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CIVIL ENGINEERING | WATER RESOURCES | COMMUNITY PLANNING

PRELIMINARY STORMWATER REPORT

Alden Apartments
7800 SW Sagert Street & 20400 SW Martinazzi Avenue
Tualatin, OR 97062

September 1, 2022

Prepared For:

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Project No: 22791
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DESIGNER'S CERTIFICATION & STATEMENT

I hereby certify that this Preliminary Stormwater Management Report for the Alden Apartments development has been prepared by me or under my supervision and meets minimum standards of the City of Tualatin, Clean Water Services, ODOT, and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.

EXECUTIVE SUMMARY

The Alden Apartments project is proposed at 7800 SW Sagert Street & 20400 SW Martinazzi Avenue (tax lot 2S125BA0100), Tualatin, Washington County, Oregon. The property is 16.53 ac in size. This project is within the jurisdictions of City of Tigard and CWS. The project discharges to storm drain infrastructure within ODOT ROW.

This project proposes to redevelop 1.85 acres of the 16.53-ac lot. Proposed improvements include twelve (12) new apartment buildings, parking lots, other hardscaping, landscaping, and appurtenant utility improvements. Due to the amount of impervious area modified/created, stormwater management approaches must be proposed and will be addressed as follows:

- Water Quality Treatment
  - Two (2) Infiltration Planters are proposed to treat runoff from post-developed basins in the northern and southern portions of the site.
  - A Proprietary Treatment Device (BayFilter Manhole) is proposed to treat runoff from the post-developed basin consisting of the centrally located, main redevelopment area.
- Hydromodification Management
  - The proposed Infiltration Planters mentioned above will provide hydromodification management for their contributing basins.
  - A 10,500-cf Underground Infiltration Facility is proposed to provide hydromodification management for its contributing basin (main redevelopment area).
- Water Quantity Management
  - A Downstream Analysis will be included in the Final Stormwater Report. If downstream deficiencies exist, proposed detention/retention facilities will be designed to mitigate the 25-yr storm.
  - Since the project discharges to ODOT storm drain infrastructure, proposed detention/retention facilities will be designed to mitigate the 50-yr storm.

An Operations & Maintenance Plan will be provided in the Final Stormwater Report for all stormwater management facilities.

A Conveyance Analysis will be provided in the Final Stormwater Report demonstrating sufficient flow capacity in the proposed private storm drain systems.

Please refer to this project's Construction Plans for locations and construction details of all stormwater management facilities.

The purpose of this report is to accomplish the following.

- Describe pre- and post-developed basins and drainage;
- Describe the design and analysis of the proposed stormwater management facilities; and,
- Demonstrate compliance with City of Tualatin, Clean Water Services, and ODOT standards pertaining to stormwater management.

PROJECT DESCRIPTION

The Alden Apartments project is proposed at 7800 SW Sagert Street & 20400 SW Martinazzi Avenue, Tualatin, Oregon. The property is 16.53 ac in size. This project is within the jurisdictions of City of Tigard and Clean Water Services (CWS). The project will also discharge to storm drain infrastructure within ODOT right-of-way (ROW).

This project proposes to redevelop 1.85 acres of the 16.53-ac lot. Proposed improvements include new apartment buildings, parking lots, other hardscaping, landscaping, and appurtenant utility improvements. Due to the amount of impervious area modified/created, stormwater management approaches must be proposed. Runoff from the project site ultimately discharges to Saum Creek.

The design and analysis of required stormwater management approaches will be per City of Tualatin standards, CWS' *Design & Construction Standards for Sanitary Sewer & Surface Water Management* (CWS D&C; 2019), and ODOT's *Hydraulics Design Manual* (Apr 2014).

