STORMWATER CALCULATIONS

Prepared For:

Clutch Industries

360 Belmont St. NE

Salem, OR 97303

Project:

Blossom Apartments

Blossom Drive NE

Salem, OR 97305

Prepared By:

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J.O. 3366.0000.0 November 2022

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PROJECT OVERVIEW & DESCRIPTION SECTION 1

1.1 SIZE & LOCATION OF PROJECT

The proposed residential development project is located on a 3.55-acre lot. The property is located on Blossom Drive NE, in Salem, Oregon. Refer to the Civil Drawings for a site map of the project area.

1.2 BRIEF DESCRIPTION OF PROJECT SCOPE AND PROPOSED IMPROVEMENTS

The project scope is to develop the lot for residential use with construction of a parking lot, and associated improvements. The project includes site preparation and construction of the facilities.

1.3 DESCRIPTION OF SIZE OF WATERSHED DRAINING TO THE SITE

The proposed stormwater facilities receive runoff from a 123,000 square foot area on-site which includes all proposed impervious improvements and the majority of pervious improvements on-site. No additional drainage area drains to the project site.

1.4 DESCRIPTION OF THE EXISTING SITE CONDITIONS, TREES & NATIVE VEGETATION, CONSTRAINTS, SENSITIVE AREAS & WATERWAYS

The existing site is primarily covered in grass and a few existing buildings. The existing site does not contain any trees. Stormwater from the site will drain to the proposed stormwater facility.

1.5 SUMMARY OF GREEN STORMWATER INFRASTRUCTURE

Per Appendix 4E of the City of Salem (COS) Design Standards, a large project will be considered to have met the maximum extent feasible (MEF) requirement when the stormwater runoff from the total amount of new plus replaced impervious surfaces flows into an area set aside for GSI that is at least 10% of the total area of the new plus replaced impervious surfaces or at least 80% of all impervious area must be treated by GSI. This design implements GSI for the entire project impervious area and therefore meets MEF for GSI.

1.6 REGULATORY PERMITS REQUIRED

City of Salem permits are required. A 1200-C permit is required since more than one acre of land is disturbed. No other permits are required for this project.

1.7 100 YEAR STORM ESCAPE ROUTES

Please refer to the Developed Basin Map in Appendix A for 100-year storm emergency overflow routes.

METHODOLOGY SECTION 2

2.1 DEPTH TO GROUNDWATER

Per the Geotechnical Report in Appendix D groundwater was encountered at a depth of 15 feet below ground surface. The proposed stormwater rain garden has drain rock to an elevation of 168.25, which is approximately 8.5' feet below ground surface and therefore conforms to the COS Design Standards requirement of 3 feet of separation from groundwater.

2.2 MAXIMUM INFILTRATION AND VEGETATIVE TREATMENT

Per the attached Geotechnical Reports, the measured average infiltration rate onsite is between 0.4 and 0.7 inches per hour near the location of the raingarden. The design infiltration rate for the stormwater infiltration facility was determined based on the adjacent measured infiltration rates. A design infiltration rate of 0.275 inches per hour is used for stormwater calculations for the raingarden.

The proposed stormwater design will treat and detain the entire site's impervious area with one raingarden, therefore GSI has been implemented to the maximum extent feasible.

2.3 SOIL INFORMATION

The pre-developed project site contains primarily hydrologic soil group C-rated soils. Hydrologic group C-rated soils were used for analysis. Refer to the Soils Report in Appendix B for more details.

2.4 HAZARDOUS MATERIAL

The owner is not aware of any hazardous material contamination onsite.

3.1 METHODS & SOFTWARE USED

HydroCAD modeling software was used to size the stormwater facilities. The Santa Barbara Unit Hydrograph Type 1A storm was used to model the required design storms. Per the City of Salem Design Standards, the design storms used were the 1.38-inch, 24-hour (water quality storm), half the 2-year, 24-hour, the 10-year, 24-hour, the 25-year, 24-hour, and the 100-year, 24-hour storm events.

Table 1 | City of Salem 24-hour Design Storms

	24-Hour Rainfall Depths for Salem, OR						
Recurrence Interval, Years	WQ	2	5	10	25	50	100
24-Hour Depths, Inches	1.38	2.2	2.7	3.2	3.6	4.1	4.4

Source: City of Salem Administrative Rules Chapter 109 – Division 004 Appendix D

3.2 CURVE NUMBER AND TIME OF CONCENTRATION CALCULATIONS

Per the COS Design Standards, the pre-developed site was covered in a combination of woods and grass, which corresponds to a pre-developed curve number of 72 for hydrologic soil group C-rated soils.

The developed impervious areas were assigned a curve number of 98. The impervious areas were assigned a curve number of 98 which corresponds paved areas. The pervious areas were assigned a curve number of 74 which corresponds to greater than 75% grassed area in good condition for hydrologic soil group C-rated soils.

Time of concentration (Tc) for the pre-developed conditions was calculated to be 49.5 minutes using the sheet flow equation. See the Pre-Developed Basin Map in Appendix A for the flow path used and refer to the HydroCAD Summaries in Appendix C for calculations. A minimum time of concentration (Tc) of 5 minutes is applied to the developed basins due to the minimum time-step used by the HydroCAD modeling software.

3.3 TREATMENT & FLOW CONTROL SIZING CALCULATIONS

The site was analyzed as one (1) basin for predeveloped and developed stormwater calculations. General basin characteristics of both pre-developed and developed conditions are listed in Table 2. For more detail refer to the Basin Maps in Appendix A and the Civil Drawings.

Table 2 | General Basin Characteristics

Basin ID	Source (Roof/Road/ Other)	Impervious Area (sf)	Pervious Area (sf)	Design Storms ½ 2 Year (cfs)	10 Year (cfs)	25 Year (cfs)	100 Year (cfs)	CN[1]	Tc (min)
Predeveloped	Native	-	123,000	0.035	0.23	0.32	0.55	72	49.5
Developed	Paved/Roof/ Landscape	90,100	32,900	1.07	1.68	1.93	2.45	92	5.0

[1] Weighted Curve number listed for the impervious / pervious areas in the basin

Stormwater is released from the RG by exfiltration into the subsoils and a Type III Flow Control Catch Basin. See Table 3 below for a summary of facility release rates for the RG. Refer to the Civil Drawings for details.

Table 3 | Summary of Facility Outlet Sizing and Release Rates – RG

Outlet ID/ Storm Event	Orifice Size (in)	Orifice Elevation (ft)	Release Rate (cfs)	Peak WSE[1] (ft)	Overflow Elevation (ft)	Infiltration Rate (in/hr)
Half 2 Year	2.0	171.43	0.02	171.57	176.5	0.275
WQ	-	-	0.06	171.85	176.5	0.275
10 Year	1.0	174.80	0.23	175.46	176.5	0.275
25 Year	3.5	175.50	0.32	175.70	176.5	0.275
100 Year[2]	24	175.94	0.53	176.00	176.5	0.275

[1] WSE = water surface elevation
[2] Flow Control provided by 24" weir opening in top of the Type III Flow Control Catch Basin.

The RG has been sized to drain the water quality storm below the growing media in 25 hours from the start of the event, which is less than the required 54 hours per the COS Design Standards. See the HydroCAD Summaries in Appendix C for drain time during the water quality storm.

As noted above the developed release from the site is less than or equal to that of the predeveloped release for all design storms.

A summary of the rain garden geometry and required drain rock is provided in Table 4 below. Please note that the RG requires drain rock with areas shown in Table 4 (and denoted on the Civil Drawings) to detain and control the design storms in conformance with COS standards.

Table 4 | Facility Sizing Summary – RG 1

Facility ID[1]	Facility Elevations[2] (ft)		Facility Surface Area[2] (SF)		Required Drain Rock Surface Area (SF)	Depth of Drain Rock (in)
	Top	Bottom	Top	Bottom		
RG	176.5	173.75	8,010	1,350	3,270	48

[1] All facilities are privately owned and maintained stormwater GSI facilities.
[2] The top facility elevation and corresponding square footage area refer to the top of the 3:1 slope. The bottom elevation and corresponding square footage area refer to the bottom of the 3:1 slope.

The HydroCAD modeled release rates and water surface elevations (WSE) shown in Table 3 assume free-flow though the rain garden growing media. Release from the rain garden facility can also be controlled by the filtration capacity of the growing media. To verify the entire WQ storm event is filtered through the growing media for treatment, the rain garden hydraulics were also modeled at the facility surface with an assumed filtration rate of 2 in/hr per COS Design Standards. The surface tests were calculated using Darcy's Law of hydraulic conductivity with the groundwater elevation set 1.5 feet below the surface to represent the 1.5 feet (18 inches) of growing media thickness per COS Design Standards. The rain gardens provide treatment for the entire developed basin. See the HydroCAD analysis in Appendix C for surface test calculations.

Table 5 | Surface Filtration Test Summary – WQ Storm

Facility ID[1]	Facility Bottom Elevation (ft)	Max. Treatment Elevation[2]	WSE (ft)
RG	173.75	174.60	174.60

[1] The facility is a privately owned and maintained rain garden
[2] Elevation at which water overtops the 24-inch inlet in the top of the Type III Flow Control Catch Basin within rain garden.

3.4 Conveyance Capacity Calculations

Per the COS Design Standards for sites less than 50 acres, the stormwater facilities were designed to convey the developed 100-year, 24-hour storm which has a total peak flow of 0.53 cfs released from the RG. The 100-year. Stormwater runoff is conveyed from the rain garden by a 12-inch pipe. See the Civil Drawings for more detail. The 12-inch pipe has a full-flow capacity of 1.42 cfs using a minimum slope of 0.3%.

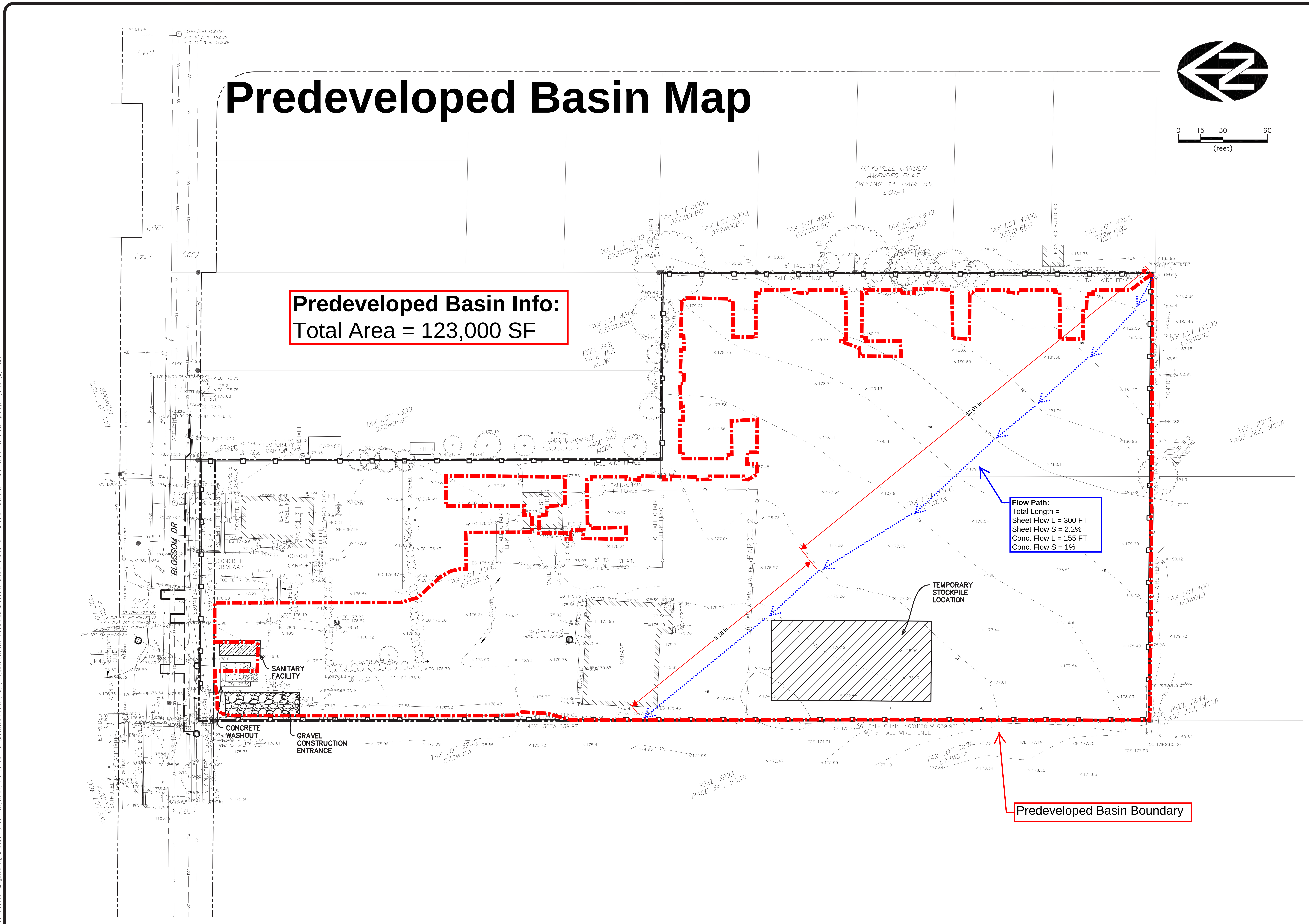
3.5 Summary

The stormwater system has been designed to release half the 2-year, 24-hour, the 10-year, 24-hour, the 25-year, 24-hour, and the 100-year, 24-hour storm events at rates less than their respective pre-developed storm. The proposed design also treats the water quality storm in less than the required 54 hours from the start of the storm event. Therefore, the project meets the flow control and treatment requirements as set forth in Administrative Rule 109 Division 004 - Stormwater System.

APPENDIX A

BASIN MAPS

Predeveloped Basin Map



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NO.	DATE	DESCRIPTION	BY
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REVISIONS

DSN. JW
DRN. AK
CKD. JW
DATE: 06/2022

REVIEW

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CLUTCH INDUSTRIES
BLOSSOM APARTMENTS

DRAWING

JOB NUMBER
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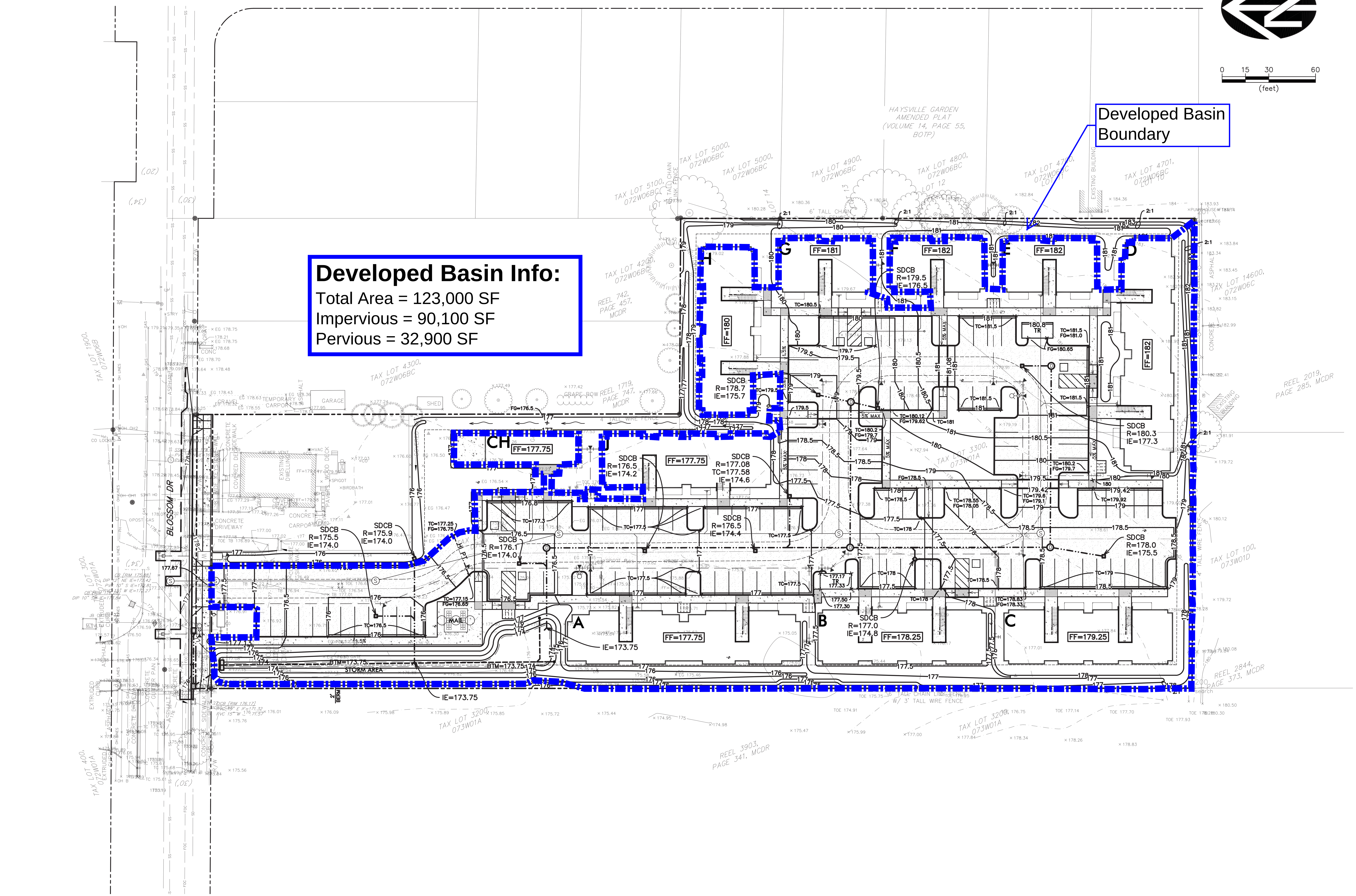
Developed Basin Map

Developed Basin Info:
Total Area = 123,000 SF
Impervious = 90,100 SF
Pervious = 32,900 SF



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BLOSSOM APARTMENTS

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REVISIONS

REVIEW

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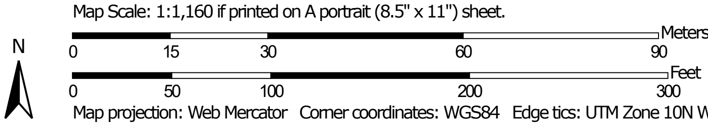
APPENDIX B

NRCS SOIL REPORT

Map Scale: 1:1,160 if printed on A portrait (8.5" x 11") sheet.



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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil 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.

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: Marion County Area, Oregon
Survey Area Data: Version 20, Sep 14, 2022

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

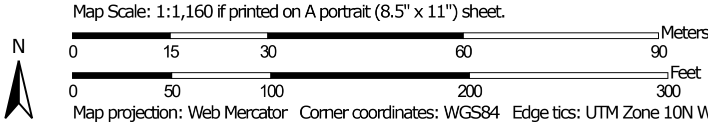
Date(s) aerial images were photographed: Aug 1, 2018—Aug 31, 2018

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
WuA	Woodburn silt loam, 0 to 3 percent slopes	3.6	100.0%
Totals for Area of Interest		**3.6**	**100.0%**

Map Scale: 1:1,160 if printed on A portrait (8.5" x 11") sheet.



