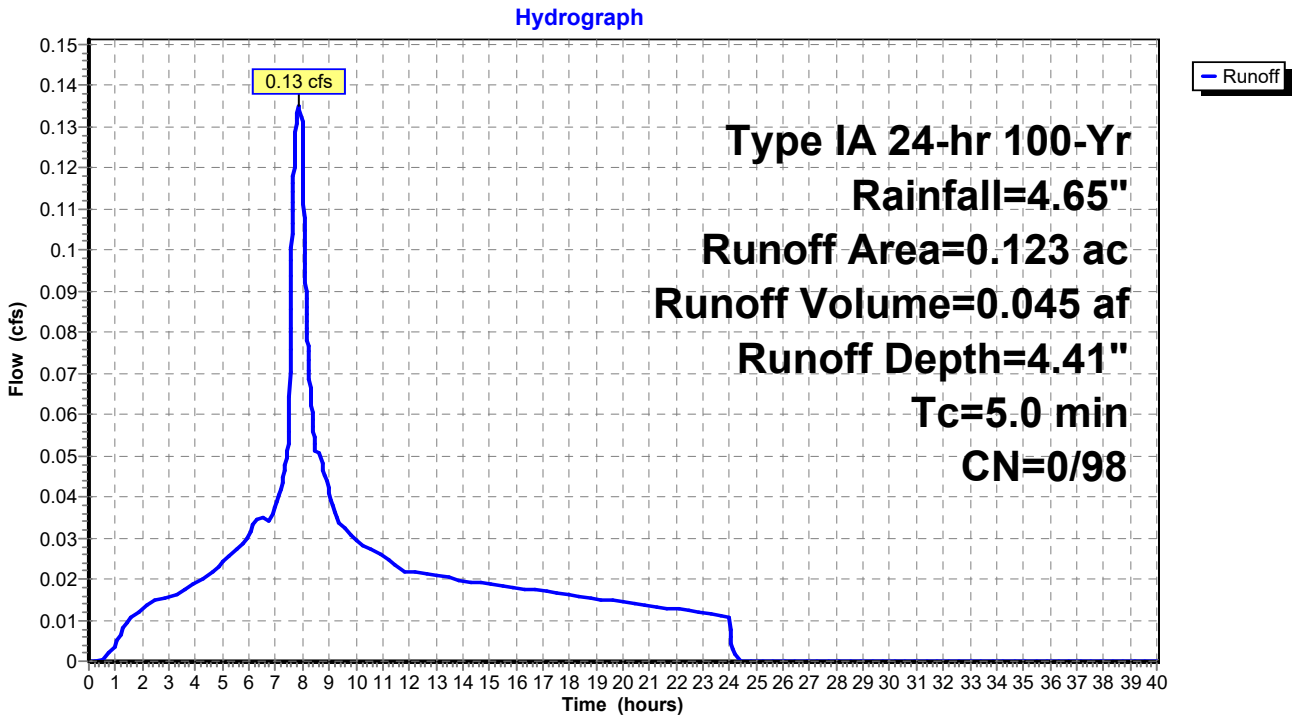
Runoff = 0.13 cfs @ 7.88 hrs, Volume= 0.045 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.123	98	
	0.123	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-3: Basin 63



Summary for Subcatchment 7: Basin 70

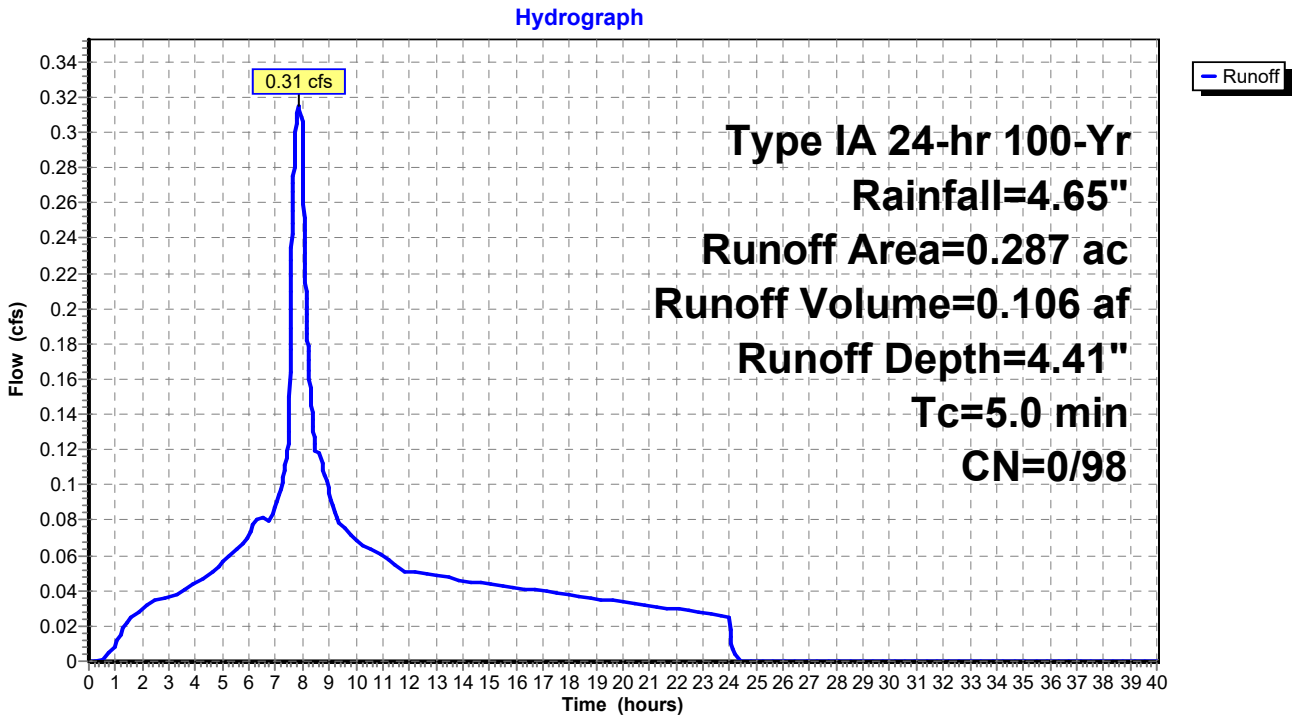
Runoff = 0.31 cfs @ 7.88 hrs, Volume= 0.106 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.287	98	
	0.287	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7: Basin 70



Summary for Subcatchment 7-1: Basin 71

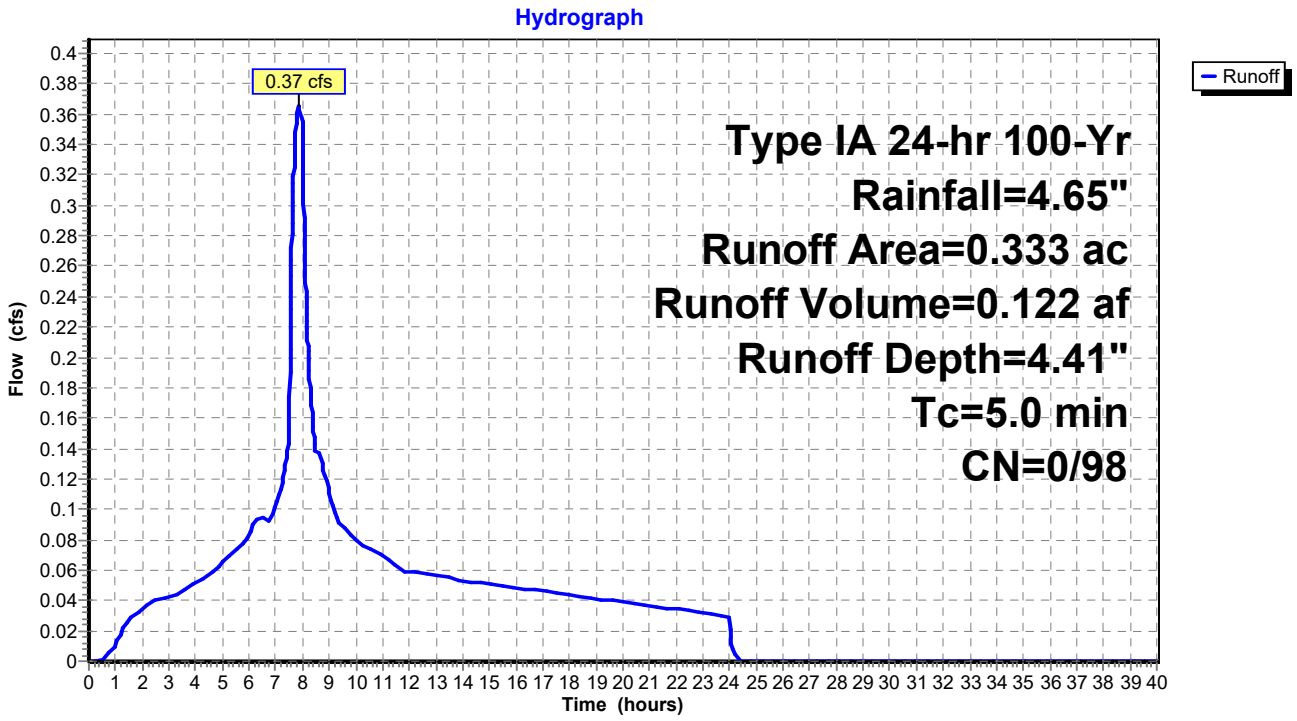
Runoff = 0.37 cfs @ 7.88 hrs, Volume= 0.122 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.333	98	
	0.333	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7-1: Basin 71



Summary for Subcatchment 7-2: Basin 72

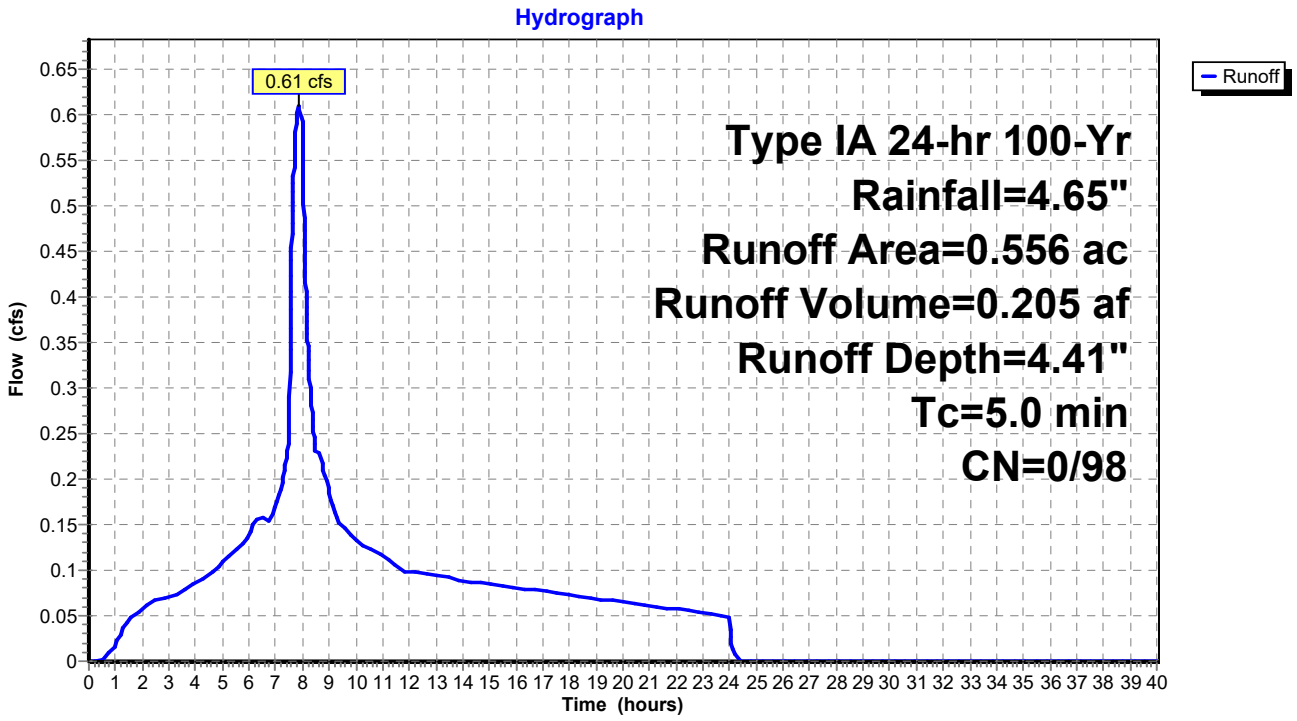
Runoff = 0.61 cfs @ 7.88 hrs, Volume= 0.205 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	0.556	98	
	0.556	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7-2: Basin 72



Summary for Subcatchment 8: Basin 8

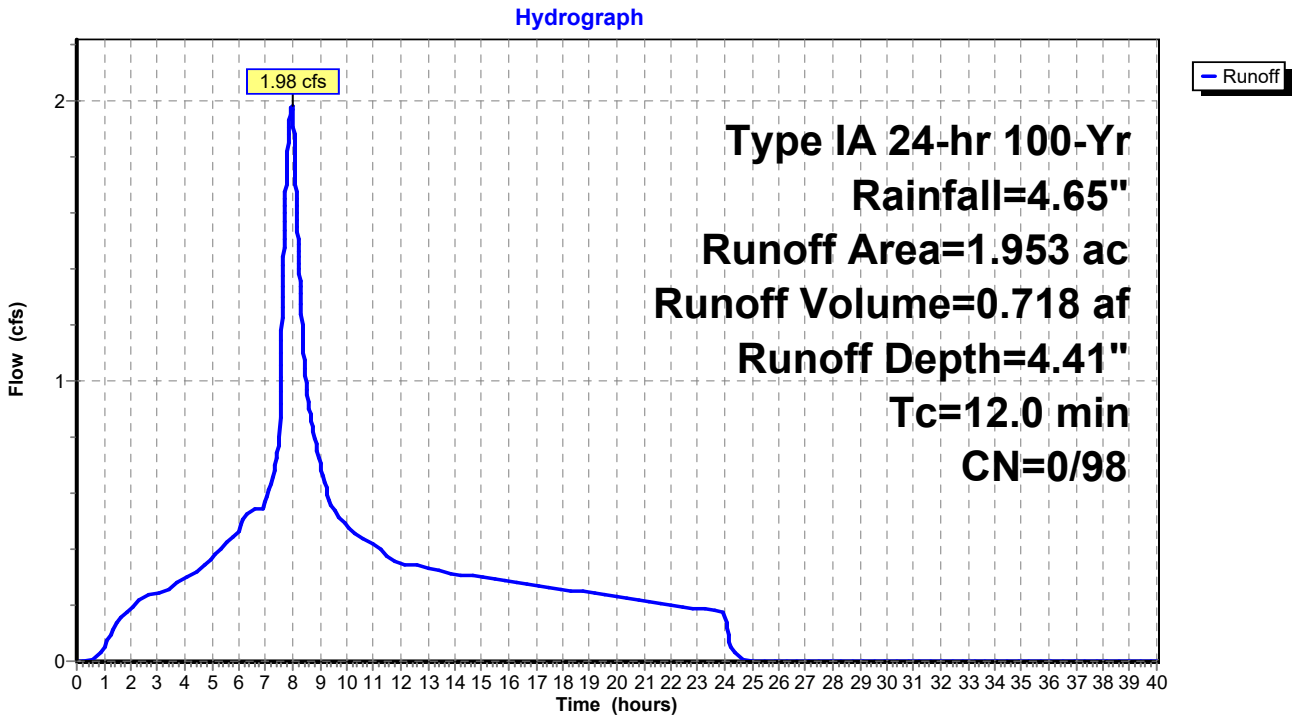
Runoff = 1.98 cfs @ 7.99 hrs, Volume= 0.718 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

	Area (ac)	CN	Description
*	1.953	98	
	1.953	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, 8C**

Subcatchment 8: Basin 8



Summary for Subcatchment 10S: Package B Pavement

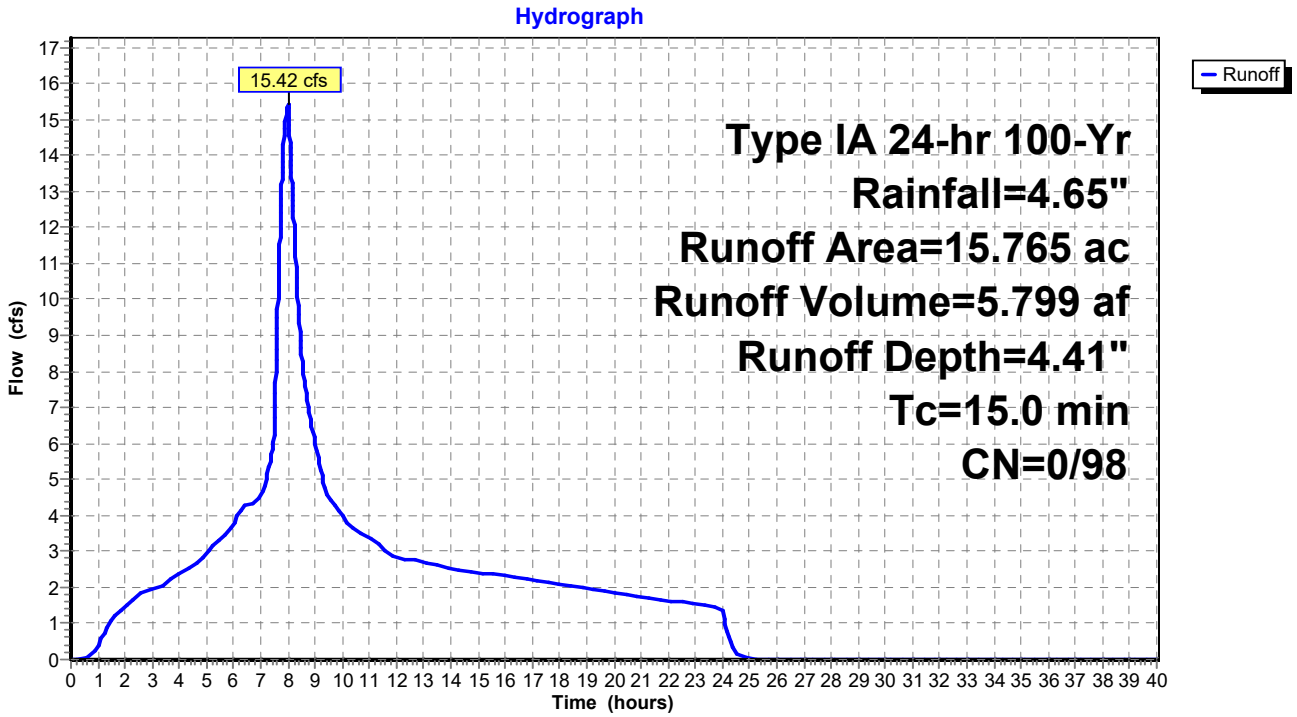
Runoff = 15.42 cfs @ 8.00 hrs, Volume= 5.799 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

Area (ac)	CN	Description
2.296	98	Paved roads w/curbs & sewers, HSG B
2.629	98	Paved roads w/curbs & sewers, HSG B
2.078	98	Paved roads w/curbs & sewers, HSG B
2.195	98	Paved roads w/curbs & sewers, HSG B
3.686	98	Paved roads w/curbs & sewers, HSG B
0.913	98	Paved roads w/curbs & sewers, HSG B
1.968	98	Paved roads w/curbs & sewers, HSG B
15.765	98	Weighted Average
15.765	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment 10S: Package B Pavement



Summary for Subcatchment A: Offsite Basin A

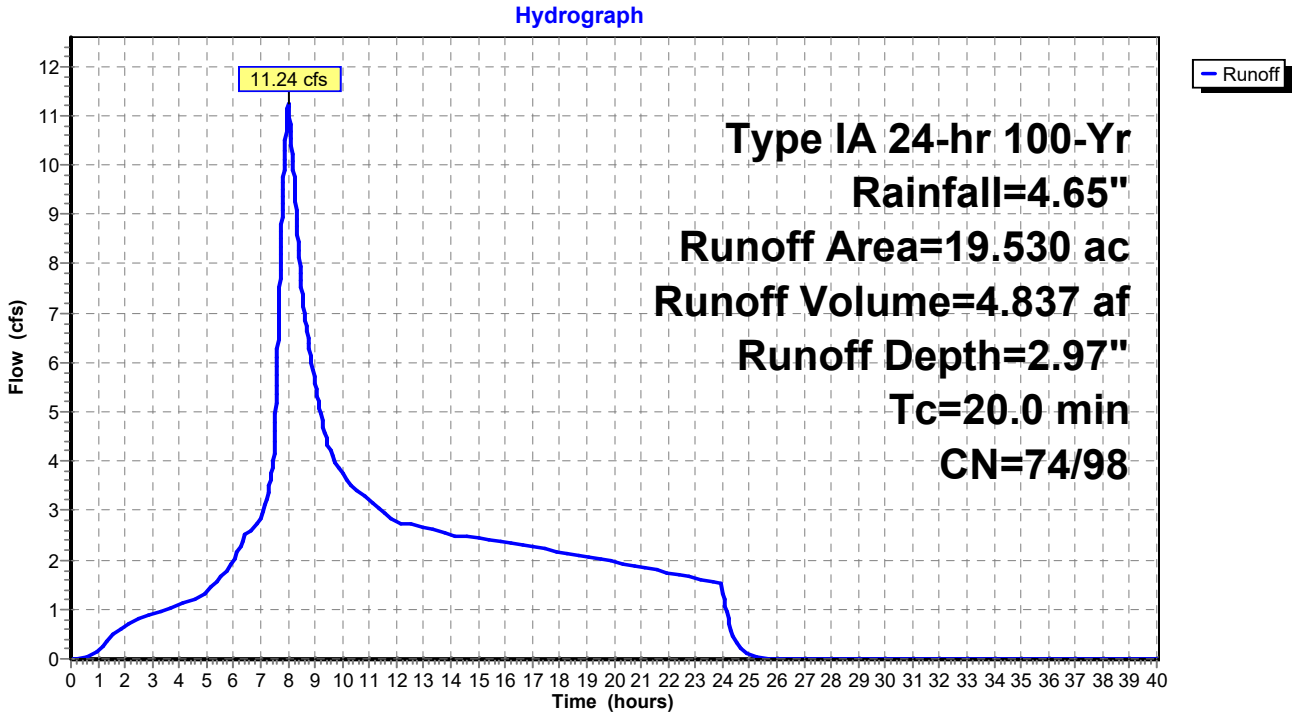
Runoff = 11.24 cfs @ 8.00 hrs, Volume= 4.837 af, Depth= 2.97"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

Area (ac)	CN	Description
19.530	83	1/4 acre lots, 38% imp, HSG C
12.109	74	62.00% Pervious Area
7.421	98	38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry, Rough estimate based on SCF formula**

Subcatchment A: Offsite Basin A



Summary for Subcatchment B: Offsite Basin B

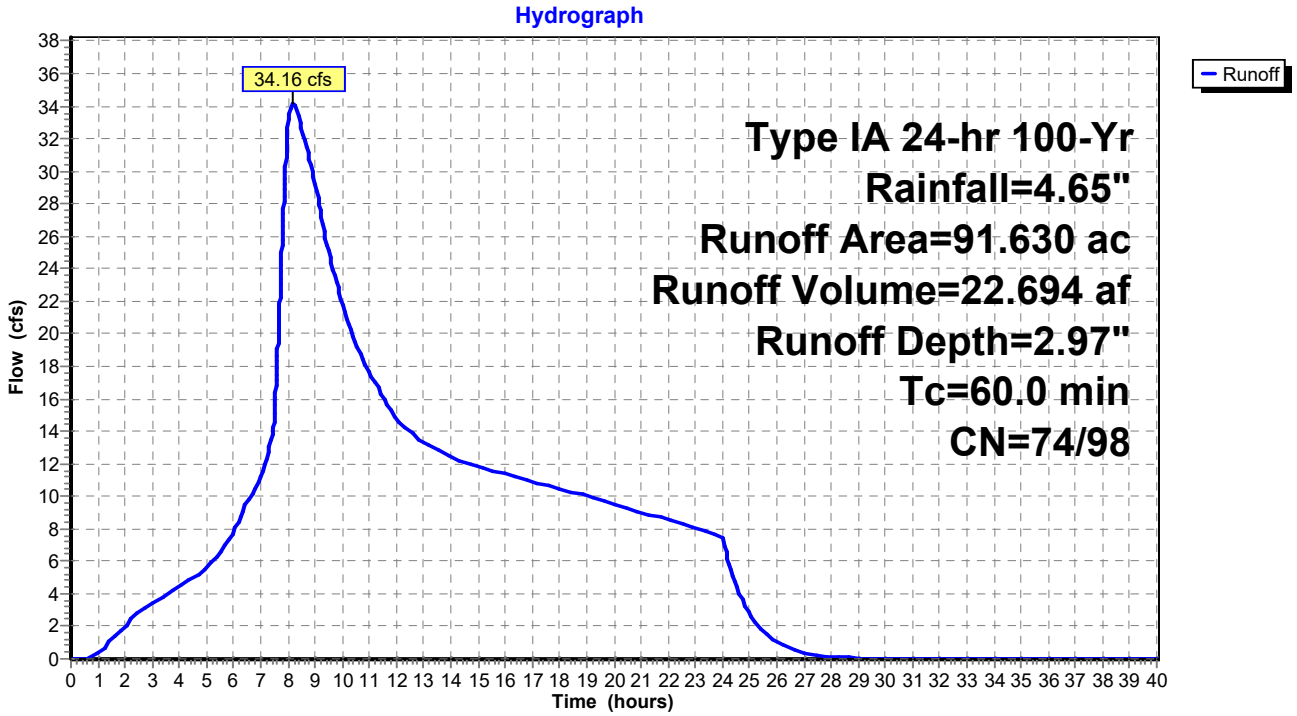
Runoff = 34.16 cfs @ 8.19 hrs, Volume= 22.694 af, Depth= 2.97"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

Area (ac)	CN	Description
91.630	83	1/4 acre lots, 38% imp, HSG C
56.811	74	62.00% Pervious Area
34.819	98	38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
60.0					**Direct Entry, Rough estimate based on SCF formula**

Subcatchment B: Offsite Basin B



Summary for Subcatchment OS-3: Basin OS 31

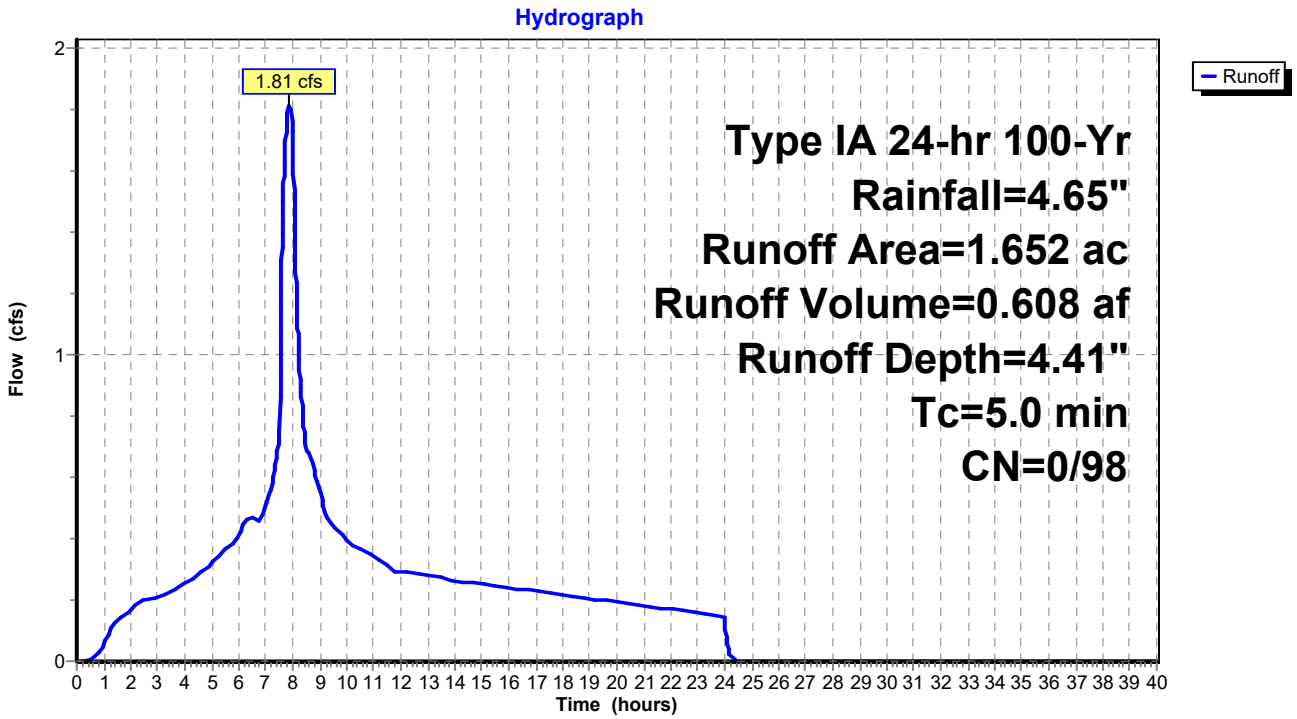
Runoff = 1.81 cfs @ 7.88 hrs, Volume= 0.608 af, Depth= 4.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-Yr Rainfall=4.65"

Area (ac)	CN	Description
1.652	98	Paved roads w/curbs & sewers, HSG B
1.652	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment OS-3: Basin OS 31



Summary for Pond 3P: (new Pond)

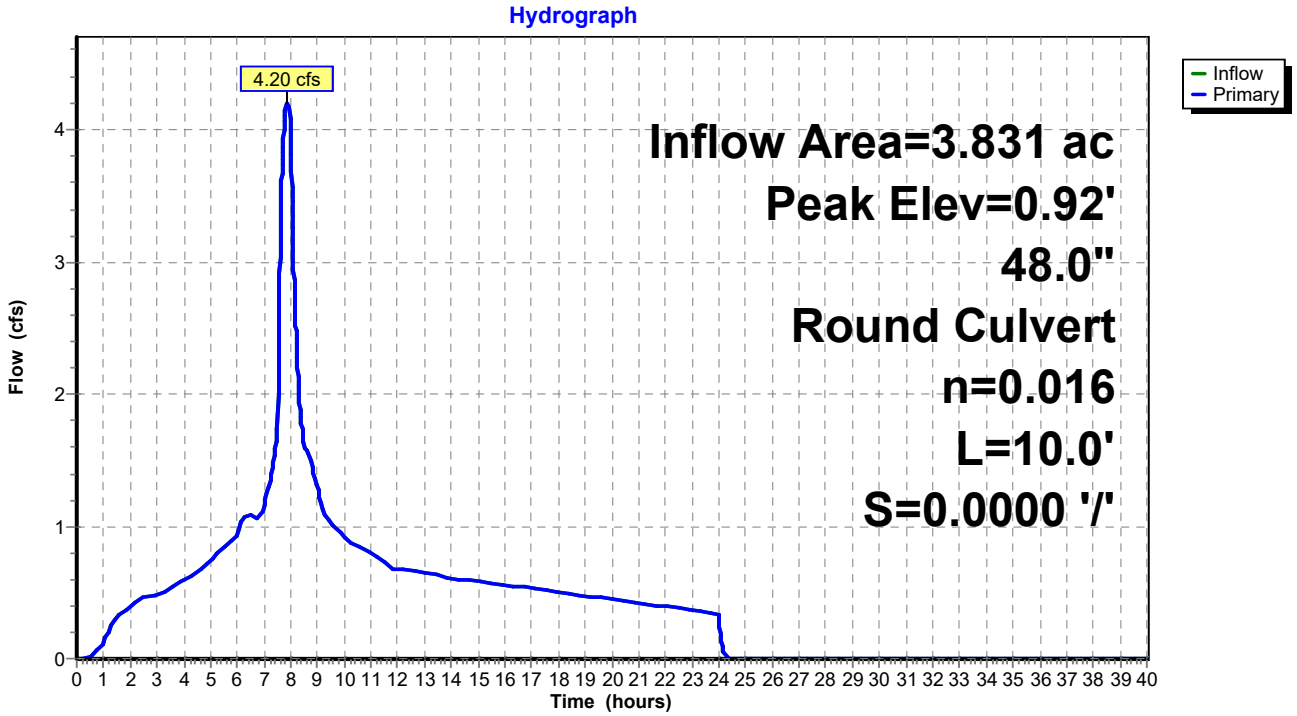
Inflow Area = 3.831 ac,100.00% Impervious, Inflow Depth = 4.41" for 100-Yr event
Inflow = 4.20 cfs @ 7.88 hrs, Volume= 1.409 af
Outflow = 4.20 cfs @ 7.88 hrs, Volume= 1.409 af, Atten= 0%, Lag= 0.0 min
Primary = 4.20 cfs @ 7.88 hrs, Volume= 1.409 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.92' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=4.20 cfs @ 7.88 hrs HW=0.92' (Free Discharge)
└─**1=Culvert** (Barrel Controls 4.20 cfs @ 2.92 fps)

Pond 3P: (new Pond)



Summary for Pond 4P: (new Pond)

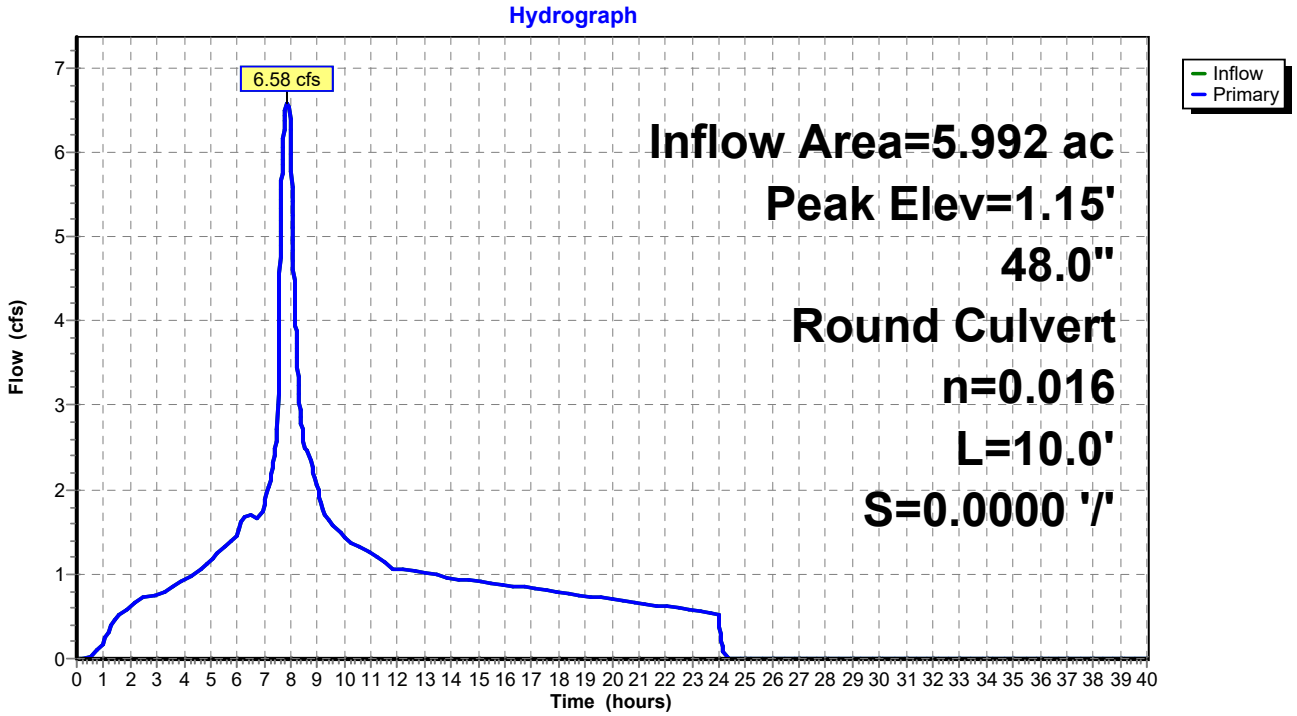
Inflow Area = 5.992 ac,100.00% Impervious, Inflow Depth = 4.41" for 100-Yr event
Inflow = 6.58 cfs @ 7.88 hrs, Volume= 2.204 af
Outflow = 6.58 cfs @ 7.88 hrs, Volume= 2.204 af, Atten= 0%, Lag= 0.0 min
Primary = 6.58 cfs @ 7.88 hrs, Volume= 2.204 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 1.15' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=6.57 cfs @ 7.88 hrs HW=1.15' (Free Discharge)
└**1=Culvert** (Barrel Controls 6.57 cfs @ 3.31 fps)

Pond 4P: (new Pond)



Summary for Pond 5P: (new Pond)

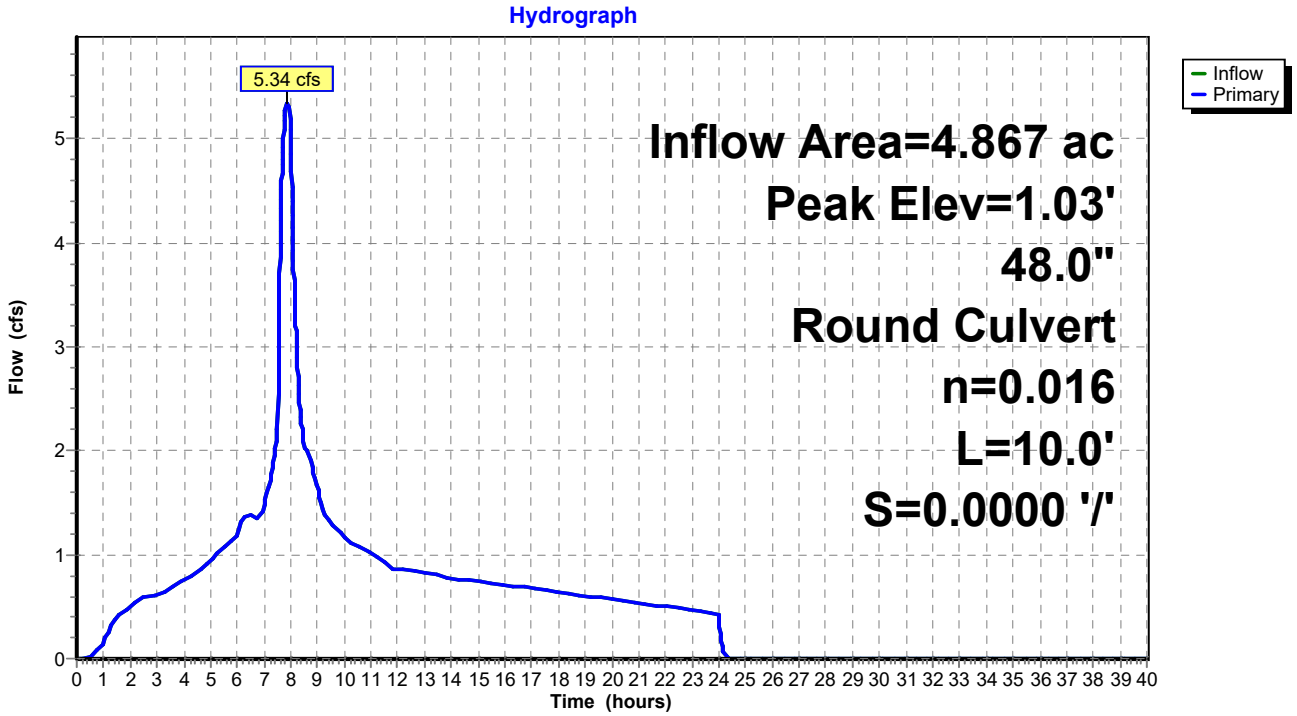
Inflow Area = 4.867 ac,100.00% Impervious, Inflow Depth = 4.41" for 100-Yr event
Inflow = 5.34 cfs @ 7.88 hrs, Volume= 1.790 af
Outflow = 5.34 cfs @ 7.88 hrs, Volume= 1.790 af, Atten= 0%, Lag= 0.0 min
Primary = 5.34 cfs @ 7.88 hrs, Volume= 1.790 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 1.03' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=5.34 cfs @ 7.88 hrs HW=1.03' (Free Discharge)
└**1=Culvert** (Barrel Controls 5.34 cfs @ 3.12 fps)

Pond 5P: (new Pond)



Summary for Pond 6P: (new Pond)

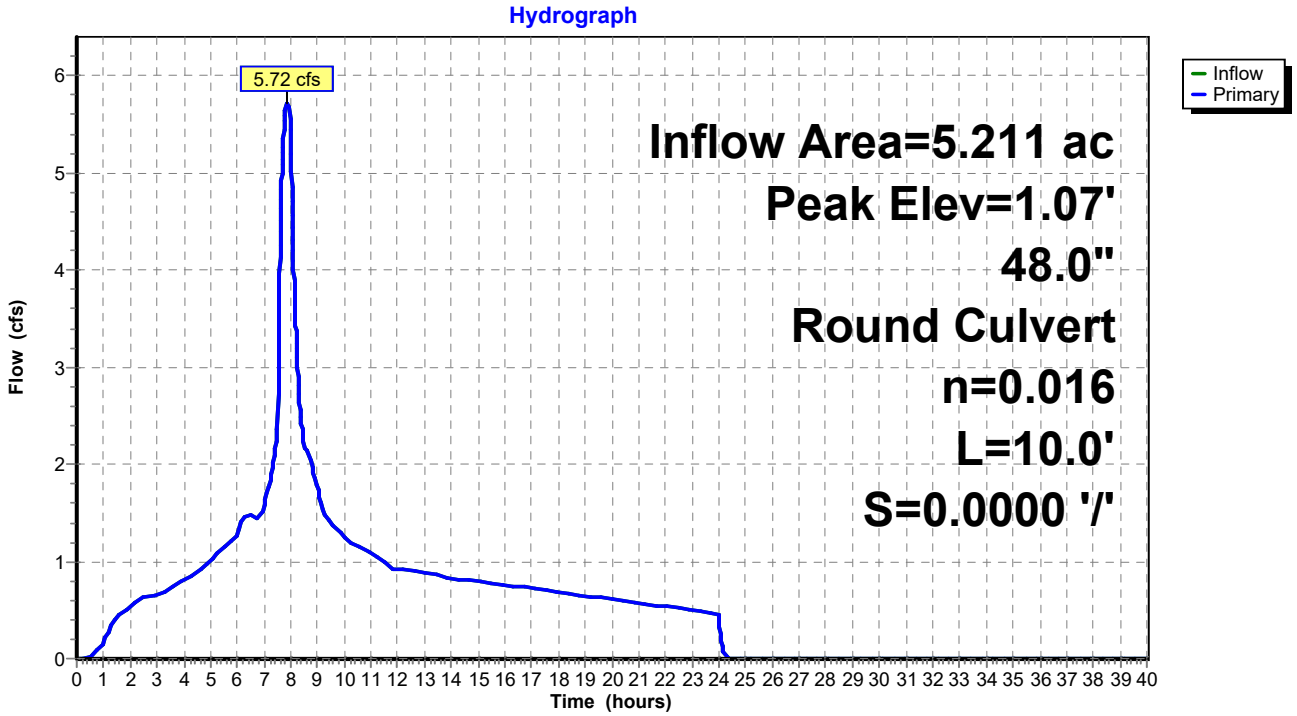
Inflow Area = 5.211 ac,100.00% Impervious, Inflow Depth = 4.41" for 100-Yr event
Inflow = 5.72 cfs @ 7.88 hrs, Volume= 1.917 af
Outflow = 5.72 cfs @ 7.88 hrs, Volume= 1.917 af, Atten= 0%, Lag= 0.0 min
Primary = 5.72 cfs @ 7.88 hrs, Volume= 1.917 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 1.07' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=5.72 cfs @ 7.88 hrs HW=1.07' (Free Discharge)
└─**1=Culvert** (Barrel Controls 5.72 cfs @ 3.18 fps)

Pond 6P: (new Pond)



Summary for Pond 7P: (new Pond)

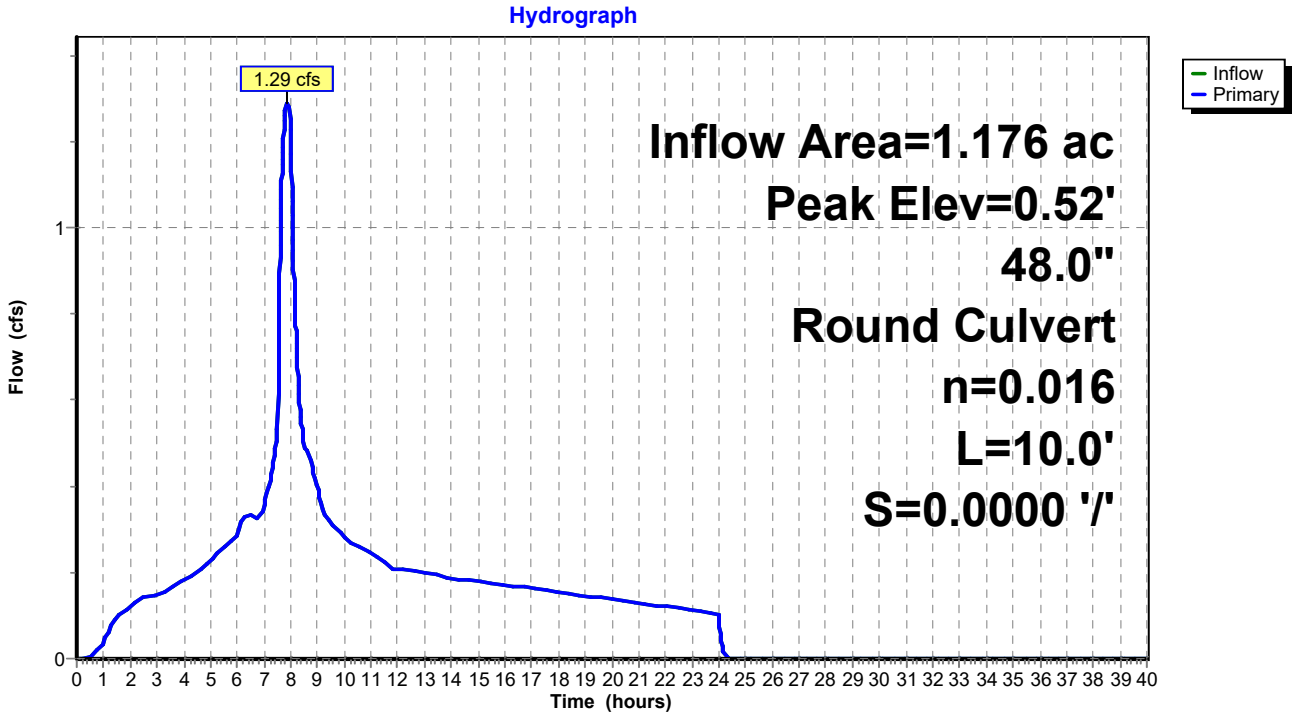
Inflow Area = 1.176 ac,100.00% Impervious, Inflow Depth = 4.41" for 100-Yr event
Inflow = 1.29 cfs @ 7.88 hrs, Volume= 0.433 af
Outflow = 1.29 cfs @ 7.88 hrs, Volume= 0.433 af, Atten= 0%, Lag= 0.0 min
Primary = 1.29 cfs @ 7.88 hrs, Volume= 0.433 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.52' @ 7.88 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=1.29 cfs @ 7.88 hrs HW=0.52' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.29 cfs @ 2.05 fps)

Pond 7P: (new Pond)



Summary for Pond 10P: Offsite Flows

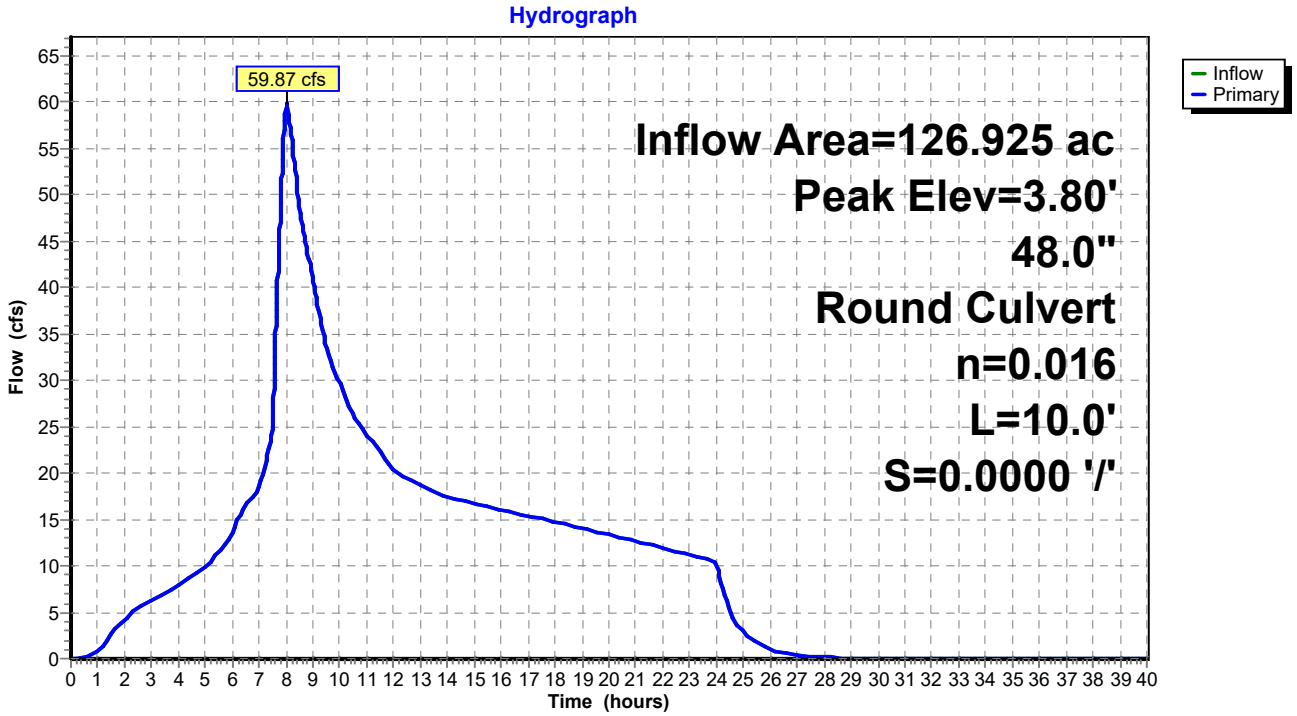
Inflow Area = 126.925 ac, 45.70% Impervious, Inflow Depth = 3.15" for 100-Yr event
Inflow = 59.87 cfs @ 8.01 hrs, Volume= 33.330 af
Outflow = 59.87 cfs @ 8.01 hrs, Volume= 33.330 af, Atten= 0%, Lag= 0.0 min
Primary = 59.87 cfs @ 8.01 hrs, Volume= 33.330 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 3.80' @ 8.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=59.87 cfs @ 8.01 hrs HW=3.80' (Free Discharge)
└**1=Culvert** (Barrel Controls 59.87 cfs @ 6.26 fps)

Pond 10P: Offsite Flows



Time span=0.00-40.00 hrs, dt=0.01 hrs, 4001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2: Basin 20 Runoff Area=3.080 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.80 cfs 0.258 af

Subcatchment3: Basin 30 Runoff Area=2.179 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.57 cfs 0.183 af

Subcatchment4: Basin 40 Runoff Area=0.396 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.10 cfs 0.033 af

Subcatchment4-1: Basin 41 Runoff Area=4.560 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=1.19 cfs 0.382 af

Subcatchment4-2: Basin 42 Runoff Area=0.698 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.18 cfs 0.058 af

Subcatchment4-3: Basin 43 Runoff Area=0.338 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.09 cfs 0.028 af

Subcatchment5: Basin 50 Runoff Area=0.719 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.19 cfs 0.060 af

Subcatchment5-1: Basin 51 Runoff Area=0.578 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.15 cfs 0.048 af

Subcatchment5-2: Basin 52 Runoff Area=3.570 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.93 cfs 0.299 af

Subcatchment6: Basin 60 Runoff Area=2.299 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.60 cfs 0.193 af

Subcatchment6-1: Basin 61 Runoff Area=0.474 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.12 cfs 0.040 af

Subcatchment6-2: Basin 62 Runoff Area=2.315 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.60 cfs 0.194 af

Subcatchment6-3: Basin 63 Runoff Area=0.123 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.03 cfs 0.010 af

Subcatchment7: Basin 70 Runoff Area=0.287 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.07 cfs 0.024 af

Subcatchment7-1: Basin 71 Runoff Area=0.333 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.09 cfs 0.028 af

Subcatchment7-2: Basin 72 Runoff Area=0.556 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.14 cfs 0.047 af

Subcatchment8: Basin 8 Runoff Area=1.953 ac 100.00% Impervious Runoff Depth=1.01"
Tc=12.0 min CN=0/98 Runoff=0.47 cfs 0.164 af

Subcatchment10S: Package B Pavement Runoff Area=15.765 ac 100.00% Impervious Runoff Depth=1.01"
Tc=15.0 min CN=0/98 Runoff=3.65 cfs 1.321 af

SubcatchmentA: Offsite Basin A Runoff Area=19.530 ac 38.00% Impervious Runoff Depth=0.42"
Tc=20.0 min CN=74/98 Runoff=1.60 cfs 0.689 af

SubcatchmentB: Offsite Basin B Runoff Area=91.630 ac 38.00% Impervious Runoff Depth=0.42"
Tc=60.0 min CN=74/98 Runoff=4.94 cfs 3.231 af

SubcatchmentOS-3: Basin OS 31 Runoff Area=1.652 ac 100.00% Impervious Runoff Depth=1.01"
Tc=5.0 min CN=0/98 Runoff=0.43 cfs 0.138 af

Pond 3P: (new Pond) Peak Elev=0.46' Inflow=1.00 cfs 0.321 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=1.00 cfs 0.321 af

Pond 4P: (new Pond) Peak Elev=0.57' Inflow=1.56 cfs 0.502 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=1.56 cfs 0.502 af

Pond 5P: (new Pond) Peak Elev=0.51' Inflow=1.27 cfs 0.408 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=1.27 cfs 0.408 af

Pond 6P: (new Pond) Peak Elev=0.53' Inflow=1.36 cfs 0.437 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=1.36 cfs 0.437 af

Pond 7P: (new Pond) Peak Elev=0.27' Inflow=0.31 cfs 0.099 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=0.31 cfs 0.099 af

Pond 10P: Offsite Flows Peak Elev=1.43' Inflow=10.11 cfs 5.240 af
48.0" Round Culvert n=0.016 L=10.0' S=0.0000 '/' Outflow=10.11 cfs 5.240 af

Summary for Subcatchment 2: Basin 20

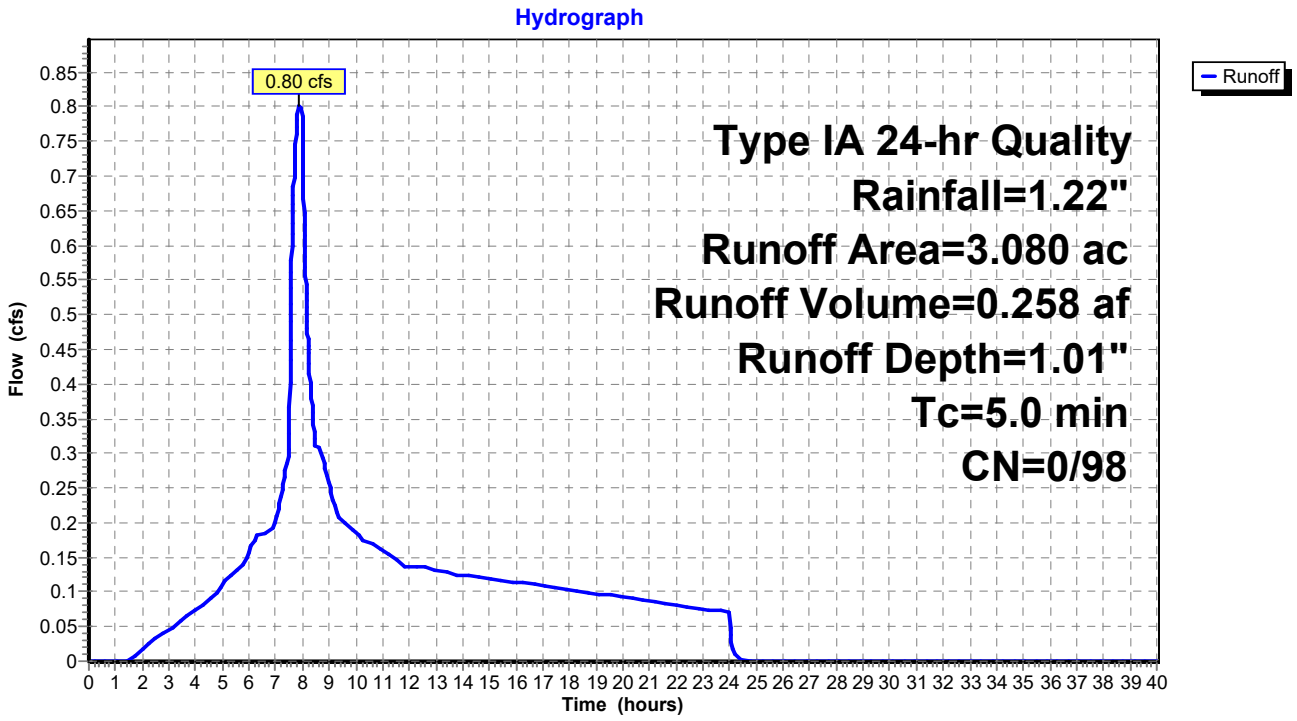
Runoff = 0.80 cfs @ 7.89 hrs, Volume= 0.258 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	3.080	98	
	3.080	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2: Basin 20



Summary for Subcatchment 3: Basin 30

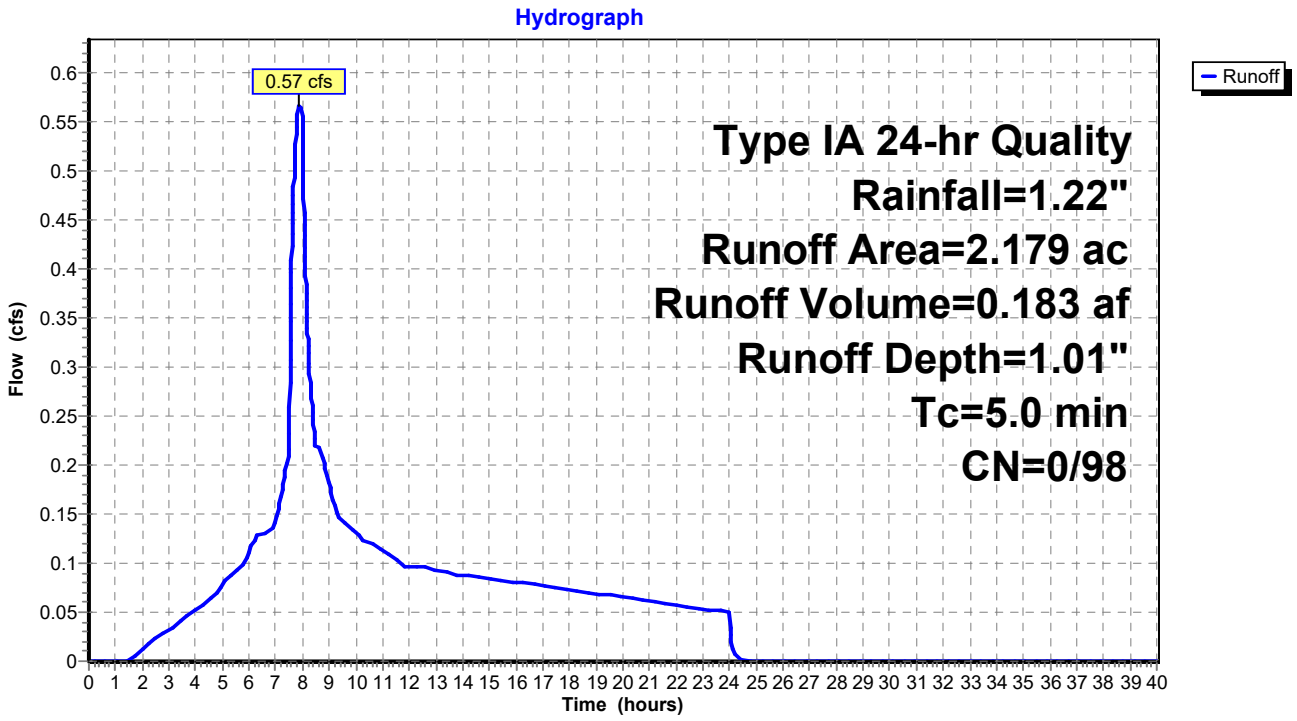
Runoff = 0.57 cfs @ 7.89 hrs, Volume= 0.183 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	2.179	98	
	2.179	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3: Basin 30



Summary for Subcatchment 4: Basin 40

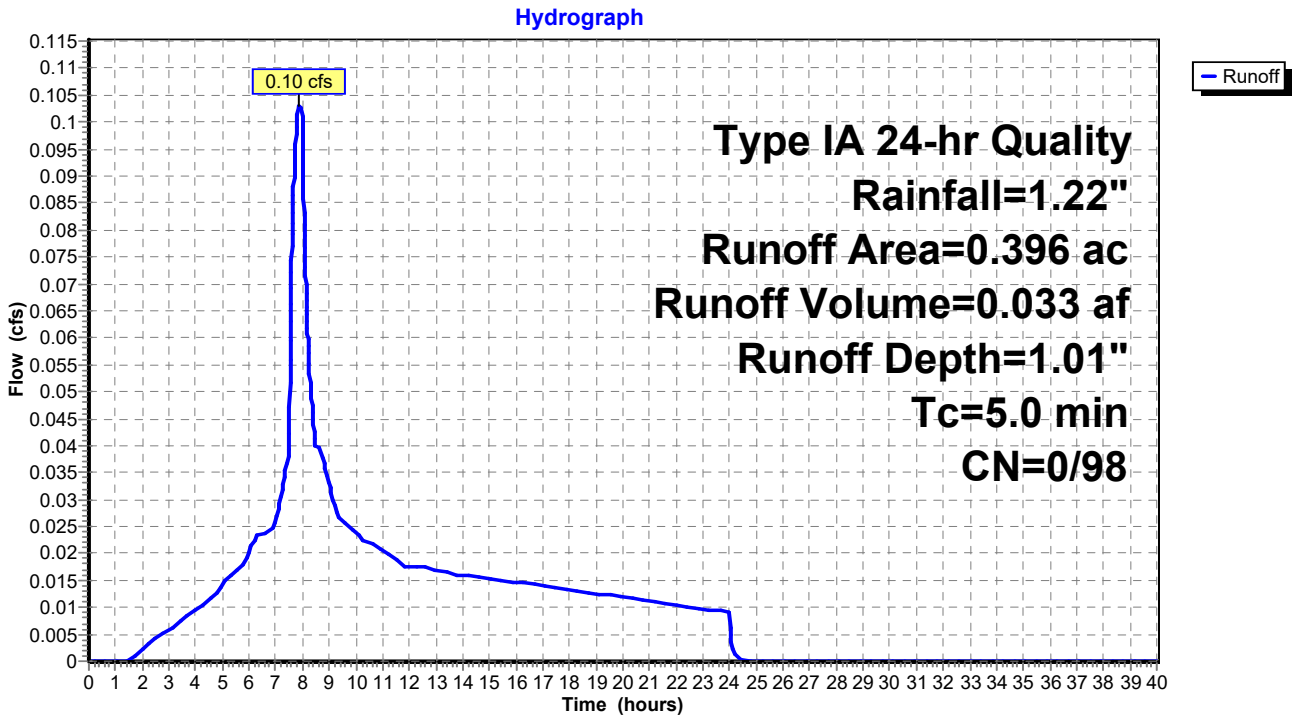
Runoff = 0.10 cfs @ 7.89 hrs, Volume= 0.033 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.396	98	
	0.396	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4: Basin 40



Summary for Subcatchment 4-1: Basin 41

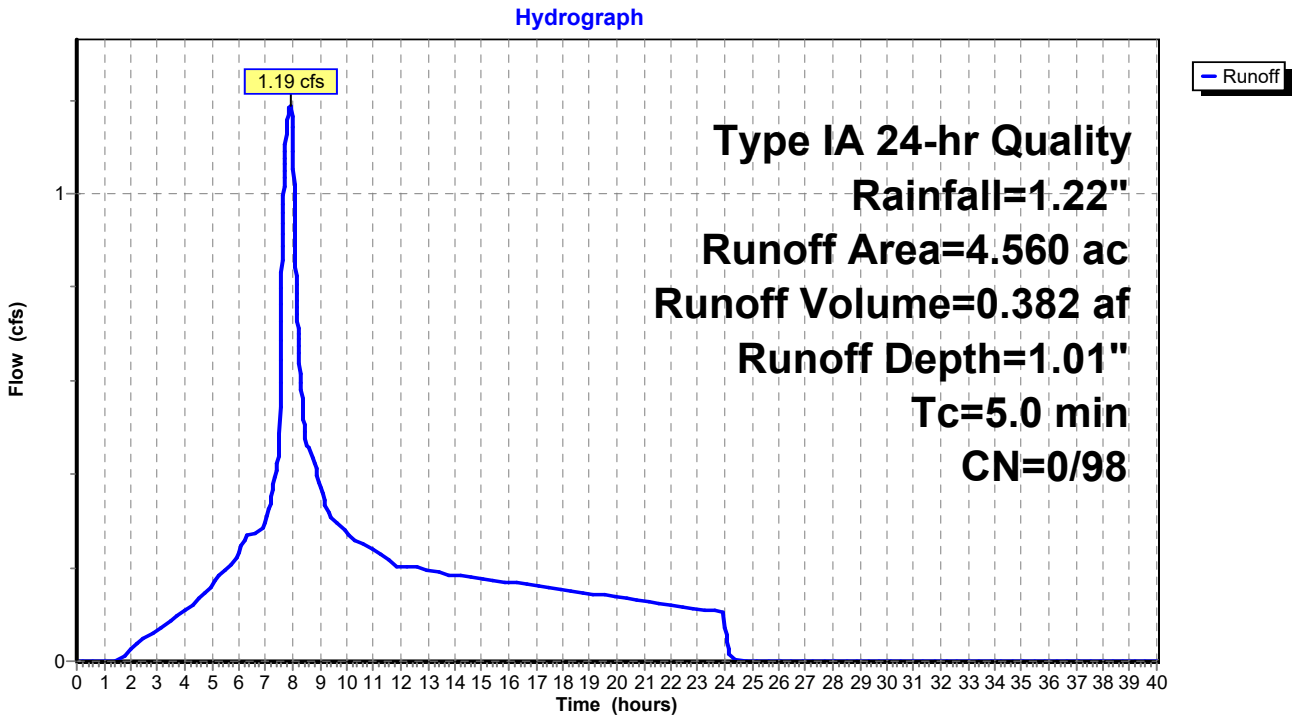
Runoff = 1.19 cfs @ 7.89 hrs, Volume= 0.382 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	4.560	98	
	4.560	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-1: Basin 41



Summary for Subcatchment 4-2: Basin 42

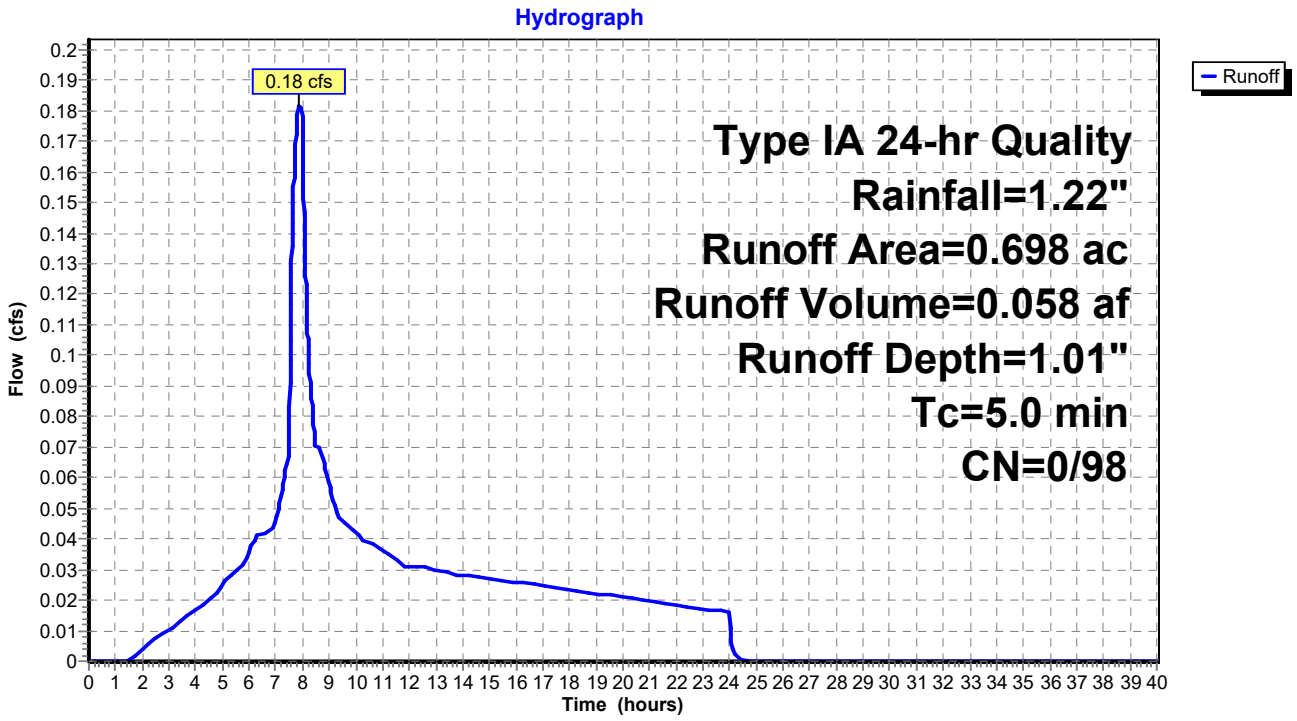
Runoff = 0.18 cfs @ 7.89 hrs, Volume= 0.058 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.698	98	
	0.698	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-2: Basin 42



Summary for Subcatchment 4-3: Basin 43

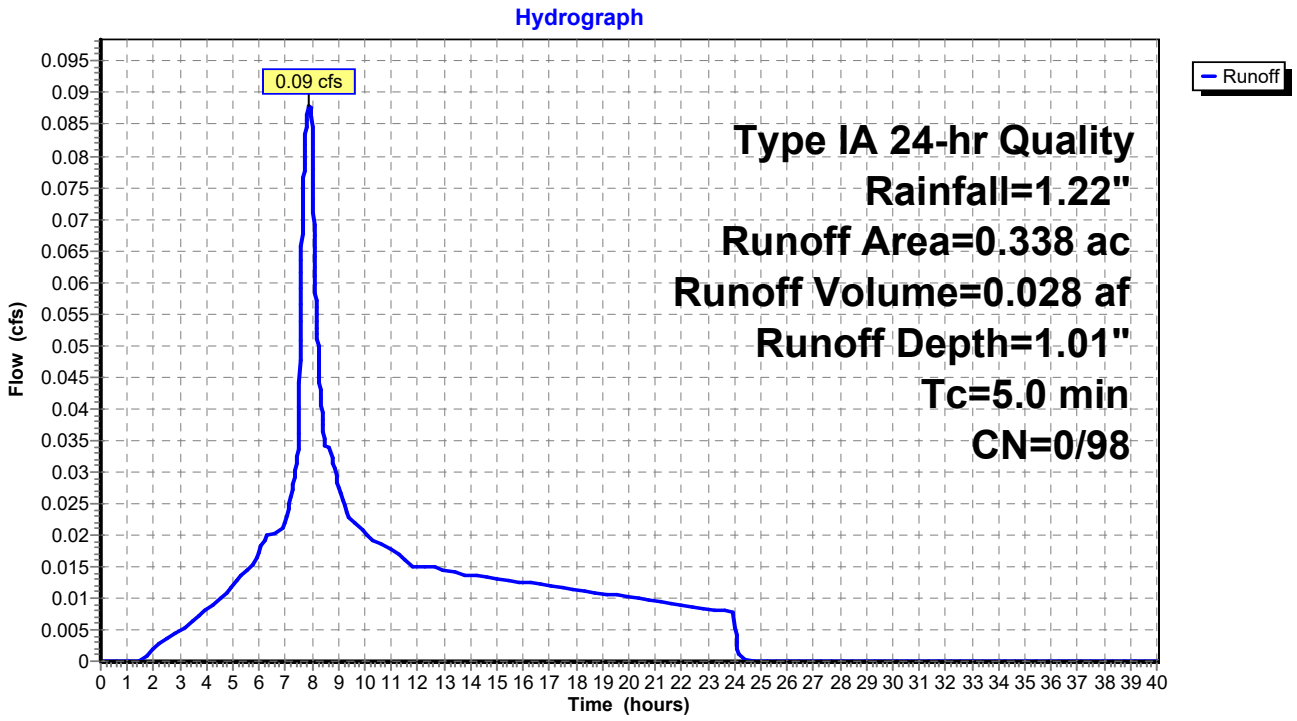
Runoff = 0.09 cfs @ 7.89 hrs, Volume= 0.028 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.338	98	
	0.338	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4-3: Basin 43



Summary for Subcatchment 5: Basin 50

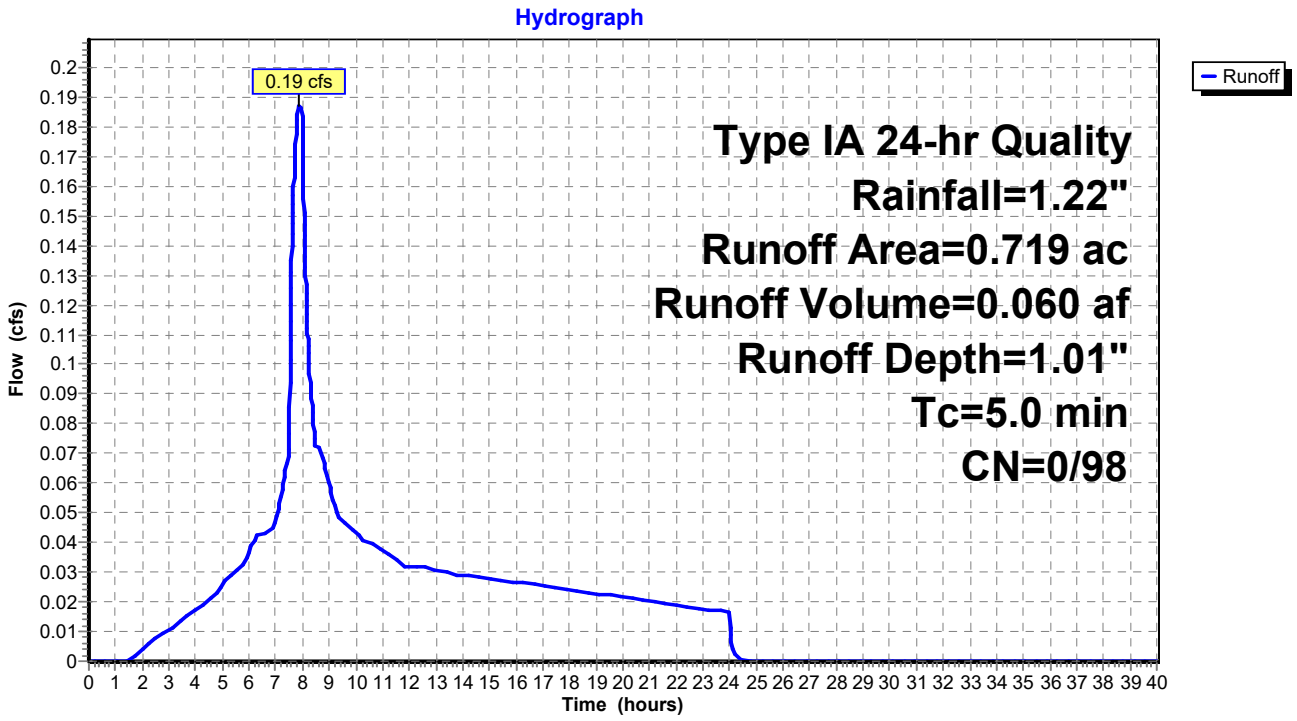
Runoff = 0.19 cfs @ 7.89 hrs, Volume= 0.060 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.719	98	
	0.719	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5: Basin 50



Summary for Subcatchment 5-1: Basin 51

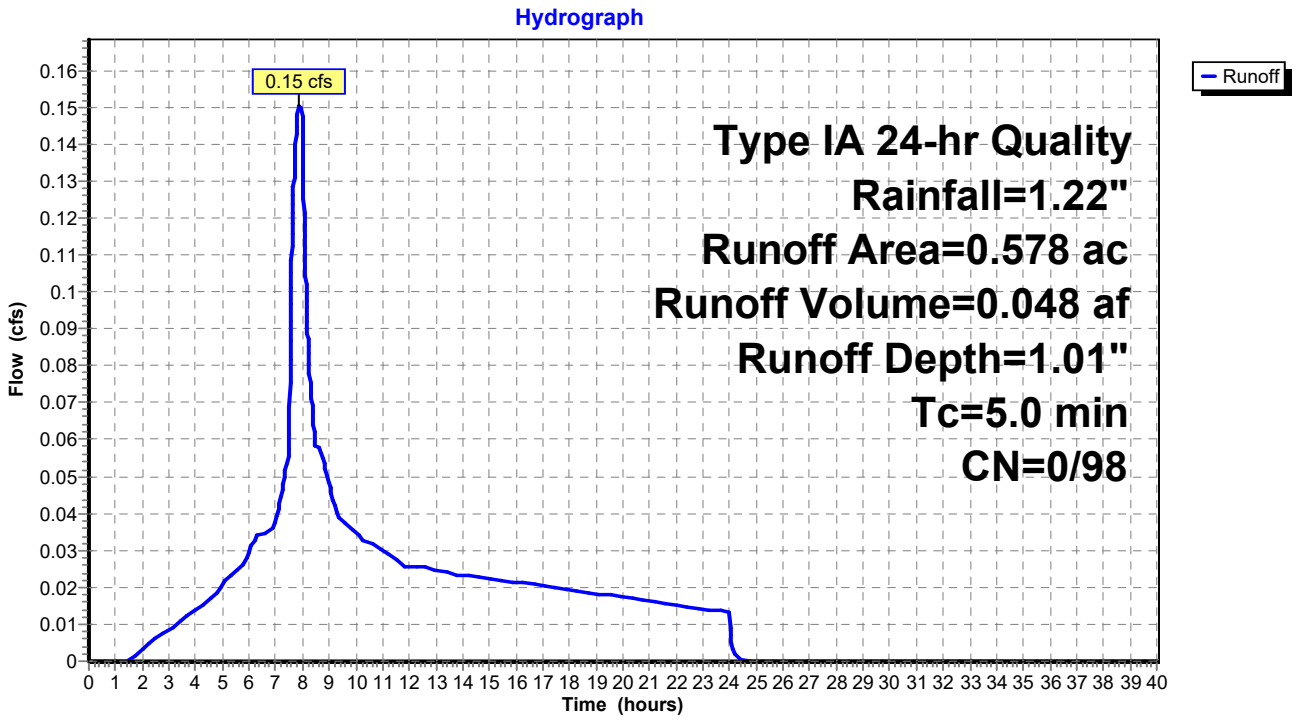
Runoff = 0.15 cfs @ 7.89 hrs, Volume= 0.048 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.578	98	
	0.578	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5-1: Basin 51