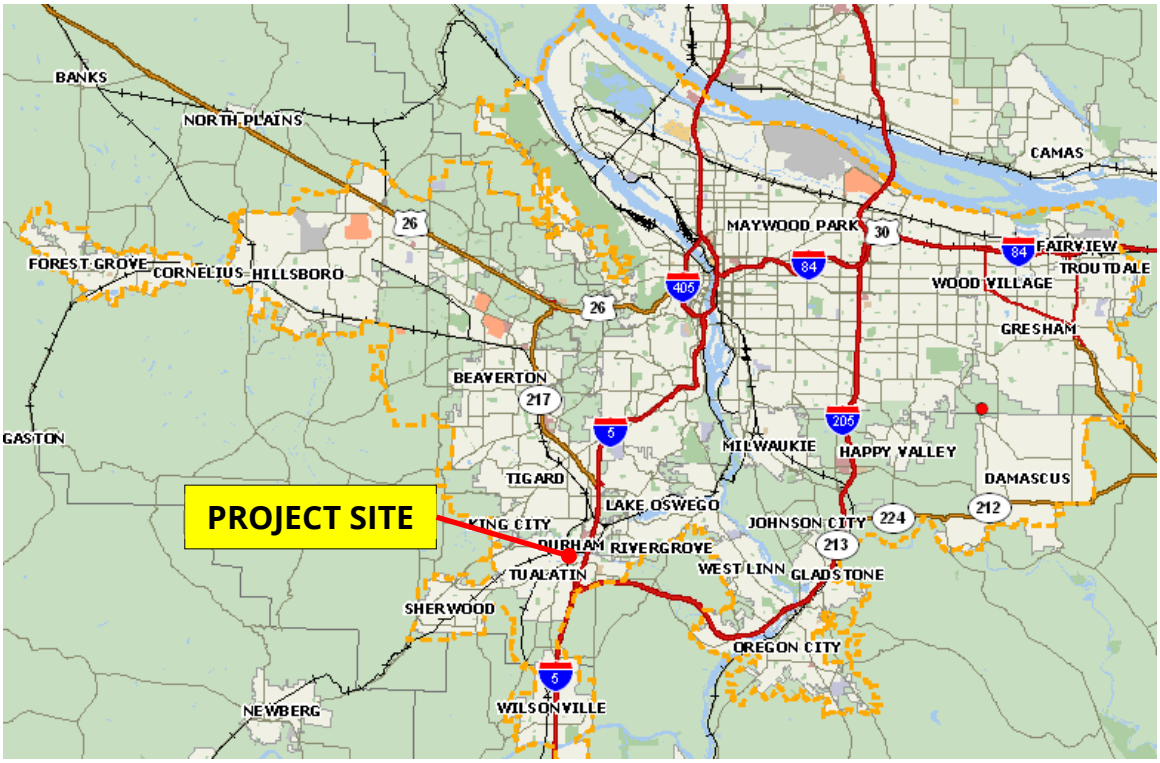


Figure 1 – Vicinity Map

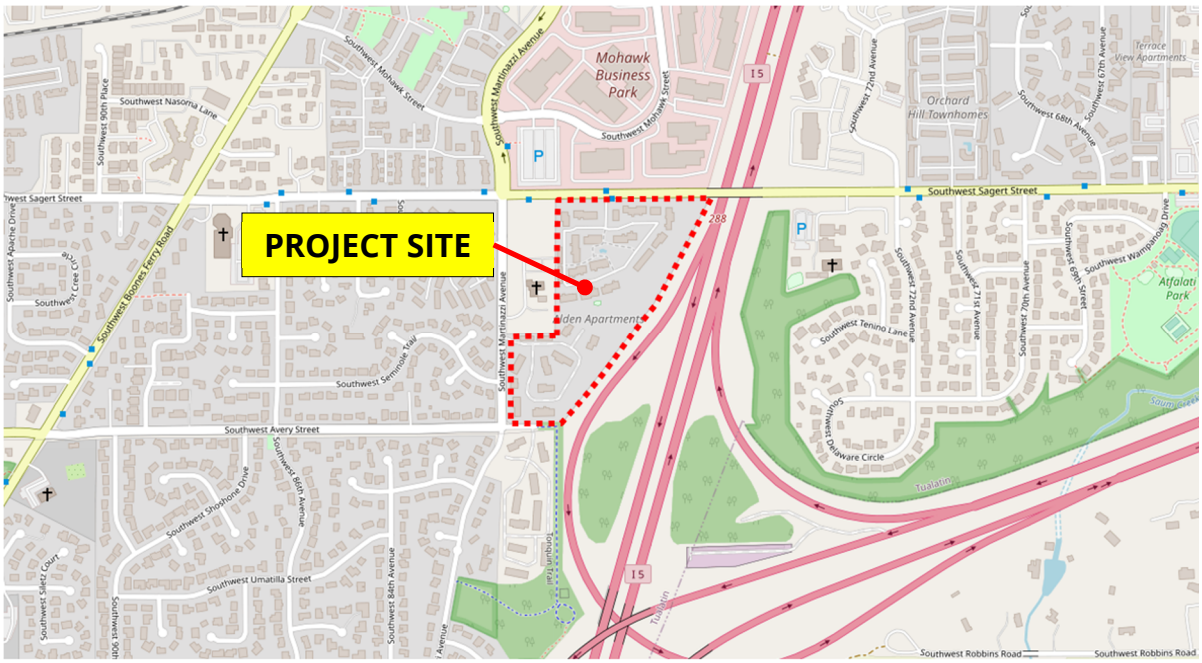


Figure 2 – Site Location

EXISTING CONDITIONS

Site

In existing conditions, the project site is occupied by The Alden apartment complex, consisting of multiple apartment buildings, parking lots, driveways, other hardscaping, and landscaping. The property has a size of 16.53 ac; however, this project will result in redeveloping 1.85 acres onsite (project site). The two onsite basketball courts, two adjacent apartment buildings, and the parking lot nearest the court will be demolished for this redevelopment.

The project site is noncontiguous and was divided into three (3) basins for design and analysis (see Technical Appendix: Exhibits – Existing Conditions). The basins were denoted as North Basin, Main Basin, and South Basin.

Flood Map

The site is located within Zone X (unshaded) per flood insurance rate map (FIRM) community-panel number 41067C0607E (See Technical Appendix: Exhibits – FIRMette). FEMA's definition of Zone X (un-shaded) is an area of minimal flood hazard.

Soil Type & Infiltration

USDA Web Soil Survey indicates that the project site is underlain with Hillsboro Loam, which is categorized as hydrologic soil group B (See Technical Appendix: Exhibits – Hydrologic Soil Group). Per CWS D&C, Hillsboro Loam is expected to have an infiltration rate of approximately 2 in/hr; therefore, infiltration-based facilities will be modeled with this design rate for preliminary sizing. Infiltration rates will be confirmed with further testing.

Drainage

The project site either drains directly to the existing vegetated channel to the east or to the southeast corner of the property to two (2) existing catch basins, which proceed to discharge to the vegetated channel. The channel conveys flow to storm drain infrastructure within the ODOT right-of-way, which conveys flow easterly for approximately 0.5 miles and discharges to Saum Creek.

Basin Areas

Table 1 shows the existing impervious and pervious areas for each basin (See Technical Appendix: Exhibits – Existing Conditions). All existing impervious areas in the basins are expected to be modified.

Basin	Impervious Area		Pervious Area		Subtotal Area	
	sf	ac	sf	ac	sf	ac
North	967	0.02	5,921	0.14	6,888	0.16
Main	30,356	0.70	35,260	0.81	65,616	1.51
South	1,907	0.04	6,000	0.14	7,907	0.18
Total	33,230	0.76	47,181	1.08	80,411	1.85

Table 1 – Existing Basin Areas

POST-DEVELOPED CONDITIONS

Site & Drainage

This project proposes twelve (12) new apartment buildings, parking lots, other hardscaping, landscaping, and appurtenance utilities. The project also proposes storm drain infrastructure to capture and convey runoff from the post-developed basins to stormwater management facilities before discharging to the vegetated channel to the east as in existing conditions (see Technical Appendix: Exhibits – Post-Developed Conditions).

Basin Areas

Table 2 shows the post-developed impervious and pervious areas for each basin (See Technical Appendix: Exhibits – Post-Developed Conditions).

Basin	Impervious Area		Pervious Area		Subtotal Area	
	sf	ac	sf	ac	sf	ac
North	6,428	0.15	460	0.01	6,888	0.16
Main	58,146	1.33	7,470	0.17	65,616	1.51
South	6,836	0.16	1,071	0.02	7,907	0.18
Total	71,410	1.64	9,001	0.21	80,411	1.85

Table 2 – Post-Developed Basin Areas

When comparing Tables 1 & 2, the project proposes 38,180 sf (i.e., 71,410 – 33,230) of new impervious area.

HYDROLOGIC ANALYSIS

Design Guidelines

The site is located within the jurisdictions of the City of Tualatin and Clean Water Services (CWS), and discharges to storm drain infrastructure under ODOT jurisdiction. The guidelines used for the design of this project reflect current City of Tualatin standards, CWS D&C, and ODOT *Hydraulics Design Manual*.

Hydrograph Method

Naturally occurring rainstorms dissipate over long periods of time. An effective way of estimating storm rainfall is by using the hydrograph method. The Santa Barbara Urban Hydrograph (SBUH) method was used to develop runoff rates, which follows City, CWS, and ODOT standards. The computer software XPSTORM was used to perform SBUH calculations to compare predeveloped and post-developed runoff responses.

Design Storms

The Type 1A rainfall distribution (24-hr duration) was used in conjunction with the SBUH. Table 3 shows total precipitation depths referenced from the CWS D&C, which were used as multipliers for the Type 1A distribution to develop the rainfall distribution for each recurrence interval.

Recurrence Interval (yr)	Precipitation Depth (in)
2	2.50
5	3.10
10	3.45
25	3.90
50	4.20

Table 3 – Design Storms

Curve Number

The curve number represents runoff potential from the ground. The major factors for determining runoff curve numbers (CN) are hydrologic soil group, cover type, treatment, hydrologic condition, and antecedent runoff condition. Table 2-2a from the TR-55 *Urban Hydrology for Small Watersheds* manual was used to determine the appropriate curve numbers (See Technical Appendix: Exhibits – Curve Numbers).

As indicated previously, the site is underlain by soil type B. In predeveloped conditions, pervious areas were modeled with a CN of 55, which is associated with woods in good condition. Per CWS D&C, modified impervious areas were modeled with a CN of 75. In post-developed conditions, pervious areas were modeled with a CN of 61, which is associated with lawn in good condition. Impervious areas were modeled with a CN of 98.

Time of Concentration

In accordance with the CWS D&C, the predeveloped time of concentration (Tc) was evaluated per the USDA's TR-55 manual. The Tc's for North, Main, and South Basins were calculated to be 9, 7, and 8 minutes, respectively (See Technical Appendix: Calculations – Time of Concentration). For conservativeness, a Tc of 10 minutes was assumed for all predeveloped basins. The post-developed Tc for all basins was assumed to be 5 minutes.

Basin Runoff

Pre- and post-developed peak runoff rates for each basin, evaluated using SBUH, are shown in Table 4 (See Technical Appendix: Hydrographs).

Recurrence Interval (yr)	North Basin Peaks (cfs)			Main Basin Peaks (cfs)			South Basin Peaks (cfs)		
	Pre	Post	Incr.	Pre	Post	Incr.	Pre	Post	Incr.
2	0.004	0.090	0.086	0.063	0.769	0.706	0.002	0.085	0.083
5	0.008	0.113	0.105	0.125	0.964	0.839	0.004	0.107	0.103
10	0.010	0.127	0.117	0.166	1.079	0.913	0.005	0.120	0.115
25	0.014	0.145	0.001	0.222	1.232	1.010	0.007	0.136	0.129
50	0.018	0.157	0.139	0.271	1.335	1.064	0.010	0.147	0.137

Table 4 – Peak Runoff Rates

WATER QUALITY TREATMENT

Design Criteria

Per CWS D&C, stormwater treatment facilities are required to be designed to treat all runoff produced during the water quality storm event. CWS defines this event as 0.36" of precipitation falling over 4 hours with a return period of 96-hours.