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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

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

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

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Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
WuA	Woodburn silt loam, 0 to 3 percent slopes	C	3.6	100.0%
Totals for Area of Interest			**3.6**	**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

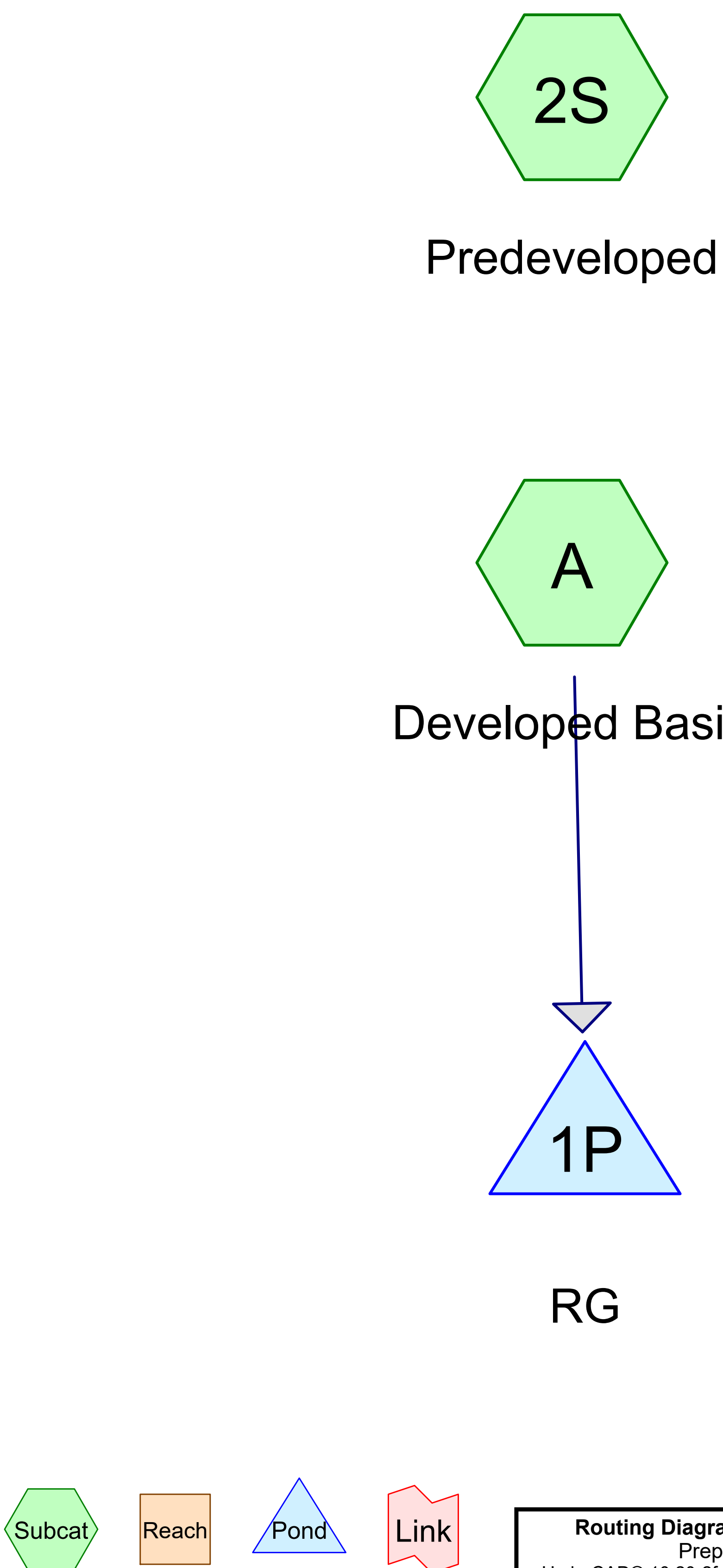
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX C

HYDROCAD SUMMARIES



Routing Diagram for Blossom Aptmts (AS Drawn - 176.01)
Prepared by Westech Engineering Inc
HydroCAD® 10.20-2f s/n 07289 © 2022 HydroCAD Software Solutions LLC

Summary for Subcatchment 2S: Predeveloped

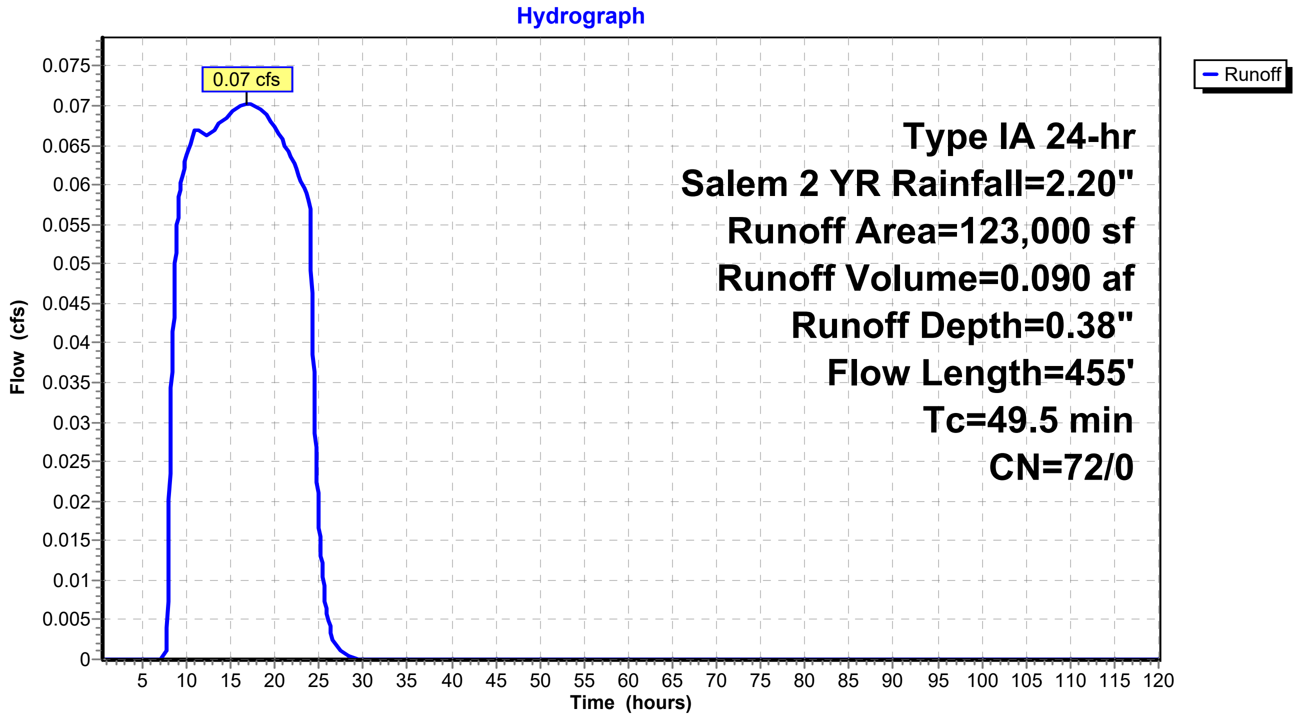
Runoff = 0.07 cfs @ 16.84 hrs, Volume= 0.090 af, Depth= 0.38"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 2 YR Rainfall=2.20"

Area (sf)	CN	Description
123,000	72	Woods/grass comb., Good, HSG C
123,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.7	300	0.0220	0.10		**Sheet Flow,** n= 0.300 P2= 2.20"
1.8	155	0.0096	1.47		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
49.5	455	Total			

Subcatchment 2S: Predeveloped



Summary for Subcatchment 2S: Predeveloped

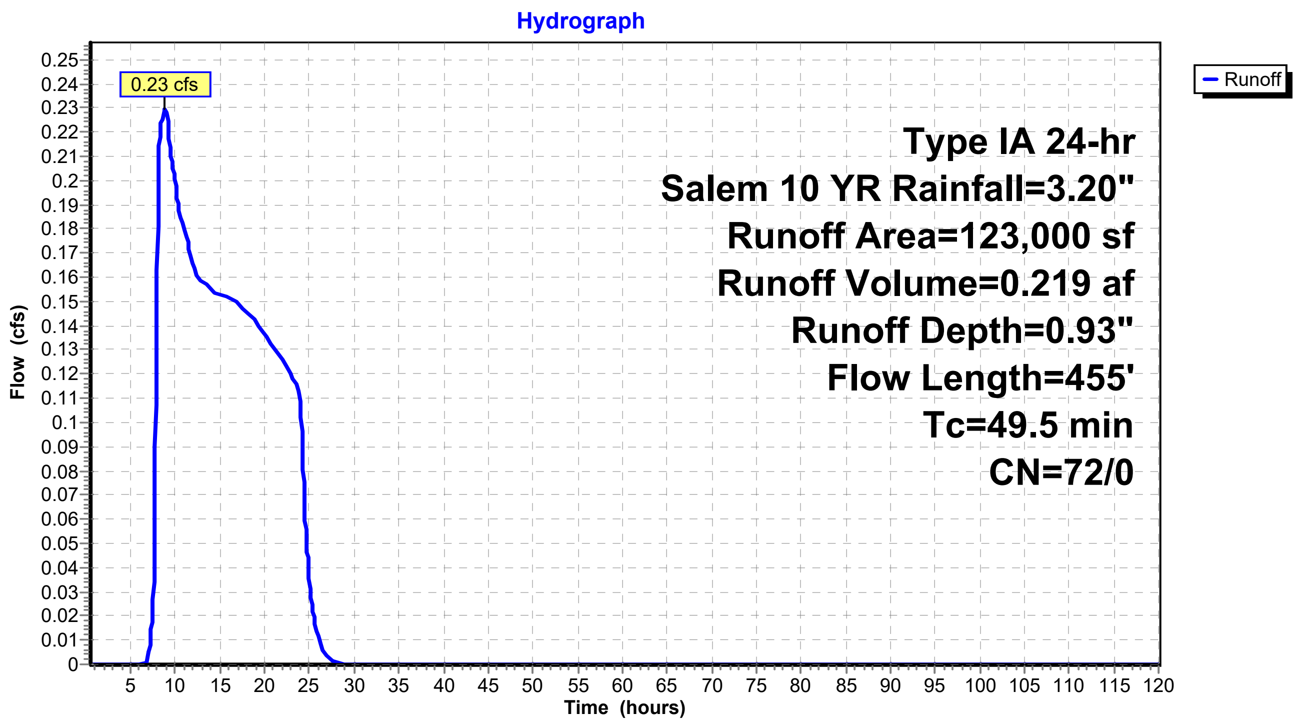
Runoff = 0.23 cfs @ 8.80 hrs, Volume= 0.219 af, Depth= 0.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

Area (sf)	CN	Description
123,000	72	Woods/grass comb., Good, HSG C
123,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.7	300	0.0220	0.10		**Sheet Flow,** n= 0.300 P2= 2.20"
1.8	155	0.0096	1.47		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
49.5	455	Total			

Subcatchment 2S: Predeveloped



Summary for Subcatchment 2S: Predeveloped

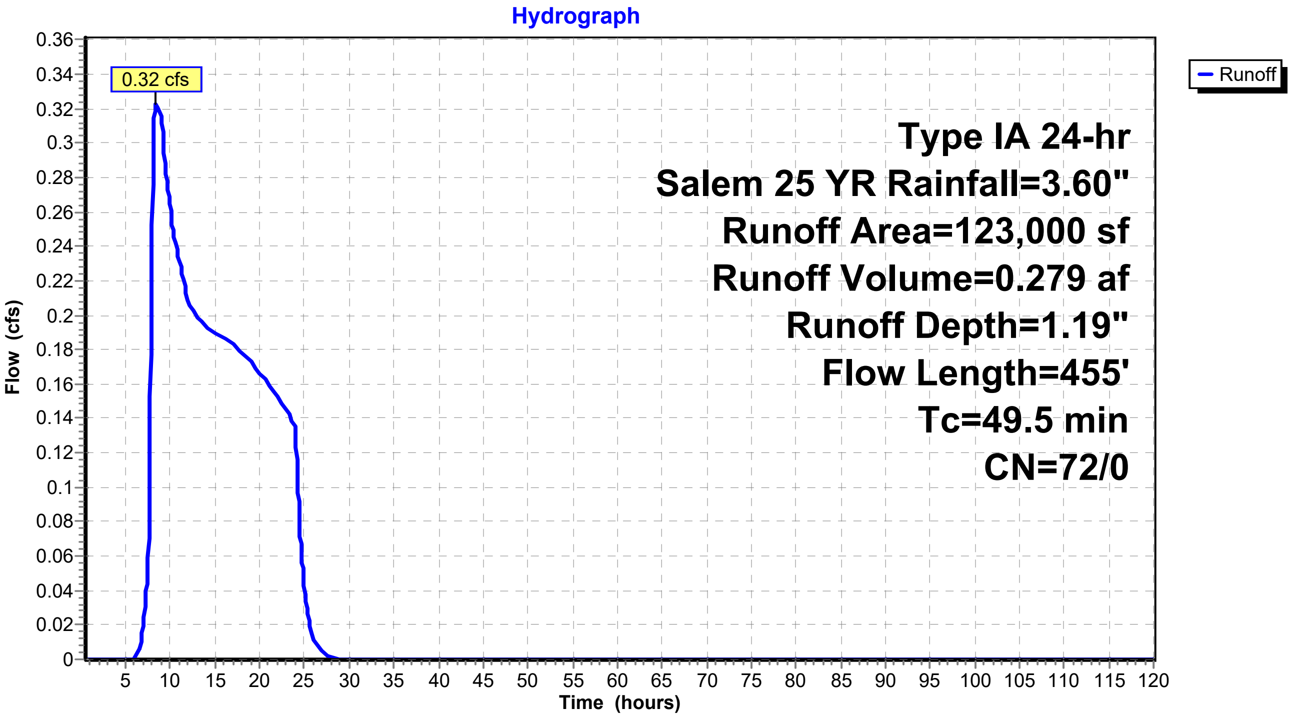
Runoff = 0.32 cfs @ 8.39 hrs, Volume= 0.279 af, Depth= 1.19"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 25 YR Rainfall=3.60"

Area (sf)	CN	Description
123,000	72	Woods/grass comb., Good, HSG C
123,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.7	300	0.0220	0.10		**Sheet Flow,** n= 0.300 P2= 2.20"
1.8	155	0.0096	1.47		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
49.5	455	Total			

Subcatchment 2S: Predeveloped



Summary for Subcatchment 2S: Predeveloped

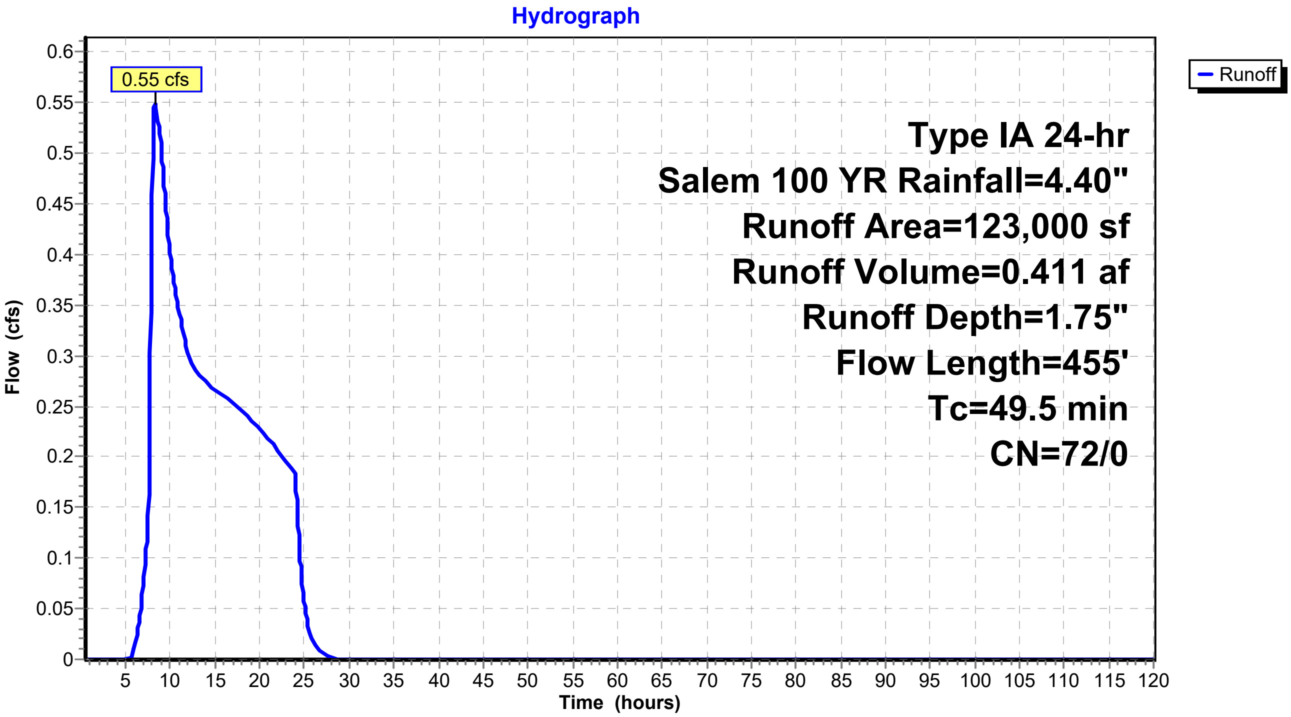
Runoff = 0.55 cfs @ 8.30 hrs, Volume= 0.411 af, Depth= 1.75"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 100 YR Rainfall=4.40"

Area (sf)	CN	Description
123,000	72	Woods/grass comb., Good, HSG C
123,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.7	300	0.0220	0.10		**Sheet Flow,** n= 0.300 P2= 2.20"
1.8	155	0.0096	1.47		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
49.5	455	Total			

Subcatchment 2S: Predeveloped



Summary for Subcatchment A: Developed Basin

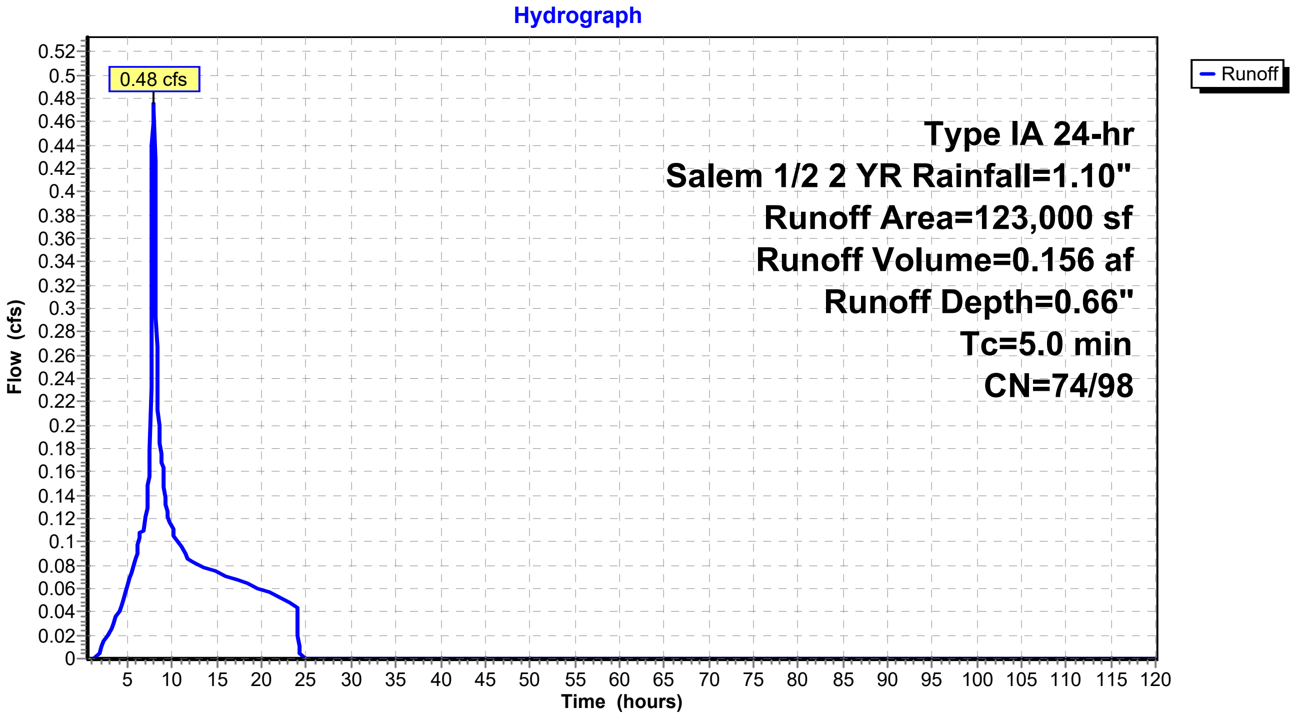
Runoff = 0.48 cfs @ 7.92 hrs, Volume= 0.156 af, Depth= 0.66"
Routed to Pond 1P : RG

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 1/2 2 YR Rainfall=1.10"

Area (sf)	CN	Description
90,100	98	Paved parking, HSG C
32,900	74	>75% Grass cover, Good, HSG C
123,000	92	Weighted Average
32,900		26.75% Pervious Area
90,100		73.25% Impervious Area