Summary for Subcatchment 5-2: Basin 52

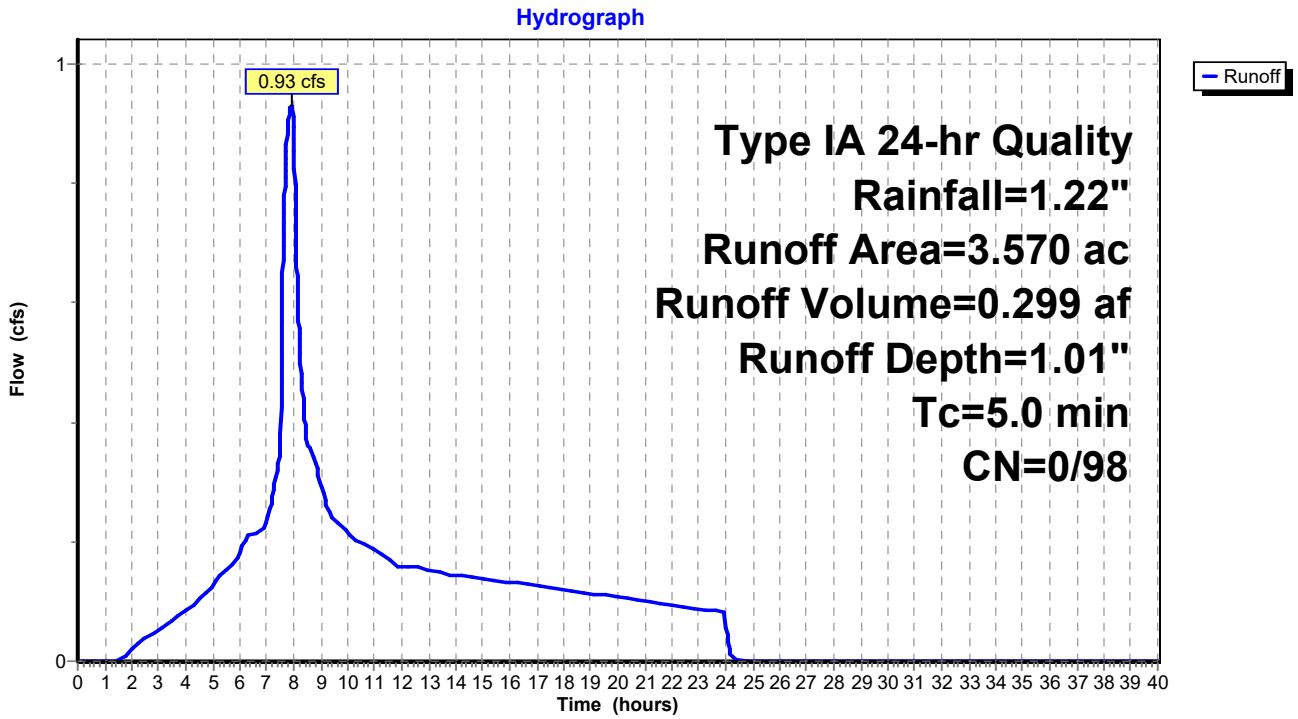
Runoff = 0.93 cfs @ 7.89 hrs, Volume= 0.299 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	3.570	98	
	3.570	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5-2: Basin 52



Summary for Subcatchment 6: Basin 60

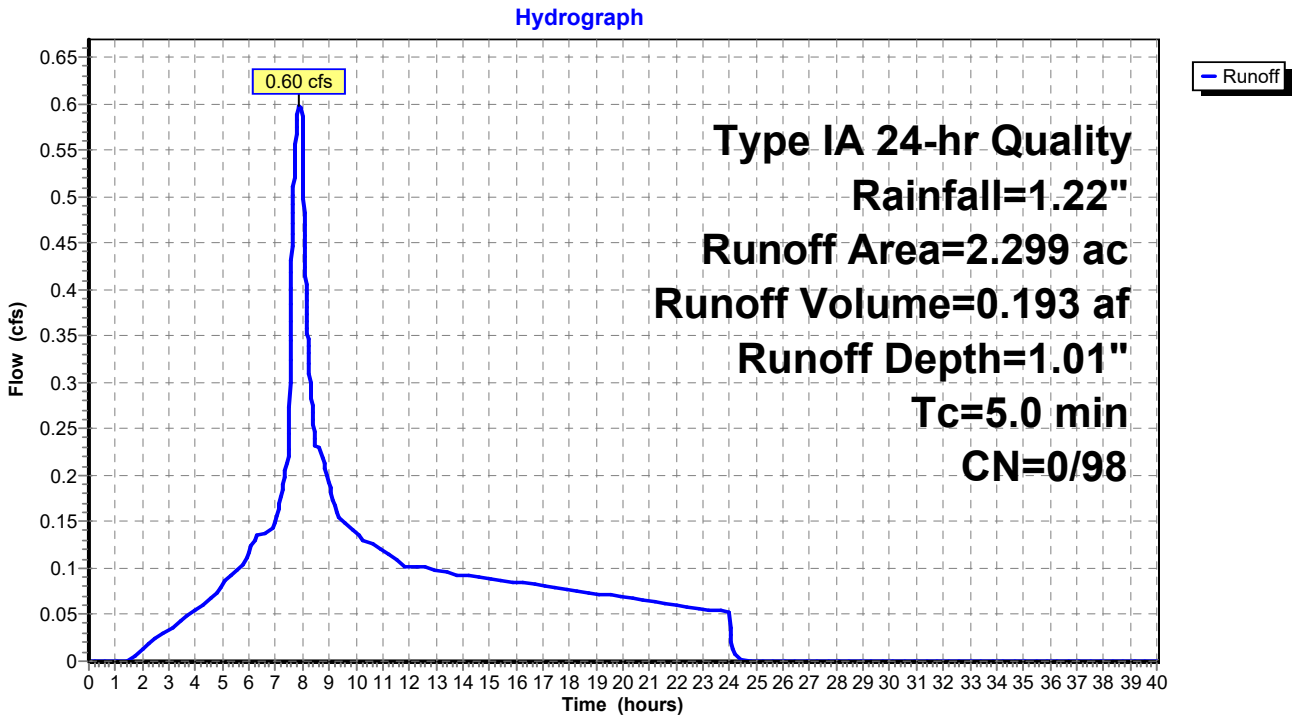
Runoff = 0.60 cfs @ 7.89 hrs, Volume= 0.193 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	2.299	98	
	2.299	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6: Basin 60



Summary for Subcatchment 6-1: Basin 61

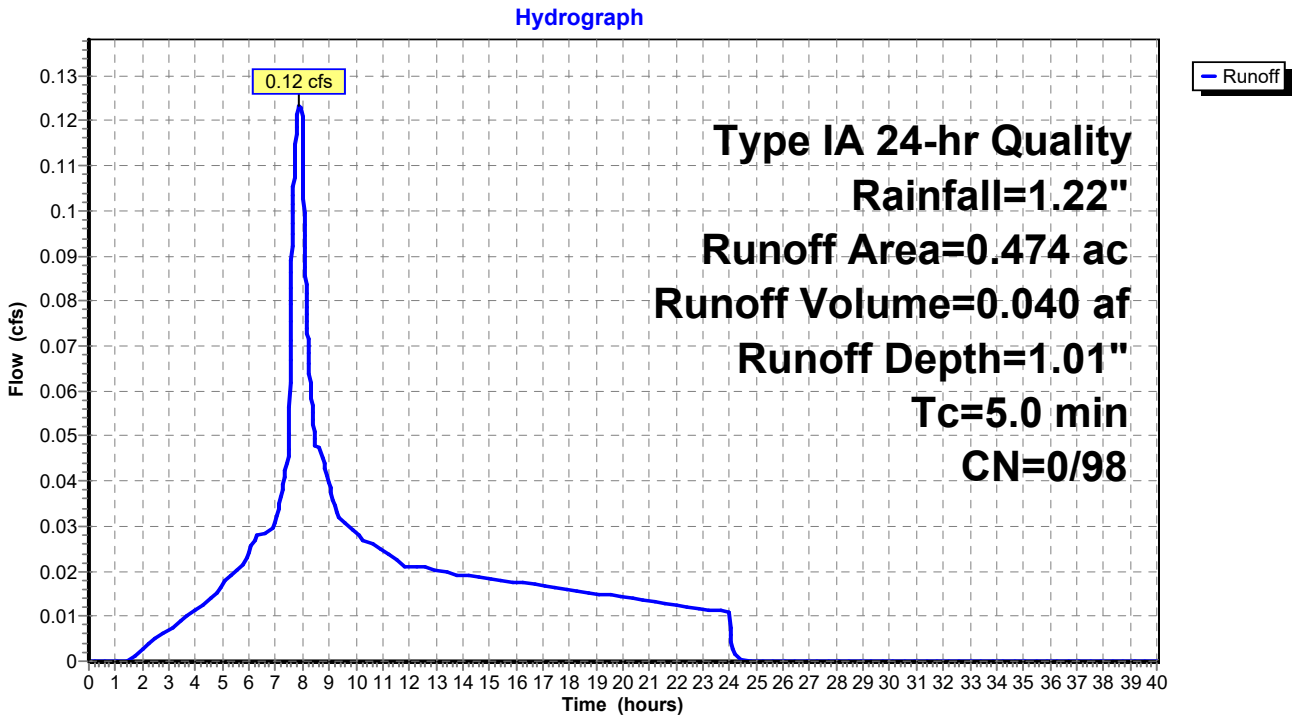
Runoff = 0.12 cfs @ 7.89 hrs, Volume= 0.040 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.474	98	
	0.474	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-1: Basin 61



Summary for Subcatchment 6-2: Basin 62

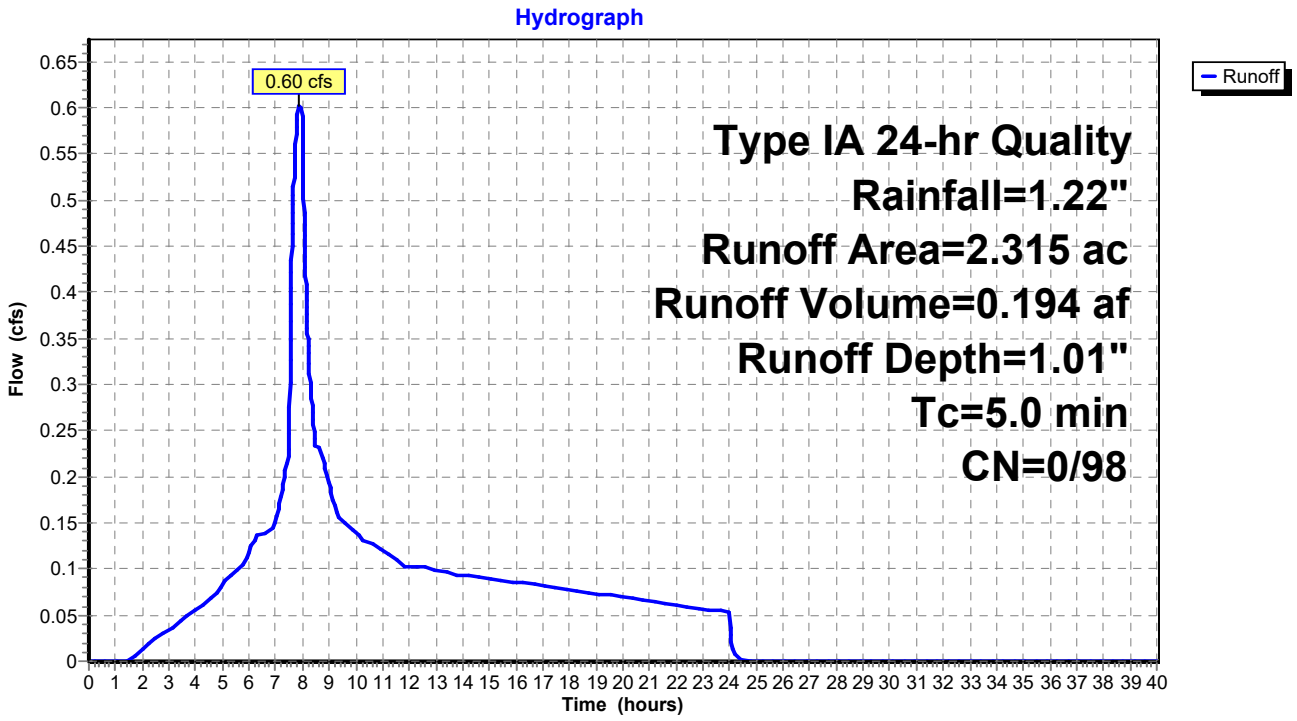
Runoff = 0.60 cfs @ 7.89 hrs, Volume= 0.194 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	2.315	98	
	2.315	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-2: Basin 62



Summary for Subcatchment 6-3: Basin 63

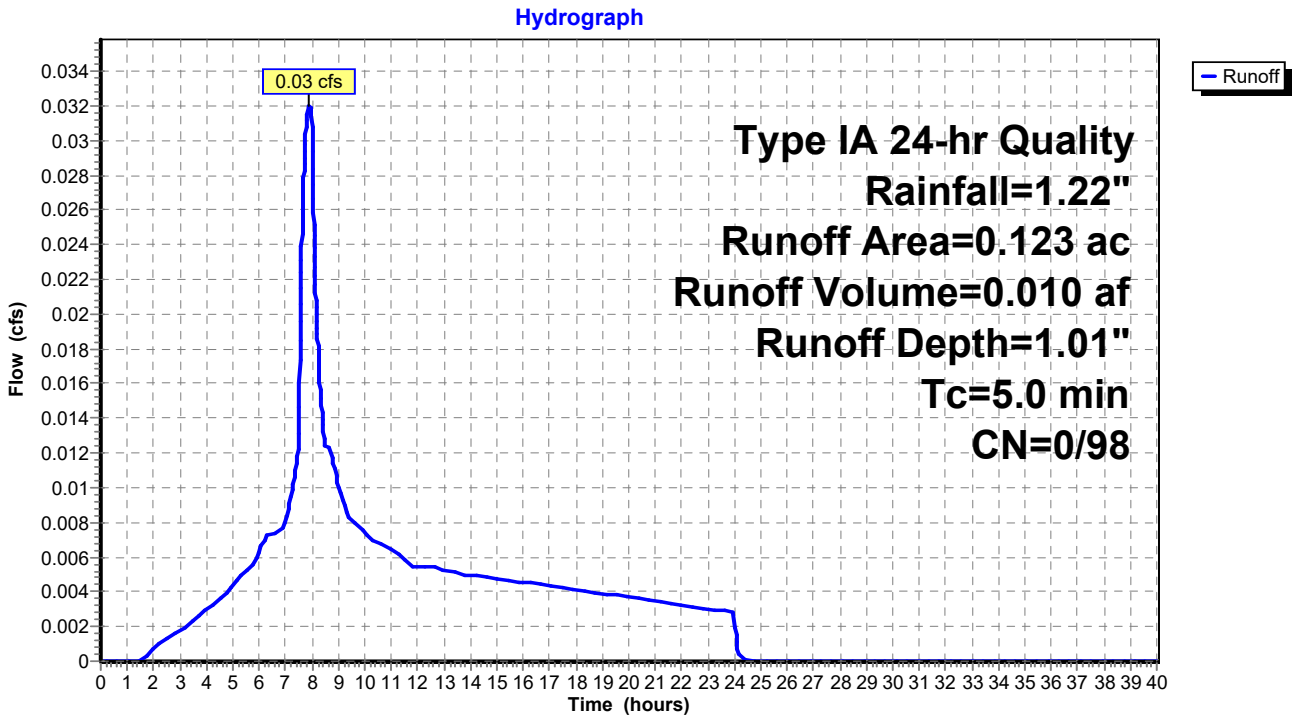
Runoff = 0.03 cfs @ 7.89 hrs, Volume= 0.010 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.123	98	
	0.123	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6-3: Basin 63



Summary for Subcatchment 7: Basin 70

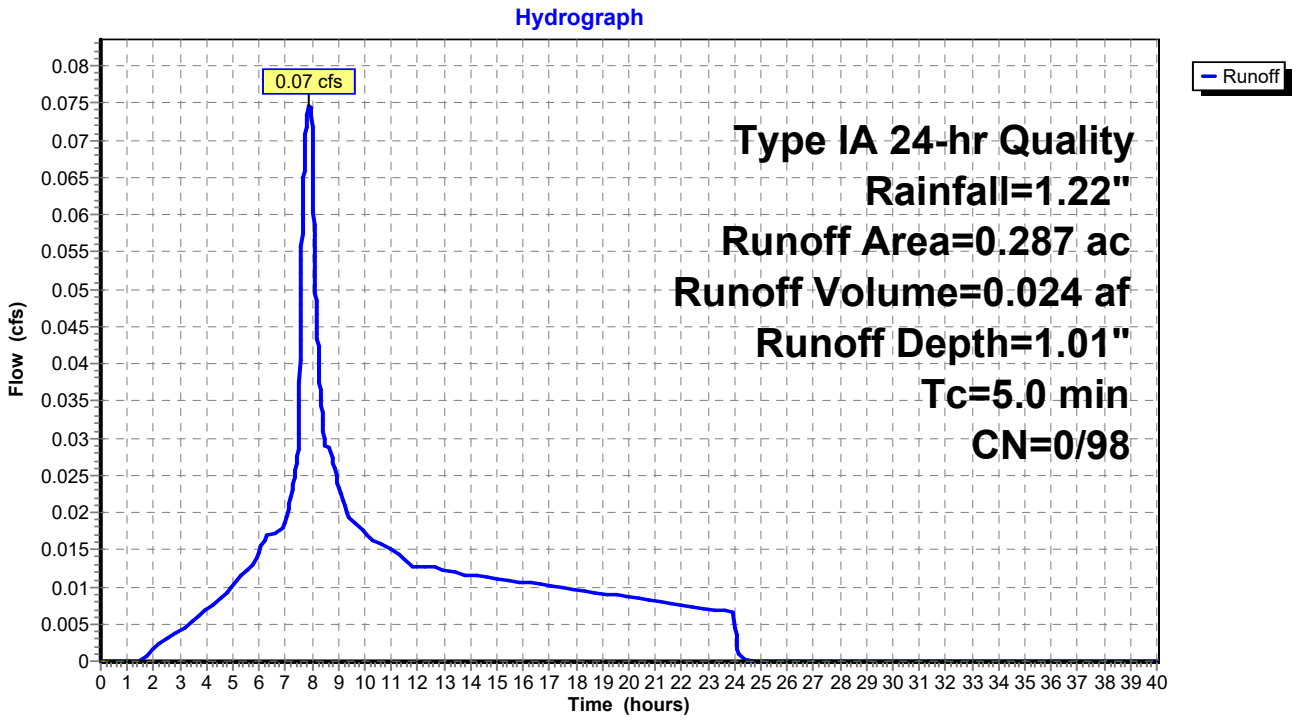
Runoff = 0.07 cfs @ 7.89 hrs, Volume= 0.024 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.287	98	
	0.287	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7: Basin 70



Summary for Subcatchment 7-1: Basin 71

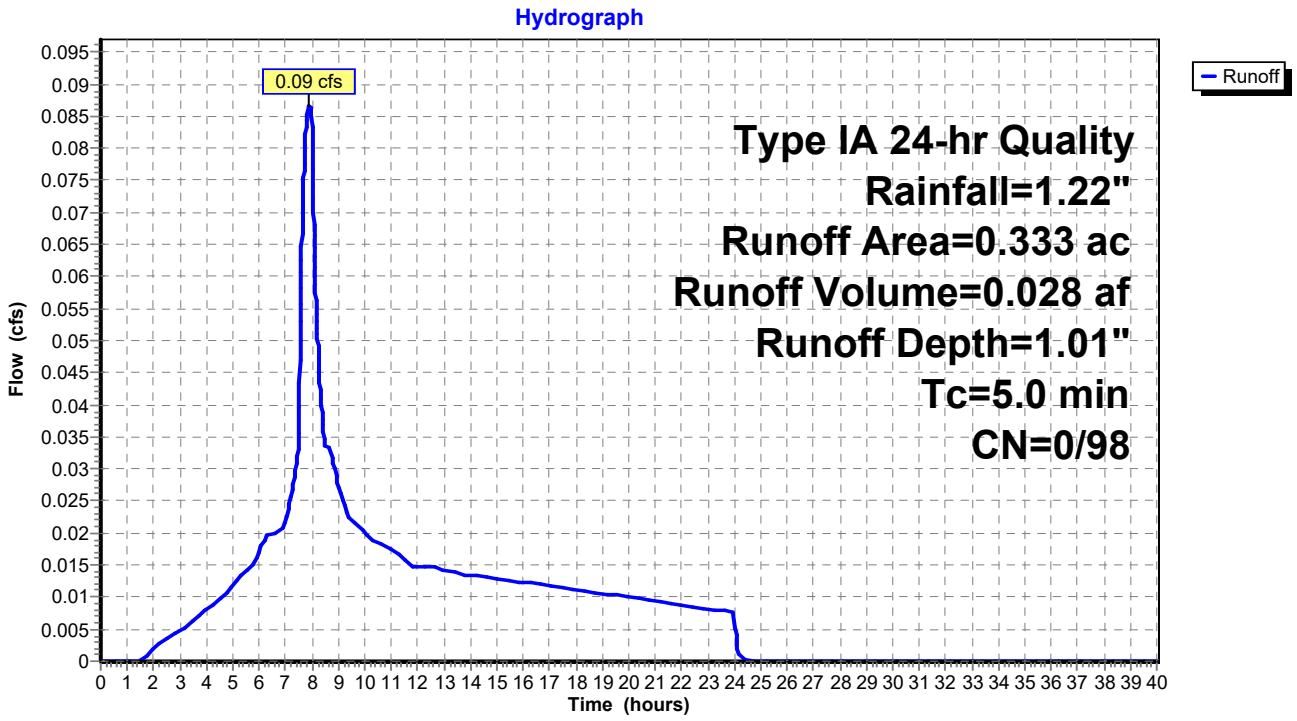
Runoff = 0.09 cfs @ 7.89 hrs, Volume= 0.028 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.333	98	
	0.333	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7-1: Basin 71



Summary for Subcatchment 7-2: Basin 72

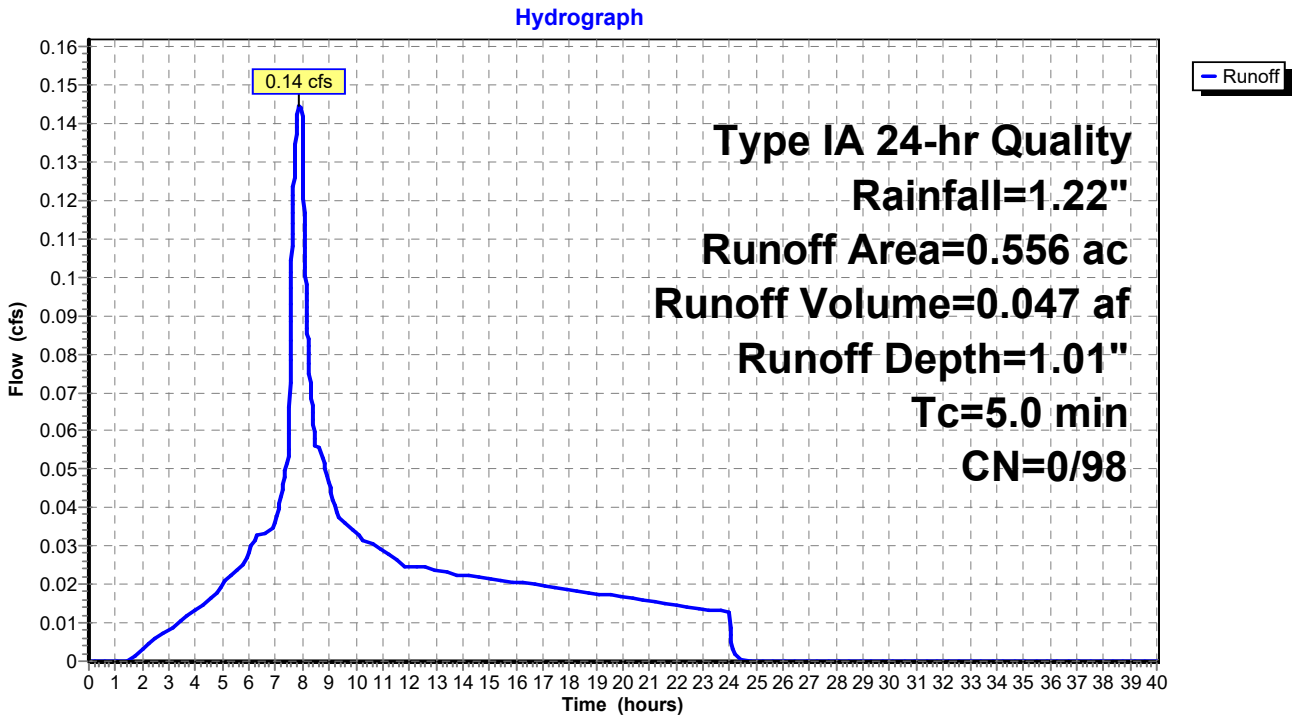
Runoff = 0.14 cfs @ 7.89 hrs, Volume= 0.047 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	0.556	98	
	0.556	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 7-2: Basin 72



Summary for Subcatchment 8: Basin 8

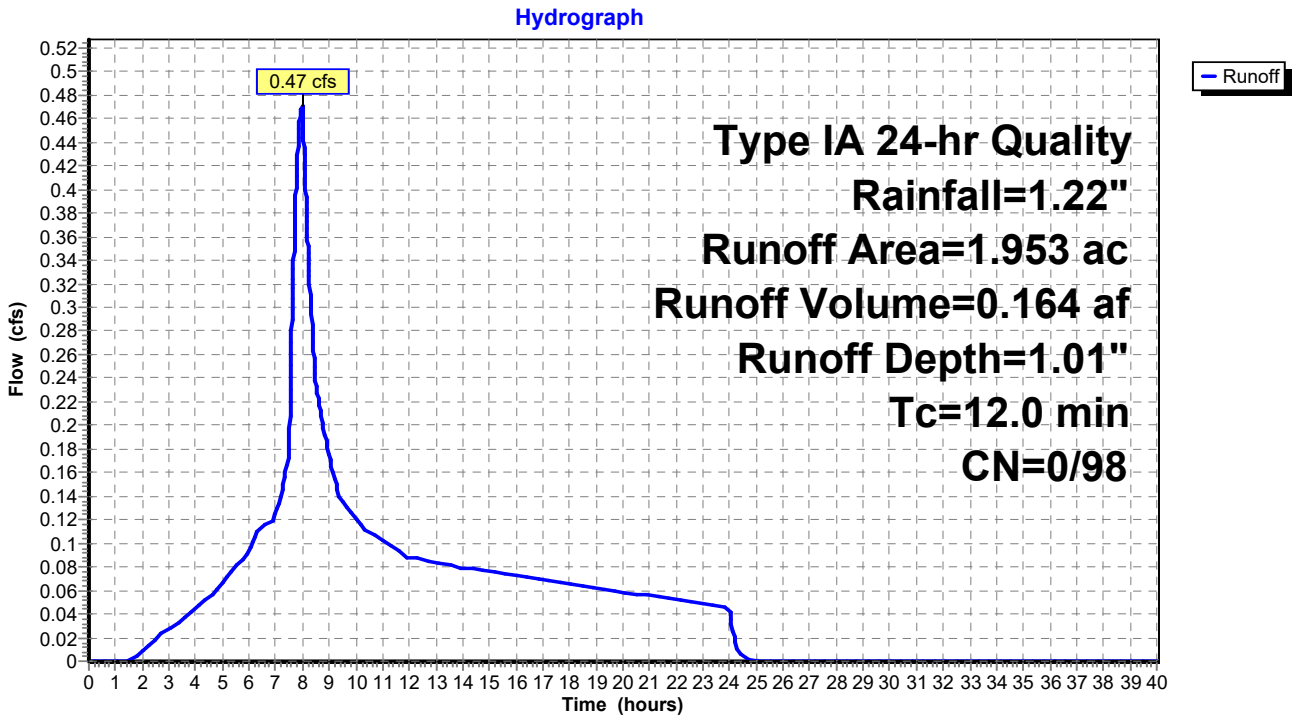
Runoff = 0.47 cfs @ 8.00 hrs, Volume= 0.164 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

	Area (ac)	CN	Description
*	1.953	98	
	1.953	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0					**Direct Entry, 8C**

Subcatchment 8: Basin 8



Summary for Subcatchment 10S: Package B Pavement

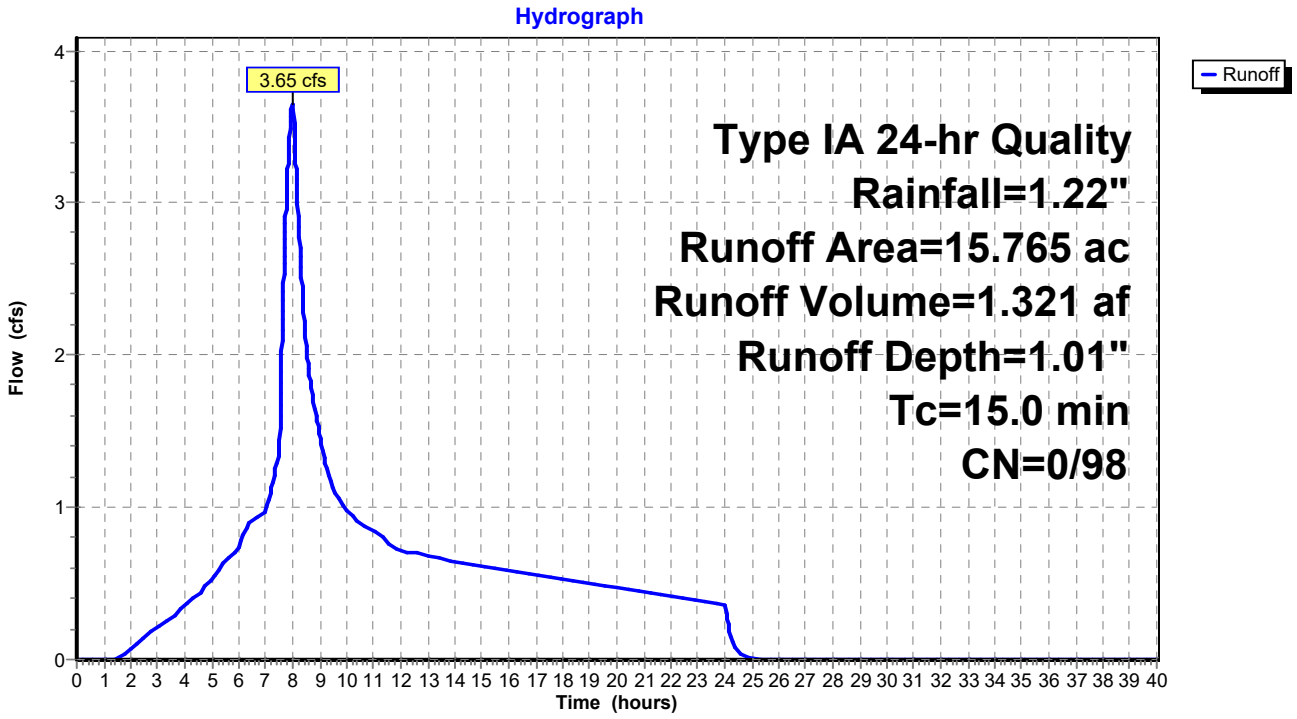
Runoff = 3.65 cfs @ 8.00 hrs, Volume= 1.321 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

Area (ac)	CN	Description
2.296	98	Paved roads w/curbs & sewers, HSG B
2.629	98	Paved roads w/curbs & sewers, HSG B
2.078	98	Paved roads w/curbs & sewers, HSG B
2.195	98	Paved roads w/curbs & sewers, HSG B
3.686	98	Paved roads w/curbs & sewers, HSG B
0.913	98	Paved roads w/curbs & sewers, HSG B
1.968	98	Paved roads w/curbs & sewers, HSG B
15.765	98	Weighted Average
15.765	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.0					**Direct Entry,**

Subcatchment 10S: Package B Pavement



Summary for Subcatchment A: Offsite Basin A

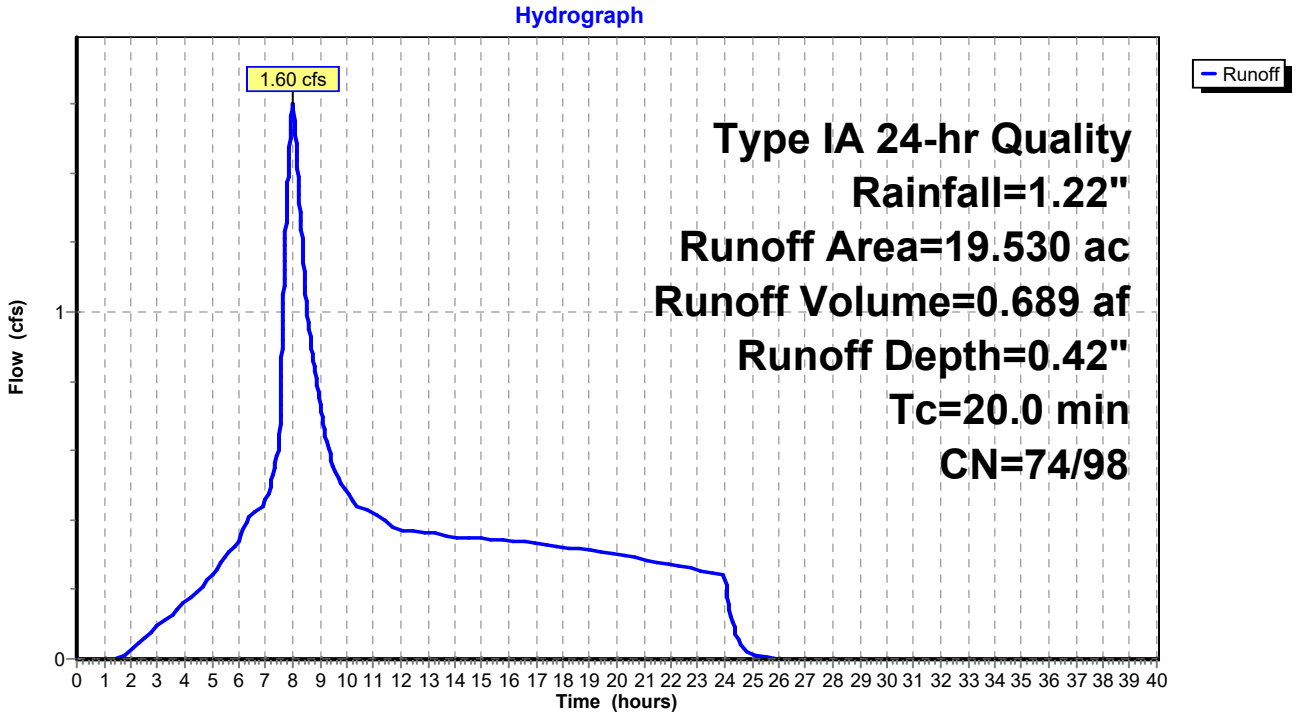
Runoff = 1.60 cfs @ 8.00 hrs, Volume= 0.689 af, Depth= 0.42"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

Area (ac)	CN	Description
19.530	83	1/4 acre lots, 38% imp, HSG C
12.109	74	62.00% Pervious Area
7.421	98	38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0					**Direct Entry, Rough estimate based on SCF formula**

Subcatchment A: Offsite Basin A



Summary for Subcatchment B: Offsite Basin B

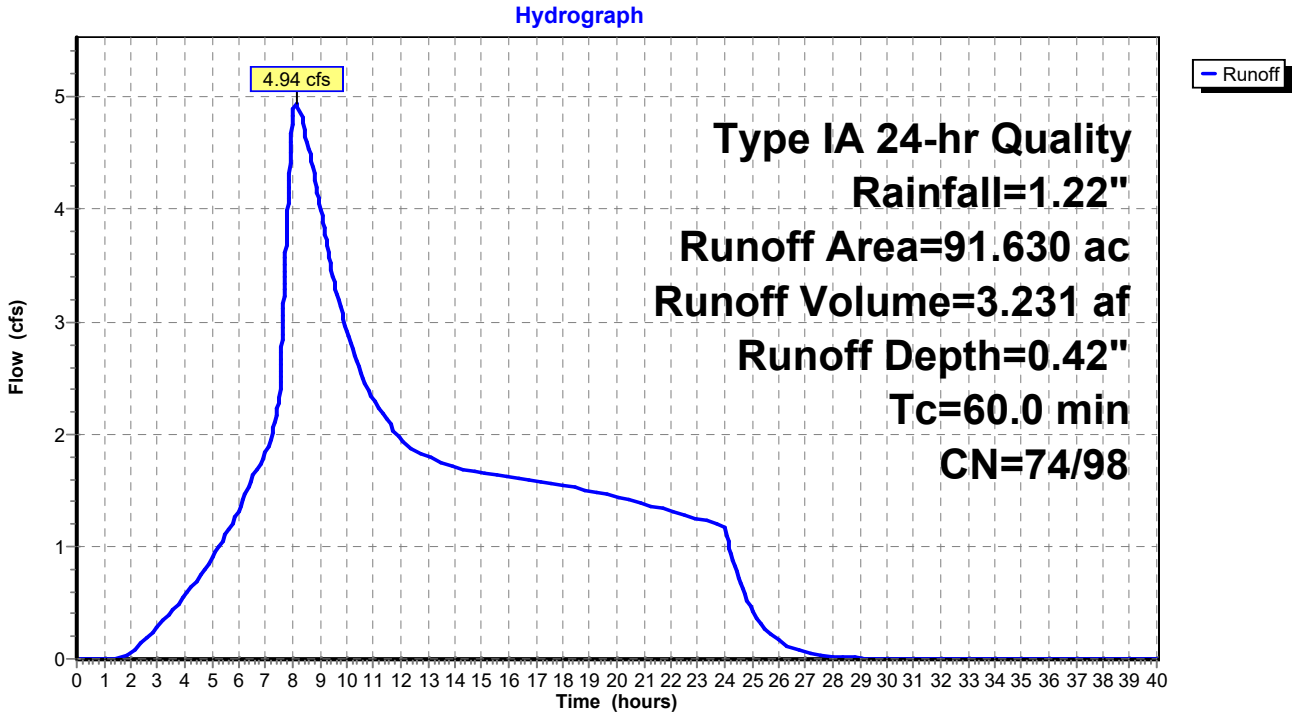
Runoff = 4.94 cfs @ 8.14 hrs, Volume= 3.231 af, Depth= 0.42"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

Area (ac)	CN	Description
91.630	83	1/4 acre lots, 38% imp, HSG C
56.811	74	62.00% Pervious Area
34.819	98	38.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
60.0					**Direct Entry, Rough estimate based on SCF formula**

Subcatchment B: Offsite Basin B



Summary for Subcatchment OS-3: Basin OS 31

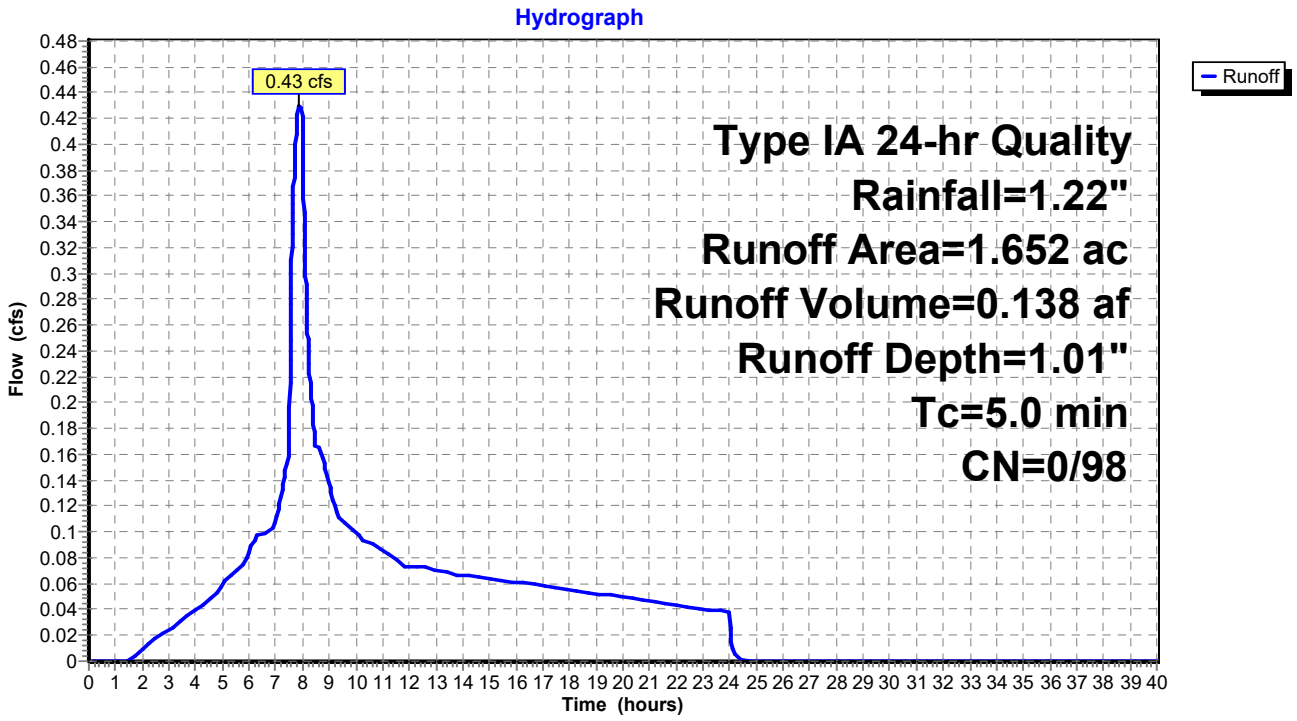
Runoff = 0.43 cfs @ 7.89 hrs, Volume= 0.138 af, Depth= 1.01"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr Quality Rainfall=1.22"

Area (ac)	CN	Description
1.652	98	Paved roads w/curbs & sewers, HSG B
1.652	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment OS-3: Basin OS 31



Summary for Pond 3P: (new Pond)

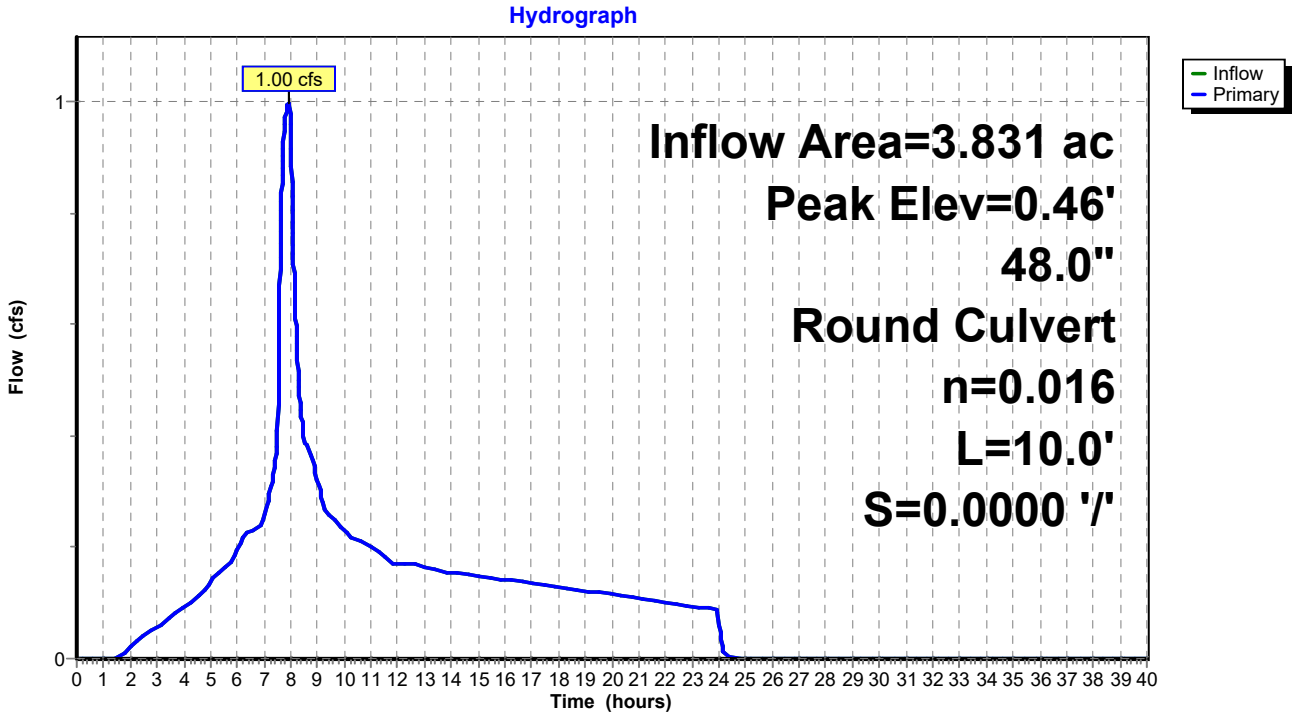
Inflow Area = 3.831 ac,100.00% Impervious, Inflow Depth = 1.01" for Quality event
Inflow = 1.00 cfs @ 7.89 hrs, Volume= 0.321 af
Outflow = 1.00 cfs @ 7.89 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min
Primary = 1.00 cfs @ 7.89 hrs, Volume= 0.321 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.46' @ 7.89 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=0.99 cfs @ 7.89 hrs HW=0.46' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.99 cfs @ 1.89 fps)

Pond 3P: (new Pond)



Summary for Pond 4P: (new Pond)

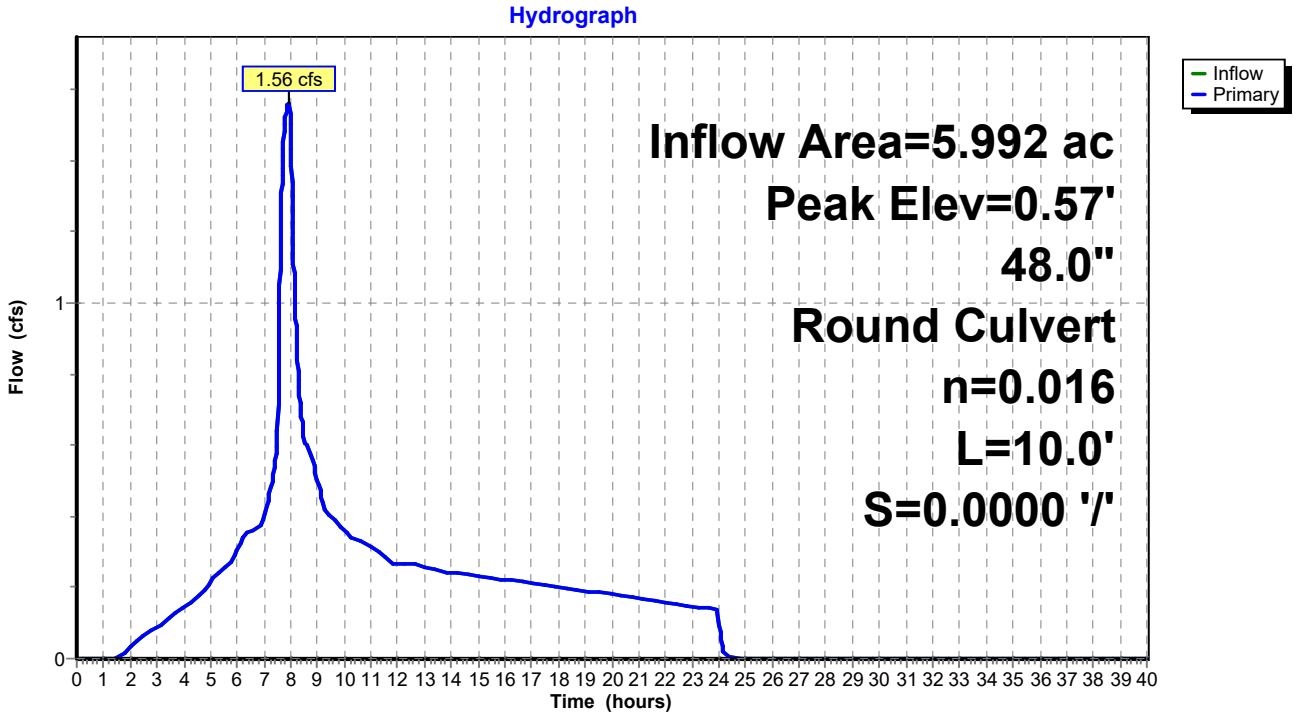
Inflow Area = 5.992 ac,100.00% Impervious, Inflow Depth = 1.01" for Quality event
Inflow = 1.56 cfs @ 7.89 hrs, Volume= 0.502 af
Outflow = 1.56 cfs @ 7.89 hrs, Volume= 0.502 af, Atten= 0%, Lag= 0.0 min
Primary = 1.56 cfs @ 7.89 hrs, Volume= 0.502 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.57' @ 7.89 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=1.56 cfs @ 7.89 hrs HW=0.57' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.56 cfs @ 2.17 fps)

Pond 4P: (new Pond)



Summary for Pond 5P: (new Pond)

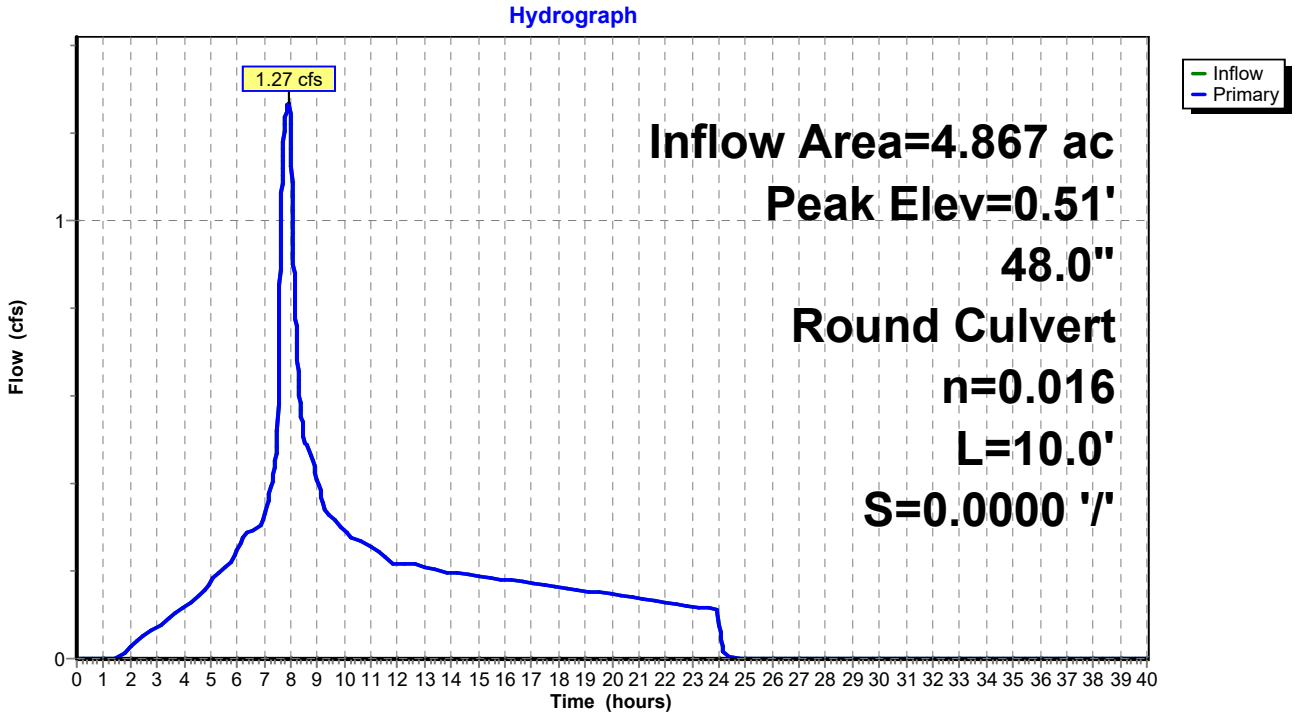
Inflow Area = 4.867 ac,100.00% Impervious, Inflow Depth = 1.01" for Quality event
Inflow = 1.27 cfs @ 7.89 hrs, Volume= 0.408 af
Outflow = 1.27 cfs @ 7.89 hrs, Volume= 0.408 af, Atten= 0%, Lag= 0.0 min
Primary = 1.27 cfs @ 7.89 hrs, Volume= 0.408 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.51' @ 7.89 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=1.26 cfs @ 7.89 hrs HW=0.51' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.26 cfs @ 2.04 fps)

Pond 5P: (new Pond)



Summary for Pond 6P: (new Pond)

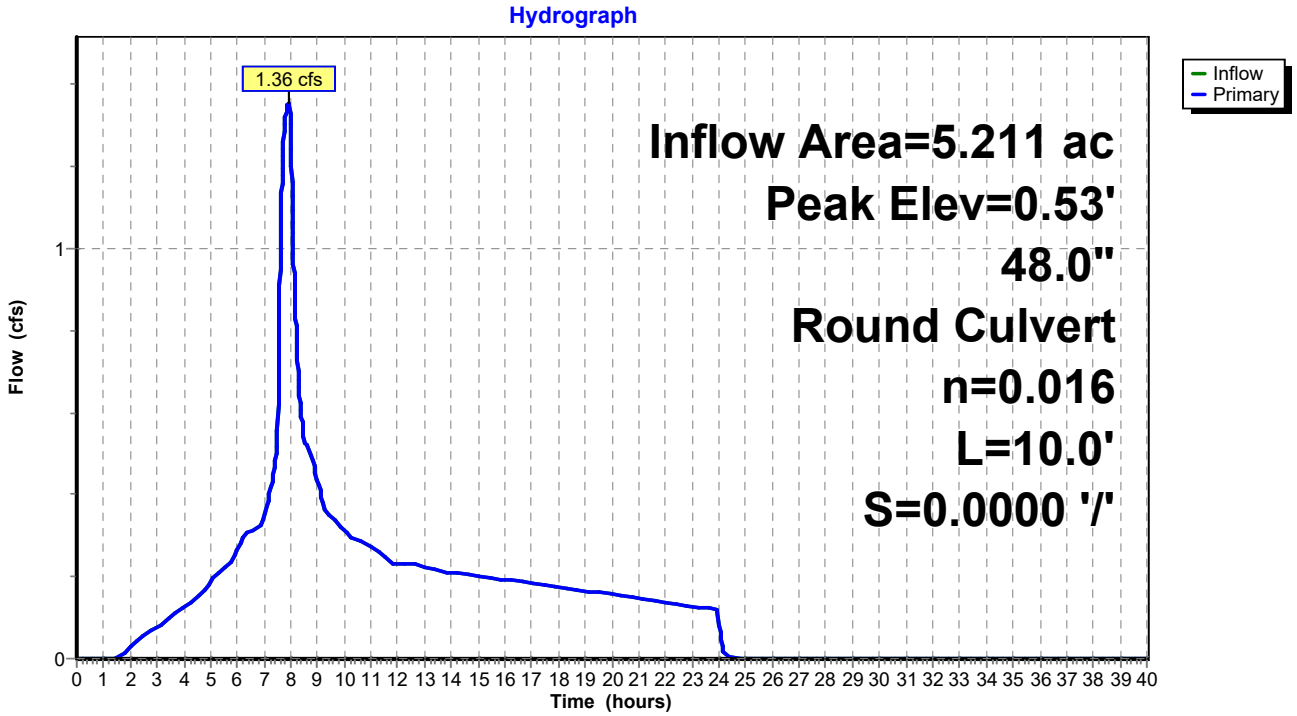
Inflow Area = 5.211 ac,100.00% Impervious, Inflow Depth = 1.01" for Quality event
Inflow = 1.36 cfs @ 7.89 hrs, Volume= 0.437 af
Outflow = 1.36 cfs @ 7.89 hrs, Volume= 0.437 af, Atten= 0%, Lag= 0.0 min
Primary = 1.36 cfs @ 7.89 hrs, Volume= 0.437 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.53' @ 7.89 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=1.35 cfs @ 7.89 hrs HW=0.53' (Free Discharge)
└─**1=Culvert** (Barrel Controls 1.35 cfs @ 2.08 fps)

Pond 6P: (new Pond)



Summary for Pond 7P: (new Pond)

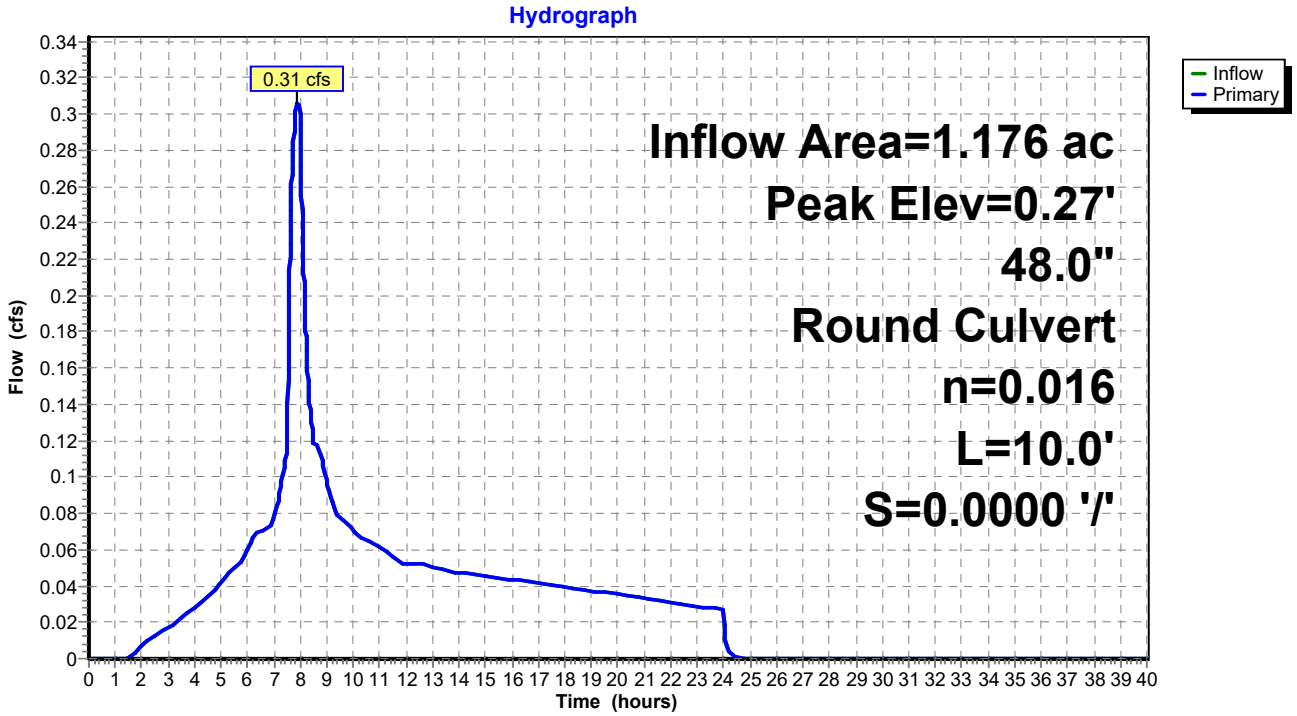
Inflow Area = 1.176 ac,100.00% Impervious, Inflow Depth = 1.01" for Quality event
Inflow = 0.31 cfs @ 7.89 hrs, Volume= 0.099 af
Outflow = 0.31 cfs @ 7.89 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.0 min
Primary = 0.31 cfs @ 7.89 hrs, Volume= 0.099 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 0.27' @ 7.89 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=0.30 cfs @ 7.89 hrs HW=0.27' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.30 cfs @ 1.28 fps)

Pond 7P: (new Pond)



Summary for Pond 10P: Offsite Flows

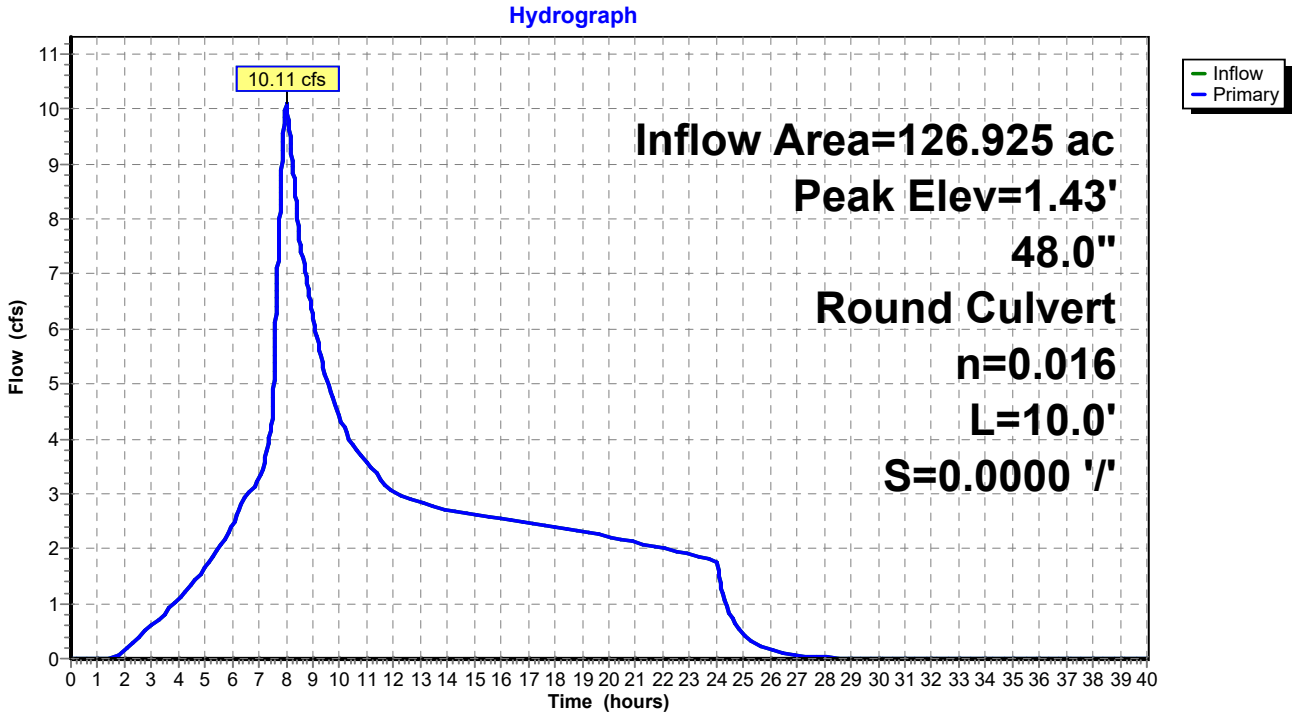
Inflow Area = 126.925 ac, 45.70% Impervious, Inflow Depth = 0.50" for Quality event
Inflow = 10.11 cfs @ 8.01 hrs, Volume= 5.240 af
Outflow = 10.11 cfs @ 8.01 hrs, Volume= 5.240 af, Atten= 0%, Lag= 0.0 min
Primary = 10.11 cfs @ 8.01 hrs, Volume= 5.240 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Peak Elev= 1.43' @ 8.01 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	**48.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 0.00' / 0.00' S= 0.0000 '/' Cc= 0.900 n= 0.016

Primary OutFlow Max=10.10 cfs @ 8.01 hrs HW=1.43' (Free Discharge)
└**1=Culvert** (Barrel Controls 10.10 cfs @ 3.74 fps)

Pond 10P: Offsite Flows



Appendix D. Stormwater Facility Design Calculations

WQF#1

WES BMP Sizing Software Version 1.6.0.2, May 2018

WES BMP Sizing Report

Project Information

Project Name	New Project
Project Type	Addition
Location	
Stormwater Management Area	4817
Project Applicant	
Jurisdiction	OutofDistrict

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
Pavement	46,407	Grass	ConventionalConcrete	B	BMP(1)
Grass	27,950	Grass	Grass	B	BMP(1)

LID Facility Sizing Details

Pond Sizing Details

Pond ID	Design Criteria(1)	Facility Soil Type	Max Depth (ft)(2)	Top Area (sq-ft)	Side Slope (1:H)	Facility Vol. (cu-ft)(3)	Water Storage Vol. (cu-ft)(4)	Adequate Size?
BMP(1)	FCWQT	A1	7.00	4,817.0	4	13,832.4	12,583.5	Yes

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.

WQF#1

Simple Pond Geometry Configuration

Pond ID: BMP(1)
Design: FlowControlAndTreatment

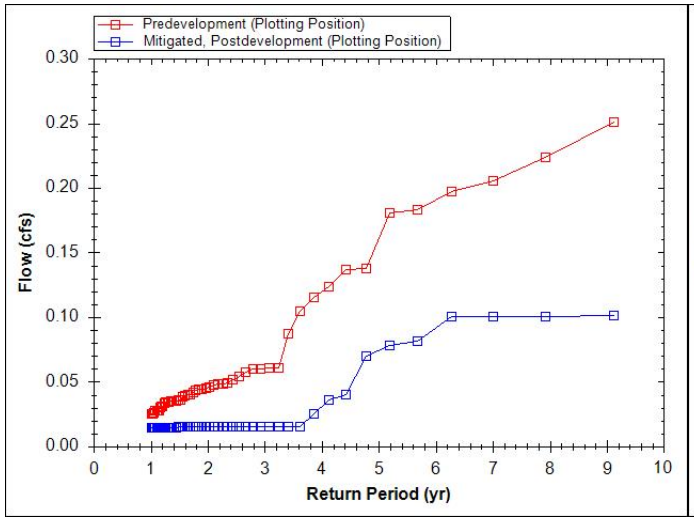
Shape Curve

Depth (ft)	Area (sq ft)
7.0	4,817.0

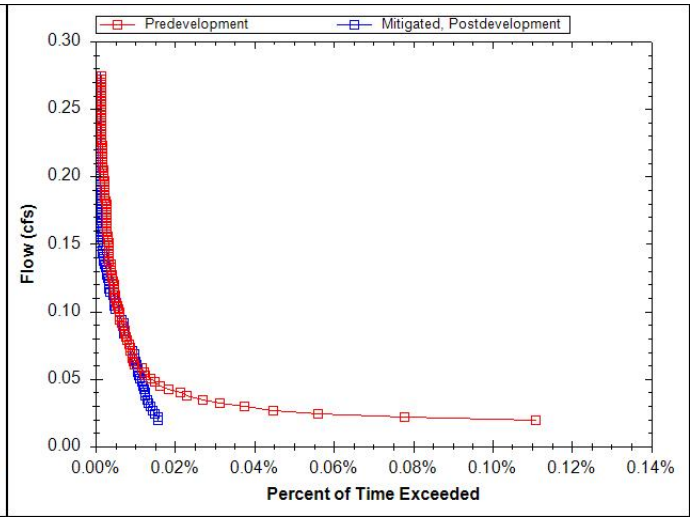
Outlet Structure Details

Lower Orifice Invert (ft)	0.0
Lower Orifice Dia (in)	0.5
Upper Orifice Invert(ft)	4.7
Upper Orifice Dia (in)	2.5
Overflow Weir Invert(ft)	6.0
Overflow Weir Length (ft)	6.3

Flow Frequency Chart



Flow Duration Chart



ODOT I-205 CW/Abernethy Post-Construction SWMP
Stormwater Facility Design Calculations - WQF #2 (bioslope)

Theory: ODOT Hydraulics Manual - Chapter 14, Appendix C

Long term infiltration rate of ecology mix (inches/hour)	10
Length of Bioslope (feet)	1900
Width of bioslope (feet)	4.5
Converstion Factor	43200
Safety Factor	1

$$Q_{infiltration}=(LTIR_{EM})(L_{BIO})(W_{BIO})/(C)(SF)$$

Assumed long Term infiltration Capacity $Q_{infiltration}$, cfs	1.98
Required Water Quality Design Flow, cfs	0.80

ODOT I-205 CW/Abernethy Post-Construction SWMP

Stormwater Facility Design Calculations - WQF #3 (biofiltration swale)

Theory: ODOT Hydraulics Manual - Chapter 14, Appendix B

Manning's n	0.24	
Bottom width, ft	**7.5**	$B=nQ/(1.49*y^{1.67}*s^{0.5})$, Minimum 4 ft
Side slope	4	Maximum 4
Bottom slope, ft/ft	0.018	Minimum 1.5%, maximum 6%
Water depth, ft	0.33	Max Depth 4-6% is 3", 4" for less than 4%
Top width	10.2	
XS Area, ft^2	2.96	
Velocity, fps	0.338	v=Q/A
Design flow, cfs	1.00	From HydroCAD output, WQ storm event
Bottom length, ft	**184.6**	L=v*t, Minimum 100 ft
Top length, ft	**195.2**	
Depth w/FB, ft	1.33	
Top width w/ FB, ft	**18.2**	
Max shear stress, lb/sf	0.372	
Residence time, min	9	Minimum t= 9 minutes
25-year v, fps	1.16	$v=Q_{25\text{-}yr}/A_{XS}$, Max 3 ft/s

ODOT I-205 CW/Abernethy Post-Construction SWMP

Stormwater Facility Design Calculations - WQF #4 (biofiltration swale)

Theory: ODOT Hydraulics Manual - Chapter 14, Appendix B

Manning's n	0.24	
Bottom width, ft	**16.0**	$B=nQ/(1.49*y^{1.67}*s^{0.5})$, Minimum 4 ft
Side slope	4	Maximum 4
Bottom slope, ft/ft	0.01	Minimum 1.5%, maximum 6%
Water depth, ft	0.33	Max Depth 4-6% is 3", 4" for less than 4%
Top width	18.6	
XS Area, ft^2	5.72	
Velocity, fps	0.273	v=Q/A
Design flow, cfs	1.56	From HydroCAD output, WQ storm event
Bottom length, ft	**149.4**	L=v*t, Minimum 100 ft
Top length, ft	**160.0**	
Depth w/FB, ft	1.33	
Top width w/ FB, ft	**26.6**	
Max shear stress, lb/sf	0.20592	
Residence time, min	9	Minimum t= 9 minutes
25-year v, fps	N/A	$v=Q_{25\text{-}yr}/A_{XS}$, Max 3 ft/s

ODOT I-205 CW/Abernethy Post-Construction SWMP

Stormwater Facility Design Calculations - WQF#5 (biofiltration swale)

Theory: ODOT Hydraulics Manual - Chapter 14, Appendix B

Manning's n	0.24	
Bottom width, ft	**12.6**	$B=nQ/(1.49*y^{1.67}*s^{0.5})$, Minimum 4 ft
Side slope	4	Maximum 4
Bottom slope, ft/ft	0.0107	Minimum 1.5%, maximum 6%
Water depth, ft	0.33	Max Depth 4-6% is 3", 4" for less than 4%
Top width	15.2	
XS Area, ft^2	4.59	
Velocity, fps	0.277	v=Q/A
Design flow, cfs	1.27	From HydroCAD output, WQ storm event
Bottom length, ft	**151.3**	L=v*t, Minimum 100 ft
Top length, ft	**162.0**	
Depth w/FB, ft	1.33	
Top width w/ FB, ft	**23.2**	
Max shear stress, lb/sf	0.220334	
Residence time, min	9	Minimum t= 9 minutes
25-year v, fps	N/A	$v=Q_{25\text{-}yr}/A_{XS}$, Max 3 ft/s

ODOT I-205 CW/Abernethy Post-Construction SWMP

Stormwater Facility Design Calculations - WQF#6 (biofiltration swale)

Theory: ODOT Hydraulics Manual - Chapter 14, Appendix B

Manning's n	0.24	
Bottom width, ft	**37.8**	$B=nQ/(1.49*y^{1.67}*s^{0.5})$, Minimum 4 ft
Side slope	4	Maximum 4
Bottom slope, ft/ft	0.0204	Minimum 1.5%, maximum 6%
Water depth, ft	0.33	Max Depth 4-6% is 3", 4" for less than 4%
Top width	40.5	
XS Area, ft^2	13.04	
Velocity, fps	0.410	v=Q/A
Current design flow, cfs	1.35	
Full build out additional flow, cfs	4.00	
Total design flow, cfs	5.35	From HydroCAD output, WQ storm event
Bottom length, ft	**223.5**	L=v*t, Minimum 100 ft
Top length, ft	**234.2**	
Depth w/FB, ft	1.33	
Top width w/ FB, ft	**48.5**	
Max shear stress, lb/sf	0.42432	
Residence time, min	9	Minimum t= 9 minutes
25-year v, fps	N/A	$v=Q_{25\text{-}yr}/A_{XS}$, Max 3 ft/s

ODOT I-205 CW/Abernethy Post-Construction SWMP

Stormwater Facility Design Calculations - WQF#7 (biofiltration swale)

Theory: ODOT Hydraulics Manual - Chapter 14, Appendix B

Manning's n	0.24	
Bottom width, ft	**26.6**	$B=nQ/(1.49*y^{1.67}*s^{0.5})$, Minimum 4 ft
Side slope	4	Maximum 4
Bottom slope, ft/ft	0.015	Minimum 1.5%, maximum 6%
Water depth, ft	0.25	Max Depth 4-6% is 3", 4" for less than 4%
Top width	28.6	
XS Area, ft^2	6.91	
Velocity, fps	0.289	v=Q/A
Current design flow, cfs	0.30	
Full build out additional flow, cfs	1.70	
Total design flow, cfs	2.00	From HydroCAD output, WQ storm event
Bottom length, ft	**158.3**	L=v*t, Minimum 100 ft
Top length, ft	**168.3**	
Depth w/FB, ft	1.25	
Top width w/ FB, ft	**36.6**	
Max shear stress, lb/sf	0.234	
Residence time, min	9	Minimum t= 9 minutes
25-year v, fps	N/A	$v=Q_{25\text{-}yr}/A_{XS}$, Max 3 ft/s

ODOT I-205 CW/Abernethy Post-Construction SWMP

Stormwater Facility Design Calculations - WQF #8 (biofiltration swale)

Theory: ODOT Hydraulics Manual - Chapter 14, Appendix B

Manning's n	0.24	
Bottom width, ft	**50.0**	$B=nQ/(1.49*y^{1.67}*s^{0.5})$, Minimum 4 ft
Side slope	4	Maximum 4
Bottom slope, ft/ft	0.01	Minimum 1.5%, maximum 6%
Water depth, ft	0.33	Max Depth 4-6% is 3", 4" for less than 4%
Top width	52.7	
XS Area, ft^2	17.12	
Velocity, fps	0.290	v=Q/A
Current design flow, cfs	0.47	
Full build out additional flow, cfs	4.49	
Total design flow, cfs	4.96	From HydroCAD output, WQ storm event
Bottom length, ft	**158.4**	L=v*t, Minimum 100 ft
Top length, ft	**169.1**	
Depth w/FB, ft	1.33	
Top width w/ FB, ft	**60.7**	
Max shear stress, lb/sf	0.208	
Residence time, min	9	Minimum t= 9 minutes
25-year v, fps	1.88	$v=Q_{25\text{-}yr}/A_{XS}$, Max 3 ft/s

WQF#9

WES BMP Sizing Software Version 1.6.0.2, May 2018

WES BMP Sizing Report

Project Information

Project Name	Jon Storm Parking Lot
Project Type	RoadProject
Location	
Stormwater Management Area	240
Project Applicant	
Jurisdiction	OutofDistrict

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
Parking Lot	10,200	Grass	ConventionalConcrete	D	BMP

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	WaterQuality	Stormwater Planter - Infiltration	A1	153.0	240.0	0.0

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.

Appendix E. Operation and Maintenance Manuals

OPERATION & MAINTENANCE MANUAL

DFI No. : DXXXXX
Facility Type: Bioretention Pond

MARCH, 2019

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1. IDENTIFICATION 1
2. FACILITY CONTACT INFORMATION 1
3. CONSTRUCTION 1
4. STORM DRAIN SYSTEM AND FACILITY OVERVIEW 2
5. FACILITY HAZ MAT SPILL FEATURE(S) 2
6. AUXILIARY OUTLET (HIGH FLOW BYPASS) 3
7. MAINTENANCE REQUIREMENTS 3
8. WASTE MATERIAL HANDLING 4

APPENDIX A: Operational Plan and Profile Drawing(s)

APPENDIX B: ODOT Project Plan Sheets

1. Identification

Drainage Facility ID (DFI):	**[DXXXXX]**
Facility Type:	Bioretention Pond
Construction Drawings:	(V-File Number) [xxV-xxx]
Location:	District: 1
	Highway No.: 064
	Mile Post: [10.15; 10.17 (beg./end)]
	Description: This facility is located in the gore zone between NB I-205 and the exit ramp to OR213.

2. Facility Contact Information

Contact the Engineer of Record, Region Technical Center, or Geo-Environmental's Senior Hydraulics Engineer for:

- Operational clarification
- Maintenance clarification
- Repair or restoration assistance

<u>Engineering Contacts</u>:

Region Technical Center Hydro Unit Manager

Or

Geo-Environmental Senior Hydraulics Engineer (503) 986-3365.

3. Construction

Engineer of Record:	[ODOT Designer – [Region 1 Tech. Center, David McDonald Consultant Designer – [HDR, Cory Gieseke, 503.423.3803]
Facility construction:	20__
Contractor:	_____.

DRAFT

4. Storm Drain System and Facility Overview

A bioretention pond facility provides water quality treatment of the smaller storm events and detention of the larger storm events.

The bioretention pond is a grassy-lined facility with a flat trapezoidal cross section and a flat bottom. Treatment is provided through infiltration processes through the amended soil media. The facility is sized to fully infiltrate the water quality storm event.

When the flows exceed the water quality flows, the facility begins to provide detention. Detention is required to reduce or mitigate the increases in discharge, resulting from development. The facility is designed to store and gradually release (or attenuate) stormwater runoff via a control structure or release mechanism, then releasing it slowly over a more extended period of time. The flow control mechanism for this facility involves an orifice surrounded by a wirecloth strainer assembly. When flows exceed the water quality design flow, the orifice restricts the flow causing the water to backup within the facility.

The outlet of the facility will convert an existing ditch drain to an outlet structure. Discharge is routed through an existing stormwater system and eventually reaches the Clackamas River.

A. Maintenance equipment access:

Maintenance access to the facility will be from the shoulder of I-205 NB.

B. Heavy equipment access into facility:

☐ Allowed (no limitations)
☐ Allowed (with limitations)
☒ Not allowed

C. Special Features:

☒ Amended Soils
☒ Porous Pavers
☐ Liners
☒ Underdrains

5. Facility Haz Mat Spill Feature(s)

The bioretention pond can be used to store a volume of liquid by blocking the outlet pipe located at the outlet of the facility.

DRAFT

6. Auxiliary Outlet (High Flow Bypass)

Auxiliary Outlets are provided if the primary outlet control structure can not safely pass the projected high flows. Broad-crested spillway weirs and over flow risers are the two most common auxiliary outlets used in stormwater treatment facility design. The auxiliary outlet feature is either a part of the facility or an additional storm drain feature/structure.

The auxiliary outlet feature for this facility is:

☒ Designed into facility
The auxiliary outlet feature is built in to the outlet structure. When high flows occur, water will bypass the primary outlet and overtop the auxiliary outlet to be routed downstream.

☐ Other, as noted below

7. Maintenance Requirements

Routine maintenance table for non-proprietary stormwater treatment and storage/detention facilities have been incorporated into ODOT's Maintenance Guide. These tables summarize the maintenance requirements for ponds, swales, filter strips, bioslopes, and detention tanks and vaults. Special maintenance requirements in addition to the routine requirements are noted below when applicable.

The ODOT Maintenance Guide can be viewed at the following website:

http://www.oregon.gov/ODOT/HWY/OOM/MGuide.shtml

Maintenance requirements for proprietary structures, such as underground water quality manholes and/or vaults with filter media are noted in Appendix C when applicable.