Required Treatment Area

Per CWS D&C, the impervious area requiring water quality treatment is evaluated as the new impervious area plus three times the modified impervious area; the calculation is shown below. It was previously indicated that the project results in 38,180 and 33,230 sf of new and modified impervious area, respectively.

Required Treatment Area = New Impervious Area + 3 x Modified Impervious Area
= 38,180 sf + 3 X 33,230 sf = 137,870 sf

The calculated treatment area exceeds the post-developed impervious area (i.e., 71,410 sf); therefore, the required treatment area is 71,410 sf.

LIDA Feasibility

Per Section 4.05 of the CWS D&C, new development shall reduce its hydrologic impacts through Low Impact Development Approaches (LIDA) unless the criteria in 4.05.2 apply.

Water Quality Approaches

Infiltration Planters

Infiltration Planters are proposed to treat runoff from North & South Basins (see Technical Appendix: Exhibits – Post-Developed Conditions). The facilities were modeled in XPSTORM to demonstrate that all runoff produced during the water quality storm will be filtered through the growing medium with no overflow bypass.

Each Planter will consist of 18" of surface ponding, 18" of growing medium, and 18" of drain rock. Overflow will be managed by an 18"-diameter beehive structure with RIM 12" above the bottom of the surface pond; this provides 6" of freeboard. The infiltration rate for the growing medium is assumed to be 2 in/hr. The porosity of the drain rock is assumed to be 40%. Table 5 outlines the resulting ponding depths within the Planters.

Post-Dev. Basin	CIA (sf)	Infiltration Planters	
		Area (sf)	WQ Ponding (in)[1]
North	6,428	520	0.6
South	6,836	500	0.6

Table 5 – Infiltration Planters (WQ Compliance)

[1]Ponding during WQ storm (see Technical Appendix: Hydrographs – Stage Hydrographs)

The table above demonstrates that all runoff during the water quality storm is expected to infiltrate through the growing medium without bypass.

Proprietary Treatment Device

Due to site constraints, a BayFilter Manhole (Proprietary Treatment Device) is proposed to treat runoff from the Main Basin prior to discharging to an Underground Infiltration Facility (see Technical Appendix: Exhibits – Post-Developed Conditions). The treatment manhole will be equipped with BayFilter 545 cartridges, which have a treatment capacity of 45 gpm (0.10 cfs). The following equation was used in conjunction with the water quality storm event to determine the water quality flow rate for the treatment manhole.

Water Quality Flow (WQF) = (Required Treatment Area, sf) x 0.36" x (1 ft/12 in) / (4 hr x 3600 sec/1 hr)
= (58,146 sf) x 0.36" x (1 ft/12 in) / (4 hr x 3600 sec/1 hr) = 0.12 cfs

Two (2) BayFilter 545 cartridges can be implemented to treat the WQF above. The treatment capacity of this facility is 0.20 cfs.

Summary of Approaches

Table 6 summarizes the provided treatment by each proposed approach.

Post-Dev. Basin	Water Quality Approach	Impervious Area (sf)
North	Infiltration Planter	6,428
Main	Proprietary Treatment Device	58,146
South	Infiltration Planter	6,836
Total	-	71,410

Table 6 – Summary of Approaches

The table indicates that the proposed water quality approaches are expected to sufficiently treat the Required Treatment Area.

Pretreatment Manhole

A pretreatment manhole, per CWS Standard Dwg. No. 250, is proposed upstream of the BayFilter Manhole. Inline pretreatment manholes are sized using the 25-year post-developed runoff rate for the contributing drainage area. As indicated in Table 4, the 25-yr peak flow for Main Basin was evaluated to be 1.23 cfs. Per CWS D&C, the following equation was used to size the manhole.

Sump Volume = (20 cf/1 cfs) x (25-yr Peak Flow) = (20 cf/1 cfs) x 1.23 cfs = 24.6 cf

Assuming a 60" manhole, this sump volume results in a required sump depth of 1.25 ft. The sump depth will be rounded up to minimum 3 ft, which will be proposed below the invert of the snout.

HYDROMODIFICATION MANAGEMENT

Hydromodification Assessment

Per the CWS D&C, a Hydromodification Assessment was performed to determine the Project Category of the project site. It was established previously that runoff from the project site ultimately discharges to Saum Creek. The assessment was based on the following factors.

- Reach-Specific Risk Level – The CWS Hydromod Planning Tool indicates that the receiving reach within Saum Creek has a "Moderate" Risk Level.
- Development Class – The CWS Hydromod Planning Tool indicates that the entire project site has a Development Class of "Developed".
- Project Size – Project Size is based on the new & modified impervious areas created by the project. The total new and modified impervious area results in a "Medium" Project Size.

Based on the contributing factors above, this project is considered to be Category 2.

Hydromodification Approaches

Infiltration Planters

Infiltration LIDA Facilities will be implemented to the maximum extent practicable. The two (2) Infiltration Planters per Table 5 will also serve as hydromodification approaches and be designed per Standard Sizing. Each Planter will capture runoff generated from the 10-yr, 24-hr storm from its contributing basin and

infiltrate the volume within 36 hours. Table 7 shows the evaluated peak ponding depths during the 10-yr storm for each Planter.

Post-Dev. Basin	CIA (sf)	Infiltration Planters	
		Area (sf)	10-yr Ponding (in)[(1)]
North	6,428	520	10.1
South	6,836	500	9.6

Table 7 – Infiltration Planters (Hydromod Compliance)

[(1)]Ponding during 10-yr storm (see Technical Appendix: Hydrographs – Stage Hydrographs)

The table above demonstrates that there is no expected overflow bypass during 10-yr storm in each Planter; all flow is expected to infiltrate through the growing medium and into the underlying soil

Underground Infiltration Facility

Runoff from Main Basin will be managed by a proposed Underground Infiltration Facility. Assuming a design infiltration rate of 2 in/hr for the native soil, it was demonstrated that a facility with an area of 2,100 sf and maximum depth of 5 ft (i.e., 10,500-cf storage capacity) would sufficiently detain the 10-yr runoff volume and infiltrate it within 36 hours. The 10-yr peak ponding depth within this facility was evaluated to be 3.90 ft (see Technical Appendix: Hydrographs – Stage Hydrographs).

DOWNSTREAM ANALYSIS

Per TMC 3-5-210, a Review of the Downstream System must be performed to demonstrate public storm lines flowing at a maximum 82% full. The analysis will extend downstream to a point at which the runoff from the development in a build out condition is less than 10% of the total runoff of the basin in its current development status; the analysis will extend downstream for at least 1/4-mile. The downstream system will be analyzed for the 2-, 5-, 10- and 25-yr storm events.

Data on the downstream system has been requested and the Review of the Downstream System will be provided in the Final Stormwater Report. If downstream deficiencies exist, onsite detention/retention facilities will be sized to mitigate the 25-yr, 24-hr peak flow in addition to other water quantity management requirements.

WATER QUANTITY MANAGEMENT

All runoff for up to and including the 10-yr storm event is expected to be infiltrated in the Planters and Underground Infiltration Facility to comply with hydromodification requirements. Results of the Downstream Analysis may require detention of the 25-yr, 24-hr storm event. Furthermore, since the project is discharging to ODOT storm drain infrastructure, the post-developed 50-yr, 24-hr peak flow must be mitigated to predeveloped levels.