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

Subcatchment A: Developed Basin



Summary for Subcatchment A: Developed Basin

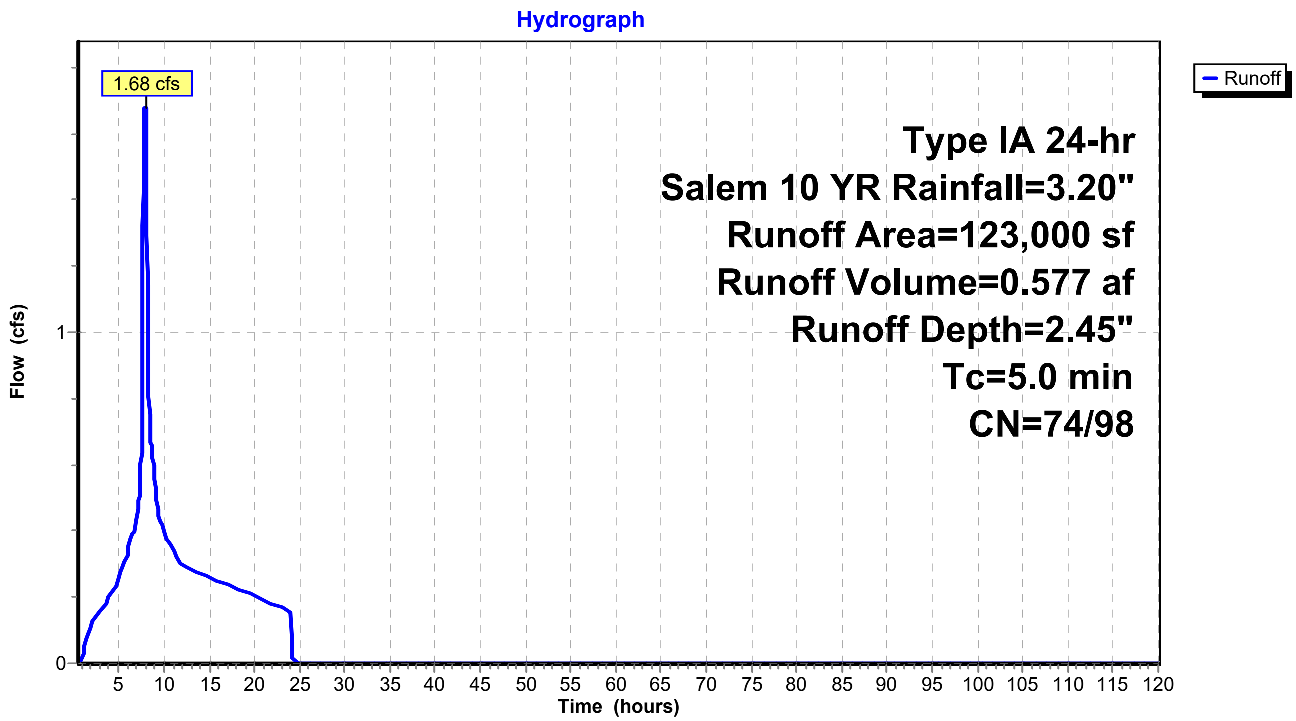
Runoff = 1.68 cfs @ 7.92 hrs, Volume= 0.577 af, Depth= 2.45"
Routed to Pond 1P : RG

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 10 YR Rainfall=3.20"

Area (sf)	CN	Description
90,100	98	Paved parking, HSG C
32,900	74	>75% Grass cover, Good, HSG C
123,000	92	Weighted Average
32,900		26.75% Pervious Area
90,100		73.25% Impervious Area

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

Subcatchment A: Developed Basin



Summary for Subcatchment A: Developed Basin

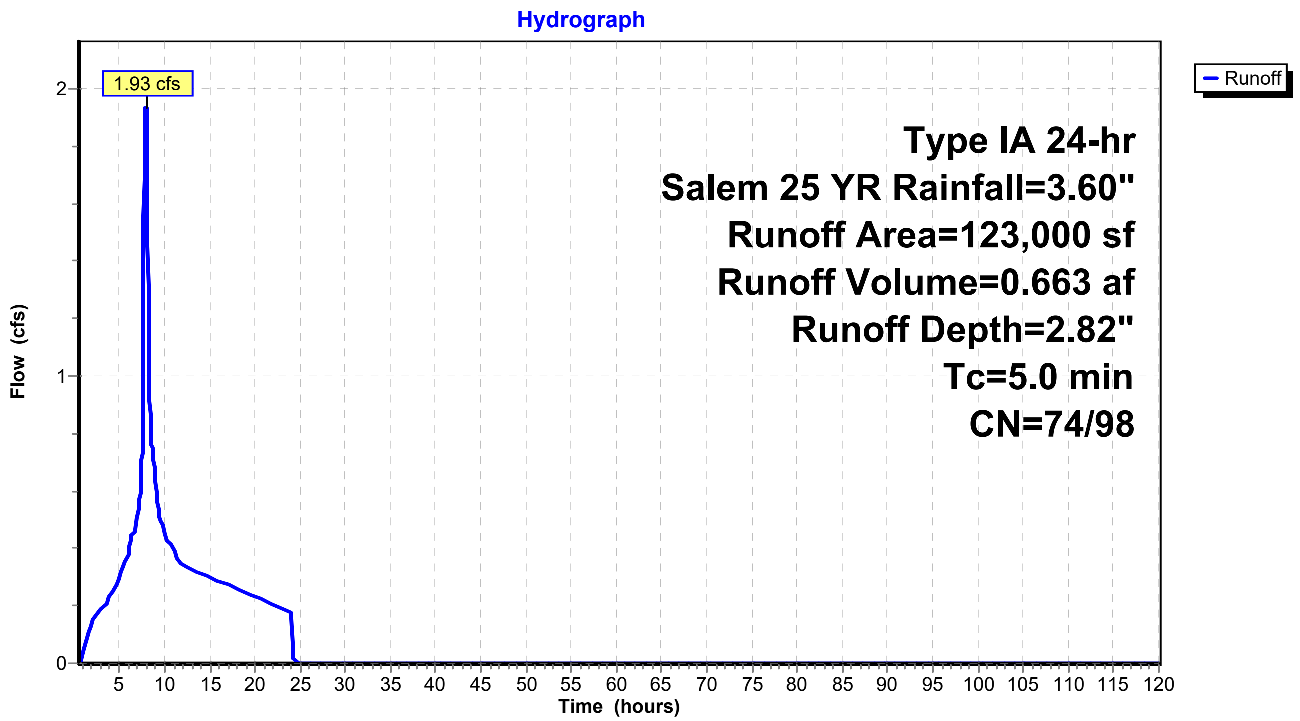
Runoff = 1.93 cfs @ 7.91 hrs, Volume= 0.663 af, Depth= 2.82"
Routed to Pond 1P : RG

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 25 YR Rainfall=3.60"

Area (sf)	CN	Description
90,100	98	Paved parking, HSG C
32,900	74	>75% Grass cover, Good, HSG C
123,000	92	Weighted Average
32,900		26.75% Pervious Area
90,100		73.25% Impervious Area

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

Subcatchment A: Developed Basin



Summary for Subcatchment A: Developed Basin

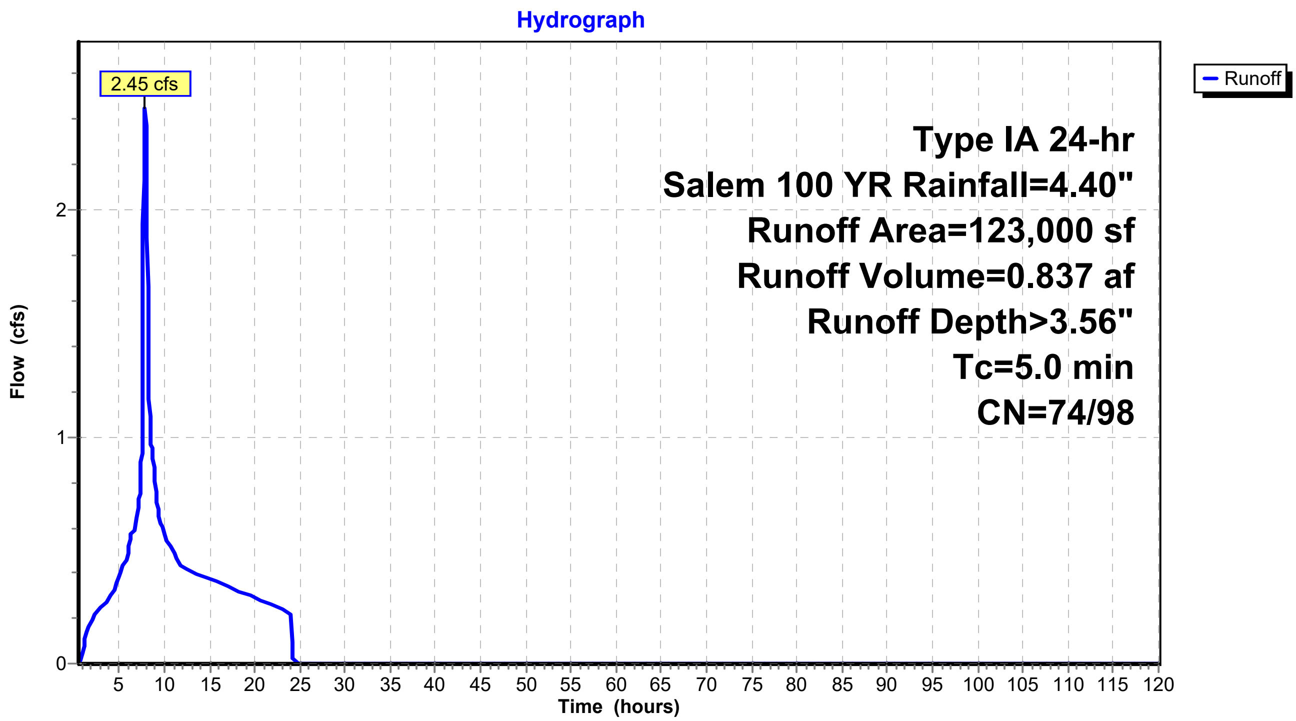
Runoff = 2.45 cfs @ 7.91 hrs, Volume= 0.837 af, Depth> 3.56"
Routed to Pond 1P : RG

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem 100 YR Rainfall=4.40"

Area (sf)	CN	Description
90,100	98	Paved parking, HSG C
32,900	74	>75% Grass cover, Good, HSG C
123,000	92	Weighted Average
32,900		26.75% Pervious Area
90,100		73.25% Impervious Area

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

Subcatchment A: Developed Basin



Summary for Subcatchment A: Developed Basin

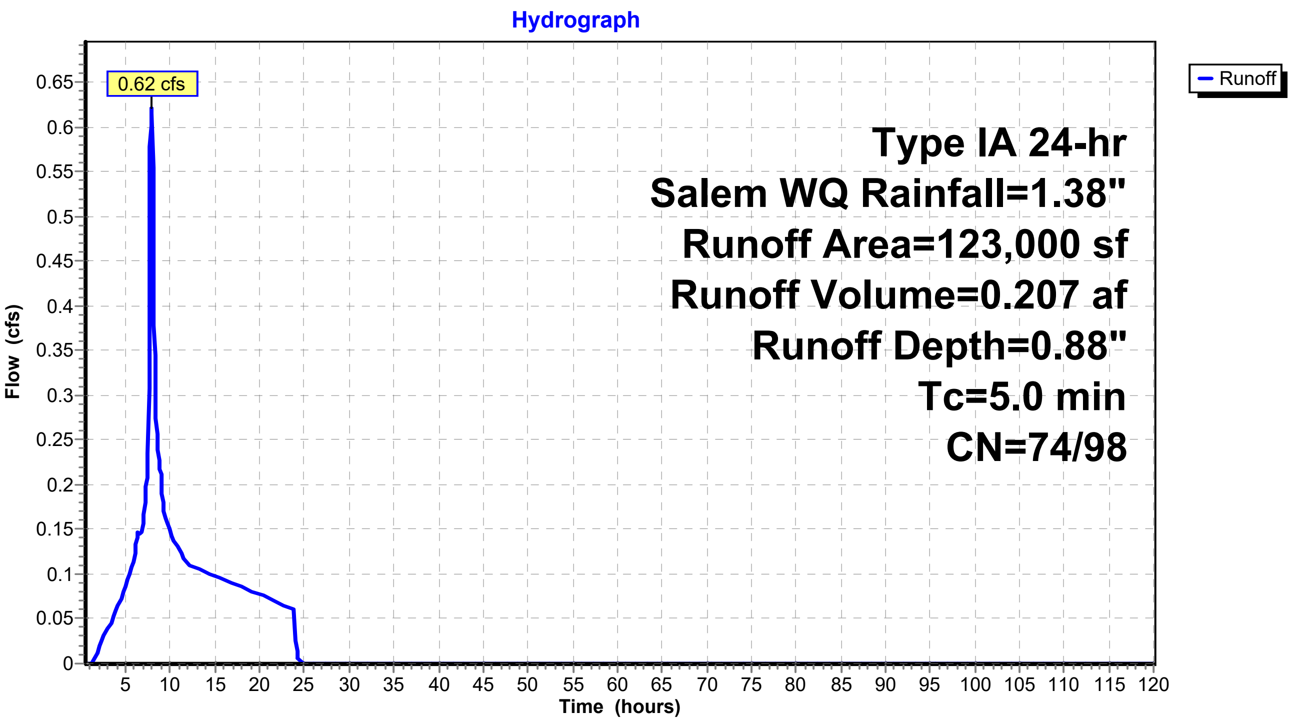
Runoff = 0.62 cfs @ 7.91 hrs, Volume= 0.207 af, Depth= 0.88"
Routed to Pond 1P : RG

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem WQ Rainfall=1.38"

Area (sf)	CN	Description
90,100	98	Paved parking, HSG C
32,900	74	>75% Grass cover, Good, HSG C
123,000	92	Weighted Average
32,900		26.75% Pervious Area
90,100		73.25% Impervious Area

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

Subcatchment A: Developed Basin



Summary for Pond 1P: RG

Inflow Area = 2.824 ac, 73.25% Impervious, Inflow Depth = 0.66" for Salem 1/2 2 YR event
Inflow = 0.48 cfs @ 7.92 hrs, Volume= 0.156 af
Outflow = 0.05 cfs @ 22.75 hrs, Volume= 0.156 af, Atten= 90%, Lag= 890.2 min
Discarded = 0.03 cfs @ 22.75 hrs, Volume= 0.147 af
Primary = 0.02 cfs @ 22.75 hrs, Volume= 0.008 af
Routed to nonexistent node 6L

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 171.57' @ 22.75 hrs Surf.Area= 3,270 sf Storage= 4,666 cf

Plug-Flow detention time= 1,666.3 min calculated for 0.156 af (100% of inflow)
Center-of-Mass det. time= 1,665.9 min (2,381.5 - 715.7)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	16,982 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

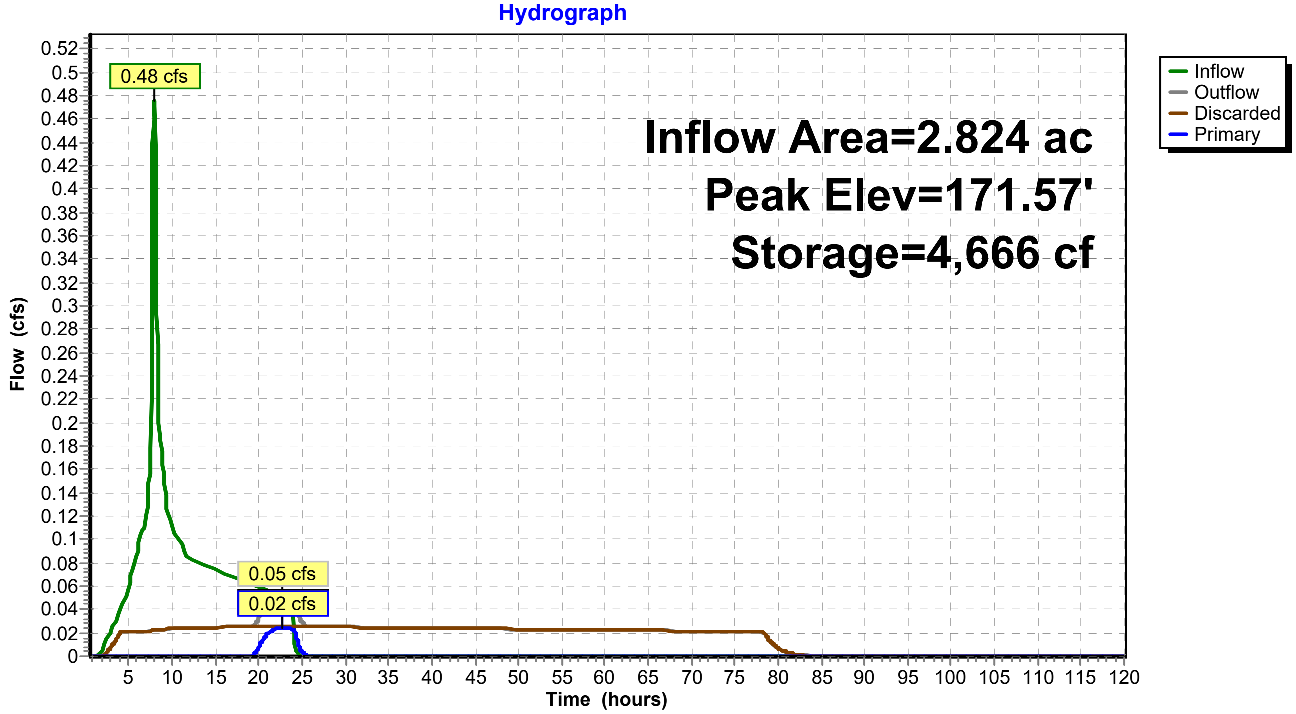
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
168.00	3,270	0.0	0	0	3,270
172.25	3,270	40.0	5,559	5,559	4,132
173.74	3,270	0.1	5	5,564	4,434
173.75	1,350	100.0	22	5,586	6,354
174.00	1,870	100.0	401	5,987	6,875
175.00	3,270	100.0	2,538	8,525	8,286
176.00	6,560	100.0	4,821	13,345	11,585
176.50	8,010	100.0	3,636	16,982	13,043

Device	Routing	Invert	Outlet Devices
#1	Discarded	168.00'	**0.275 in/hr Exfiltration over Wetted area**
#2	Primary	171.43'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	174.80'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	175.50'	**3.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	175.94'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.03 cfs @ 22.75 hrs HW=171.57' (Free Discharge)
└—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.02 cfs @ 22.75 hrs HW=171.57' (Free Discharge)
├—**2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 1.26 fps)
├—**3=Orifice/Grate** (Controls 0.00 cfs)
├—**4=Orifice/Grate** (Controls 0.00 cfs)
└—**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: RG


Hydrograph
0.48 cfs
0.05 cfs
0.02 cfs
Inflow Area=2.824 ac
Peak Elev=171.57'
Storage=4,666 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0.52
0.5
0.48
0.46
0.44
0.42
0.4
0.38
0.36
0.34
0.32
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120

Summary for Pond 1P: RG

Inflow Area = 2.824 ac, 73.25% Impervious, Inflow Depth = 2.45" for Salem 10 YR event
Inflow = 1.68 cfs @ 7.92 hrs, Volume= 0.577 af
Outflow = 0.29 cfs @ 12.65 hrs, Volume= 0.577 af, Atten= 83%, Lag= 283.8 min
Discarded = 0.06 cfs @ 12.65 hrs, Volume= 0.215 af
Primary = 0.23 cfs @ 12.65 hrs, Volume= 0.362 af
Routed to nonexistent node 6L

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 175.46' @ 12.65 hrs Surf.Area= 4,651 sf Storage= 10,347 cf

Plug-Flow detention time= 788.1 min calculated for 0.577 af (100% of inflow)
Center-of-Mass det. time= 787.8 min (1,476.6 - 688.8)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	16,982 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