The following stormwater facility maintenance table (See ODOT Maintenance Guide) should be used to maintain the facility outlined in this Operation and Maintenance Manual or follow the Maintenance requirements outlined in Appendix C when proprietary structure is selected below:

☒ Table 1 (general maintenance)
☒ Table 2 (stormwater ponds)
☐ Table 3 (water quality biofiltration swales)
☐ Table 4 (water quality filter strips)
☐ Table 5 (water quality bioslopes)
☐ Table 6 (detention tank)

DRAFT

☐ Table 7 (detention vault)
☐ Appendix C (proprietary structure)

8. Waste Material Handling

Material removed from the facility is defined as waste by DEQ. Refer to the roadwaste section of the ODOT Maintenance Yard Environmental Management System (EMS) Policy and Procedures Manual for disposal options: http://egov.oregon.gov/ODOT/HWY/OOM/EMS.shtml

Contact any of the following for more detailed information about management of waste materials found on site:

ODOT Clean Water Unit	(503) 986-3008
ODOT Statewide Hazmat Coordinator	(503) 229-5129
ODOT Region 1 Hazmat Coordinator	(503) 731-8290
ODEQ Northwest Region Office	(503) 229-5263

DRAFT

OPERATION & MAINTENANCE MANUAL

DFI No. : [DXXXXX]
Facility Type: Bioslope

DRAFT

MARCH, 2019

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1. IDENTIFICATION 1

2. FACILITY CONTACT INFORMATION 1

3. CONSTRUCTION 1

4. STORM DRAIN SYSTEM AND FACILITY OVERVIEW..... 2

5. FACILITY HAZ MAT SPILL FEATURE(S)ERROR! BOOKMARK NOT DEFINED.

6. AUXILIARY OUTLET (HIGH FLOW BYPASS)..... ERROR! BOOKMARK NOT DEFINED.

7. MAINTENANCE REQUIREMENTS 3

8. WASTE MATERIAL HANDLING 3

APPENDIX A: **Operational Plan and Profile Drawing(s)**

APPENDIX B: **ODOT Project Plan Sheets**

DRAFT

1. Identification

Drainage Facility ID (DFI):	**[DXXXXX]**
Facility Type:	Bioslope
Construction Drawings:	(V-File Number) [xxV-xxx]
Location:	District: 1
	Highway No.: 064
	Mile Post: 9.76; 10.13 (beg./end)1
	Description: This facility is located along the northbound lanes of I-205 between 99E and OR213.

2. Facility Contact Information

Contact the Engineer of Record, Region Technical Center, or Geo-Environmental's Senior Hydraulics Engineer for:

- Operational clarification
- Maintenance clarification
- Repair or restoration assistance

<u>Engineering Contacts</u>:

Region Technical Center Hydro Unit Manager

Or

Geo-Environmental Senior Hydraulics Engineer (503) 986-3365.

3. Construction

Engineer of Record:	ODOT Designer – Region 1 Tech. Center, David McDonald Consultant Designer – HDR, Cory Gieseke, 503.423.3803
Facility construction:	20__
Contractor:	_____.

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4. Storm Drain System and Facility Overview

Bioslopes are flow-through stormwater treatment facilities incorporated into roadside embankments and placed between pavement and a downstream conveyance system. These facilities utilize physical straining or filtration, sorption, carbonate precipitation, vegetative uptake and microbial degradation to provide stormwater treatment. Bioslopes are recommended for highway application because of their minimal right-of-way requirements and maintenance schedule. Other names for bioslopes that have been used include ecology embankment and media filter drain.

Bioslopes are designed to treat sheet flow from an adjacent impervious surface. A typical bioslope has the following facility features and components:

- **Treatment Zone using Ecology mix** – It is provided to remove pollutants as stormwater runoff drains through this zone. The ecology mix is a mixture of aggregate, dolomite, gypsum, and perlite.
- **Sub surface drain** – it is provided to allow positive outflow for runoff at the toe of the bioslope.

This facility is located from Station “L” 665+00 to 684+00. This facility is located adjacent to the roadway shoulder and is 4 feet wide. This facility incorporates 1 foot of water quality soil and 18 inches of granular rock backfill. A 6 inch perforated pipe will be used to drain the facility. The facility will discharge into an adjacent existing roadside ditch which conveys runoff to the Clackamas River through an existing stormwater conveyance system.

A. Maintenance equipment access:
Maintenance of the bioslope will be accessed from the shoulder of the northbound I-205 lanes.

B. Heavy equipment access into facility:

☐ Allowed (no limitations)
☐ Allowed (with limitations)
☒ Not allowed

C. Special Features:

☒ Amended Soils
☐ Porous Pavers
☒ Liners
☒ Underdrains

DRAFT

5. Maintenance Requirements

Routine maintenance table for non-proprietary stormwater treatment and storage/detention facilities have been incorporated into ODOT's Maintenance Guide. These tables summarize the maintenance requirements for ponds, swales, filter strips, bioslopes, and detention tanks and vaults. Special maintenance requirements in addition to the routine requirements are noted below when applicable.

The ODOT Maintenance Guide can be viewed at the following website:

http://www.oregon.gov/ODOT/HWY/OOM/MGuide.shtml

Maintenance requirements for proprietary structures, such as underground water quality manholes and/or vaults with filter media are noted in Appendix C when applicable.

The following stormwater facility maintenance table (See ODOT Maintenance Guide) should be used to maintain the facility outlined in this Operation and Maintenance Manual or follow the Maintenance requirements outlined in Appendix C when proprietary structure is selected below:

- ☒ Table 1 (general maintenance)
- ☐ Table 2 (stormwater ponds)
- ☐ Table 3 (water quality biofiltration swales)
- ☐ Table 4 (water quality filter strips)
- ☒ Table 5 (water quality bioslopes)
- ☐ Table 6 (detention tank)
- ☐ Table 7 (detention vault)
- ☐ Appendix C (proprietary structure)

6. Waste Material Handling

Material removed from the facility is defined as waste by DEQ. Refer to the roadwaste section of the ODOT Maintenance Yard Environmental Management System (EMS) Policy and Procedures Manual for disposal options: http://egov.oregon.gov/ODOT/HWY/OOM/EMS.shtml

Contact any of the following for more detailed information about management of waste materials found on site:

ODOT Clean Water Unit	(503) 986-3008
ODOT Statewide Hazmat Coordinator	(503) 229-5129
ODOT Region 1 Hazmat Coordinator	(503) 731-8290
ODEQ Northwest Region Office	(503) 229-5263

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OPERATION & MAINTENANCE MANUAL

DFI No. : [DXXXXX]
Facility Type: Water Quality Biofiltration Swale

DRAFT

MARCH, 2019

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5. FACILITY HAZ MAT SPILL FEATURE(S)ERROR! BOOKMARK NOT DEFINED.

6. AUXILIARY OUTLET (HIGH FLOW BYPASS)..... ERROR! BOOKMARK NOT DEFINED.

7. MAINTENANCE REQUIREMENTS 2

8. WASTE MATERIAL HANDLING 3

APPENDIX A: **Operational Plan and Profile Drawing(s)**

APPENDIX B: **ODOT Project Plan Sheets**

DRAFT

1. Identification

Drainage Facility ID (DFI):	**[DXXXXX]**
Facility Type:	Water Quality Swale
Construction Drawings:	(V-File Number) [xxV-xxx]
Location:	District: 1
	Highway No.: 064
	Mile Post: 9.63; 9.66 (beg./end)
	Description: This facility is located to the north of I-205 between the highway and Main St.

2. Facility Contact Information

Contact the Engineer of Record, Region Technical Center, or Geo-Environmental's Senior Hydraulics Engineer for:

- Operational clarification
- Maintenance clarification
- Repair or restoration assistance

Engineering Contacts:

Region Technical Center Hydro Unit Manager

Or

Geo-Environmental Senior Hydraulics Engineer (503) 986-3365.

3. Construction

Engineer of Record: ODOT Designer – Region 1 Tech. Center, David McDonald
Consultant Designer – HDR, Cory Gieseke, 503.423.3803

Facility construction: 20__
Contractor: _____.

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4. Storm Drain System and Facility Overview

A water quality swale is a flat-bottomed open channel designed to treat stormwater runoff from highway pavement areas. This type of facility is lined with grass. Treatment by trapping sedimentation occurs when stormwater runoff flows through the grass.

The facility is located between the southbound lanes of I-205 and Main St. Access to the facility is provided by an access road off of the northbound shoulder of Main St.

The swale treats 3.2 acres of I-205. Runoff is conveyed to a pollution control manhole located directly upstream of the facility. The swale discharges to an existing stormwater system which is connected to the Clackamas River.

A. Maintenance equipment access:

Maintenance to the facility is provided through a constructed access road off of Main St.

B. Heavy equipment access into facility:

☐ Allowed (no limitations)
☒ Allowed (with limitations)
☐ Not allowed

C. Special Features:

☒ Amended Soils
☒ Porous Pavers
☐ Liners
☐ Underdrains

5. Maintenance Requirements

Routine maintenance table for non-proprietary stormwater treatment and storage/detention facilities have been incorporated into ODOT's Maintenance Guide. These tables summarize the maintenance requirements for ponds, swales, filter strips, bioslopes, and detention tanks and vaults. Special maintenance requirements in addition to the routine requirements are noted below when applicable.

The ODOT Maintenance Guide can be viewed at the following website:

http://www.oregon.gov/ODOT/HWY/OOM/MGuide.shtml

DRAFT

Maintenance requirements for proprietary structures, such as underground water quality manholes and/or vaults with filter media are noted in Appendix C when applicable.

The following stormwater facility maintenance table (See ODOT Maintenance Guide) should be used to maintain the facility outlined in this Operation and Maintenance Manual or follow the Maintenance requirements outlined in Appendix C when proprietary structure is selected below:

- ☒ Table 1 (general maintenance)
- ☐ Table 2 (stormwater ponds)
- ☒ Table 3 (water quality biofiltration swales)
- ☐ Table 4 (water quality filter strips)
- ☐ Table 5 (water quality bioslopes)
- ☐ Table 6 (detention tank)
- ☐ Table 7 (detention vault)
- ☐ Appendix C (proprietary structure)

6. Waste Material Handling

Material removed from the facility is defined as waste by DEQ. Refer to the roadwaste section of the ODOT Maintenance Yard Environmental Management System (EMS) Policy and Procedures Manual for disposal options: http://egov.oregon.gov/ODOT/HWY/OOM/EMS.shtml

Contact any of the following for more detailed information about management of waste materials found on site:

ODOT Clean Water Unit	(503) 986-3008
ODOT Statewide Hazmat Coordinator	(503) 229-5129
ODOT Region 1 Hazmat Coordinator	(503) 731-8290
ODEQ Northwest Region Office	(503) 229-5263

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OPERATION & MAINTENANCE MANUAL

DFI No. : [DXXXXX]
Facility Type: Stormwater Planter

March 2019

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3. CONSTRUCTION 1

4. STORM DRAIN SYSTEM AND FACILITY OVERVIEW 2

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6. WASTE MATERIAL HANDLING 3

Appendix A: Operational Plan and Profile Drawing(s)

Appendix B: ODOT Project Plan Sheets

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1. Identification

Drainage Facility ID (DFI):	**DXXXXX**
Facility Type:	Stormwater Planter
Construction Drawings:	(V-File Number) xxV-xxx
Location:	District: 2B
	Highway No.: xx
	Mile Post: x.xx; x.xx (beg./end)
	Description: This facility is located along the west side of Clackamette Dr. approximately 100 feet north of driveway for John Storm Park.

2. Facility Contact Information

Contact the Engineer of Record, Region Technical Center, or Geo-Environmental's Senior Hydraulics Engineer for:

- Operational clarification
- Maintenance clarification
- Repair or restoration assistance

<u>Engineering Contacts</u>:

Region Technical Center Hydro Unit Manager

Or

Geo-Environmental Senior Hydraulics Engineer (503) 986-3365.

3. Construction

Engineer of Record: ODOT Designer – Region 1 Tech. Center, David McDonald
Consultant Designer – HDR, Cory Gieseke, 503.423.3803

Facility construction: 20__
Contractor: _____.

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4. Storm Drain System and Facility Overview

Stormwater planters are structural landscaped reservoirs used to collect, filter, and infiltrate stormwater, allowing pollutants to settle and filter out as the water percolates through the vegetation, growing medium, and gravel. Depending on site conditions, planters can be designed to completely or partially infiltrate the stormwater they receive.

This facility is located along the east side of Clackamette Dr. approximately 100 feet north of the driveway for John Storm Park. This facility is designed with 18 inches of water quality soil on top of 18 inches of storage rock.

Stormwater is conveyed into the stormwater planter through evenly spaced curb cut inlets along the side of the stormwater planter adjacent to the roadway. Once the stormwater percolates through the vegetation and water quality soil, it infiltrates into the native subsoil.

A. Maintenance equipment access:
   The facility can be accessed from Clackamette Dr.

B. Heavy equipment access into facility:

   ☐ Allowed (no limitations)
   ☐ Allowed (with limitations)
   ☒ Not allowed

C. Special Features:

   ☒ Amended Soils
   ☐ Porous Pavers
   ☒ Liners
   ☒ Underdrains

5. Maintenance Requirements

Routine maintenance table for non-proprietary stormwater treatment and storage/detention facilities have been incorporated into ODOT's Maintenance Guide. These tables summarize the maintenance requirements for ponds, swales, filter strips, bioslopes, and detention tanks and vaults. Special maintenance requirements in addition to the routine requirements are noted below when applicable.

The ODOT Maintenance Guide can be viewed at the following website:

https://www.oregon.gov/ODOT/GeoEnvironmental/Pages/Stormwater.aspx

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The stormwater facility maintenance table (See ODOT Maintenance Guide) should be used to maintain the facility outlined in this Operation and Maintenance Manual:

Mark as Required and always include Table 1:

- ☒ Table 1 (general maintenance)
- ☐ Table 2 (stormwater ponds)
- ☐ Table 3 (water quality biofiltration swales)
- ☒ Table 4 (water quality filter strips)
- ☐ Table 5 (water quality bioslopes)
- ☐ Table 6 (detention tank)
- ☐ Table 7 (detention vault)
- ☐ Appendix C (proprietary structure)

6. Waste Material Handling

Material removed from the facility is defined as waste by DEQ. Refer to the Roadwaste section of the ODOT Maintenance Yard Environmental Management System (EMS) Policy and Procedures Manual for disposal options:
https://www.oregon.gov/ODOT/Maintenance/Documents/ems_manual.pdf

Contact any of the following for more detailed information about management of waste materials found on site:

ODOT Clean Water Unit	(503) 986-3008
ODOT Statewide Hazmat Coordinator	(503) 229-5129
ODOT Region 1 Hazmat Coordinator	(503) 731-8290
ODEQ Northwest Region Office	(503) 229-5263

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Table 1: General Maintenance			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
Annual Visual Inspection and Maintenance	Routine inspection	**Facilities should be inspected annually prior to fall rains**. If appropriate, also inspect the facility after the first significant rain event following dry spell (e.g. the first 24-hour rainfall greater then 0.5 inches after summer)	Identify existing and potential operational problems. Repair damaged components that are critical to the operation of the feature (e.g. flow control valves, liners, underdrains, and pipes) as soon as practical. Schedule routine maintenance such as mowing, sump cleanout, lube moving parts, repairs, etc. If the facility is problematic, schedule additional inspections or maintenance. Repair or replace facility field markers according to Technical Bulletin GE10-01(B). A marked facility has an O&M Plan.
	Maintenance of ancillary structures, if present Examples include • Flow splitter manhole • Diversion manhole • Catch basin • Shut-off valve assembly • Pretreatment or primary treatment manhole • Large detention pipe • Vault • Outfall	Damage or problems are observed or anticipated during the annual inspection.	Grease moving parts to ensure proper operation. Remove sediment from sumps, vaults, catch basins, and structures to prevent the release of oil or sediment. Annual cleaning is recommended. The use of a Vactor® truck is allowed unless prohibited in the facility's O&M manual Repair or replace damaged orifice assembly/riser pipe. Restore to design standards. Be aware of possible confined space requirements. Repair or replace damaged gates, locks, chains, etc that are used to secure valves and access points to prevent vandalism
General	Temporary erosion control hampers maintenance	Erosion control remains from project construction (contractor did not remove)	Contact contractor to complete work OR remove temporary erosion control that is not specified in the O&M Plan.

Table 1: General Maintenance			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
General	Spilled material has entered the pond or structures	Oil, fuel, or other pollutants are evident following a spill event or accident.	Utilize valves or other features, if present, to contain the spilled material. Remove and properly manage spilled material and contaminated soil. Contact Region HazMat or spill response company for spill cleanup assistance where appropriate. Contact a Region Hydraulic Engineer for technical assistance with pond restoration, if necessary.
	Litter (trash and debris)	Trash poses a hazard, inhibits function, or is aesthetically unacceptable (e.g. evidence of dumping).	Remove problematic trash and debris as soon as practical. There should be no evidence of dumping. Remove non-problematic trash in accordance with District litter practices.
	Insects	Insects interfere with maintenance activities.	Implement vector control in accordance with County Health and District practices.
	Vegetation growth (mowing and brushing)	Vegetation growth restricts access, limits sight distance, obstructs water flow, or interferes with maintenance activity.	Mow access, berms, bottom, and side-slopes of the facility as noted in the District Integrated Vegetation Management (IVM) Plan. Remove vegetation in or around grates that obstruct (or could obstruct) flow. Avoid mowing or removing vegetation that does not need to be controlled. Avoid removing vegetation too low to the ground. NOTE: Removing vegetation too near to the ground may result in scalping of the soil, unwanted damaged to vegetation, or growth of unwanted plant species. Heavy equipment is allowed within aboveground water quality and detention facilities unless access restrictions are listed in the O&M Manual.

Table 1: General Maintenance			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
	Noxious weed growth	Control of noxious weeds is required by law or prescribed in the District IVM Plan	Remove noxious weeds in accordance with the District IVM Plan. Follow Environmental Protection Agency (EPA) label and ODOT policies on herbicide usage.
General	Hazard trees	Trees are found to be weakened, unsound, undermined, leaning, or exposed and may fall across the highway	Remove hazard trees as soon as practical. Where appropriate, consult an ODOT Forester for help identifying or removing hazard trees.
	Tree growth	Tree growth restricts access, obstructs function, jeopardizes infrastructure, or interferes with maintenance actions.	Prune or remove as needed to maintain access, function, and tree health. Manage potentially problematic woody material before the trees reach 6 inches diameter at breast height (DBH). Consult an ODOT Forester for the removal or management of trees greater than 6 inches DBH. Obtain permits where appropriate. Refer to the District IVM Plan for the management of smaller trees. Avoid removing trees that will not interfere with the operation or maintenance of the facility.

Table 2: Maintenance of Stormwater Ponds Stormwater ponds should retain water and slowly release by either infiltration or outflow.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
General	Follow applicable Guidance from Table 1 AND applicable guidance from this table.		
	Vegetation growth in **dry ponds** (mowing and brushing)	Vegetation growth restricts access, limits sight distance, obstructs water flow, or interferes with maintenance activity. Collected water should drain.	Dry ponds need vegetation on the bottom and sides. Vegetation management typically occurs around and within the facility. Mow access, berms, bottom, and side-slopes as noted in the District Integrated Vegetation Management (IVM) Plan. (typically annually) Heavy equipment is allowed on dry pond bottoms unless access restrictions are listed in the O&M Manual.
	Vegetation growth in **wet ponds** (mowing and brushing) NOTE: Wet ponds are not typical.	Vegetation growth restricts access, limits sight distance, obstructs water flow, or interferes with maintenance activity. Water may be stored year-round without draining.	Wet ponds need vegetation on the bottom and sides. Vegetation management typically occurs around the facility. Mow access and berms as noted in the District Integrated Vegetation Management (IVM) Plan. Ponds bottoms are intended to capture and store water. Vegetation removal from pond bottoms is infrequent.
	Sediment accumulation in pre-treatment features (e.g. forebays, basins, or fully exposed impermeable liners) NOTE: Exposed liners are not typical.	Sediment affects flow. Sediment jeopardizes infrastructure.	Remove sediment from ponds and pipe ends as needed to ensure adequate drainage into treatment pond (grassy or wet pond). Use methods that minimize disturbance to surrounding vegetation. Heavy equipment is allowed on dry pond bottoms unless access restrictions are listed in the O&M Manual. Sediment may contain oil and other pollutants, especially in areas with high ADT. Refer to the ODOT Maintenance Environmental Management System (EMS) Manual for the disposal of contaminated sediment. Note: Pollutant concentrations may increase if sediment is not routinely removed.

Table 2: Maintenance of Stormwater Ponds Stormwater ponds should retain water and slowly release by either infiltration or outflow.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
Storage areas	Sediment accumulation along bottom of grassy ponds	Sediment inhibits the flow of water through the grass (>12 inches deep). Sediment inhibits grass growth.	Where practical use a Vactor® truck to remove sediment from grassy areas. When Vactoring® is not practical, follow ditch cleaning practices. Restore slope and geometry to design standards, if necessary. Reseed grass cover where needed. Stormwater should infiltrate or flow toward outlet once inflow has ceased. Refer to the general section of this table for side-slope mowing and other routine maintenance actions.
	Sediment accumulation in wet ponds or channels. NOTE: Currently there is limited use of wet ponds to treat stormwater.	Capacity has noticeably decreased (examples below) • low and medium flows go through the bypass, • the ordinary high water level has increased, • flooding occurs when the outflows are not blocked, • pond bottom is level with outlets.	Remove sediment build-up from pipe ends as needed to ensure flow. Use methods that minimize disturbance to surrounding vegetation. Remove sediment to restore designed shape and depth. In high ADT areas, pond dredging may be required every 5 to 10 years to restore the capacity. Cease sediment removal when riprap or liner is encountered. Reseed if necessary to control erosion.
	Erosion	Side slopes show evidence of erosion greater than 4 inches deep and the potential for continued erosion is evident.	Promptly address erosion that causes immediate problems (e.g. damage to highway or highway structure) Schedule non-urgent repairs with routine work. Stabilize slope using appropriate erosion control and repair methods. Repair the cause of the erosion where possible. If necessary, contact the ODOT Erosion Control Coordinator to evaluate the condition.

Table 2: Maintenance of Stormwater Ponds Stormwater ponds should retain water and slowly release by either infiltration or outflow.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
Storage areas	Beaver dams	Dam inhibits function or jeopardizes the infrastructure.	Dispose of dam debris offsite or outside of the riparian area. Coordinate the removal or relocation of beaver with Oregon Department of Fish and Wildlife (ODFW). Consider installing deterrents where appropriate.
	Flooding	Water is flowing over or is approaching the top of the pond	Check storm drain pipes and structures for blockage. Ensure valves are open. Remove obstructions to restore flow. Evaluate and remove excessive sediment from pond storage areas. Contact the Region Hydraulic Engineer to evaluate the source of flooding or provide design modifications.
Treatment Components	Poor vegetation coverage	Vegetation (grass) is sparse or eroded patches occur in more than 10 percent of pond bottom.	Repair and reseed as appropriate to restore coverage. Install erosion control measures as needed. Trim overhanging limbs and remove brushy vegetation that limit grass growth (provide too much shade).
	Missing or eroded amended soil mix	Bare soil is observed over 10 percent of the amended area.	Identify and resolve erosion problem Add amended soil. Contact a Region Hydraulics Engineer for required material specifications.
	Amended soil mix along pond bottom is clogged	Standing water is observed for seven (7) consecutive days or longer from May through October.	Remove and replace amended soil mix. Contact a Region Hydraulics Engineer for required material specifications. Replace or repair damaged underlying drainage geotextile, impermeable liner, drain piping, and granular drain backfill material when applicable.
	Granular drain backfill material for underdrain pipe plugged	Amended soil mix has been replaced and standing water is still observed for seven (7) consecutive days or longer from May through October.	Remove and replace granular drain backfill material. Contact a Region Hydraulics Engineer for required material specifications. Install new drainage geotextile over new granular drain backfill material. Replace amended soil mix.

Table 2: Maintenance of Stormwater Ponds Stormwater ponds should retain water and slowly release by either infiltration or outflow.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
Treatment Components	Impermeable liner damage NOTE: Liners (if installed) are typically below the grass surface and may not be visible.	Liner is damaged (e.g. during sediment removal or by motoring public). Liner is damaged when condition allows potential contamination to be released to the subsurface.	Repair or replace the liner with similar material. In many cases, rigid plastic liners may be repaired by welding a similar material over the damaged portion or using a non-toxic, waterproof epoxy. If necessary, contact a Region Hydraulics Engineer for technical assistance regarding permanent repair.
Berms and Dikes	Settlement	Any part of the berm has settled 4 inches or lower. Note: Settlement may indicate potential problems with the facility.	Repair berm to design height with similar materials. Contact a Region Hydraulics and Geotechnical Engineer as needed to evaluate the source of the settlement and determine repair options.
	Flow-through	Water is flowing through the pond berm.	Correct cause of flow through (e.g. eliminate burrowing rodents) Install erosion control measures where appropriate. Repair berm with similar materials. If necessary, contact a Region Geotechnical Engineer to evaluate the condition.
	Sloughing	Ongoing erosion is observed with potential for erosion to continue.	Where possible correct the cause of the erosion. Install or replace energy dissipaters where appropriate. Install erosion control measures where appropriate Repair berm with similar materials. If necessary, contact the ODOT Erosion Control Coordinator to evaluate the condition.

Table 2: Maintenance of Stormwater Ponds Stormwater ponds should retain water and slowly release by either infiltration or outflow.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
Structures and piping Includes • flow splitters • vaults • inlets • bypasses • valves • catch basins • gates	Damaged or missing components	Flow control assembly is not working properly (e.g. loose, bent, unattached, etc.).	Repair or replace valves, gates, orifices and pipes as necessary with similar components. Divert flows when needed.
	Obstruction or blockage	Water does not flow in, through, or out of the structure or piping.	If valves are part of the flow control assembly, verify the valves are open. Refer to the O&M for the location of control valves. Remove obstructions to restore flow (e.g. remove trash, debris, sediment, or vegetation as necessary). Jet rodders may be used to clean piping unless specifically prohibited in the O&M plan.
Outfalls	Insufficient rock armoring at outlets • along channel side slopes and bottom • pipe outlet • along the length of spillway	Minimal layer of rock exists Rock missing along armored area Flow channelization or high flows exposed native soil around the rock armored area	Install erosion control measures Repair or replace rock armoring to original design standard Repair, re-grade, and reseed eroded areas adjacent to rock armoring. Contact a Region Hydraulics Engineer for technical assistance if rock armoring problems continue or a highway structure is at risk

Table 3: Maintenance of Water Quality or Biofiltration Swales Swales should provide even sheet flow that moves water from the inlet to the outlet.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
General	Follow applicable Guidance from Table 1 AND applicable guidance from this table.		
	Vegetation growth (mowing and brushing)	Vegetation growth restricts access, limits sight distance, obstructs water flow, or interferes with maintenance activity. **Swales should be mowed annually.**	Mow access, berms, swale, and side-slopes as noted in the District Integrated Vegetation Management (IVM) Plan. The use of heavy equipment is allowed unless access restrictions are listed in the O&M Manual.
Swale Components	Sediment accumulation in pre-treatment areas or ancillary structures (e.g. manholes)	Sediment affects flow. Sediment jeopardizes infrastructure.	Remove sediment that prevents adequate drainage into swale. Use methods that minimize disturbance to surrounding vegetation. The use of heavy equipment is allowed unless access restrictions are listed in the O&M Manual. Sediment may contain oil and other pollutants, especially in areas with high ADT. Refer to the ODOT Maintenance Environmental Management System (EMS) Manual for the disposal of contaminated sediment. Note: Pollutant concentrations may increase if sediment is not routinely removed.
	Sediment accumulation along swale bottom	Sediment inhibits the flow of water through the grass (e.g. water is ponding or cutting a channel).	Remove sediment from grassy areas. The use of a Vactor® truck is allowed unless access restrictions are listed in the O&M Manual. Restore slope and geometry to design standards, if necessary. Reseed grass cover where needed. Stormwater should infiltrate or flow toward outlet once inflow has ceased.

Table 3: Maintenance of Water Quality or Biofiltration Swales Swales should provide even sheet flow that moves water from the inlet to the outlet.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
Swale Components	Erosion	Side slopes show evidence of erosion greater than 2 inches deep and the potential for continued erosion is evident.	Promptly address erosion that causes immediate problems (e.g. damage to highway or highway structure) Schedule non-urgent repairs with routine work. Stabilize slope using appropriate erosion control and repair methods. Repair the cause of the erosion where possible. If necessary, contact the ODOT Erosion Control Coordinator to evaluate the condition.
	Poor vegetation coverage	Vegetation (grass) is sparse or eroded patches occur in more than 10 percent of swale. NOTE: A single incident (e.g. vehicle accident) typically effects less than 10 percent of the area and is unlikely to trigger a repair.	Repair and reseed as appropriate to restore coverage. Install erosion control measures as needed. Trim overhanging limbs and remove brushy vegetation that limit grass growth (provide too much shade).
	Missing or eroded amended soil mix	Bare soil is observed over 10 percent of the amended area.	Identify and resolve erosion problem Add amended soil. Contact a Region Hydraulics Engineer for required material specifications.
	Amended soil mix along swale bottom is clogged	Standing water is observed for seven (7) consecutive days or longer from May through October.	Remove and replace amended soil mix. Contact a Region Hydraulics Engineer for required material specifications. Replace or repair damaged underlying drainage geotextile, impermeable liner, drain piping, and granular drain backfill material when applicable.
	Granular drain backfill material for underdrain pipe plugged	Amended soil mix has been replaced and standing water is still observed for seven (7) consecutive days or longer from May through October.	Remove and replace granular drain backfill material. Contact a Region Hydraulics Engineer for required material specifications. Install new drainage geotextile over new granular drain backfill material. Replace amended soil mix.

Table 3: Maintenance of Water Quality or Biofiltration Swales Swales should provide even sheet flow that moves water from the inlet to the outlet.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
Swale Components	Impermeable liner damage NOTE: Liners may not be visible. If present, liners are typically below the grass surface along the bottom of the swale Fabric wrapped around underdrains is not a liner.	Liner is damaged (e.g. during sediment removal or by motoring public). Liner is damaged when condition allows potential contamination to be released to the subsurface.	Repair or replace the liner with similar material. Replace top soil and grass as appropriate. Features with liners, typically have maintenance option limitations; check the O&M Manual. If necessary, contact a Region Hydraulics Engineer for technical assistance.
	Obstruction or blockage of pipes	Water does not flow in, through, or out of the swale.	Remove obstructions to restore flow (e.g. remove trash, debris, sediment, or vegetation as necessary). Jet rodders may be used to clean piping unless specifically prohibited in the O&M plan.
	Flow spreader is uneven or clogged	Water does not flow evenly across the structure	Clean sump or forebay as needed to maintain capacity. Clean or repair spreader as needed to provide a uniform flow and prevent erosion. Level portions of the flow spreader that have settled.

Table 5: Bioslopes Bioslopes should provide even sheet flow that moves water from edge of pavement.			
Maintenance Component	**Defect or Problem**	**Condition When Maintenance is Needed**	**Recommended Maintenance to Correct Problem**
General	Follow applicable Guidance from Table 1 AND applicable guidance from this table.		
	Vegetation growth (mowing and brushing)	Vegetation growth restricts access, limits sight distance, obstructs water flow, or interferes with maintenance activity. **Slopes should be mowed annually.**	Mow as noted in the District Integrated Vegetation Management (IVM) Plan. The use of heavy equipment is allowed unless access restrictions are listed in the O&M Manual.
Bioslope Components	Sediment accumulation	Sediment inhibits the flow of water to the bioslope (e.g. water is ponding or cutting a channel).	Remove sediment from grassy areas. The use of a Vactor® truck is allowed unless access restrictions are listed in the O&M Manual. Restore slope and geometry to design standards, if necessary. Reseed grass cover where needed.
	Ecology mix is clogged	Standing water is observed for seven (7) consecutive days or longer from May through October.	Remove and replace ecology mix. Contact a Region Hydraulics Engineer for required material specifications. Replace or repair damaged underlying drainage geotextile, impermeable liner, drain piping, and granular drain backfill material when applicable.
	Granular drain backfill material for underdrain pipe plugged	Ecology mix has been replaced and standing water is still observed for seven (7) consecutive days or longer from May through October.	Remove and replace granular drain backfill material. Contact a Region Hydraulics Engineer for required material specifications. Install new drainage geotextile over new granular drain backfill material. Replace amended soil mix.
	Poor vegetation coverage	Vegetation (grass) is sparse or eroded patches occur in more than 10 percent of the strip	Repair and reseed as appropriate to restore coverage. Install erosion control measures as needed.

Appendix F. Downstream Analysis

Downstream Conveyance Analysis Memo

Date:	Friday, December 20, 2019
Project:	ODOT | K19786 I-205: I-5 to OR 213, Phase 1
To:	Tom Hamstra, ODOT – PM
From:	Mike Bertram, HDR – PM
Subject:	Task 7 – Hydraulics and Stormwater

Oregon City Downstream Drainage Analysis

The following downstream drainage conveyance system requirements will be incorporated into the design of the stormwater management plan.

- Stormwater runoff discharges will not adversely affect the safety and/or flooding potential of adjacent or downstream property owners.
- A written downstream analysis will document existing conditions and demonstrate adequate conveyance capacity of the natural and constructed drainage system downstream of the project site.
- The downstream analysis will extend to the distance where the project site contributes less than 15 percent of the cumulative tributary drainage area or 1,500 feet downstream of the approved point of discharge, whichever is greater. In capacity constrained areas, the City may extend the distance of the required downstream analysis.
- When downstream drainage conveyance systems are inadequate or systems are determined to be undersized, or when, in the opinion of the City, property or properties may be adversely affected by the existing and/or proposed stormwater release rates, the applicant may provide additional onsite stormwater flow control measures to reduce contributions to the downstream system, or correct and/or improve downstream drainage conditions so that the proposed stormwater release rates do not have to be restricted further.
- The applicant is responsible for replacing, repairing, upsizing, constructing, or reconstructing the downstream conveyance system to provide the capacity necessary to develop the property. The downstream conveyance system may include any open or closed public or private stormwater conveyance system.
- The applicant is required to identify all offsite downstream conveyance restrictions and the cost of upsizing/improving the conveyance systems to meet the minimum conveyance requirements.

Design Methods

The design event is determined by the size of the contributing areas. See Table 1 for a list of design storms for corresponding contributing areas. Conveyance systems will be designed and constructed to carry the design storm flowing full with no pressure flow. Flow conditions in existing pipe systems will be evaluated on a case-by-case basis for adequacy. Conveyance systems in the public right-of-way will be designed as gravity systems. The Rational Method for

computing peak discharge is preferred by the City. The Rational Method will be used for all existing and proposed conveyance systems that receive drainage from contributing areas of 25 acres or less and that have a time of concentration of less than 100 minutes. For all other conditions, an approved hydrograph method (e.g., Santa Barba Urban Hydrograph, Natural Resources Conservation Service Method, or Technical Release 55), stormwater management model, or other standard methods as approved by the City will be used. The Manning's equation generally will be acceptable for determining pipe or open channel capacity for drainageways with a contributing area of 50 acres or less. For larger drainage areas, backwater effects will be included in determining capacity for a drainage way.

Table 1 Conveyance System Design Storms

Contributing Drainage Area	Design Storm for Conveyance System Sizing		
	Storm Sewer, Culverts, and Outfall Pipes[a]	Creek or Stream Channels	Bridges
Less than 40 acres	10-year, 24-hour storm	10-year, 24-hour storm	100-year, 24-hour storm
40 to 640 acres	25-year, 24-hour storm	25-year, 24-hour storm	
640 acres or greater	50-year, 24-hour storm	50-year, 24-hour storm	

[a] *When a backwater condition exists, the storm drain system will be designed to convey and contain at least the peak runoff for the 25-year design storm.*

Main Street Outfall

The portion of the project located between station "L" 661+00 and station "L" 698+00 drains north to the Clackamas River through a stormwater conveyance system owned and maintained by Oregon City. The proposed project would add 1.03 acres of impervious area within the contributing drainage basin. A downstream analysis of the Oregon City conveyance system was preformed to verify that the existing system has adequate capacity to convey the increased runoff volume generated from the new impervious area.

The area that drains to the conveyance system is 138 acres and is composed of impervious, industrial, forested, residential, grassed, and wetland areas. The basin area is shown in Figure 1. The NRCS runoff curve numbers used for the hydrologic analysis are listed in Table 2. Per Oregon City standards for drainage areas between 40 and 640 acres, the design storm for analyzing the conveyance system is the 25-year, 24-hour storm or 4.0 inches over a 24-hour storm event. The Santa Barbara Urban Hydrograph (SBUH) Method using a Type 1A unit hydrograph distribution was used to model the runoff. The existing modeled flow was 41.2 cubic feet per second (cfs) and the proposed modeled flow was 41.9 cfs. (Attachment A)

Table 2 NRCS Curve Number Values

Landcover Classification	NRCS Runoff Curve Number
Impervious	98
Industrial	88
Forested	60
Light Residential	68
Grassed Areas >75% Grass	75
Wetland	55

The existing conveyance system is composed of six pipes. The upstream-most pipe is 42 inches in diameter and the five downstream pipes are 48 inches in diameter. The upstream-most pipe is polyvinyl chloride (PVC) and the remainder of the pipes are reinforced concrete pipe (RCP). A Manning's n value of 0.0110 was used for PVC pipe and 0.0130 was used for the RCP.

The existing conveyance system discharges directly to the Clackamas River and is subject to tailwater conditions that range from free discharge to a completely submerged outfall. The system was modeled using both a free discharge tailwater condition and a tailwater elevation of 30 feet, equal to the ordinary high water on the Willamette River. The stage on the Willamette River was used because of the proximity of the outlet to the Willamette River. Table 3 through Table 6 summarize the hydraulic grade line calculations for the proposed and the existing conditions. The proposed conditions for both the free discharge and the submerged outlet meet Oregon City's design guideline of maintaining one foot of freeboard between the hydraulic grade line and the structure rims. The increase in hydraulic grade line due to the increased runoff from the additional pervious surface ranges from no observed increase at the outlet, to 0.02 foot increase in the first pipe of the conveyance system.

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Figure 1 Drainage Basins

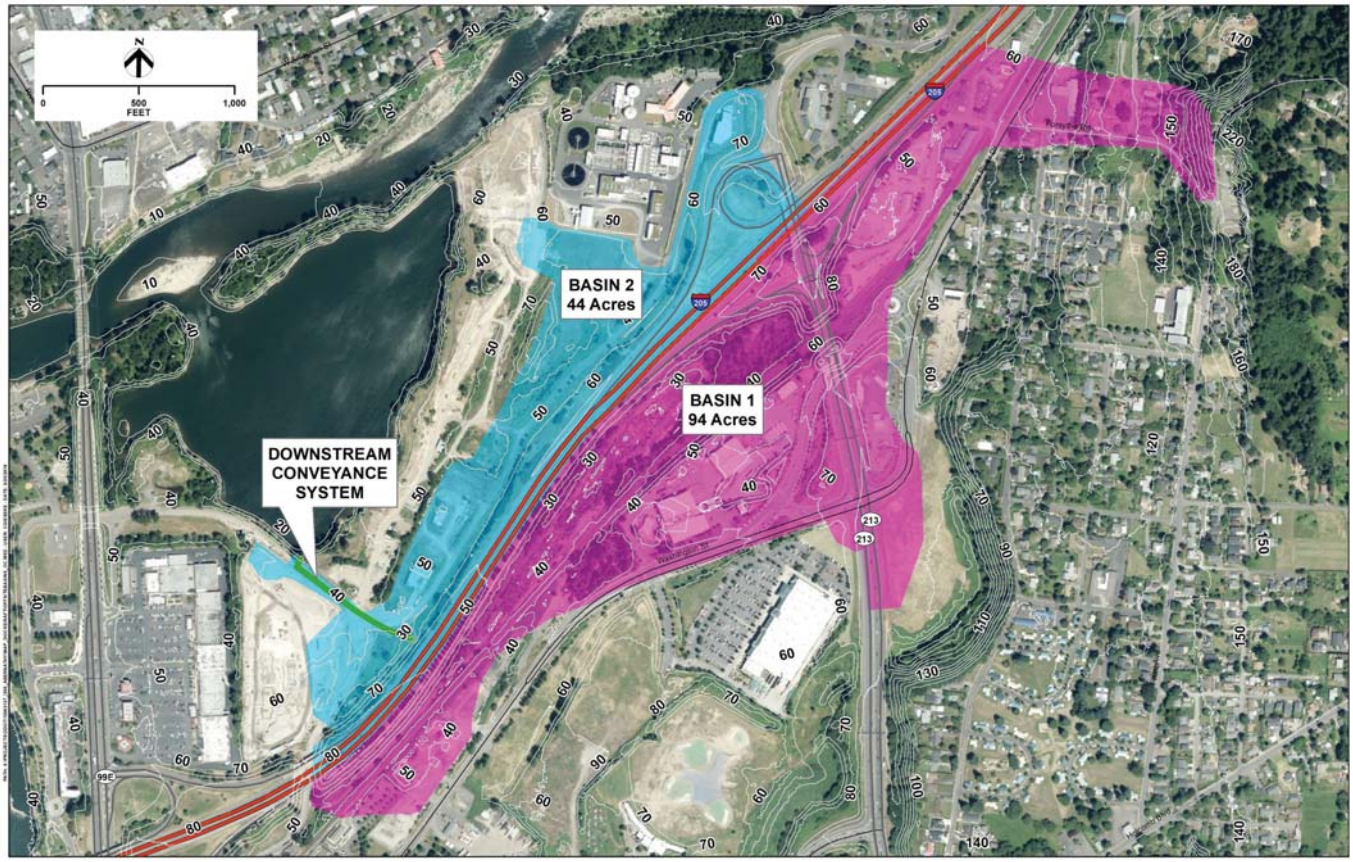


Table 3 Submerged Outlet Existing Conditions

Node	Design Q (cfs)	Diameter (ft)	Length (ft)	V1	V12/2g	Slope	Minor Pipe Losses	Sf = (Qn/ 0.46d2.67)2	Hf = Sf x L	EGL0	K	K*V22/2g	EGLi	HGL (ft)	Crown of pipe US	Crown of pipe DS	Rim or Surface Elev. (ft)	Freeboard (ft)
PIPE 1	41.42	3.5	116.2	17.06	4.52	1.90%	0.0000	0.0012	0.14	41.19	0.9	4.067	41.05	36.67	33.12	30.91	39.00	2.33
PIPE 2	41.42	4.0	66.2	8.20	1.04	0.51%	0.0000	0.0008	0.06	36.98	0.9	0.940	36.93	35.94	31.41	31.07	37.88	1.94
PIPE 3	41.42	4.0	130.8	12.25	2.33	1.15%	0.0000	0.0008	0.11	35.99	0.9	2.098	35.88	33.66	31.07	29.57	34.88	1.22
PIPE 4	41.42	4.0	216.0	10.87	1.84	0.90%	0.0000	0.0008	0.18	33.78	0.9	1.652	33.60	31.95	29.37	27.42	35.17	3.22
PIPE 5	41.42	4.0	159.3	9.97	1.54	0.76%	0.0000	0.0008	0.13	31.95	0.9	1.390	31.82	30.40	27.32	26.11	32.34	1.94
PIPE 6	41.42	4.0	42.1	5.29	0.43	0.21%	0.0000	0.0008	0.04	30.43	0.9	0.391	30.39	29.99	25.91	25.82	31.21	1.22
Outfall										30.00				30.00				

Table 4 Free Discharge Existing Conditions

Node	Design Q (cfs)	Diameter (ft)	Length (ft)	V1	V12/2g	Slope	Minor Pipe Losses	Sf = (Qn/ 0.46d2.67)2	Hf = Sf x L	EGL0	K	K*V22/2g	EGLi	HGL (ft)	Crown of pipe US	Crown of pipe DS	Rim or Surface Elev. (ft)	Freeboard (ft)
PIPE 1	41.42	3.5	116.2	17.06	4.52	1.90%	0.0000	0.0012	0.14	33.01	0.9	4.067	32.87	28.49	33.12	30.91	39.00	10.51
PIPE 2	41.42	4.0	66.2	8.20	1.04	0.51%	0.0000	0.0008	0.06	28.80	0.9	0.940	28.75	27.76	31.41	31.07	37.88	10.12
PIPE 3	41.42	4.0	130.8	12.25	2.33	1.15%	0.0000	0.0008	0.11	27.81	0.9	2.098	27.70	25.48	31.07	29.57	34.88	9.40
PIPE 4	41.42	4.0	216.0	10.87	1.84	0.90%	0.0000	0.0008	0.18	25.60	0.9	1.652	25.42	23.77	29.37	27.42	35.17	11.40
PIPE 5	41.42	4.0	159.3	9.97	1.54	0.76%	0.0000	0.0008	0.13	23.77	0.9	1.390	23.64	22.22	27.32	26.11	32.34	10.12
PIPE 6	41.42	4.0	42.1	5.29	0.43	0.21%	0.0000	0.0008	0.04	22.25	0.9	0.391	22.21	21.81	25.91	25.82	31.21	9.40
Outfall										21.82				21.82				

Table 5 Submerged Outlet Proposed Conditions

Node	Design Q (cfs)	Diameter (ft)	Length (ft)	V1	V12/2g	Slope	Minor Pipe Losses	Sf = (Qn/ 0.46d2.67)2	Hf = Sf x L	EGL0	K	K*V22/2g	EGLi	HGL (ft)	Crown of pipe US	Crown of pipe DS	Rim or Surface Elev. (ft)	Freeboard (ft)
PIPE 1	41.93	3.5	116.2	17.06	4.52	1.90%	0.0000	0.0013	0.15	41.21	0.9	4.067	41.06	36.69	33.12	30.91	39.00	2.31
PIPE 2	41.93	4.0	66.2	8.20	1.04	0.51%	0.0000	0.0009	0.06	37.00	0.9	0.940	36.94	35.95	31.41	31.07	37.88	1.93
PIPE 3	41.93	4.0	130.8	12.25	2.33	1.15%	0.0000	0.0009	0.11	36.00	0.9	2.098	35.89	33.67	31.07	29.57	34.88	1.21
PIPE 4	41.93	4.0	216.0	10.87	1.84	0.90%	0.0000	0.0009	0.18	33.79	0.9	1.652	33.60	31.95	29.37	27.42	35.17	3.22
PIPE 5	41.93	4.0	159.3	9.97	1.54	0.76%	0.0000	0.0009	0.14	31.95	0.9	1.390	31.82	30.41	27.32	26.11	32.34	1.93
PIPE 6	41.93	4.0	42.1	5.29	0.43	0.21%	0.0000	0.0009	0.04	30.43	0.9	0.391	30.39	29.99	25.91	25.82	31.21	1.22
Outfall										30.00				30.00				

Table 6 Free Discharge Proposed Conditions

Node	Design Q (cfs)	Diameter (ft)	Length (ft)	V1	V12/2g	Slope	Minor Pipe Losses	Sf = (Qn/ 0.46d2.67)2	Hf = Sf x L	EGL0	K	K*V22/2g	EGLi	HGL (ft)	Crown of pipe US	Crown of pipe DS	Rim or Surface Elev. (ft)	Freeboard (ft)
PIPE 1	41.93	3.5	116.2	17.06	4.52	1.90%	0.0000	0.0013	0.15	33.03	0.9	4.067	32.88	28.51	33.12	30.91	39.00	10.49
PIPE 2	41.93	4.0	66.2	8.20	1.04	0.51%	0.0000	0.0009	0.06	28.82	0.9	0.940	28.76	27.77	31.41	31.07	37.88	10.11
PIPE 3	41.93	4.0	130.8	12.25	2.33	1.15%	0.0000	0.0009	0.11	27.82	0.9	2.098	27.71	25.49	31.07	29.57	34.88	9.39
PIPE 4	41.93	4.0	216.0	10.87	1.84	0.90%	0.0000	0.0009	0.18	25.61	0.9	1.652	25.42	23.77	29.37	27.42	35.17	11.40
PIPE 5	41.93	4.0	159.3	9.97	1.54	0.76%	0.0000	0.0009	0.14	23.77	0.9	1.390	23.64	22.23	27.32	26.11	32.34	10.11
PIPE 6	41.93	4.0	42.1	5.29	0.43	0.21%	0.0000	0.0009	0.04	22.25	0.9	0.391	22.21	21.81	25.91	25.82	31.21	9.40
Outfall										21.82				21.82				

Jon Storm Park Outfall

The proposed project would add on-street parking along the northbound lane of Clackamette Drive, adjacent to Jon Storm Park. Approximately 2,600 square feet of grassed area is proposed to be converted into paved parking spaces and sidewalk. The area would drain to a stormwater planter located at the northern end of the proposed improvements. Overflows from the stormwater planter would be routed to an existing stormwater conveyance system owned and maintained by Oregon City that discharges directly to the Willamette River.

The changes would not result in additional areas draining to the system; the project would generate additional runoff by converting currently pervious ground into impervious. Currently 1.42 acres drain through the existing conveyance system, as shown in Figure 2. The Rational Method was used to calculate the estimated discharge. Oregon City design guidelines specify that because the drainage area is less than 10 acres, the design storm should be the 10-year, 24-hour storm event. Runoff coefficients of 0.3 and 0.9 were used for grassed and paved areas respectively. A time of concentration of 5 minutes was used, which equates to a rainfall intensity of 2.84 inches per hour. The modeled discharge through the conveyance system for the proposed conditions was 2.32 cfs, which is a 0.10 cfs increase from the existing conditions peak flow of 2.22 cfs.

Table 7 Jon Storm Park Hydrology

Area	Square feet	Acres	Runoff Coefficient	Intensity	Flow
Extg Rdwy North	14,908	0.34	0.90	2.84	0.87
Extg Rdwy South	10,824	0.25	0.90	2.84	0.64
Grassed Offsite	33,613	0.77	0.30	2.84	0.66
Parking Lot	2,622	0.06	0.90	2.84	0.15
Sum					**2.32**

The conveyance system was modeled both as a free discharge and a submerged outlet tailwater condition to account for high stages on the Willamette River. The ordinary high water level of 30 feet was used for the tailwater condition in the submerged outlet scenario. Table 8 through Table 11 summarize the hydraulic grade line calculations for both the free discharge and the submerged outlet condition. Both the free discharge and the submerged outlet meet the Oregon City design guideline of maintaining 1 foot of freeboard between the hydraulic grade line and the structure rims.

Figure 2 Jon Storm Park Drainage Area

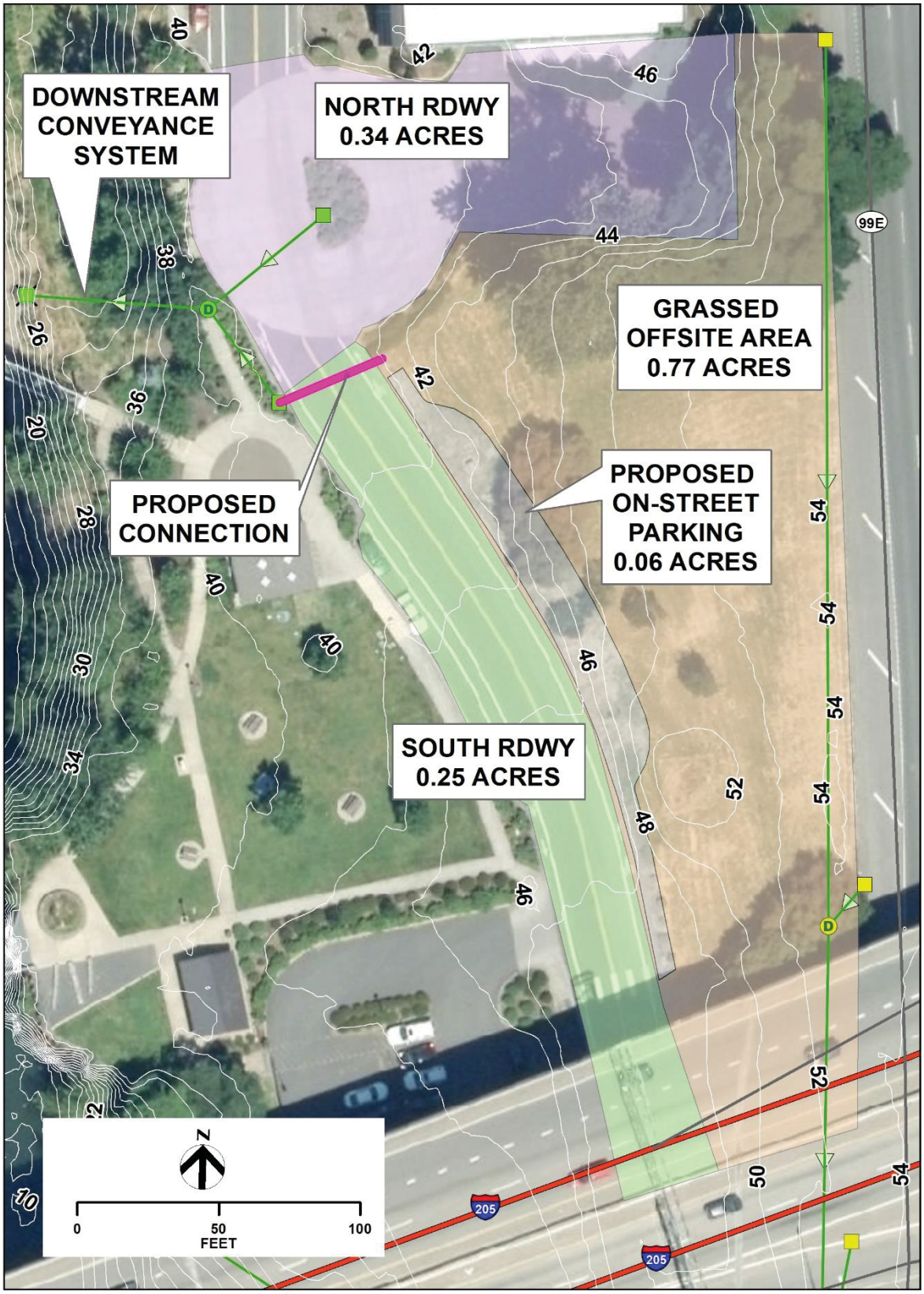


Table 8 Free Discharge Existing Conditions

Node	Design Q (cfs)	Diameter (ft)	Length (ft)	Slope	V1	V12/2g	Minor Pipe Losses	Sf = (Qn/ 0.46d2.67)2	Hf = Sf x L	EGL0	K	K*V22/2g	EGLi	HGL (ft)	Crown of pipe US	Crown of pipe DS	Rim or Surface Elev. (ft)	Freeboard (ft)
PIPE 1*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PIPE 2	1.34	1.0	41.6	3.6%	8.65	1.1610	0.0000	0.0014	0.06	28.15	0.9	1.045	28.09	26.99	34.31	32.80	35.74	8.75
PIPE 3	2.22	1.0	64.4	13.5%	16.68	4.3208	0.0000	0.0039	0.25	27.04	0.9	3.889	26.79	22.72	32.60	23.90	36.70	13.98
Outfall										22.90				22.90				

**Pipe 1 not present in existing conditions*

Table 9 Submerged Outlet Existing Conditions

Node	Design Q (cfs)	Diameter (ft)	Length (ft)	Slope	V1	V12/2g	Minor Pipe Losses	Sf = (Qn/ 0.46d2.67)2	Hf = Sf x L	EGL0	K	K*V22/2g	EGLi	HGL (ft)	Crown of pipe US	Crown of pipe DS	Rim or Surface Elev. (ft)	Freeboard (ft)
PIPE 1*	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
PIPE 2	1.34	1.0	41.6	3.6%	8.65	1.1610	0.0000	0.0014	0.06	35.25	0.9	1.045	35.19	34.09	34.31	32.80	35.74	1.65
PIPE 3	2.22	1.0	64.4	13.5%	16.68	4.3208	0.0000	0.0039	0.25	34.14	0.9	3.889	33.89	29.82	32.60	23.90	36.70	6.88
Outfall										30.00				30.00				

**Pipe 1 not present in existing conditions*

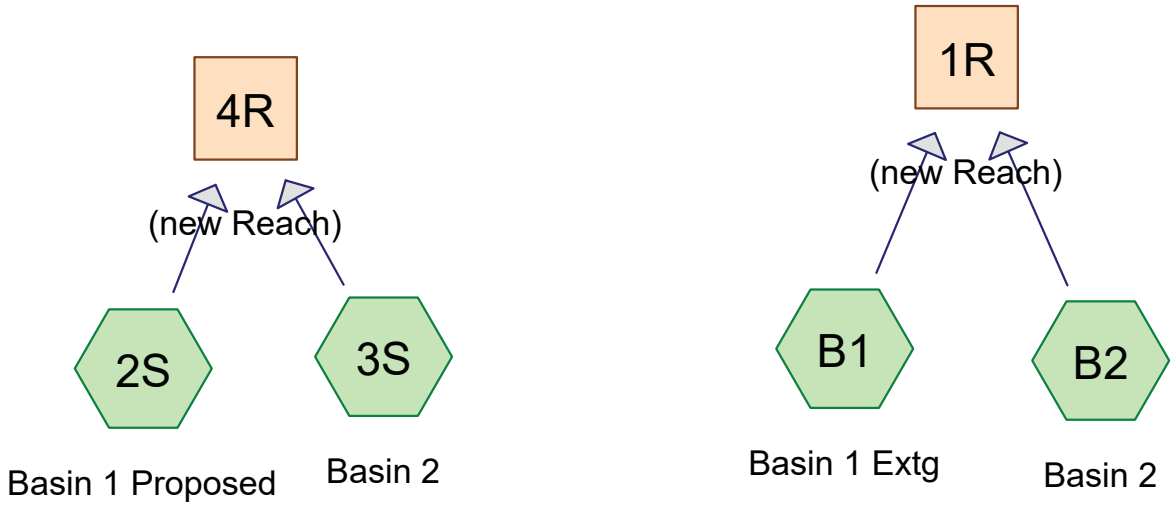
Table 10 Free Discharge Proposed Conditions

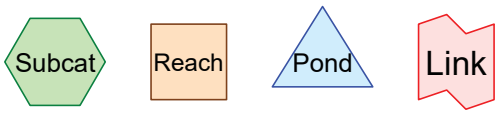
Node	Design Q (cfs)	Diameter (ft)	Length (ft)	Slope	V1	V12/2g	Minor Pipe Losses	Sf = (Qn/ 0.46d2.67)2	Hf = Sf x L	EGL0	K	K*V22/2g	EGLi	HGL (ft)	Crown of pipe US	Crown of pipe DS	Rim or Surface Elev. (ft)	Freeboard (ft)
PIPE 1	1.11	1.0	51.0	1.0%	4.49	0.3136	0.0000	0.0005	0.0267	28.49	0.9	0.282	28.46	28.18	35.00	34.50	40.00	11.82
PIPE 2	1.74	1.0	41.6	3.6%	8.65	1.1610	0.0000	0.0017	0.07	28.18	0.9	1.045	28.11	27.02	34.31	32.80	35.74	8.72
PIPE 3	2.62	1.0	64.4	13.5%	16.68	4.3208	0.0000	0.0043	0.28	27.07	0.9	3.889	26.79	22.74	32.60	23.90	36.70	13.96
Outfall										22.90				22.90				

Table 11 Submerged Outlet Proposed Conditions

Node	Design Q (cfs)	Diameter (ft)	Length (ft)	Slope	V1	V12/2g	Minor Pipe Losses	Sf = (Qn/ 0.46d2.67)2	Hf = Sf x L	EGL0	K	K*V22/2g	EGLi	HGL (ft)	Crown of pipe US	Crown of pipe DS	Rim or Surface Elev. (ft)	Freeboard (ft)
PIPE 1	0.81	1.0	51.0	1.0%	4.49	0.3136	0.0000	0.0005	0.0267	35.59	0.9	0.282	35.56	35.28	35.00	34.50	40.00	4.72
PIPE 2	1.45	1.0	41.6	3.6%	8.65	1.1610	0.0000	0.0017	0.07	35.28	0.9	1.045	35.21	34.12	34.31	32.80	35.74	1.62
PIPE 3	2.32	1.0	64.4	13.5%	16.68	4.3208	0.0000	0.0043	0.28	34.17	0.9	3.889	33.89	29.84	32.60	23.90	36.70	6.86
Outfall										30.00				30.00				

Attachment A: HydroCAD Hydrology





Drainage Diagram for OC Offsite Basins
Prepared by HDR, Printed 9/26/2019
HydroCAD® 9.10 s/n 04284 © 2010 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
54.258	55	Forest / wetlands (2S, B1)
9.600	60	Forest (2S, 3S, B1, B2)
1.066	61	Field (2S, B1)
0.798	68	Light residential (2S, B1)
9.840	75	Field (2S, B1)
6.144	75	Field / Ag (2S, B1)
61.355	75	Grass cover>75% (3S, B2)
35.348	88	Dirt / Industrial? (2S, B1)
32.810	88	Industrial (2S, B1)
60.032	98	Impervious (2S, 3S, B1, B2)
1.030	98	Imperviousl (2S)
3.428	98	Open water (2S, B1)

Time span=0.00-40.00 hrs, dt=0.01 hrs, 4001 points
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment2S: Basin 1 Proposed Runoff Area=3,881,588 sf 19.15% Impervious Runoff Depth=1.96"
Flow Length=5,564' Tc=26.3 min CN=73/98 Runoff=27.95 cfs 14.525 af

Subcatchment3S: Basin 2 Runoff Area=48.745 ac 32.19% Impervious Runoff Depth=2.29"
Flow Length=10,300' Tc=52.4 min CN=74/98 Runoff=14.31 cfs 9.320 af

SubcatchmentB1: Basin 1 Extg Runoff Area=3,881,575 sf 18.00% Impervious Runoff Depth=1.93"
Flow Length=5,564' Tc=26.3 min CN=73/98 Runoff=27.43 cfs 14.333 af

SubcatchmentB2: Basin 2 Runoff Area=2,123,346 sf 32.19% Impervious Runoff Depth=2.29"
Flow Length=10,300' Tc=52.4 min CN=74/98 Runoff=14.31 cfs 9.320 af

Reach 1R: (new Reach) Avg. Flow Depth=1.53' Max Vel=10.21 fps Inflow=41.45 cfs 23.653 af
42.0" Round Pipe n=0.013 L=730.0' S=0.0107 '/' Capacity=104.13 cfs Outflow=41.42 cfs 23.653 af

Reach 4R: (new Reach) Avg. Flow Depth=1.55' Max Vel=10.24 fps Inflow=41.96 cfs 23.846 af
42.0" Round Pipe n=0.013 L=730.0' S=0.0107 '/' Capacity=104.13 cfs Outflow=41.93 cfs 23.846 af

Summary for Subcatchment 2S: Basin 1 Proposed

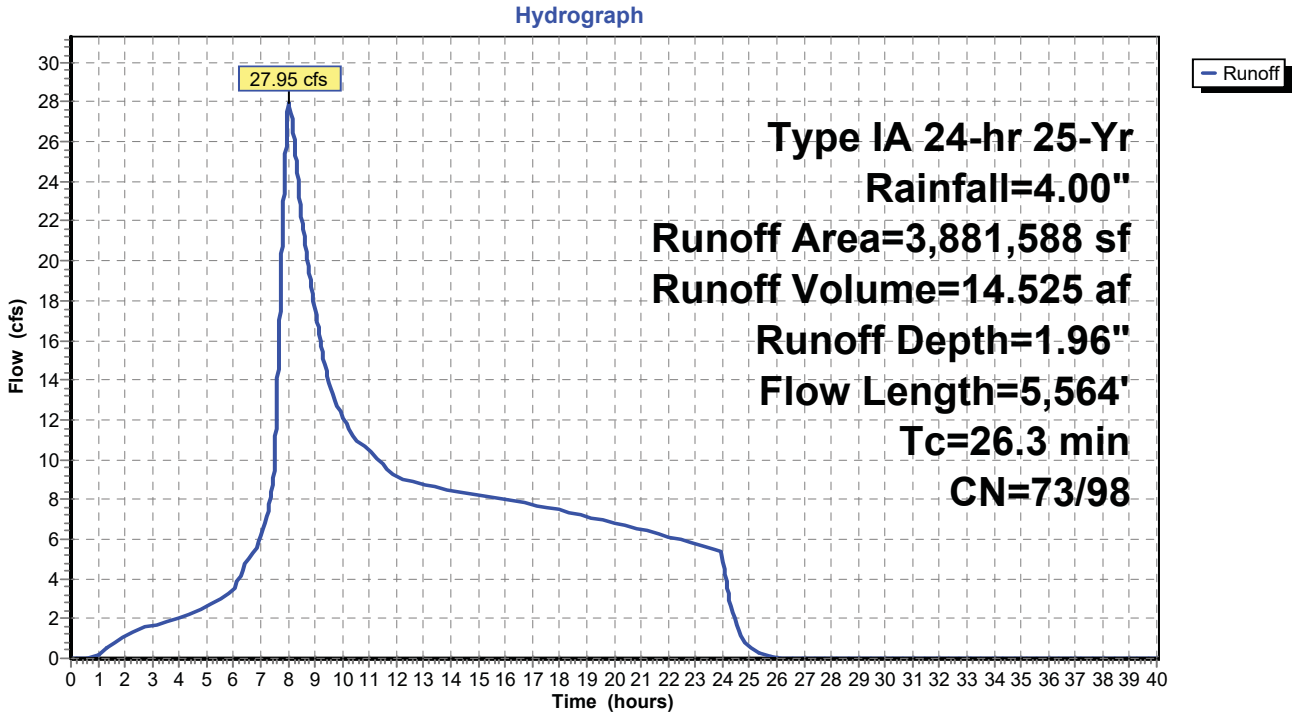
Runoff = 27.95 cfs @ 8.01 hrs, Volume= 14.525 af, Depth= 1.96"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=4.00"

	Area (sf)	CN	Description
*	69,173	60	Forest
*	71,961	98	Impervious
*	95,135	88	Industrial
*	23,217	61	Field
*	17,380	68	Light residential
*	573,990	88	Dirt / Industrial?
*	100,929	98	Impervious
*	36,416	60	Forest
*	28,750	98	Impervious
*	139,740	88	Industrial
*	133,816	75	Field / Ag
*	355,058	98	Impervious
*	48,003	75	Field
*	52,272	98	Impervious
*	85,465	75	Field
*	45,259	75	Field
*	479,726	88	Industrial
*	8,146	98	Impervious
*	6,839	98	Impervious
*	35,589	75	Field
*	1,159,306	55	Forest / wetlands
*	74,662	98	Open water
*	195,889	88	Dirt / Industrial?
*	44,867	98	Imperviousl
	3,881,588	78	Weighted Average
	3,138,104	73	80.85% Pervious Area
	743,484	98	19.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	130	0.4200	0.24		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.44"
17.3	5,434	0.0100	5.22	78.31	**Channel Flow,** Area= 15.0 sf Perim= 11.0' r= 1.36' n= 0.035 Earth, dense weeds
26.3	5,564	Total			

Subcatchment 2S: Basin 1 Proposed



Summary for Subcatchment 3S: Basin 2

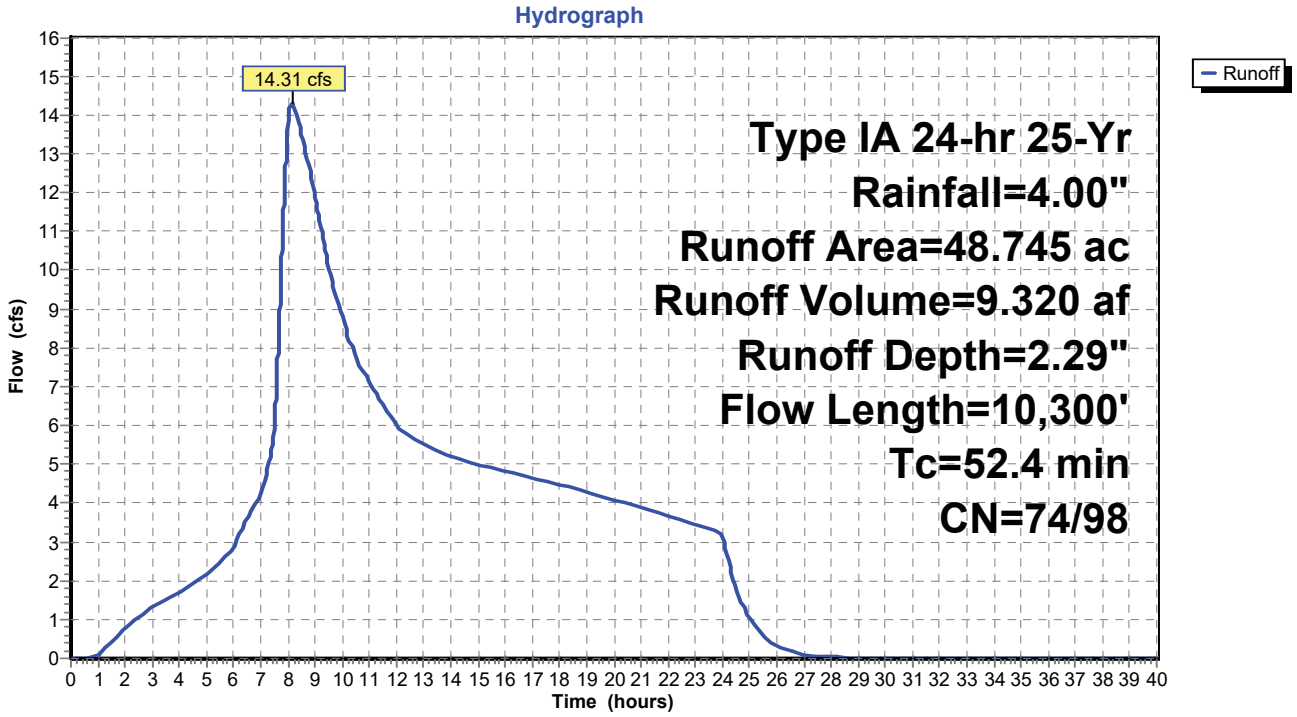
Runoff = 14.31 cfs @ 8.17 hrs, Volume= 9.320 af, Depth= 2.29"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=4.00"

	Area (ac)	CN	Description
*	0.913	98	Impervious
*	2.376	60	Forest
*	5.723	75	Grass cover>75%
*	1.566	98	Impervious
*	22.712	75	Grass cover>75%
*	11.858	98	Impervious
*	1.359	75	Grass cover>75%
*	1.355	98	Impervious
*	0.883	75	Grass cover>75%
	48.745	82	Weighted Average
	33.053	74	67.81% Pervious Area
	15.692	98	32.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	300	0.0400	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.44"
31.9	10,000	0.0100	5.22	78.31	**Channel Flow,** Area= 15.0 sf Perim= 11.0' r= 1.36' n= 0.035
52.4	10,300	Total			

Subcatchment 3S: Basin 2



Summary for Subcatchment B1: Basin 1 Extg

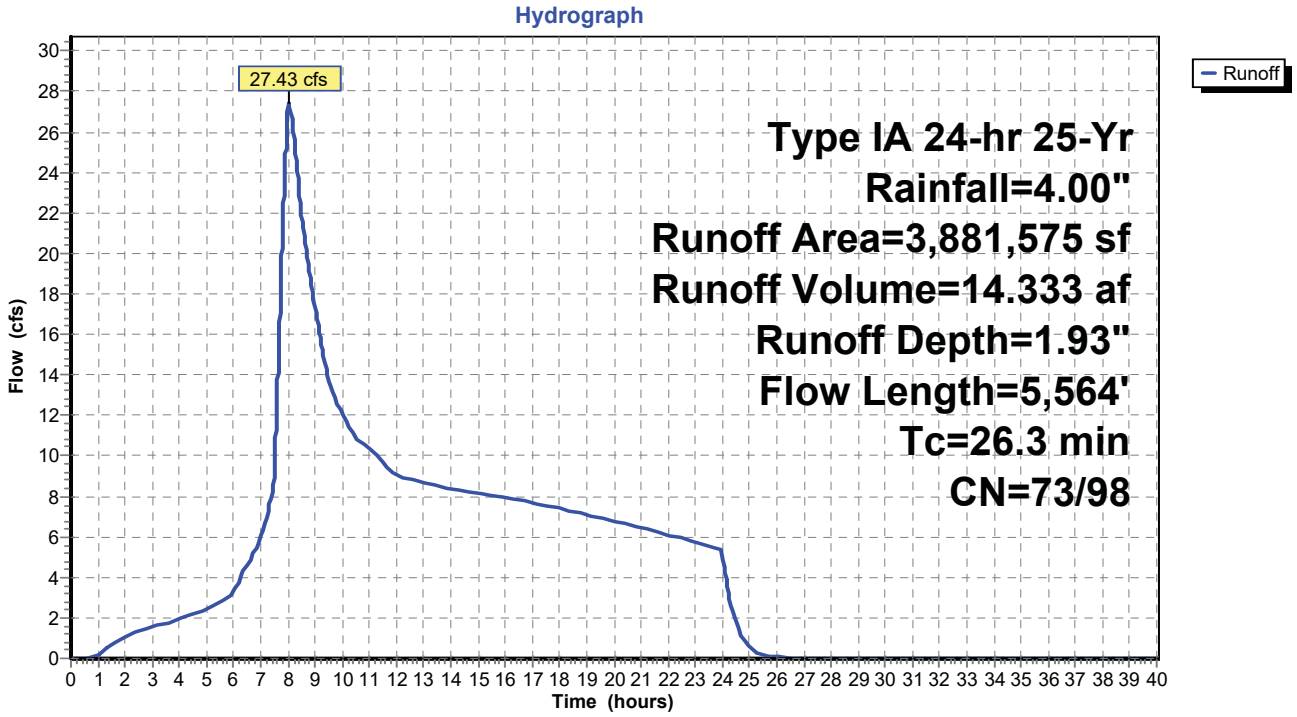
Runoff = 27.43 cfs @ 8.01 hrs, Volume= 14.333 af, Depth= 1.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=4.00"

	Area (sf)	CN	Description
*	69,157	60	Forest
*	71,969	98	Impervious
*	95,150	88	Industrial
*	23,198	61	Field
*	17,380	68	Light residential
*	573,999	88	Dirt / Industrial?
*	100,908	98	Impervious
*	36,415	60	Forest
*	28,767	98	Impervious
*	139,747	88	Industrial
*	133,826	75	Field / Ag
*	355,062	98	Impervious
*	47,986	75	Field
*	52,288	98	Impervious
*	85,448	75	Field
*	45,251	75	Field
*	479,718	88	Industrial
*	8,126	98	Impervious
*	6,853	98	Impervious
*	35,609	75	Field
*	1,204,184	55	Forest / wetlands
*	74,646	98	Open water
*	195,888	88	Dirt / Industrial?
	3,881,575	77	Weighted Average
	3,182,956	73	82.00% Pervious Area
	698,619	98	18.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	130	0.4200	0.24		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 2.44"
17.3	5,434	0.0100	5.22	78.31	**Channel Flow,** Area= 15.0 sf Perim= 11.0' r= 1.36' n= 0.035 Earth, dense weeds
26.3	5,564	Total			

Subcatchment B1: Basin 1 Extg



Summary for Subcatchment B2: Basin 2

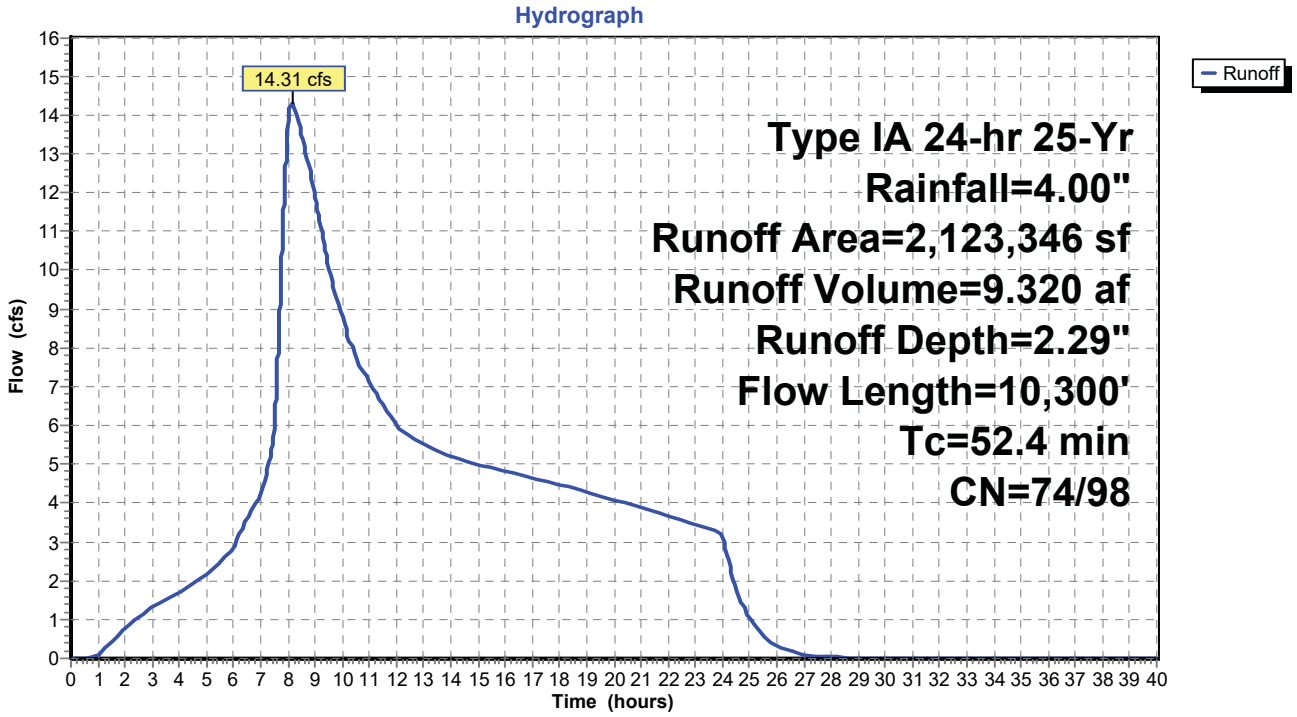
Runoff = 14.31 cfs @ 8.17 hrs, Volume= 9.320 af, Depth= 2.29"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Yr Rainfall=4.00"

	Area (sf)	CN	Description
*	39,766	98	Impervious
*	103,497	60	Forest
*	249,307	75	Grass cover>75%
*	68,236	98	Impervious
*	989,348	75	Grass cover>75%
*	516,514	98	Impervious
*	59,205	75	Grass cover>75%
*	59,008	98	Impervious
*	38,465	75	Grass cover>75%
	2,123,346	82	Weighted Average
	1,439,822	74	67.81% Pervious Area
	683,524	98	32.19% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.5	300	0.0400	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.44"
31.9	10,000	0.0100	5.22	78.31	**Channel Flow,** Area= 15.0 sf Perim= 11.0' r= 1.36' n= 0.035
52.4	10,300	Total			

Subcatchment B2: Basin 2



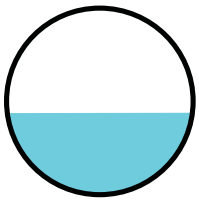
Summary for Reach 1R: (new Reach)

Inflow Area = 137.854 ac, 23.02% Impervious, Inflow Depth = 2.06" for 25-Yr event
Inflow = 41.45 cfs @ 8.03 hrs, Volume= 23.653 af
Outflow = 41.42 cfs @ 8.08 hrs, Volume= 23.653 af, Atten= 0%, Lag= 2.6 min