Table 8 outlines the required release rates for each basin (or cumulatively if over-detention is needed). Full details of the detention/retention facilities will be provided in the Final Stormwater Report.

Post-Dev. Basin	Predev. Runoff Rates (cfs)	
	25-yr	50-yr
North	0.014	0.018
Main	0.222	0.271
South	0.007	0.010
Total	0.243	0.299

Table 8 – Required Release Rates

CONVEYANCE ANALYSIS

Conveyance calculations will be provided in the Final Stormwater Report that demonstrates sufficient flow capacity in proposed private storm drain systems during the 25-yr storm and overland flow to the public stormwater system during the 100-yr storm in accordance with City and CWS standards.

OPERATIONS & MAINTENANCE

An Operations & Maintenance (O&M) Plan will be prepared and provided in the Final Stormwater Report for any proposed privately maintained stormwater management facilities. The O&M Plan will be prepared per CWS D&C.

REFERENCES

1. *Design & Construction Standards for Sanitary Sewer & Surface Water Management*. December 2019, Clean Water Services
2. *Urban Hydrology for Small Watersheds (Technical Release 55)*. June 1986, U.S. Department of Agriculture

TECHNICAL APPENDIX

Exhibits

- FIRMette
- Hydrologic Soil Group
- Curve Numbers
- Existing Conditions
- Post-Developed Conditions

Calculations

- Time of Concentration

Hydrographs

- Runoff Hydrographs
- Stage Hydrographs

Downstream Analysis (Will be included in Final Stormwater Report)

Operations & Maintenance Plan (Will be included in Final Stormwater Report)

EXHIBITS

National Flood Hazard Layer FIRMette

FEMA

122°45'56"W 45°22'42"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

122°45'18"W 45°22'17"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

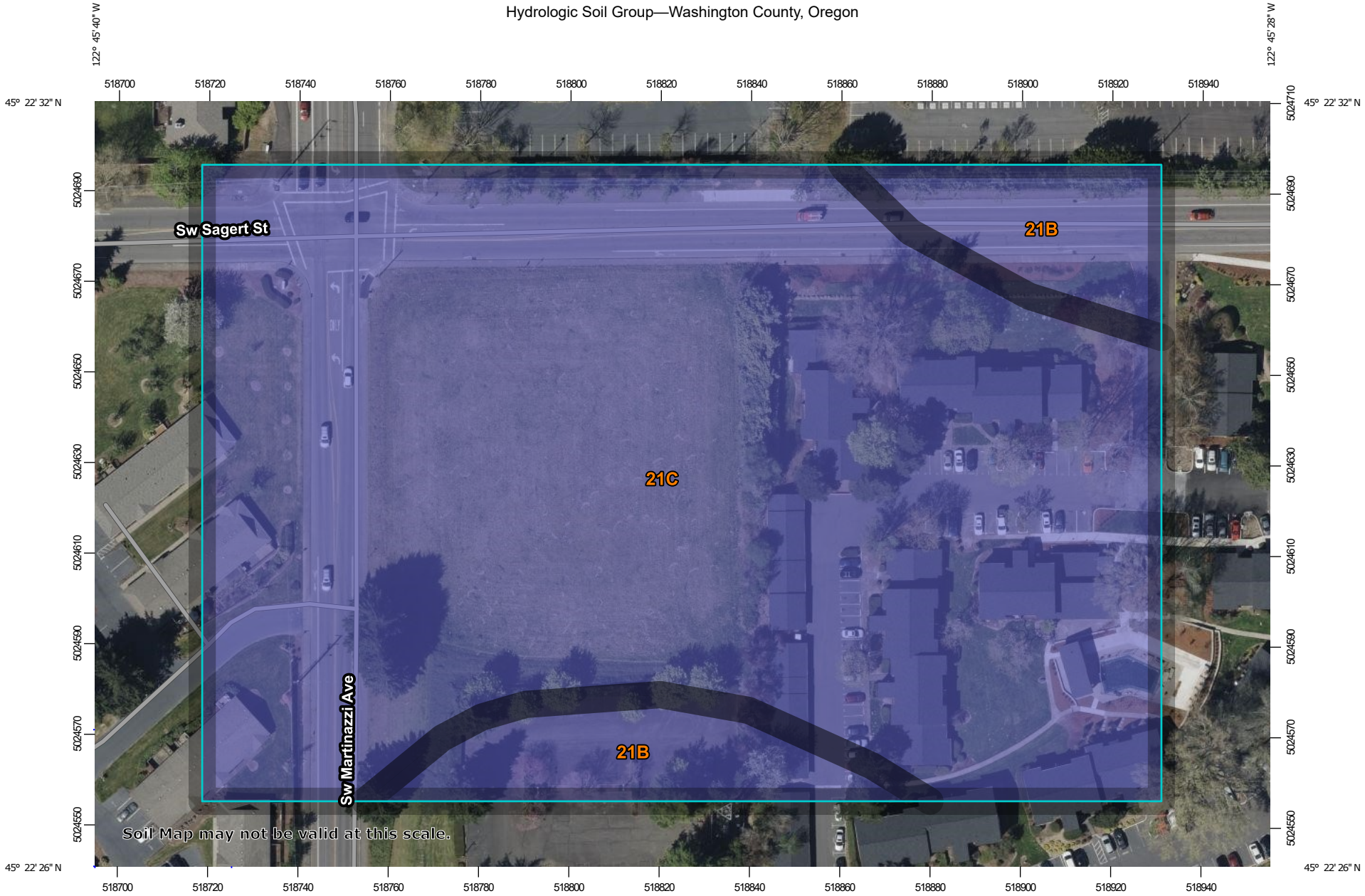
N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/5/2022 at 5:23 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



Map Scale: 1:1,190 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 21, Oct 27, 2021

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

Date(s) aerial images were photographed: Apr 16, 2021—Apr 18, 2021

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
21B	Hillsboro loam, 3 to 7 percent slopes	B	0.9	12.3%
21C	Hillsboro loam, 7 to 12 percent slopes	B	6.5	87.7%
Totals for Area of Interest			**7.4**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2/]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

1 Average runoff condition, and $I_a = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Table 2-2c Runoff curve numbers for other agricultural lands [1/]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2/]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3/]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4/]	48	65	73
Woods—grass combination (orchard or tree farm). [5/]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6/]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4/]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