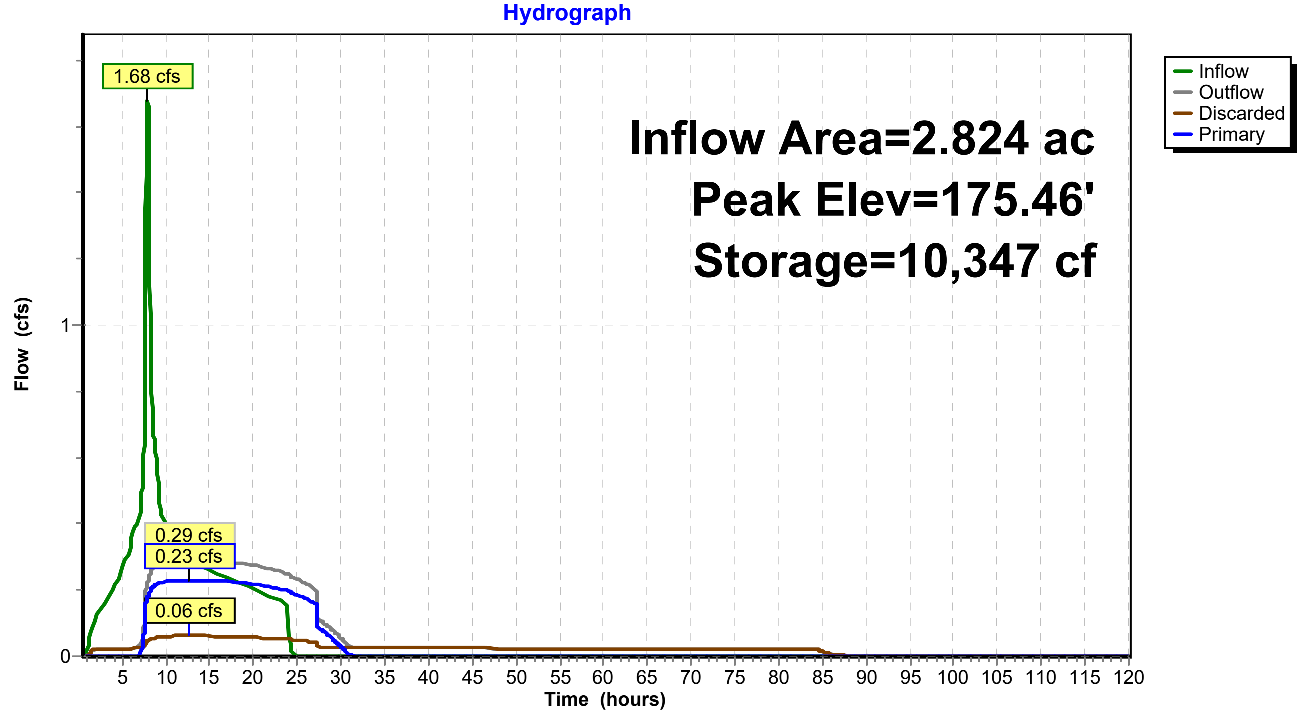
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
168.00	3,270	0.0	0	0	3,270
172.25	3,270	40.0	5,559	5,559	4,132
173.74	3,270	0.1	5	5,564	4,434
173.75	1,350	100.0	22	5,586	6,354
174.00	1,870	100.0	401	5,987	6,875
175.00	3,270	100.0	2,538	8,525	8,286
176.00	6,560	100.0	4,821	13,345	11,585
176.50	8,010	100.0	3,636	16,982	13,043

Device	Routing	Invert	Outlet Devices
#1	Discarded	168.00'	**0.275 in/hr Exfiltration over Wetted area**
#2	Primary	171.43'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	174.80'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	175.50'	**3.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	175.94'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.06 cfs @ 12.65 hrs HW=175.46' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Primary OutFlow Max=0.23 cfs @ 12.65 hrs HW=175.46' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 9.57 fps)
├─**3=Orifice/Grate** (Orifice Controls 0.02 cfs @ 3.79 fps)
├─**4=Orifice/Grate** (Controls 0.00 cfs)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: RG


Hydrograph
1.68 cfs
0.29 cfs
0.23 cfs
0.06 cfs
Inflow Area=2.824 ac
Peak Elev=175.46'
Storage=10,347 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
1
0
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120
Time (hours)

Summary for Pond 1P: RG

Inflow Area = 2.824 ac, 73.25% Impervious, Inflow Depth = 2.82" for Salem 25 YR event
Inflow = 1.93 cfs @ 7.91 hrs, Volume= 0.663 af
Outflow = 0.38 cfs @ 11.23 hrs, Volume= 0.663 af, Atten= 80%, Lag= 198.9 min
Discarded = 0.07 cfs @ 11.23 hrs, Volume= 0.228 af
Primary = 0.32 cfs @ 11.23 hrs, Volume= 0.435 af
Routed to nonexistent node 6L

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 175.70' @ 11.23 hrs Surf.Area= 5,462 sf Storage= 11,558 cf

Plug-Flow detention time= 749.8 min calculated for 0.663 af (100% of inflow)
Center-of-Mass det. time= 749.5 min (1,435.8 - 686.4)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	16,982 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

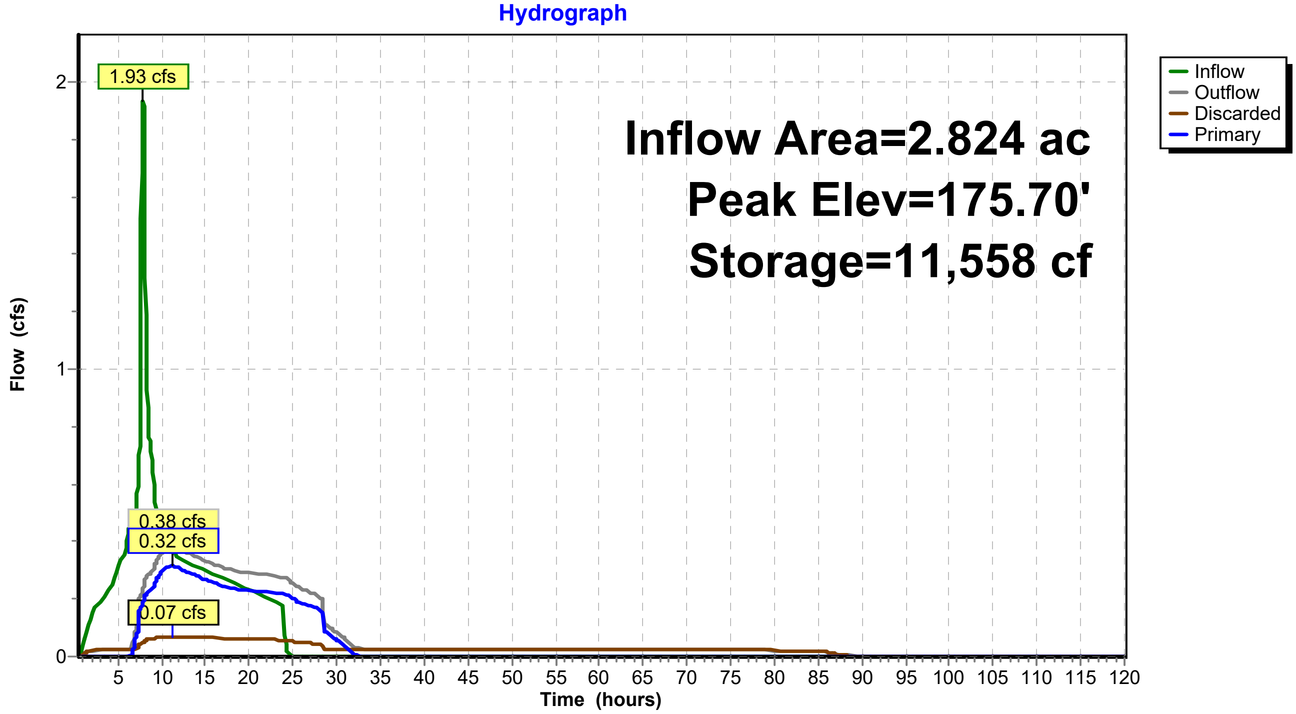
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
168.00	3,270	0.0	0	0	3,270
172.25	3,270	40.0	5,559	5,559	4,132
173.74	3,270	0.1	5	5,564	4,434
173.75	1,350	100.0	22	5,586	6,354
174.00	1,870	100.0	401	5,987	6,875
175.00	3,270	100.0	2,538	8,525	8,286
176.00	6,560	100.0	4,821	13,345	11,585
176.50	8,010	100.0	3,636	16,982	13,043

Device	Routing	Invert	Outlet Devices
#1	Discarded	168.00'	**0.275 in/hr Exfiltration over Wetted area**
#2	Primary	171.43'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	174.80'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	175.50'	**3.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	175.94'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.07 cfs @ 11.23 hrs HW=175.70' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.32 cfs @ 11.23 hrs HW=175.70' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 9.85 fps)
├─**3=Orifice/Grate** (Orifice Controls 0.02 cfs @ 4.47 fps)
├─**4=Orifice/Grate** (Orifice Controls 0.08 cfs @ 1.53 fps)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: RG


Hydrograph
1.93 cfs
0.38 cfs
0.32 cfs
0.07 cfs
Inflow Area=2.824 ac
Peak Elev=175.70'
Storage=11,558 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)
0
1
2
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120

Summary for Pond 1P: RG

Inflow Area = 2.824 ac, 73.25% Impervious, Inflow Depth > 3.56" for Salem 100 YR event
Inflow = 2.45 cfs @ 7.91 hrs, Volume= 0.837 af
Outflow = 0.60 cfs @ 9.79 hrs, Volume= 0.837 af, Atten= 75%, Lag= 112.5 min
Discarded = 0.07 cfs @ 9.79 hrs, Volume= 0.242 af
Primary = 0.53 cfs @ 9.79 hrs, Volume= 0.595 af
Routed to nonexistent node 6L

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 176.00' @ 9.79 hrs Surf.Area= 6,563 sf Storage= 13,353 cf

Plug-Flow detention time= 653.2 min calculated for 0.837 af (100% of inflow)
Center-of-Mass det. time= 652.9 min (1,335.1 - 682.2)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	16,982 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

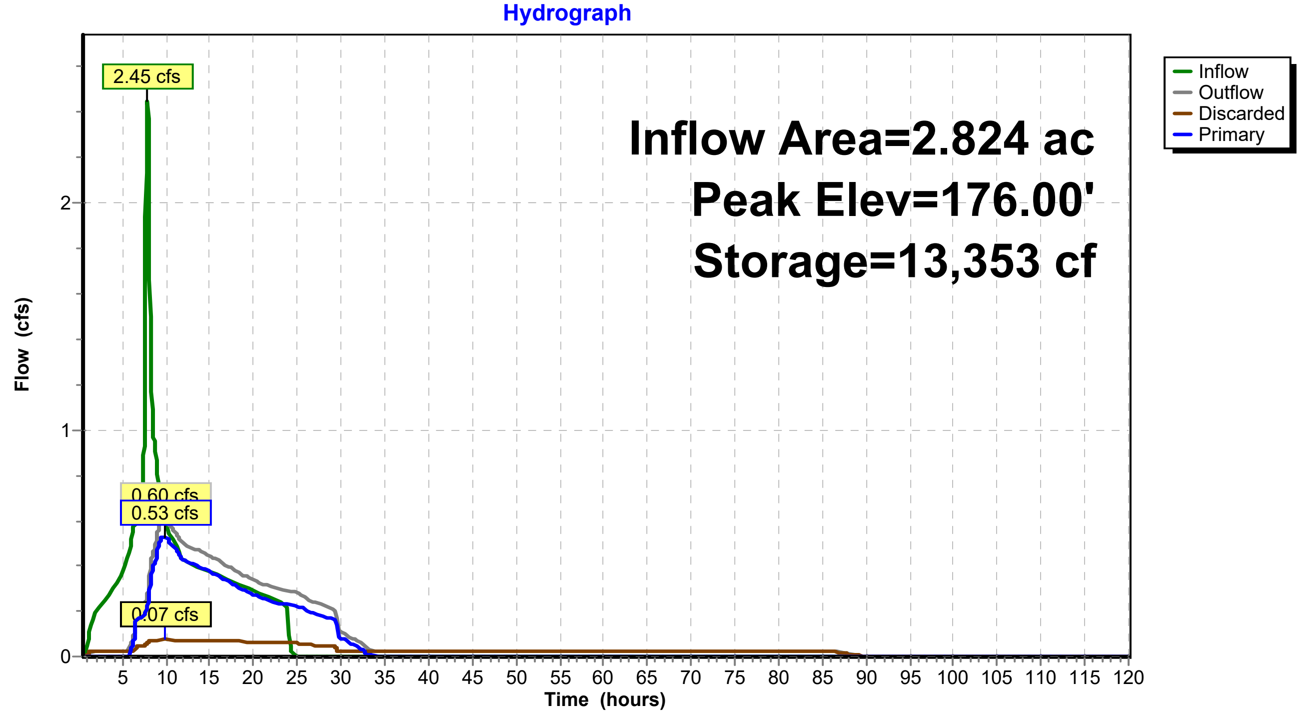
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
168.00	3,270	0.0	0	0	3,270
172.25	3,270	40.0	5,559	5,559	4,132
173.74	3,270	0.1	5	5,564	4,434
173.75	1,350	100.0	22	5,586	6,354
174.00	1,870	100.0	401	5,987	6,875
175.00	3,270	100.0	2,538	8,525	8,286
176.00	6,560	100.0	4,821	13,345	11,585
176.50	8,010	100.0	3,636	16,982	13,043

Device	Routing	Invert	Outlet Devices
#1	Discarded	168.00'	**0.275 in/hr Exfiltration over Wetted area**
#2	Primary	171.43'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	174.80'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	175.50'	**3.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	175.94'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.07 cfs @ 9.79 hrs HW=176.00' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.53 cfs @ 9.79 hrs HW=176.00' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.22 cfs @ 10.20 fps)
├─**3=Orifice/Grate** (Orifice Controls 0.03 cfs @ 5.18 fps)
├─**4=Orifice/Grate** (Orifice Controls 0.19 cfs @ 2.87 fps)
└─**5=Broad-Crested Rectangular Weir** (Weir Controls 0.08 cfs @ 0.69 fps)

Pond 1P: RG


Hydrograph
2.45 cfs
0.60 cfs
0.53 cfs
0.07 cfs
Inflow Area=2.824 ac
Peak Elev=176.00'
Storage=13,353 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

Summary for Pond 1P: RG

Inflow Area = 2.824 ac, 73.25% Impervious, Inflow Depth = 0.88" for Salem WQ event
Inflow = 0.62 cfs @ 7.91 hrs, Volume= 0.207 af
Outflow = 0.09 cfs @ 17.82 hrs, Volume= 0.207 af, Atten= 86%, Lag= 594.7 min
Discarded = 0.03 cfs @ 17.82 hrs, Volume= 0.151 af
Primary = 0.06 cfs @ 17.82 hrs, Volume= 0.056 af
Routed to nonexistent node 6L

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 171.85' @ 17.82 hrs Surf.Area= 3,270 sf Storage= 5,032 cf

Plug-Flow detention time= 1,373.6 min calculated for 0.207 af (100% of inflow)
Center-of-Mass det. time= 1,374.6 min (2,083.5 - 708.9)

Volume	Invert	Avail.Storage	Storage Description
#1	168.00'	16,982 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

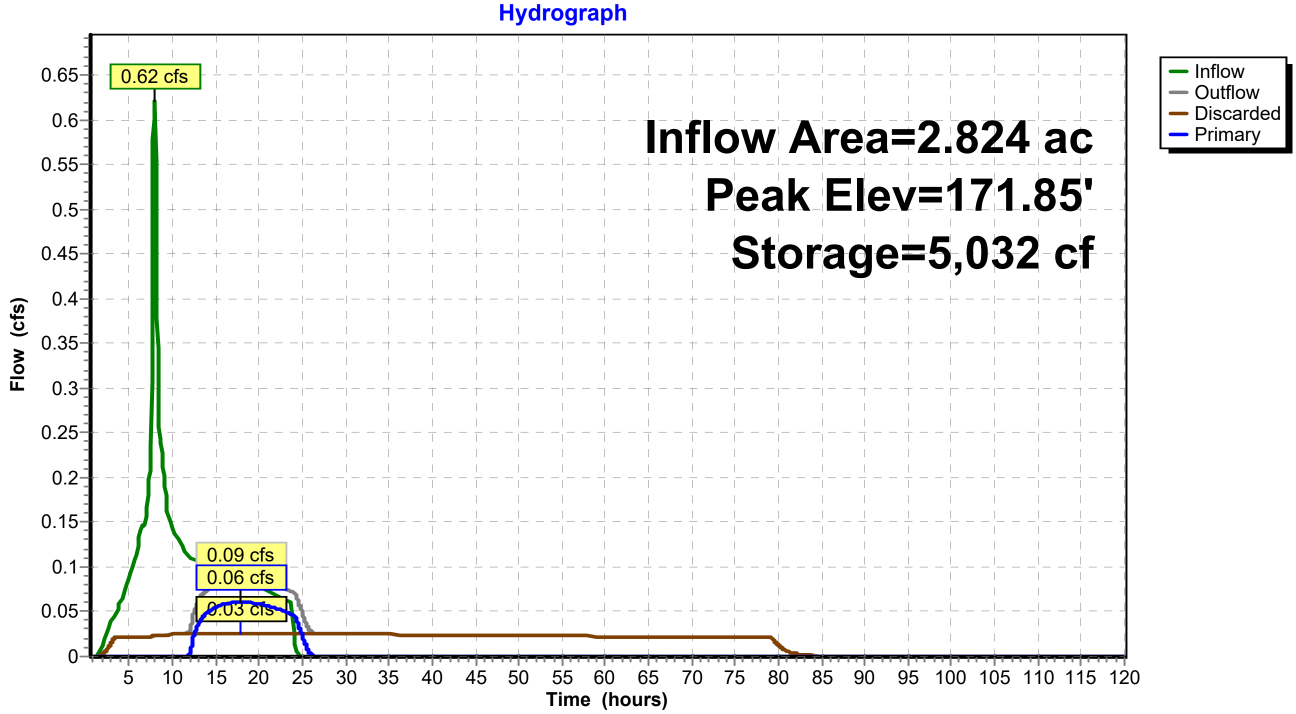
Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
168.00	3,270	0.0	0	0	3,270
172.25	3,270	40.0	5,559	5,559	4,132
173.74	3,270	0.1	5	5,564	4,434
173.75	1,350	100.0	22	5,586	6,354
174.00	1,870	100.0	401	5,987	6,875
175.00	3,270	100.0	2,538	8,525	8,286
176.00	6,560	100.0	4,821	13,345	11,585
176.50	8,010	100.0	3,636	16,982	13,043