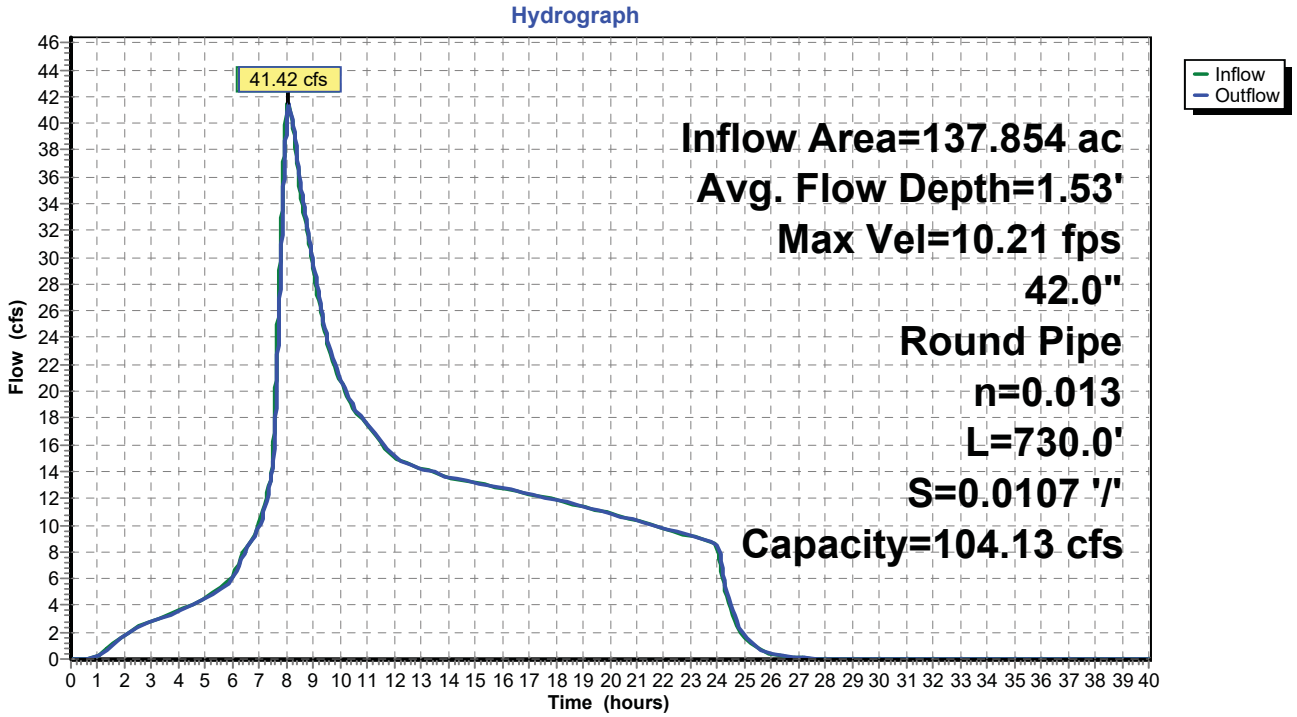
Routing by Stor-Ind+Trans method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.21 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 5.39 fps, Avg. Travel Time= 2.3 min

Peak Storage= 2,963 cf @ 8.06 hrs
Average Depth at Peak Storage= 1.53'
Bank-Full Depth= 3.50', Capacity at Bank-Full= 104.13 cfs

42.0" Round Pipe
n= 0.013
Length= 730.0' Slope= 0.0107 '/'
Inlet Invert= 29.62', Outlet Invert= 21.80'



Reach 1R: (new Reach)



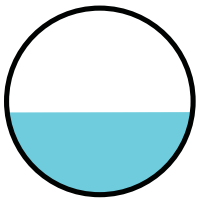
Summary for Reach 4R: (new Reach)

Inflow Area = 137.854 ac, 23.76% Impervious, Inflow Depth = 2.08" for 25-Yr event
Inflow = 41.96 cfs @ 8.03 hrs, Volume= 23.846 af
Outflow = 41.93 cfs @ 8.08 hrs, Volume= 23.846 af, Atten= 0%, Lag= 2.7 min

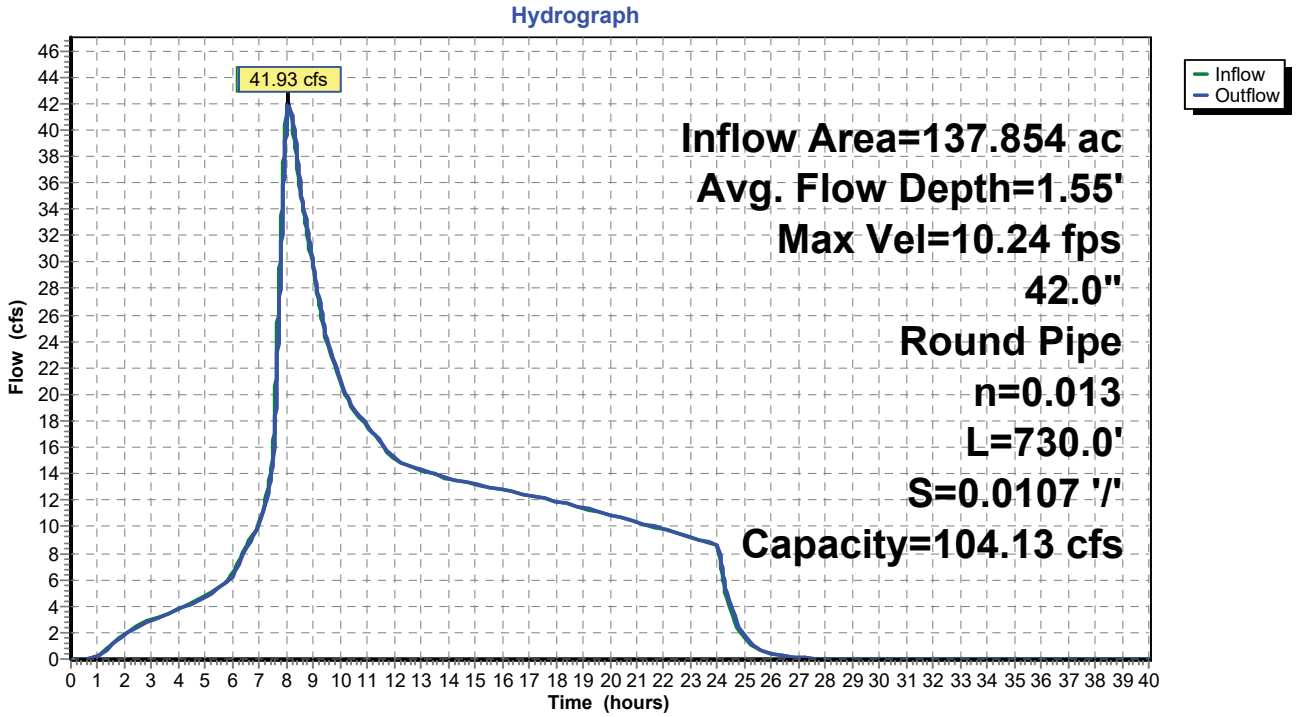
Routing by Stor-Ind+Trans method, Time Span= 0.00-40.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.24 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 5.41 fps, Avg. Travel Time= 2.2 min

Peak Storage= 2,990 cf @ 8.06 hrs
Average Depth at Peak Storage= 1.55'
Bank-Full Depth= 3.50', Capacity at Bank-Full= 104.13 cfs

42.0" Round Pipe
n= 0.013
Length= 730.0' Slope= 0.0107 '/'
Inlet Invert= 29.62', Outlet Invert= 21.80'



Reach 4R: (new Reach)



Attachment C(2). Engineered Drainage Plan

SITE ASSESSMENT AND PLANNING CHECKLIST

✓	Information needed	Attach supporting materials as needed
2.2.1 Site Information		
	Applicant contact information	Applicant name: Paul Scarlett Business name: ODOT Contact address, phone number, and e-mail: 123 NW Flanders St, Portland, OR 97209 503-731-3186 paul.scarlett@odot.state.or.us
	Project location	Site address: ODOT Right-of-way (Map 22E29CB, Tax Lots: 300, 500, ROADS; Map 22E29, Tax Lot: ROADS; Map 22E30DD, Tax Lot: ROADS) Site description: ODOT rights-of-way are built transportation environments. The two tax lots being impacted are within City parks. Major drainage basin: Willamette Is the project site located with the WQRA as defined in OCMC 17.49? Y (Y/N) *Include a vicinity map of the site (including location of property in relation to adjacent properties, roads, and pedestrian/bike facilities).*
	Project type	Identify types of development planned for the site such as commercial, industrial, single-family residential, multi-family residential, or other (describe): Transportation improvements - widening of I-205 northbound and southbound; seismic upgrade of Abernethy Bridge
	Size of site	Size of site: ~2900 (acres) Number of existing/proposed tax lots: Existing: 5 Proposed: 0 Amount of new and replaced impervious area: 284,795 (SF)
2.2.2 Site Assessment *Note: Site assessment information may be available from the OCMaps online tool available through the City's website.*		
	Site Assessment Map	*Attach engineered scale Site Assessment Map, showing items below.*
	Topography Evaluate site and map slopes: *Flat: 0-10%* *Moderate: 10-25%* *Steep: 25% and greater*	*Surveyed or aerial-based mapping with 2-foot intervals for slopes 0-25% slope and 10-foot intervals for steeper. Indicate Geologic Hazard Areas as defined by OCMC 17.04.510 and Geologic Hazards Overlay Zone as defined by OCMC 17.04.515.*
	Soils and Groundwater Research and map site soil hydrologic group, depth to groundwater	NRCS Hydrologic Soil Type (show on map if more than one type present): *Attach seasonal groundwater depth evaluation if available or required (site has floodplain and/or wetland).* *Groundwater depth information is available from the City.* Soil types and groundwater depth are included in the Stormwater Report
	Infiltration Assessment Determine soil capacity for onsite infiltration	If an infiltration test is performed, attach the documentation. Report the test type (Basic/Professional) performed and results. See **Appendix D** for the approved infiltration testing methods. Test type: Encased Falling Head/ Open Pit Falling Head See Report (inches/hour)

SITE ASSESSMENT AND PLANNING CHECKLIST		
	Hydrology – Conditions and Natural Features Map site floodplains, wetlands, streams, and location of outfalls	Clearly label on map all intermittent and perennial creeks/streams/rivers and wetlands, FEMA floodplains, and existing drainage systems (pipes, ditches, outfalls). Check here if present on site: X Sensitive area(s) Willamette River, Abernethy Creek, two wetlands Floodplain Willamette River
	Downstream Conveyance	Indicate the proposed point of discharge on the site plan. *Prepare and attach a Downstream Analysis as required by **Chapter 5**.* Check here to verify that adequate downstream capacity is available: X
	Existing Vegetation Map trees and vegetation	Using aerial photos or survey, map all trees and vegetation. Note all existing trees 6-inch caliper and greater (DBH) on map. Delineate and identify other areas and types of existing vegetation. The local planning authority may require a formal tree survey. See attached map (Attachment A)
	Required Vegetated Buffers and Setbacks Assess and map buffers	Identify required vegetated buffer areas and other setback limits as defined by OCMC Title 17. See attached map (Attachment BA
	Land Use and Zoning	Existing Land Use Zoning designation(s): MUD district, I district, NROD, WRG, Flood management overlay district
	Access and Parking	Delineate proposed access points for all transportation modes on map. Indicate amount and area of required parking onsite if applicable, *attach documentation as needed.* Att. B
	Utilities to Site and Surrounding Area	Map existing utilities including stormwater facilities, storm conveyance, sewer, water, electricity, phone/cable, gas, and any public storm system/facility downstream. Att. B
2.2.3 Site Planning Design Objectives *(attach engineered scale Preliminary Site Plan)*		
	1. Preserve existing resources	**Required:** Show sensitive areas and buffers on site plan. Denote buffer areas that require enhancement. Show any proposed areas of encroachment and associated buffer mitigation areas. Attachment A
	2. Minimize site disturbance	**Required:** Delineate protection areas on site plan for areas to remain undisturbed during construction. Attachment C
	3. Minimize soil compaction	**Required:** Delineate and note temporary fencing on site plan for proposed infiltration facilities, vegetated stormwater management facilities, and re-vegetation areas. Att. C
	4. Minimize imperviousness	**Required:** Delineate proposed impervious areas and proposed impervious area reduction methods on the site plan. A. Total proposed new/replaced impervious area: 284,795 (SF) B. Area of proposed Green Roofs: 0 (SF) C. Area of proposed pervious pavements: 0 (SF) D. Describe type of pavers or pavement proposed: _____ E. Impervious area requiring management [A-(B+C)]: 284,795 (SF)

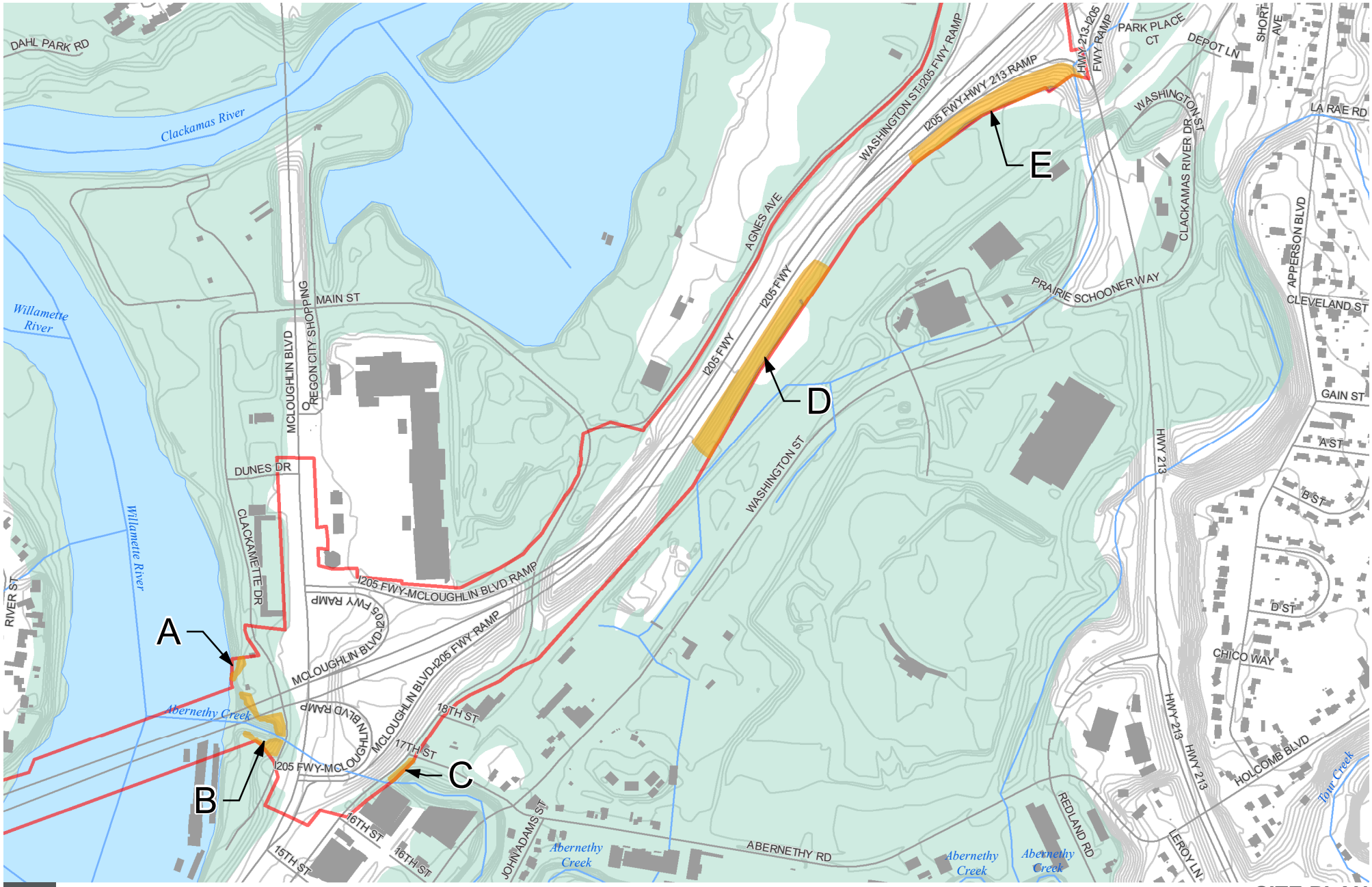
SITE ASSESSMENT AND PLANNING CHECKLIST

2.2.4 Proposed Stormwater Management Strategy

	Proposed Stormwater Management Strategy	X Infiltration facilities ____ Surface Infiltration facilities to the MEP X Full onsite retention/infiltration up to the 10-year storm event X Infiltration facilities are limited by the following conditions *(include documentation to demonstrate the limiting condition and choose an alternate strategy below):* ____ Stormwater management facility to be located on fill ____ Steep slopes X High groundwater ____ Contaminated soils ____ Conflict with required Source Controls (**Chapter 6**) X Onsite Stormwater management facilities (indicate below) ____ Offsite stormwater management facilities/regional facilities ____ Fee in Lieu, as determined by the City
	Preliminary Facility Selection/Sizing	Check all that apply, *attach output from BMP Sizing Tool*, and show proposed Stormwater Management Facilities on Preliminary Site Plan. stormwater Appendix D of report LID facilities: ____ Infiltration Stormwater Planter X Filtration Stormwater Planter WQF #9 ____ Infiltration Rain Garden ____ Filtration Rain Garden X Vegetated Swale WQF #3, Treatment only X Detention Pond WQF #1 ____ Infiltration Trench ____ Manufactured Treatment Technology X Other: Bioslope WQF #2, Treatment only
	Verify Minimum Facility Size	A. Required surface area of onsite surface infiltration facilities: As determined by BMP sizing tool or engineered method: 4,817 (SF) WQF #1 153 WQF #9 B. Calculate MEP surface area of surface infiltration facilities for sites with limiting conditions: Total new/replaced impervious area (SF) x 0.10 = _____ (SF) C. Calculate required surface area of onsite LID facilities: Smaller of [A] or [B]: 4,817 (SF) WQF #1 153 WQF #9 D. Proposed surface infiltration facility size(s): From site plan: 5,400 (SF) *must be larger than [C]* WQF #1 240 WQF #9

SITE ASSESSMENT AND PLANNING CHECKLIST		
2.2.5 Other Project Requirements		
	Grading Permit	Review OCMC 15.48 to determine whether a grading permit will be required. Grading permit required? ___Y__ (Y/N) Type of Grading Plan proposed (see **Chapter 3**): Engineered Grading Plan
	Erosion Prevention and Sediment Control	Identify the required permits: X ESC Permit from the City *(sites that include 1,000+ SF new or replaced impervious area)* X 1200-C Permit from DEQ *(sites that disturb 1 acre or more land surface)*
	Source Control for High Use Sites	Identify whether the proposed development will include any of the following: _____ Fuel Dispensing Facilities and Surrounding Traffic Areas _____ Above-Ground Storage of Liquid Materials _____ Solid Waste Storage Areas, Containers, and Trash Compactors _____ Exterior Storage of Bulk Materials _____ Material Transfer Areas/Loading Docks _____ Equipment and/or Vehicle Washing Facilities _____ Development on Land With Suspected or Known Contamination _____ Covered Vehicle Parking Areas _____ Industrial and Commercial High Traffic Areas _____ Other land uses subject to the ODEQ 1200-Z Industrial Stormwater Permit
	Other Permits	Identify other natural resources related permits from local, state, or federal agencies that may be required as part of the proposed development activity. It is the responsibility of the applicant to identify and obtain required permits prior to project approval. List other anticipated permits: DSL removal/fill, USACE Section 404, NEPA Categorical Exclusion, ESA Biological Opinion, ESA No Effect Determination, DEQ 401 Certification, Section 4(f), Section 6(f), USCG Bridge Permit

Attachment A. Existing Vegetation



NROD Boundary
Project Area
Buildings
Streams, Rivers, Waterbodies
Wetlands
100-Year Floodplain

0 Miles 0.1

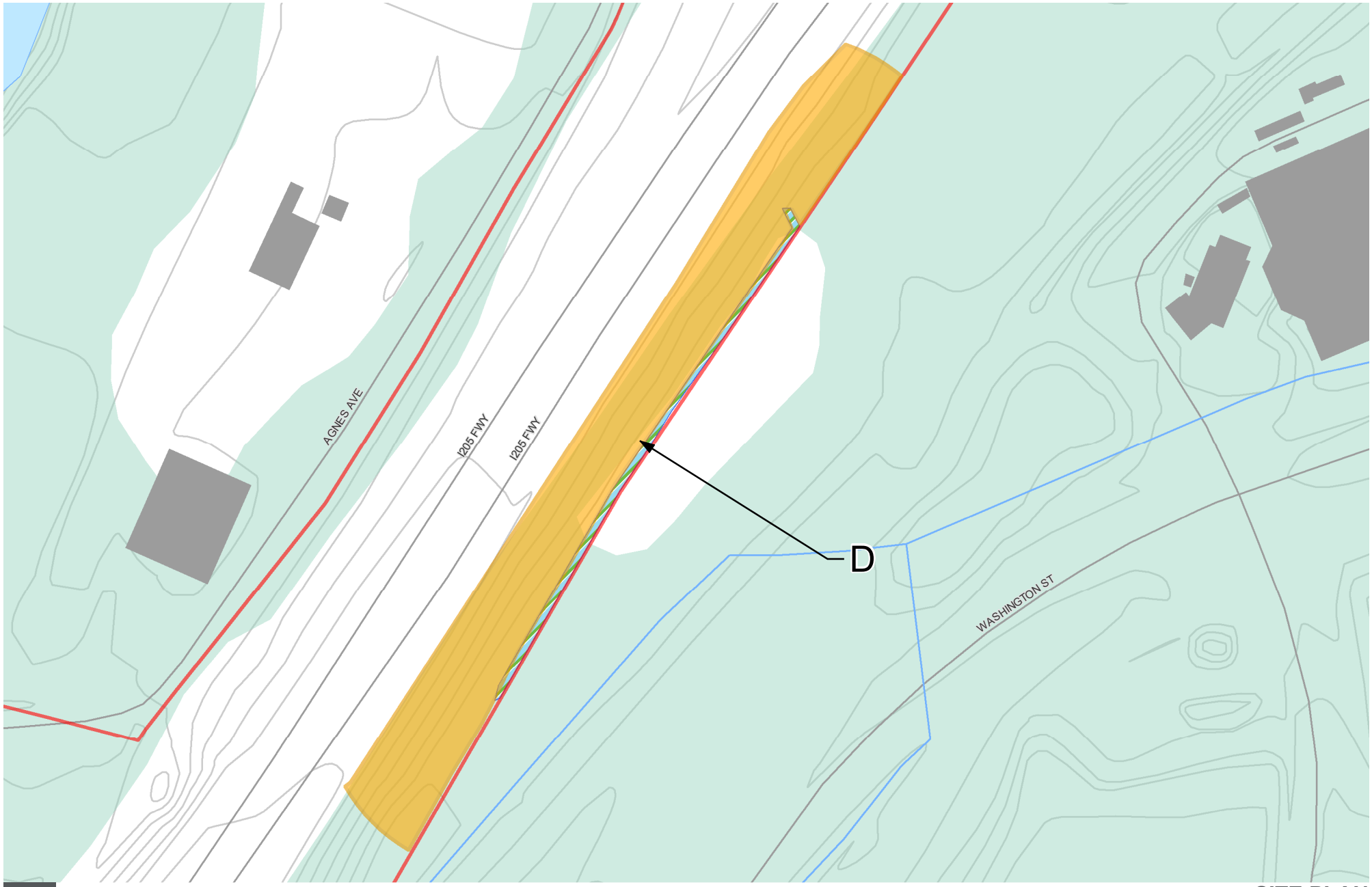
DATA SOURCE: ESRI, HDR, City of Oregon City

SITE PLAN

OCMC 17.49.220 (A)

FIGURE 1

PATH: X:\PROJECTS\ODOT\10063137_I205_ABERNATHY\WORKING\RB\NROD_SITE_PLANRB.MXD - USER: RBARKSDALE - DATE: 7/29/2019



NROD Boundary
Project Area
Buildings
Streams, Rivers, Waterbodies
Wetlands
100-Year Floodplain

0 Miles 0.03

DATA SOURCE: ESRI, HDR, City of Oregon City

SITE PLAN

OCMC 17.49.220 (A)

FIGURE 2

PATH: X:\PROJECTS\ODOT\10063137_I205_ABERNATHY\WORKING\RB\NROD_SITE_PLANRB.MXD - USER: RBARKSDALE - DATE: 7/29/2019

NROD Boundary
Project Area
Buildings
Streams, Rivers, Waterbodies
Wetlands
100-Year Floodplain

0 Miles 0.02

DATA SOURCE: ESRI, HDR, City of Oregon City

SITE PLAN

OCMC 17.49.220 (A)

FIGURE 3

PATH: X:\PROJECTS\ODOT\10063137_I205_ABERNATHY\WORKING\RB\NROD_SITE_PLANRB.MXD - USER: RBARKSDALE - DATE: 7/29/2019

0 12.5 25 Feet

Project Area
NROD
Disturbance Area
Trees > 6" in Diameter
Shrub/Ground Cover Distribution Outline
Trees to be Removed

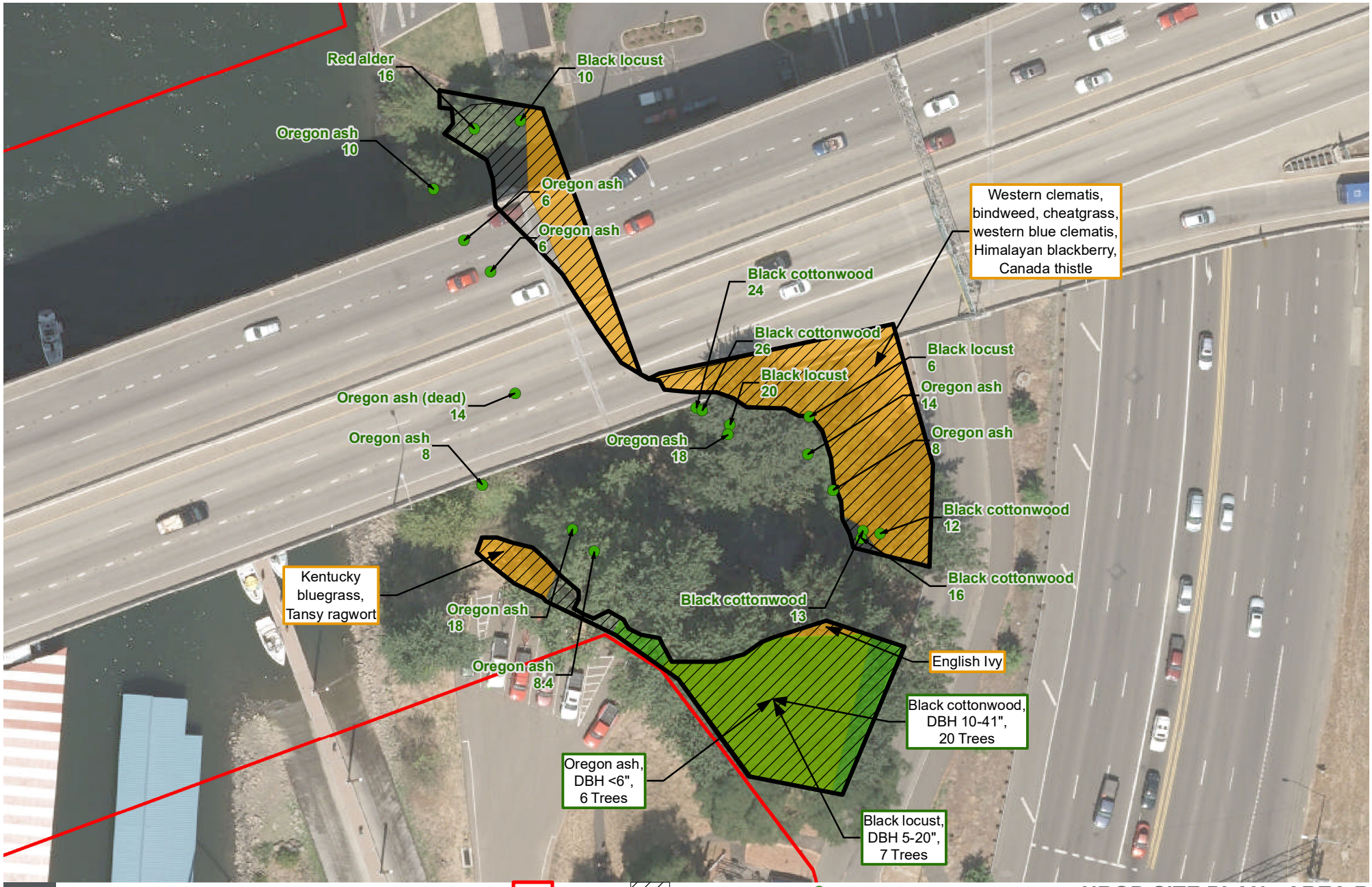
DATA SOURCE: ESRI, HDR, City of Oregon City

NROD SITE PLAN - AREA A

(OCMC 17.49.220 (B))

FIGURE 4

PATH: X:\PROJECTS\ODOT\10063137_I205_ABERNATHY\WORKING\RB\NROD_SITEPLAN_UPDATED.MXD - USER: RBARKSDALE - DATE: 7/29/2019



HDR

0 30 60 Feet

Project Area
NROD
Disturbance Area
Trees > 6" in Diameter
Shrub/Ground Cover Distribution Outline
Trees to be Removed

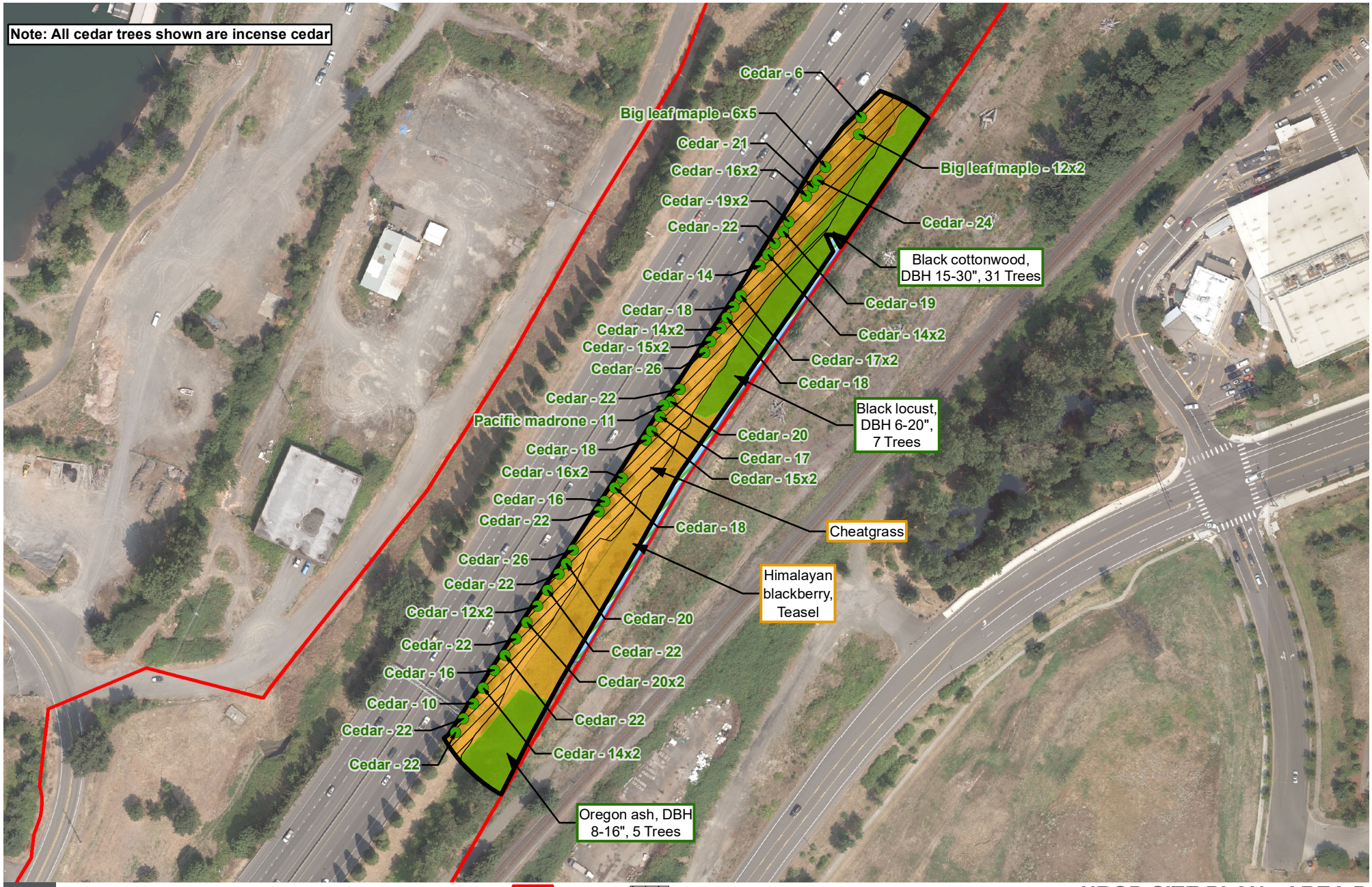
DATA SOURCE: ESRI, HDR, City of Oregon City

NROD SITE PLAN - AREA B

(OCMC 17.49.220 (B))

FIGURE 5

PATH: X:\PROJECTS\ODOT\10063137_I205_ABERNATHY\WORKING\RB\NROD_SITEPLAN_UPDATED.MXD - USER: RBARKSDALE - DATE: 8/7/2019



0 105 210 Feet

Project Area
NROD
Disturbance Area
Trees > 6" in Diameter
Shrub/Ground Cover Distribution Outline
Trees to be Removed
Wetlands

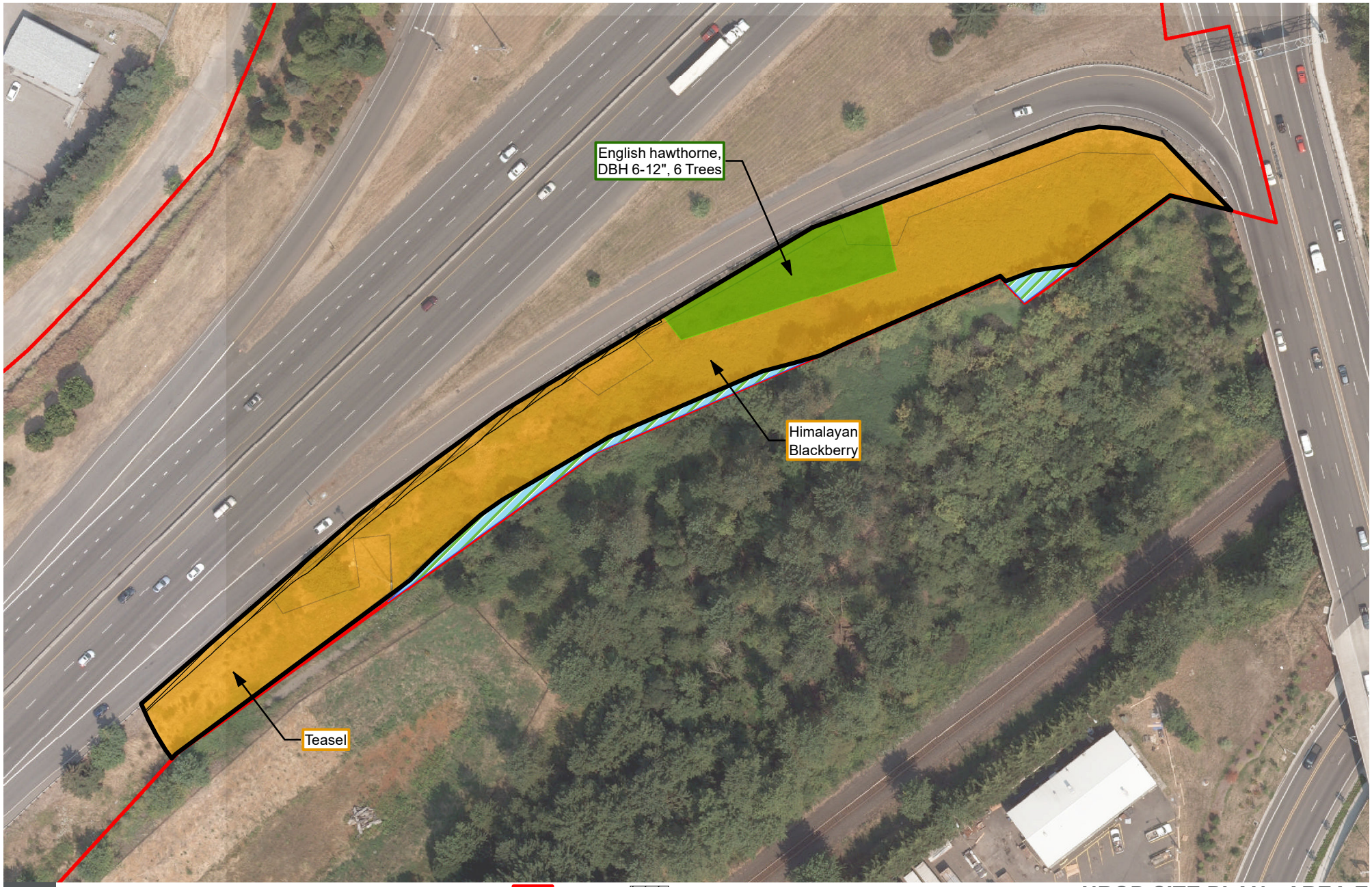
DATA SOURCE: ESRI, HDR, City of Oregon City

NROD SITE PLAN - AREA D

(OCMC 17.49.220 (B))

FIGURE 7

PATH: X:\PROJECTS\ODOT\10063137_I205_ABERNATHY\WORKING\RB\NROD_SITEPLAN_UPDATED.MXD - USER: RBARKSDALE - DATE: 7/29/2019



0 60 120 Feet

Project Area
NROD
Disturbance Area
Trees > 6" in Diameter
Shrub/Ground Cover Distribution Outline
Trees to be Removed
Wetlands

DATA SOURCE: ESRI, HDR, City of Oregon City

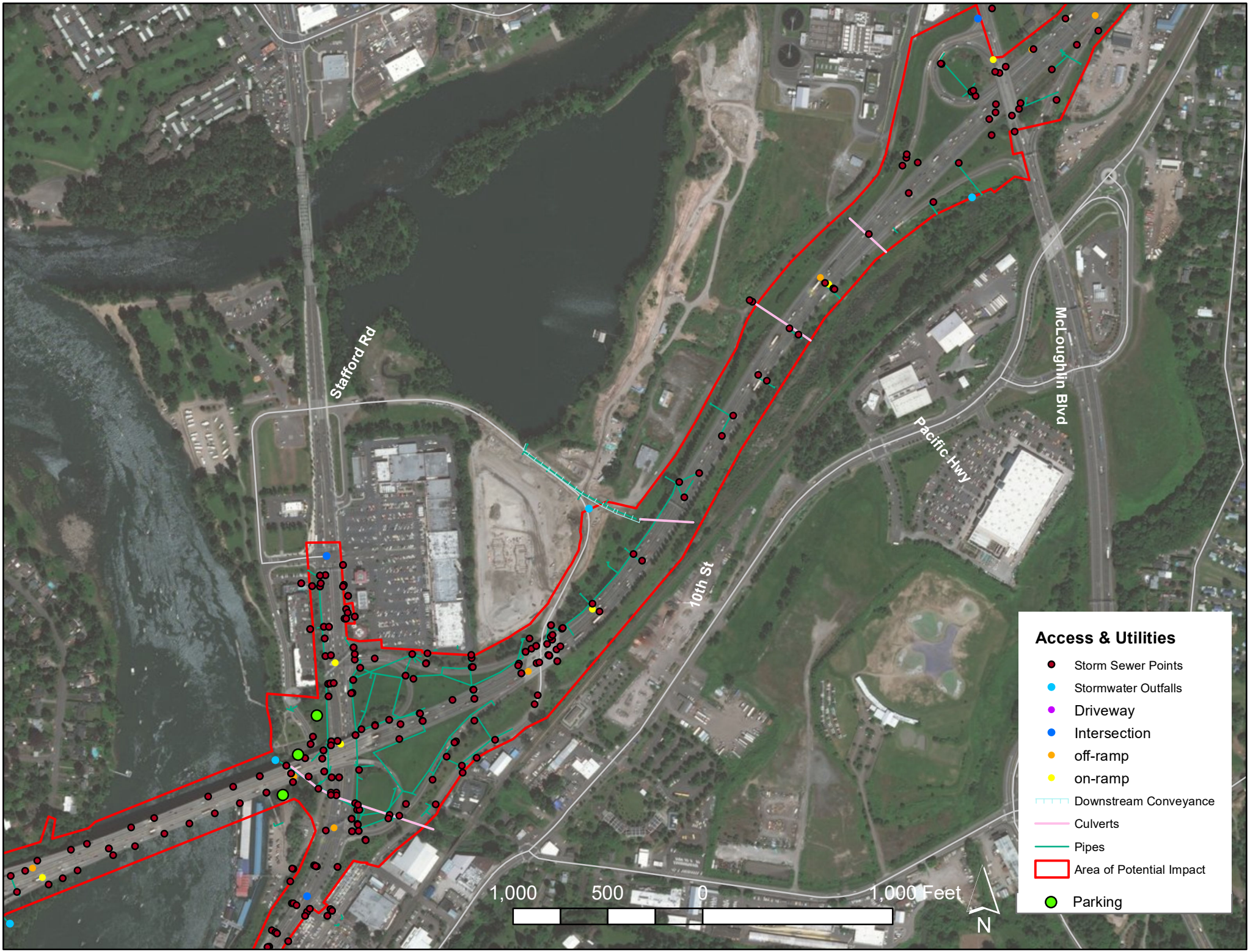
NROD SITE PLAN - AREA E

(OCMC 17.49.220 (B))

FIGURE 8

PATH: X:\PROJECTS\ODOT\10063137_I205_ABERNATHY\WORKING\RB\NROD_SITEPLAN_UPDATED.MXD - USER: RBARKSDALE - DATE: 7/29/2019

Attachment B. Access and Utilities Map


Stafford Rd
10th St
Pacific Hwy
McLoughlin Blvd
Access & Utilities
Storm Sewer Points
Stormwater Outfalls
Driveway
Intersection
off-ramp
on-ramp
Downstream Conveyance
Culverts
Pipes
Area of Potential Impact
Parking
1,000
500
0
1,000 Feet
N

Attachment C. Construction Management Plan

GENERAL NOTES:

The construction, adjustment, maintenance, and upgrading of these Erosion and Sediment Control measures is the responsibility of the contractor for the duration of the project to comply with Section 00280 of the Oregon Standard Specifications for construction and the NPDES 1200-CA permit.

Erosion and Sediment Control measures shown on this plan are for anticipated site conditions. Adjust or upgrade these measures for unexpected storm events to ensure that sediment and sediment-laden water does not leave the site.

Develop a revised plan of the Erosion and Sediment Control measures shown as required by Section 00280, Oregon Standard Specifications for Construction. Implement this plan for all clearing and grading activities and in segments applicable to each staging phase. Construct in such a manner so as to ensure that sediment and sediment-laden water does not enter the roadway or drainage system, or violate applicable water standards.

Install measures within the right-of-way unless directed otherwise.

Inlet protection for existing facilities shall be installed before construction begins and shall remain in place until all construction is completed and approved. The contractor shall protect all storm drain inlets within the work area and adjacent to the work limits within 100' outside all working, stockpile, and staging areas, including the first inlet downstream (at any distance). In the case of inlets to be removed, protection measures shall remain in place until the new inlet is constructed and connected to the drainage network, and the existing inlet has been disconnected from the existing drainage network. Inlet protection shall be installed on new inlets before they are connected to the existing drainage network.

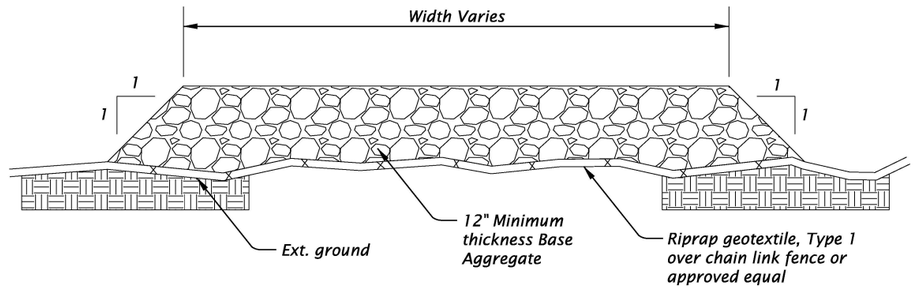
See section 00280 for material not shown in plans.

STANDARD DRAWINGS

- ☒ RD1000 Construction Entrances
- ☐ RD1005 Check Dams Type 1, 3 and 4
- ☒ RD1006 Check Dams Type 2 and 6
- ☒ RD1010 Inlet Protection Type 2, 3, 6 and 7
- ☐ RD1015 Inlet Protection Type 4
- ☒ RD1030 Sediment Barrier Type 2, 3 and 4
- ☐ RD1031 Sediment Barrier Type 5 and 6
- ☒ RD1032 Sediment Barrier Type 8
- ☒ RD1033 Sediment Barrier Type 9
- ☒ RD1040 Sediment Fence
- ☐ RD1045 Temporary Slope Drain With Energy Dissipator
- ☐ RD1050 Temporary Scour Basin
- ☒ RD1055 Slope and Channel Matting
- ☒ RD1060 Tire Wash Facility Type 1 and 2
- ☒ RD1065 Sediment Trap
- ☒ RD1070 Concrete Truck Wash Out

SEQUENCE OF WORK NOTES:

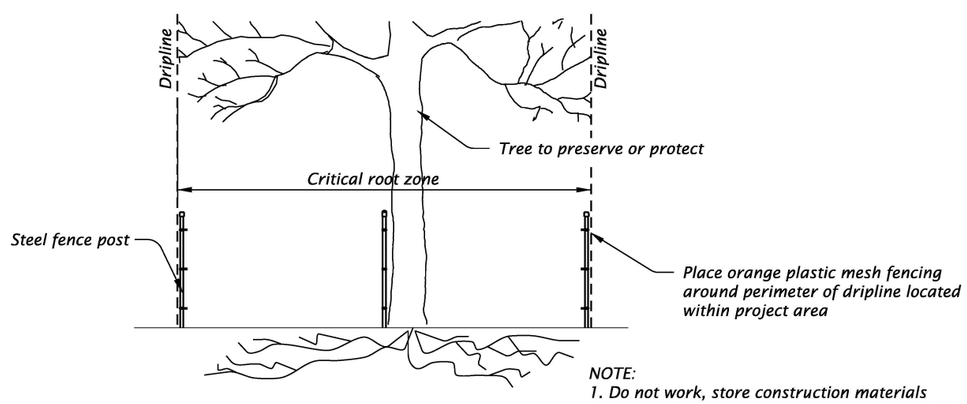
This Erosion and Sediment Control Plan has been prepared based upon the construction sequence represented in the Traffic Control Plan Sheets. This ESCP is not intended to supercede a construction sequencing plan. The ESCP is to be reviewed and revised to fit the actual construction sequence.



1. Existing ground shall grubbed to a depth 6".

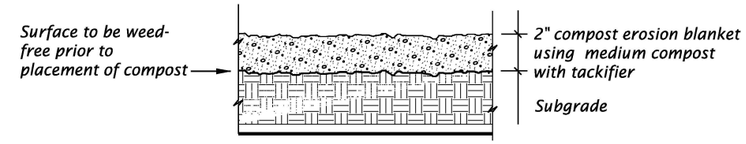
2. Cover existing ground under Staging Area with riprap geotextile and either chain link fence or other approved geogrid type material and cover with Base Aggregate.

STAGING AREA DETAIL
N.T.S.

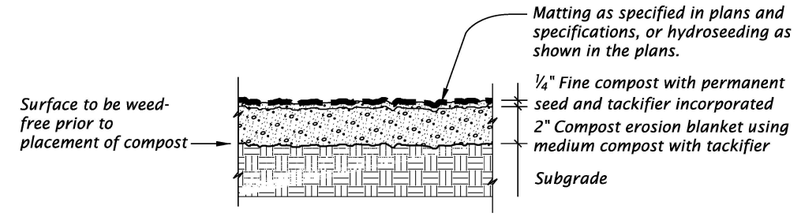


NOTE:
1. Do not work, store construction materials or park within the critical root zone of marked trees unless written approval has been obtained from the Engineer.

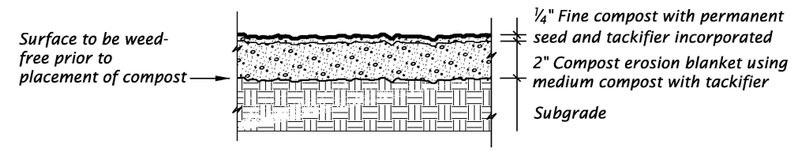
TREE PROTECTION DETAIL
N.T.S.



APPLICATION - TEMPORARY/PERMANENT MULCHING
N.T.S.



APPLICATION - STEEP SLOPES, SHALLOW DITCHES & BIO-SWALES
N.T.S.



APPLICATION – TEMPORARY/PERMANENT VEGETATIVE COVER
N.T.S.

PRELIMINARY COPY
INFORMATION ONLY

HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

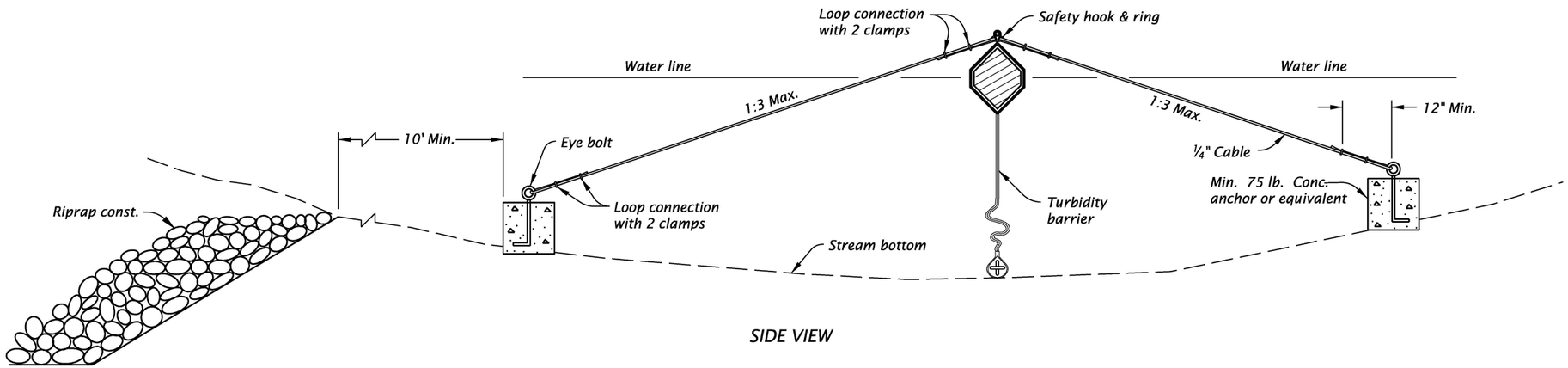
EROSION AND SEDIMENT CONTROL

SHEET NO.
FB01

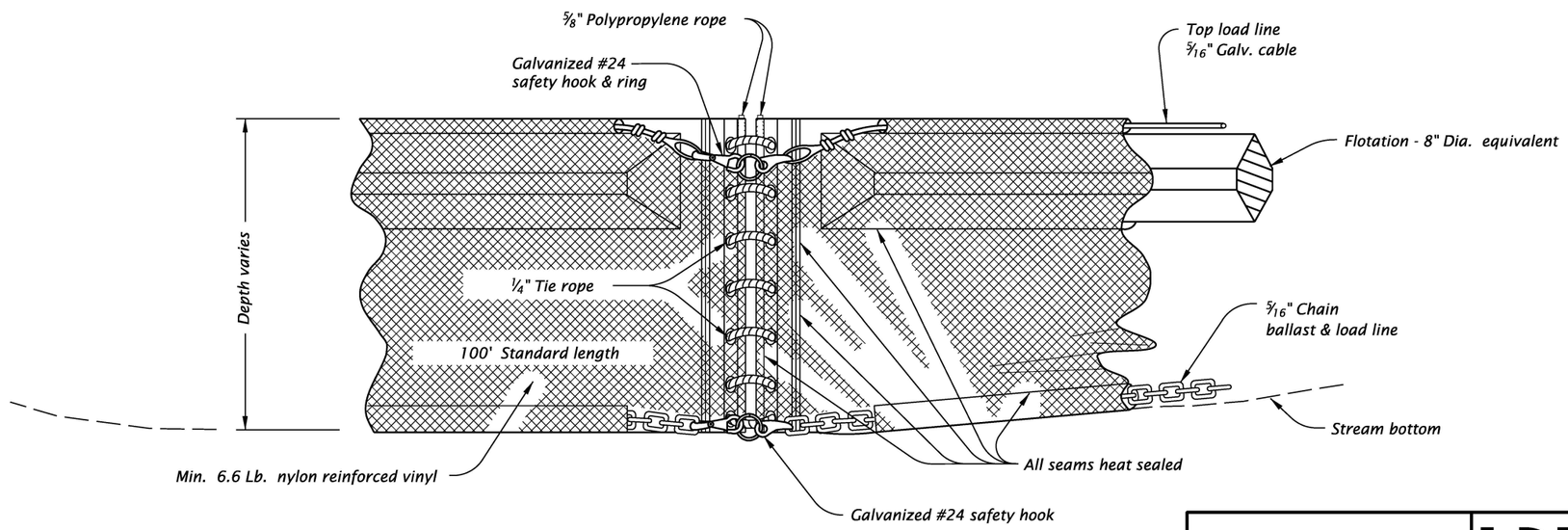
FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 0° Scale: 1"=100'

SEDIMENT BARRIER FLOATING



SIDE VIEW



ANCHOR ASSEMBLY

NOTE:

Components of this barrier may be similar or identical to proprietary designs. Any infringement on the proprietary rights of the designer shall be the sole responsibility of the contractor. Substitutions shall be as approved by the engineer.

TURBIDITY BARRIER

PRELIMINARY COPY
INFORMATION ONLY

HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

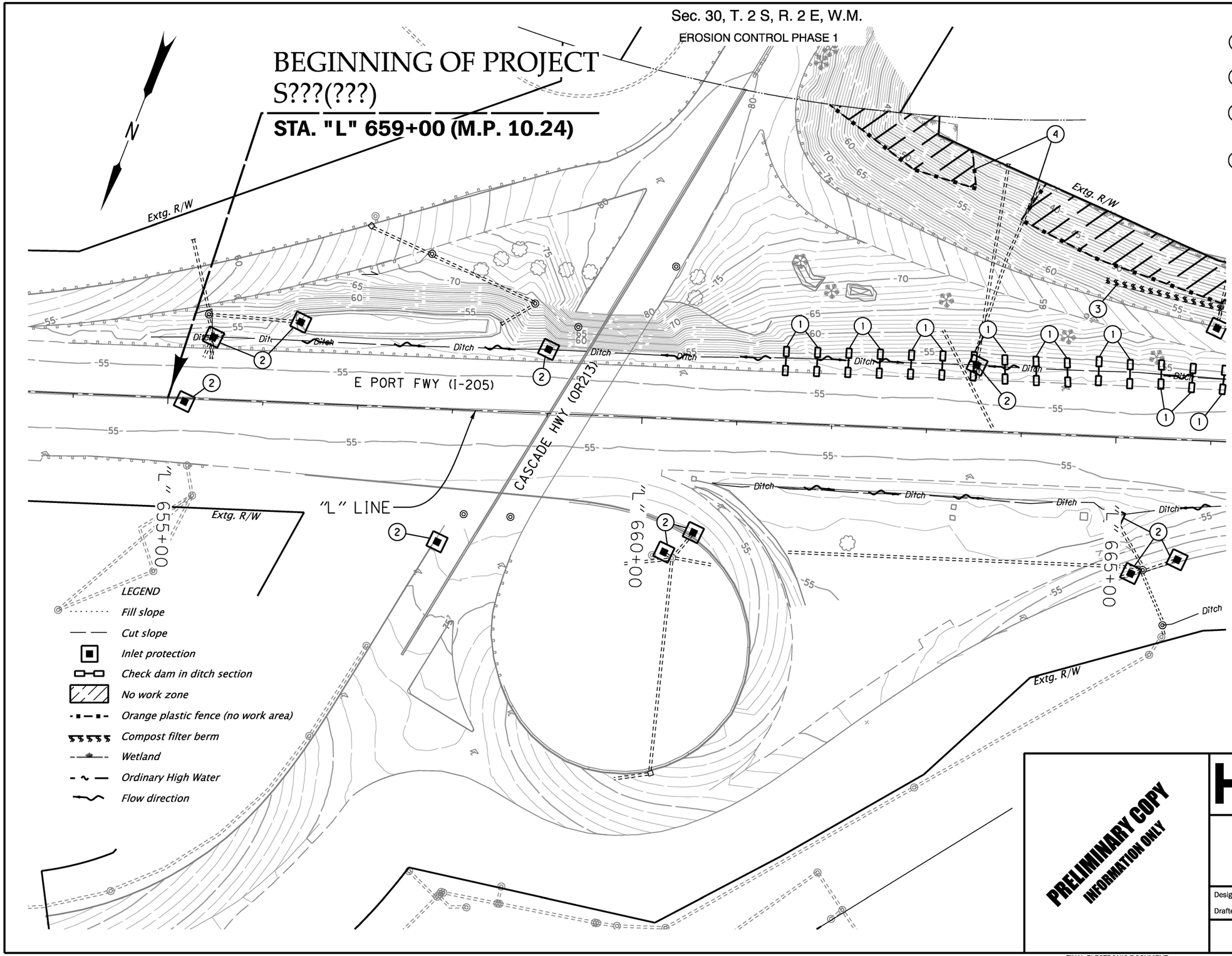
EROSION AND SEDIMENT CONTROL

SHEET NO.
FB02

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

??V-???



1. Const. check dam, (Type 6) - xx (See drg. no. RD1006)
2. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
3. Install sediment barrier (Type 9, Compost filter berm) (See drg. no. RD1033)
4. Install orange plastic mesh fencing

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INFORMATION ONLY

HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

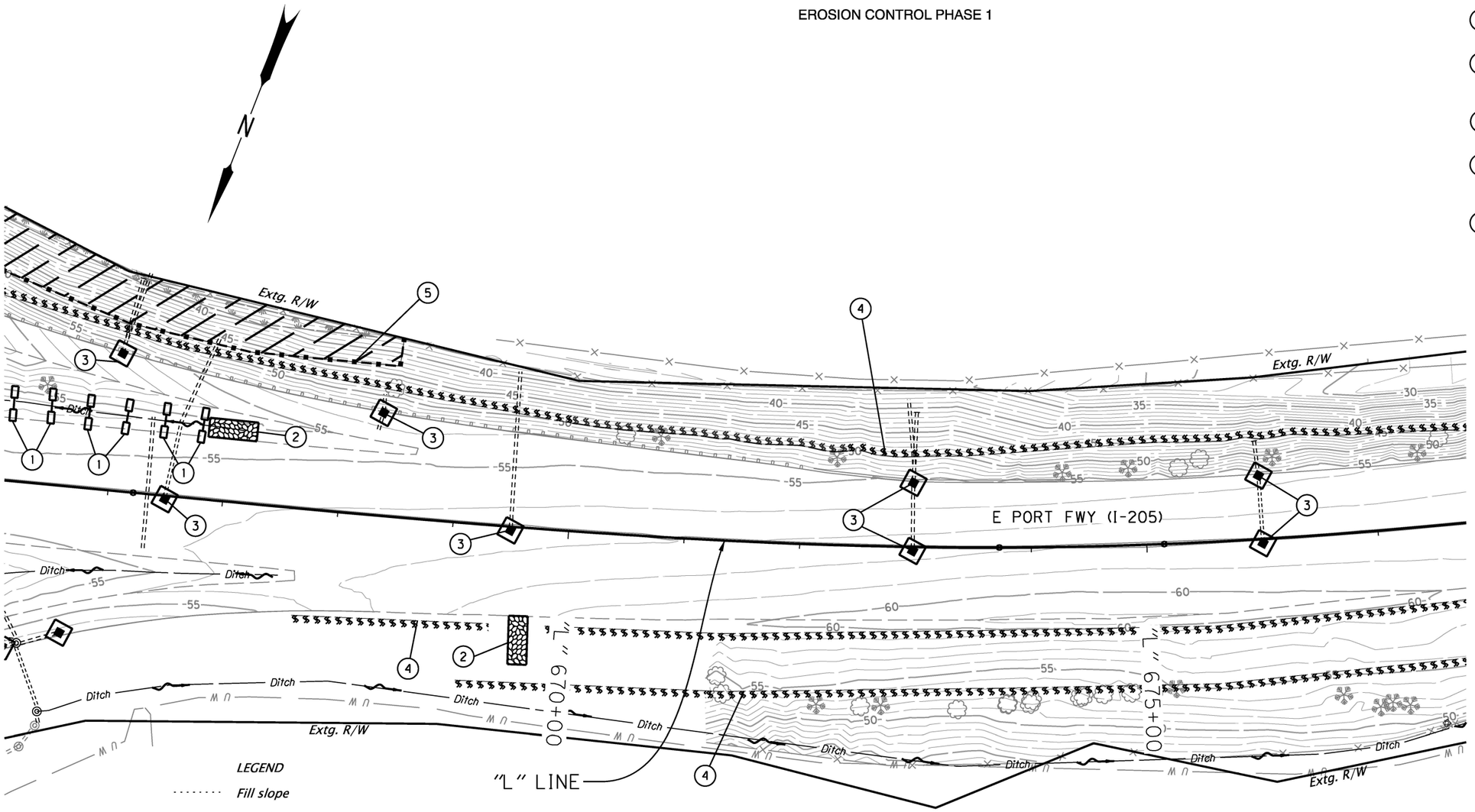
SHEET NO. FB03

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

??V-???

1. Const. check dam, (Type 6) - xx (See drg. no. RD1006)
2. Const. construction entrance - xx (Type 1) (See drg. no. RD1000)
3. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
4. Install sediment barrier (Type 9, Compost filter berm) (See drg. no. RD1033)
5. Install orange plastic mesh fencing



LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Check dam in ditch section
- No work zone
- Orange plastic fence (no work area)
- Wetland
- Ordinary High Water
- Compost filter berm
- Flow direction
- Construction entrance

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503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO. FB04

Sec. 30, T. 2 S, R. 2 E, W.M.

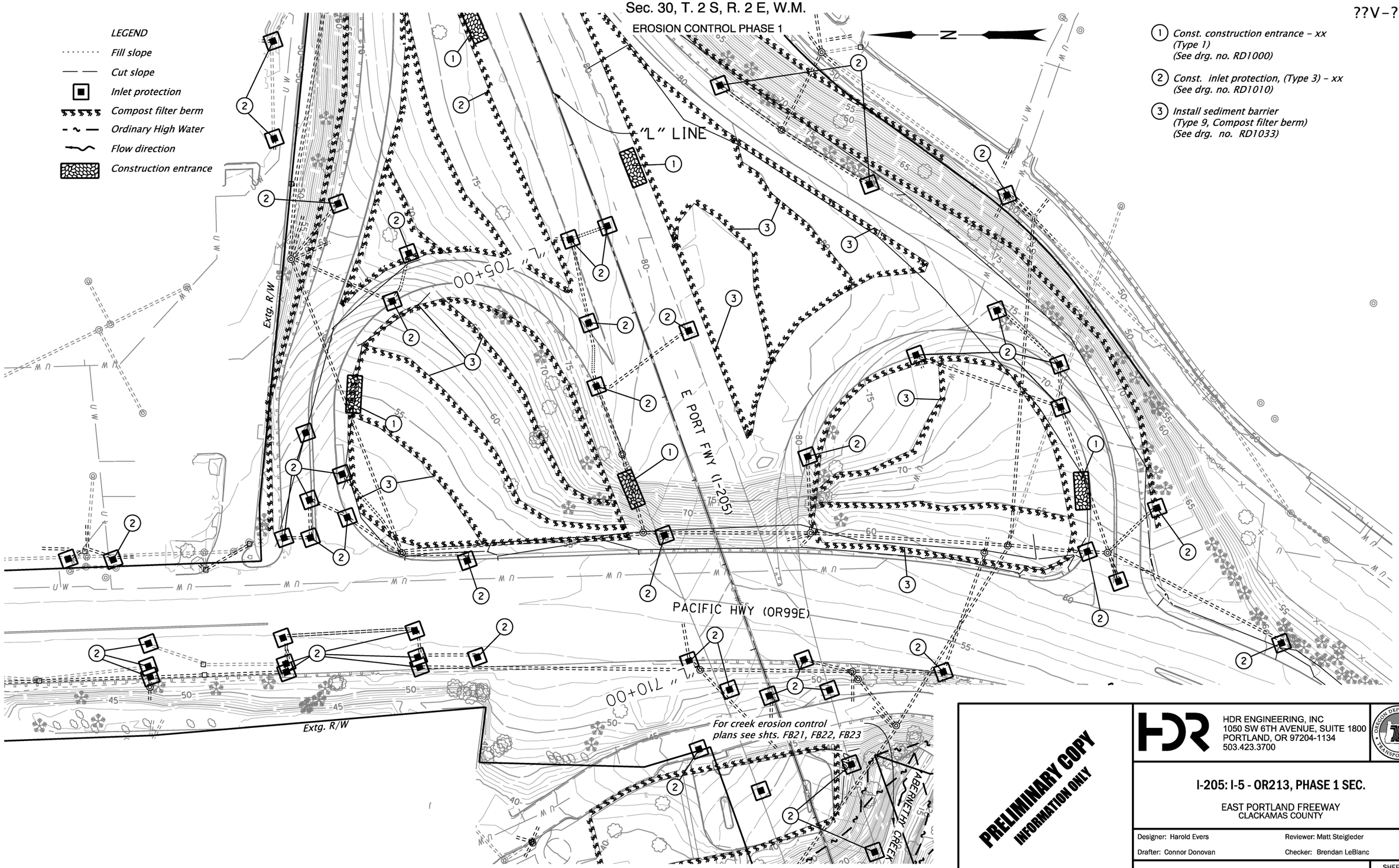
EROSION CONTROL PHASE 1

??V-???

LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Compost filter berm
- Ordinary High Water
- Flow direction
- Construction entrance

1. Const. construction entrance - xx (Type 1) (See drg. no. RD1000)
2. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
3. Install sediment barrier (Type 9, Compost filter berm) (See drg. no. RD1033)



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I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

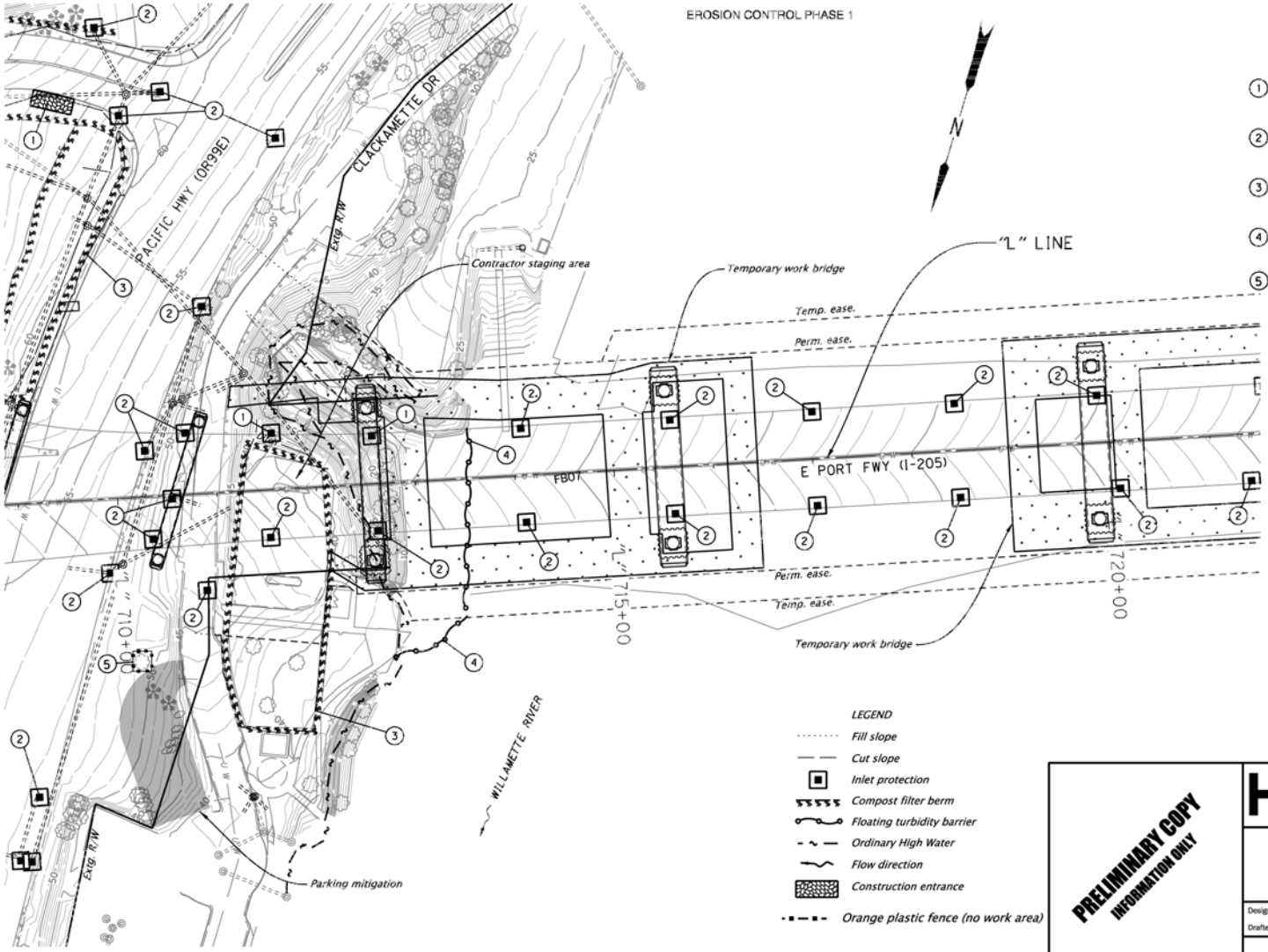
EROSION AND SEDIMENT CONTROL

SHEET NO. FB07

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

??V-???



GENERAL NOTES:

Floating turbidity barrier only required for rip rap removal.

1. Const. construction entrance - x (Type 1) (See drg. no. RD1000)
2. Const. inlet protection - xx (Type 3) (See drg. no. RD1010)
3. Install sediment barrier - xx (Type 9) (See drg. no. RD1033)
4. Const. turbidity barrier - xx (See Sheet FB11)
5. Install orange plastic mesh fencing - xx

LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Compost filter berm
- Floating turbidity barrier
- Ordinary High Water
- Flow direction
- Construction entrance
- Orange plastic fence (no work area)

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers | Reviewer: Matt Steigleder
Drafter: Connor Donovan | Checker: Brendan LeBlanc

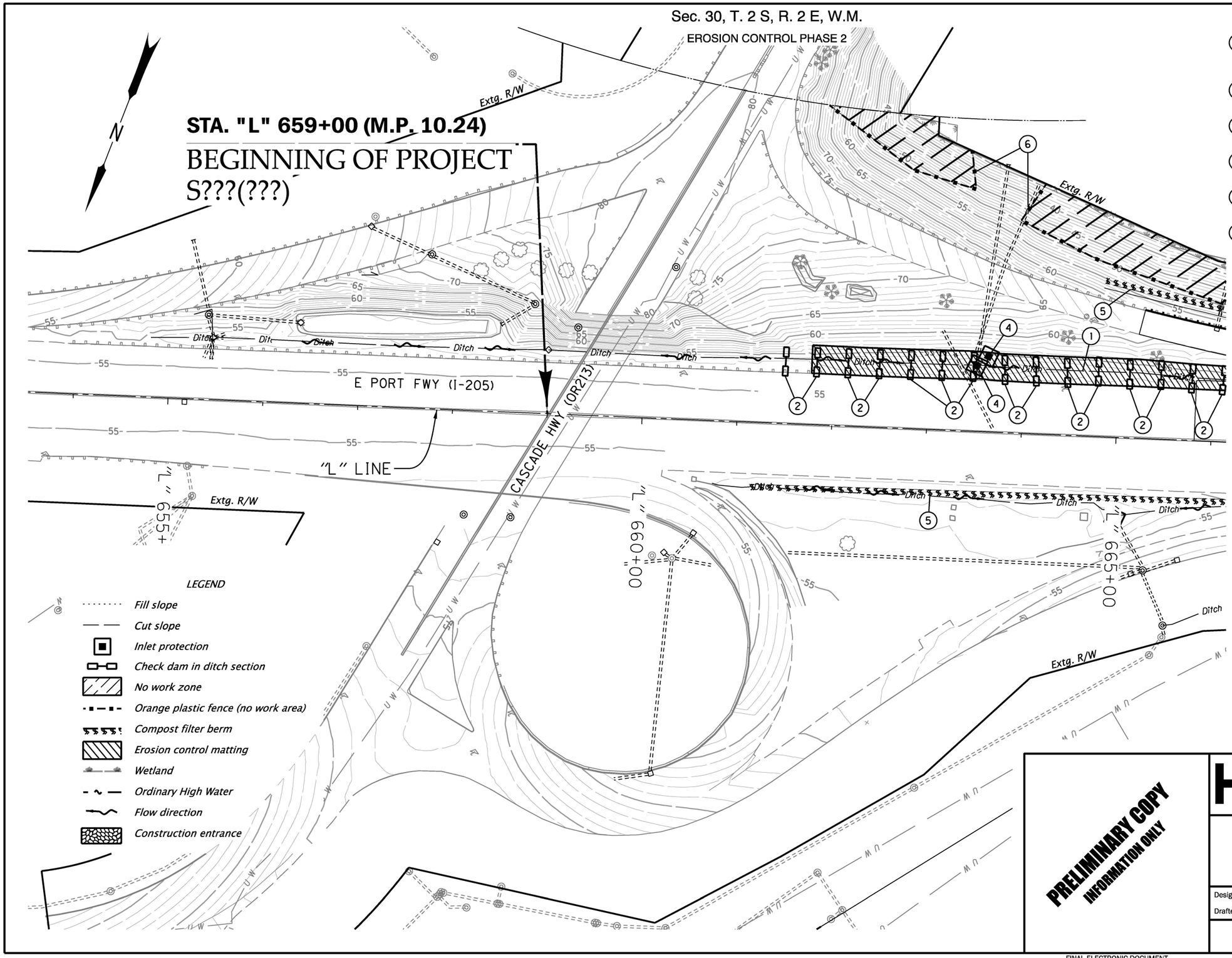
EROSION AND SEDIMENT CONTROL

SHEET NO. FB08

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 2

??V-???



1. Install matting - xx (Flexible channel liner, Type F) (See drg. no. RD1055)
2. Const. check dam, (Type 6) - xx (See drg. no. RD1006)
3. Const. construction entrance - xx (See drg. no. RD1000)
4. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
5. Install sediment barrier, (Type 9) - xx (See drg. no. RD1033)
6. Install orange plastic mesh fencing - xx

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

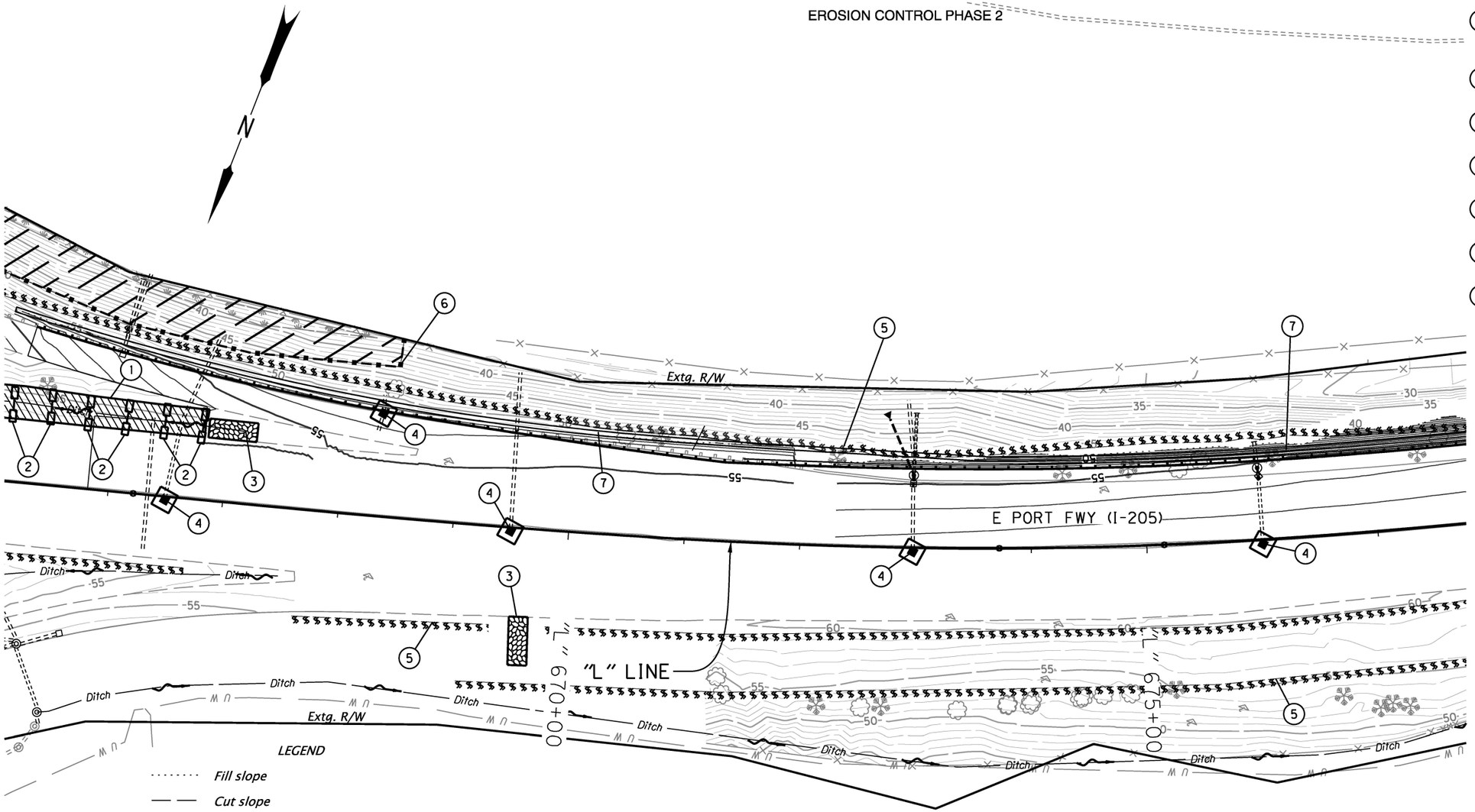
SHEET NO. FB12

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 2

??V-???