1 Average runoff condition, and $I_a = 0.2S$.

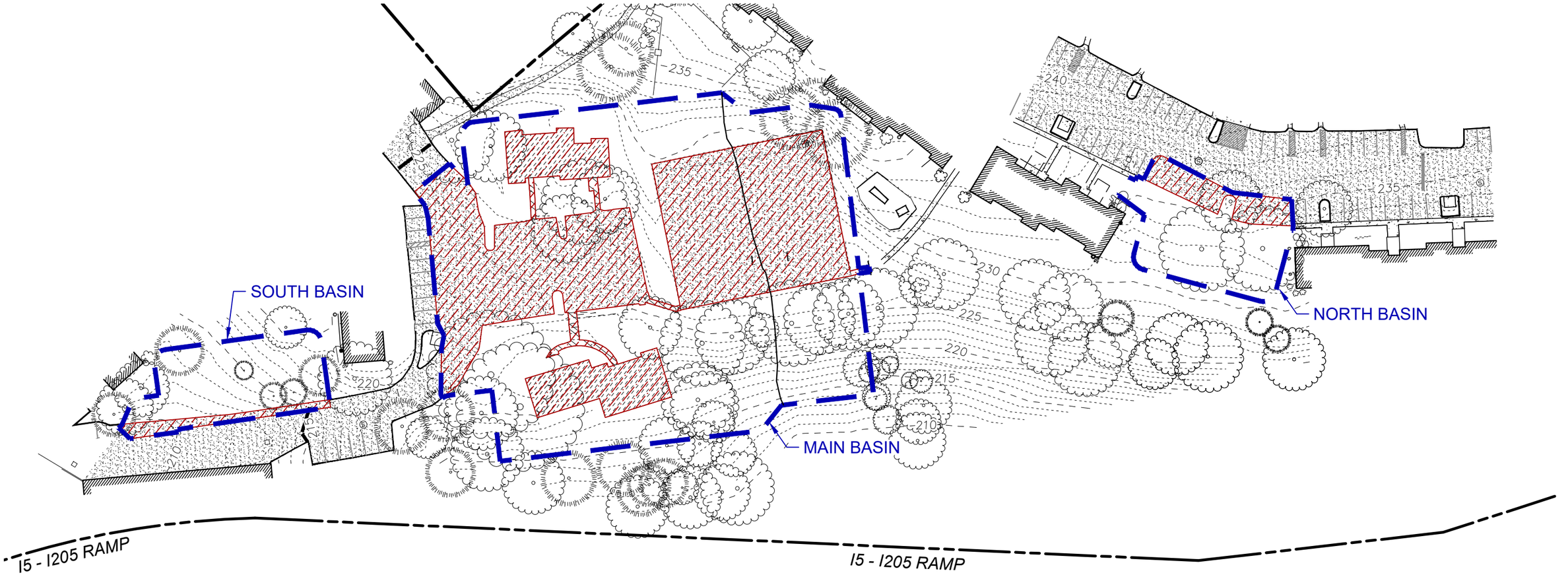
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

3 *Poor*: <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

4 Actual curve number is less than 30; use CN = 30 for runoff computations.

5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.



LEGEND

BASIN BOUNDARY

MODIFIED IMPERVIOUS AREA

EXISTING BASIN AREAS

	Impervious		Pervious		Total	
	sf	ac	sf	ac	sf	ac
South	967	0.02	5,921	0.14	6,888	0.16
Main	30,356	0.70	35,260	0.81	65,616	1.51
North	1,907	0.04	6,000	0.14	7,907	0.18
Total	33,230	0.76	47,181	1.08	80,411	1.85

N W E S

SCALE: 1" = 70'

0 70 FT

ALDEN APARTMENTS

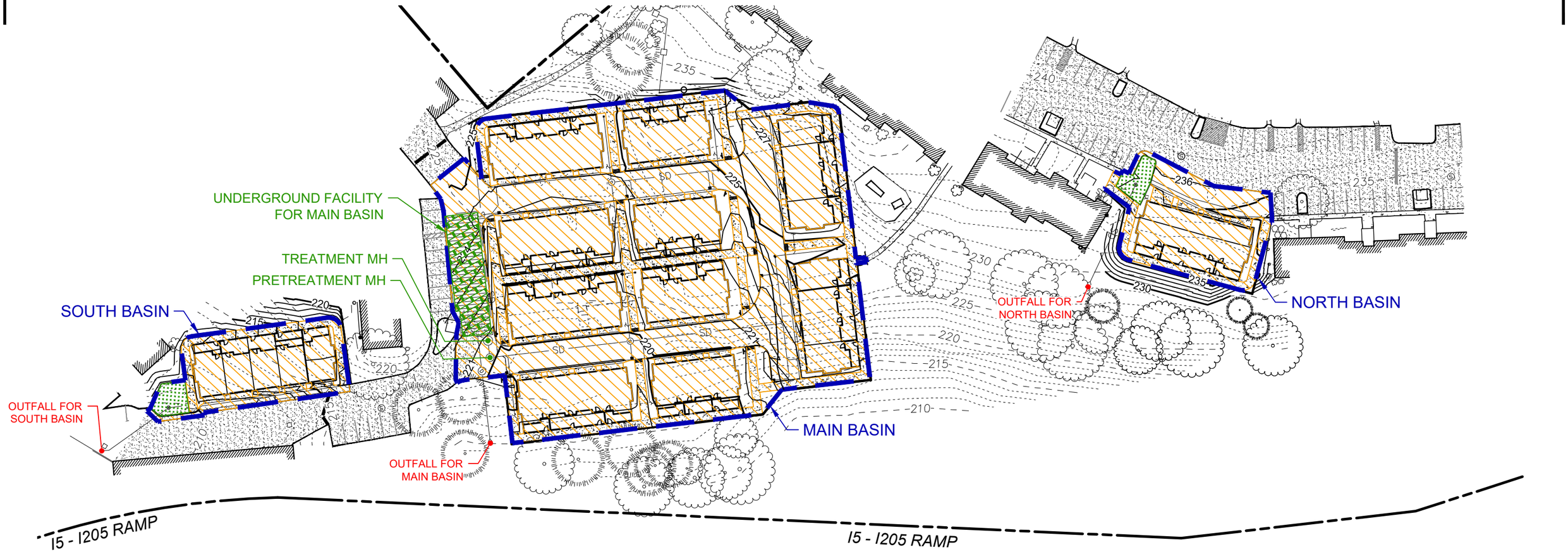
COLRICH MULTIFAMILY

SEP 2022

EXISTING CONDITIONS EXHIBIT

3J CONSULTING

CIVIL ENGINEERING . WATER RESOURCES . COMMUNITY PLANNING



LEGEND

- BASIN BOUNDARY
- IMPERVIOUS AREA
- INFILTRATION PLANTER
- UNDERGROUND INFILTRATION FACILITY

POST-DEVELOPED BASIN AREAS

	Impervious		Pervious		Total	
	sf	ac	sf	ac	sf	ac
South	6,428	0.15	460	0.01	6,888	0.16
Main	58,146	1.33	7,470	0.17	65,616	1.51
North	6,836	0.16	1,071	0.02	7,907	0.18
Total	71,410	1.64	9,001	0.21	80,411	1.85