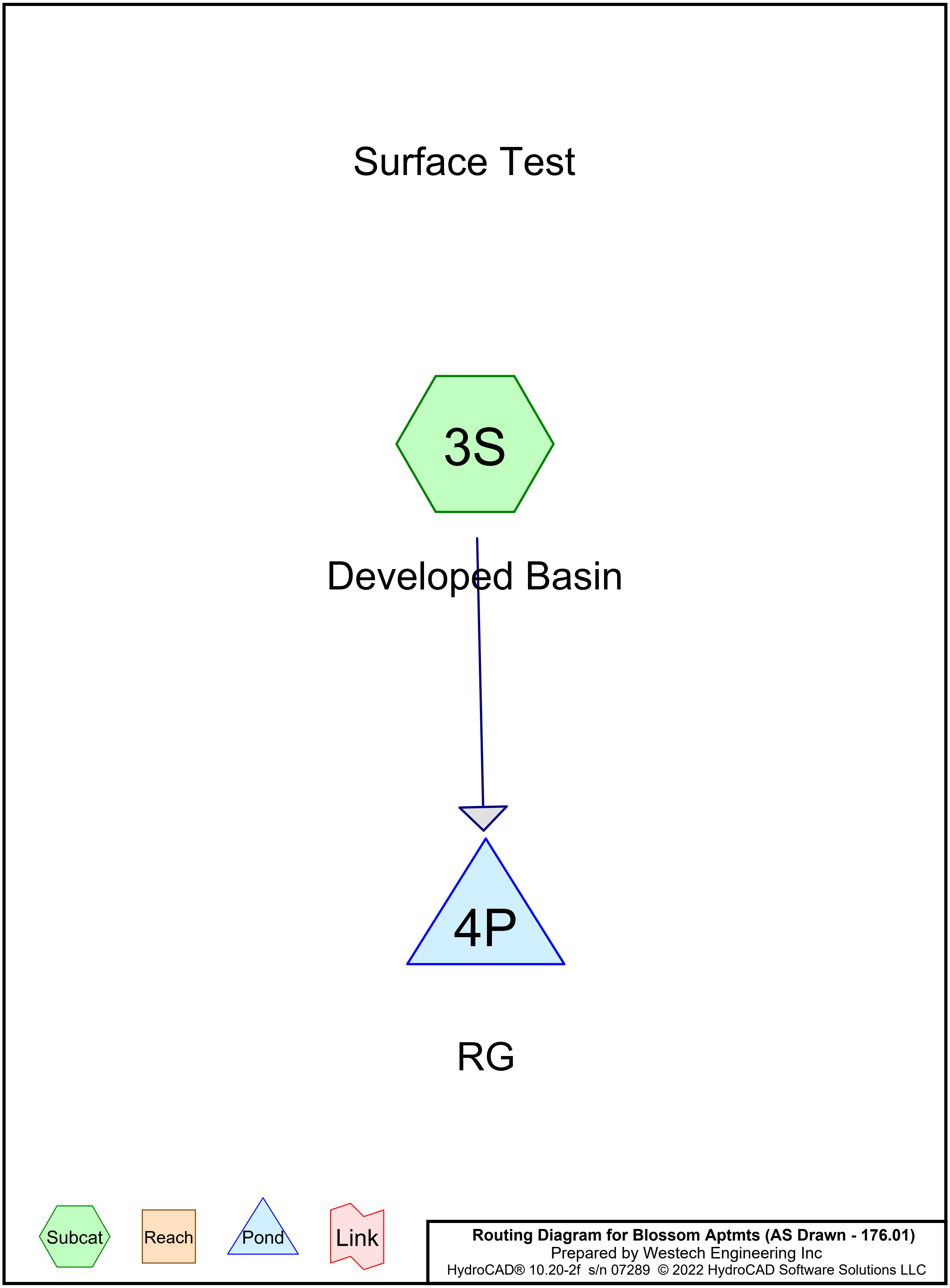
Device	Routing	Invert	Outlet Devices
#1	Discarded	168.00'	**0.275 in/hr Exfiltration over Wetted area**
#2	Primary	171.43'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Primary	174.80'	**1.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Primary	175.50'	**3.5" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Primary	175.94'	**2.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.03 cfs @ 17.82 hrs HW=171.85' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.06 cfs @ 17.82 hrs HW=171.85' (Free Discharge)
├─**2=Orifice/Grate** (Orifice Controls 0.06 cfs @ 2.78 fps)
├─**3=Orifice/Grate** (Controls 0.00 cfs)
├─**4=Orifice/Grate** (Controls 0.00 cfs)
└─**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: RG


Hydrograph
0.62 cfs
0.09 cfs
0.06 cfs
0.03 cfs
Inflow Area=2.824 ac
Peak Elev=171.85'
Storage=5,032 cf
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)



Routing Diagram for Blossom Aptmts (AS Drawn - 176.01)
Prepared by Westech Engineering Inc

Summary for Subcatchment 3S: Developed Basin

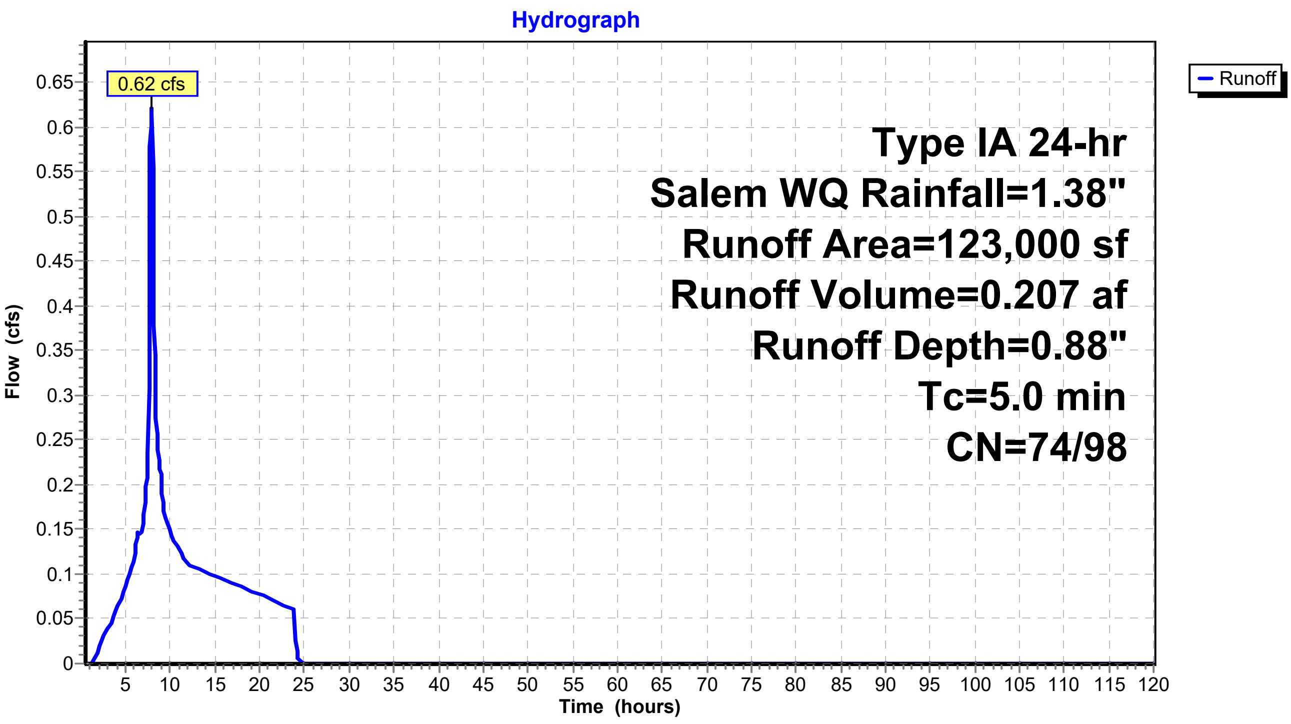
Runoff = 0.62 cfs @ 7.91 hrs, Volume= 0.207 af, Depth= 0.88"
Routed to Pond 4P : RG

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Type IA 24-hr Salem WQ Rainfall=1.38"

Area (sf)	CN	Description
90,100	98	Paved parking, HSG C
32,900	74	>75% Grass cover, Good, HSG C
123,000	92	Weighted Average
32,900		26.75% Pervious Area
90,100		73.25% Impervious Area

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

Subcatchment 3S: Developed Basin



Summary for Pond 4P: RG

Inflow Area = 2.824 ac, 73.25% Impervious, Inflow Depth = 0.88" for Salem WQ event
Inflow = 0.62 cfs @ 7.91 hrs, Volume= 0.207 af
Outflow = 0.17 cfs @ 9.23 hrs, Volume= 0.207 af, Atten= 72%, Lag= 79.0 min
Discarded = 0.17 cfs @ 9.23 hrs, Volume= 0.207 af

Routing by Stor-Ind method, Time Span= 0.50-120.00 hrs, dt= 0.05 hrs
Peak Elev= 174.60' @ 9.23 hrs Surf.Area= 2,658 sf Storage= 1,745 cf

Plug-Flow detention time= 105.9 min calculated for 0.207 af (100% of inflow)
Center-of-Mass det. time= 105.9 min (814.8 - 708.9)

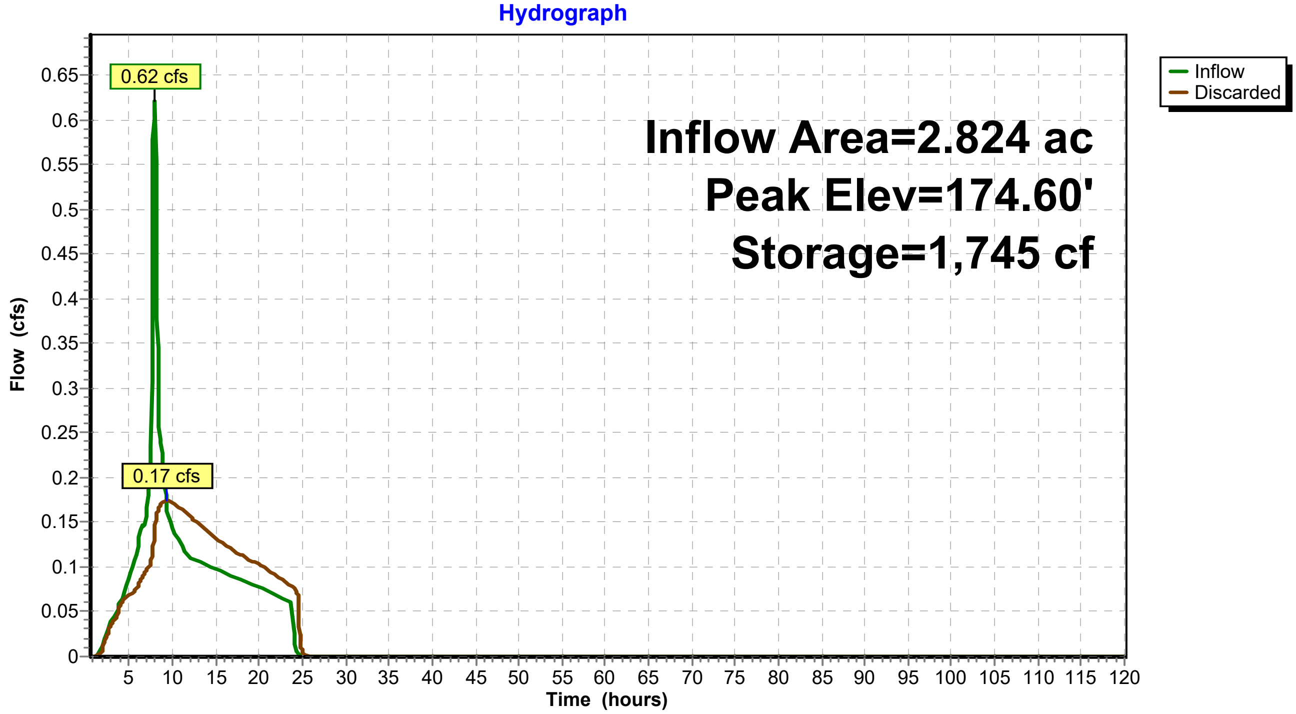
Volume	Invert	Avail.Storage	Storage Description
#1	173.75'	11,395 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
173.75	1,350	0.0	0	0	1,350
174.00	1,870	100.0	401	401	1,871
175.00	3,270	100.0	2,538	2,938	3,282
176.00	6,560	100.0	4,821	7,759	6,582
176.50	8,010	100.0	3,636	11,395	8,039

Device	Routing	Invert	Outlet Devices
#1	Discarded	173.75'	**2.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 172.25'

Discarded OutFlow Max=0.17 cfs @ 9.23 hrs HW=174.60' (Free Discharge)
└─**1=Exfiltration** (Controls 0.17 cfs)

Pond 4P: RG


Hydrograph
0.62 cfs
0.17 cfs
Inflow
Discarded
Inflow Area=2.824 ac
Peak Elev=174.60'
Storage=1,745 cf
Flow (cfs)
Time (hours)
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120

APPENDIX D

GEOTECHNICAL REPORT

Geotechnical Engineering Report

Blossom Drive Apartments
Salem, Oregon

for
Clutch Industries, Inc.

July 28, 2020

GeoEngineers
Earth Science + Technology

Geotechnical Engineering Report

Blossom Drive Apartments
Salem, Oregon

for
Clutch Industries, Inc.

July 28, 2020

GeoEngineers

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971.304.3078

Geotechnical Engineering Report

Blossom Drive Apartments
Salem, Oregon

File No. 23830-006-00

July 28, 2020

Prepared for:

Clutch Industries, Inc.
360 Belmont Street NE
Salem, Oregon 97301

Attention: Chris Anderson

Prepared by:

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Benjamin J. Hoffman, PE
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for

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Principal

REGISTERED PROFESSIONAL ENGINEER
77490PE
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GREG ALAN LANDAU

EXPIRES: 12.31.20

BJH:JCV:cje

GEOENGINEERS

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APPENDICES

1.0 INTRODUCTION

GeoEngineers, Inc. (GeoEngineers), is pleased to submit this geotechnical engineering report for the proposed Blossom Drive Apartments located at the property at 3480 Blossom Drive NE in Salem, Oregon. Our understanding of the project is based on information provided to us by Mr. Chris Anderson of Clutch Industries, LLC, including a "Proposed Site Plan" dated June 10, 2020, that was prepared by others. The location of the site relative to the surrounding area is shown in the Vicinity Map, Figure 1.

Based on the information provided to us, we understand that the project consists of constructing a total of eight apartment buildings (Buildings 1 through 8), that are two- or three-story wood-framed structures, as well as associated paved parking and drive areas. The apartment development would be located to the south of the current private residence at 3480 Blossom Drive NE, in areas of the property generally consisting of an agricultural use area that includes farm-related structures and an open grass field. Building and pavement traffic loads were not provided. We have assumed typical light wood-frame structural loads consistent with development of two- and three-story wood-framed apartment structures with assumed maximum column and wall loads on the order of 30 kips per column and 2 to 3 kips per lineal foot (klf) respectively, and floor loads for slabs on grade of 100 pounds per square foot (psf) or less. We have also assumed that maximum cuts and fills will be less than 2 feet each, and that no on-site retaining walls will be required.

2.0 SCOPE OF SERVICES

The purpose of our services was to evaluate soil and groundwater conditions as a basis for developing geotechnical design and construction recommendations for the proposed apartment development project.

Our proposed scope of services included the following:

1. Reviewed existing available subsurface soil and groundwater information, geologic maps and other available geotechnical engineering related information pertinent to the site.
2. Coordinated and managed the field investigation, including public utility notification and scheduling of subcontractors and GeoEngineers' field staff.
3. Explored subsurface soil and groundwater conditions at the site by drilling a total of eight borings. Six borings (B-1 through B-6) advanced within proposed apartment building footprints, each extending to a depth of 16½ feet below ground surface (bgs), and two borings (B-7 and B-8) advanced in proposed paved and parking areas, extending to a depth of 6½ feet bgs. Exploration locations are shown in the Site Plans, Figures 2A and 2B. Logs of each exploration are provided in Appendix A.
4. Obtained samples at representative intervals from the explorations, observed groundwater conditions and maintained detailed logs in general accordance with ASTM International (ASTM) Standard Practices Test Method D 2488. Qualified staff from our office observed and documented field activities.
5. Performed two infiltration tests (IT-1 and IT-2) at select locations at the project site as shown in Figures 2A and 2B. Infiltration testing was conducted as required by Division 004 of the *City of Salem Department of Public Works Administrative Rules Design Standards* (COSDS).

6. Performed laboratory tests on selected soil samples obtained from the explorations to evaluate pertinent engineering characteristics. Laboratory test results are included in the exploration logs in Appendix A.
7. Provided a geotechnical evaluation of the site and provided project-specific design recommendations in this geotechnical report that address the following geotechnical components:
   a. A general description of site topography, geology and subsurface conditions.
   b. An opinion as to the adequacy of the proposed development from a geotechnical engineering standpoint.
   c. Recommendations for site preparation measures, including disposition of undocumented fill and unsuitable native soils, recommendations for temporary cut slopes and constraints for wet weather construction.
   d. Provide estimates of groundwater level and management recommendations.
   e. Recommendations for temporary excavation and temporary excavation protection, such as excavation sheeting and bracing.
   f. Recommendations for earthwork construction, including use of on-site and imported structural fill, and fill placement and compaction requirements.
   g. Recommendations for shallow foundations to support the proposed structures, including minimum width and embedment, design soil bearing pressures, settlement estimates (total and differential), coefficient of friction and passive earth pressures for sliding resistance.
   h. Recommendations for supporting on-grade slabs, including base rock, capillary break, and modulus of subgrade reaction.
   i. Summary of infiltration testing and discussion of suitability of on-site infiltration facilities based on subsurface conditions.
   j. Seismic design parameters, including soil site class evaluation in accordance with the current version of the International Building Code (IBC).

Our geotechnical work has been directly supervised by a professional engineer licensed in the state of Oregon.

3.0 SITE CONDITIONS

3.1. Surface Conditions

The proposed new development is located in an approximate 3.5-acre farm property consisting of several farm structures, fencing, trees, and an open grass field. The property is generally level to gently undulating, with the majority of the site ground surface elevation between approximately 179 and 186 feet North American Vertical Datum 1988 (NAVD 88). Site surface conditions are shown in Figures 2A and 2B.

3.2. Site Geology

The geology of the site is mapped by Tolan and Beeson (2000) as underlain by Holocene to Pleistocene "older alluvium" of the Willamette River and its tributaries, described as "…..poorly indurated glaciofluvial clays and silts deposited by the catastrophic (Missoula) Floods."

Our on-site investigation suggests that the site geology is generally consistent with the published mapping and our experience in the area. Subsurface conditions encountered in our borings suggest the shallow soils are typically silt.

3.3. Subsurface Conditions

We completed field explorations at the project site on July 14, 2020. Our explorations included eight drilled borings (B-1 through B-8) to depths of between 6½ to 16½ feet bgs, two infiltration tests (IT-1 and IT-2) at depths of 3 and 2.5 feet bgs, respectively, and two dynamic cone penetrometer (DCP) readings (DCP-1 and DCP-2) to depths of approximately 42 inches bgs. A summary of our exploration methods as well as the boring logs/infiltration test logs can be found in Appendix A. Laboratory test results are also provided in the exploration logs and described in Appendix A. The approximate locations of the explorations are shown in Figures 2A and 2B.

At the time of our explorations, the site was surfaced with a gravel driveway, mowed grass lawn, and a tall grass field that included an approximate 6-inch-thick rootzone/topsoil layer with a tilled soil zone that extended to a depth of 12 to 18 inches. The surface soil is generally underlain by 15 or more feet of medium stiff to very stiff silt and silt with sand to the maximum depth explored.

3.4. Groundwater

Groundwater was not encountered during drilling and likely present at depths greater than 15 feet bgs. Groundwater may be present at shallower depths in a perched or capillary condition during wet times of the year or during extended periods of wet weather. Groundwater conditions at the site are expected to vary seasonally due to rainfall events and other factors not observed in our explorations.

4.0 CONCLUSIONS

4.1. General

Based on our explorations, testing and analyses, it is our opinion that the site is suitable for the proposed project from a geotechnical standpoint, provided the recommendations in this report are included in design and construction. We offer the following summary of conclusions regarding geotechnical design at the site.

- Groundwater was not encountered in the upper 15 feet bgs during drilling.
- Surface conditions at the site consist primarily of undeveloped areas covered with field-type grass; therefore, stripping will be required in all proposed development areas. We anticipate a stripping depth of approximately 6 inches bgs to remove the grass roots and topsoil layer. The upper tilled zone is considered disturbed and classified as undocumented fill. The upper tilled zone should be compacted after stripping and prior to placement of fill.
- Measured infiltration rates generally range from 0.4 to 0.7 inches/hour (in/hr). In general, soils with infiltration rates less than 2 in/hr are not well suited as the sole means of stormwater disposal for sites.

In addition, relatively shallow groundwater levels limit the depth to which infiltration facilities can be extended.

- Typical infiltration facilities require at least 5 feet of separation between the base of the facility and the seasonal high groundwater level. Groundwater was not encountered at depths of at least 15 feet bgs.
- On-site near surface soils generally consist of silt. The silty soil will become significantly disturbed when trafficked during earthwork, particularly when construction traffic over the site occurs during periods of wet weather or when the moisture content of the soil is more than a few percentage points above optimum. Wet weather construction practices will be required over exposed native soils unless earthwork occurs during the dry summer months (typically mid-July to mid-September).
- Proposed structures can be satisfactorily supported on continuous and isolated shallow foundations supported on medium stiff to very stiff native soils or on structural fill that extends to native soil.
- Based on proposed development, our foundation recommendations are based on maximum anticipated loads of 30 kips or less for columns, 3 klf or less for walls, and floor loads of 100 psf or less. Based on these design loads, we estimate total settlement to be less than 1 inch. If larger structural loads are anticipated, we should review and reassess the estimated settlement.
- Fill material encountered at subgrade elevation should be evaluated by GeoEngineers during construction. Soft fill or fill with significant debris or unsuitable material should be removed to native stiff or firmer material and replaced with compacted structural fill.
- Slabs-on-grade will be satisfactorily supported on medium stiff to very stiff native soils with a minimum 6-inch-thick layer of compacted crushed rock base overlying approved subgrade or on structural fill over medium stiff to stiff native soils.
- Standard pavement sections prepared as described in this report will suitably support the estimated traffic loads provided the site subgrade is prepared as recommended.