1. Install matting - xx (Flexible channel liner, Type F) (See drg. no. RD1055)
2. Const. check dam, (Type 6) - xx (See drg. no. RD1006)
3. Const. construction entrance - xx (See drg. no. RD1000)
4. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
5. Install sediment barrier, (Type 9) - xx (See drg. no. RD1033)
6. Install orange plastic mesh fencing - xx
7. Seeding and mulching - xx



LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Check dam in ditch section
- Seeding and mulching
- No work zone
- Erosion control matting
- Orange plastic fence (no work area)
- Compost filter berm
- Wetland
- Ordinary High Water
- Construction entrance
- Flow direction

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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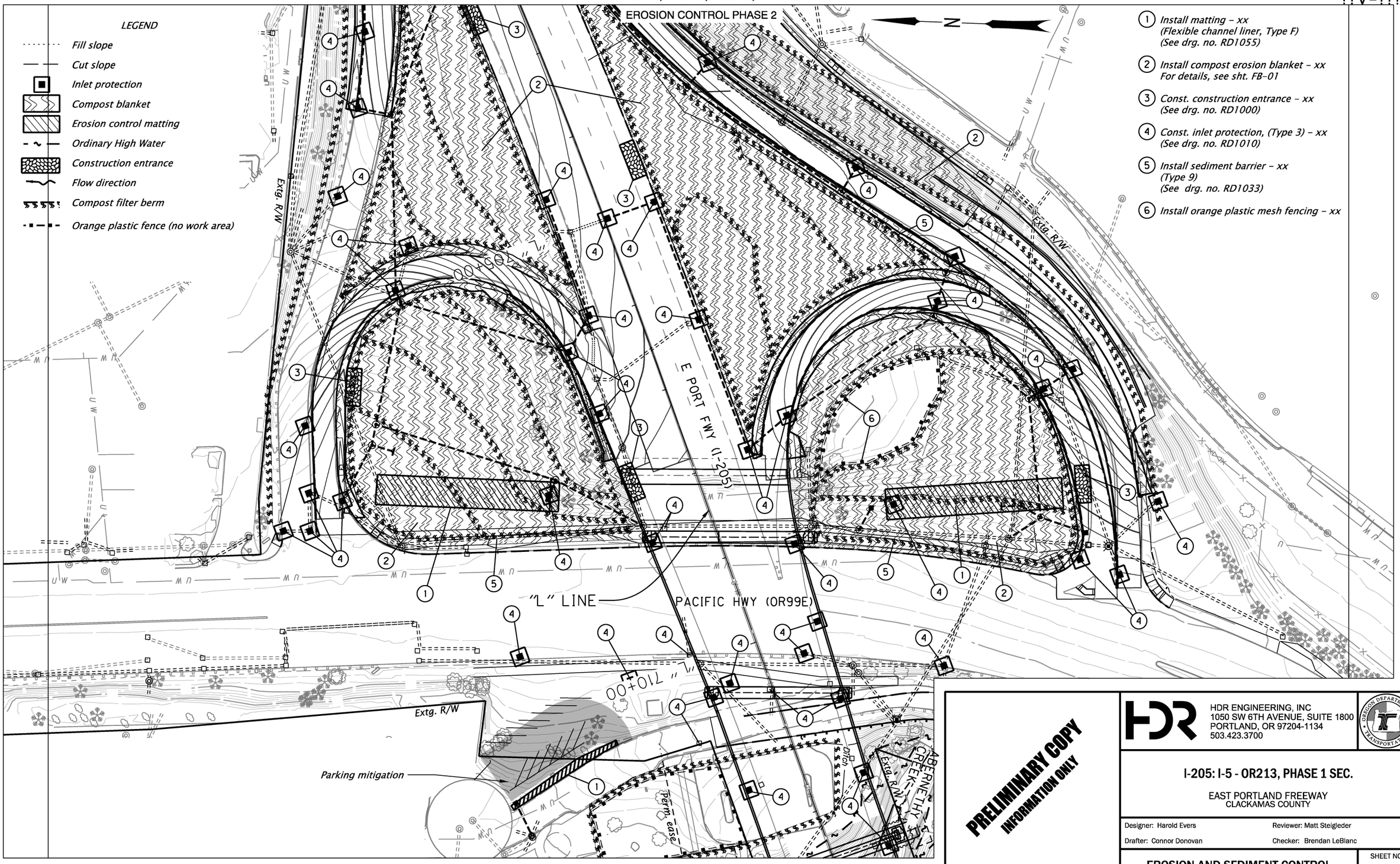
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO. FB13

Sec. 30, T. 2 S, R. 2 E, W.M.

??V-???



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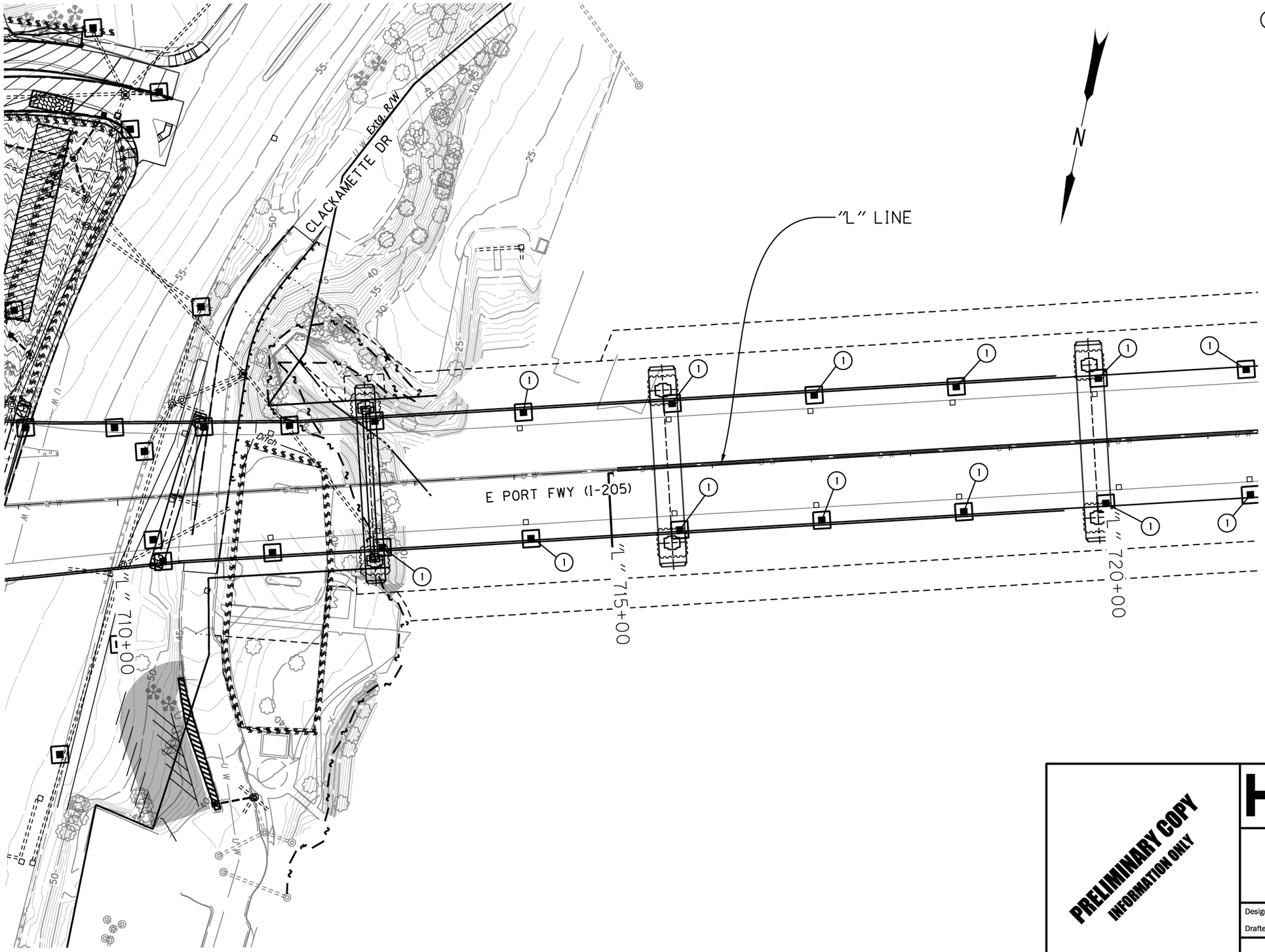
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO.
FB16



(1) *Const. inlet protection – 25 (Type 3) (See drg. no. RD1010)*

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

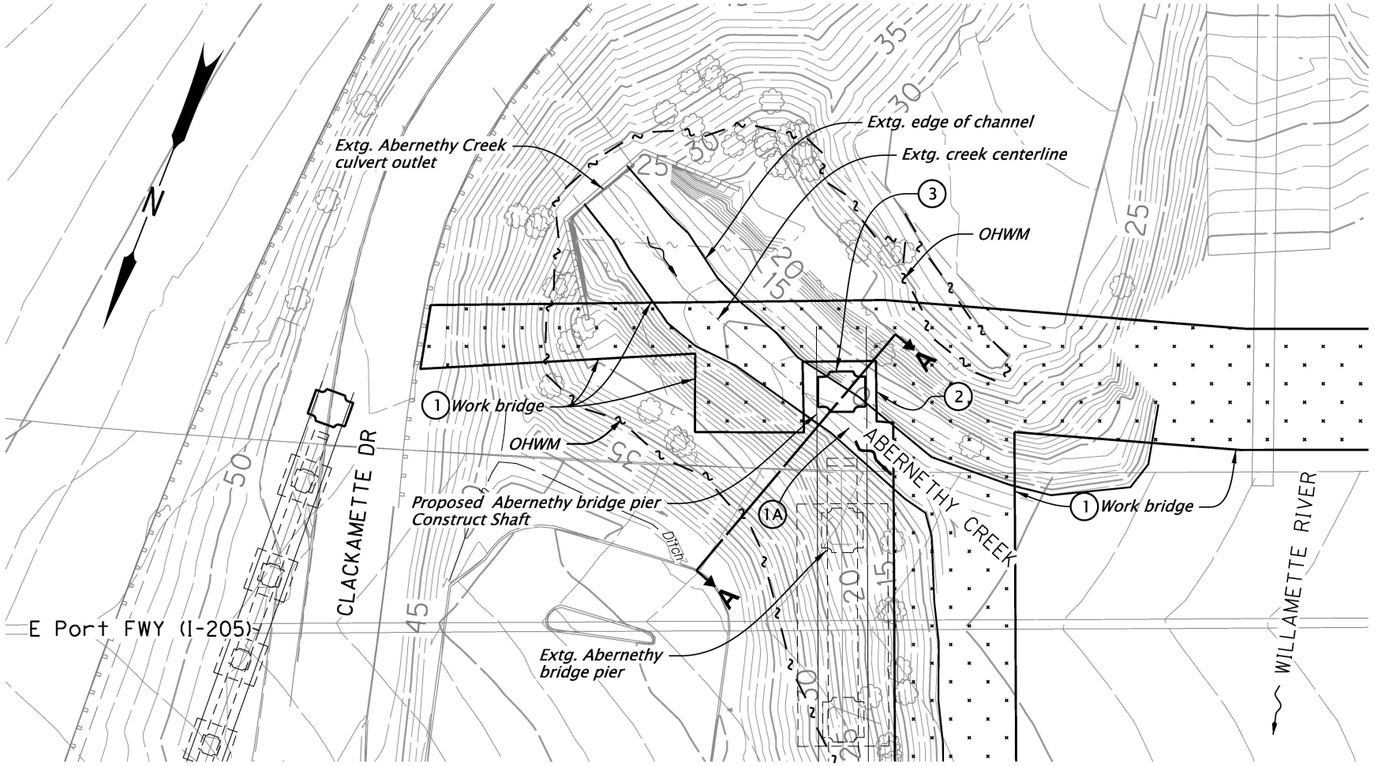
Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO.
FB17

FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 198.3393° Scale: 1"=100'



Abernethy Creek - Phase 1
(In-water-work activity)
Construct temporary work bridge and Pier 3, south side.

CONSTRUCTION SEQUENCE

1A *Remove existing rip rap (as required)*

1 *Install temporary work bridge*

2 *Install temporary shoring at Pier 3*

3 *Construct shaft*

Note:
Work bridge location and temporary work access is shown for reference only and is subject to change.

Temporary work access must accommodate existing flow rates for Abernethy Creek
See sht. XX for additional shoring details.

See sht. FB 24 for section A–A.

LEGEND

- *Fill slope*
- *Cut slope*
- *Ordinary High Water*
- *Flow direction*

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

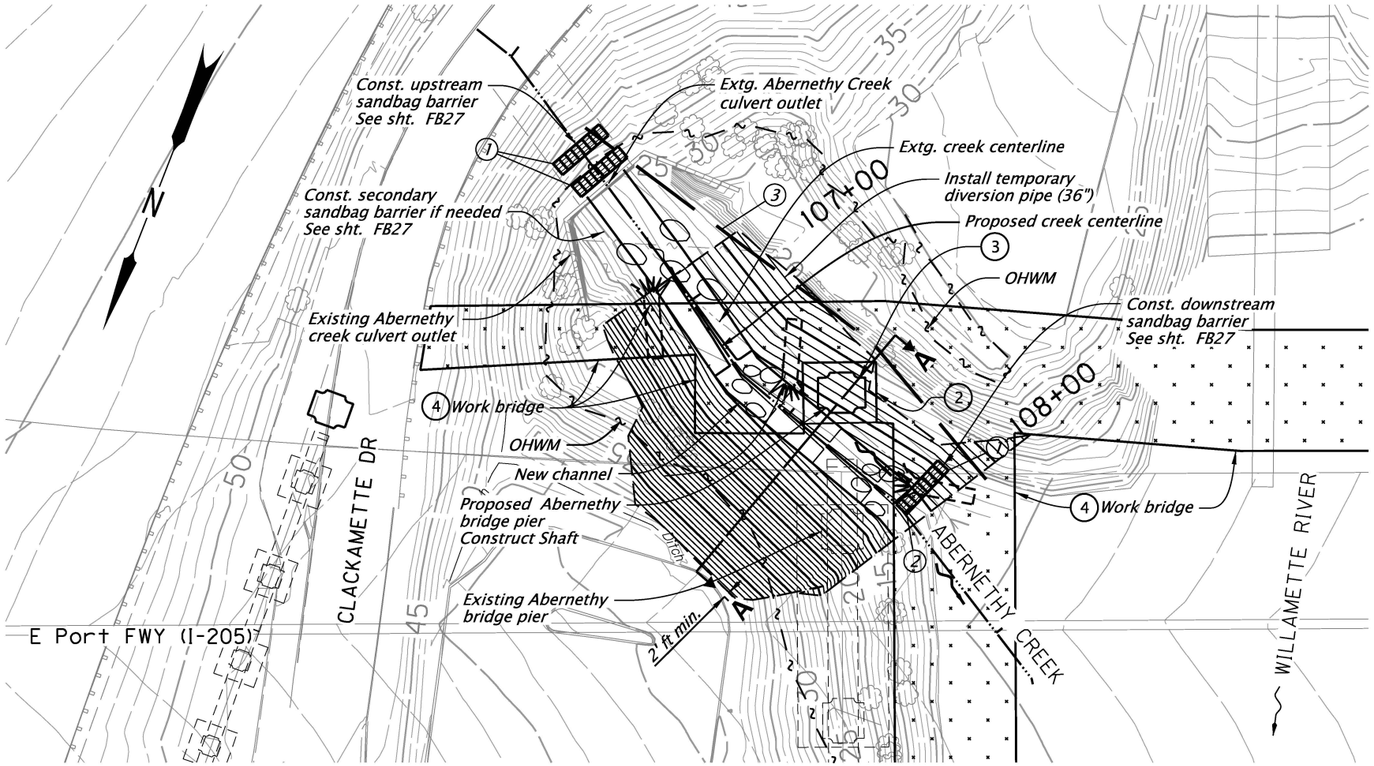
Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO.
FB21

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 201.4396° Scale: 1"=50'



Abernethy Creek Construction - Phase 2A
(In-water-work)
Complete Pier 3 south side architetural treatment and channel restoration

CONSTRUCTION SEQUENCE

1. *Complete architectural finish on Pier 3 southern shaft*
2. *Install temporary diversion*
3. *Remove coffer dam at soutern shaft of Pier 3*
4. *Remove work bridge*

5a *Realign Abernethy Creek*

5b *Remove temporary water management features*

6. *Install channel restoration features*

FULL ISOLATION NOTES:

1. *Isolating the work site upstream: Install single primary sandbag barrier across the stream channel. If Needed, install secondary sandbag barrier. Downstream: Install sandbag barrier.*
2. *Install sandbag barrier downstream from work area. Location to be set based on topography and easements available.*
3. *Size the temporary water management facility based on site conditions. Route water around work area using pipe, pump or combination. The discharge table below can be used to estimate the size of the bypass pipe and/or pump.*

Note:
Work bridge location and temporary work access is shown for reference only and is subject to change.

Temporary work access must accommodate existing flow rates for Abernethy Creek
See sht. XX for additional shoring details.

LEGEND

- *Fill slope*
- *Cut slope*
- *Ordinary High Water*
- *Flow direction*

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PORTLAND, OR 97204-1134
503.423.3700

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

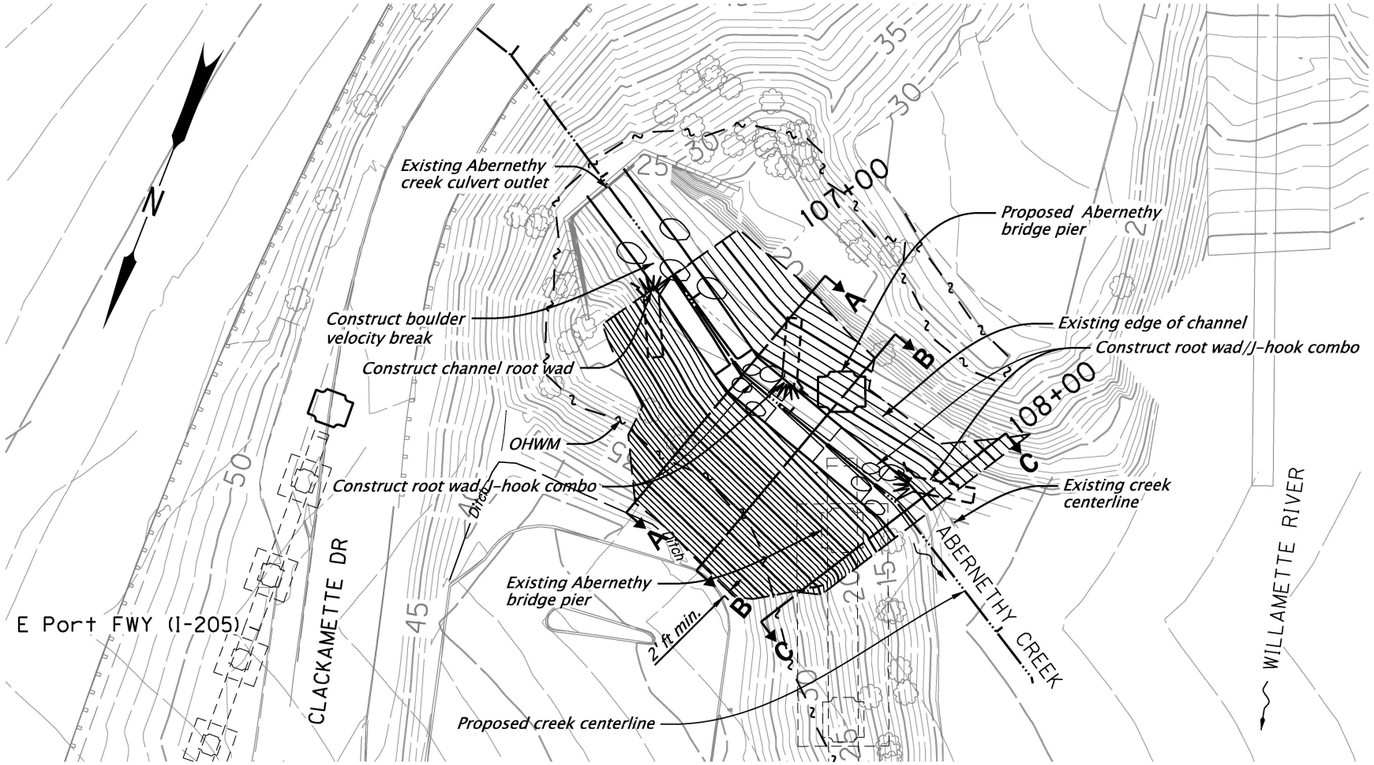
Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO.
FB22

FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 201.4396° Scale: 1"=50'



Notes:
Root wad key pieces should be at least 22 inches in diameter and buried 10-15 feet.

Boulders and structure rocks should be greater than 30 inches in diameter.

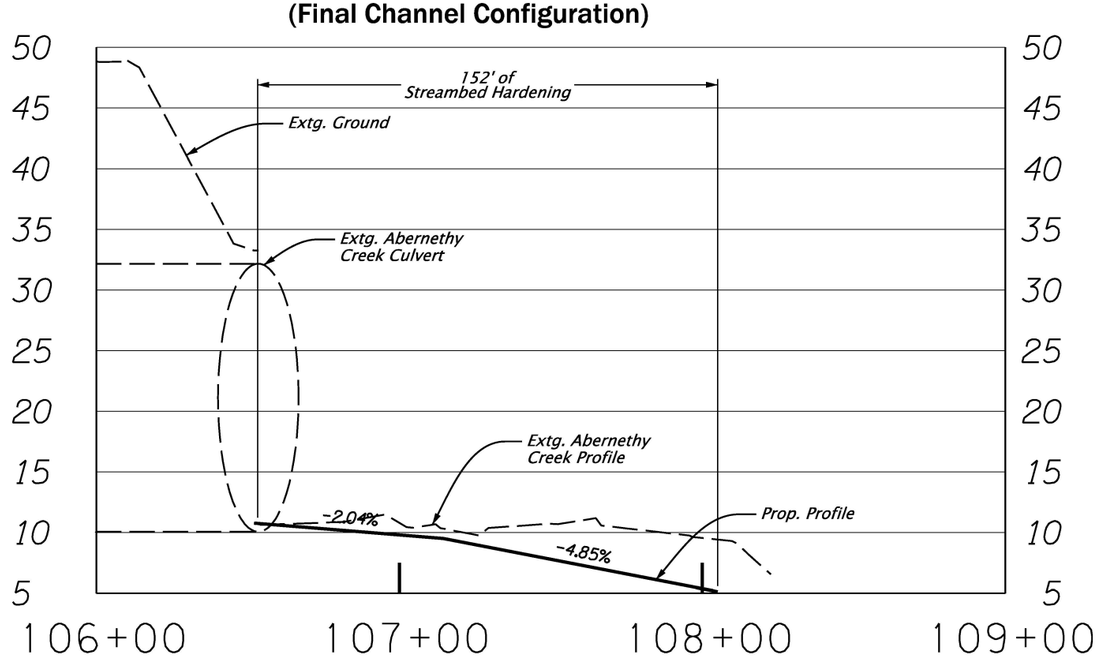
For root wad/J-hook combo, channel root wad, and boulder velocity break, see details XX, XX, and .

For section B-B, see sht. FB24. For section A-A and C-C, see sht. FB25.

LEGEND

- Fill slope
- Cut slope
- Ordinary High Water
- Flow direction

Abernethy Creek - Phase 2B
(Final Channel Configuration)



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I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

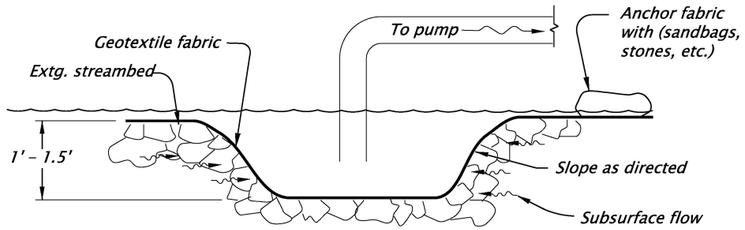
EROSION AND SEDIMENT CONTROL

SHEET NO.
FB23

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 201.4396° Scale: 1"=50'

TEMPORARY WATER MANAGEMENT FACILITY



SUMP DETAIL

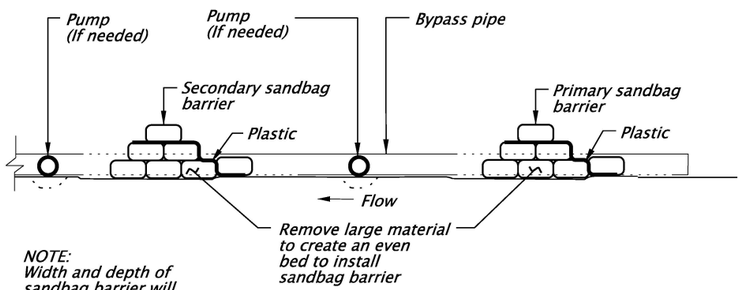
NTS

GENERAL NOTES:

The implementation of this Temporary Water Management Plan and the construction, maintenance, replacement and upgrading of this facility is the responsibility of the contractor until all construction is completed and approved.

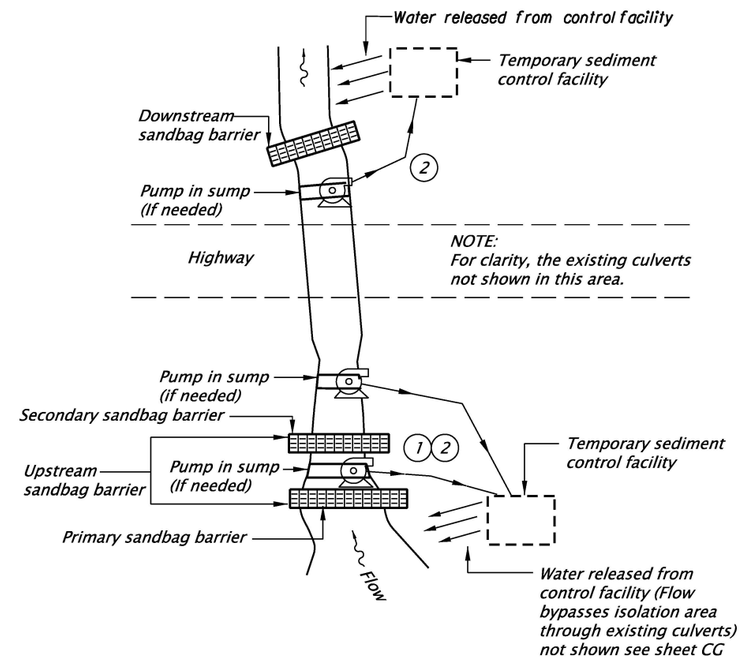
The Temporary Water Management Facility shown on this plan is the minimum requirements for anticipated site conditions. During the construction periods, this facility shall be upgraded for unexpected storm events and to insure that sediment and sediment-laden water does not leave the site.

Remove all Temporary Water Management features and restore site as per plans and specifications.



NOTE:
Width and depth of sandbag barrier will vary depending on site and stream flow conditions.

SANDBAG BARRIER SECTION



COMBINED PUMP/GRAVITY BYPASS DETAIL

NTS

LEGEND:

Sandbag barrier line

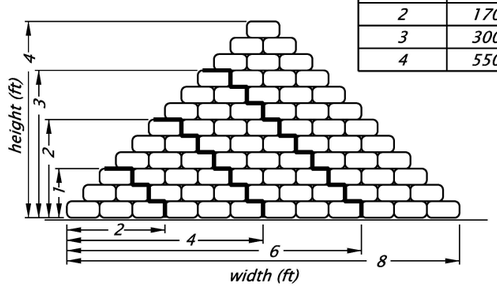
Sediment control facility

Sump pump

A common recommendation is to make the sandbag barrier twice as wide as its height (e.g., a one foot high wall would have a base width of 2 feet). This is the minimum width-to-height ratio that should be used to construct a sandbag barrier. This is based on each bag having a placed dimension of about 4 to 5 inches high by 9 to 10 inches wide by 14 inches long. This is a 30 pound bag of dry sand.

The estimated number of bags needed for 100 linear feet of barrier that is twice as wide as its height is:

Height (ft)	# bags
1	600
2	1700
3	3000
4	5500



FULL ISOLATION NOTES:

1. See sheet FB22 note.
2. See sheet FB22 note.

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OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

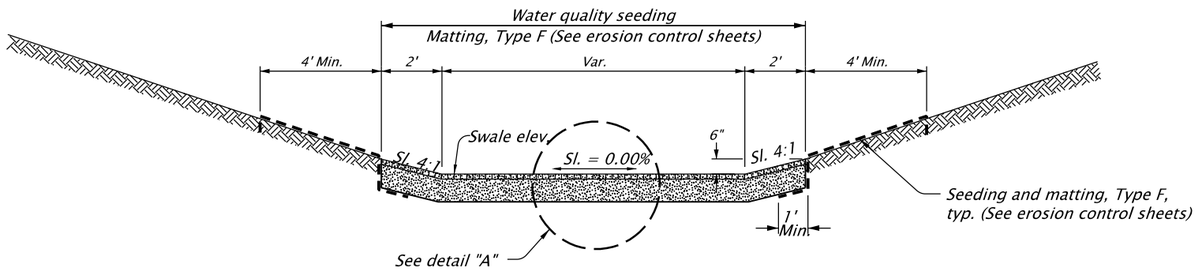
Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

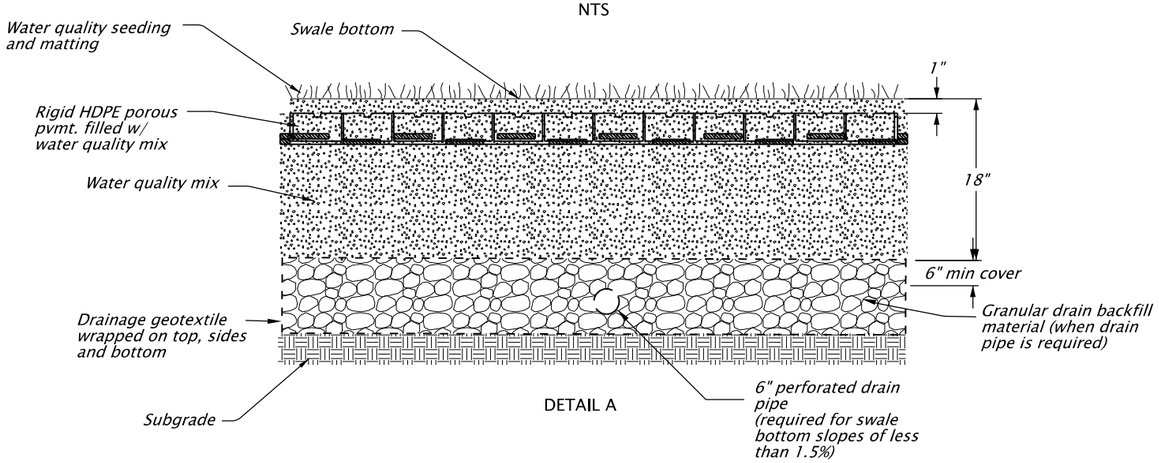
SHEET NO.
FB27

Attachment D. Stormwater Plans

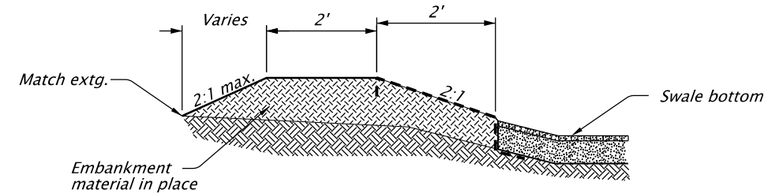
W A T E R Q U A L I T Y S W A L E D E T A I L S



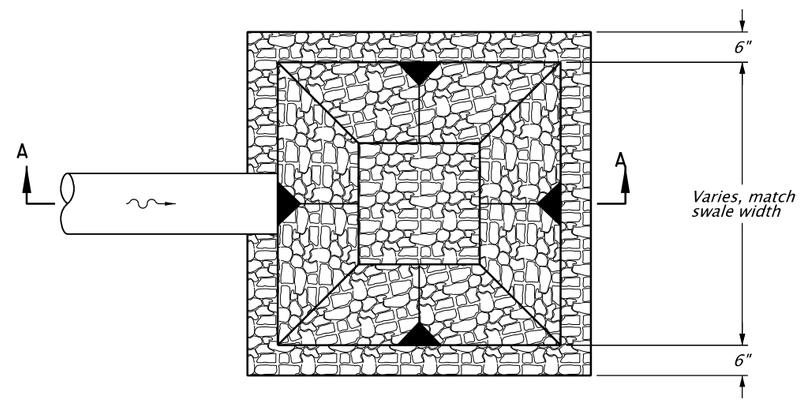
WATER QUALITY SWALE
NTS



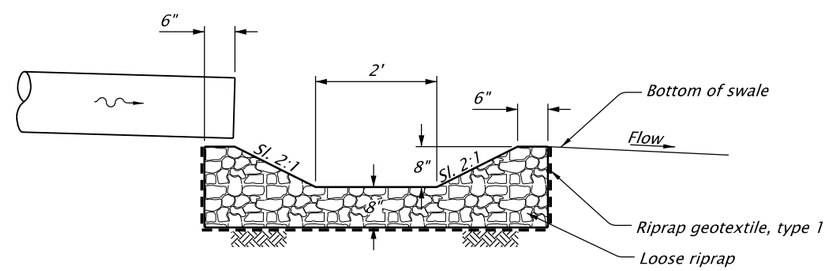
DETAIL A



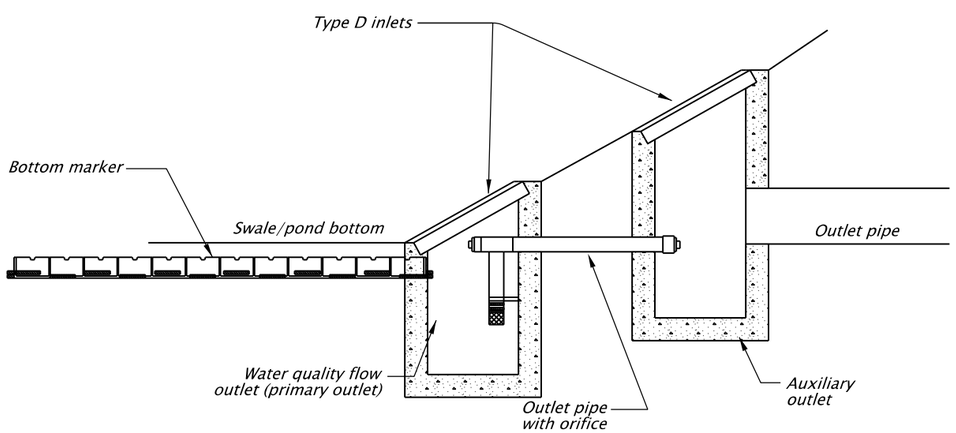
SWALE BERM
NTS



ROCK BASIN FLOW SPREADER
Scale: NTS



SECTION A–A



SWALE/POND OUTLET STRUCTURE

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OREGON DEPARTMENT OF TRANSPORTATION

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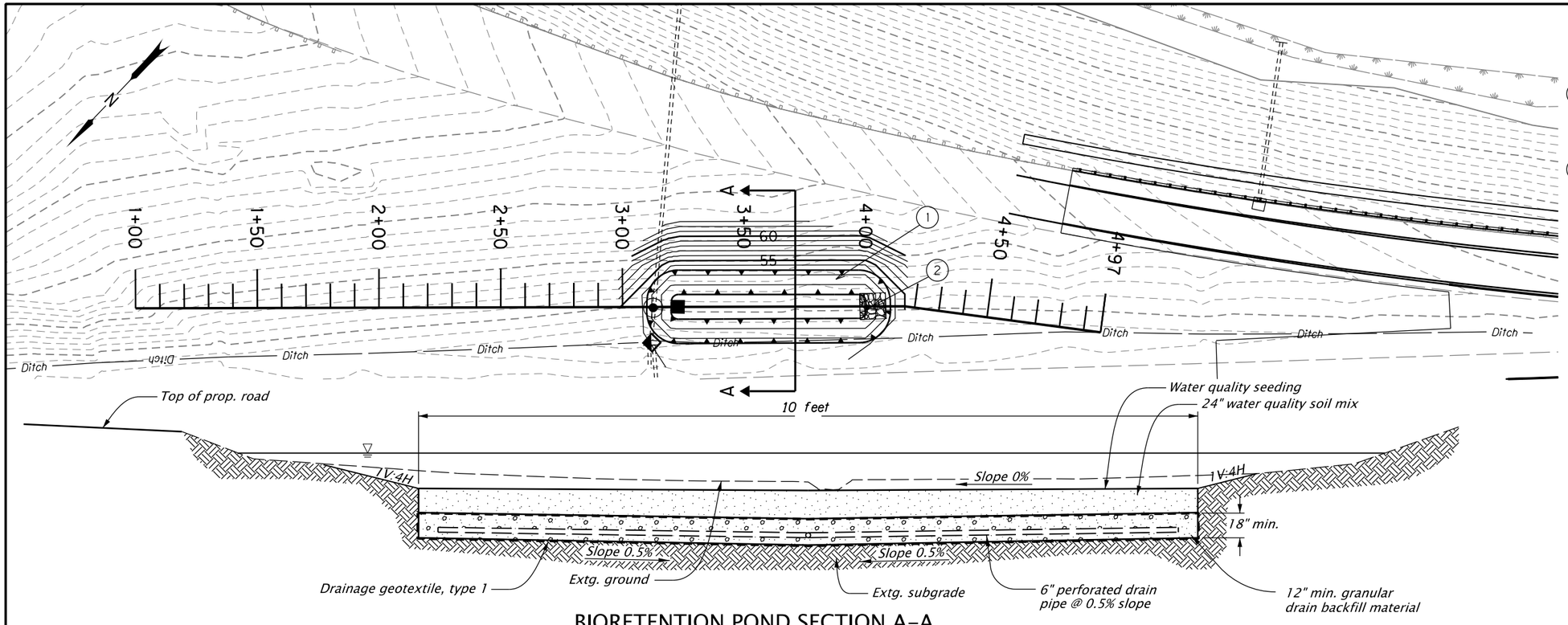
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer:	Reviewer:
Drafter:	Checker:

STORMWATER DETAILS

SHEET NO.
HA01

Rotation: 0° Scale: 1"=60'

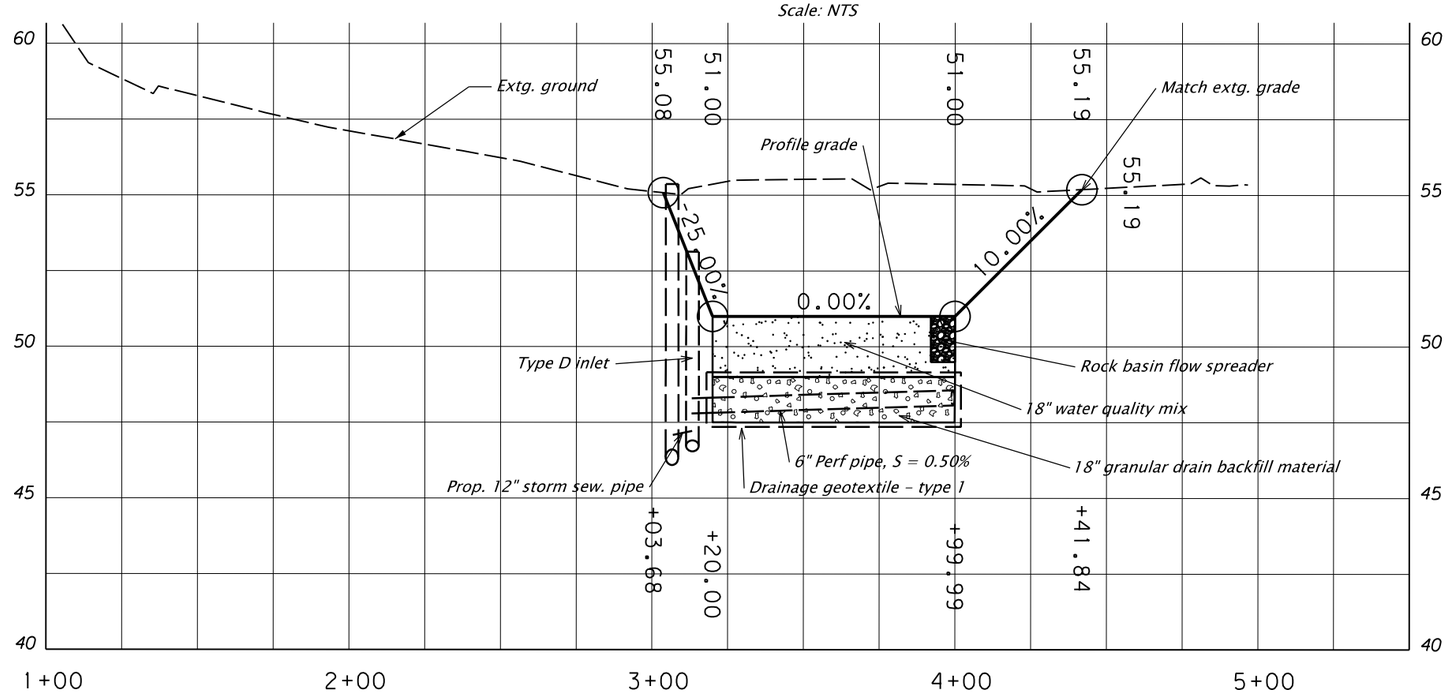


1 Sta. 3+09.86 to Sta. 4+10.05
Construct biorention pond
(For details, see sht. HA01)

2 Sta. 4+02.85, 0.00'
Construct rock basin flow spreader
(For details, see sht. HA01)

BIORETENTION POND SECTION A-A

Scale: NTS



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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

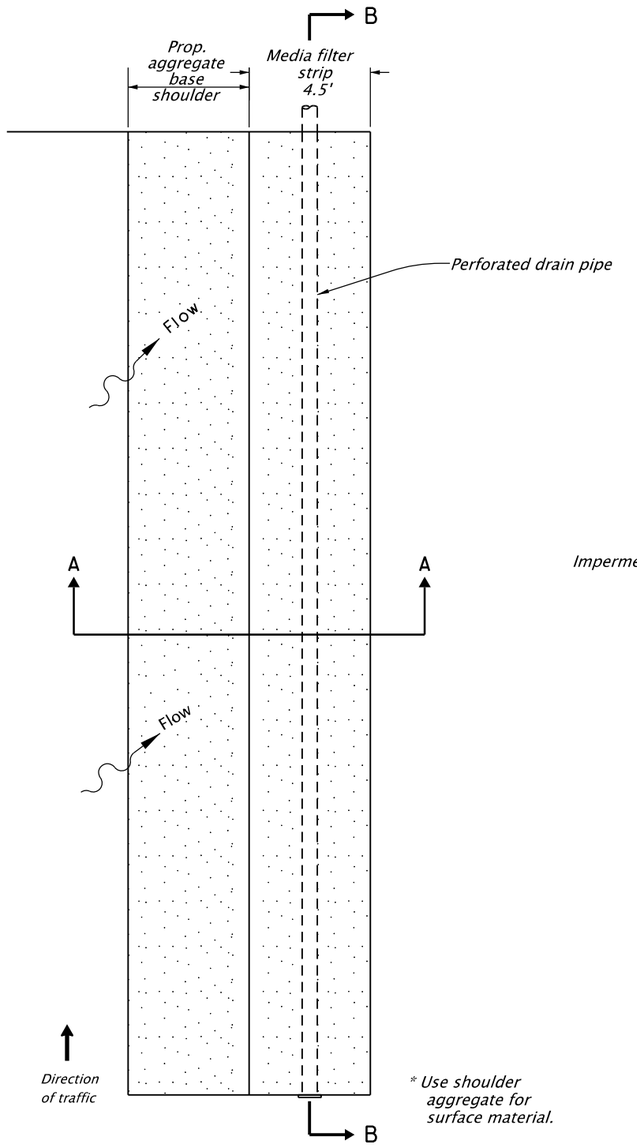
WATER QUALITY PLAN AND PROFILE

SHEET NO.
HA02

Rotation: 223.5514° Scale: 1"=50'
Vertical Scale: 1:10

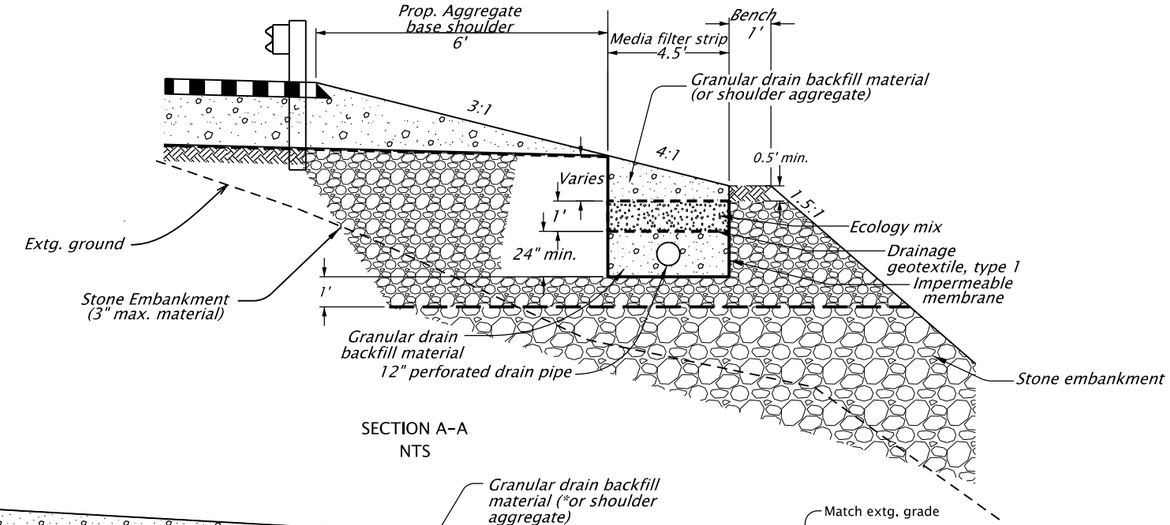
B I O S L O P E D E T A I L S

Sta. "L" 665+00 to Sta. "L" 684+00

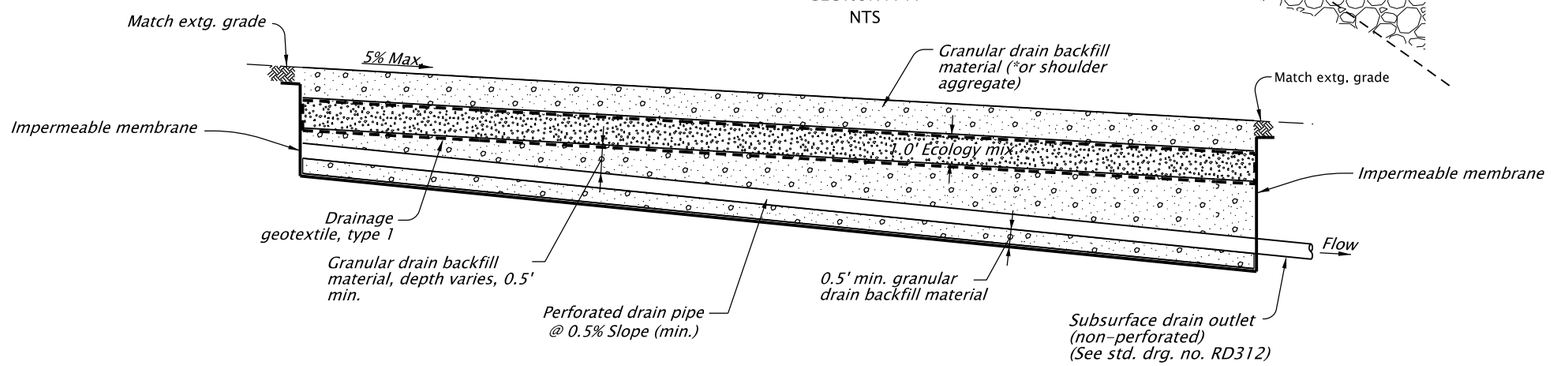


* Use shoulder aggregate for surface material.

PLAN
NTS



SECTION A-A
NTS



SECTION B-B
NTS

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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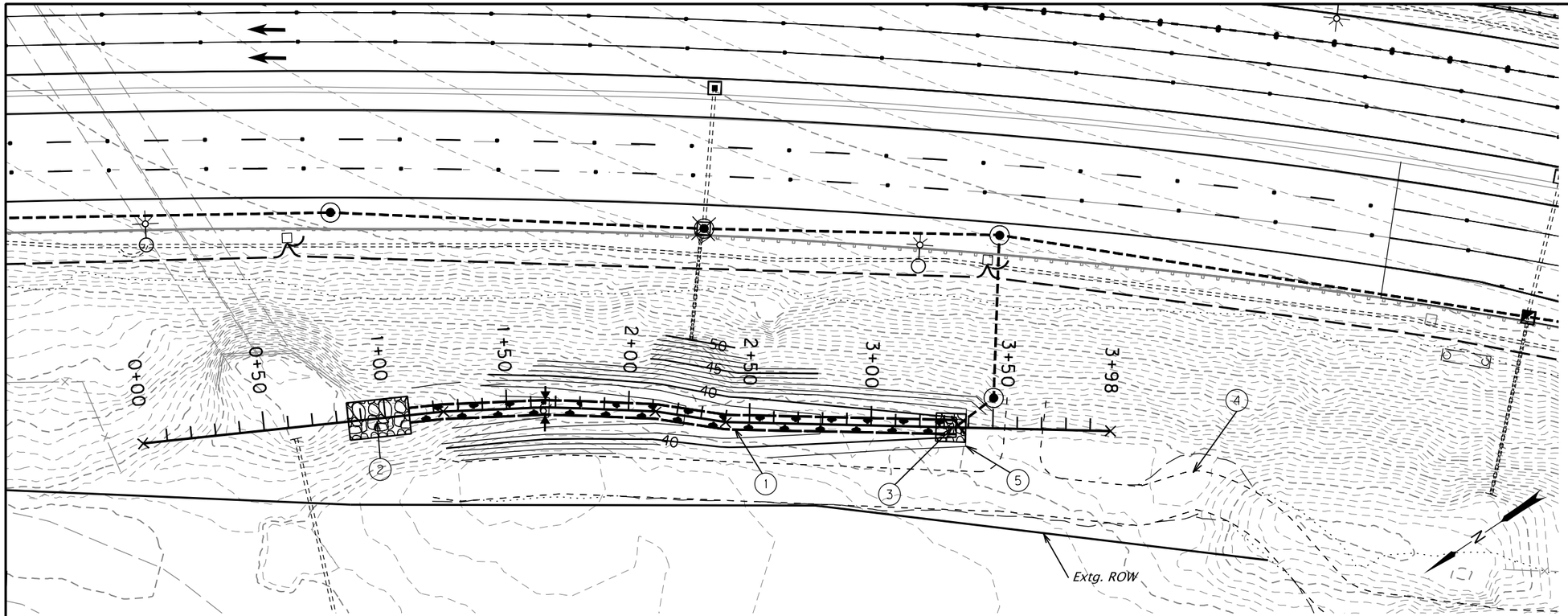
Drafter: Checker:

STORMWATER DETAILS

SHEET NO.
HA03

Rotation: 0° Scale: 1"=60'



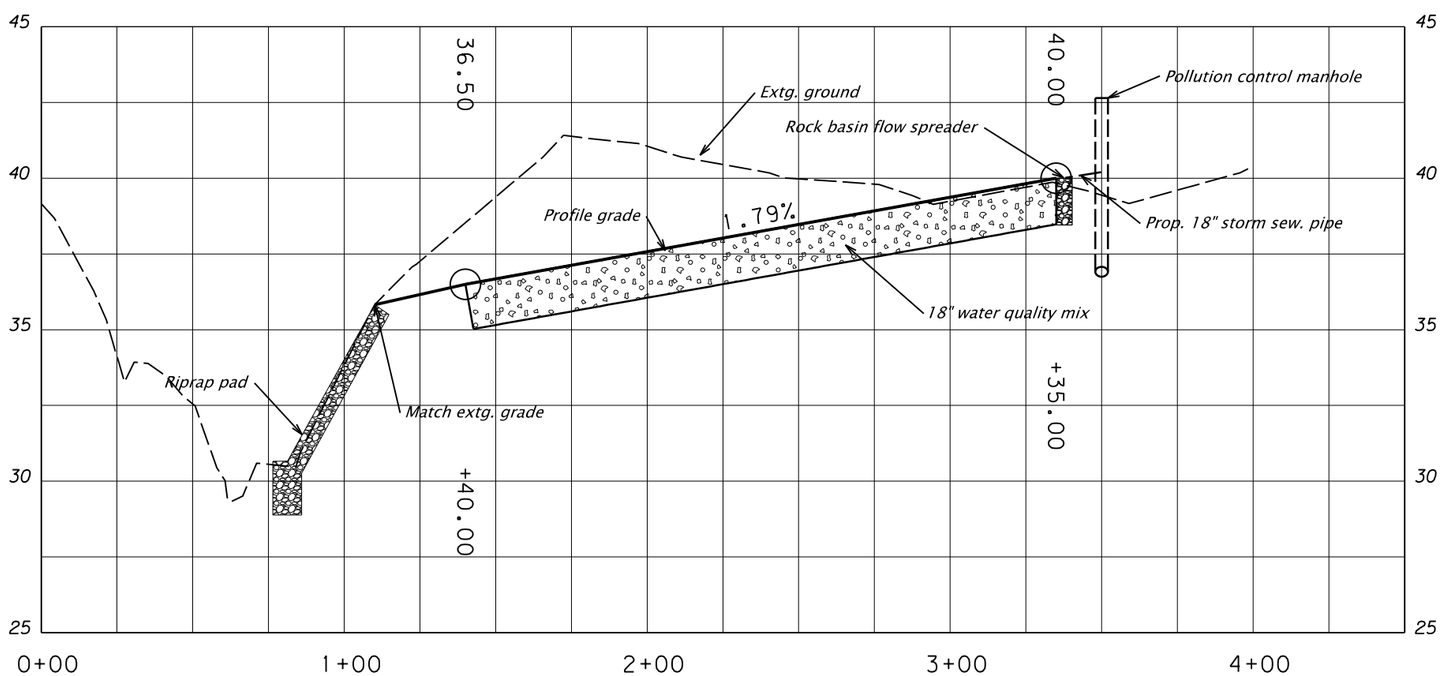
1. Sta. 3+34.91 to Sta. 1+09.97
   Const.biofiltration swale
   (For details, see sht. HA01)

2. Sta. 0+97.37, 0.00'
   Const. riprap pad
   Loose riprap (class 50) - 5.0 tons
   (See drg. no. RD317)

3. Sta. 3+33.58, 0.00'
   Const. rock basin flow spreader
   (For details, see sht. HA01)

4. Sta. XX+XX.XX
   Const. maintenance access road
   (For details, see sht. HAXX)

5. Sta. XX+XX.XX
   Const. berm
   (For details, see sht. HA01)



DFI no. ######

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HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

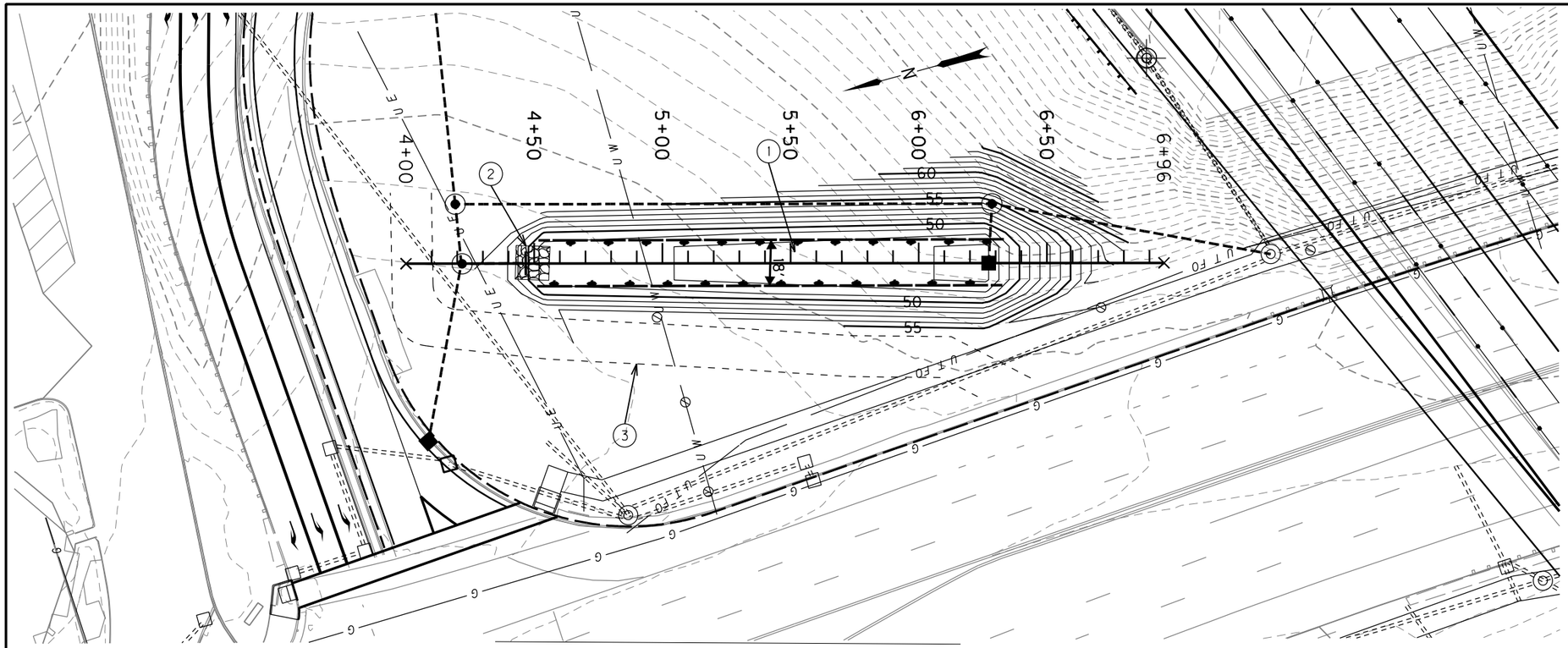
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

WATER QUALITY PLAN AND PROFILE

SHEET NO.
HA04

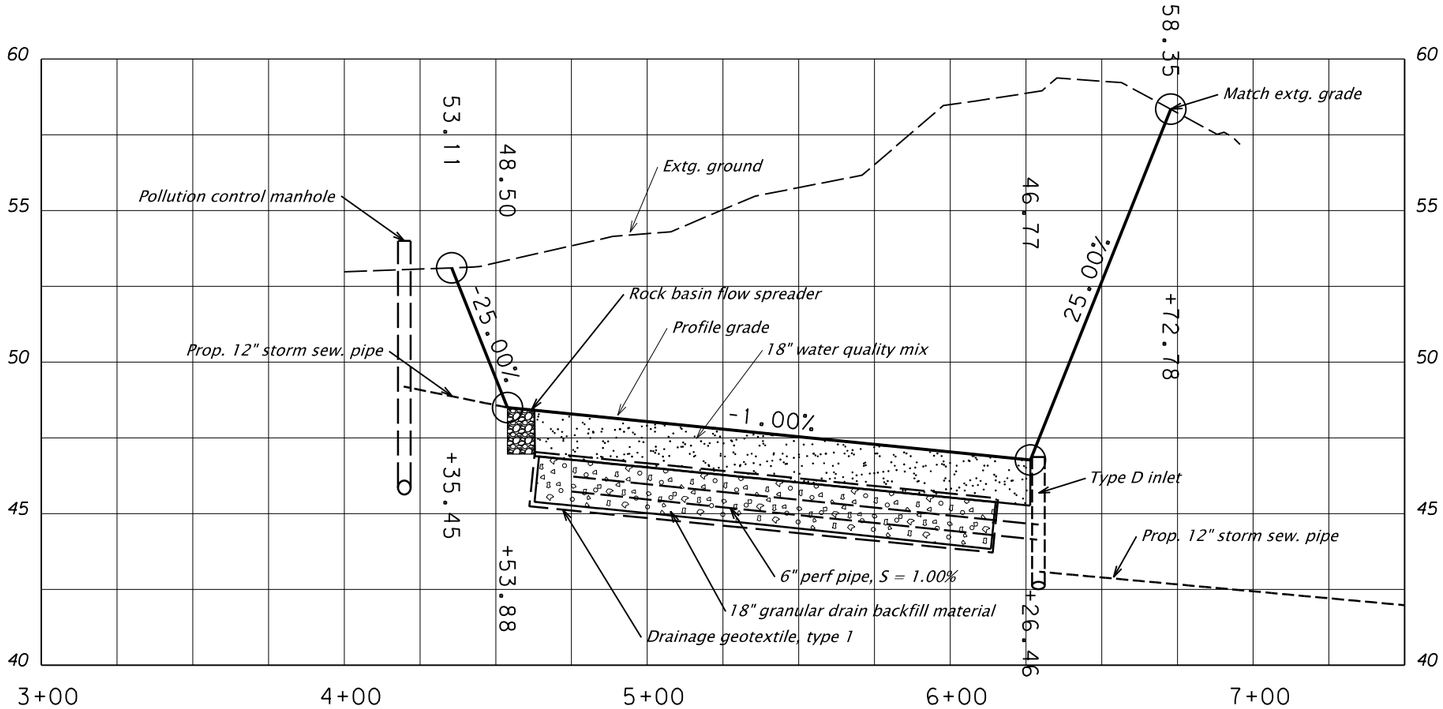
Rotation: 236.1297° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 4+50.41 to Sta. 6+34.91
   Const. biofiltration swale
   (For details, see sht. HA01)

2. Sta. 4+48.95, 0.00'
   Construct rock basin flow spreader
   (For details, see sht. HA01)

3. Sta. XX+XX.XX
   Construct maintenance access road
   (For details, see sht. HAxx)



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I-205: I-5 - OR213, PHASE 1 SEC.

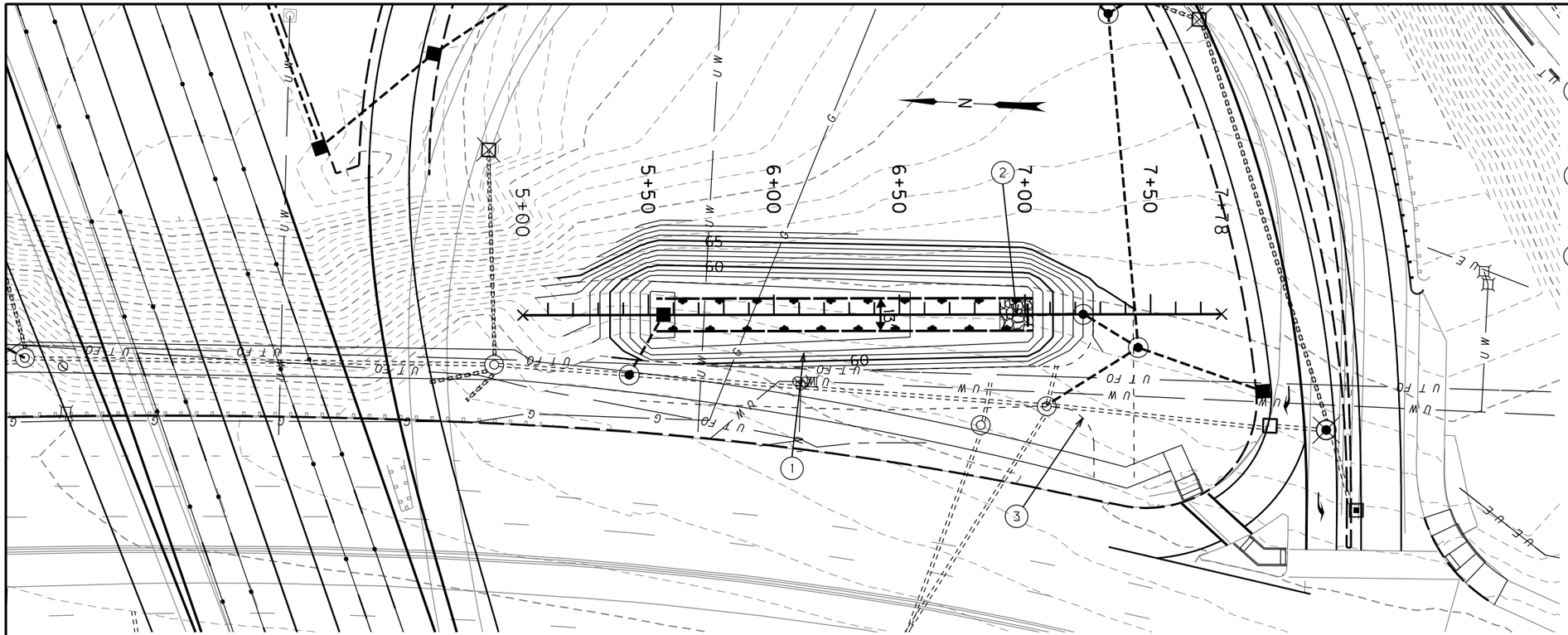
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

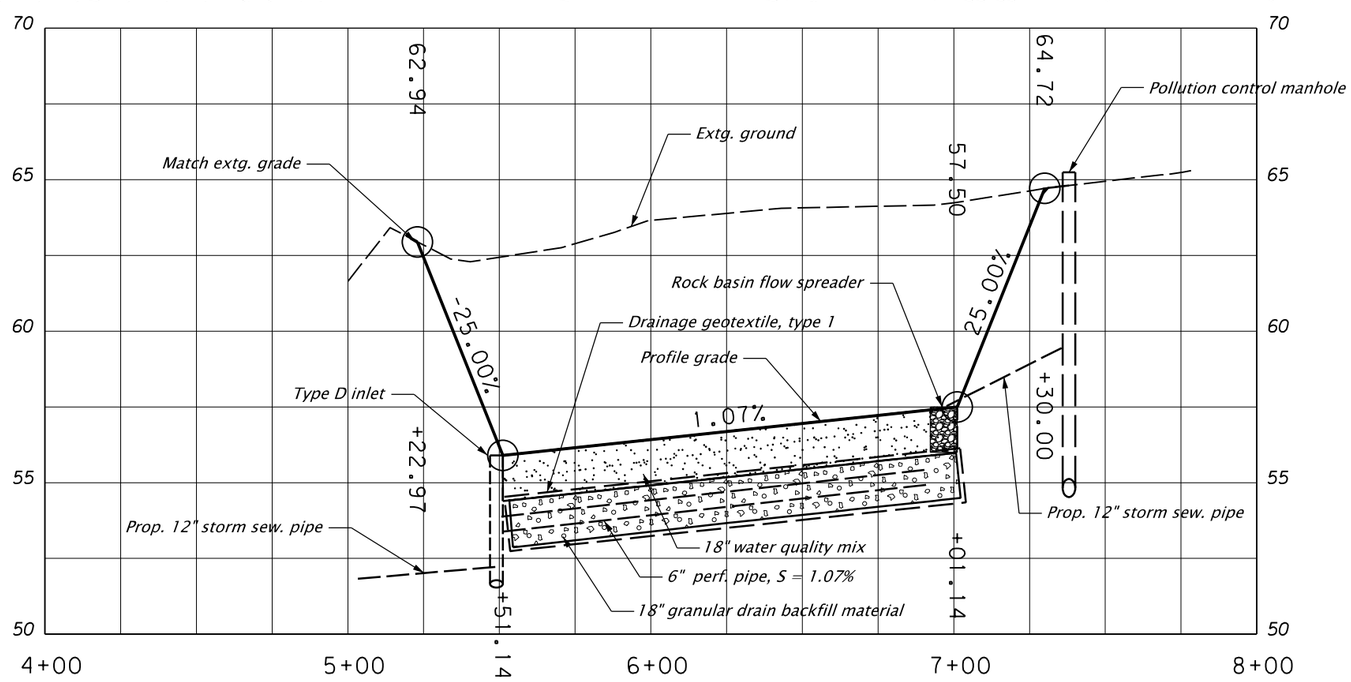
WATER QUALITY PLAN AND PROFILE

SHEET NO.
HA05

Rotation: 254.7731° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 7+03.50 to 5+52.97
   Construct biofiltration swale
   (For details, see sht. HA02)
2. Sta. 6+95.86, 0.00'
   Construct rock basin flow spreader
   (For details, see sht. HA02)
3. Sta. XX+XX.XX
   Construct maintenance access road
   (For details, see sht. HAxx)



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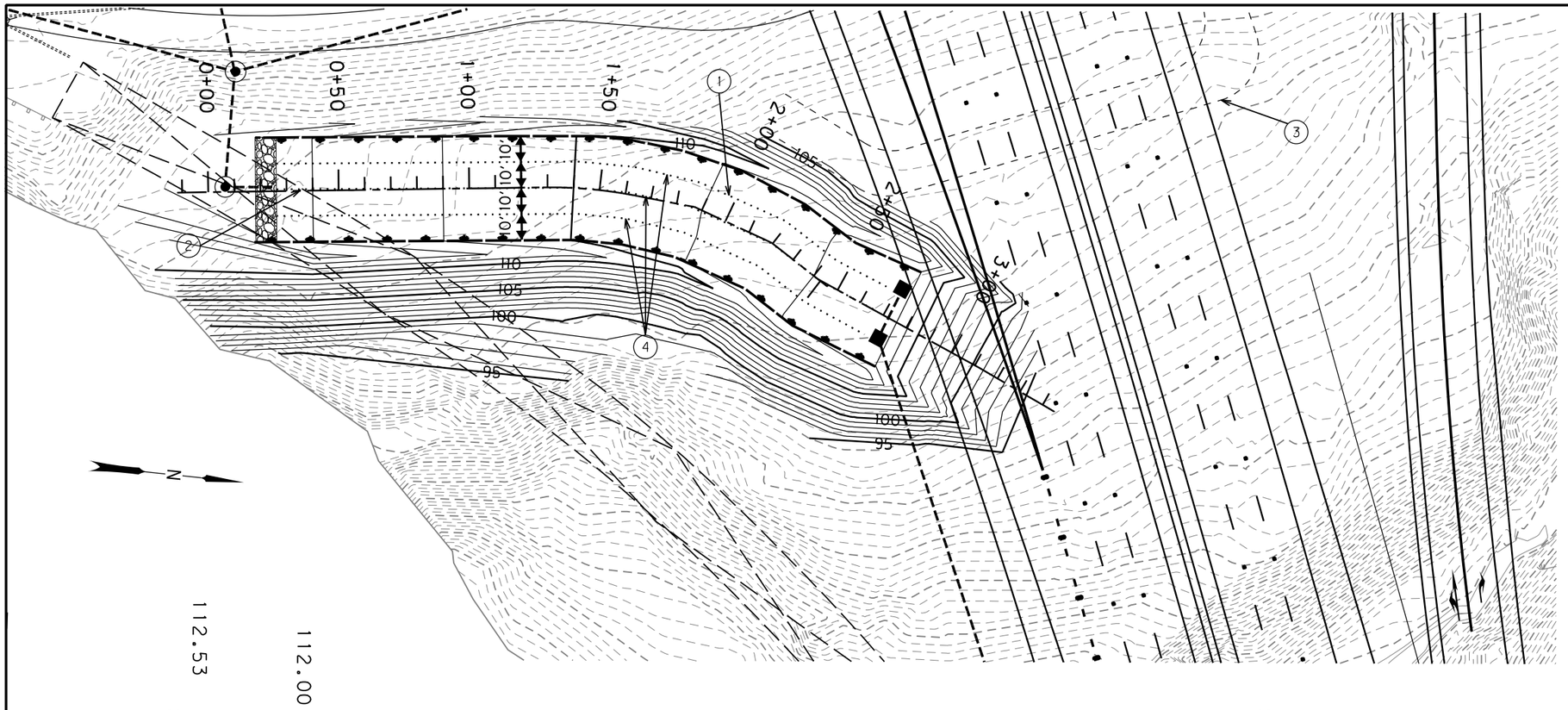
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer:	Reviewer:
Drafter:	Checker:

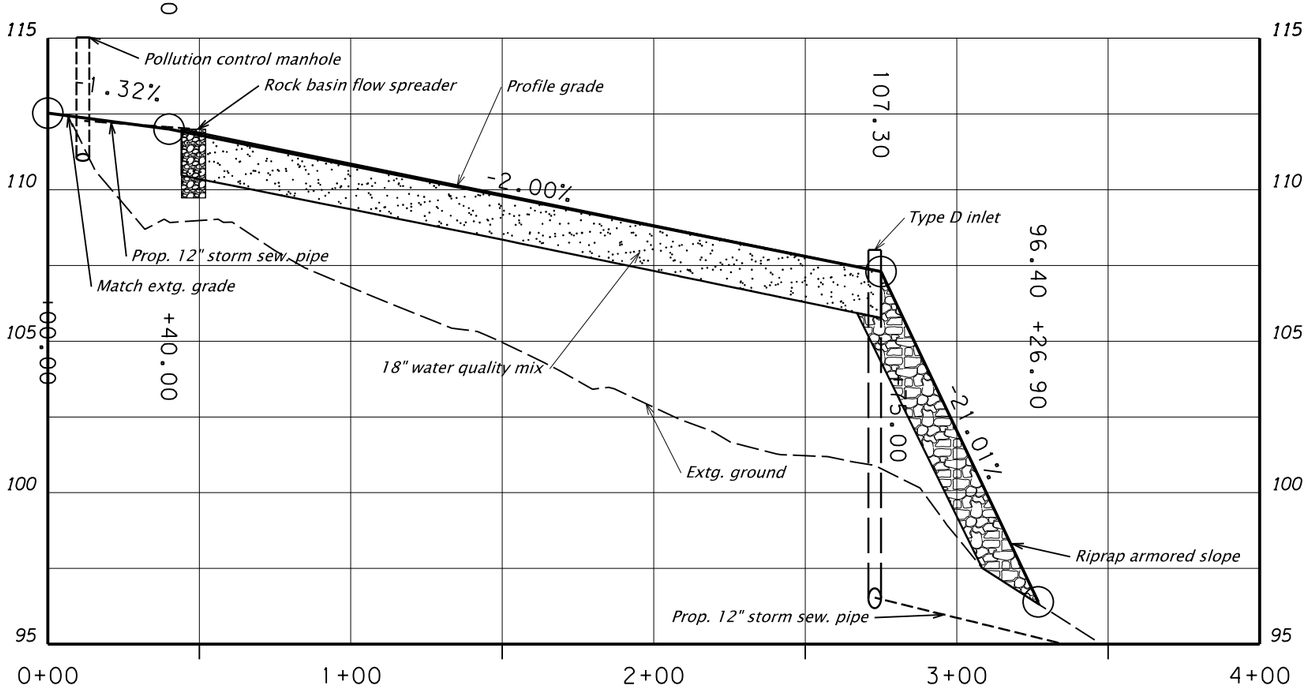
WATER QUALITY PLAN AND PROFILE

SHEET NO. HA06

Rotation: 272.7106° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 0+31.89 to Sta. 2+48.39
   Construct biofiltration swale
   (For details, see sht. HA01)
2. Sta. 0+37.15, 2.22' Lt.
   Construct rock basin flow spreader
   (For details, see sht. HA01)
3. Sta. XX+xx.xx
   Construction maintenance access road
   (For details, see sht. HAXX)
4. Construct dividing berm
   (For details, see sht. HA01)



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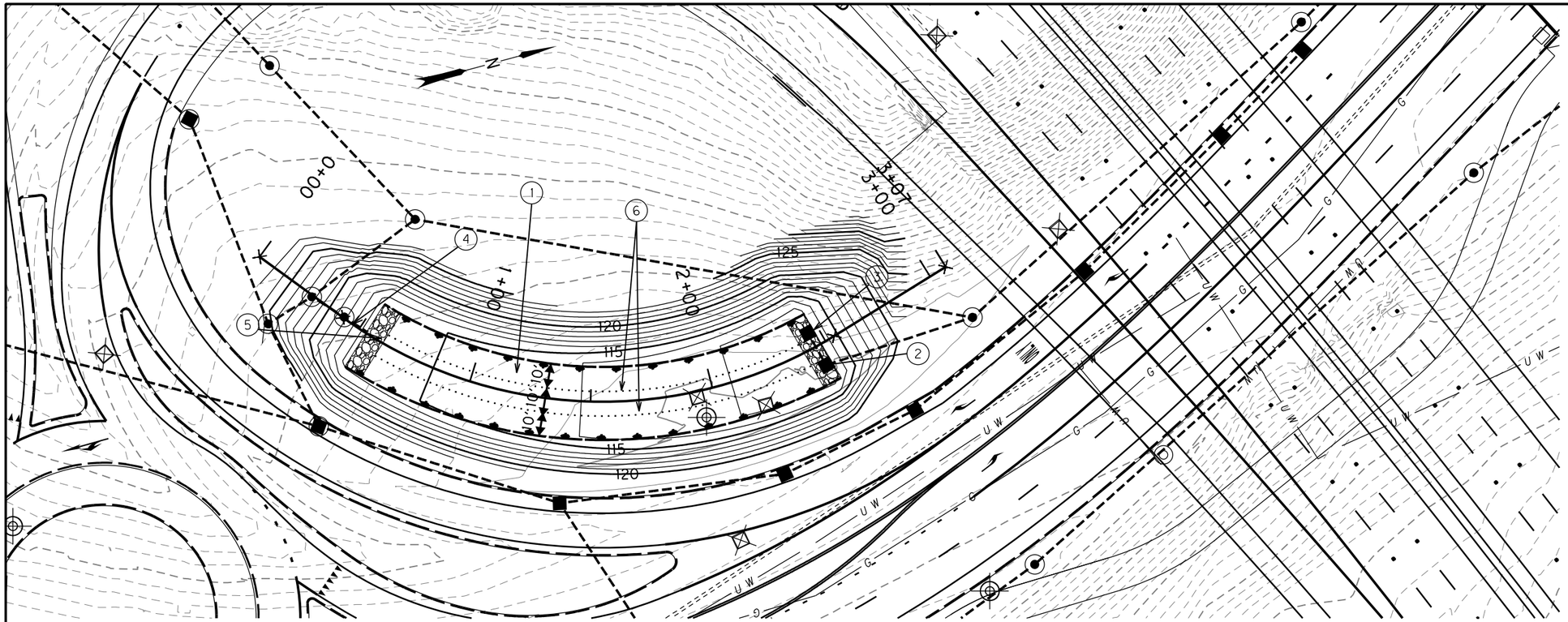
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

WATER QUALITY PLAN AND PROFILE

SHEET NO. HA07

Rotation: 96.0998° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 0+54.22 to 2+55.48
   Construct 30' wide biofiltration swale
   (For details, see sht. HA01)

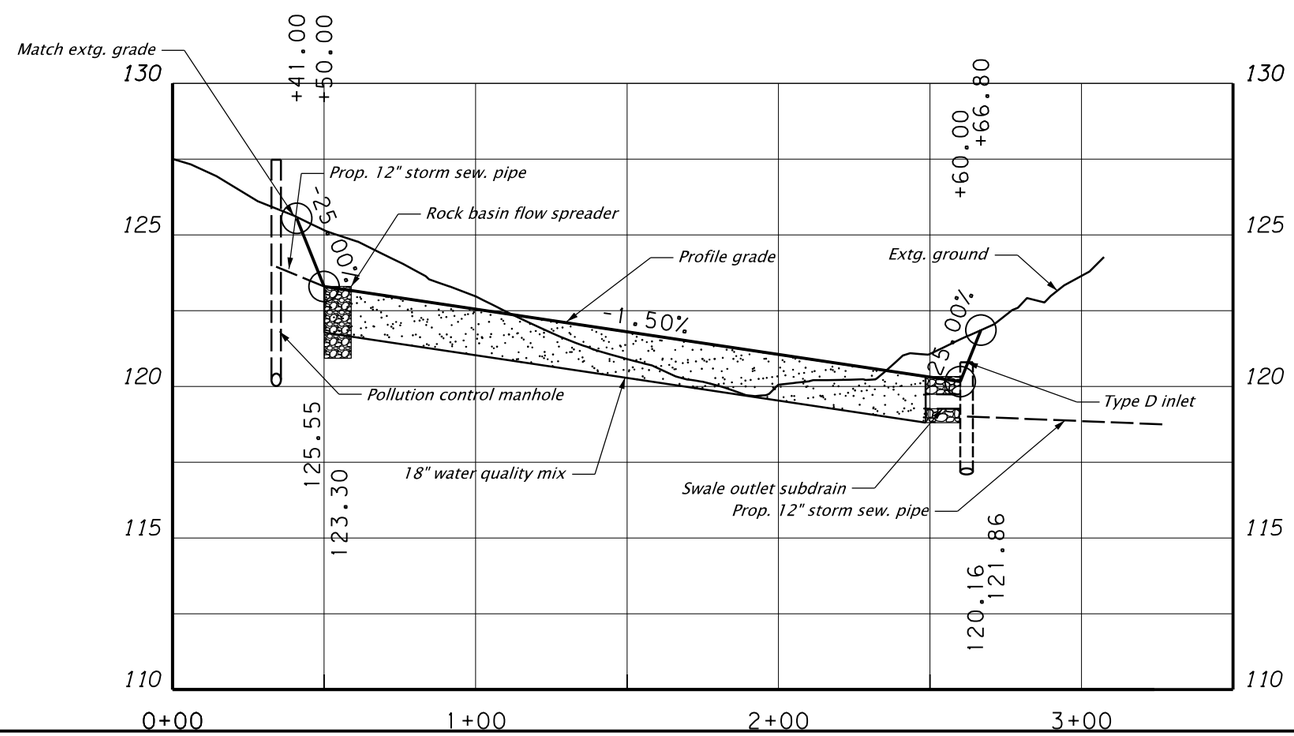
2. Sta. 2+64.06, 20.53' Lt.
   Construct type "D" inlet
   (See drg. no. RD370)

3. Sta. 2+63.54, 5.88' Lt.
   Construct type "D" inlet

4. Sta. 0+43.25
   Construct pollution control manhole
   (See drg. nos. RD340, RD345, RD356 and RD336)

5. Sta. 0+54.22
   Construct rock basin flow spreader
   (For details, see sht. HA01)

6. Construct dividing berm



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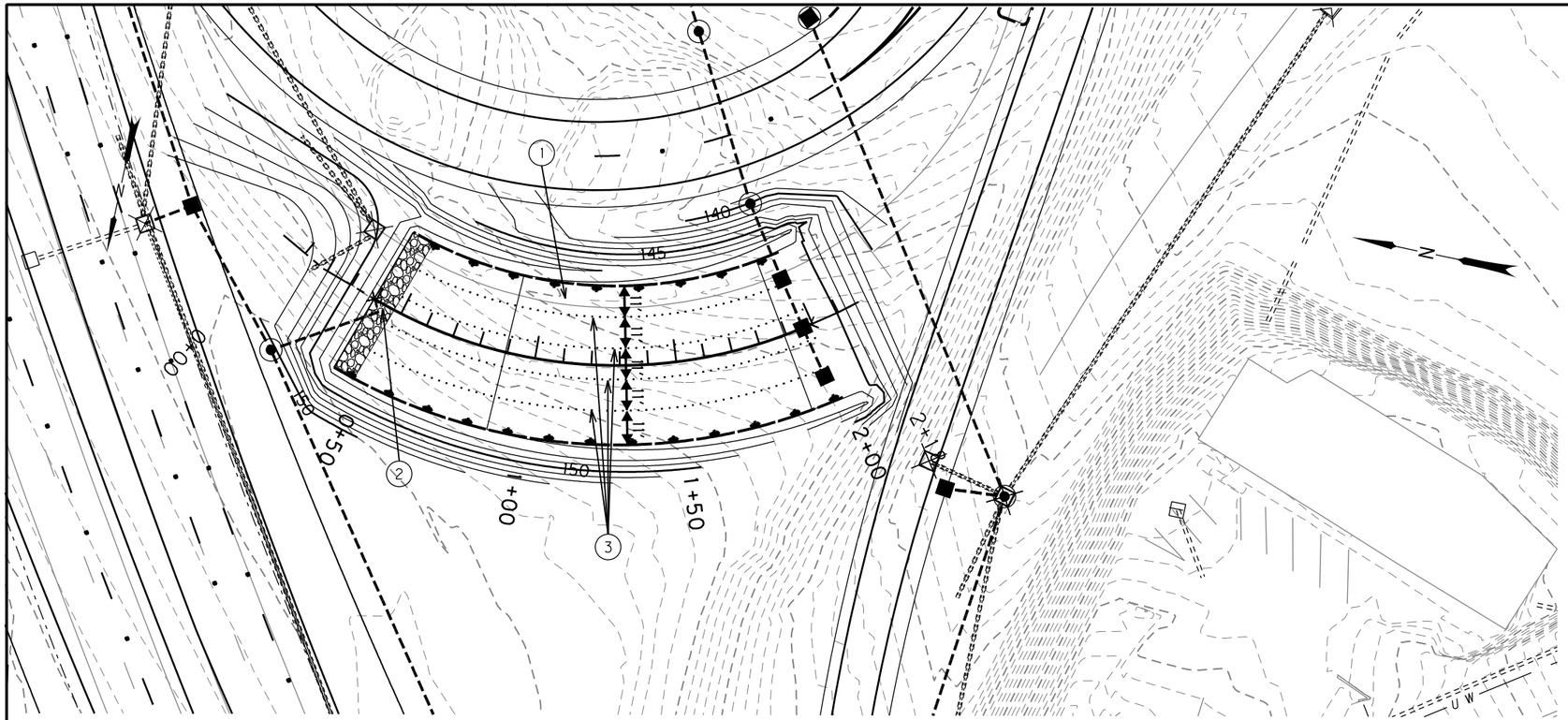
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer:	Reviewer:
Drafter:	Checker:

WATER QUALITY PLAN AND PROFILE

SHEET NO.
HA08

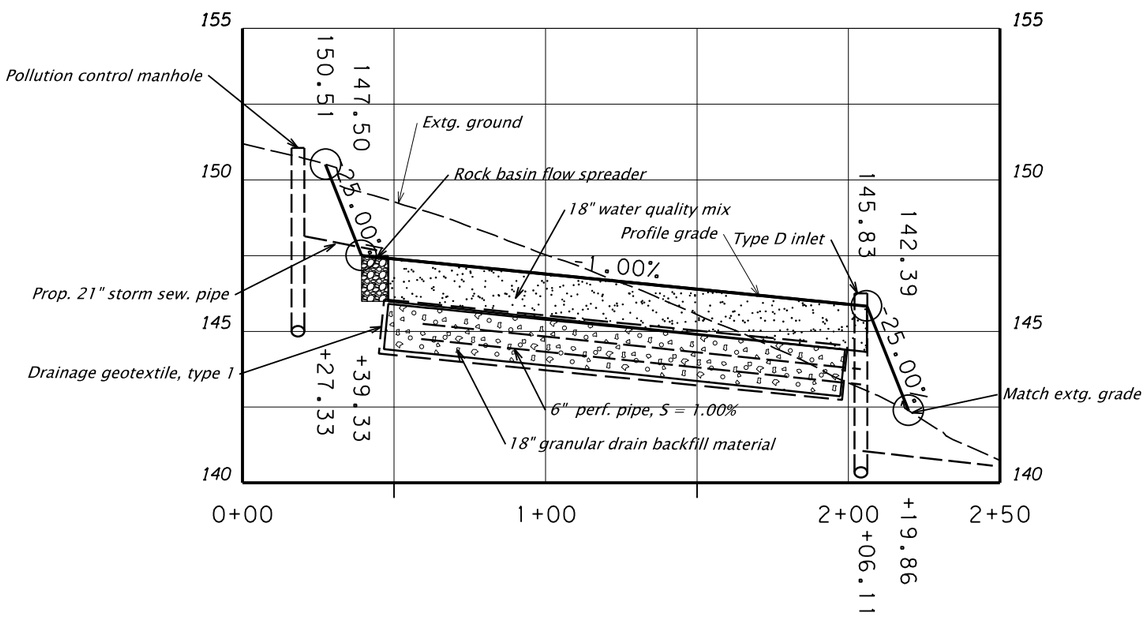
Rotation: 75.0253° Scale: 1"=50'
Vertical Scale: 1:10



1. Sta. 0+39.24 to Sta. 1+98.79
   Construct biofiltration swale
   (For details, see sht. HA01)

2. Sta. 0+44.18, 0.00'
   Construct rock basin flow spreader
   (For details, see sht. HA01)

3. Construct dividing berm



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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

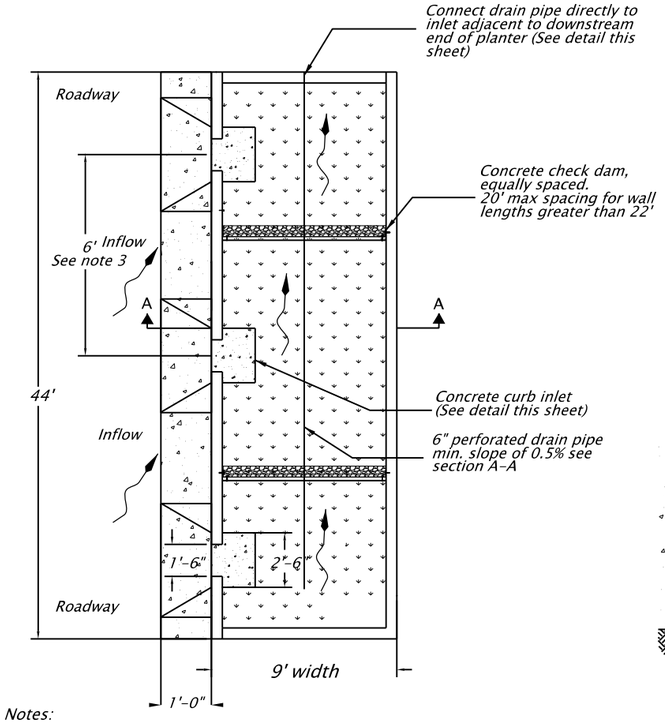
Designer: Reviewer:
Drafter: Checker:

WATER QUALITY PLAN AND PROFILE

SHEET NO.
HA09

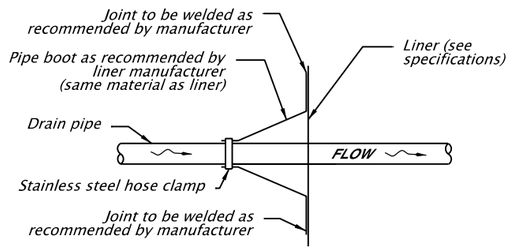
Rotation: 281.7947° Scale: 1"=50'
Vertical Scale: 1"=5'

S T O R M W A T E R P L A N T E R

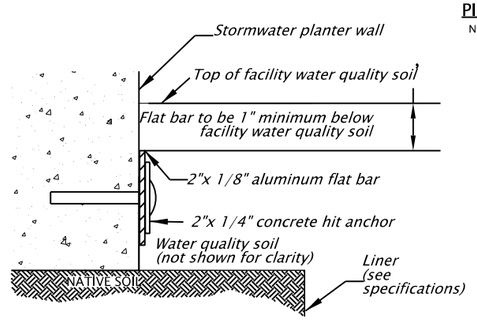


Notes:
1. Match longitudinal slope of planter to slope of the road.
2. If less than 18" is between splash pad and planter end wall, extend pad to wall.
3. Install inlets (6' on center) on all sides of facility that are adjacent to parking lot.