SCALE: 1" = 70'
0 70 FT

ALDEN APARTMENTS

SEP 2022

COLRICH MULTIFAMILY

POST-DEVELOPED CONDITIONS EXHIBIT

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CALCULATIONS

TIME OF CONCENTRATION

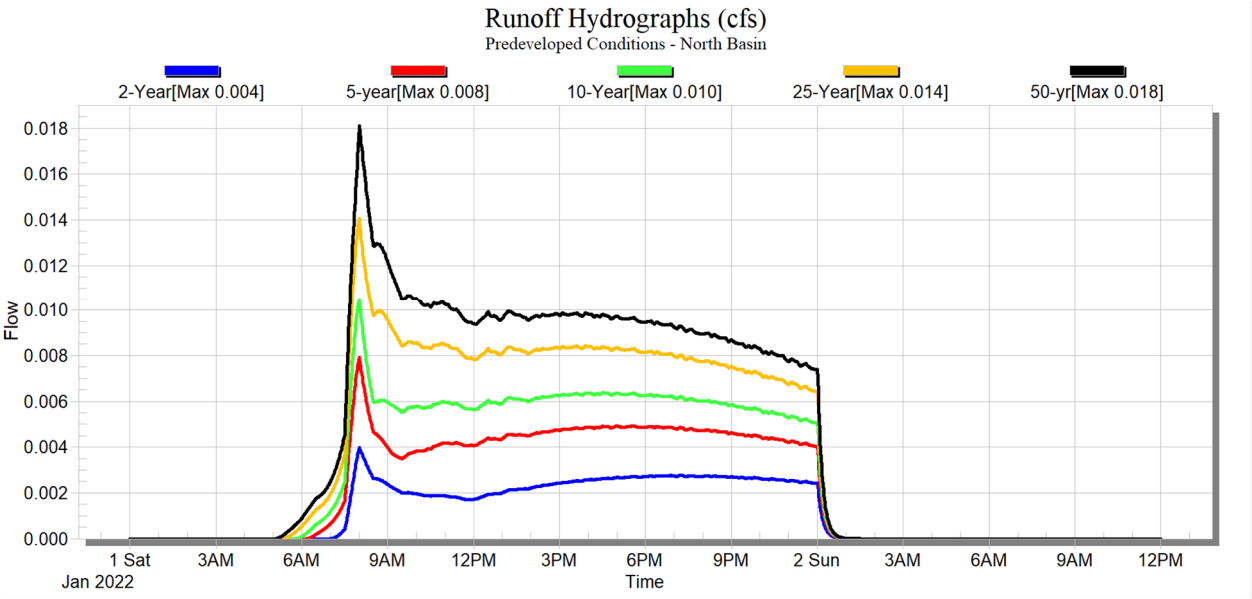
PROJECT NO. 22791	BY PJP	DATE 9/1/2022

SHEET FLOW			
INPUT	**Predev. North Basin**	**Predev. Main Basin**	**Predev. South Basin**
Surface Description	**Type 9 Woods (light_underbrush)**	**Type 9 Woods (light_underbrush)**	**Type 9 Woods (light_underbrush)**
Manning's "n"	**0.4**	**0.4**	**0.4**
Flow Length, L	**50** ft	**50** ft	**50** ft
2-Yr 24 Hour Rainfall, P_2	**2.5** in	**2.5** in	**2.5** in
Land Slope, s	**0.070** ft/ft	**0.120** ft/ft	**0.110** ft/ft
OUTPUT			
Travel Time	0.14 hr	0.11 hr	0.12 hr
SHALLOW CONCENTRATED FLOW			
INPUT	**VALUE**	**VALUE**	**VALUE**
Surface Description	**Unpaved**	**Unpaved**	**Unpaved**
Flow Length, L	**26** ft	**175** ft	**120** ft
Watercourse Slope*, s	**0.090** ft/ft	**0.080** ft/ft	**0.050** ft/ft
OUTPUT			
Average Velocity, V	4.84 ft/s	4.56 ft/s	3.61 ft/s
Travel Time	0.001 hr	0.011 hr	0.009 hr
CHANNEL FLOW			
INPUT	**VALUE**	**VALUE**	**VALUE**
Cross Sectional Flow Area, a	**0** ft^2	**0** ft^2	**0** ft^2
Wetted Perimeter, P_w	**0** ft	**0** ft	**0** ft
Channel Slope, s	**0** ft/ft	**0** ft/ft	**0** ft/ft
Manning's "n"	**0.24**	**0.24**	**0.24**
Flow Length, L	**0** ft	**0** ft	**0** ft
OUTPUT			
Average Velocity	0.00 ft/s	0.00 ft/s	0.00 ft/s
Hydraulic Radius, r = a / P_w	1.00 ft	1.00 ft	1.00 ft
Travel Time	0.00 hr	0.00 hr	0.00 hr
Watershed or Subarea T_c =	**0.14 hr**	**0.12 hr**	**0.13 hr**
Watershed or Subarea T_c =	**9 minutes**	**7 minutes**	**8 minutes**