5.0 INFILTRATION TESTING

5.1. General

As is typical for development projects in the Salem area, we conducted infiltration tests on site to assist in evaluation of the site for potential stormwater infiltration design. We conducted two infiltration tests, at depths of 2.5 and 3 feet bgs; one (IT-1) near Blossom Drive NE at the entrance to the site and near boring B-7, the other (IT-2) near the center of the open grass field and boring B-8. This is a typical depth for consideration of stormwater disposal.

Testing was conducted using the encased falling head procedure consistent with the method outlined in “Division 004” of the COSDS. A 2- to 3-inch-thick layer of pea gravel was placed in the pipes prior to adding water to diminish disturbance from flowing water at the base of the pipe interior. The test areas were pre-soaked over a 4-hour period by repeated addition of water into the pipe when necessary. A good seal was present between the base of the pipe and the underlying soil in our opinion.

In both infiltration tests (IT-1 and IT-2), after the saturation period, the pipe was filled with clean water to at least 1 foot above the bottom of the pipe placed in the boring. The drop in water level was measured over a period of time after the soak period. In the case where water levels fall during the time-measured testing, infiltration rates diminish as a result of less head from the water column in the test. Field test results are summarized in Table 1.

TABLE 1. INFILTRATION RESULTS

Infiltration Test No.	Location	Depth (feet)	USCS Material Type	Field Measured Infiltration Rate[1] (inches/hour)
IT-1	North area of site (near B-7)	3	ML	0.4 to 0.7
IT-2	South-central area of site (near B-8)	2.5	ML	0.4 to 0.7

Notes:

[1] Appropriate factors should be applied to the field-measured infiltration rate, based on the design methodology and specific system.

USCS = Unified Soil Classification System

Infiltration rates shown in Table 1 are field-measured rates and represent a relatively short-term measured rate. Factors of safety have not been applied for the type of infiltration system being considered, or for variability that may be present in the on-site soil. In our opinion, and consistent with the state of the practice, correction factors should be applied to this measured rate to reflect the small area of testing and the number of tests conducted.

Appropriate correction factors should be applied by the project civil engineer to account for long-term infiltration parameters. From a geotechnical perspective, we recommend a factor of safety (correction factor) of at least 2 be applied to this type of field infiltration testing result to account for potential soil variability with depth and location within the area tested. In addition, the stormwater system design engineer should determine and apply appropriate remaining correction factor values, or factors of safety, to account for repeated wetting and drying that occur in this area, degree of in-system filtration, frequency and type of system maintenance, vegetation, potential for siltation and bio-fouling, etc., as well as system design correction factors for overflow or redundancy, and base and facility size.

Actual depths, lateral extent, and estimated infiltration rates can vary from the values presented above. Field testing/confirmation during construction is often required in large or long systems or other situations where soil conditions may vary within the area where the system is constructed. The results of this field testing during construction might necessitate that the infiltration locations be modified to achieve the design infiltration rate for the overall system.

Even in the best of circumstances. the infiltration flow rate of a focused stormwater system typically diminishes over time as suspended solids and precipitates in the stormwater slowly clog the void spaces between soil particles or cake on the infiltration surface. The serviceable life of a stormwater system can be extended by pre-filtering or with on-going accessible maintenance. Eventually, most systems will fail and will need to be replaced or have media regenerated or replaced. We recommend that infiltration systems include an overflow that is connected to a suitable discharge point. Also, infiltration systems can cause localized high groundwater levels and should not be located near basement walls, retaining walls, or other embedded structures unless these are specifically designed to account for resulting hydrostatic pressure. Infiltration locations should not be located on or adjacent to sloping ground, unless it is approved by the project geotechnical engineer of record, and should not be infiltrated at a location that allows for flow to travel laterally toward a slope face, such as a mounded water condition or too near the slope face.

5.2. Suitability of Infiltration System

Successful design and implementation of stormwater infiltration systems, and whether a system is suitable for a development depend on several site-specific factors. Stormwater infiltration systems are generally best suited for sites having sandy or gravelly soil with saturated hydraulic conductivities greater than 2 in/hr. Sites with silty or clayey soil, including sites with fine sand, silty sand such as at the upper portions of this site, or gravel with a high percentage of silt or clay in the matrix are generally not well suited for stormwater infiltration. Soil that has higher fine-grained matrices is susceptible to volumetric change and softening during wetting and drying cycles. Fine-grained soil also has large variations in the magnitude of infiltration rates because of bedding and stratification that occurs during deposition and often has thin layers of less permeable or impermeable soil within a larger layer.

As a result of fine-grained soil conditions and relatively low measured infiltration rates, we recommend infiltration of stormwater not be used in the upper soils, or at the very least not be used as the sole method of stormwater management at this site unless those design factors can be otherwise accounted for by increasing infiltration area or coupling with other methods of stormwater disposal. At a minimum, an overflow method should be provided for the overall system.

6.0 EARTHWORK RECOMMENDATIONS

6.1. Site Preparation

In general, site preparation and earthwork for site development will include demolition of existing farm structures, excavation for removal of existing tree and tree root removal, stripping and grubbing, grading the site and excavating for utilities and foundations, and may also include removal or relocation of existing site utilities where present beneath proposed buildings.

6.1.1. Demolition

Existing structures should be demolished and removed from the site. If present, existing utilities that will be abandoned on site should be identified prior to project construction. Abandoned utility lines beneath proposed structural areas should be completely removed or filled with grout if abandoned and left in-place in order to reduce potential settlement or caving in the future. Materials generated during demolition of existing utilities should be transported off site for disposal.

Existing voids and new depressions created due to removal of existing utilities, or other subsurface elements, should be cleaned of loose soil or debris down to firm soil and backfilled with compacted structural fill. Disturbance to a greater depth should be expected if site preparation and earthwork are conducted during periods of wet weather.

6.1.2. Stripping and Grubbing

Based on our observations at the site, we estimate that the depth of stripping of on-site organics in grass-covered areas will be on the order of about 6 inches. Greater stripping depths may be required to remove localized zones of loose or organic soil, and in areas where moderate to heavy vegetation may be present, or surface disturbance has occurred. In addition, if present in areas of proposed development, the primary root systems of trees should be completely removed. Stripped material should be transported off site for disposal or processed and used as fill in landscaping areas.

Where encountered, trees and their root balls should be grubbed to the depth of the roots, which could exceed 3 feet bgs. Depending on the methods used to remove the preceding material, considerable disturbance and loosening of the subgrade could occur. We recommend that disturbed soil be removed to expose stiff native soil. The resulting excavations should be backfilled with structural fill.

6.2. Subgrade Preparation and Evaluation

Upon completion of site preparation activities, exposed subgrades that are to receive fill should be compacted in-place prior to fill placement due to the presence of a tilled zone that extends to depths of 12 to 18 inches bgs. If site grading extends to below these depths, and to the native in-place (non-tilled) soils, compaction of in-place subgrade is not required.

Exposed subgrades should be proof-rolled with a fully loaded dump truck or similar heavy rubber-tired construction equipment where space allows to identify soft, loose or unsuitable areas. Probing may be used for evaluating smaller areas or where proof-rolling is not practical. Proof-rolling and probing should be conducted prior to placing fill, and should be performed by a representative of GeoEngineers who will evaluate the suitability of the subgrade and identify areas of yielding that are indicative of soft or loose soil. If soft or loose zones are identified during proof-rolling or probing, these areas should be excavated to the extent indicated by our representative and replaced with structural fill.

As discussed in Section 4.1 of this report, the native fine-grained, silty soil can be sensitive to small changes in moisture content and will be difficult, if not impossible, to compact adequately during wet weather. While tilling and compacting the subgrade is the economical method for subgrade improvement, it will likely only be possible during extended dry periods and following moisture conditioning of the soil.

During wet weather, or when the exposed subgrade is wet or unsuitable for proof-rolling, the prepared subgrade should be evaluated by observing excavation activity and probing with a steel foundation probe. Observations, probing, and compaction testing should be performed by a member of our staff. Wet soil that has been disturbed due to site preparation activities or soft or loose zones identified during probing should be removed and replaced with compacted structural fill.

6.3. Subgrade Protection and Wet Weather Considerations

The upper fine-grained soils at the site are highly susceptible to moisture. Wet weather construction practices will be necessary if work is performed during periods of wet weather. If site grading will occur during wet weather conditions, it will be necessary to use track-mounted equipment, load material into trucks supported on gravel work pads and employ other methods to reduce ground disturbance. The contractor should be responsible to protect the subgrade during construction, reflective of their proposed means and methods and time of year.

Earthwork planning should include considerations for minimizing subgrade disturbance. The following recommendations can be implemented if wet weather construction is considered:

- The ground surface in and around the work area should be sloped so that surface water is directed to a sump or discharge location. The ground surface should be graded such that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches. Measures should be implemented to remove surface water from the work area.

- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting or similar means.
- The site soils should not be left uncompacted and exposed to moisture. Sealing the surficial soils by rolling with a smooth-drum roller prior to periods of precipitation will reduce the extent to which these soils become wet or unstable.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practicable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with working pad materials not susceptible to wet weather disturbance such as haul roads and rocked staging areas.
- When on-site fine-grained soils are wet of optimum, they are easily disturbed and will not provide adequate support for construction traffic or the proposed development. The use of granular haul roads and staging areas will be necessary for support of construction traffic. Generally, a 12- to 16-inch-thick mat of imported granular base rock aggregate material is sufficient for light staging areas for building pad and light staging activities but is not expected to be adequate to support repeated heavy equipment or truck traffic. The granular mat for haul roads and areas with repeated heavy construction traffic should be increased to between 18 and 24 inches. The actual thickness of haul roads and staging areas should be based on the contractor's approach to site development, and the amount and type of construction traffic.
- During periods of wet weather, concrete should be placed as soon as practical after preparation of the footing excavations. Foundation bearing surfaces should not be exposed to standing water. If water collects in the excavation, it should be removed before placing structural fill or reinforcing steel. Subgrade protection for foundations consisting of a lean concrete mat may be necessary if footing excavations are exposed to extended wet weather conditions.
- The base rock (Aggregate Base and Aggregate Subbase) thicknesses described in Section 9.0 of this report is intended to support post-construction design traffic loads. The design base rock thicknesses will likely not support repeated heavy construction traffic during site construction, or during pavement construction. A thicker base rock section, as described above for haul roads, will likely be required to support construction traffic.

During wet weather, or when the exposed subgrade is wet or unsuitable for proof-rolling, the prepared subgrade should be evaluated by observing excavation activity and probing with a steel foundation probe. Observations, probing and compaction testing should be performed by a member of our staff. Wet soil that has been disturbed due to site preparation activities or soft or loose zones identified during probing should be removed and replaced with compacted structural fill.

6.4. Cement Treated Subgrade Design

These recommendations are included as a potential alternative to the use of imported granular material for wet weather structural fill provided areas being graded or developed make the cement treating process a feasible option.

An experienced contractor may be able to amend the on-site soil with portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content and amendment quantities. Specific recommendations, based on exposed site conditions, for soil amending can be provided if necessary. However, for preliminary planning purposes, it may be assumed that a minimum of 5 percent cement (by dry weight, assuming a unit weight of 100 pounds per cubic foot [pcf]) will be sufficient for subgrade and general fill amendment. Treatment depths of 12 to 16 inches for roadway subgrades are typical (assuming a seven-day unconfined compressive strength of at least 80 pounds per square inch [psi]), though they may be adjusted in the field depending on site conditions. Soil amending should be conducted in accordance with the specifications provided in Oregon Structural Specialty Code 00344 (Treated Subgrade).

Portland cement-amended soil is hard and has low permeability; therefore, this soil does not drain well nor is it suitable for planting. Future landscape areas should not be cement amended, if practical, or accommodations should be planned for drainage and planting. Cement amendment should not be used if runoff during construction cannot be directed or drained away from areas that would be negatively affected by runoff from the amended surface, including adjacent building foundations, low-lying wet areas or active waterways, and area drainage paths.

We recommend a target strength for cement-amended soils of 80 psi. The amount of cement used to achieve this target generally varies with moisture content and soil type. It is difficult to predict field performance of soil to cement amendment due to variability in soil response, and we recommend laboratory testing to confirm expectations. However, for preliminary design purposes, 4 to 5 percent cement by weight of dry soil can generally be used when the soil moisture content does not exceed approximately 25 percent. If the soil moisture content is in the range of 25 to 35 percent, 5 to 7 percent by weight of dry soil is recommended. The amount of cement added to the soil may need to be adjusted based on field observations and performance.

When used for construction of pavement, staging, or haul road subgrades, the amended surface should be protected from abrasion by placing a minimum 4-inch thickness of crushed rock. To prevent strength loss during curing, cement-amended soil should be allowed to cure for a minimum of four days prior to placing the crushed rock. The crushed rock may typically become contaminated with soil during construction. Contaminated base rock should be removed and replaced with clean rock in pavement areas such that the minimum thickness of free-draining base at the surface is 4 inches.

It is not possible to amend soil during heavy or continuous rainfall. Work should be completed during suitable conditions.

6.5. Excavation

Based on the materials encountered in our subsurface exploration, it is our opinion that conventional earthmoving equipment in proper working condition should be capable of making necessary general excavations.

The earthwork contractor should be responsible for reviewing this report, including the boring logs, providing their own assessments, and providing equipment and methods needed to excavate the site soils while protecting subgrades.

6.6. Dewatering

As discussed in Section 3.4 of this report, groundwater was not encountered during drilling in the upper 15 feet at the site. We do not anticipate excavations to extend below this depth. However, if excavations do extend into saturated/wet soils they should be dewatered. Sump pumps are expected to adequately address groundwater encountered in shallow excavations. Deeper excavations may require more intensive or filtered dewatering or use of well points. Deeper excavations that extend below groundwater into sandier soils may be difficult to dewater with conventional sumps because inflow of water may promote a "running soils" condition into excavations, where sandy material flows in with seeping groundwater. For deep excavations or where running soils are encountered, dewatering from well points would likely be required to maintain an open and workable trench.

In addition to groundwater seepage and upward confining flow, surface water inflow to the excavations during the wet season can be problematic. Provisions for surface water control during earthwork and excavations should be included in the project plans and should be installed prior to commencing earthwork.

6.7. Trench Cuts and Trench Shoring

All trench excavations should be made in accordance with applicable Occupational Safety and Health Administration (OSHA) and state regulations. Site soils within expected excavation depths typically range from medium stiff to stiff silt. In our opinion, native soils are generally OSHA Type B, provided there is no seepage and excavations occur during periods of dry weather. Excavations deeper than 4 feet should be shored or laid back at an inclination of 1H:1V (horizontal to vertical) for Type B soils. Flatter slopes may be necessary if workers are required to enter. Excavations made to construct footings or other structural elements should be laid back or shored at the surface as necessary to prevent soil from falling into excavations.

Shoring for trenches less than 6 feet deep that are above the effects of groundwater should be possible with a conventional box system. Slight to moderate sloughing should be expected outside the box. Shoring deeper than 6 feet or below the groundwater table should be designed by a registered engineer before installation. Further, the shoring design engineer should be provided with a copy of this report.

In our opinion, the contractor will be in the best position to observe subsurface conditions continuously throughout the construction process and to respond to the soil and groundwater conditions. Construction site safety is generally the sole responsibility of the contractor, who also is solely responsible for the means, methods and sequencing of the construction operations and choices regarding excavations and shoring. Under no circumstances should the information provided by GeoEngineers be interpreted to mean that GeoEngineers is assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.8. Erosion Control

Erosion control plans are required on construction projects located within Marion County in accordance with Oregon Administrative Rules (OAR) 340-41-006 and 340-41-455 and City of Salem (City) regulations. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds and granular haul roads.

6.9. Structural Fill and Backfill

6.9.1. General

Structural areas include areas beneath foundations, floor slabs, pavements, and any other areas intended to support structures or within the influence zone of structures, should generally meet the criteria for structural fill presented below. All structural fill soils should be free of debris, clay balls, roots, organic matter, frozen soil, man-made contaminants, particles with greatest dimension exceeding 4 inches (3-inch maximum particle size in building footprints) and other deleterious materials. The suitability of soil for use as structural fill will depend on the gradation and moisture content of the soil. As the amount of fines in the soil matrix increases, the soil becomes increasingly more sensitive to small changes in moisture content and achieving the required degree of compaction becomes more difficult or impossible. Recommendations for suitable fill material are provided in the following sections.

6.9.2. On-Site Soils

On-site near-surface soil consists of native silt. On-site soils can be used as structural fill, provided the material meets the above requirements, although due to moisture sensitivity, this material will likely be unsuitable as structural fill during most of the year. If the soil is too wet to achieve satisfactory compaction, moisture conditioning by drying back the material will be required. If the material cannot be properly moisture conditioned, we recommend using imported material for structural fill.

An experienced geotechnical engineer from GeoEngineers should determine the suitability of on-site soil encountered during earthwork activities for reuse as structural fill.

6.9.3. Imported Select Structural Fill

Select imported granular material may be used as structural fill. The imported material should consist of pit or quarry run rock, crushed rock, or crushed gravel and sand that is fairly well-graded between coarse and fine sizes (approximately 25 to 65 percent passing the U.S. No. 4 sieve). It should have less than 5 percent passing the U.S. No. 200 sieve and have a minimum of 75 percent fractured particles according to American Association of State Highway and Transportation Officials (AASHTO) TP-61.

6.9.4. Aggregate Base

Aggregate base material located under floor slabs and pavements and crushed rock used in footing overexcavations should consist of imported clean, durable, crushed angular rock. Such rock should be well-graded, have a maximum particle size of 1 inch and have less than 5 percent passing the U.S. No. 200 sieve (3 percent for retaining walls), and meet the gradation requirements in Table 2. In addition, aggregate base shall have a minimum of 75 percent fractured particles according to AASHTO TP-61 and a sand equivalent of not less than 30 percent based on AASHTO T-176.

TABLE 2. RECOMMENDED GRADATION FOR AGGREGATE BASE

Sieve Size	Percent Passing (by weight)
1 inch	100
½ inch	50 to 65
No. 4	40 to 60

Sieve Size	Percent Passing (by weight)
No. 40	5 to 15
No. 200	0 to 5

6.9.5. Trench Backfill

Backfill for pipe bedding and in the pipe zone should consist of well-graded granular material with a maximum particle size of ¾ inch and less than 5 percent passing the U.S. No. 200 sieve. The material should be free of organic matter and other deleterious materials. Further, the backfill should meet the pipe manufacturer's recommendations. Above the pipe zone backfill, Imported Select Structural Fill may be used as described above.

6.10. Fill Placement and Compaction

Structural fill should be compacted at moisture contents that are within 3 percent of the optimum moisture content as determined by ASTM Test Method D 1557 (Modified Proctor). The optimum moisture content varies with gradation and should be evaluated during construction. Fill material that is not near the optimum moisture content should be moisture conditioned prior to compaction.

Fill and backfill material should be placed in uniform, horizontal lifts, and compacted with appropriate equipment. The appropriate lift thickness will vary depending on the material and compaction equipment used. Fill material should be compacted in accordance with Table 3, below. It is the contractor's responsibility to select appropriate compaction equipment and place the material in lifts that are thin enough to meet these criteria. However, in no case should the loose lift thickness exceed 18 inches.

TABLE 3. COMPACTION CRITERIA

Fill Type	Compaction Requirements Percent Maximum Dry Density Determined by ASTM Test Method D 1557 at ± 3% of Optimum Moisture		
	0 to 2 Feet Below Subgrade	> 2 Feet Below Subgrade	Pipe Zone
Fine-grained soils (non-expansive)	92	92	----
Imported Granular, maximum particle size < 1¼ inch	95	95	----
Imported Granular, maximum particle size 1¼ inch to 4 inches (3-inch maximum under building footprints)	n/a (proof-roll)	n/a (proof-roll)	----
Retaining Wall Backfill*	92	92	----
Nonstructural Zones	90	90	90
Trench Backfill	95	90	90

Note:

* Measures should be taken to prevent overcompaction of the backfill behind retaining walls. We recommend placing the zone of backfill located within 5 feet of the wall in lifts not exceeding about 6 inches in loose thickness and compacting this zone with hand-operated equipment such as a vibrating plate compactor and a jumping jack.