PLAN VIEW

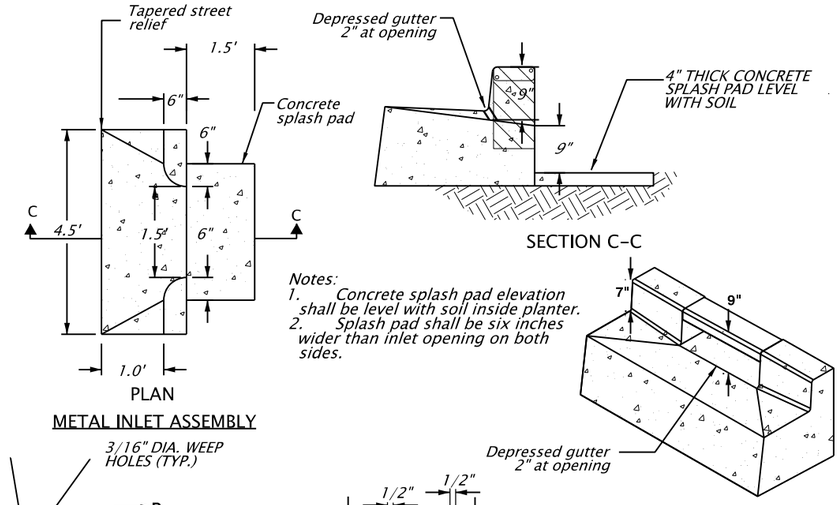


PIPE BOOT
NOT TO SCALE



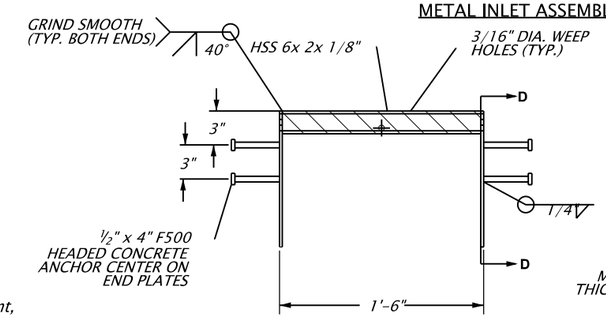
Notes:
1. Adhere liner to concrete with top coat tc moldable sealant, or approved equal.
2. Liner to extend from top of water quality soil to the bottom of excavation.
3. 3" of concrete is required on all sides of attachment. Adjust sidewalk depth as necessary.
4. Secure liner to concrete with 2" aluminum flat bar, placed as directed (around entire facility).
5. Attach flat bar with concrete hit anchors, 24" o.c.
6. Trim excess liner to the top of the flat bar.

LINER ATTACHMENT DETAIL
NOT TO SCALE

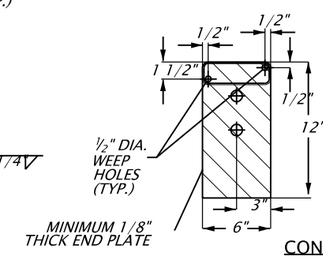


Notes:
1. Concrete splash pad elevation shall be level with soil inside planter.
2. Splash pad shall be six inches wider than inlet opening on both sides.

METAL INLET ASSEMBLY

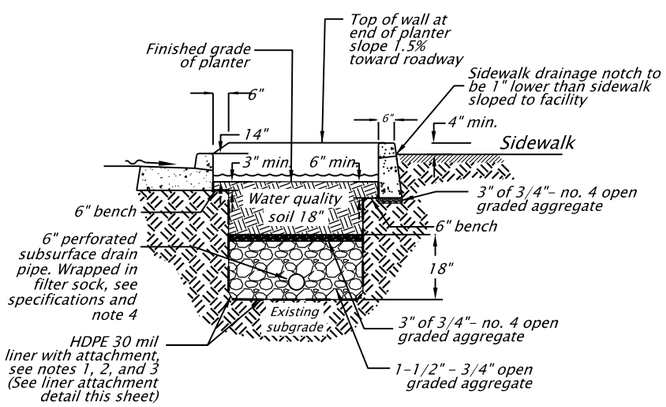


ELEVATION



SECTION D-D

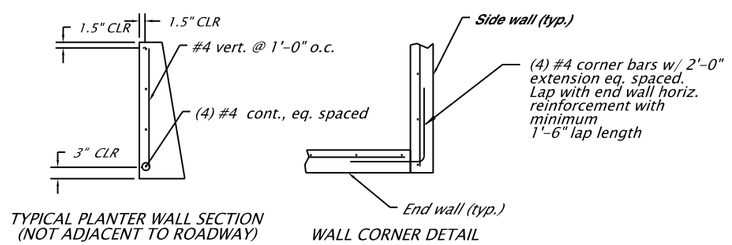
CONCRETE CURB INLET
NOT TO SCALE



Notes:
1. Partial or full liner required. See stormwater planter table (this sheet) for requirement.
2. Partial liner located along side of planter adjacent to roadway.
3. Full liner located along all sides of planter.
4. Drain pipe only required for fully lined planters.
5. Scarify the native soil 12" following the initial excavation and before installing water quality soil and rock.

SECTION A-A

STORMWATER PLANTER DETAIL
NOT TO SCALE

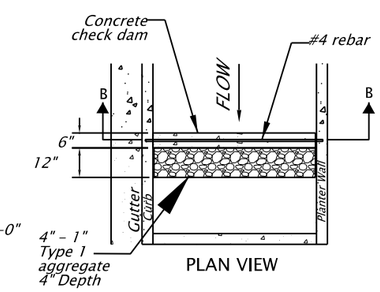


TYPICAL PLANTER WALL SECTION (NOT ADJACENT TO ROADWAY)

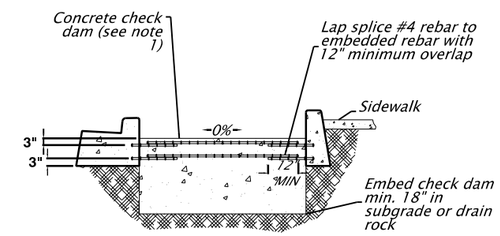
WALL CORNER DETAIL

Notes:
1. Top of planter walls to be 4" higher than adjacent sidewalk.
2. Bottom of planter walls to be 6" below top of water quality soil.

PLANTER WALL
NOT TO SCALE



PLAN VIEW



SECTION B-B

Notes:
1. Top of dam elevation to be 2" lower than upstream curb depression elevation.
2. Concrete to be 3,000 psi.
3. Embed #4 rebar 3" into curb and planter wall.

CONCRETE CHECK DAM
NOT TO SCALE

DFI no. ######

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OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

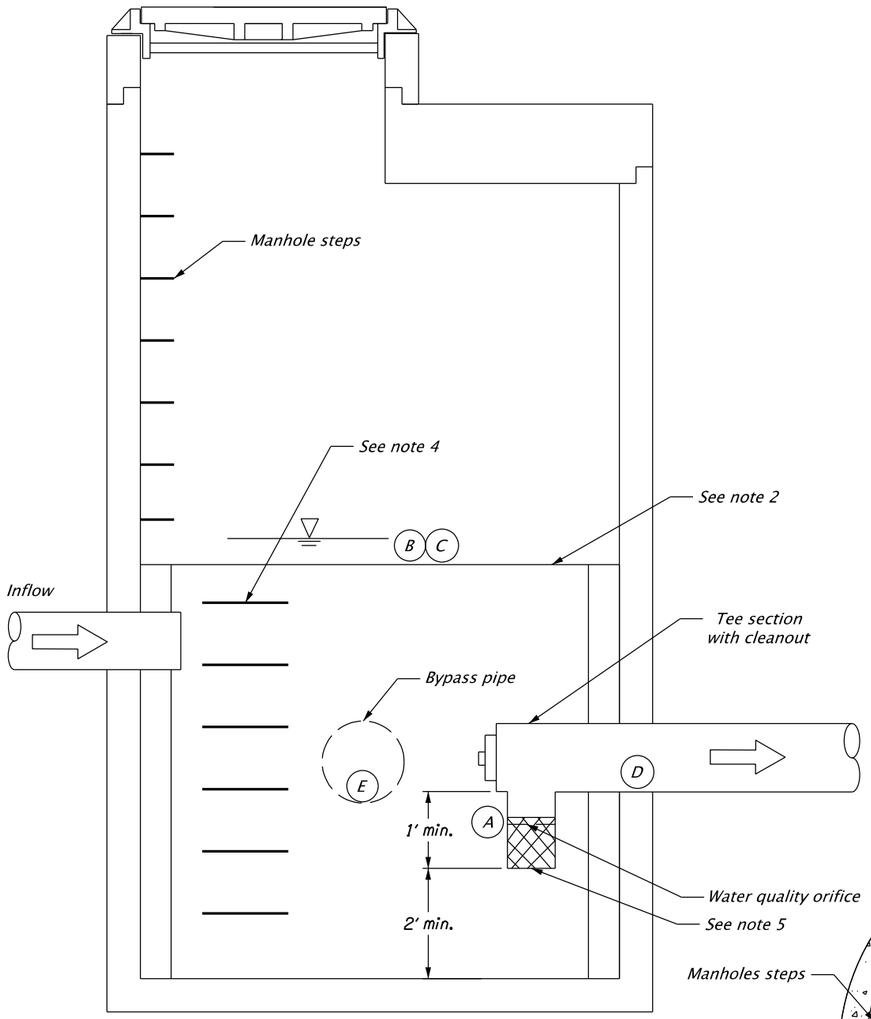
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Reviewer:
Drafter: Checker:

STORMWATER DETAILS

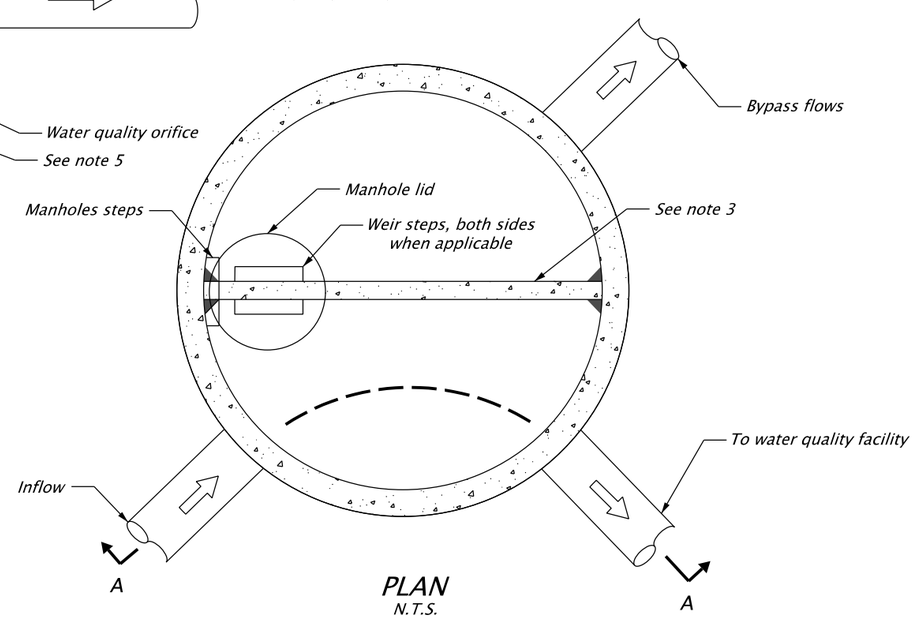
SHEET NO. HA10

Rotation: 0° Scale: 1"=60'



SECTION A-A
N.T.S.

		WQF#4	WQF#5	WQF#6	WQF#7
DESCRIPTION	LETTER	VALUE	VALUE	VALUE	VALUE
ORIFICE DIAMETER	A	$8\frac{1}{8}$"			
WEIR ELEVATION	B	50.83'			
WEIR LENGTH	C	6.0'			
INVERT OF OUTLET PIPE TO WATER QUALITY FACILITY	D	48.7'			
INVERT OF HIGH FLOW BYPASS OUTLET PIPE	E	48.7'			



PLAN
N.T.S.

GENERAL NOTES:

1. *Manhole structure 72 in. min. dia.*
2. *4 in . min. thickness reinforced concrete weir.*
3. *Weir shall be grouted to manhole stucture (both ends)*
4. *Provide weir steps when height of weir is greater than 36 inches, both sides*
5. *Water quality orifice screening. The wire cloth strainer assembly should be secured to pipe with a stainless steel hose clamp. Orifice screening must contain mulitple openings that are equal to or less than the orifice diameter.*
6. *Include tracer wire as shown in Standard Drawing RD336.*

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503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Cory Gieseke
Reviewer: Karen Tatman
Drafter: Morgan Tholl
Checker: Christine Higgins

STORMWATER DETAILS

SHEET NO.
HA11

FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 0° Scale: Full Size 1=1

Attachment E. Erosion and Sediment Control Plan

GENERAL NOTES:

1. Plant all trees beyond "clear zone"; verify with engineer prior to planting. Engineer shall approve all work outside designated work limits prior to construction. Do not plant trees within 20' of a bridge/viaduct or within 10' of a trail, waterline, or stormwater line.

2. Locate underground utility lines prior to any digging or ground disturbance.

3. Adjust planting locations so vegetation does not conflict with above- or below-ground utilities.

4. Adjust plant locations to avoid conflict with traffic sight lines and signs or other appurtenances. Adjust plant material in the field to meet setback requirements for signs, lighting, barriers, and other existing and proposed roadside elements.

5. All dimensions shown on details are minimum dimensions.

6. See Plant Schedule FA02, FA03 for plants and landscape material.

7. Plan is schematic. Planting may be adjusted to fit site conditions with prior Agency approval.

8. Lay out plant material in groups as indicated in plant and material schedule, details and plan sheets.

9. Stake all planting areas for review and approval by Area Regional Landscape Architect or Engineer prior to planting.

10. Do not install plant material without prior inspection and approval by Area Regional Landscape Architect.

11. Comply with Oregon Standard Specifications for Construction and Special Provisions for construction applicable to this project.

12. Thoroughly water all plant material (saturated backfill) within 24-hours of installation regardless of rainfall events.

13. Verify field conditions prior to construction with any adjustments to the plans made as directed by the Engineer.

14. Protect all trees and land areas marked for protection. Do not damage natural (non-invasive) vegetation.

15. Comply with erosion control measures per Section 00280 and all applicable permits during construction.

16. Where discrepancies between the Plant Schedule and the plans exist, plans shall prevail.

17. See Special Provision 01030.13(f) for seed mixes

18. Prepare all planting and seeding areas per Method B, see 01040.48(b).

19. Include Mycorrhizal innoculates for all seeding and individual plant installations, apply per manufacturer's recommendation.

20. Flag all planted tree species with color-coded identifyer flags.

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OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke Reviewer: Ben Ngan
Drafter: David Goodyke Checker: Ben Ngan

ROADSIDE DEVELOPMENT GENERAL NOTES

SHEET NO. FA01

FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 0° Scale: NA

ROADSIDE DEVELOPMENT PLANT SCHEDULE

Plant and Material Schedule

Trees

Key	Botanical Name	Common Name	Size	Spacing	Root Type	Percent Mix	Plant Condition	FA08	FA09	FA10	FA11	FA12	FA13	FA14	FA15	FA16	TOTAL
TARME	*Arbutus menziesii*	Madrone	1/2" Calip.	As Shown	Container	N/A	Single trunk	-	-	-	-	-	-	-	1	-	1
TCADE	*Calocedrus decurrens*	Incense Cedar	4' Height	As Shown	Container or B&B	N/A	Single trunk	-	-	-	-	12	-	-	6	8	26
TCONU	*Cornus nuttallii*	Pacific Dogwood	1" Calip.	As Shown	Container	N/A	Single trunk	-	-	-	-	-	-	-	7	-	7
TPIPO	*Pinus ponderosa 'Willamette Valley'*	Willamette Ponderosa Pine	4' Height	As Shown	Container or B&B	N/A	Single trunk	-	-	-	-	28	3	-	29	23	89
TPSME	*Pseudotsuga menziesii*	Douglas Fir	4' Height	As Shown	Container or B&B	N/A	Single trunk	-	-	-	-	-	-	-	34	-	34
TQUCH	*Quercus chrysolepis*	Canyon Live Oak	1" Calip.	As Shown	Container or B&B	N/A	Single trunk	-	-	-	-	46	-	-	-	15	61
TQUGA	*Quercus garryana*	Oregon White Oak	1" Calip.	As Shown	Container or B&B	N/A	Single trunk	-	-	-	-	54	5	-	23	12	97
TULAM	*Ulmus americana 'Valley Forge'*	Valley Forge American Elm	1" Calip.	As Shown	Container or B&B	N/A	Single trunk	-	-	-	-	-	4	-	-	-	4
TUMCA	*Umbellularia californica*	Oregon Myrtle	1" Calip.	As Shown	Container or B&B	N/A	Single trunk	-	-	-	-	30	-	-	-	-	30

Broadleaf Evergreen Shrubs
Deciduous Shrubs

Key	Botanical Name	Common Name	Size	Spacing	Root Type	Percent Mix	Plant Condition	FA08	FA09	FA10	FA11	FA12	FA13	FA14	FA15	FA16	TOTAL
ARCO	*Arctostaphylos columbiana x 'Patula'*	Manzanita	12" Height	5' O.C.	#1 Container	N/A	N/A	-	-	-	-	214	-	-	-	-	214
COSE	*Cornus sericea*	Red Osier Dogwood	12" Height	5' O.C.	#1 Container	N/A	N/A	-	-	-	-	1,005	-	-	-	-	1,005
FRCA	*Frangula californica 'Eve Case'*	Eve Case Coffeeberry	12" Height	10' O.C.	#1 Container	N/A	N/A	-	-	-	-	51	-	-	-	-	51
GAEL	*Garrya elliptica 'James Roof'*	Wavyleaf Silktassel	12" Height	10' O.C.	#1 Container	N/A	N/A	-	-	-	-	61	-	-	-	-	61
MAAQ	*Mahonia aquifolium*	Tall Oregon Grape	12" Height	5' O.C.	#1 Container	N/A	N/A	-	-	-	-	397	-	-	-	-	397
MOCA	*Morella californica*	Pacific Wax Myrtle	12" Height	10' O.C.	#1 Container	N/A	N/A	-	-	-	-	57	-	-	-	-	57

Ornamental Grasses and Forbs

Key	Botanical Name	Common Name	Size	Spacing	Root Type	Percent Mix	Plant Condition	FA08	FA09	FA10	FA11	FA12	TOTAL
-	*Asclepias speciosa*	Showy milkweed	12" Height	2' O.C.	#1 Container	10%	N/A	-	-	-	-	1,248	1,248
-	*Calamagrostis x acutiflora 'Karl Foerster'*	Feather reed grass	12" Height	2' O.C.	#1 Container	15%	N/A	-	-	-	-	1,873	1,873
-	*Carex glauca*	Blue Sedge	12" Height	1' O.C.	#1 Container	15%	N/A	-	-	-	-	1,873	1,873
-	*Deschampsia cespitosa 'Goldtau'*	Tufted hairgrass	12" Height	3' O.C.	#1 Container	15%	N/A	-	-	-	-	1,873	1,873
-	*Juncus patens 'Carmen's Grey'*	Carman's Grey Blue Rush	12" Height	2' O.C.	#1 Container	10%	N/A	-	-	-	-	1,248	1,248
-	*Solidago 'Goldkind'*	Golden Baby goldenrod	12" Height	1' O.C.	#1 Container	10%	N/A	-	-	-	-	1,248	1,248
-	*Stipa gigantea*	Giant feather grass	12" Height	3' O.C.	#1 Container	15%	N/A	-	-	-	-	1,873	1,873
-	*Veratrum californicum*	California false hellebore	12" Height	2' O.C.	#1 Container	10%	N/A	-	-	-	-	1,248	1,248

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HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke Reviewer: Ben Ngan
Drafter: David Goodyke Checker: Ben Ngan

ROADSIDE DEVELOPMENT GENERAL NOTES

SHEET NO. FA02

FINAL ELECTRONIC DOCUMENT
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ROADSIDE DEVELOPMENT PLANT SCHEDULE

Upland Riparian Restoration Mix

	Key	Botanical Name	Common Name	Size	Spacing	Root Type	Percent Mix	Plant Condition	FA13	FA14	FA15	TOTAL
MIX A: Trees		*Acer macrophyllum*	Bigleaf Maple	1/2" Calip.	30' Min.	Bareroot	8%	N/A	-	-	36	36
		Arbutus menziesii	Pacific Madrone	1/2" Calip.	15'-20' Min.	Container	15%	N/A	-	-	67	67
		Calocedrus decurrens	Incense Cedar	18" Height	30' Min.	Bareroot	8%	N/A	-	-	36	36
		Corylus cornuta var. californica	Western Hazelnut	1/2" Calip.	15'-20' Min.	Bareroot	15%	N/A	-	-	67	67
		Cornus nuttallii	Western Dogwood	1/2" Calip.	15'-20' Min.	Bareroot	5%	N/A	-	-	22	22
		Quercus garryana	Oregon White Oak	1/2" Calip.	15'-20' Min.	Bareroot	26%	N/A	-	-	116	116
		Pseudotsuga menziesii	Douglas Fir	18" Height	30' Min.	Bareroot	8%	N/A	-	-	36	36
		Rhamnus purshiana	Cascara	1/2" Calip.	15'-20' Min.	Bareroot	15%	N/A	-	-	67	67
MIX A & B: Shrubs		*Mahonia aquifolium*	Tall Oregon Grape	12" Height	5' Min.	Bareroot	25%	N/A	-	-	370	370
		Oemleria cerasiformis	Osoberry	12" Height	5' Min.	Bareroot	10%	N/A	-	-	148	148
		Rubus parviflorus	Thimbleberry	12" Height	5' Min.	Bareroot	15%	N/A	-	-	222	222
		Sambucus racemosa	Red Elderberry	12" Height	5' Min.	Bareroot	10%	N/A	-	-	148	148
		Spiraea douglasii	Western Spirea	12" Height	5' Min.	Bareroot	15%	N/A	-	-	222	222
		Symphoricarpos albus	Snowberry	12" Height	5' Min.	Bareroot	25%	N/A	-	-	370	370

Lowland Riparian Restoration Mix

	Key	Botanical Name	Common Name	Size	Spacing	Root Type	Percent Mix	Plant Condition	FA13	FA14	FA15	TOTAL
MIX C: Trees		*Abies grandis*	Grand Fir	18" Height	30' Min.	Bareroot	10%	N/A	8	21	-	29
		Acer macrophyllum	Bigleaf Maple	1/2" Calip.	30' Min.	Bareroot	10%	N/A	8	21	-	29
		Alnus rubra	Red Alder	1/2" Calip.	15'-20' Min.	Bareroot	26%	N/A	22	54	-	76
		Fraxinus latifolia	Oregon Ash	1/2" Calip.	30' Min.	Bareroot	6%	N/A	5	13	-	18
		Prunus emarginata	Bitter Cherry	1/2" Calip.	15'-20' Min.	Bareroot	15%	N/A	13	31	-	44
		Rhamnus purshiana	Cascara	1/2" Calip.	15'-20' Min.	Bareroot	10%	N/A	8	21	-	29
		Salix lucida	Shining Willow	1/2" Calip.	15'-20' Min.	Bareroot	15%	N/A	13	31	-	44
		Thuja plicata	Western Redcedar	18" Height	30' Min.	Bareroot	8%	N/A	7	17	-	24
MIX C & D: Shrubs		*Cornus sericea*	Redtwig Dogwood	12" Height	5' Min.	Bareroot	25%	N/A	46	115	-	161
		Oemleria cerasiformis	Osoberry	12" Height	5' Min.	Bareroot	10%	N/A	18	46	-	64
		Rubus parviflorus	Thimbleberry	12" Height	5' Min.	Bareroot	15%	N/A	28	69	-	97
		Sambucus racemosa	Red Elderberry	12" Height	5' Min.	Bareroot	10%	N/A	18	46	-	64
		Spiraea douglasii	Western Spirea	12" Height	5' Min.	Bareroot	15%	N/A	28	69	-	97
		Symphoricarpos albus	Snowberry	12" Height	5' Min.	Bareroot	25%	N/A	46	115	-	161

Roadside Riparian Restoration Mix

	Key	Botanical Name	Common Name	Size	Spacing	Root Type	Percent Mix	Plant Condition	FA13	FA14	FA15	TOTAL
MIX E: Trees & Shrubs		*Pinus ponderosa var. willamettensis*	Willamette Ponderosa Pine	3'-4' Height	25'	#5 Container	50%	N/A	12	-	8	20
		Quercus garryana	Oregon White Oak	1/2" caliper	25'	Bareroot	40%	N/A	9	-	7	16
		Arbutus menziesii	Pacific Madrone	1'-2' Height	25'	#1 Container	10%	N/A	2	-	2	4
		Ceanothus velutinus	Snowbrush	12" Height	5' Min.	#1 Container	10%	N/A	7	-	9	16
		Mahonia aquifolium	Tall Oregon Grape	12" Height	5' Min.	#1 Container	60%	N/A	14	-	55	69
		Ribes sanguineum	Redflowering Currant	12" Height	5' Min.	#1 Container	15%	N/A	3	-	14	17
		Symphoricarpos albus	Snowberry	12" Height	5' Min.	#1 Container	15%	N/A	3	-	14	17

SHRUB PLANTING NOTES FOR MIXES A.B.C.D. and E

1. Install shrubs at a density of 108 shrubs per 10,000 s.f.

2. Install shrubs 5' O.C. in groups of three to nine plants per species. Space shrub groups no closer than 15' apart and no closer than 5' to an adjacent tree stem.

3. Spread species throughout the planting area to avoid a monoculture; a random 10,000 s.f. sample shall contain all species.

4. Maintain a 1' diameter plant-free area around each stem and mulch with shredded wood to prevent weeds.

Seed Mix* **See Special Provisions 01030.13(f) for Seed Mix** **Area (square feet)**

Key		FA08	FA09	FA10	FA11	FA12	FA13	FA14	FA15	FA16	TOTAL
	Permanent Seeding	2,066	-	-	1,273	175,749	-	-	-	129,854	309,940
	Water Quality Seeding	787	-	-	1,294	4,934	411	-	8,634	14,616	30,676
Varies	Riparian Seeding	-	-	-	-	-	23,824	42,555	-	-	66,379
	Wildflower Seeding	-	-	-	-	-	21,941	-	144,117	6,082	172,140
Varies	Native Shade Seeding	-	-	-	-	-	-	-	80,985	-	80,985
	Wetland Seeding	-	-	-	-	-	-	-	410	-	410
	Upland Shrub Seeding	-	-	-	-	-	7,672	-	46,091	-	53,763

*** Verify compost erosion blanket is installed prior to applying seed**

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OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

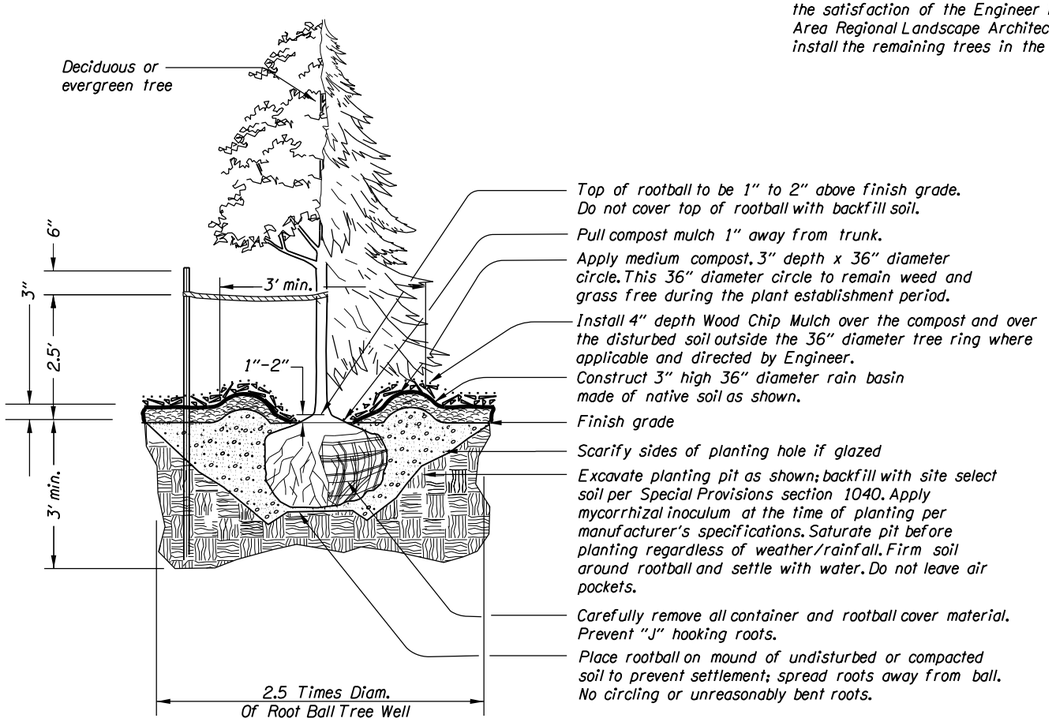
Designer: David Goodyke Reviewer: Ben Ngan
Drafter: David Goodyke Checker: Ben Ngan

ROADSIDE DEVELOPMENT GENERAL NOTES

SHEET NO. FA03

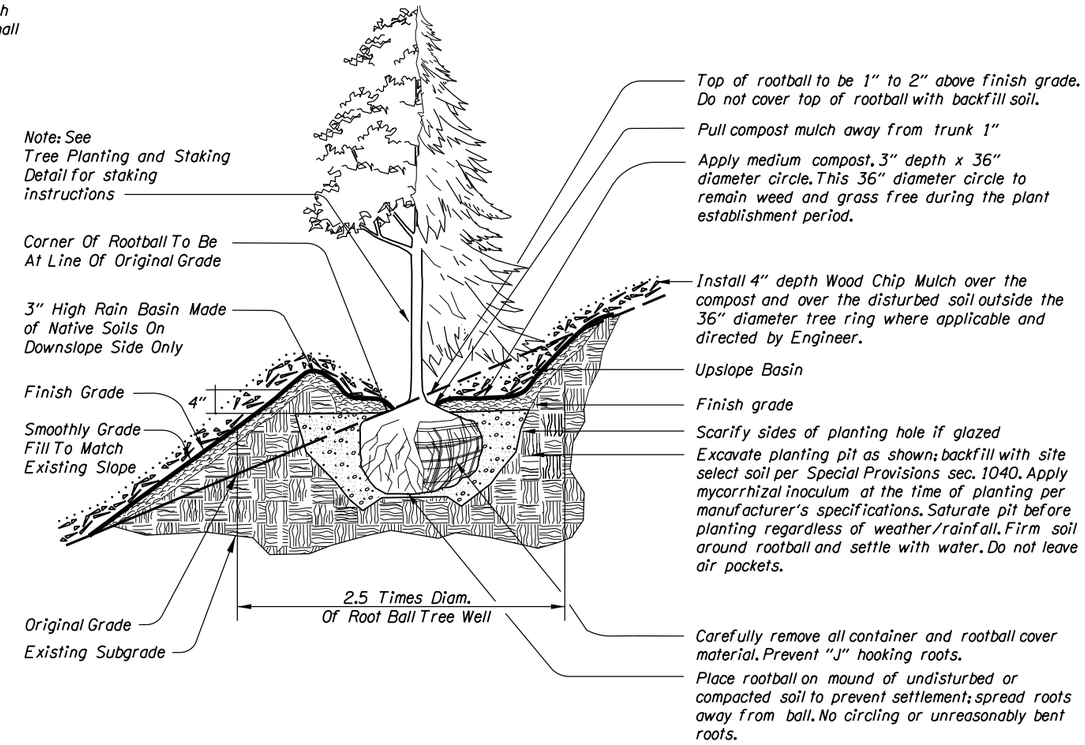
NOTE:

After tree location staking is complete and prior to planting any trees, Contractor shall construct two typical tree planting and staking installations per details and specifications, with Engineer and Area Regional Landscape Architect present. When the installations are complete to the satisfaction of the Engineer in coordination with Area Regional Landscape Architect, the Contractor shall install the remaining trees in the same manner.



TREE PLANTING and STAKING
On Terrain Less Than 5:1

Not To Scale



TREE PLANTING and STAKING on SLOPES
On slopes 5:1 or greater

Not To Scale

TREE STAKING NOTES:

1) Tree ties to be either:

Rigid guy system. Galvanized wire to be approximately 1/8" thickness and 24" length with a plastic sleeve over the portion that goes around tree. The wire tie is to go through the wood stake and be securely fastened.

Plastic chain type, approximately 1" width by 1/8" thickness where two stakes are required. Cross ties between stakes and wrap tie around tree. Fasten securely to stake.

2) Furnish tree stakes on all tree plantings.

Stakes to be construction grade, rough sawn or finished Douglas Fir or Pine. Stain with approved green penetrating oil. Stake Size is to be 1½"x1½" by following lengths:

Trees 36" and shorter - Use one - 6' (approximate) stake
Trees taller than 36" - Use one - 8' (approximate) stake

Drive stakes vertically and at least 24" into undisturbed soil. Do not drive stakes through root ball. Locate stakes to best resist prevailing winds.

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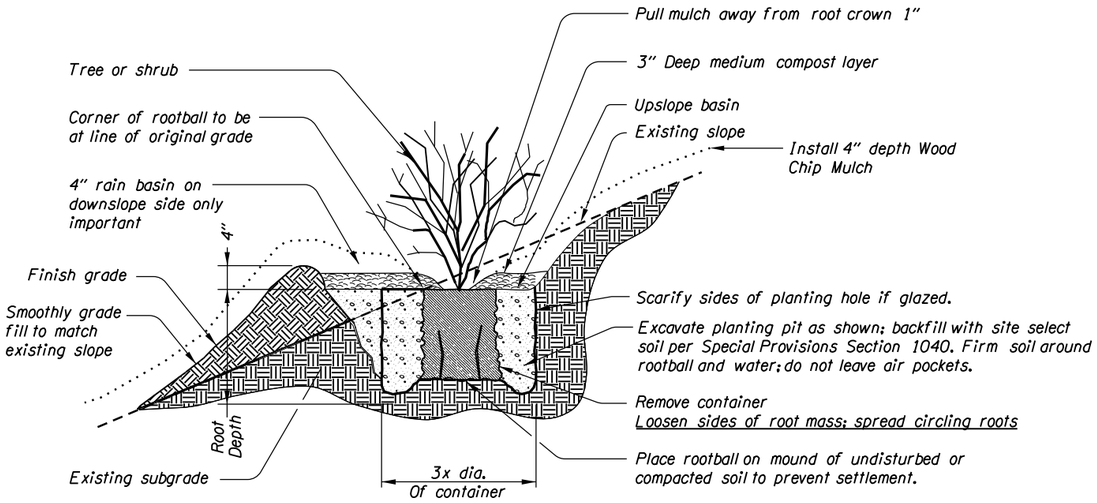
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

ROADSIDE DEVELOPMENT GENERAL NOTES

SHEET NO. FA04

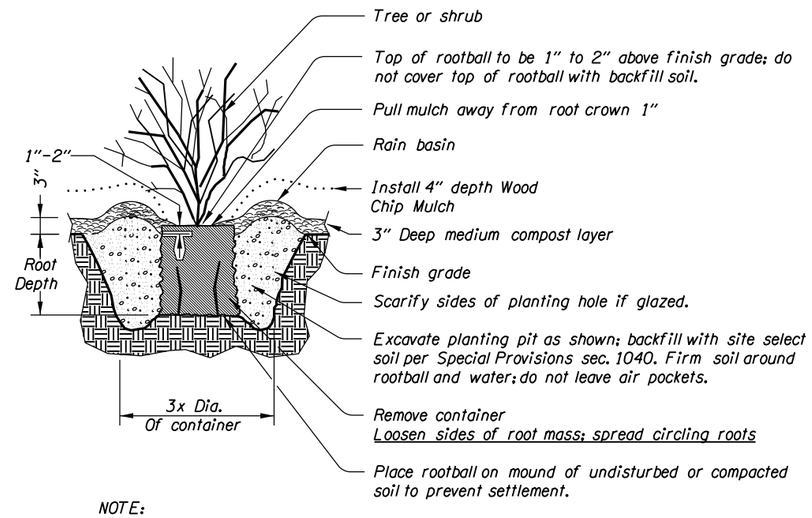


NOTE:
1) 3" Medium Compost layer to be uniform and completely cover planting holes.

2) Apply Mychorrhizae per specifications.

SLOPE PLANTING FOR #1 & #2 CONTAINERS

Not To Scale



NOTE:
1) 3" Medium Compost layer to be uniform and completely cover planting holes.

2)Apply Mycorrhizae per specifications.

GENERAL PLANTING FOR #1 & #2 CONTAINERS

Not To Scale

GENERAL NOTE:
1) All dimensions shown on details are minimum dimensions.

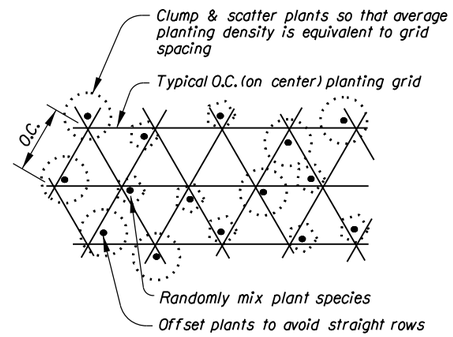
2) See "American Standard for Nursery Stock" for plant quality minimum standards such as size of root ball or caliper of trunk.

3) See plant list or special provisions and identify plant material that may need to be or contract-grown.

4) Important: Excavate all plant wells per detail at 3x diameter of rootball or container & backfill with site select topsoil free of noxious weeds plant material including roots & sprigs.

5) After shrub location staking is complete and prior to planting any shrubs. Contractor shall construct a typical shrub planting per detail and specifications with Engineer and Area Regional Landscape Architect present. When the installation is complete to the satisfaction of the Engineer in coordination with Area Regional Landscape Architect, the Contractor shall install the remaining shrubs in the same manner.

6) Apply Mycorrhizae per specifications.



RANDOM PLANTING PATTERN

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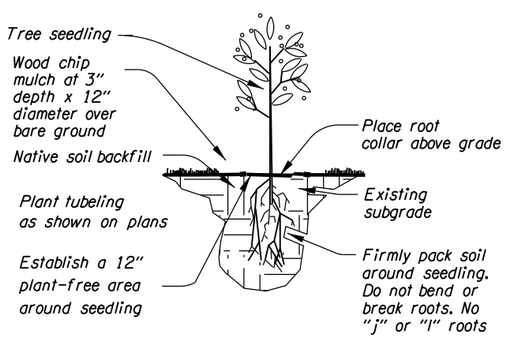
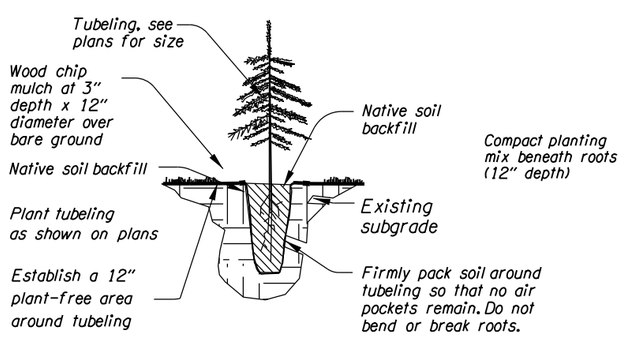


SEEDLING PLANTING

Not To Scale



TUBELING PLANTING

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OREGON DEPARTMENT OF TRANSPORTATION

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

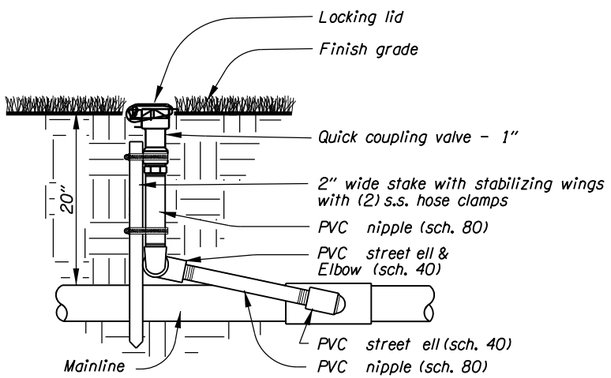
Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

ROADSIDE DEVELOPMENT GENERAL NOTES

SHEET NO. FA05

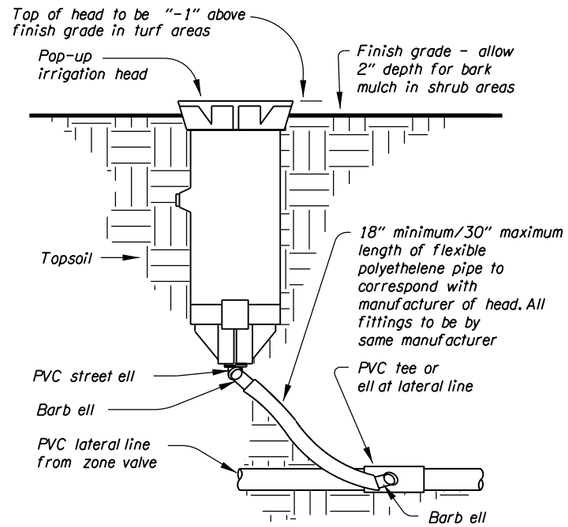
FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 0° Scale: NA



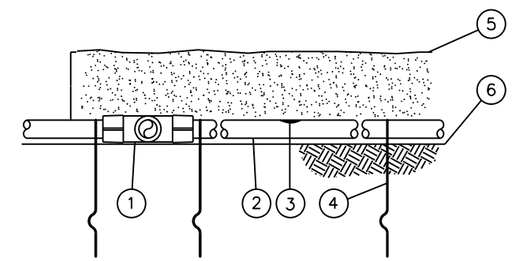
QUICK COUPLING VALVE

Not To Scale



SPRINKLER HEAD AND JOINTS

Not To Scale



1. Compression Fitting
2. On-Surface Dripline
3. Inline Drip Emitter Outlet
4. Tie-Down Stake
5. Mulch
6. Finish Grade

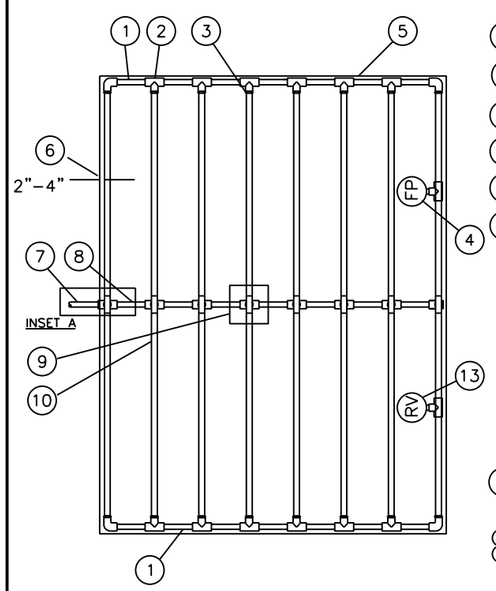
DRIPLINE AT GRADE

Not To Scale

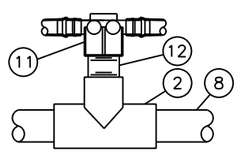
NOTES:

1) Place tie-down stakes every 3' in sand, 4' in loam, and 5' in clay.

2) At fittings where there is a change of direction, such as tees or elbows, use tie-down stakes on each leg of the change of direction.



1. PVC exhaust header
2. PVC SCH 40 TEE or EL (Typical)
3. Barb x Male Fitting
4. Flush Point (Typical)
5. Perimeter of Area
6. Perimeter Dripline to Pipe to be installed 2"-4" from Perimeter of Area
7. PVC Supply Pipe from Existing Valve
8. PVC Supply Manifold
9. Connection from Supply Manifold to Dripline (Typical) - see Inset A
10. On-Surface Dripline:
11. Barb x Female Fitting
12. ¾" PVC Nipple, length as necessary
13. At ends of area, add air relief valve



INSET A

NOTE:

1) Provide Low Volume (Drip) Tubing with emitters spaced at 18" and providing a flow rate of 0.9 gallons/hour and spaced at 24", or approved equal.

2) Modify detail to meet the specific requirements of the selected equipment brand's manufacturer and the specific shape and size of the plant bed to be irrigated.

LOW VOLUME (DRIP) TUBING

Not To Scale

NOTE:
Irrigation details are placeholders for 60%

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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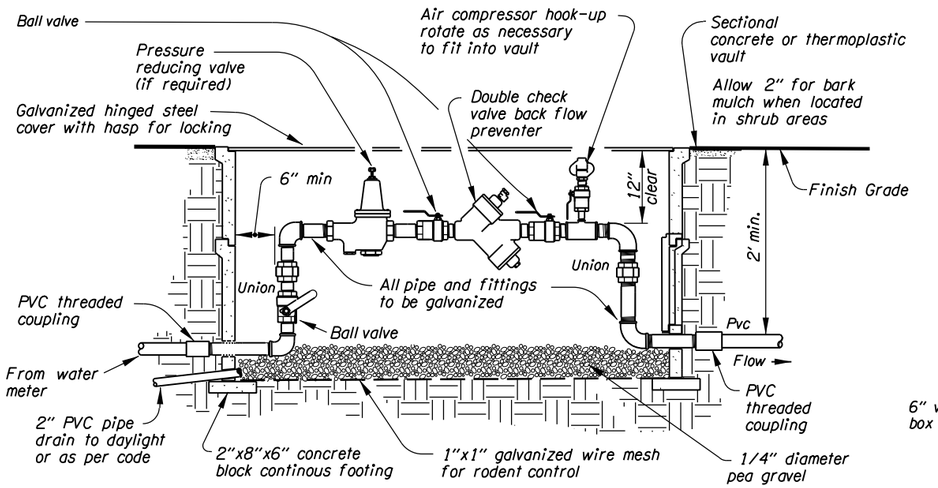
ROADSIDE DEVELOPMENT GENERAL NOTES

SHEET NO. FA06

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 0° Scale: NA



BACKFLOW PREVENTION ASSEMBLY

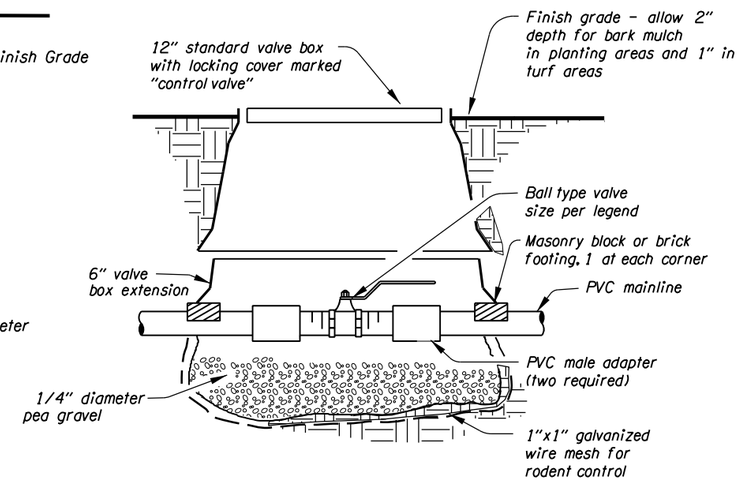
Not To Scale

NOTES:
1) Install backflow prevention assembly in accordance with "accepted procedure and practice in cross connection control manual"

2) Comply with local jurisdiction requirements. These may vary from those shown on drawings. verify compliance.

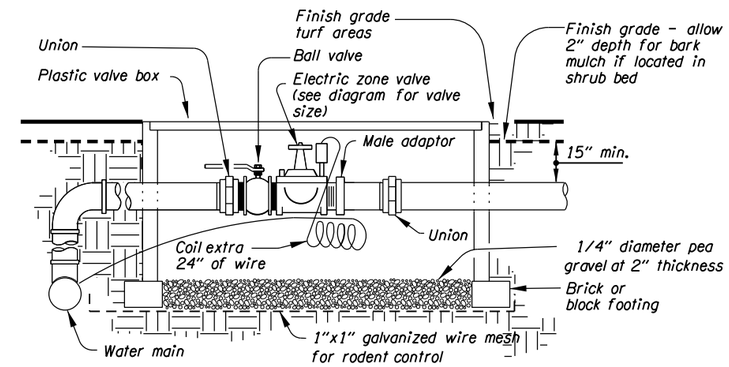
3) Provide 6" access clearance for devices 2" and smaller.

4) Size of double check valve shown on plans or specifications.



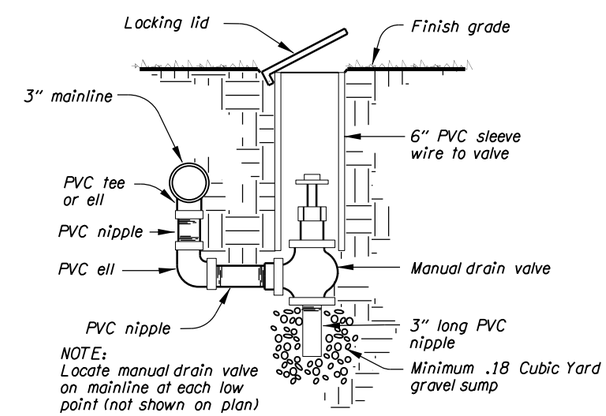
ISOLATION VALVE & BOX

Not To Scale



ELECTRIC ZONE VALVE

Not To Scale



NOTE:
Locate manual drain valve on mainline at each low point (not shown on plan)

MANUAL DRAIN VALVE

Not To Scale

NOTE:
Irrigation details are placeholders for 60%

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ROADSIDE DEVELOPMENT GENERAL NOTES

SHEET NO.
FA07

FINAL ELECTRONIC DOCUMENT
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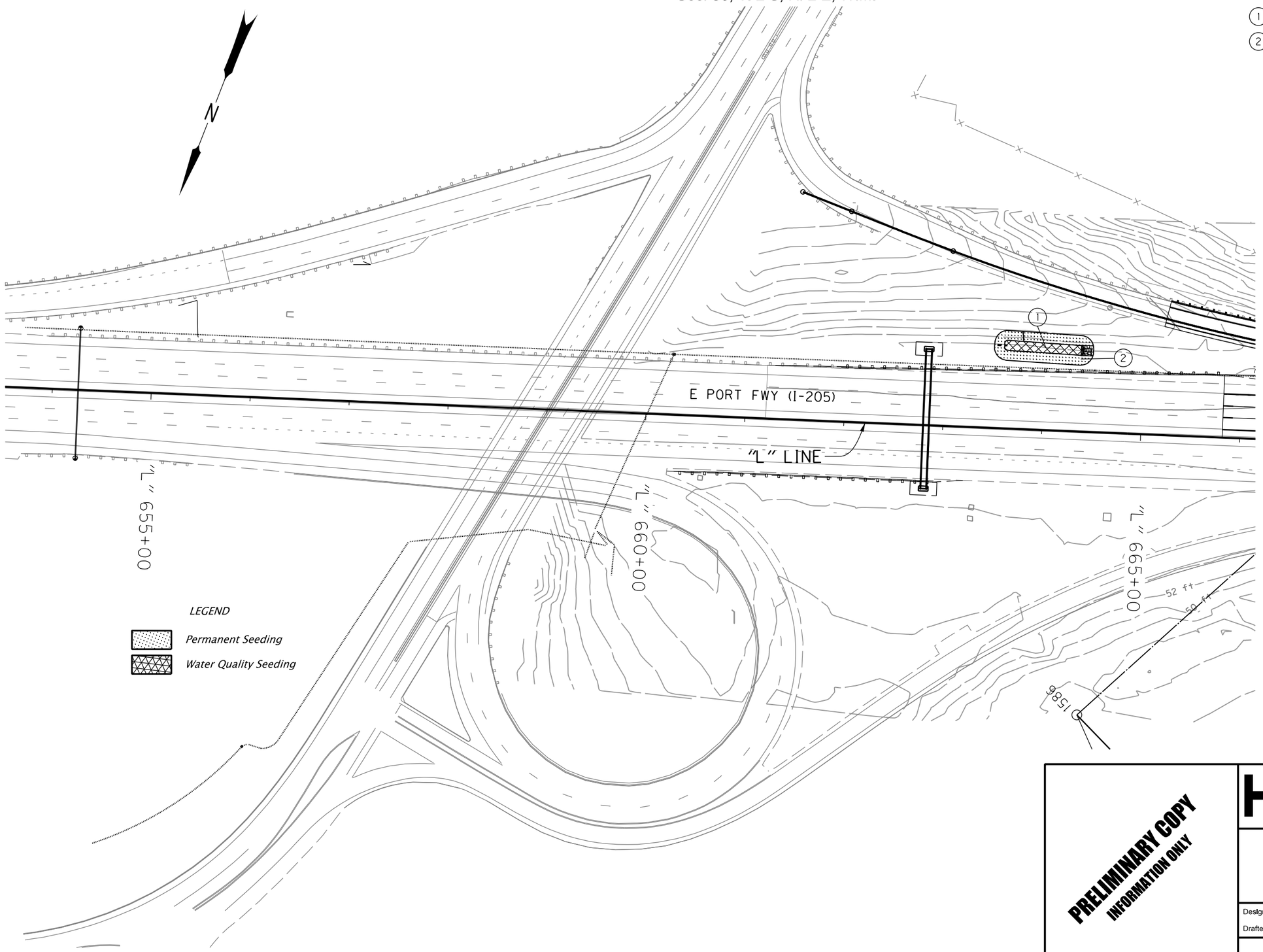
Rotation: 0° Scale: NA

Sec. 30, T. 2 S, R. 2 E, W.M.

1 *Install 787 s.f. Water Quality Seeding*

2 *Install 2,066 s.f. Permanent Seeding*



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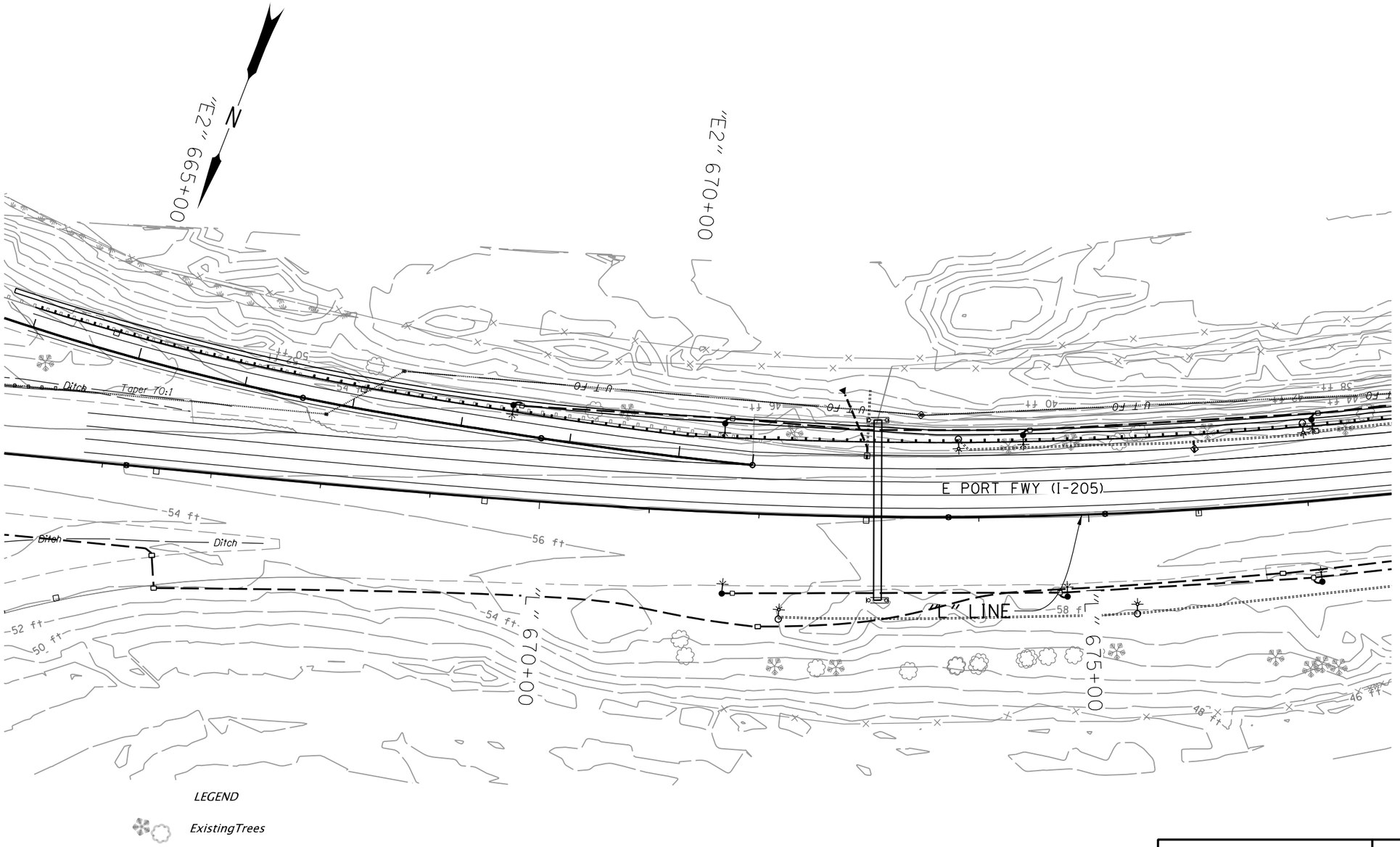
ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

SHEET NO. FA08

Sec. 30, T. 2 S, R. 2 E, W.M.

??V-???



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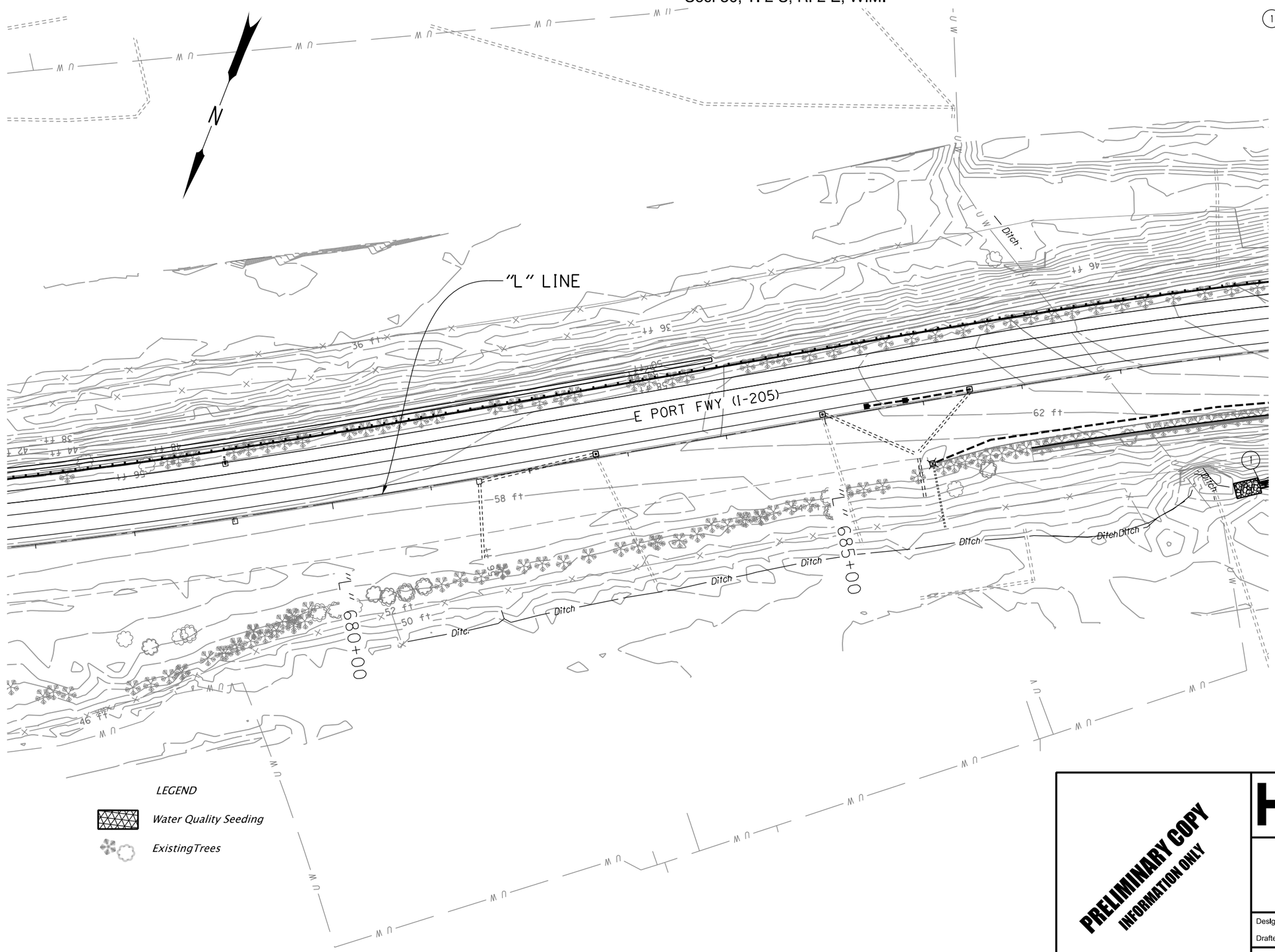
ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

SHEET NO. FA09

Sec. 30, T. 2 S, R. 2 E, W.M.

1 *Total quantity for area on FA10 and FA11, shown on FA11, note 1*



LEGEND

Water Quality Seeding

ExistingTrees

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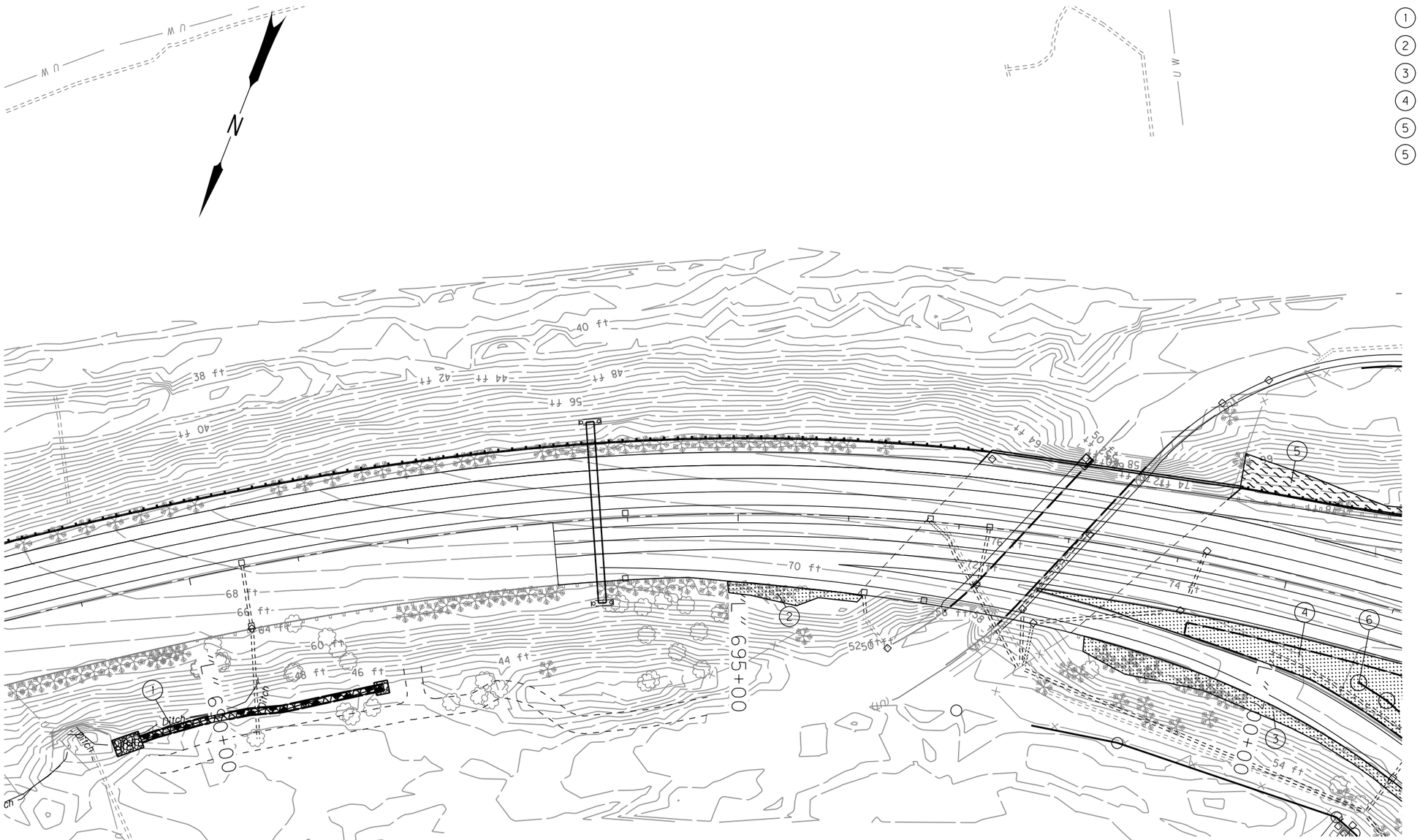
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

SHEET NO. FA10

1. Install 1,294 s.f. Water Quality Seeding
2. Install 1,273 s.f. Permanent Seeding
3. Total area on FA11and FA12, shown on FA12, note 1
4. Total area on FA11 and FA12, shown on FA12, note 2
5. Total area on FA11 and FA12, shown on FA12, note 33
5. Total area on FA11 and FA12, shown on FA12, note 36



LEGEND

- Permanent Seeding
- Water Quality Seeding
- Proposed Trees
- ExistingTrees

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INFORMATION ONLY

HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

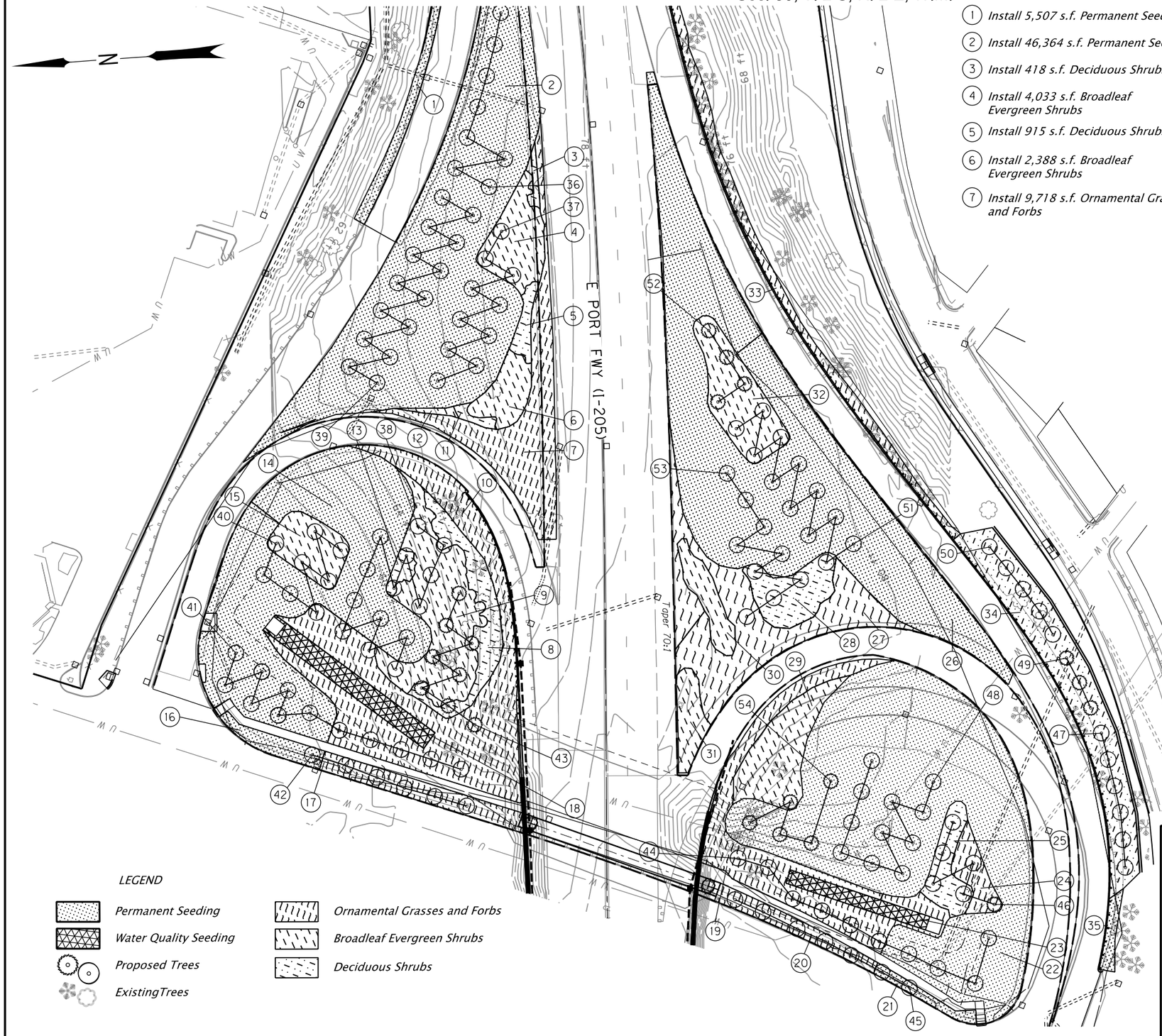
SHEET NO. FA11

FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 222.7112° Scale: 1"=100'

Sec. 30, T. 2 S, R. 2 E, W.M.

??V-???