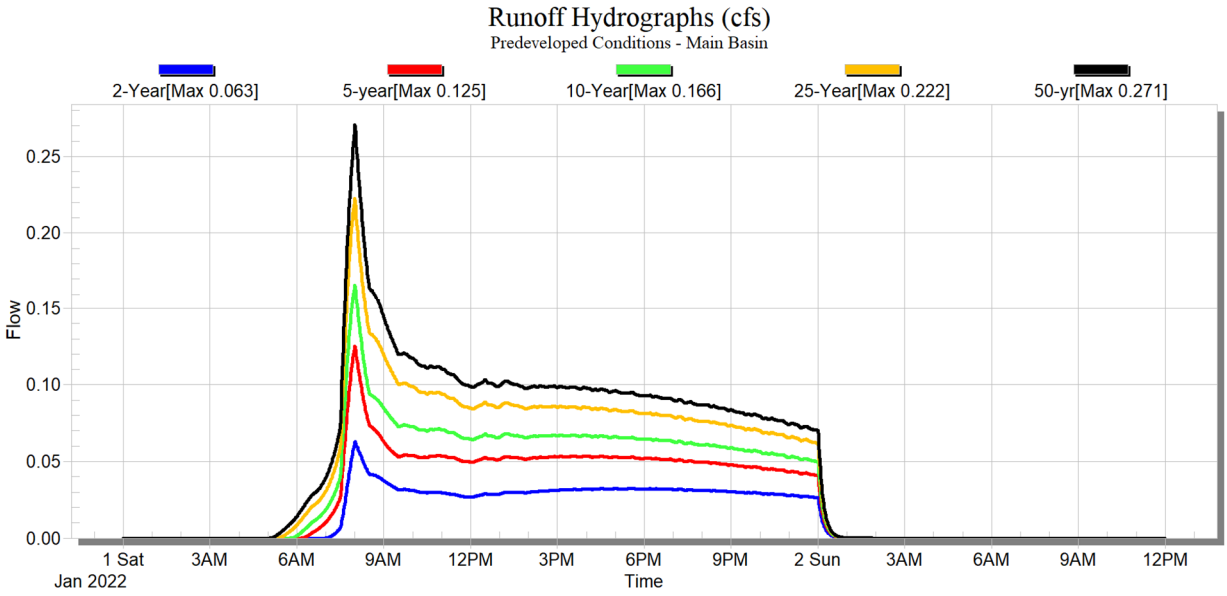
HYDROGRAPHS

Predeveloped Runoff Hydrographs

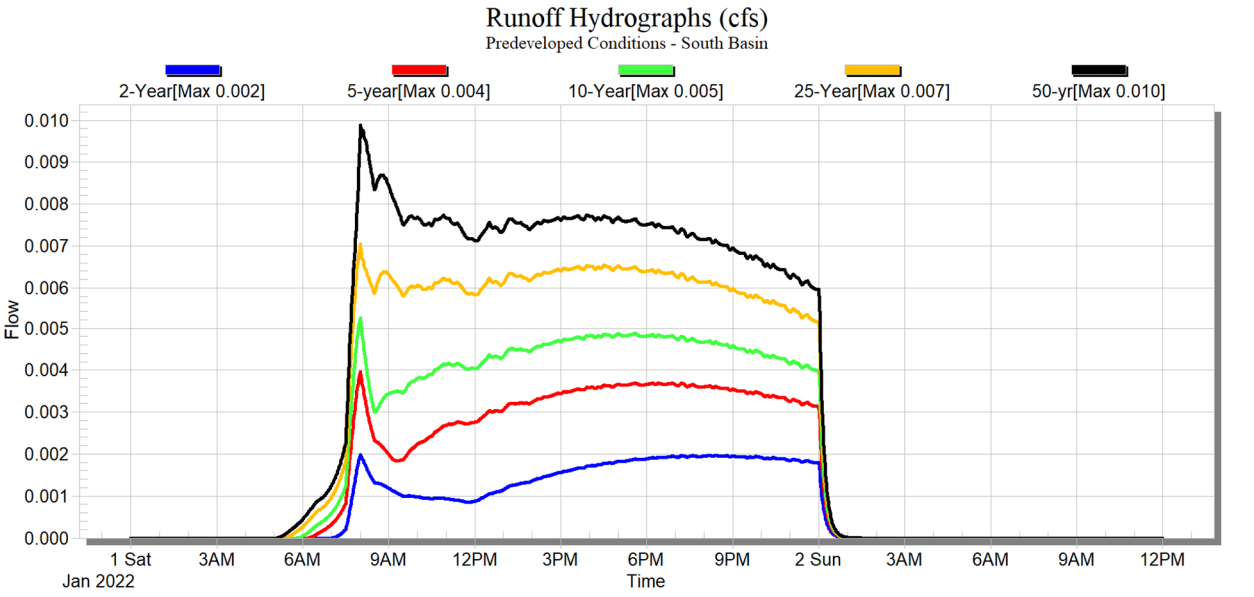
North Basin



Main Basin

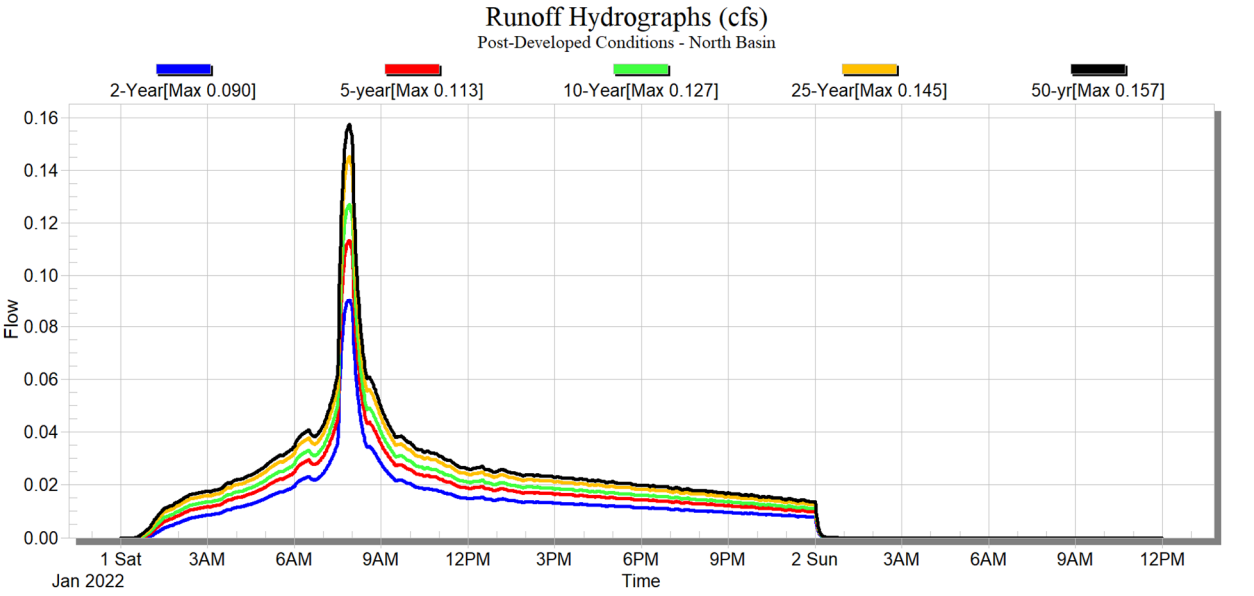


South Basin

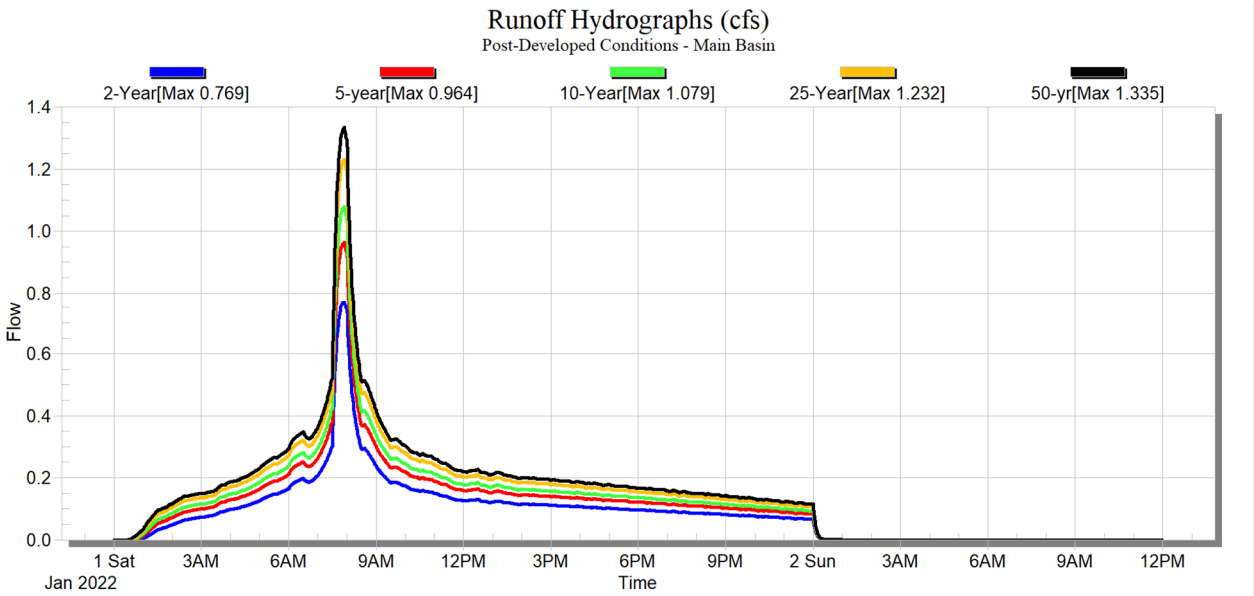


Post-Developed Runoff Hydrographs

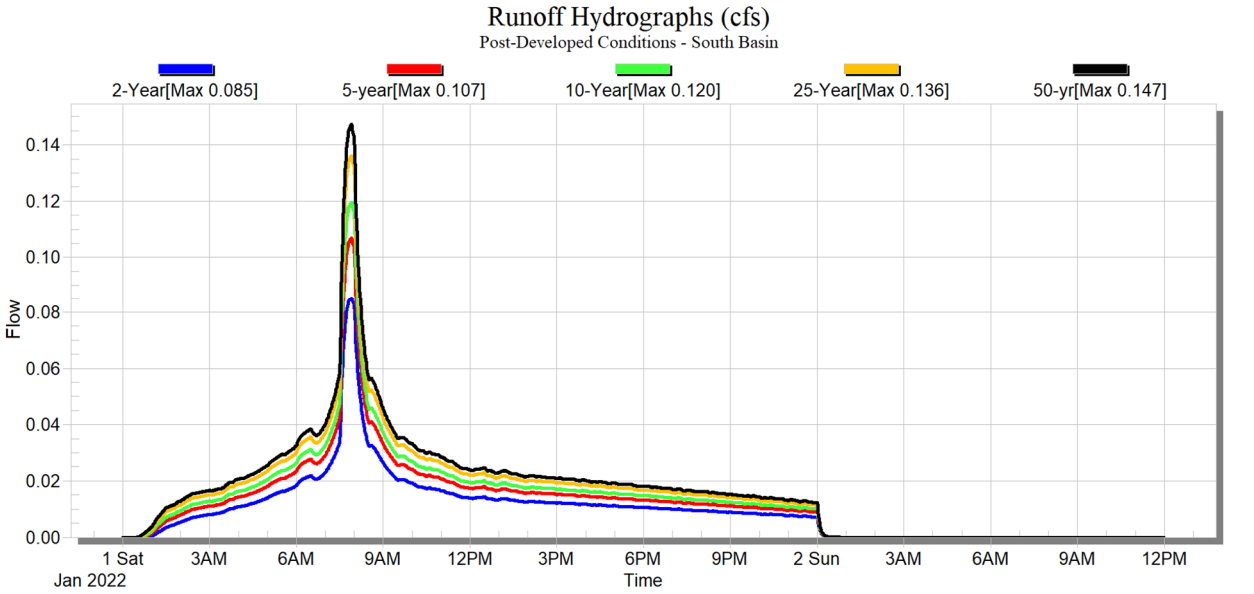
North Basin



Main Basin



South Basin



Stage Hydrographs

A design infiltration rate of 2 in/hr is assumed for both growing medium (in Planters) and native soil.