A representative from GeoEngineers should evaluate compaction of each lift of fill. Compaction should be evaluated by compaction testing unless other methods are proposed for oversized materials and are approved by GeoEngineers during construction. These other methods typically involve procedural placement and compaction specifications together with verifying requirements such as proof-rolling.

6.11. Slopes

6.11.1. Permanent Slopes

Permanent cut or fill slopes should not exceed a gradient of 2H:1V. Where access for landscape maintenance is desired, we recommend a maximum gradient of 3H:1V. Fill slopes should be overbuilt by at least 12 inches and trimmed back to the required slope to maintain a firm face.

Slopes should be planted with appropriate vegetation to provide protection against erosion as soon as possible after grading. Surface water runoff should be collected and directed away from slopes to prevent water from running down the face of the slope.

6.11.2. Temporary Slopes

All temporary soil cuts associated with site excavations (greater than 4 feet in depth) should be adequately sloped back to prevent sloughing and collapse, in accordance with applicable OSHA and state guidelines.

Temporary cut slopes should not exceed a gradient appropriate for the soil type being excavated. As noted in Section 6.7, medium stiff silt soils should be considered OSHA Soil Type B. However, because of the variables involved, actual slope angles required for stability in temporary cut areas can only be estimated before construction.

The stability and safety of cut slopes depend on a number of factors, including:

- The type and density of the soil.
- The presence and amount of any seepage.
- Depth of cut.
- Proximity and magnitude of the cut to any surcharge loads, such as stockpiled material, traffic loads or structures.
- Duration of the open excavation.
- Care and methods used by the contractor.

We recommend that stability of the temporary slopes used for construction be the responsibility of the contractor, since the contractor is in control of the construction operation and is continuously at the site to observe the nature and condition of the subsurface. If groundwater seepage is encountered within the excavation slopes, the cut slope inclination may have to be flatter than 1.5H:1V. However, appropriate inclinations will ultimately depend on the actual soil and groundwater seepage conditions exposed in the cuts at the time of construction. It is the responsibility of the contractor to ensure that the excavation is properly sloped or braced for worker protection, in accordance with applicable guidelines. To assist with this effort, we make the following recommendations regarding temporary excavation slopes:

- Protect the slope from erosion with plastic sheeting for the duration of the excavation to minimize surface erosion and raveling.
- Limit the maximum duration of the open excavation to the shortest time period possible.
- Place no surcharge loads (equipment, materials, etc.) within 10 feet of the top of the slope.

More restrictive requirements may apply depending on specific site conditions, which should be continuously assessed by the contractor.

If temporary sloping is not feasible based on-site spatial constraints, excavations could be supported by internally braced shoring systems, such as a trench box or other temporary shoring. There are a variety of options available. We recommend that the contractor be responsible for selecting the type of shoring system to apply.

6.11.3. Slope Drainage

If seepage is encountered at the face of permanent or temporary slopes, it will be necessary to flatten the slopes or install a subdrain to collect the water. We should be contacted to evaluate such conditions on a case-by-case basis.

7.0 STRUCTURAL DESIGN RECOMMENDATIONS

7.1. Foundation Support Recommendations

Proposed structures can be satisfactorily founded on continuous strip or isolated column footings supported on firm native soils, or on structural fill placed over native soils. Exterior footings should be established at least 18 inches below the lowest adjacent grade. The recommended minimum footing depth is greater than the anticipated frost depth. Interior footings can be founded a minimum of 12 inches below the top of the floor slab. Continuous wall footings should have a minimum width equal to 18 inches. Isolated column and continuous wall footings should have minimum widths of 24 and 18 inches, respectively. We have assumed that the maximum isolated column loads will be on the order of 30 kips, wall loads will be 3 klf or less and floor loads for slabs-on-grade will be 100 psf or less for the proposed development. If design loads exceed these values, we should be notified as our recommendations may need to be revised.

7.1.1. Foundation Subgrade Preparation

We recommend that prepared subgrades be observed by a member of our firm, who will evaluate the suitability of the subgrade and identify any areas of yielding, which are indicative of soft or loose soil. The exposed subgrade soil should be probed with a ½-inch-diameter steel rod. If soft, yielding or otherwise unsuitable areas are revealed during probing the unsuitable soils should be removed and replaced with structural fill, as needed.

Fill material encountered at subgrade elevation should be evaluated by GeoEngineers during construction. Soft fill or fill with significant debris or unsuitable material should be removed to native medium stiff or stiffer material and replaced with compacted structural fill. The width of the overexcavation should extend beyond the edge of the footing a distance equal to the depth of the overexcavation below the base of the footing.

We recommend loose or disturbed soils be removed before placing reinforcing steel and concrete. Foundation bearing surfaces should not be exposed to standing water. If water infiltrates and pools in the excavation, the water, along with any disturbed soil, should be removed before placing reinforcing steel. A thin layer (2 to 3 inches) of crushed rock can be used to provide protection to the subgrade from light foot traffic. Compaction should be performed as described in Section 6.10.

We recommend GeoEngineers observe all foundation excavations before placing concrete forms and reinforcing steel to determine that bearing surfaces have been adequately prepared and the soil conditions are consistent with those observed during our explorations.

7.1.2. Bearing Capacity – Spread Footings

We recommend conventional footings be proportioned using a maximum allowable bearing pressure of 2,500 psf if supported on medium stiff or stiffer native silt or structural fill bearing on these materials. The recommended bearing pressure applies to the total of dead and long-term live loads and may be increased by one-third when considering earthquake or wind loads. This is a net bearing pressure. The weight of the footing and overlying backfill can be ignored in calculating footing sizes.

7.1.3. Foundation Settlement

Foundations designed and constructed as recommended are expected to experience settlements of less than 1 inch. Differential settlements of up to one half of the total settlement magnitude can be expected between adjacent footings supporting comparable loads.

7.1.4. Lateral Resistance

Lateral loads on footings can be resisted by passive earth pressures on the sides of footings and by friction on the bearing surface. We recommend that passive earth pressures be calculated using an equivalent fluid unit weight of 250 pcf for foundations confined by native medium stiff or stiffer silt and 400 pcf if confined by a minimum of 2 feet of imported granular fill.

We recommend using a friction coefficient of 0.37 for foundations placed on the native medium stiff or stiffer silt, or 0.50 for foundations placed on a minimum 1-foot-thickness of compacted crushed rock. The passive earth pressure and friction components may be combined provided the passive component does not exceed two-thirds of the total.

The passive earth pressure value is based on the assumptions that the adjacent grade is level and static groundwater remains below the base of the footing throughout the year. The top 1 foot of soil should be neglected when calculating passive lateral earth pressures unless the adjacent area is covered with pavement or slab-on-grade. The lateral resistance values include a safety factor of approximately 1.5.

7.2. Drainage Considerations

We recommend the ground surface be sloped away from the buildings at least 2 percent. All downspouts should be tightlined away from the building foundation areas and should also be discharged into a stormwater disposal system. Downspouts should not be connected to footing drains.

Although not required based on expected groundwater depths, if perimeter footing drains are used for below-grade structural elements or crawlspaces, they should be installed at the base of the exterior footings. If used, perimeter footing drains should be provided with cleanouts and should consist of at least

4-inch-diameter perforated pipe placed on a 3-inch bed of, and surrounded by, 6 inches of drainage material enclosed in a non-woven geotextile such as Mirafi 140N (or approved equivalent) to prevent fine soil from migrating into the drain material. We recommend against using flexible tubing for footing drainpipes. The perimeter drains should be sloped to drain by gravity to a suitable discharge point, preferably a storm drain. We recommend that the cleanouts be covered and placed in flush-mounted utility boxes. Water collected in roof downspout lines must not be routed to the footing drain lines.

If an elevator pit or utility vaults or other subterranean open structural elements are installed below the expected level of groundwater, we recommend foundation drains be installed as described above. Active dewatering or tightline routing of draining water will be required during wet times of the year at these locations in order to provide a removal pathway.

7.3. Floor Slabs

Satisfactory subgrade support for floor slabs supporting up to 100 psf floor loads can be obtained provided the floor slab subgrade is as described in Section 6.2 of this report. Slabs should be reinforced according to their proposed use and per the structural engineer's recommendations. Subgrade support for concrete slabs can be obtained from the medium stiff or stiffer native soils. We recommend that on-grade slabs be underlain by a minimum 6-inch-thick compacted crushed rock base section to reduce the potential for moisture migration into the slab and to provide structural support as noted below. The crushed rock base material should consist of Aggregate Base material as described Section 6.9 of this report. The material should be placed as recommended in Section 6.10.

If dry slabs are required (e.g., where moisture-sensitive adhesives are used to anchor carpet or tile to the slab), a waterproof liner may be placed as a vapor barrier below the slab. The vapor barrier should be selected by the structural engineer and should be accounted for in the design floor section and mix design selection for the concrete, to accommodate the effect of the vapor barrier on concrete slab curing. Load-bearing concrete slabs should be designed assuming a modulus of subgrade reaction (k) of 125 psi per inch. We estimate that concrete slabs constructed as recommended will settle less than ½ inch. We recommend that the floor slab subgrade be evaluated by proof-rolling prior to placing concrete.

7.4. Seismic Design

Parameters provided in Table 4 are based on the conditions encountered during our subsurface exploration program and the procedure outlined in the 2015 IBC. Some jurisdictions are beginning to adopt the 2018 IBC, which references the 2016 Minimum Design Loads for Buildings and Other Structures (American Society of Civil Engineers [ASCE] 7-16). Per ASCE 7-16 Section 11.4.8, a ground motion hazard analysis or site-specific response analysis is required to determine the design ground motions for structures on Site Class D sites with S_1 greater than or equal to 0.2g.

For this project, the site is classified as Site Class D with an S_1 value of 0.401g; therefore, the provision of 11.4.8 applies. Alternatively, the parameters listed in Table 5 below may be used to determine the design ground motions if Exception 2 of Section 11.4.8 of ASCE 7-16 is used. Using this exception, the seismic response coefficient (C_s) is determined by Equation (Eq.) (12.8-2) for values of $T \leq 1.5T_S$, and taken as equal to 1.5 times the value computed in accordance with either Eq. (12.8-3) for $T_L \geq T > 1.5T_s$ or Eq. (12.8-4) for $T > T_L$, where T represents the fundamental period of the structure and T_S=0.801 sec. If requested, we can complete a site-specific seismic response analysis, which might provide somewhat reduced seismic demands from the parameters in Table 5 and the requirements for using Exception 2 of

Section 11.4.8 in ASCE 7-16. The reduced values will likely not be significant enough to warrant the additional cost of further evaluation if designing to 2018 IBC.

We recommend seismic design be performed using the values noted in Tables 4 or 5 below depending on the version of the IBC used for design.

TABLE 4. MAPPED 2015 IBC SEISMIC DESIGN PARAMETERS

Parameter	Recommended Value[1]
Site Class	D
Mapped Spectral Response Acceleration at Short Period (S_S)	0.921 g
Mapped Spectral Response Acceleration at 1 Second Period (S_1)	0.430 g
Site Modified Peak Ground Acceleration (PGA_M)	0.452 g
Site Amplification Factor at 0.2 second period (F_a)	1.132
Site Amplification Factor at 1.0 second period (F_v)	1.570
Design Spectral Acceleration at 0.2 second period (S_{DS})	0.695 g
Design Spectral Acceleration at 1.0 second period (S_{D1})	0.450 g

Note:

[1] Parameters developed based on Latitude 44.9925959° and Longitude -122.9898991° using the ATC Hazards online tool.

TABLE 5. MAPPED 2018 IBC SEISMIC DESIGN PARAMETERS

Parameter	Recommended Value[1,2]
Site Class	D
Mapped Spectral Response Acceleration at Short Period (S_S)	0.817 g
Mapped Spectral Response Acceleration at 1 Second Period (S_1)	0.406 g
Site Modified Peak Ground Acceleration (PGA_M)	0.462 g
Site Amplification Factor at 0.2 second period (F_a)	1.173
Site Amplification Factor at 1.0 second period (F_v)	1.894
Design Spectral Acceleration at 0.2 second period (S_{DS})	0.639 g
Design Spectral Acceleration at 1.0 second period (S_{D1})	0.513 g

Notes:

[1] Parameters developed based on Latitude 44. 9925959° and Longitude -122. 9898991° using the ATC Hazards online tool.

[2] These values are only valid if the structural engineer utilizes Exception 2 of Section 11.4.8 (ASCE 7-16).

7.4.1. Liquefaction Potential

Liquefaction is a phenomenon caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. The excessive buildup of pore water pressure results in the sudden loss of shear strength in a soil. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sand soil with low silt and clay contents is the most susceptible to liquefaction. Low plasticity, silty sand may be moderately susceptible to liquefaction under relatively higher levels of ground shaking.

Based on our boring logs at the project site, the groundwater is located below the extent of the depth of drilling of 15 feet bgs, indicating that the soils encountered within our boring logs are not susceptible to liquefaction. Liquefaction is not considered a hazard for the project.

8.0 OTHER CONSIDERATIONS

8.1. Frost Penetration

The near-surface soils are slightly susceptible to frost heave. However, floor slabs are expected to bear on compacted granular fill and the foundations will be founded below the anticipated depth of frost penetration in the region, which is approximately 12 inches. The recommended exterior and interior footing embedment depths provided above should allow adequate frost protection.

8.2. Expansive Soils

Based on our laboratory test results and experience with similar soils in the area, we do not consider the soils encountered in our borings to be expansive.

9.0 PAVEMENT RECOMMENDATIONS

9.1. Dynamic Cone Penetrometer (DCP) Testing

We conducted DCP testing in general accordance with ASTM D 6951 to estimate the subgrade resilient modulus (M_R) at each test location. We recorded penetration depth of the cone versus hammer blow count and terminated testing when at a depth of approximately 3 to 4 feet bgs. The approximate locations of the explorations are presented in Figures 2A and 2B. We plotted depth of penetration versus blow count and visually assessed portions of the data where slopes were relatively constant using the equation from the Oregon Department of Transportation (ODOT) Pavement Design Guide to estimate the moduli using a conversion coefficient, $C_f = 0.35$. Table 6 lists our estimate of the subgrade resilient modulus, and Appendix A (Figures A-10 and A-11) provides a summary of the field data.

TABLE 6. ESTIMATED SUBGRADE RESILIENT MODULI BASED ON DCP TESTING

Boring Number	Estimated Resilient Modulus (psi)
DCP-1	4,900
DCP-2	5,600

9.2. Asphalt Concrete (AC) Pavement Sections

Pavement recommendations are provided herein for paved parking and drive areas at the project site. Standards used for pavement design for asphalt pavement design are listed below:

- ODOT Pavement Design Guide (ODOT 2019)
- AASHTO Guide for Design of Pavement Structures (AASHTO 1993)

Our pavement recommendations assume that traffic at the site will consist of occasional truck traffic and passenger cars. We do not have specific information on the frequency and type of vehicles that will use the area; however, we have based our design analysis on traffic consisting of two heavy trucks per day to account for delivery and service-type vehicles and passenger car traffic for pavement sections within drive areas, and passenger car traffic only for pavement sections within parking areas.

Our pavement recommendations are based on the following assumptions:

- The on-site soil subgrade below proposed fill placed to raise site grades or below aggregate base sections has been prepared as described in Section 6.0 of this report, and observations indicate that subgrade is in a firm and unyielding condition.
- A resilient modulus of 20,000 psi was estimated for base rock prepared and compacted as recommended.
- A resilient modulus of 5,000 psi was estimated for firm in-place soils or structural fill placed on firm native soils.
- Initial and terminal serviceability indices of 4.2 and 2.5, respectively.
- Reliability and standard deviations of 90 percent and 0.49, respectively.
- Structural coefficients of 0.42 and 0.10 for the asphalt and base rock, respectively.
- A 20-year design life.

If any of the noted assumptions vary from project design use, our office should be contacted with the appropriate information so that the pavement designs can be revised or confirmed adequate. The recommended minimum pavement sections are provided in Table 7 below.

TABLE 7. MINIMUM PAVEMENT SECTIONS FOR ON-SITE ROADWAYS AND PARKING AREAS

	Minimum Asphalt Thickness (inches)	Minimum Base Thickness (inches)
Drive Lanes	3.0	9.0
Parking (cars only)	3.0	6.0

The aggregate base course should conform to Section 6.9.4 of this report and be compacted to at least 95 percent of the maximum dry density (MDD) determined in accordance with AASHTO T-180/ASTM Test Method D 1557.

The AC pavement should conform to Section 00745 of the most current edition of the ODOT Standard Specifications for Highway Construction. The Job Mix Formula should meet the requirements for a ½-inch Dense Graded Level 2 Mix. The AC should be PG 64-22 grade meeting the ODOT Standard Specifications for Asphalt Materials. AC pavement should be compacted to 91.0 percent at Maximum Theoretical Unit Weight (Rice Gravity) of AASHTO T-209.

The recommended pavement sections assume that final improvements surrounding the pavement will be designed and constructed such that stormwater or excess irrigation water from landscape areas does not infiltrate below the pavement section into the crushed base.

10.0 DESIGN REVIEW AND CONSTRUCTION SERVICES

Recommendations provided in this report are based on the assumptions and design information stated herein. We welcome the opportunity to review and discuss construction plans and specifications for this project as they are being developed. In addition, GeoEngineers should be retained to review the geotechnical-related portions of the plans and specifications to evaluate whether they are in conformance with the recommendations provided in this report.

Satisfactory construction and earthwork performance depend to a large degree on quality of construction. Sufficient monitoring of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those anticipated.

In order to continue as geotechnical engineer of record for the project, we recommend that GeoEngineers be retained to observe construction at the site to confirm that subsurface conditions are consistent with the site explorations, and to confirm that the intent of project plans and specifications relating to earthwork, pavement and foundation construction are being met.

11.0 LIMITATIONS

We have prepared this report for the exclusive use of Clutch Industries, Inc., and their authorized agents and/or regulatory agencies for the proposed Blossom Drive Apartments in Salem, Oregon.

This report is not intended for use by others, and the information contained herein is not applicable to other sites. No other party may rely on the product of our services unless we agree in advance and in writing to such reliance.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Please refer to Appendix B titled "Report Limitations and Guidelines for Use" for additional information pertaining to use of this report.

12.0 REFERENCES

American Association of State Highway and Transportation Officials (AASHTO). 1993. Guide for Design of Pavement Structures.

American Society of Civil Engineers (ASCE). 2017. Minimum Design Loads and Associated Criteria for Buildings and Other Structures.

City of Salem Department of Public Works Administrative Rules Design Standards (COSDS). 2014. City of Salem Administrative Rules Division 004.

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International Code Council. 2018. International Building Code (IBC).