1. Install 5,507 s.f. Permanent Seeding
2. Install 46,364 s.f. Permanent Seeding
3. Install 418 s.f. Deciduous Shrubs
4. Install 4,033 s.f. Broadleaf Evergreen Shrubs
5. Install 915 s.f. Deciduous Shrubs
6. Install 2,388 s.f. Broadleaf Evergreen Shrubs
7. Install 9,718 s.f. Ornamental Grasses and Forbs
8. Install 4,239 s.f. Deciduous Shrubs
9. Install 9,712 s,f, Broadleaf Evergreen Shrubs
10. Install 20,139 s.f. Ornamental Grasses and Shrubs
11. Install 375 s.f. Deciduous Shrubs
12. Install 260 s.f. Broadleaf Evergreen Shrubs
13. Install 648 s.f. Deciduous Shrubs
14. Install 30,343 s.f. Permanent Seeding
15. Install 3,362 s.f. Broadleaf Evergreen Shrubs
16. Install 1,603 s.f. Permanent Seeding
17. Install 3,471 s.f. Ornamental Grasses and Forbs
18. Install 3,153 s.f. Water Quality Seeding
19. Install 10,277 s.f. Ornamental Grasses and Forbs
20. Install 2,319 s.f. Ornamental Grasses and Forbs
21. Install 989 s.f. Permanent Seeding
22. Install 46,511 s.f. Permanent Seeding
23. Install 1,781 s.f. Water Quality Seeding
24. Install 1,923 s.f. Ornamental Grasses and Forbs
25. Install 2,523 s.f. Broadleaf Evergreen Shrubs
26. Install 43,636 s.f. Permanent Seeding
27. Install 12,295 s.f. Ornamental Grasses and Forbs
28. Install 3,629 s.f. Deciduous Shrubs
29. Install 5,407 s.f. Broadleaf Evergreen Shrubs
30. Install 2,113 s.f. Broadleaf Evergreen Shrubs
31. Install 1,994 s.f. Broadleaf Evergreen Shrubs
32. Install 5,574 s.f. Broadleaf Evergreen Shrubs
33. Install 7,431 s.f. Ornamental Grasses and Shrubs
34. Install 11,524 s.f. Deciduous Shrubs
35. Install 796 s.f. Permanent Seeding
36. Install 8 TPIPO
37. Install 10 TQUGA
38. Install 14 TUMCA
39. Install 14 TQUCH
40. Install 8 TQUCH
41. Install 12 TQUGA
42. Install 6 TQUGA
43. Install 8 TPIPO
44. Install 10 TQUGA
45. Install 7 TQUGA
46. Install 6 TQUCH
47. Install 6 TQUCH
48. Install 11 TUMCA
49. Install 3 TPIPO
50. Install 5 TUMCA
51. Install 12 TQUCH
52. Install 4 TPIPO
53. Install 9 TQUGA
54. Install 5 TPIPO

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HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke
Reviewer: Ben Ngan
Drafter: David Goodyke
Checker: Ben Ngan

ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

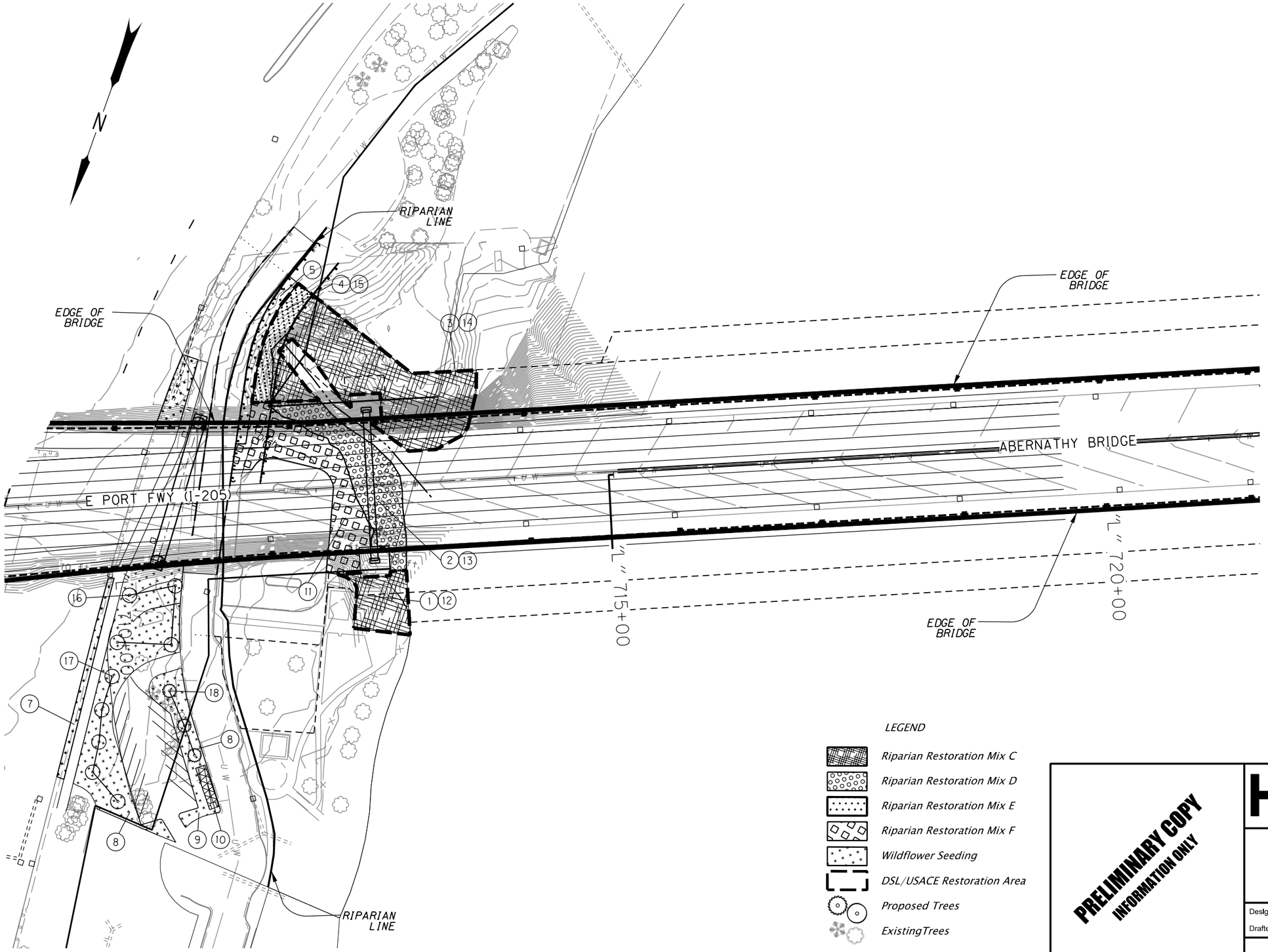
SHEET NO. FA12

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 201.4396° Scale: 1"=100'

Sec. 30, T. 2 S, R. 2 E, W.M.

??V-???



1. Install 3,144 s.f. Riparian Seeding
2. Install 6,769 s.f. Riparian Seeding
3. Install 13,911 s.f. Riparian Seeding
4. Install 2,132 s.f. Wildflower Seeding
5. Install 1,796 s.f. Wildflower Seeding
6. Install 1,468 s.f. Wildflower Seeding
7. Install 1,414 s.f. Wildflower Seeding
8. Install 11,899 s.f. Wildflower Seeding
9. Install 3,232 s.f. Wildflower Seeding
10. Install 411 s.f. Water Quality Seeding
11. Install 7,672 Riparian Restoration Mix F
12. Install 3,144 s.f. Riparian Restoration Mix C
13. Install 6,769 s.f. Riparian Restoration Mix D
14. Install 13,911 s.f. Riparian Restoration Mix C
15. Install 2,132 s.f. Riparian Restoration Mix E
16. Install 4 TULMA
17. Install 5 TQUGA
18. Install 3 TPIPO

LEGEND

- Riparian Restoration Mix C
- Riparian Restoration Mix D
- Riparian Restoration Mix E
- Riparian Restoration Mix F
- Wildflower Seeding
- DSL/USACE Restoration Area
- Proposed Trees
- ExistingTrees

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HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

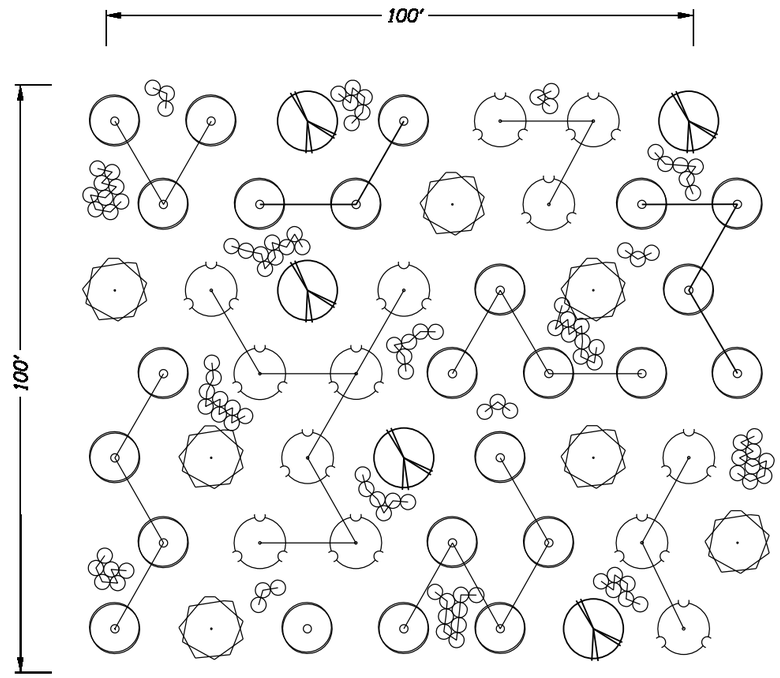
Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

SHEET NO. FA13

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 275.7836° Scale: 1"=100'



Riparian Restoration Mix C: Lowland Trees and Shrubs

Key	Tree	Approximate Planting Density	Planting Percentage
	Large, Slow-Growing Trees		
	Abies grandis	5 stems / 10,000 s.f.	10%
	Acer macrophyllum	4 stems / 10,000 s.f.	10%
	Thuja plicata	4 stems / 10,000 s.f.	8%
	Small Trees		
	Fraxinus latifolia	3 stems / 10,000 s.f.	6%
	Prunus emarginata	7 stems / 10,000 s.f.	15%
	Salix lucida ssp. lasiandra	7 stems / 10,000 s.f.	15%
	Rhamnus purshiana	6 stems / 10,000 s.f.	10%
	Fast-Growing Trees (13)*		
	Alnus rubra	13 stems / 10,000 s.f.	26%

Riparian Restoration Mix C and D: Lowland Shrubs

Key	Shrubs*	Approximate Planting Density	Planting Percentage
	Cornus sericea	27 stems / 10,000 s.f.	25%
	Physocarpus capitatus	11 stems / 10,000 s.f.	10%
	Rubus spectabilis	16 stems / 10,000 s.f.	15%
	Sambucus racemosa	11 stems / 10,000 s.f.	10%
	Spirea douglasii	16 stems / 10,000 s.f.	15%
	Symphoricarpos albus	18 stems / 10,000 s.f.	25%

* Groupings required

NOTE:
Total quantity of plants per species per area shown on FA03.

LEGEND

Large, Slow-Growing Trees
- *Acer macrophyllum (TACMA), 10%*
- *Abies grandis (TABGR), 10%*
- *Thuja plicata (TTHPL), 8%*

Small Trees
- *Fraxinus latifolia (TFRLA), 6%*
- *Prunus emarginata (TPREM), 15%*
- *Salix lucida ssp. Lasiandra(TSALU), 15%*
- *Rhamnus purshiana (TRHPU), 10%*

Fast-Growing Trees
- *Alnus rubra (TALRU), 26%*

Shrubs
- *Assorted Species*

DETAIL: LOWLAND TREES AND PLANTING MIX C AND D

Not To Scale

TREE PLANTING NOTES

1) Install trees at an overall density of 49 trees/10,000 s.f.

2) Install trees at an average of 15' O.C. with triangular spacing, 49 trees/10,000 s.f. Large, Slow-Growing Trees must be planted at minimum 30' O.C. from one another. Fast-Growing and Small Trees shall be installed at a 10 - 20' O.C. average spacing from others.

3) Install Fast-Growing Trees in groups of 2 - 7

4) Install Small Trees in groups of 2 - 5

5) Install shrubs 5' O.C. in groups of three to nine plants per species. Space shrub groups no closer than 15' apart and no closer than 5' to adjacent tree stems.

6) Spread species throughtout the given planting area to avoid monocultures, a random 10,000 s.f. sample should contain all species.

7) Maintain a 1' diameter plant-free area around all stems and mulch with shredded wood to prevent weeds.

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HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke | Reviewer: Name
Drafter: David Goodyke | Checker: Name

ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

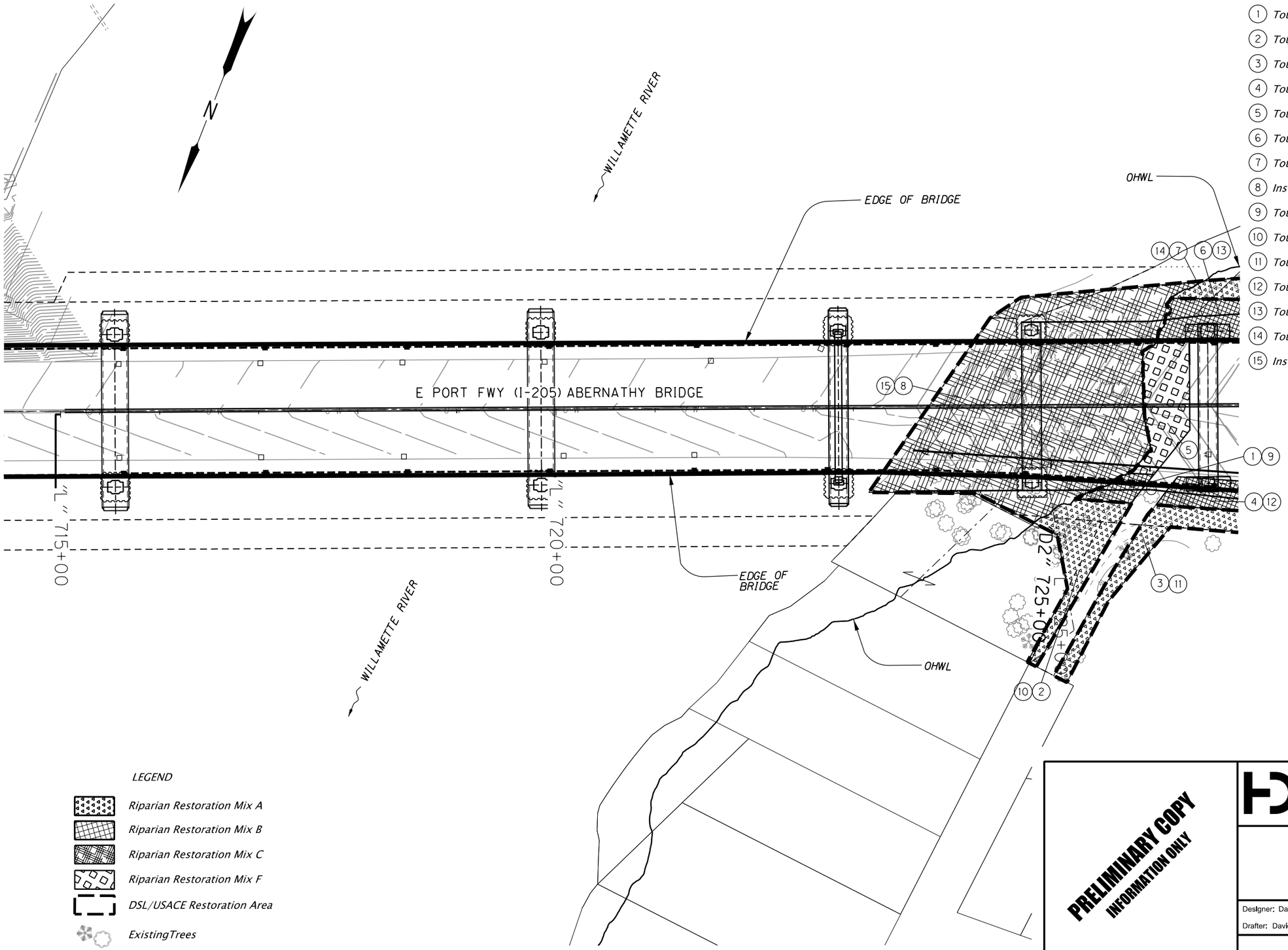
SHEET NO. FA13A

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 275.7836° Scale: 1"=100'

Sec. 30, T. 2 S, R. 2 E, W.M.

??V-???



1. Total area on FA14 and FA15, shown on FA15, note 21
2. Total area on FA14 and FA15, shown on FA15, note 1
3. Total area on FA14 and FA15, shown on FA15, note 2
4. Total area on FA14 and FA15, shown on FA15, note 3
5. Total area on FA14 and FA15, shown on FA15, note 18
6. Total area on FA14 and FA15, shown on FA15, note 17
7. Total area on FA14 and FA15, shown on FA15, note 16
8. Install 42,555 s.f. Riparian Seeding
9. Total area on FA14 and FA15, shown on FA15, note 22
10. Total area on FA14 and FA15, shown on FA15, note 20
11. Total area on FA14 and FA15, shown on FA15, note 23
12. Total area on FA14 and FA15, shown on FA15, note 24
13. Total area on FA14 and FA15, shown on FA15, note 47
14. Total area on FA14 and FA15, shown on FA15, note 46
15. Install 42,555 s.f. Riparian Restoration Mix C

LEGEND

- Riparian Restoration Mix A
- Riparian Restoration Mix B
- Riparian Restoration Mix C
- Riparian Restoration Mix F
- DSL/USACE Restoration Area
- ExistingTrees

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PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

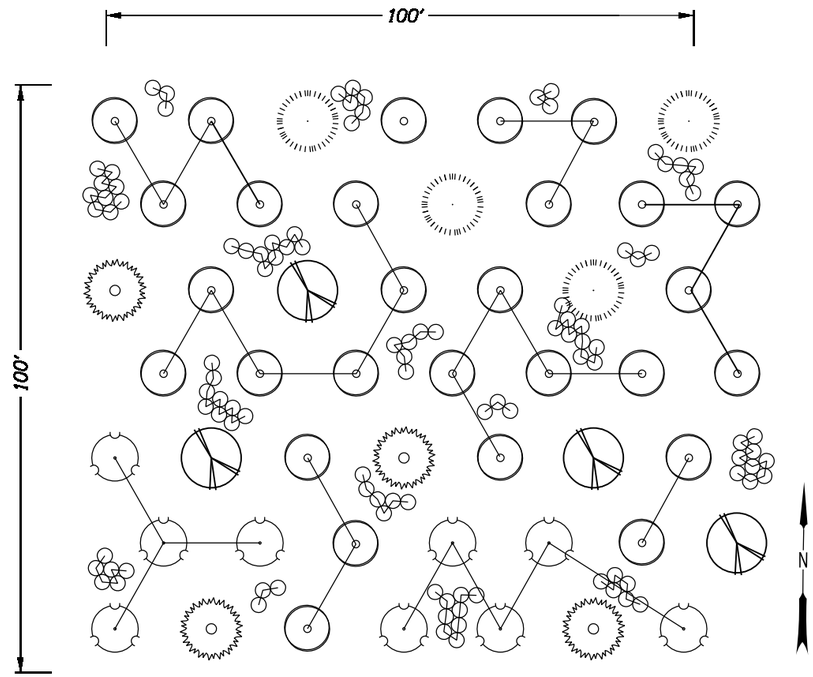
Designer: David Goodyke
Reviewer: Ben Ngan
Drafter: David Goodyke
Checker: Ben Ngan

ROADSIDE DEVELOPMENT
PLANTING PLAN/SECTION

SHEET NO.
FA14

FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 201.4396° Scale: 1"=100'



Riparian Restoration Mix A: Upland Trees and Shrubs

Key	Tree	Approximate Planting Density	Planting Percentage
	Large, Slow-Growing Trees		
	Acer macrophyllum	4 stems / 10,000 s.f.	8%
	Calocedrus decurrens	4 stems / 10,000 s.f.	8%
	Quercus garryana	13 stems / 10,000 s.f.	26%
	Pseudotsuga menziesii	4 stems / 10,000 s.f.	8%
	Small Trees		
	Arbutus menziesii	7 stems / 10,000 s.f.	15%
	Corylus cornuta ssp. californica	7 stems / 10,000 s.f.	15%
	Cornus nuttallii	3 stems / 10,000 s.f.	5%
	Rhamnus purshiana	7 stems / 10,000 s.f.	15%

Riparian Restoration Mix A and B: Upland Shrubs

Key	Shrubs*	Approximate Planting Density	Planting Percentage
	Mahonia aquifolium	27 stems / 10,000 s.f.	25%
	Omeleria ceracisformis	11 stems / 10,000 s.f.	10%
	Rubus parviflorus	16 stems / 10,000 s.f.	15%
	Sambucus racemosa	11 stems / 10,000 s.f.	10%
	Spirea douglasii	16 stems / 10,000 s.f.	15%
	Symphoricarpos albus	18 stems / 10,000 s.f.	25%

* Groupings required

NOTE:
Total quantity of plants per species per area shown on FA03.

LEGEND

Large, Slow-Growing Trees
- *Acer macrophyllum (TACMA), 8%*
- *Calocedrus decurrens (TCADE), 8%*
- *Pseudotsuga menziesii (TPSME), 8%*
- *Quercus garryana (TQUGA), 26%*

Small Trees
- *Arbutus menziesii (TARME), 15%*
- *Corylus cornuta ssp. californica (TCOCO), 15%*
- *Cornus nuttallii (TCONU), 15%*
- *Rhamnus purshiana (TRHPU), 15%*

Shrubs
- *Assorted Species*

DETAIL: UPLAND TREES AND PLANTING MIX A AND B

Not To Scale

TREE PLANTING NOTES

1) Install trees at an overall density of 49 trees/10,000 s.f.

2) Install trees at an average of 15' O.C. with triangular spacing, 49 trees/10,000 s.f. Large, Slow-Growing Trees must be planted at minimum 30' O.C. from one another. Fast-Growing and Small Trees shall be installed at a 10 - 20' O.C. average spacing from others.

3) Concentrate TQUGA in areas with most southern and western sun exposure.

4) Concentrate TPSME North and East of TQUGA.

5) Install Small Trees in groups of 2 - 5

6) Install shrubs 5' O.C. in groups of three to nine plants per species. Space shrub groups no closer than 15' apart and no closer than 5' to adjacent tree stems.

7) Spread species throughtout the given planting area to avoid monocultures, a random 10,000 s.f. sample should contain all species.

8) Maintain a 1' diameter plant-free area around all stems and mulch with shredded wood to prevent weeds.

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OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

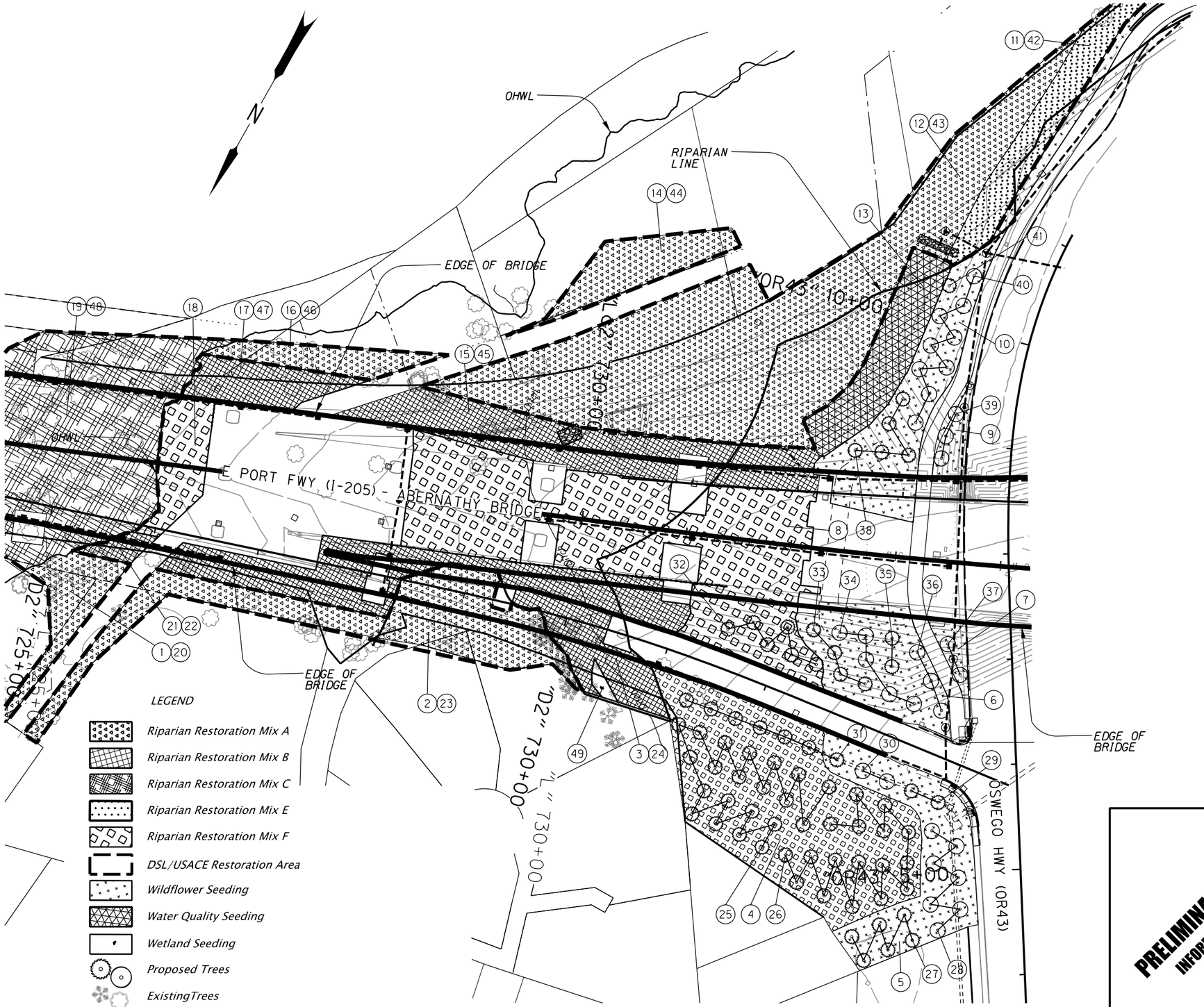
Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

SHEET NO. FA14A

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 201.4396° Scale: 1"=100'



1. Install 5,280 s.f. Native Shade Seeding
2. Install 18,680 s.f. Native Shade Seeding
3. Install 22,350 s.f. Native Shade Seeding
4. Install 33,448 s.f. Native Shade Seeding
5. Install 14,076 s.f. Wildflower Seeding
6. Install 11,537 s.f. Wildflower Seeding
7. Install 1,334 s.f. Wildflower Seeding
8. Install 40,690 s.f. Riparian Restoration Mix F Seeding
9. Install 2,108 s.f. Wildflower Seeding
10. Install 17,209 s.f. Wildflower Seeding
11. Install 8,465 s.f. Wildflower Seeding
12. Install 56,348 s.f. Wildflower Seeding
13. Install 8,634 s.f. Water Quality Seeding
14. Install 6,497 s.f. Wildflower Seeding
15. Install 16,848 s.f. Wildflower Seeding
16. Install 4,415 s.f. Wildflower Seeding
17. Install 5,280 s.f. Wildflower Seeding
18. Install 5,401 s.f. Riparian Restoration Mix F Seeding
19. Total area on FA14 and FA15, shown on FA14, note 8
20. Install 5,280 s.f. Riparian Restoration Mix A
21. Install 1,227 s.f. Native Shade Seeding
22. Install 1,227 s.f. Riparian Restoration Mix B
23. Install 18,680 s.f. Riparian Restoration Mix A
24. Install 22,350 s.f. Riparian Restoration Mix B
25. Install 20 TPSME
26. Install 17 TPIPO
27. Install 6 TPSME
28. Install 7 TQUGA
29. Install 2TPSME

Notes continue on FA15A

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PORTLAND, OR 97204-1134
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OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

ROADSIDE DEVELOPMENT
PLANTING PLAN/SECTION

SHEET NO. FA15

FINAL ELECTRONIC DOCUMENT
AVAILABLE UPON REQUEST

Rotation: 209.2943° Scale: 1"=100'

(30) *Install 2 TCONU*

(31) *Install 7 TPIPO*

(32) *Install 6 TPSME*

(33) *Install 4 TCADE*

(34) *Install 5 TCONU*

(35) *Install 2 TCADE*

(36) *Install 3 TQUGA*

(37) *Install 2 TQUGA*

(38) *Install 5 TPIPO*

(39) *Install 3 TQUGA*

(40) *Install 9 TQUGA*

(41) *Install 1 TARME*

(42) *Install 8,465 s.f. Riparian Restoration Mix E*

(41) *Install 56,348 s.f. Riparian Restoration Mix A*

(44) *Install 6,497 s.f. Riparian Restoration Mix A*

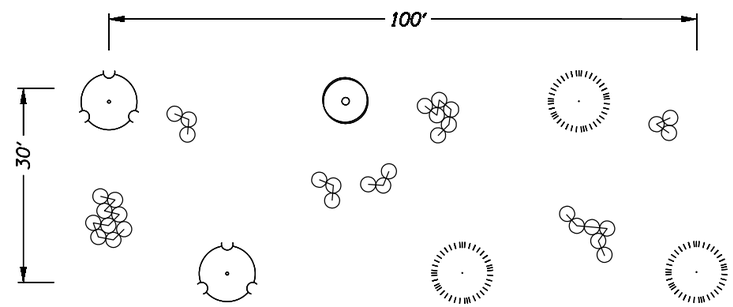
(45) *Install 16,848 s.f. Riparian Restoration MIx B*

(46) *Install 4,415 s.f. Riparian Restoration Mix A*

(47) *Install 5,280 s.f. Riparian Restoration Mix B*

(48) *Total area on FA14 and FA15, shown on FA14, note 15*

(49) *Install 410 s.f. Wetland Seeding*



LEGEND

Large, Slow-Growing Trees

Arbutus menziesii (TARME), 10%

Pinus ponderosa (TPIPO), 50%

Quercus garryana (TQUGA), 40%

Shrubs

Assorted Species

Riparian Restoration Mix E: Upland Trees and Shrubs

Key	Tree	Approximate Planting Density	Planting Percentage
	Large, Slow-Growing Trees		
	Arbutus menziesii	2 stems / 10,000 s.f.	10%
	Quercus garryana	8 stems / 10,000 s.f.	40%
	Pinus ponderosa var. willamettensis	10 stems / 10,000 s.f.	50%
	RIparIan RestoratIon MIx E: Upland Shrubs	Approximate Planting Density	Planting Percentage
	Shrubs*		
	Ceanothus velutinus	11 stems / 10,000 s.f.	10%
	Mahonia aquifolium	65 stems / 10,000 s.f.	60%
	Ribes sanguineum	16 stems / 10,000 s.f.	15%
	Symphoricarpos albus	16 stems / 10,000 s.f.	15%

* Groupings required

NOTE:
Total quantity of plants per species per area shown on FA03.

DETAIL: UPLAND TREES AND PLANTING MIX E

Not To Scale

TREE PLANTING NOTES

1) Install trees at an overall density of 20 trees/10,000 s.f.

2) Install trees at an average of 25' O.C. with triangular spacing.

3) Concentrate TQUGA in areas with most southern and western sun exposure.

4) Concentrate TPSME North and East of TQUGA.

5) Install shrubs 5' O.C. in groups of three to nine plants per species. Space shrub groups no closer than 15' apart and no closer than 5' to adjacent tree stems.

6) Spread species throughtout the given planting area to avoid monocultures, a random 10,000 s.f. sample should contain all species.

7) Maintain a 1' diameter plant-free area around all stems and mulch with shredded wood to prevent weeds.

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OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

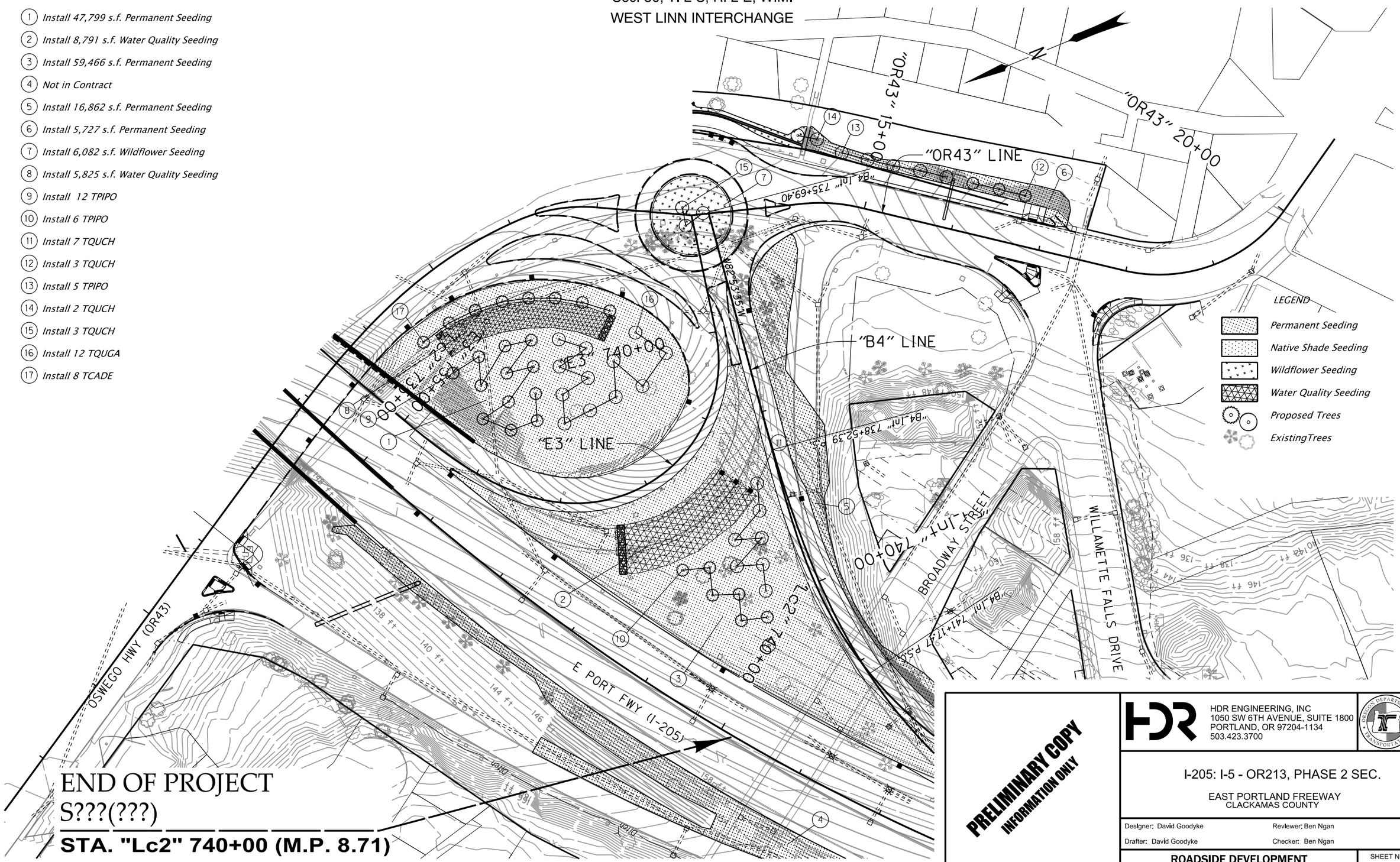
ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

SHEET NO. FA15A

Sec. 30, T. 2 S, R. 2 E, W.M.

WEST LINN INTERCHANGE

1. Install 47,799 s.f. Permanent Seeding
2. Install 8,791 s.f. Water Quality Seeding
3. Install 59,466 s.f. Permanent Seeding
4. Not in Contract
5. Install 16,862 s.f. Permanent Seeding
6. Install 5,727 s.f. Permanent Seeding
7. Install 6,082 s.f. Wildflower Seeding
8. Install 5,825 s.f. Water Quality Seeding
9. Install 12 TPIPO
10. Install 6 TPIPO
11. Install 7 TQUCH
12. Install 3 TQUCH
13. Install 5 TPIPO
14. Install 2 TQUCH
15. Install 3 TQUCH
16. Install 12 TQUGA
17. Install 8 TCADE



END OF PROJECT

S???(???)

STA. "Lc2" 740+00 (M.P. 8.71)

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HDR ENGINEERING, INC
1050 SW 6TH AVENUE, SUITE 1800
PORTLAND, OR 97204-1134
503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 2 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: David Goodyke | Reviewer: Ben Ngan
Drafter: David Goodyke | Checker: Ben Ngan

ROADSIDE DEVELOPMENT PLANTING PLAN/SECTION

SHEET NO. FA16

GENERAL NOTES:

The construction, adjustment, maintenance, and upgrading of these Erosion and Sediment Control measures is the responsibility of the contractor for the duration of the project to comply with Section 00280 of the Oregon Standard Specifications for construction and the NPDES 1200-CA permit.

Erosion and Sediment Control measures shown on this plan are for anticipated site conditions. Adjust or upgrade these measures for unexpected storm events to ensure that sediment and sediment-laden water does not leave the site.

Develop a revised plan of the Erosion and Sediment Control measures shown as required by Section 00280, Oregon Standard Specifications for Construction. Implement this plan for all clearing and grading activities and in segments applicable to each staging phase. Construct in such a manner so as to ensure that sediment and sediment-laden water does not enter the roadway or drainage system, or violate applicable water standards.

Install measures within the right-of-way unless directed otherwise.

Inlet protection for existing facilities shall be installed before construction begins and shall remain in place until all construction is completed and approved. The contractor shall protect all storm drain inlets within the work area and adjacent to the work limits within 100' outside all working, stockpile, and staging areas, including the first inlet downstream (at any distance). In the case of inlets to be removed, protection measures shall remain in place until the new inlet is constructed and connected to the drainage network, and the existing inlet has been disconnected from the existing drainage network. Inlet protection shall be installed on new inlets before they are connected to the existing drainage network.

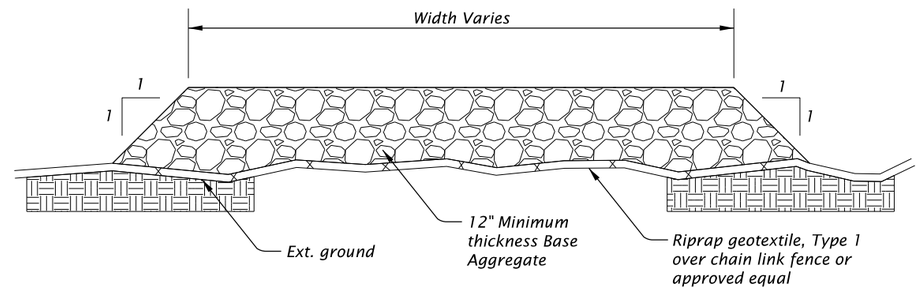
See section 00280 for material not shown in plans.

STANDARD DRAWINGS

- ☒ RD1000 Construction Entrances
- ☐ RD1005 Check Dams Type 1, 3 and 4
- ☒ RD1006 Check Dams Type 2 and 6
- ☒ RD1010 Inlet Protection Type 2, 3, 6 and 7
- ☐ RD1015 Inlet Protection Type 4
- ☒ RD1030 Sediment Barrier Type 2, 3 and 4
- ☐ RD1031 Sediment Barrier Type 5 and 6
- ☒ RD1032 Sediment Barrier Type 8
- ☒ RD1033 Sediment Barrier Type 9
- ☒ RD1040 Sediment Fence
- ☐ RD1045 Temporary Slope Drain With Energy Dissipator
- ☐ RD1050 Temporary Scour Basin
- ☒ RD1055 Slope and Channel Matting
- ☒ RD1060 Tire Wash Facility Type 1 and 2
- ☒ RD1065 Sediment Trap
- ☒ RD1070 Concrete Truck Wash Out

SEQUENCE OF WORK NOTES:

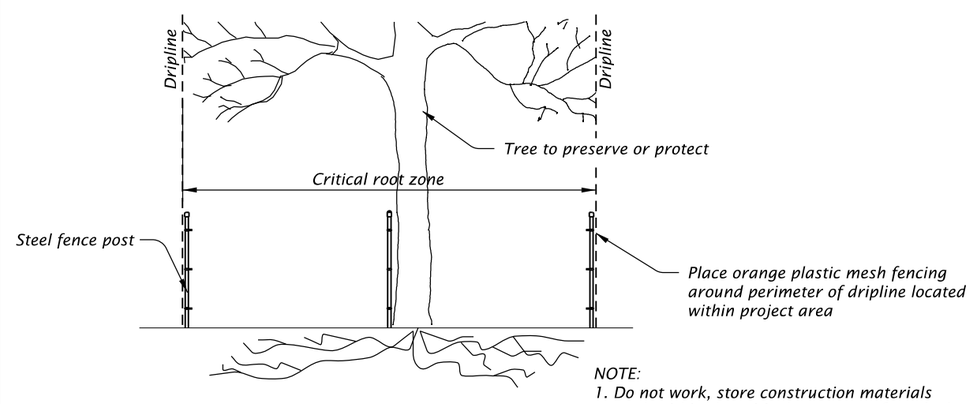
This Erosion and Sediment Control Plan has been prepared based upon the construction sequence represented in the Traffic Control Plan Sheets. This ESCP is not intended to supercede a construction sequencing plan. The ESCP is to be reviewed and revised to fit the actual construction sequence.



1. Existing ground shall grubbed to a depth 6".

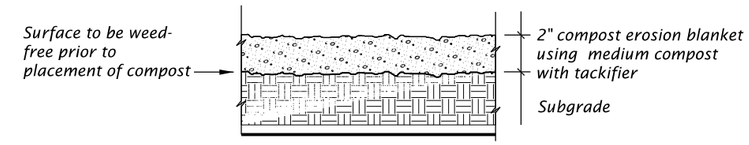
2. Cover existing ground under Staging Area with riprap geotextile and either chain link fence or other approved geogrid type material and cover with Base Aggregate.

STAGING AREA DETAIL
N.T.S.

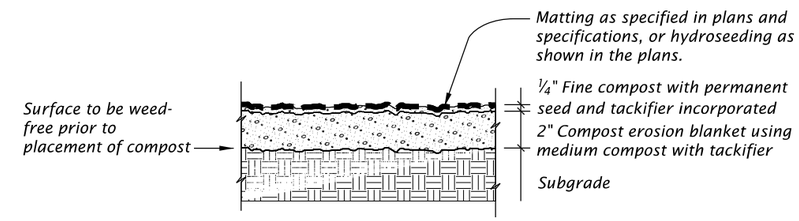


NOTE:
1. Do not work, store construction materials or park within the critical root zone of marked trees unless written approval has been obtained from the Engineer.

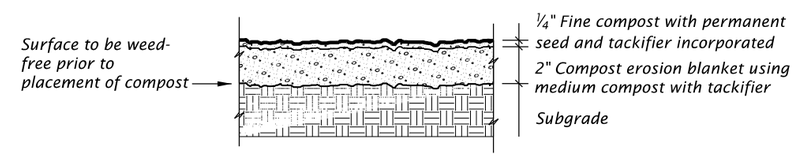
TREE PROTECTION DETAIL
N.T.S.



APPLICATION - TEMPORARY/PERMANENT MULCHING
N.T.S.



APPLICATION - STEEP SLOPES, SHALLOW DITCHES & BIO-SWALES
N.T.S.



APPLICATION – TEMPORARY/PERMANENT VEGETATIVE COVER
N.T.S.

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503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

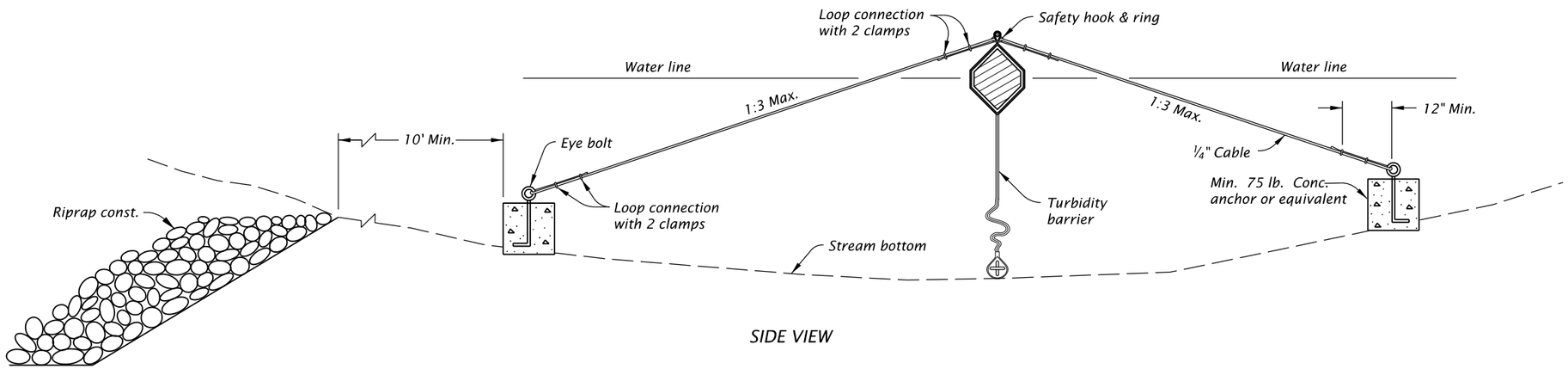
EROSION AND SEDIMENT CONTROL

SHEET NO. FB01

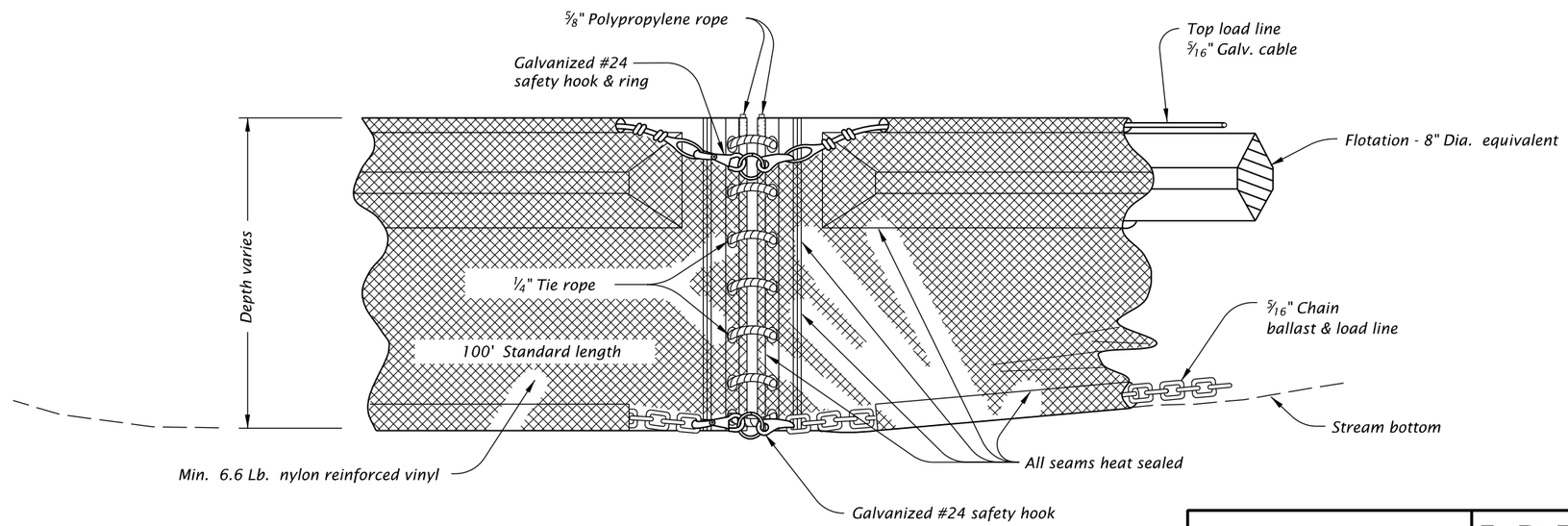
FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

Rotation: 0° Scale: 1"=100'

SEDIMENT BARRIER FLOATING



SIDE VIEW



ANCHOR ASSEMBLY

NOTE:

Components of this barrier may be similar or identical to proprietary designs. Any infringement on the proprietary rights of the designer shall be the sole responsibility of the contractor. Substitutions shall be as approved by the engineer.

TURBIDITY BARRIER

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

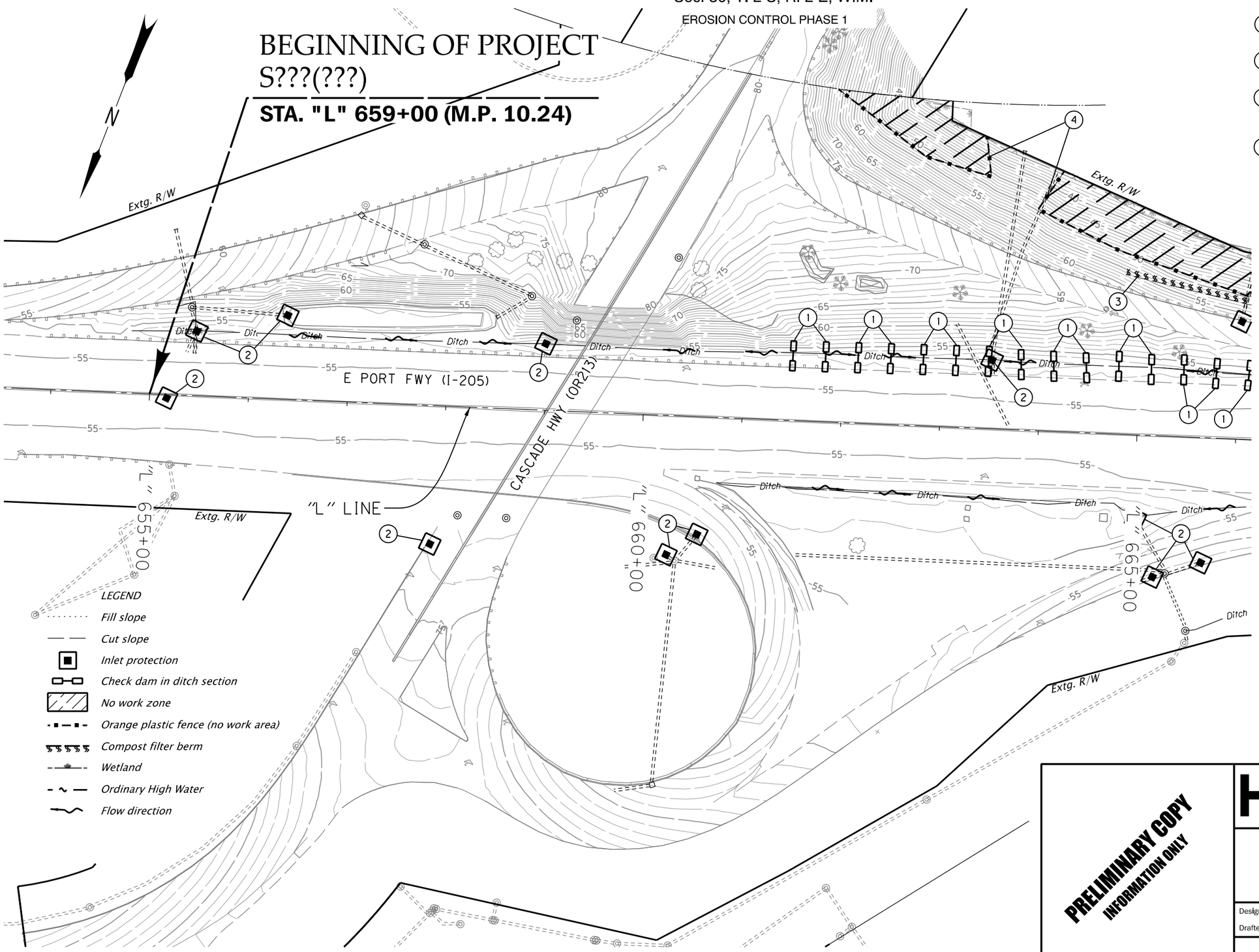
EROSION AND SEDIMENT CONTROL

SHEET NO.
FB02

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

??V-???



1. Const. check dam, (Type 6) - xx (See drg. no. RD1006)
2. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
3. Install sediment barrier (Type 9, Compost filter berm) (See drg. no. RD1033)
4. Install orange plastic mesh fencing

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

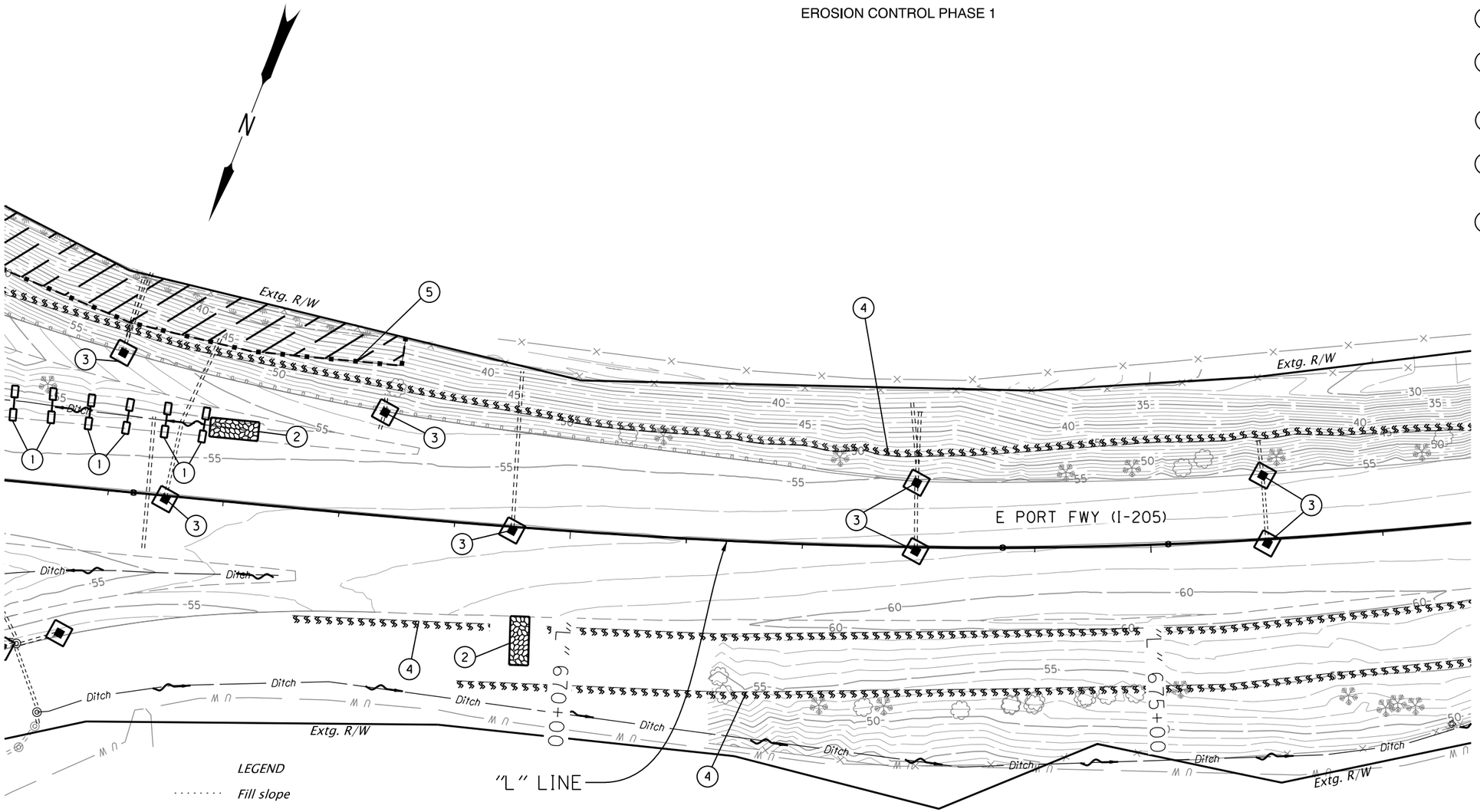
SHEET NO. FB03

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

??V-???

1. Const. check dam, (Type 6) - xx (See drg. no. RD1006)
2. Const. construction entrance - xx (Type 1) (See drg. no. RD1000)
3. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
4. Install sediment barrier (Type 9, Compost filter berm) (See drg. no. RD1033)
5. Install orange plastic mesh fencing



LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Check dam in ditch section
- No work zone
- Orange plastic fence (no work area)
- Wetland
- Ordinary High Water
- Compost filter berm
- Flow direction
- Construction entrance

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

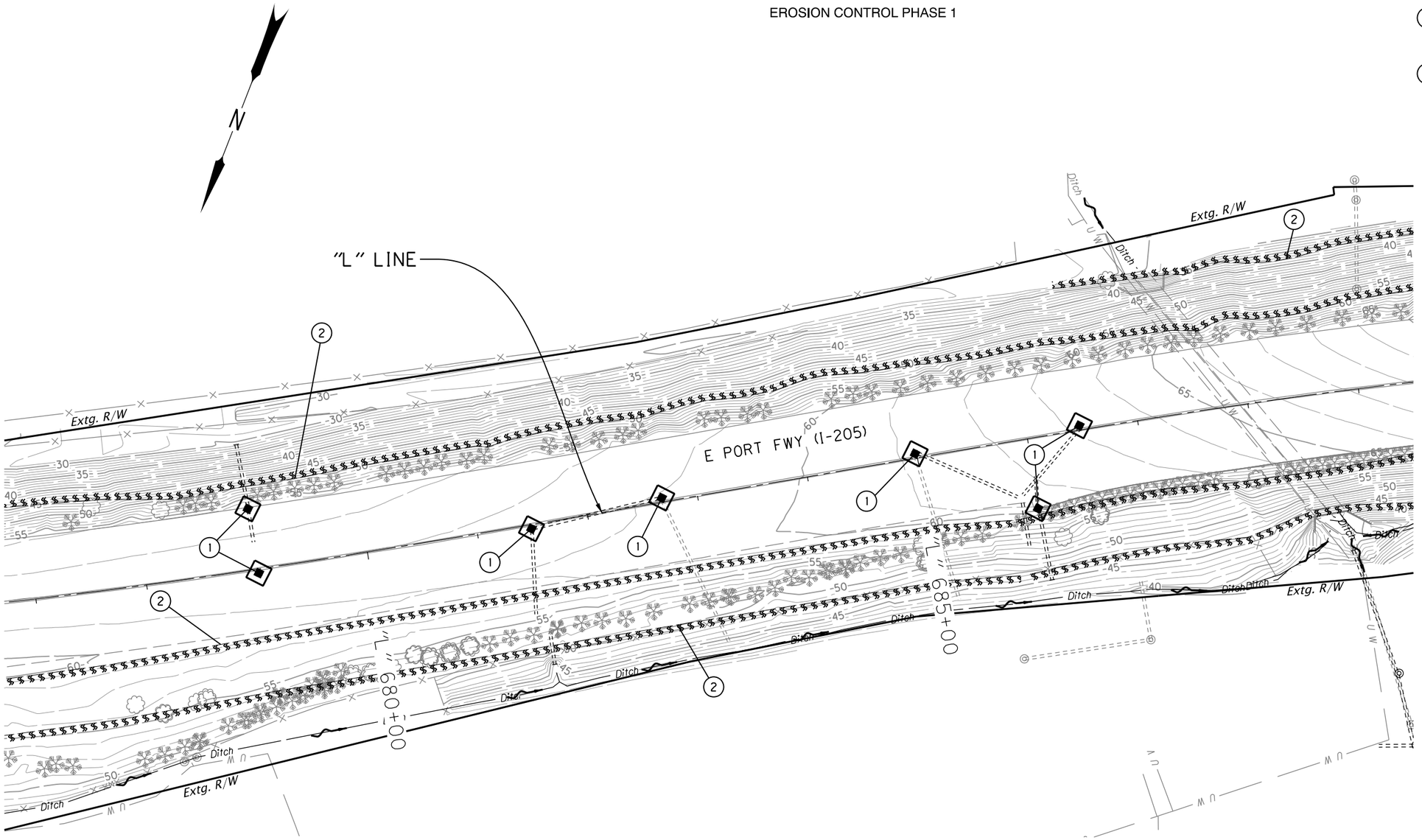
SHEET NO. FB04

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

1 *Const. inlet protection – xx (Type 3) (See drg. no. RD1010)*

2 *Install sediment barrier, (Type 9) – xx' (See drg. no. RD1033)*



LEGEND

- *Fill slope*
- *Cut slope*
- *Inlet protection*
- *Compost filter berm*
- *Ordinary High Water*
- *Flow direction*

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CLACKAMAS COUNTY

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Drafter: Connor Donovan | Checker: Brendan LeBlanc

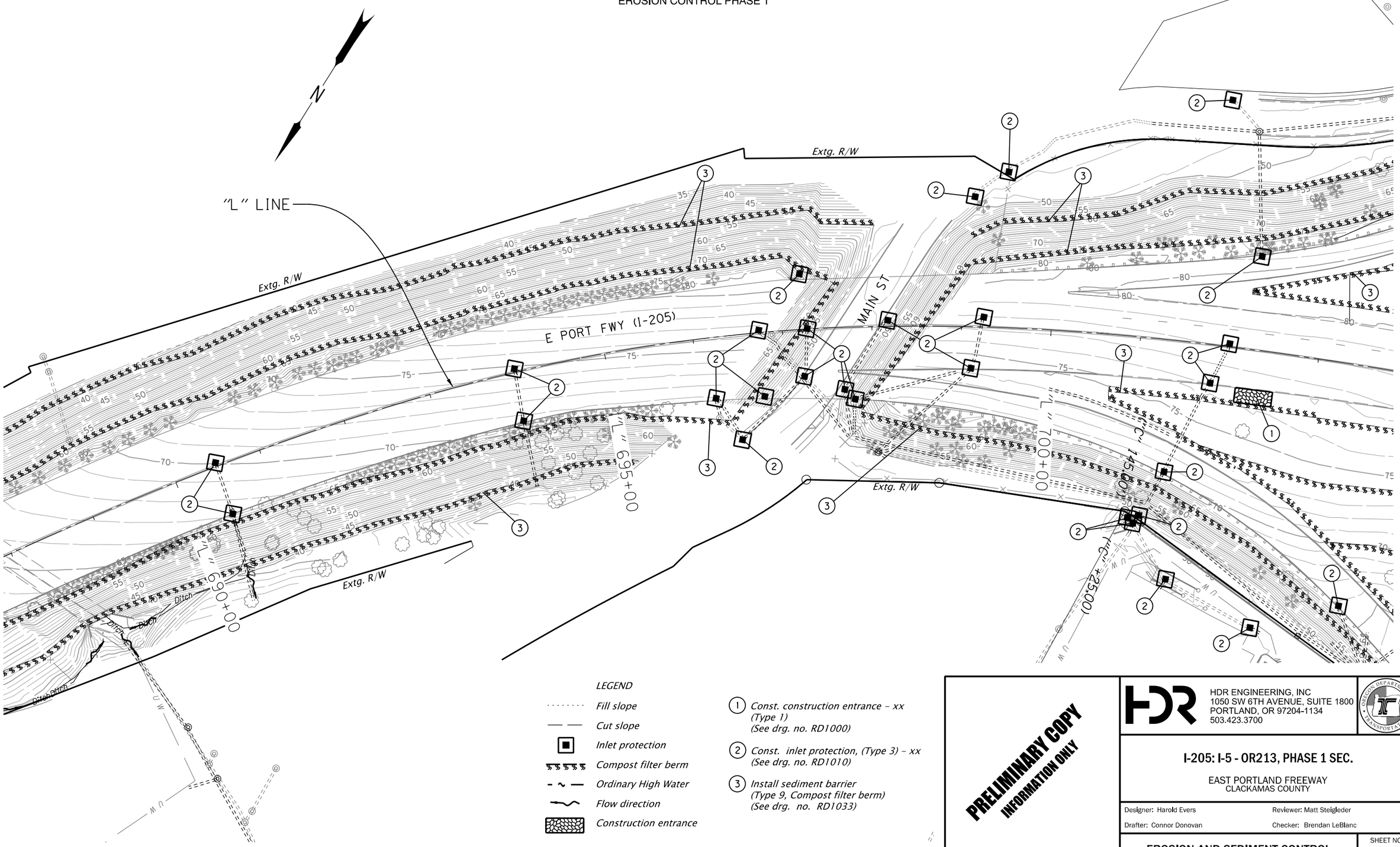
EROSION AND SEDIMENT CONTROL

SHEET NO. FB05

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

??V-???



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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO. FB06

Sec. 30, T. 2 S, R. 2 E, W.M.

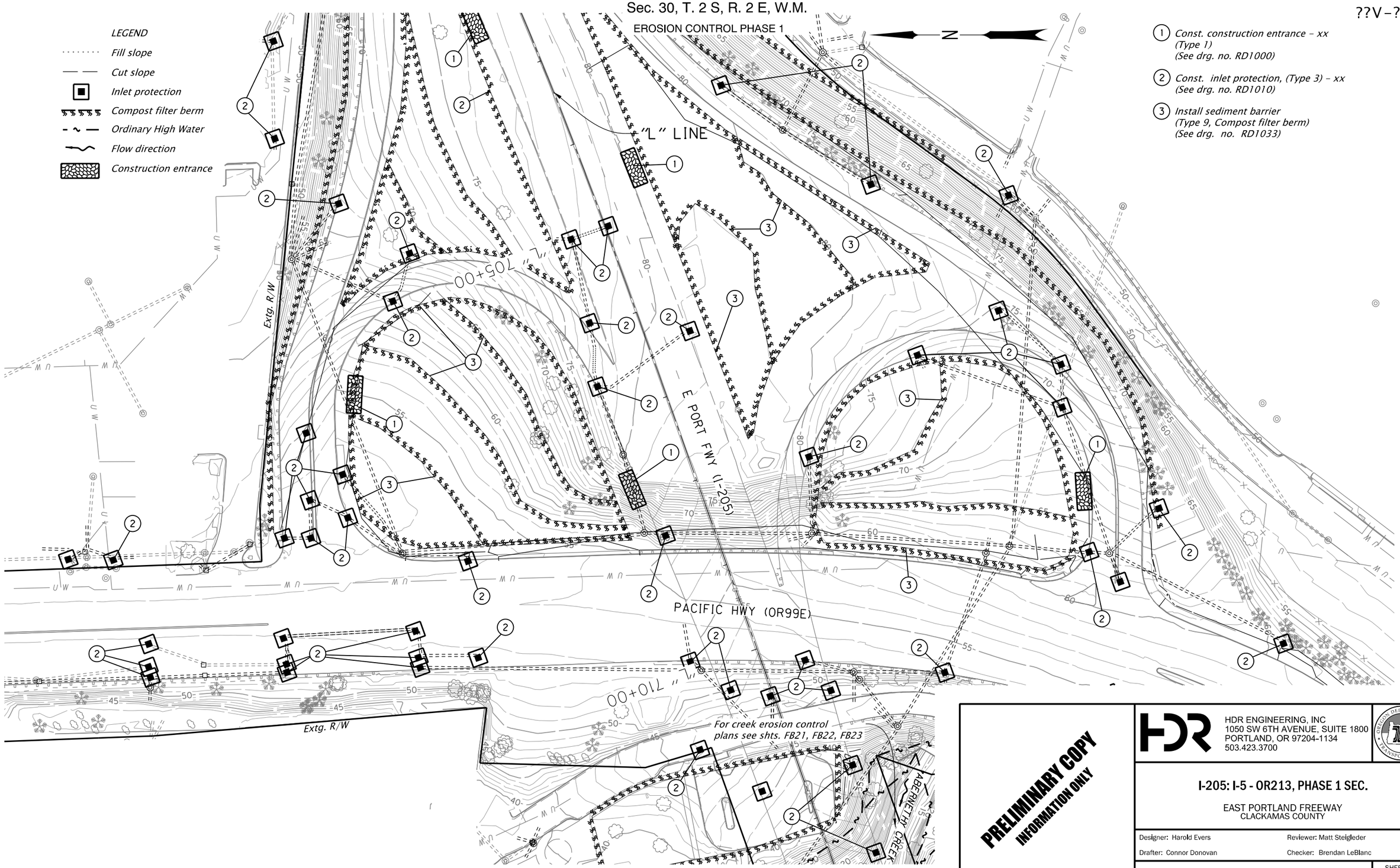
EROSION CONTROL PHASE 1

??V-???

LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Compost filter berm
- Ordinary High Water
- Flow direction
- Construction entrance

1. Const. construction entrance - xx (Type 1) (See drg. no. RD1000)
2. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
3. Install sediment barrier (Type 9, Compost filter berm) (See drg. no. RD1033)



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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

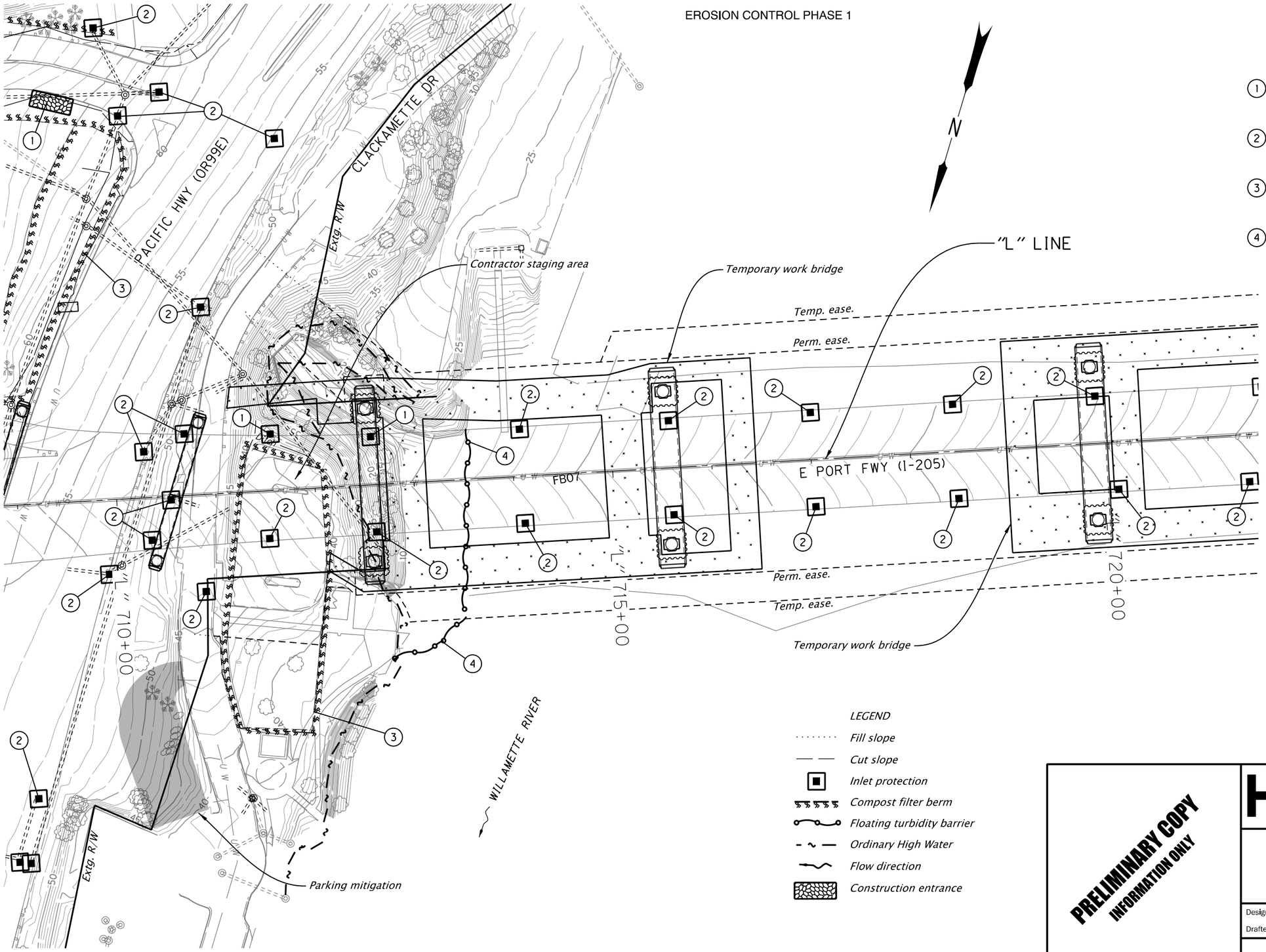
EROSION AND SEDIMENT CONTROL

SHEET NO. FB07

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

??V-???



GENERAL NOTES:

Floating turbidity barrier only required for rip rap removal.

1. *Const. construction entrance - x (Type 1) (See drg. no. RD1000)*
2. *Const. inlet protection - xx (Type 3) (See drg. no. RD1010)*
3. *Install sediment barrier - xx (Type 9) (See drg. no. RD1033)*
4. *Const. turbidity barrier - xx (See Sheet FB11)*

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

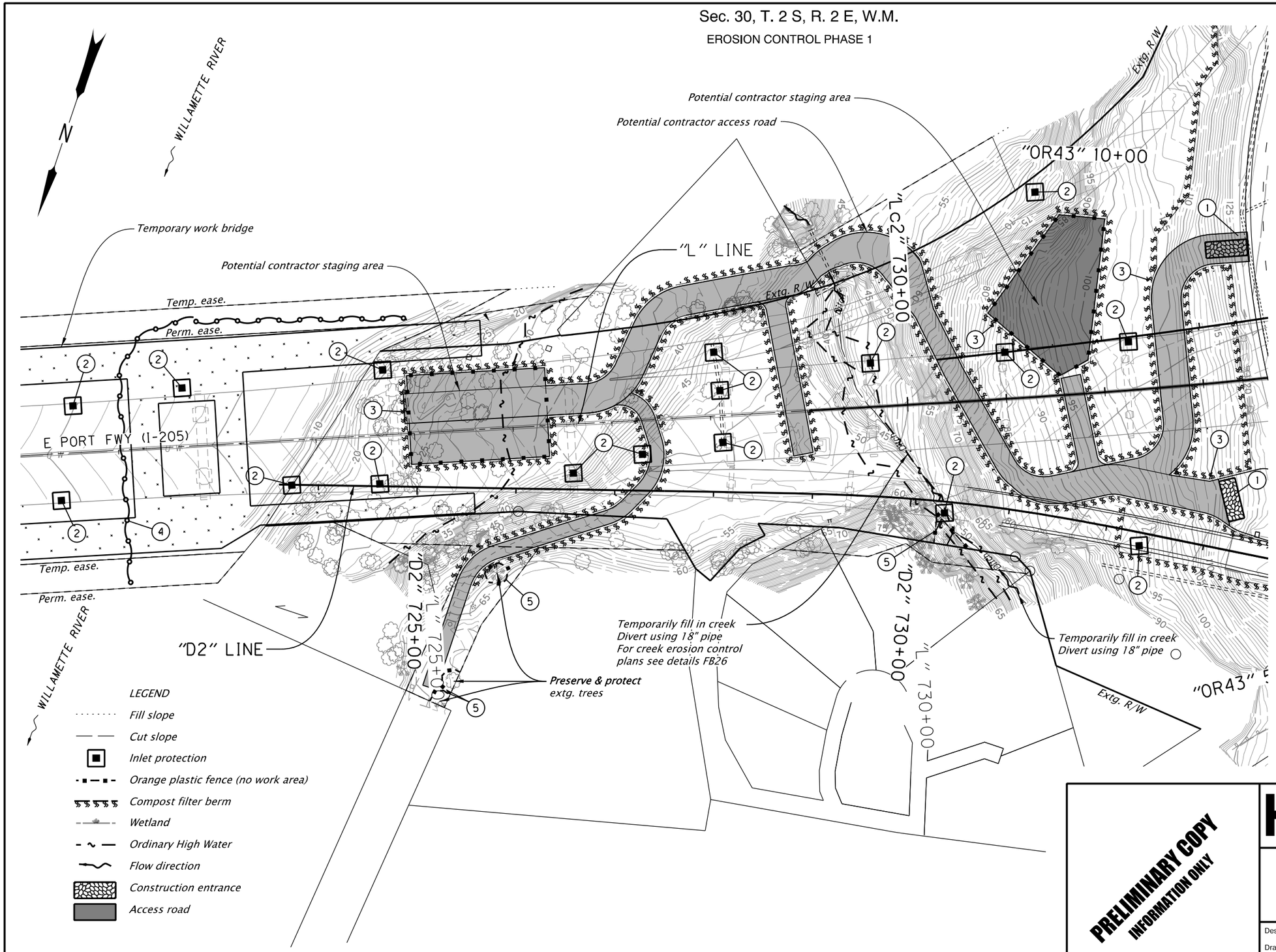
EROSION AND SEDIMENT CONTROL

SHEET NO.
FB08

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 1

??V-???



GENERAL NOTES:

Floating turbidity barrier only required for rip rap removal.

1. *Const. construction entrance - xx (Type 1) (See drg. no. RD1000)*
2. *Const. inlet protection - xx (Type 3) (See drg. no. RD1010)*
3. *Install sediment barrier - xx (Type 9) (See drg. no. RD1033)*
4. *Const. turbidity barrier - xx (See Sheet FB11)*
5. *Install orange plastic mesh fencing*

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CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

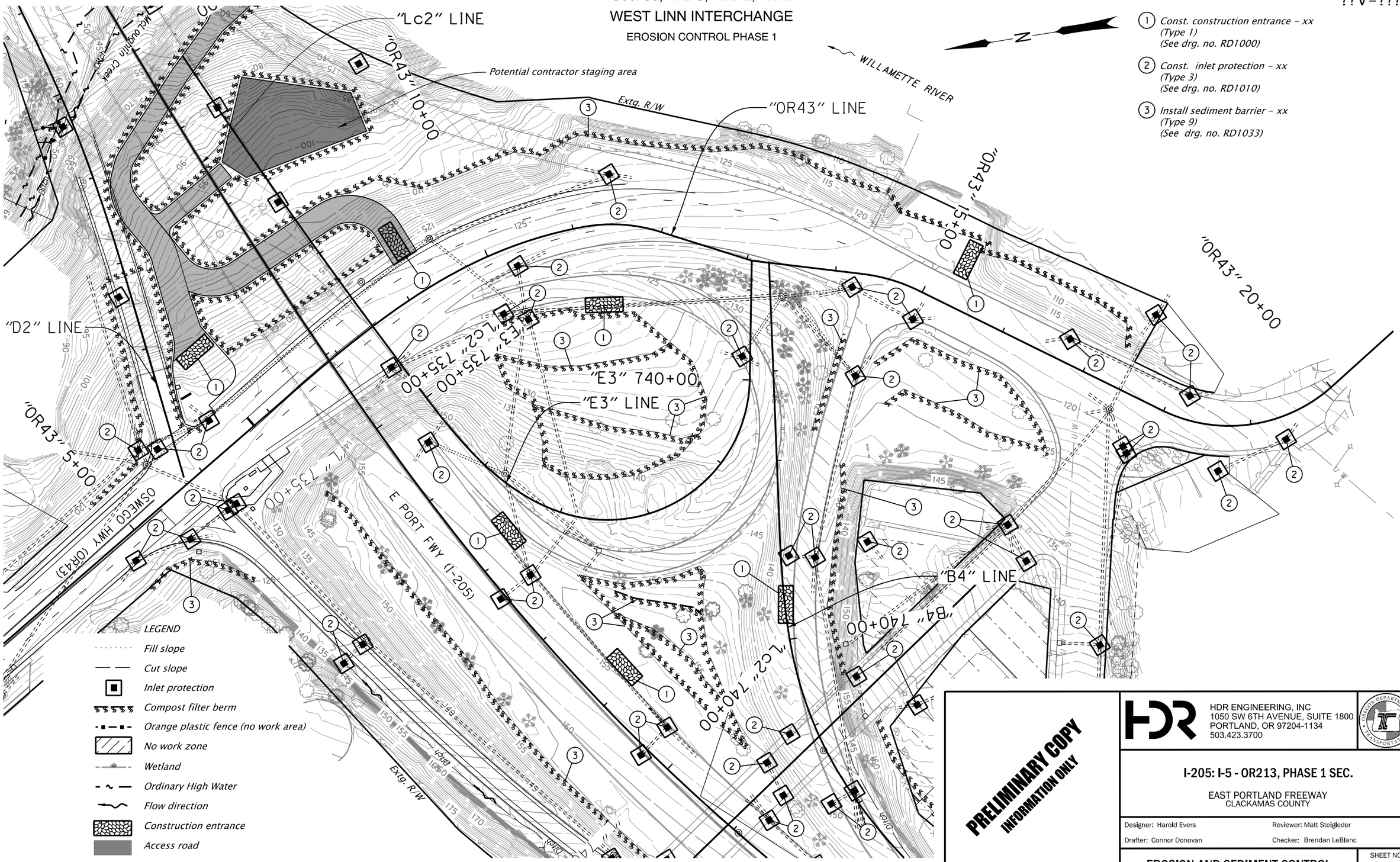
SHEET NO. FB09

Sec. 30, T. 2 S, R. 2 E, W.M.