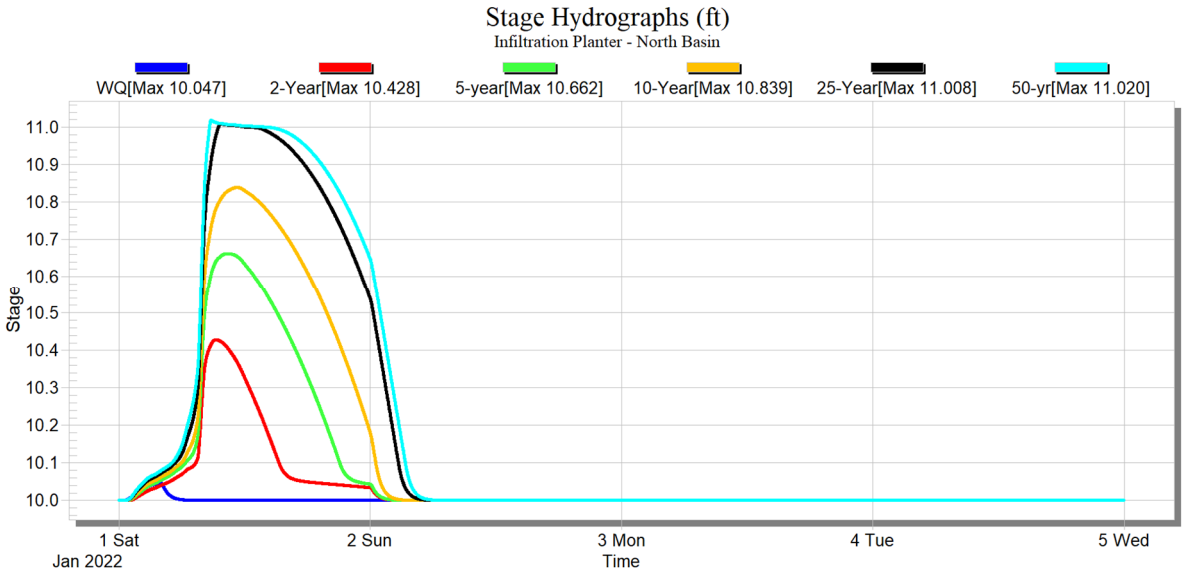
The Infiltration Planters for the North & South Basins assume:

- Elevation of bottom of surface ponding is 10 ft as reference for modeling purposes.
- 18" each for surface ponding, growing medium, and drain rock depths.
- Overflow Beehive RIM is 12" above bottom of surface ponding providing 6" of freeboard.
- Drain rock has a porosity of 40%.

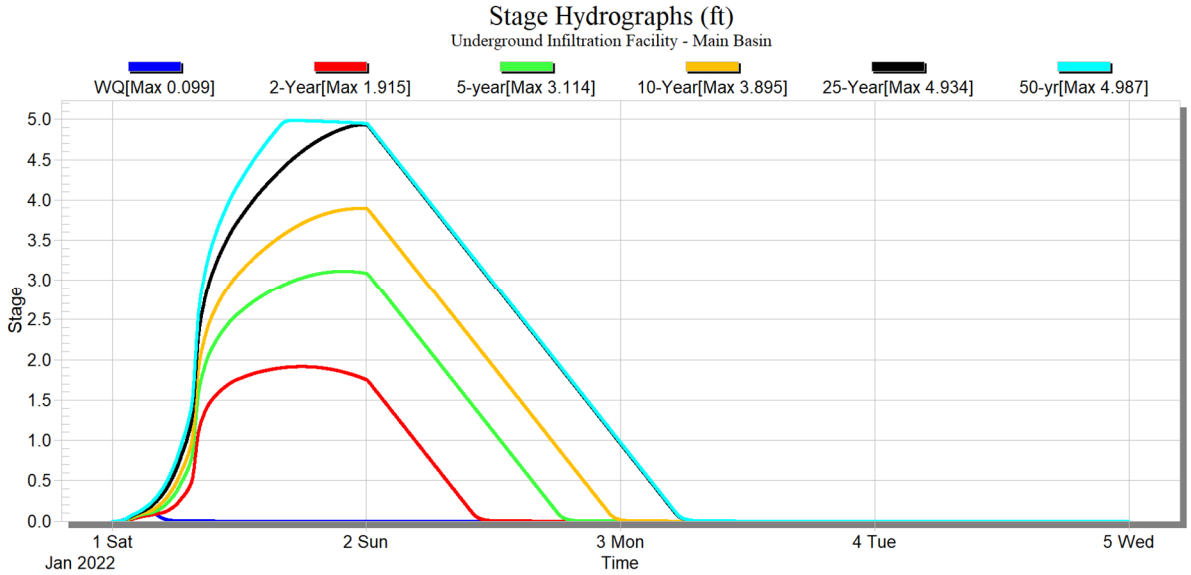
The Underground Infiltration Facility for Main Basin assumes:

- Elevation of bottom of facility is 0 ft
- Maximum depth of 5 ft.

<u>Infiltration Planter – North Basin</u>
Planter Area = 520 sf

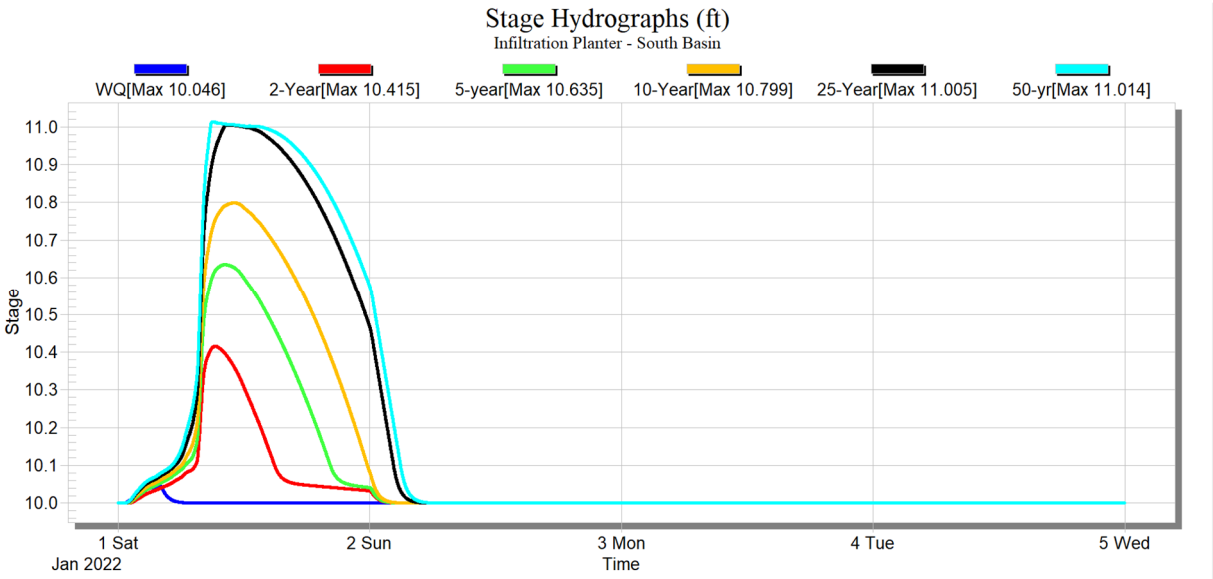


<u>Underground Infiltration Facility – Main Basin</u>
Facility Area = 2,100 sf; Facility Volume = 10,500 cf



Infiltration Planter – South Basin

Planter Area = 500 sf



DOWNSTREAM ANALYSIS

(Will be included in Final Stormwater Report)

OPERATIONS & MAINTENANCE PLAN

(Will be included in Final Stormwater Report)