WEST LINN INTERCHANGE

EROSION CONTROL PHASE 1

??V-???



1. Const. construction entrance - xx (Type 1) (See drg. no. RD1000)
2. Const. inlet protection - xx (Type 3) (See drg. no. RD1010)
3. Install sediment barrier - xx (Type 9) (See drg. no. RD1033)

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

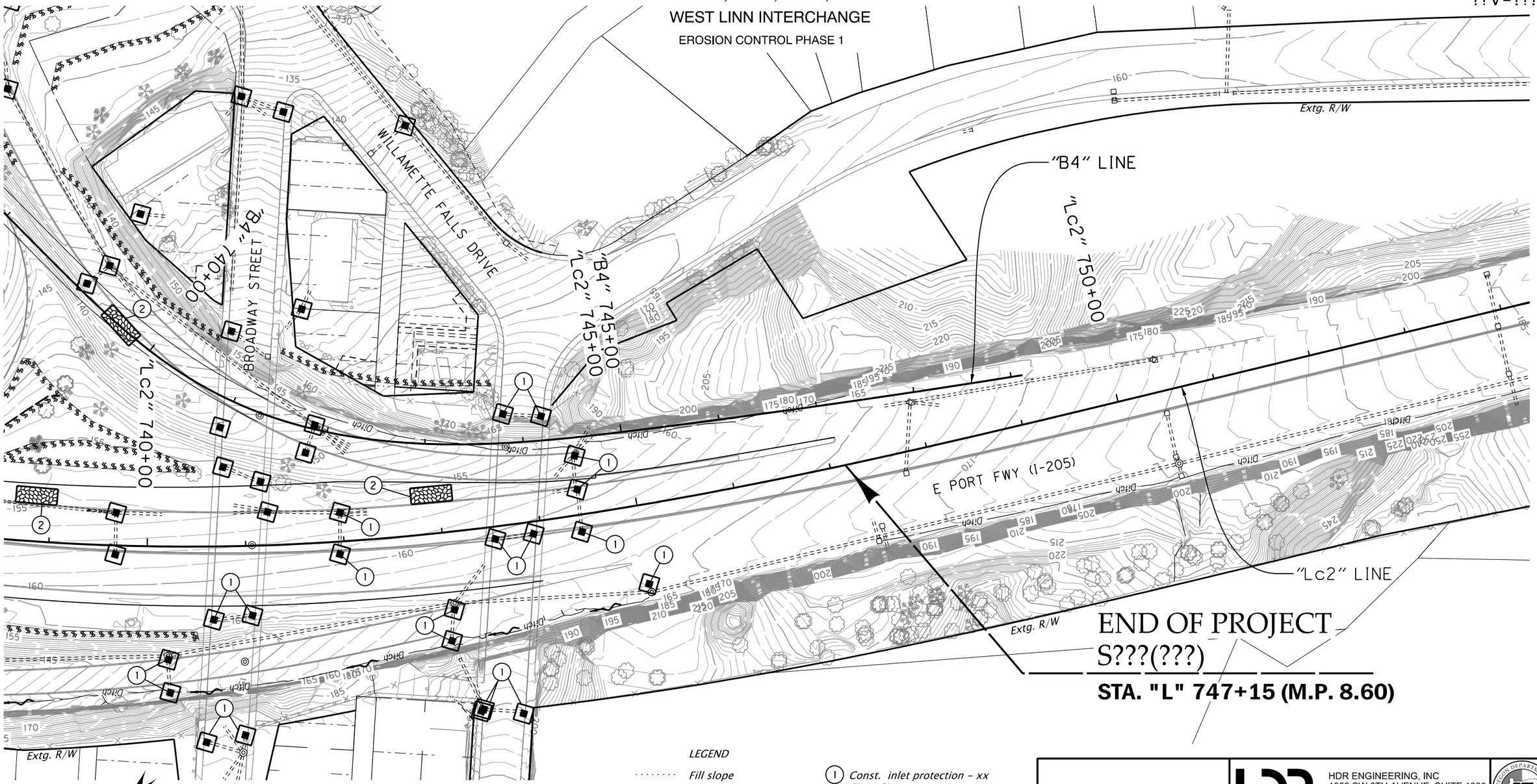
SHEET NO. FB10

Sec. 30, T. 2 S, R. 2 E, W.M.

WEST LINN INTERCHANGE

EROSION CONTROL PHASE 1

??V-???



LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Ordinary High Water
- Flow direction
- Construction entrance

(1) Const. inlet protection - xx (Type 3) (See drg. no. RD1010)

(2) Const. construction entrance - xx (Type 1) (See drg. no. RD1000)

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers | Reviewer: Matt Steigleder
Drafter: Connor Donovan | Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO. FB11

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

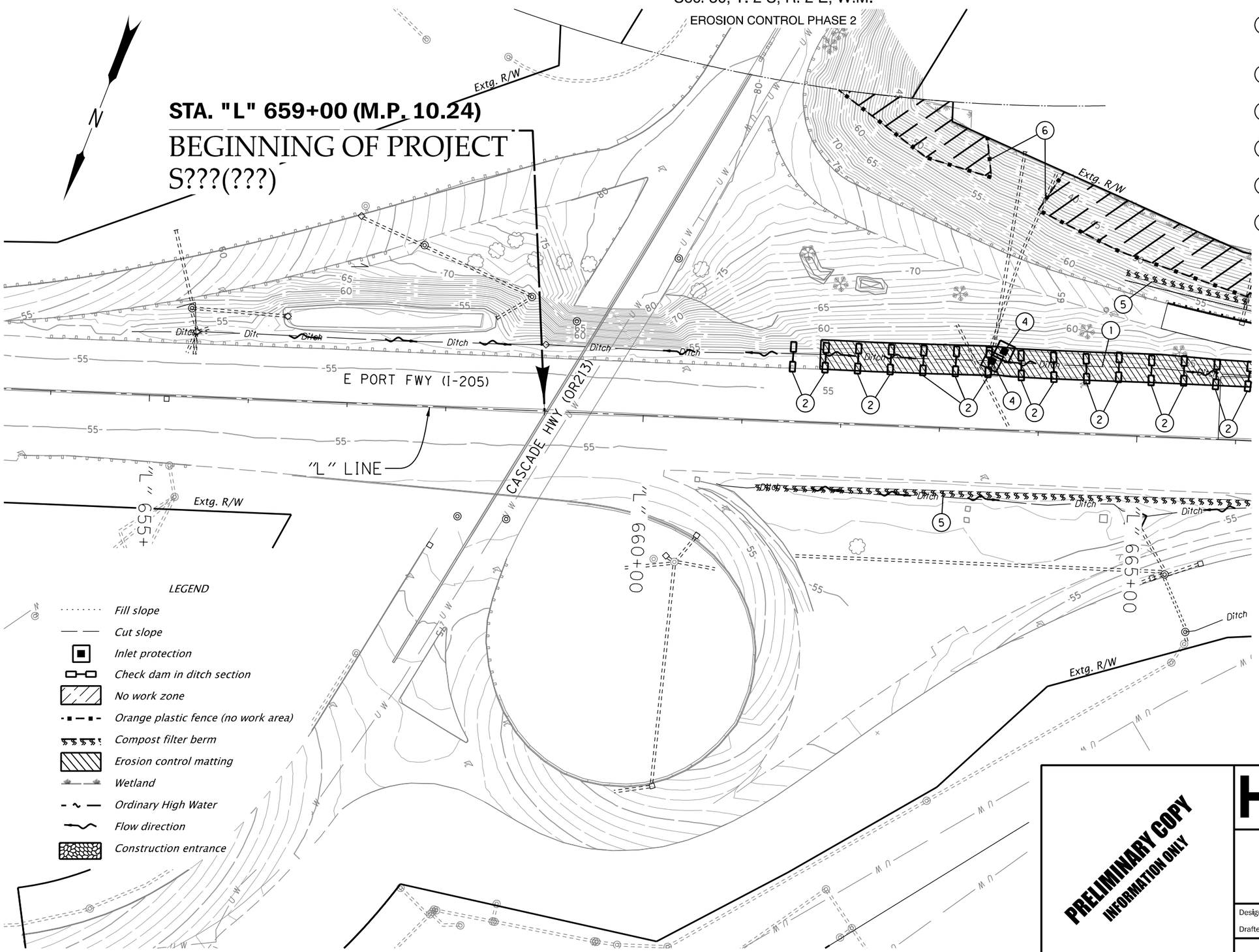
EE_K19786_HDR_ec01_phase 1.dgn :: FB11 6/25/2019 11:17:59 AM CDONOVAN

Rotation: 218.1362° Scale: 1"=100'

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 2

??V-???



1. Install matting - xx (Flexible channel liner, Type F) (See drg. no. RD1055)
2. Const. check dam, (Type 6) - xx (See drg. no. RD1006)
3. Const. construction entrance - xx (See drg. no. RD1000)
4. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
5. Install sediment barrier, (Type 9) - xx (See drg. no. RD1033)
6. Install orange plastic mesh fencing - xx

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

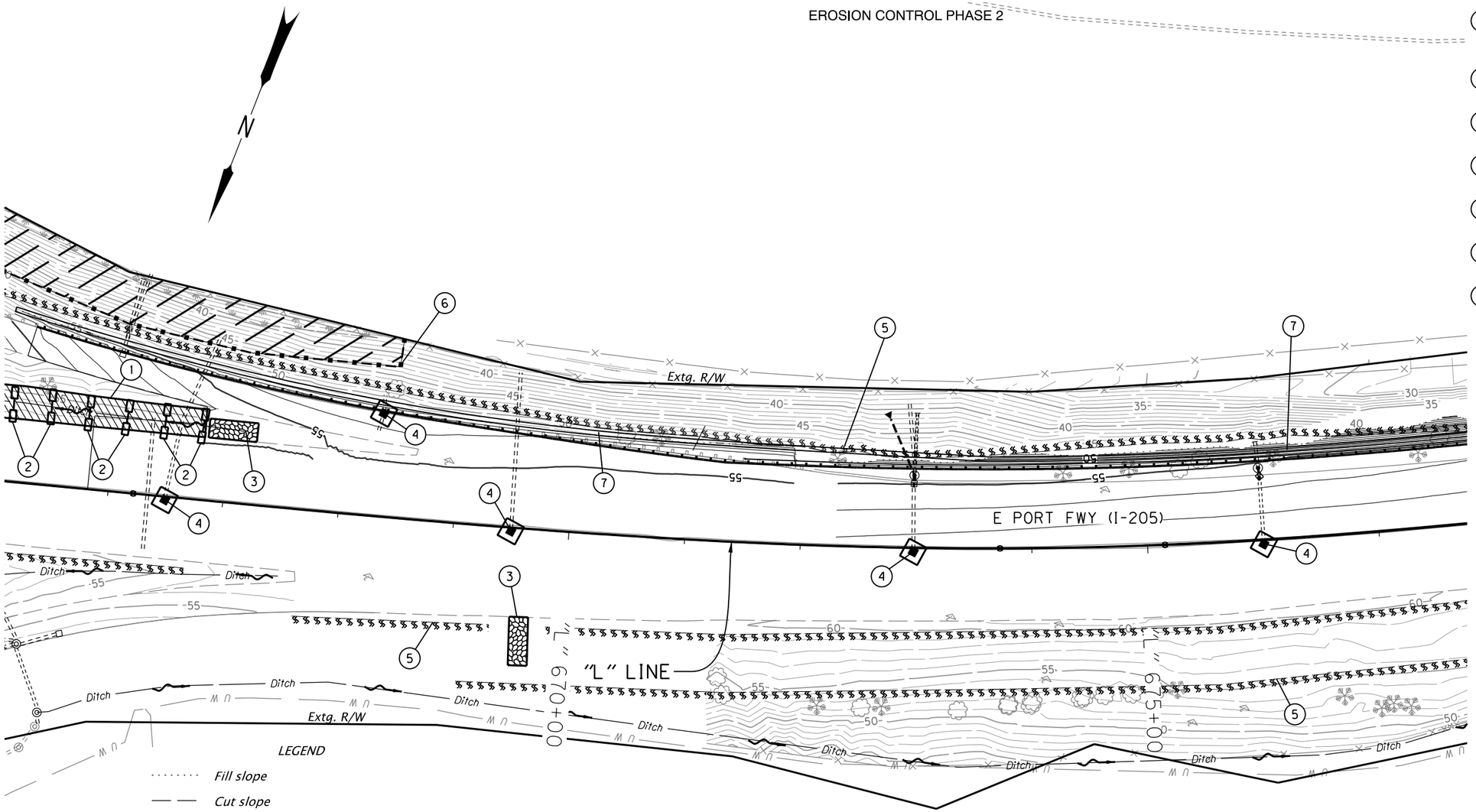
SHEET NO. FB12

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 2

??V-???

1. Install matting - xx (Flexible channel liner, Type F) (See drg. no. RD1055)
2. Const. check dam, (Type 6) - xx (See drg. no. RD1006)
3. Const. construction entrance - xx (See drg. no. RD1000)
4. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
5. Install sediment barrier, (Type 9) - xx (See drg. no. RD1033)
6. Install orange plastic mesh fencing - xx
7. Seeding and mulching - xx



LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Check dam in ditch section
- Seeding and mulching
- No work zone
- Erosion control matting
- Orange plastic fence (no work area)
- Compost filter berm
- Wetland
- Ordinary High Water
- Construction entrance
- Flow direction

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

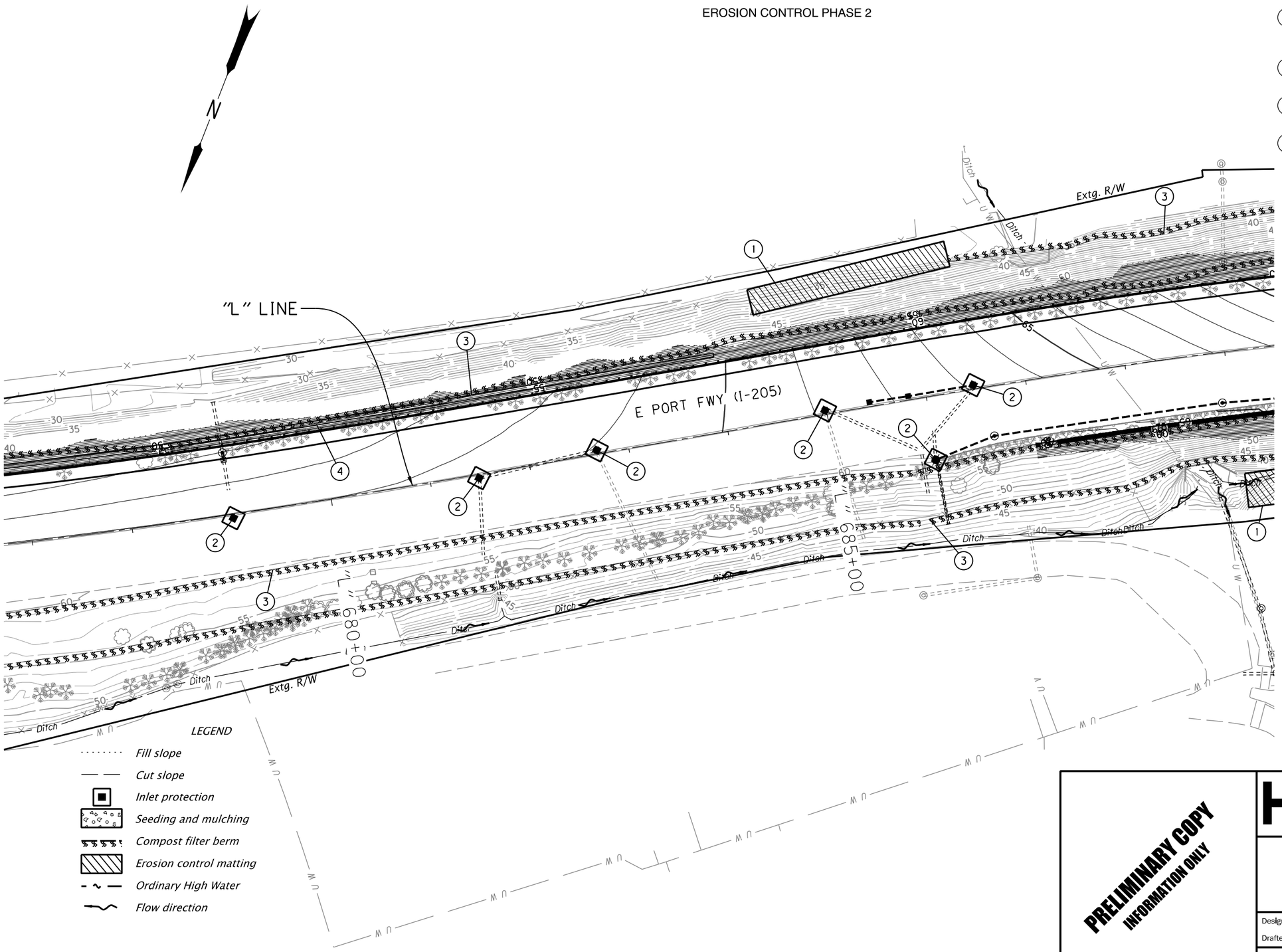
EROSION AND SEDIMENT CONTROL

SHEET NO. FB13

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 2

1. Install matting - xx (Flexible channel liner, Type F) (See drg. no. RD1055)
2. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
3. Install sediment barrier, (Type 9) - xx (See drg. no. RD1033)
4. Seeding and mulching - xx



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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

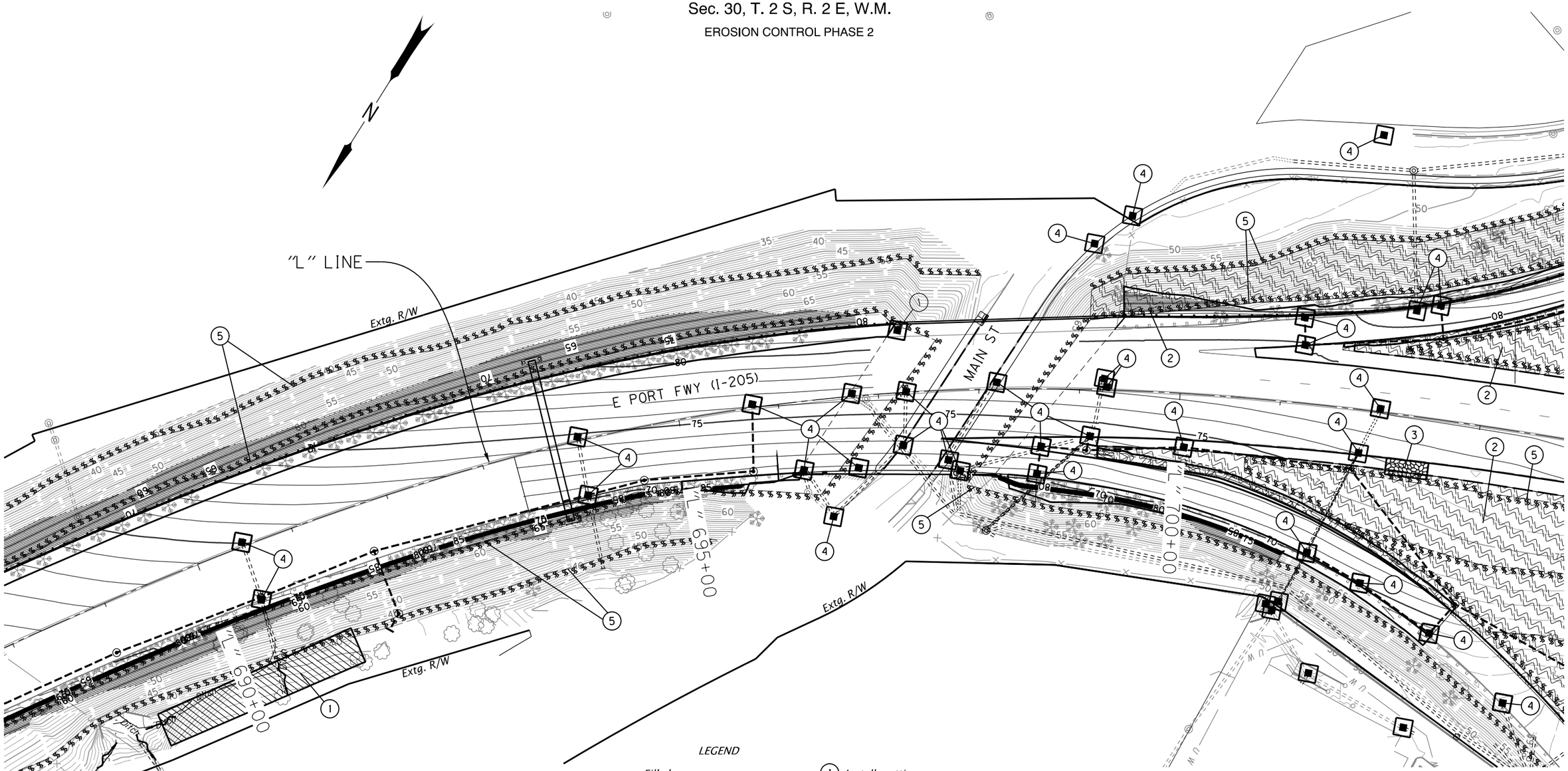
Designer: Harold Evers | Reviewer: Matt Steigleder
Drafter: Connor Donovan | Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO. FB14

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 2



LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Compost blanket
- Erosion control matting
- Wetland
- Ordinary High Water
- Flow direction
- Compost filter berm

1. Install matting - xx (Flexible channel liner, Type F) (See drg. no. RD1055)
2. Install compost erosion blanket - xx For details, see sht. FB-01
3. Const. construction entrance - xx (See drg. no. RD1000)
4. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
5. Install sediment barrier, (Type 9) - xx (See drg. no. RD1033)

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
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Drafter: Connor Donovan
Checker: Brendan LeBlanc

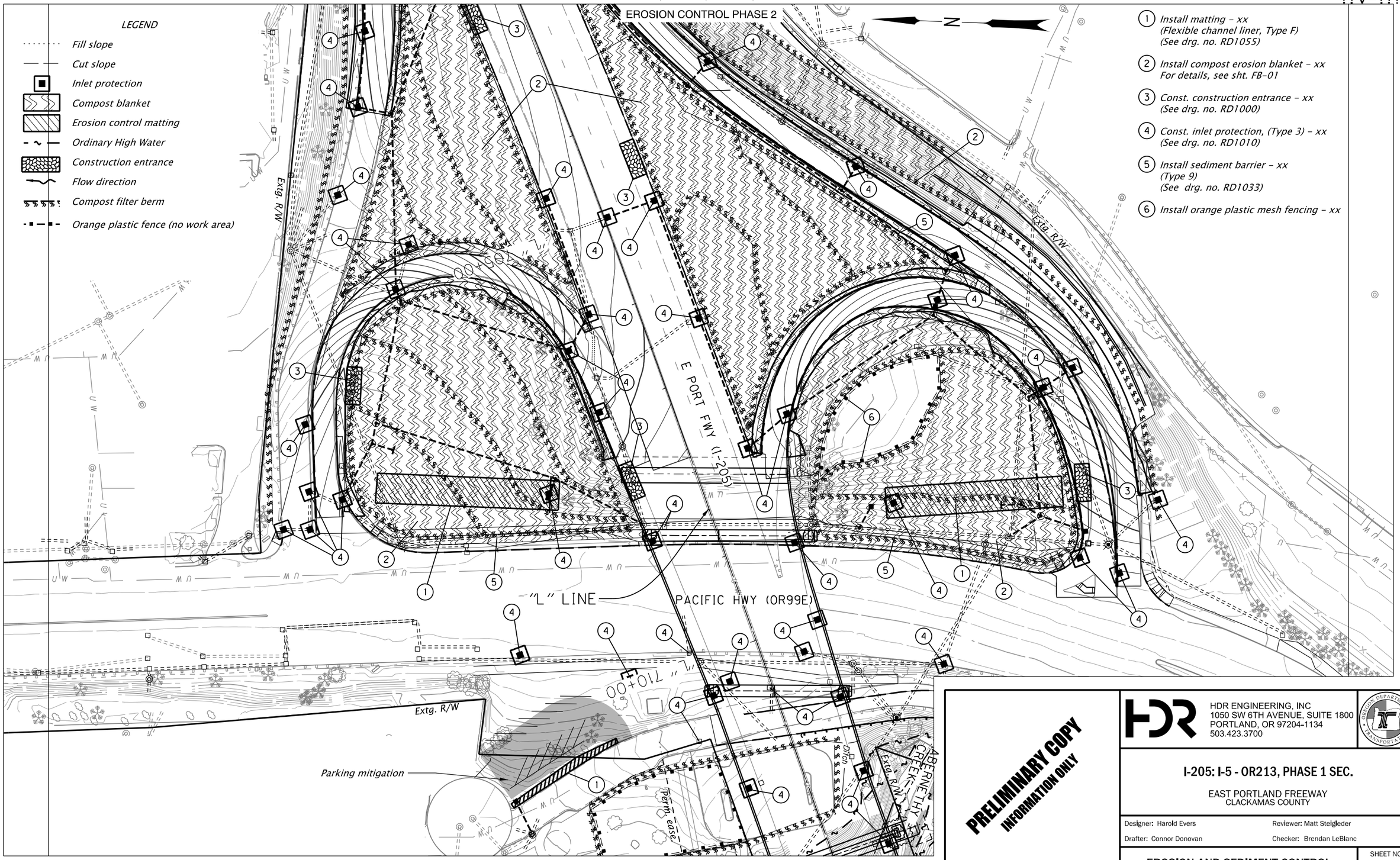
EROSION AND SEDIMENT CONTROL

SHEET NO. FB15

Sec. 30, T. 2 S, R. 2 E, W.M.

??V-???

EROSION CONTROL PHASE 2



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503.423.3700

OREGON DEPARTMENT OF TRANSPORTATION

I-205: I-5 - OR213, PHASE 1 SEC.

EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO.
FB16

FINAL ELECTRONIC DOCUMENT
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EE_K19786_HDR_ec01_phase 2.dgn :: FB16 6/25/2019 11:19:10 AM CDONOVAN

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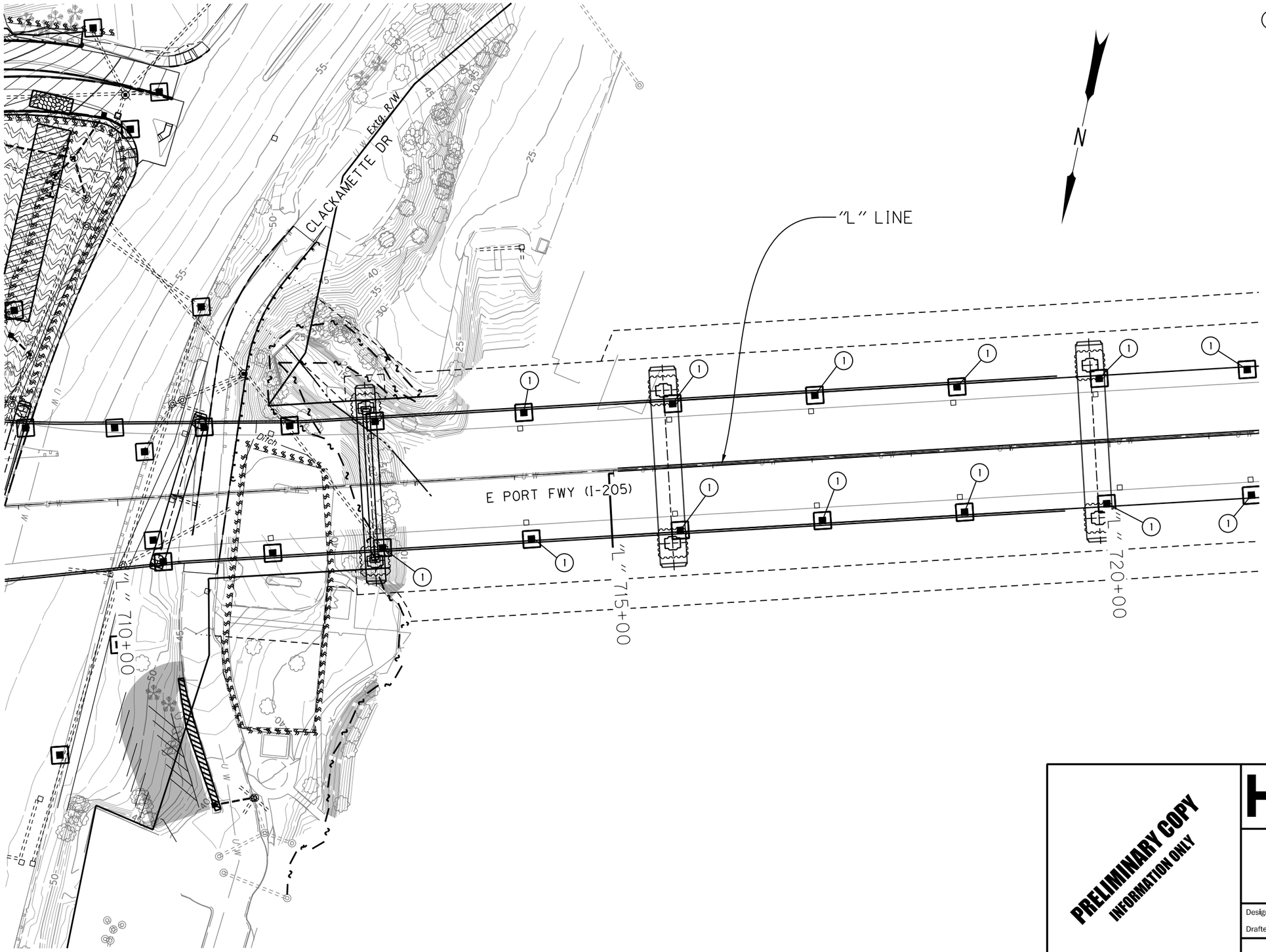

(1) *Const. inlet protection – 25 (Type 3) (See drg. no. RD1010)*

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

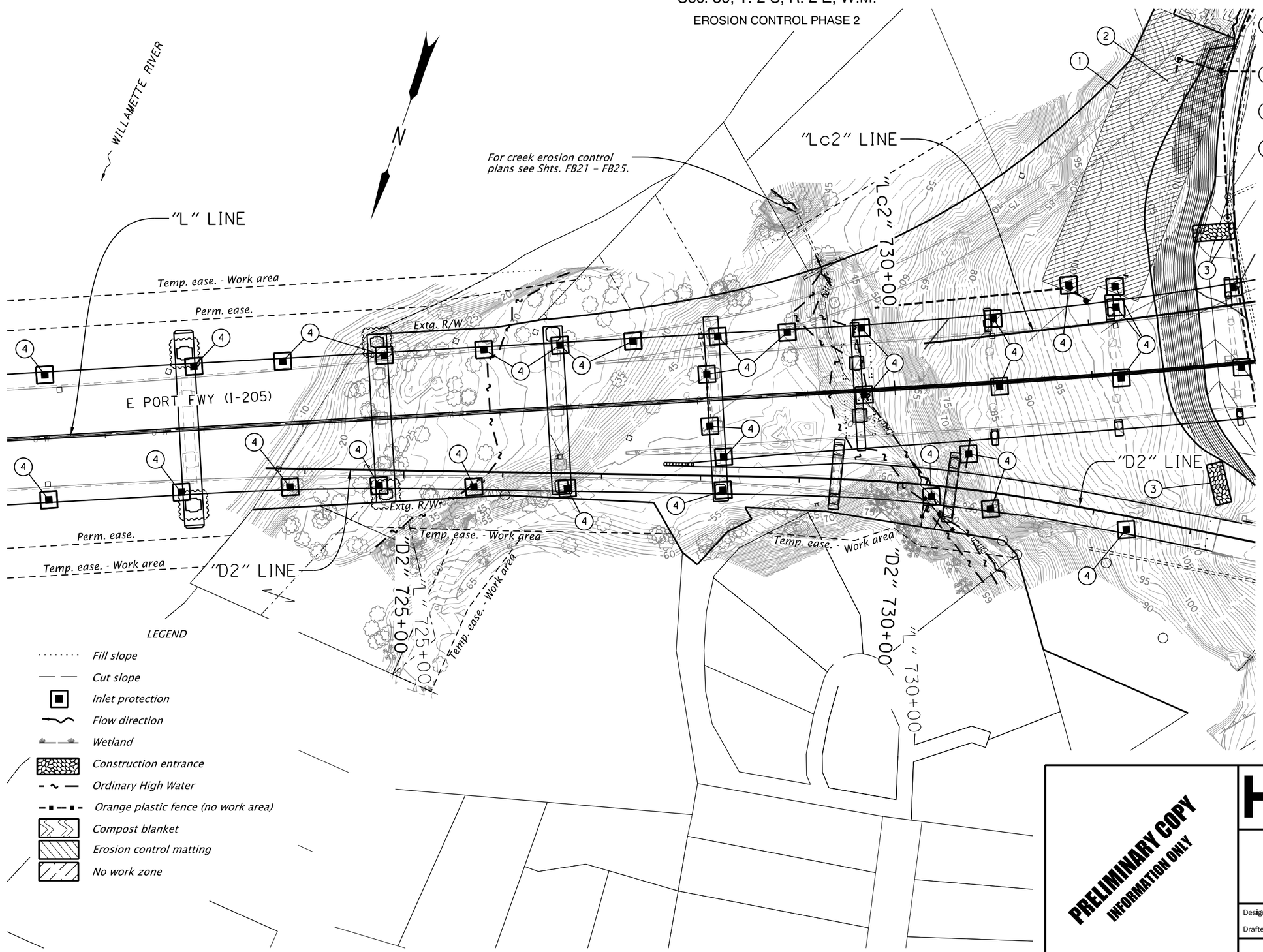
Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO.
FB17

Sec. 30, T. 2 S, R. 2 E, W.M.

EROSION CONTROL PHASE 2



1. Install matting - xx (Flexible channel liner, Type F) (See drg. no. RD1055)
2. Install compost erosion blanket - xx For details, see sht. FB-01
3. Const. construction entrance - xx (See drg. no. RD1000)
4. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO. FB18

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

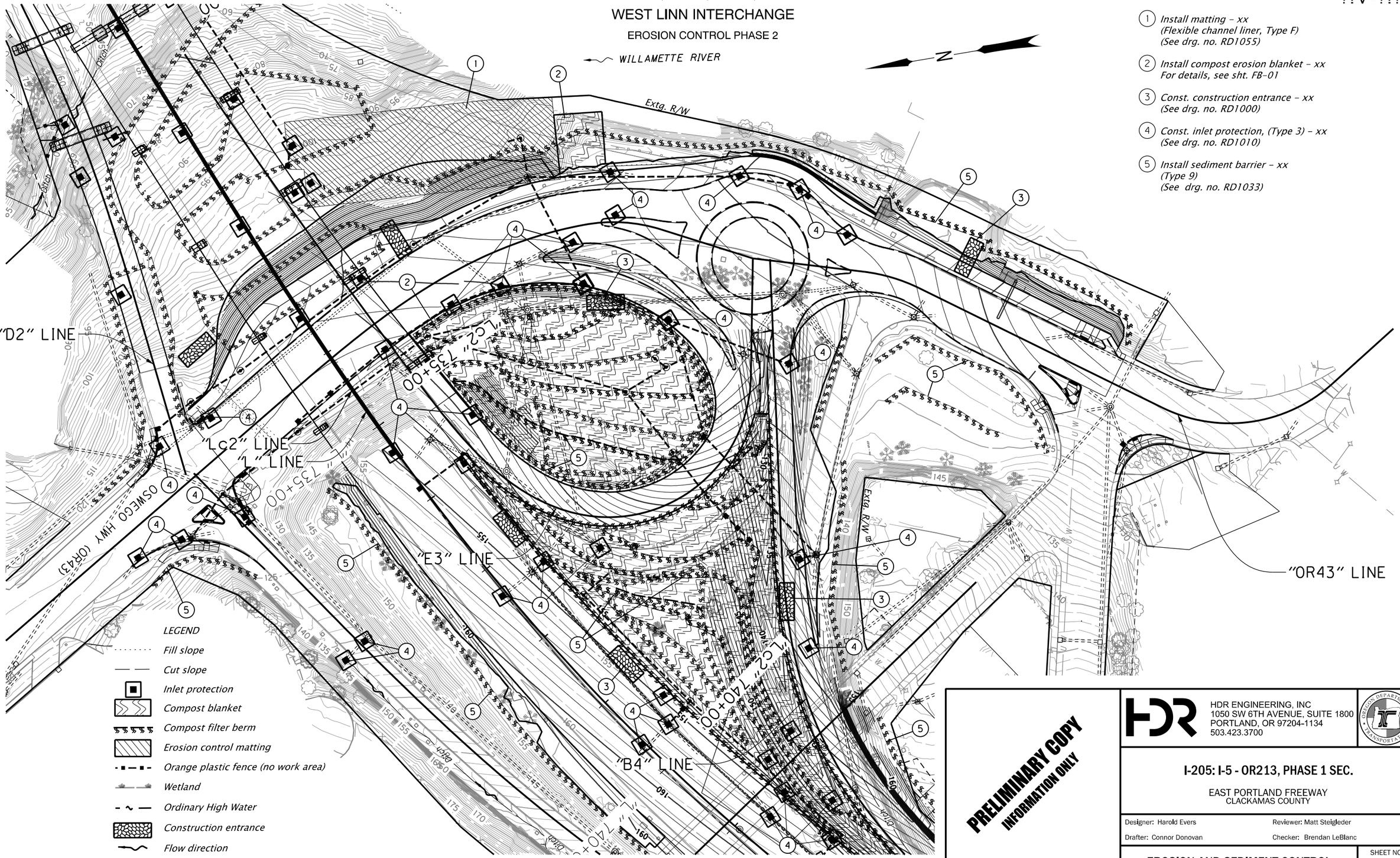
Rotation: 198.4431° Scale: 1"=100'

Sec. 30, T. 2 S, R. 2 E, W.M.

WEST LINN INTERCHANGE

EROSION CONTROL PHASE 2

??V-???



1. Install matting - xx (Flexible channel liner, Type F) (See drg. no. RD1055)
2. Install compost erosion blanket - xx For details, see sht. FB-01
3. Const. construction entrance - xx (See drg. no. RD1000)
4. Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)
5. Install sediment barrier - xx (Type 9) (See drg. no. RD1033)

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

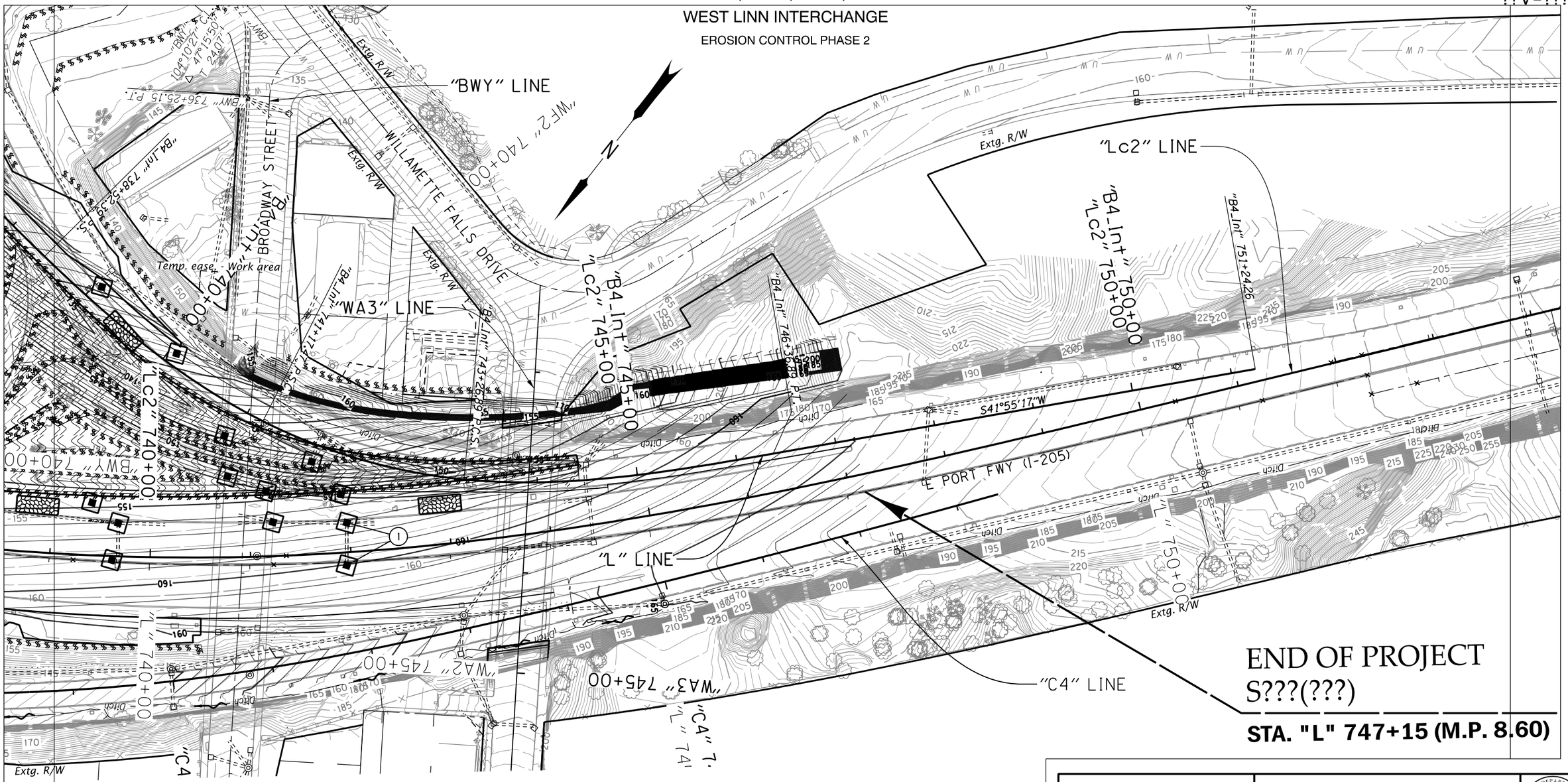
SHEET NO. FB19

Sec. 30, T. 2 S, R. 2 E, W.M.

WEST LINN INTERCHANGE

EROSION CONTROL PHASE 2

??V-???



LEGEND

- Fill slope
- Cut slope
- Inlet protection
- Check dam in ditch section
- Compost blanket
- Compost filter berm
- Wetland
- Ordinary High Water
- Construction entrance
- Flow direction
- Orange plastic fence (no work area)
- Erosion control matting

(1) Const. inlet protection, (Type 3) - xx (See drg. no. RD1010)

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CLACKAMAS COUNTY

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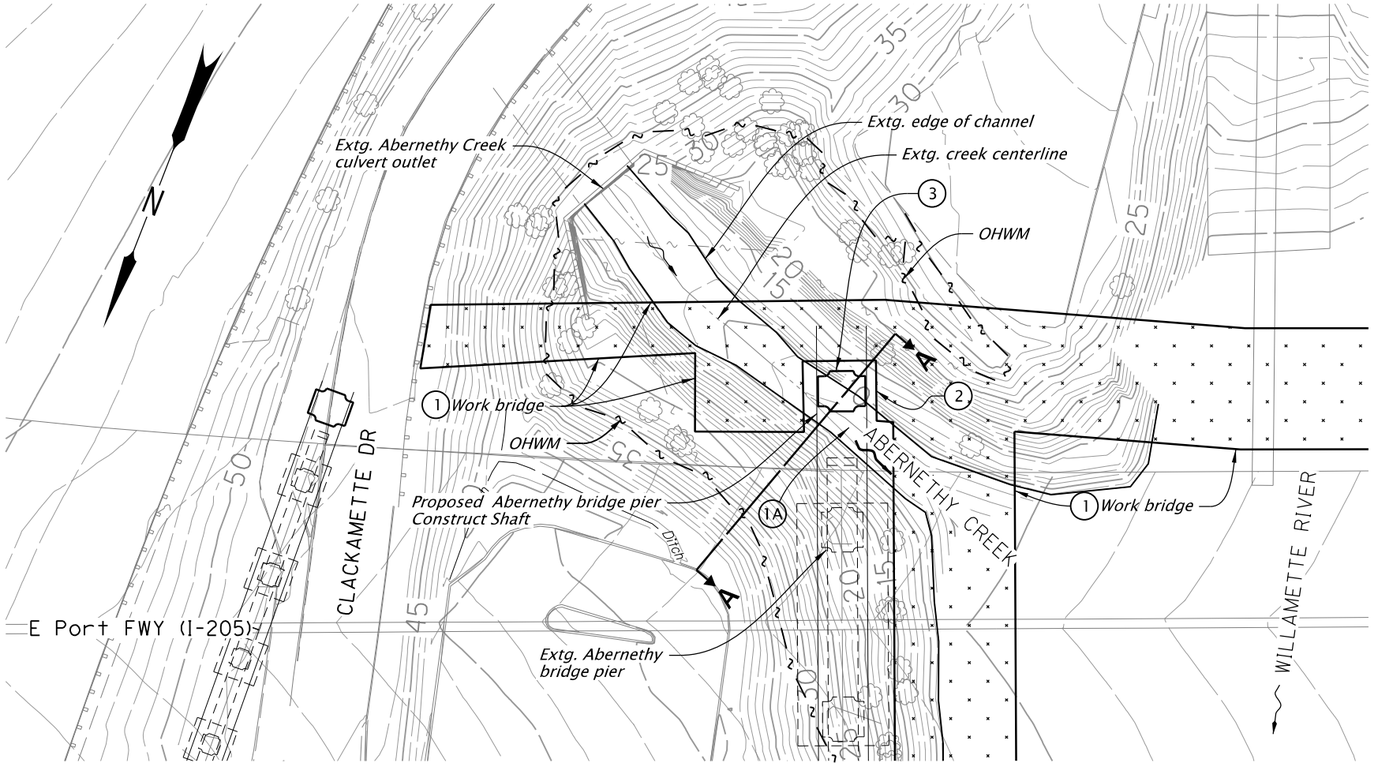
EROSION AND SEDIMENT CONTROL

SHEET NO.
FB20



Abernethy Creek - Phase 1
(In-water-work activity)
Construct temporary work bridge and Pier 3, south side.

CONSTRUCTION SEQUENCE

1A *Remove existing rip rap (as required)*

1 *Install temporary work bridge*

2 *Install temporary shoring at Pier 3*

3 *Construct shaft*

Note:
Work bridge location and temporary work access is shown for reference only and is subject to change.

Temporary work access must accommodate existing flow rates for Abernethy Creek
See sht. XX for additional shoring details.

See sht. FB 24 for section A–A.

LEGEND

- *Fill slope*
- *Cut slope*
- *Ordinary High Water*
- *Flow direction*

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO.
FB21

FINAL ELECTRONIC DOCUMENT
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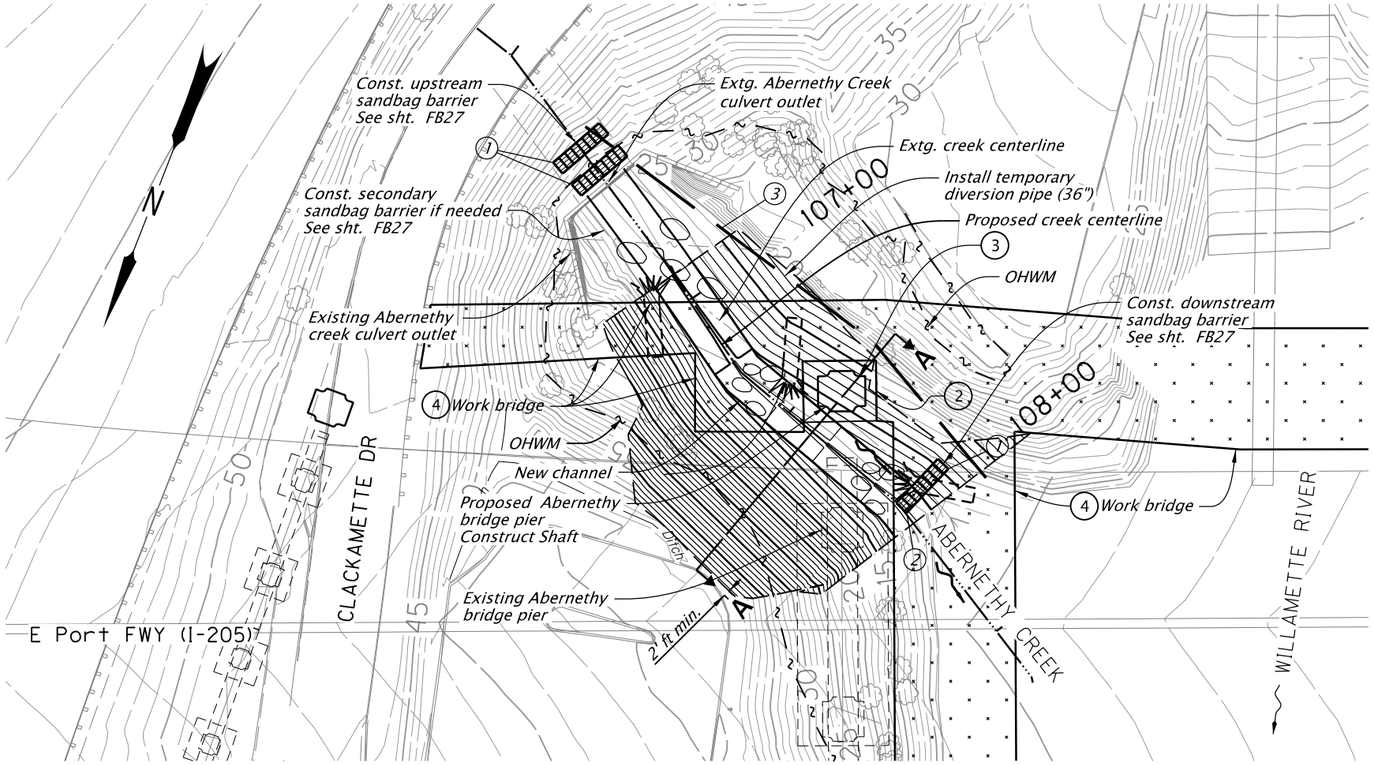
Rotation: 201.4396° Scale: 1"=50'



Abernethy Creek Construction - Phase 2A
(In-water-work)
Complete Pier 3 south side architetural treatment and channel restoration

CONSTRUCTION SEQUENCE

1. *Complete architectural finish on Pier 3 southern shaft*
2. *Install temporary diversion*
3. *Remove coffer dam at soutern shaft of Pier 3*
4. *Remove work bridge*
5a. *Realign Abernethy Creek*
5b. *Remove temporary water management features*
6. *Install channel restoration features*

FULL ISOLATION NOTES:

1. *Isolating the work site upstream: Install single primary sandbag barrier across the stream channel. If Needed, install secondary sandbag barrier. Downstream: Install sandbag barrier.*
2. *Install sandbag barrier downstream from work area. Location to be set based on topography and easements available.*
3. *Size the temporary water management facility based on site conditions. Route water around work area using pipe, pump or combination. The discharge table below can be used to estimate the size of the bypass pipe and/or pump.*

Note:
Work bridge location and temporary work access is shown for reference only and is subject to change.

Temporary work access must accommodate existing flow rates for Abernethy Creek
See sht. XX for additional shoring details.

LEGEND

- *Fill slope*
- *Cut slope*
- *Ordinary High Water*
- *Flow direction*

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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Drafter: Connor Donovan | Checker: Brendan LeBlanc

EROSION AND SEDIMENT CONTROL

SHEET NO. FB22

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

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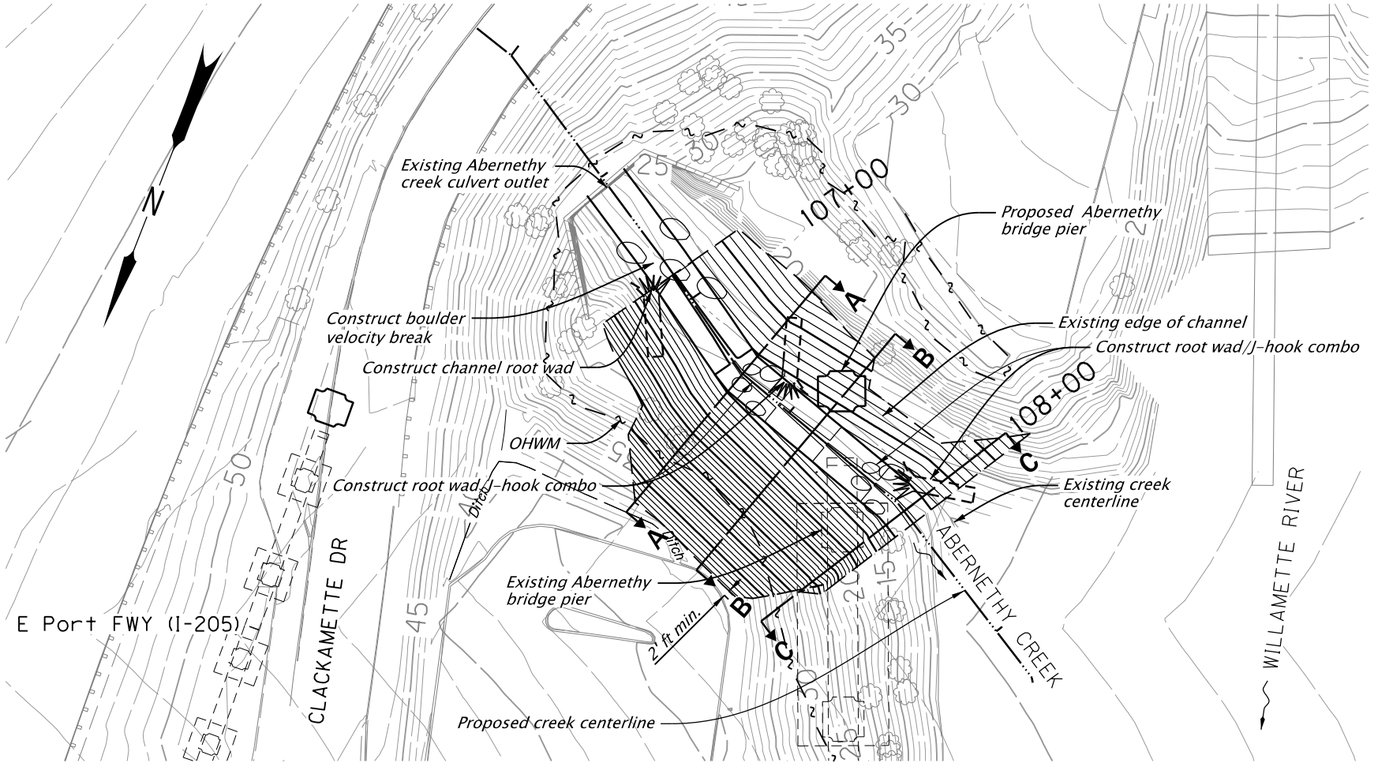


Notes:
Root wad key pieces should be at least 22 inches in diameter and buried 10-15 feet.

Boulders and structure rocks should be greater than 30 inches in diameter.

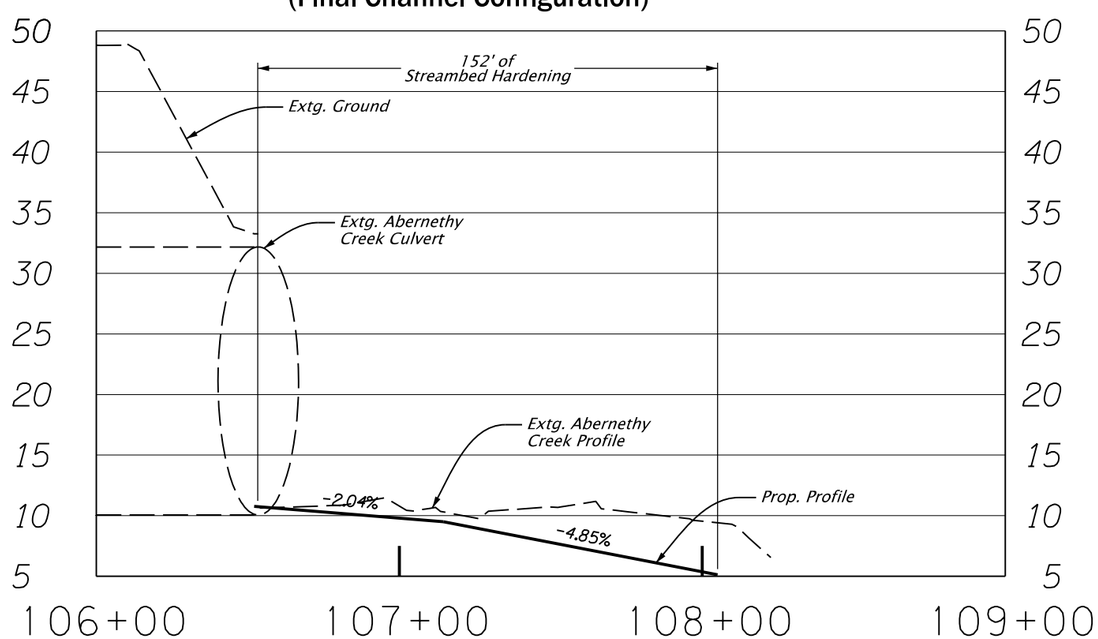
For root wad/J-hook combo, channel root wad, and boulder velocity break, see details XX, XX, and .

For section B-B, see sht. FB24. For section A-A and C-C, see sht. FB25.

LEGEND

- Fill slope
- Cut slope
- Ordinary High Water
- Flow direction

Abernethy Creek - Phase 2B
(Final Channel Configuration)



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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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Drafter: Connor Donovan
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EROSION AND SEDIMENT CONTROL

SHEET NO.
FB23

FINAL ELECTRONIC DOCUMENT AVAILABLE UPON REQUEST

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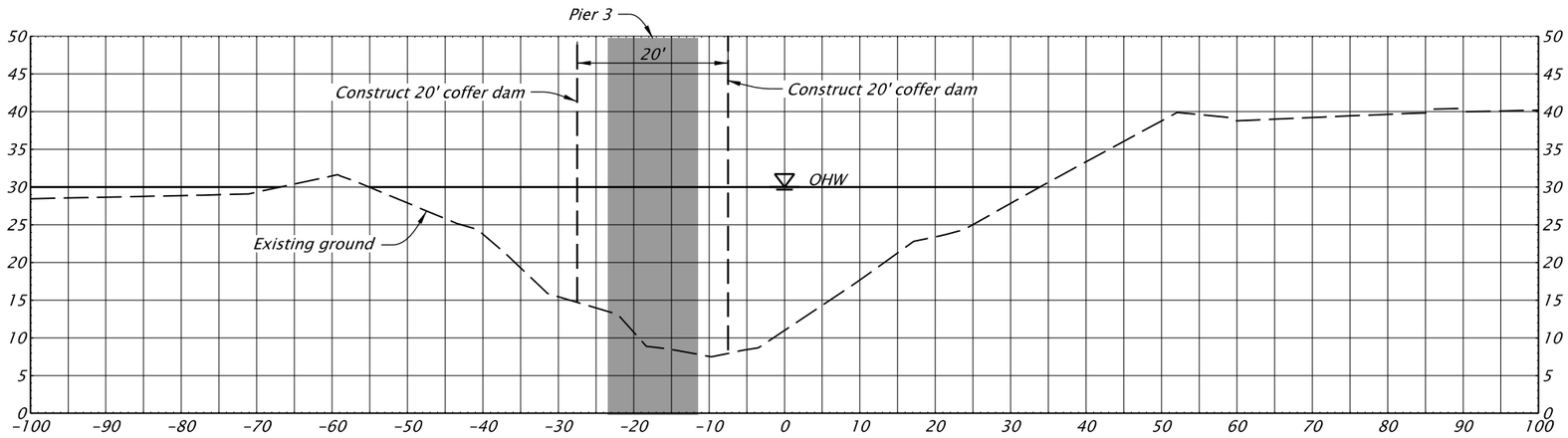
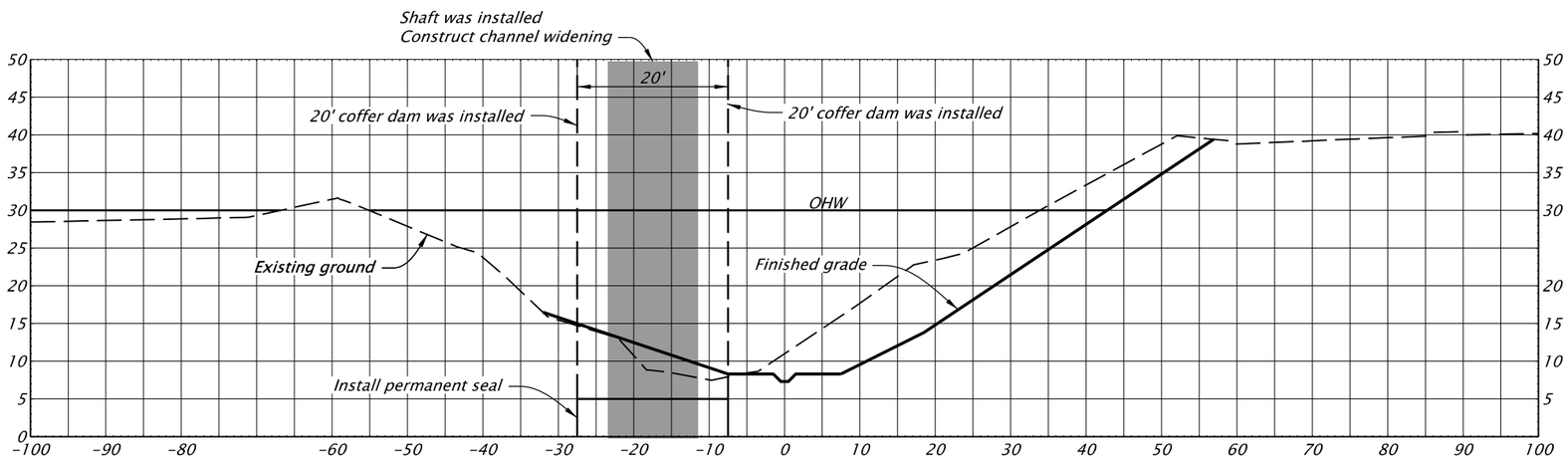


SECTION A-A STAGE 1

Stage 1:

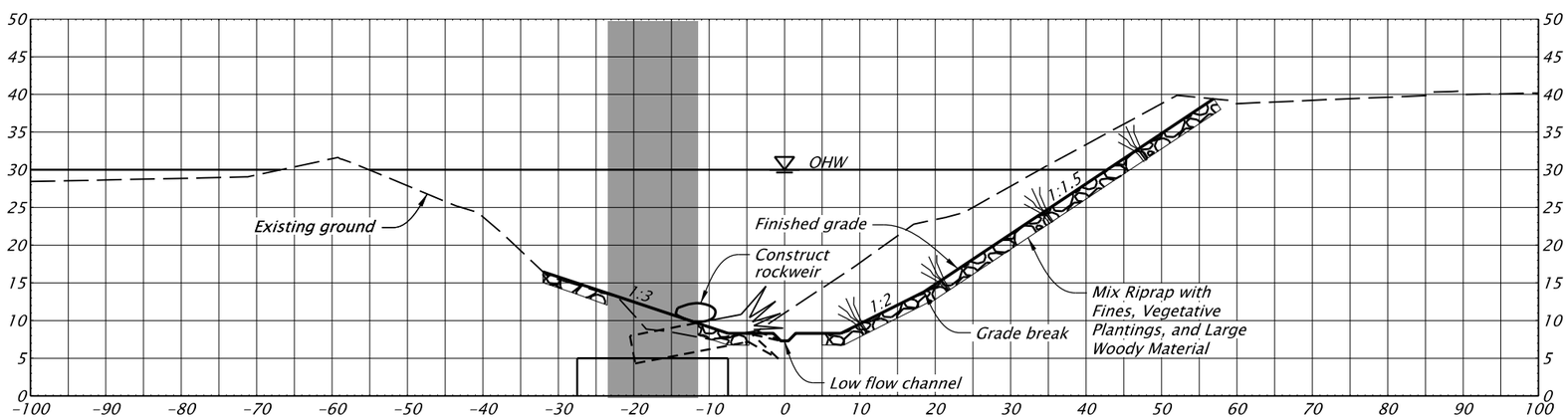
- Construct shaft
- Temporary coffer dam



SECTION A-A STAGE 2A

Stage 2A:

- Complete architectural treatment at Pier 3 (south side)
- remove coffer dam and temporary work bridge
- Construct Abernethy Creek channel realignment
- Complete final creek restoration



SECTION B-B STAGE 2B

Stage 2B:

- Complete final creek reconfiguration

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EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

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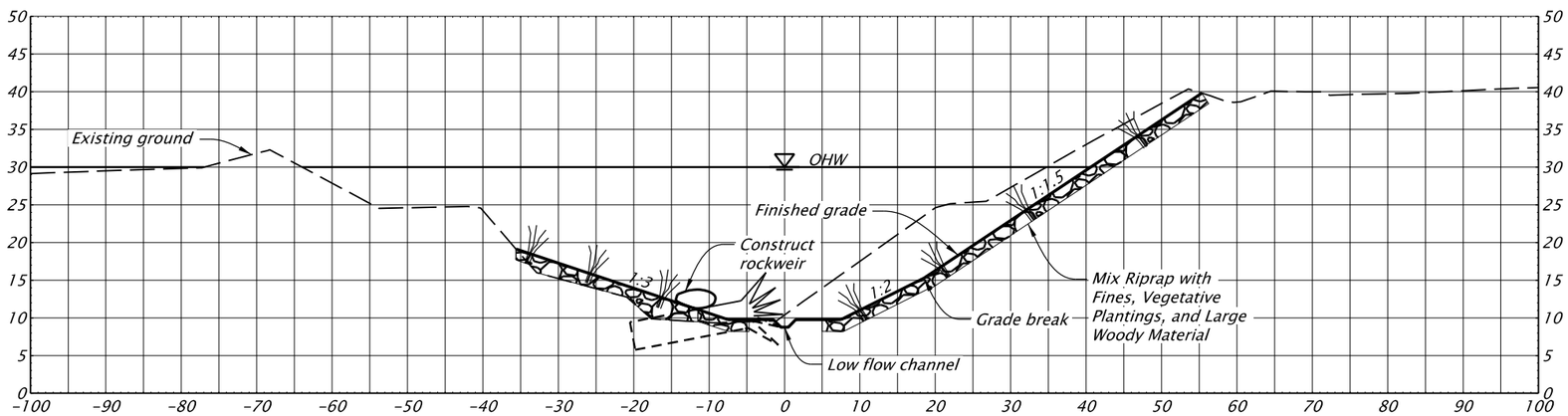
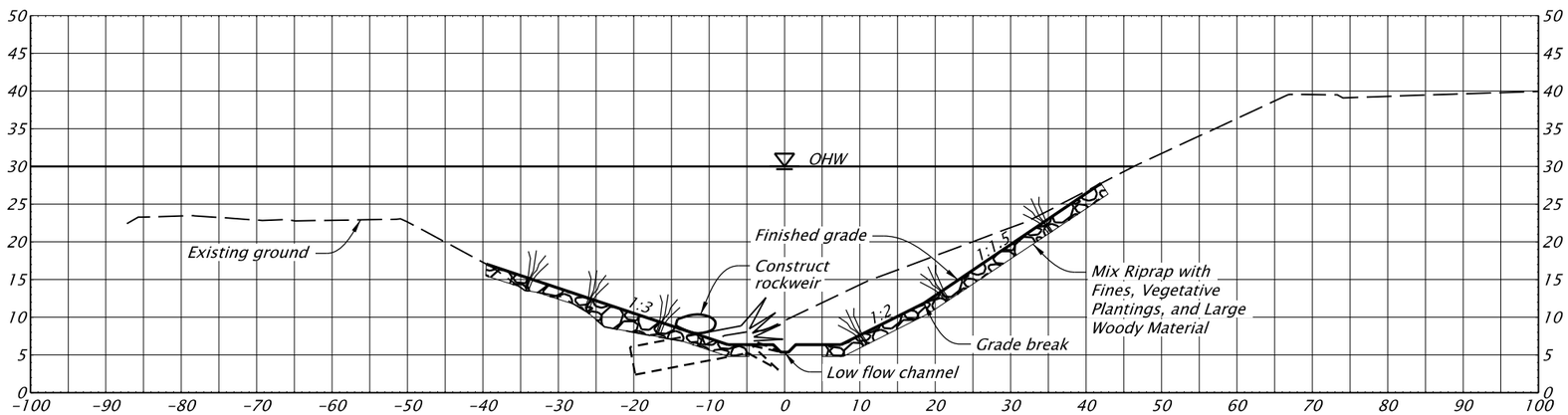
EROSION AND SEDIMENT CONTROL

SHEET NO.
FB24



SECTION A–A STAGE 2B



SECTION C–C STAGE 2B

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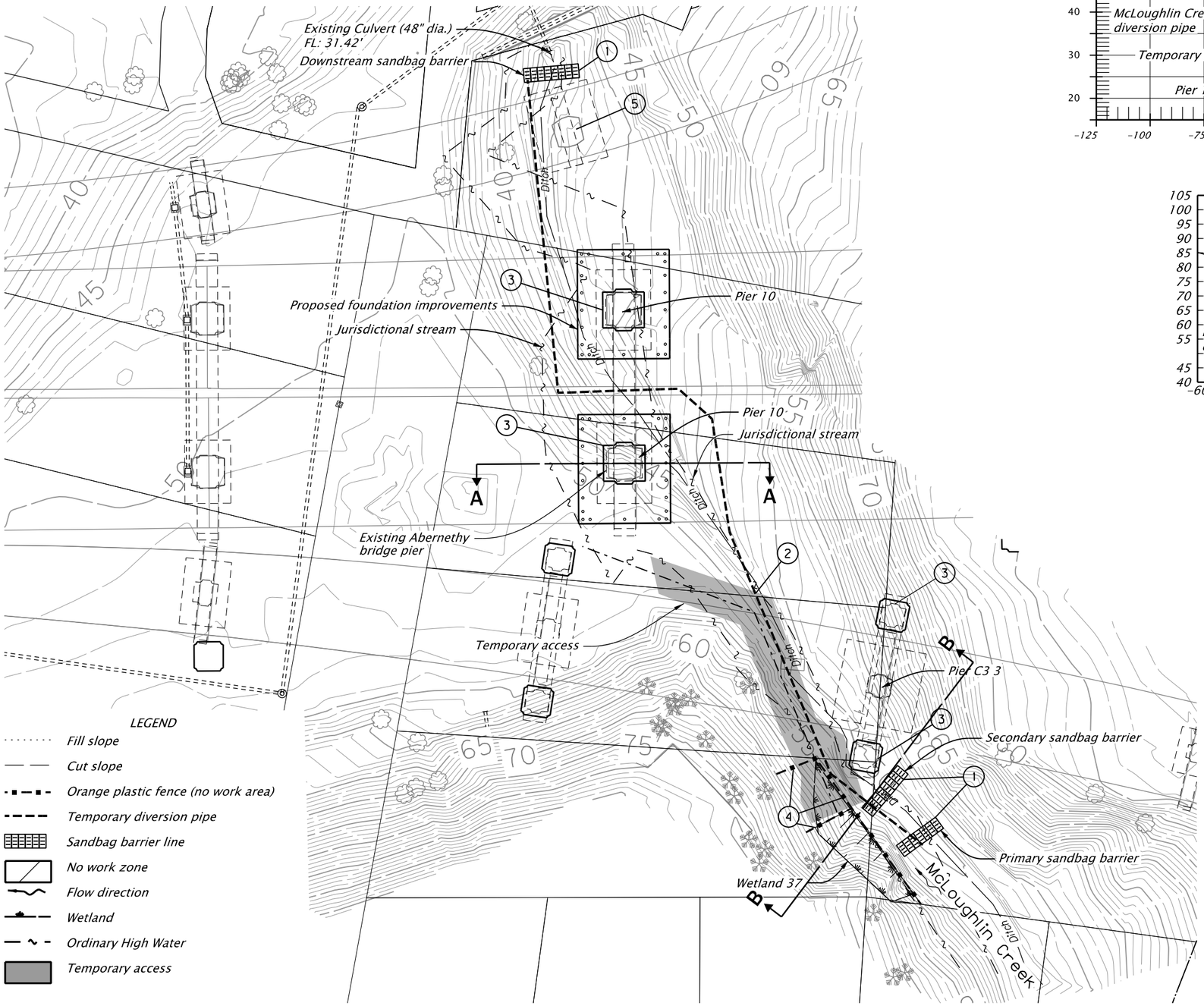
EAST PORTLAND FREEWAY
CLACKAMAS COUNTY

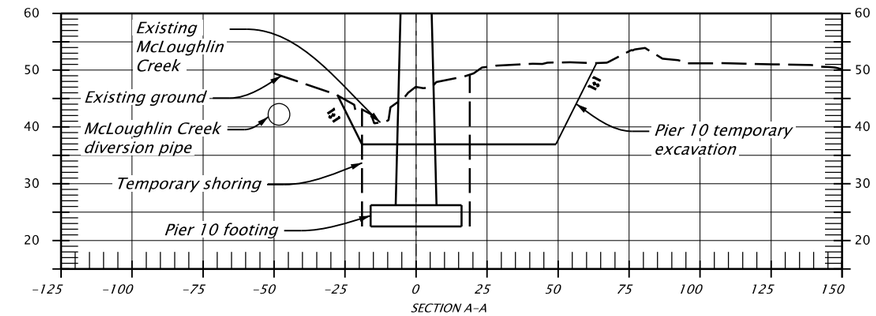
Designer: Harold Evers
Reviewer: Matt Steigleder
Drafter: Connor Donovan
Checker: Brendan LeBlanc

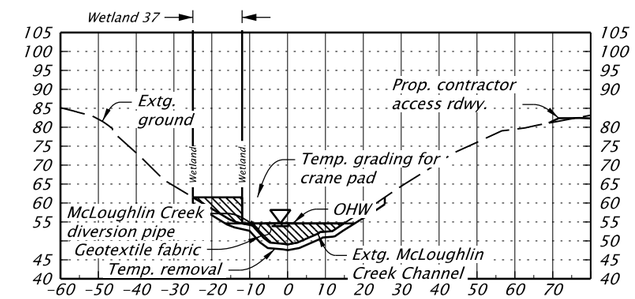
EROSION AND SEDIMENT CONTROL

SHEET NO.
FB25

McLoughlin Creek - Phase 1
Construct temporary dike
(In-water-work activities)
Construct shaft







Note:

For additional erosion control details not shown, see FB27.

Work below OHW cannot exceed 18 months. Install and remove temporary water diversion during in-water work window.

1. Install temporary BMPs and flow diversion
2. Install temporary diversion pipe (18" dia.)
3. Construct shaft
4. Install orange plastic fence (no work area)
5. Remove existing pile cap and bridge column

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CLACKAMAS COUNTY

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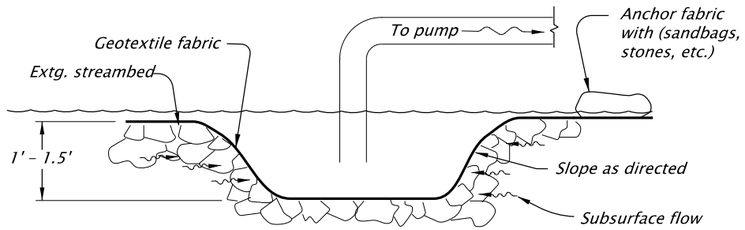
EROSION AND SEDIMENT CONTROL

SHEET NO. FB26

TEMPORARY WATER MANAGEMENT FACILITY



SUMP DETAIL

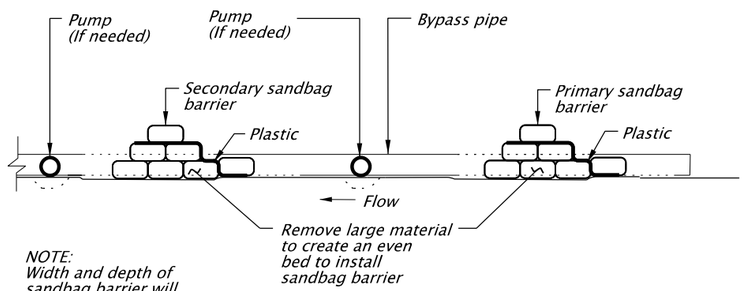
NTS

GENERAL NOTES:

The implementation of this Temporary Water Management Plan and the construction, maintenance, replacement and upgrading of this facility is the responsibility of the contractor until all construction is completed and approved.

The Temporary Water Management Facility shown on this plan is the minimum requirements for anticipated site conditions. During the construction periods, this facility shall be upgraded for unexpected storm events and to insure that sediment and sediment-laden water does not leave the site.

Remove all Temporary Water Management features and restore site as per plans and specifications.



NOTE:
Width and depth of sandbag barrier will vary depending on site and stream flow conditions.

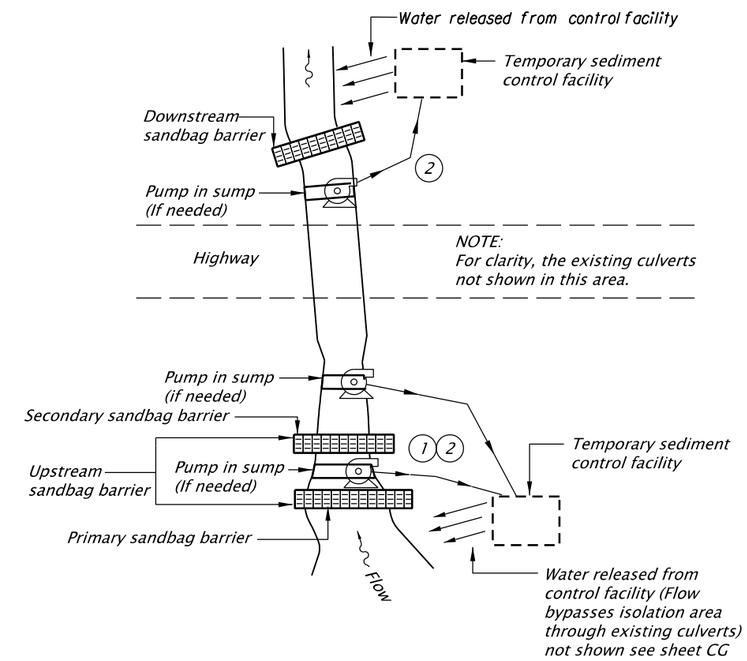
SANDBAG BARRIER SECTION

LEGEND:

Sandbag barrier line

Sediment control facility

Sump pump



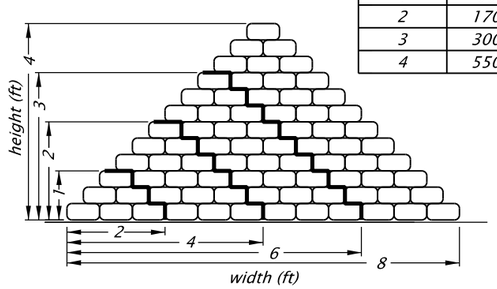
COMBINED PUMP/GRAVITY BYPASS DETAIL

NTS

A common recommendation is to make the sandbag barrier twice as wide as its height (e.g., a one foot high wall would have a base width of 2 feet). This is the minimum width-to-height ratio that should be used to construct a sandbag barrier. This is based on each bag having a placed dimension of about 4 to 5 inches high by 9 to 10 inches wide by 14 inches long. This is a 30 pound bag of dry sand.

The estimated number of bags needed for 100 linear feet of barrier that is twice as wide as its height is:

Height (ft)	# bags
1	600
2	1700
3	3000
4	5500



FULL ISOLATION NOTES:

1. See sheet FB22 note.
2. See sheet FB22 note.

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EROSION AND SEDIMENT CONTROL

SHEET NO.
FB27