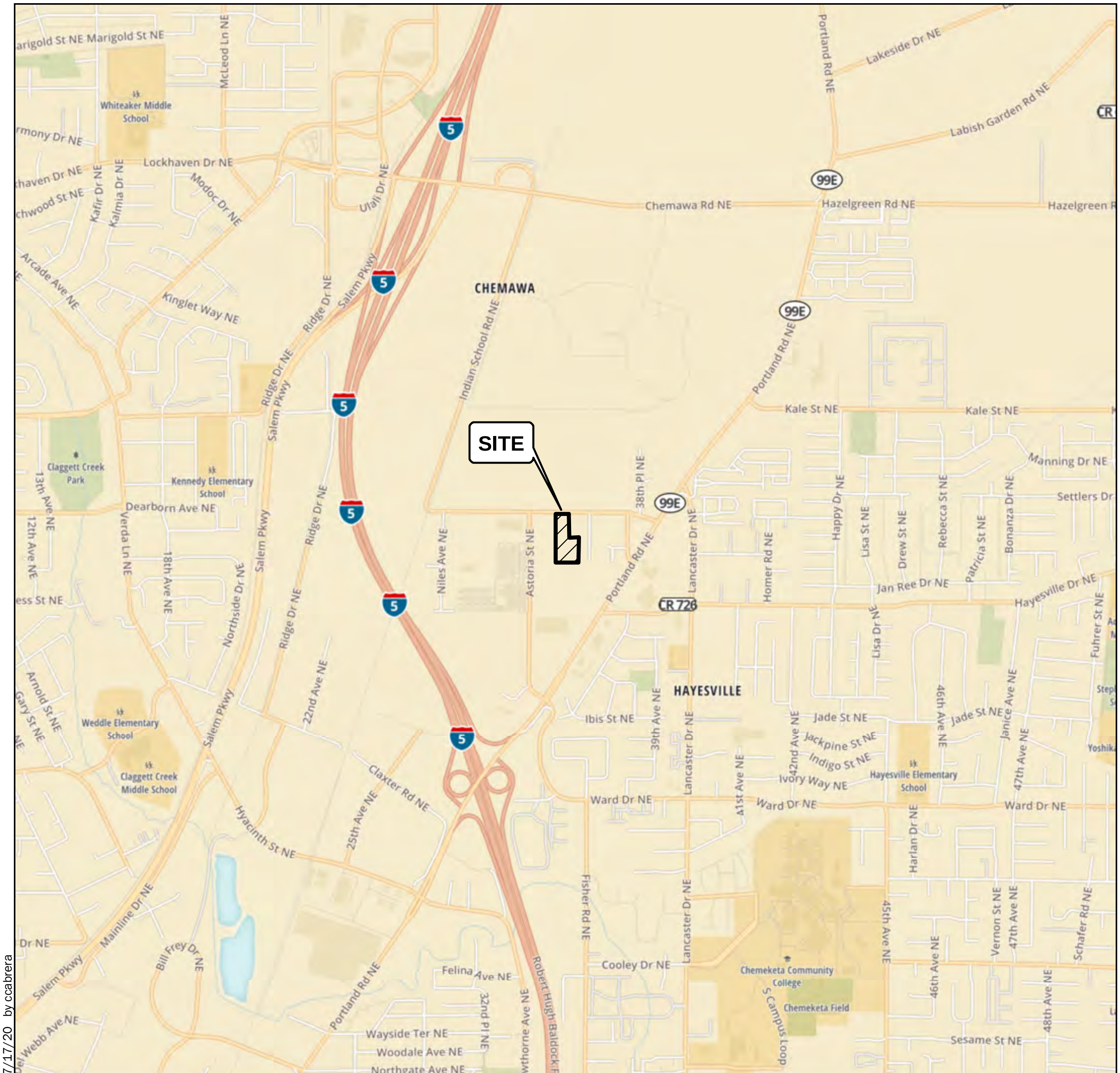
Occupational Safety and Health Administration (OSHA) Technical Manual Section V: Chapter 2, Excavations: Hazard Recognition in Trenching and Shoring: http://www.osha.gov/dts/osta/otm/otm_v/otm_v_2.html

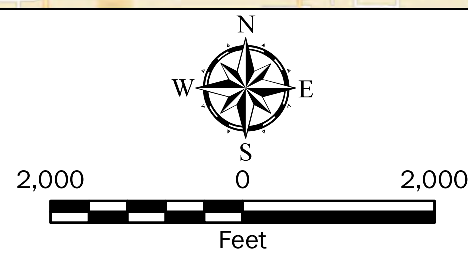
Oregon Department of Transportation (ODOT). 2018. Standard Specifications for Highway Construction. Salem, Oregon.

Oregon Department of Transportation (ODOT). 2019. ODOT Pavement Design Guide. Salem, Oregon.

Tolan, T.L. and M.H. Beeson. 2000. Geologic Map of the Salem East 7.5 Minute Quadrangle, Geologic Map and Database of the Salem East and Turner 7.5 Minute Quadrangles, Marion County, Oregon: U.S. Geological Survey.

FIGURES





Vicinity Map

Clutch Industries Blossom Drive Apartments
Salem, Oregon

GeoEngineers

Figure 1

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2016

Projection: NAD 1983 UTM Zone 10N

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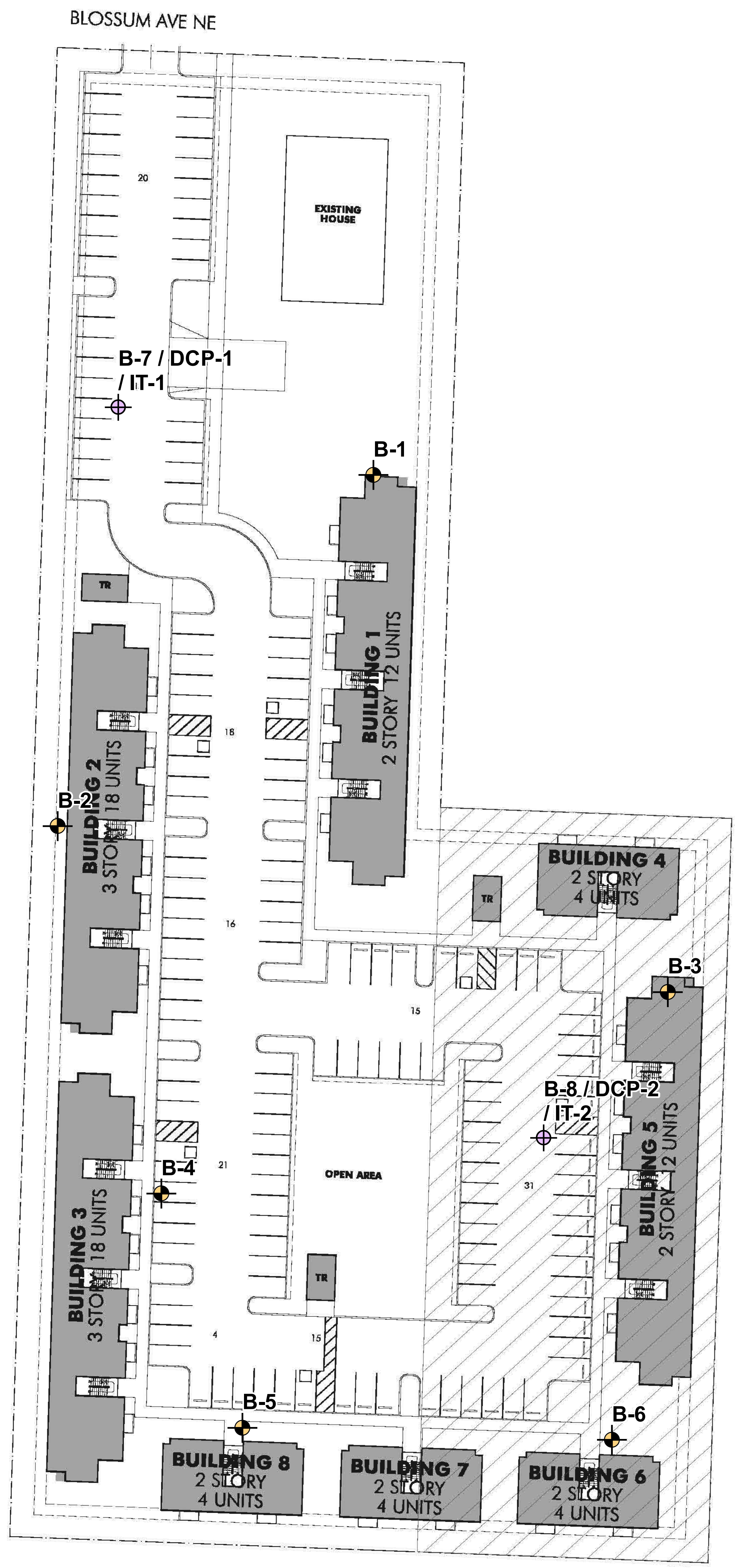

Legend

Boring Number and Approximate Location

Boring, DCP and Infiltration Test Number and Approximate Location

N W E S

55 0 55

Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Projection: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

Site Plan

Clutch Industries Blossom Drive Apartments
Salem, Oregon

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Figure 2A

Legend

- Boring Number and Approximate Location
- Boring, DCP and Infiltration Test Number and Approximate Location

N W E S

55 0 55

Feet

Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI Clarity. Taxlot from Marion County GIS.

Projection: NAD 1983 HARN StatePlane Oregon North FIPS 3601 Feet Intl

Site Plan

Clutch Industries Blossom Drive Apartments
Salem, Oregon

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Figure 2B

APPENDICES

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APPENDIX A
Field Explorations and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

Field Explorations

Soil and groundwater conditions at the site were explored on July 14, 2020, by completing eight drilled borings, two infiltration tests, and two direct cone penetrometer (DCP) tests at the approximate locations shown in the Site Plans, Figures 2A and 2B. The machine-drilled borings were advanced with a solid-stem auger using a trailer-mounted drill rig owned and operated by Dan Fischer Drilling.

The drilling was continuously monitored by an engineering geologist from our office who maintained detailed logs of subsurface exploration, visually classified the soil encountered, and obtained representative soil samples from the borings. Samples were collected using a 1-inch, inside-diameter, standard split spoon sampler and a 3-inch, inside-diameter, Dames and Moore (D&M) split spoon sampler. Samplers were driven into the soil using a rope and cathead 140-pound hammer, free-falling 30 inches on each blow. The number of blows required to drive the sampler each of three, 6-inch increments of penetration were recorded in the field. The sum of the blow counts for the last two, 6-inch increments of penetration was reported on the boring logs as the ASTM International (ASTM) Standard Practices Test Method D 1556 standard penetration testing (SPT) N-value. The approximate N-values for D&M samples were converted to SPT N-values using the Lacroix-Horn Conversion [N(SPT) = (2*N1*W1*H1)/(175*D1*D1*L1), where N1 is the non-standard blowcount, W1 is the hammer weight in pounds (140), H1 is the hammer drop height in inches (30), D1 is the non-standard sampler outside diameter in inches (3.23), and L1 is the length of penetration in inches (12)].

Recovered soil samples were visually classified in the field in general accordance with ASTM D 2488 and the classification chart listed in Key to Exploration Logs, Figure A-1. Logs of the borings are presented in Figures A-2 through A-9. The logs are based on interpretation of the field and laboratory data and indicate the depth at which subsurface materials or their characteristics change, although these changes might actually be gradual. Logs of DCP testing results are presented in Figures A-10 and A-11 and logs of infiltration testing results are presented in Figures A-12 and A-13.

Laboratory Testing

Soil samples obtained from the explorations were visually classified in the field and in our laboratory using the Unified Soil Classification System (USCS) and ASTM classification methods. ASTM Test Method D 2488 was used to visually classify the soil samples, while ASTM D 2487 was used to classify the soils, based on laboratory tests results. Moisture content tests were performed in general accordance with ASTM D 2216-05, moisture density tests of the ring samples were estimated in general accordance with ASTM Test Method D 7263, and Percent Passing the No. 200 Sieve tests were performed in general accordance with ASTM D 1140. Results of the laboratory testing are presented in the appropriate exploration logs at the respective sample depths.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

Sampler Symbol Descriptions

- 2.4-inch I.D. split barrel
- Standard Penetration Test (SPT)
- Shelby tube
- Piston
- Direct-Push
- Bulk or grab
- Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point lead test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Drilled	Start 7/14/2020	End 7/14/2020	Total Depth (ft) 16.5	Logged By JJW / Checked By BJH	Driller Dan Fischer Excavating	Drilling Method Solid-stem Auger

Surface Elevation (ft) 180 Vertical Datum NAVD88	Hammer Data: Manual Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment: Buck Rogers 160 Trailer Rig
Latitude 44° 59' 34.2996" Longitude 122° 59' 22.2792"	System OR Decimal Degrees Datum NAD83 (feet)	Groundwater not observed at time of exploration

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
180	0							TS	Brown top soil and brownish gray silty gravel with sand and organics (field grass) (medium stiff to stiff, moist)			Surface Conditions: Brownish gray silty gravel with sand and organics (field grass)
								ML				
			18	19		S-1			Brown silt with trace organics (grass rootlets) (very stiff, moist)			
175	5		18	14		S-2 / MD			Without organics, with fine sand, becomes medium stiff			DD = 78.0 pcf
			18	15		S-3 / SA					90.6	
170	10		18	15		S-4						
165	15		18	17		S-5			Becomes very stiff			

B-1 completed at 16.5' bgs

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Google Earth.

Log of Boring B-1

GEOENGINEERS

Project: Clutch Industries - Blossom Drive Apartments
Project Location: Salem, Oregon
Project Number: 23830-006-00

Drilled	Start 7/14/2020	End 7/14/2020	Total Depth (ft) 16.5	Logged By JJW, Checked By BJH	Driller Dan Fischer Excavating	Drilling Method Solid-stem Auger

Surface Elevation (ft) 179; Vertical Datum NAVD88	Hammer Data: Manual Cathead, 140 (lbs) / 30 (in) Drop	Drilling Equipment: Buck Rogers 160 Trailer Rig
Latitude 44° 59' 32.7696"; Longitude 122° 59' 24.1008"	System: OR Decimal Degrees; Datum: NAD83 (feet)	Groundwater not observed at time of exploration

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							TS	Brown silty top soil with organics (field grass) (medium stiff, moist)			Surface Conditions: Brown silty top soil with organics (field grass) Till zone extends from 1 to 1.5' bgs
								ML				
			18	15		S-1			Brown silt (stiff, moist)			
175												
	5		18	11		S-2 MC			With occasional fine sand	28.3		
			18	8		S-3			Becomes medium stiff to stiff			
170												
	10		14	12		S-4			With fine sand, becomes stiff			
165												
	15		18	14		S-5						

B-2 completed at 16.5' bgs

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Google Earth.

Log of Boring B-2

Drilled	Start 7/14/2020	End 7/14/2020	Total Depth (ft) 16.5	Logged By JJW Checked By BJH	Driller Dan Fischer Excavating	Drilling Method Solid-stem Auger

Surface Elevation (ft) 183 Vertical Datum NAVD88	Hammer Data: Manual Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment: Buck Rogers 160 Trailer Rig
Latitude 44° 59' 32.1396" Longitude 122° 59' 20.4216"	System OR Decimal Degrees Datum NAD83 (feet)	Groundwater not observed at time of exploration
Notes:		

Elevation (feet)	Depth (feet)	FIELD DATA: Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							TS	Brown silty topsoil with organics (field grass) (medium stiff, moist)			Surface Conditions: Brown silty top soil with organics (field grass) Till zone extends from 1 to 1.5' bgs
180			18	21		S-1 / MC		ML	Brown silt with occasional organics (grass rootlets) (very stiff, moist)	28.6		
	5		18	18		S-2			Without organics, grades with occasional fine sand			
175			18	11		S-3 / DD			Becomes stiff			DD = 79.2 pcf
	10		14	14		S-4 / SA			With fine sand		93.3	
170												
	15		18	13		S-5						

B-3 completed at 16.5' bgs

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Google Earth.

Log of Boring B-3

GeoEngineers

Project: Clutch Industries - Blossom Drive Apartments
Project Location: Salem, Oregon
Project Number: 23830-006-00

Drilled	Start: 7/14/2020	End: 7/14/2020	Total Depth (ft)	16.5	Logged By: JJW	Checked By: BJH	Driller	Dan Fischer Excavating	Drilling Method	Solid-stem Auger

Surface Elevation (ft) Vertical Datum	181 NAVD88	Hammer Data	Manual Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Buck Rogers 160 Trailer Rig
Latitude Longitude	44° 59' 31.2216" 122° 59' 23.4096"	System Datum	OR Decimal Degrees NAD83 (feet)	Groundwater not observed at time of exploration	

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
180	0							TS	Brown silty top soil with organics (field grass) (medium stiff, moist)			Surface Conditions: Brown silty top soil with organics (field grass) Till zone extends from 1 to 1.5' bgs
								ML				
			18	24		S-1 MC			Brown silt with trace organics (grass rootlets) (very stiff, moist)	27.6		
175	5		18	26		S-2			Without organics, with occasional fine sand			
			18	13		S-3			Becomes stiff			
170	10		18	16		S-4			With fine sand, becomes stiff to very stiff			
165	15		18	17		S-5			Becomes very stiff			

B-4 completed at 16.5' bgs

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Google Earth.

Log of Boring B-4

GeoEngineers

Project: Clutch Industries - Blossom Drive Apartments
Project Location: Salem, Oregon
Project Number: 23830-006-00

Drilled	Start 7/14/2020	End 7/14/2020	Total Depth (ft) 16.5	Logged By JJW / Checked By BJH	Driller Dan Fischer Excavating	Drilling Method Solid-stem Auger

Surface Elevation (ft) / Vertical Datum	183 / NAVD88	Hammer Data	Manual Cathead / 140 (lbs) / 30 (in) Drop	Drilling Equipment	Buck Rogers 160 Trailer Rig
Latitude / Longitude	44° 59' 30.2388" / 122° 59' 22.8912"	System / Datum	OR Decimal Degrees / NAD83 (feet)	Groundwater not observed at time of exploration	

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							TS	Brown silty top soil with organics (field grass) (medium stiff, moist)			Surface Conditions: Brown silty top soil with organics (field grass) Till zone extends from 1 to 1.5' bgs
180			18	26		S-1		ML	Brown silt with occasional organics (grass rootlets) (very stiff, moist)			
	5		18	18		S-2			Without organics, with occasional fine sand			
175			18	11		S-3			Without fine sand, becomes stiff			
	10		18	14		S-4			With fine sand			
170												
	15		18	20		S-5			Becomes very stiff			

B-5 completed at 16.5' bgs

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Google Earth.

Date:7/23/20 Path:P:\23\23830006\GINT\2383000600.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Log of Boring B-5

GeoEngineers

Project: Clutch Industries - Blossom Drive Apartments
Project Location: Salem, Oregon
Project Number: 23830-006-00

Drilled	Start 7/14/2020	End 7/14/2020	Total Depth (ft) 16.5	Logged By JJW / Checked By BJH	Driller Dan Fischer Excavating	Drilling Method Solid-stem Auger
Surface Elevation (ft) 186 / Vertical Datum NAVD88			Hammer Data: Manual Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment: Buck Rogers 160 Trailer Rig	
Latitude 44° 59' 30.2388" / Longitude 122° 59' 20.6808"			System OR Decimal Degrees / Datum NAD83 (feet)		Groundwater not observed at time of exploration	
Notes:						

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
185	0							TS	Brown silty top soil with organics (field grass) (medium stiff, moist)			Surface Conditions: Brown silty top soil with organics (field grass) Till zone extends from 1 to 1.5' bgs
								ML				
			18	22		S-1			Brown silt with trace organics (grass rootlets) (very stiff, moist)			
180	5		18	14		S-2 MC			Without organics, with occasional fine sand, becomes stiff	33		
			18	14		S-3						
175	10		18	20		S-4			With fine sand, becomes very stiff			
170	15		18	20		S-5						

B-6 completed at 16.5' bgs

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Google Earth.

Date:7/23/20 Path:P:\23\23830006\GINT\2383000600.GPJ DBLibrary/Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Log of Boring B-6

GeoEngineers

Project: Clutch Industries - Blossom Drive Apartments
Project Location: Salem, Oregon
Project Number: 23830-006-00

Drilled	Start 7/14/2020	End 7/14/2020	Total Depth (ft) 6.5	Logged By JJW / Checked By BJH	Driller Dan Fischer Excavating	Drilling Method Solid-stem Auger

Surface Elevation (ft) 180 Vertical Datum NAVD88	Hammer Data: Manual Cathead, 140 (lbs) / 30 (in) Drop	Drilling Equipment: Buck Rogers 160 Trailer Rig
Latitude 44° 59' 34.5516" Longitude 122° 59' 23.82"	System: OR Decimal Degrees Datum: NAD83 (feet)	Groundwater not observed at time of exploration

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name / Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							TS	Brown top soil and brownish gray silty gravel with sand and organic (field grass) (medium stiff to stiff, moist) DCP-1 completed at 6" bgs			Surface Conditions: Brownish gray silty gravel with sand and organics (field grass)
		X	18	25		S-1 / MC		ML	Brown silt (very stiff, moist) IT-1 completed 2' south of B-7 at 3' bgs	30.1		
175	5	X	18	15		S-2			Becomes medium stiff			

B-7 completed at 6.5' bgs

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Google Earth.

Log of Boring B-7/DCP-1/IT-1

GeoEngineers

Project: Clutch Industries - Blossom Drive Apartments
Project Location: Salem, Oregon
Project Number: 23830-006-00

Drilled	Start 7/14/2020	End 7/14/2020	Total Depth (ft) 6.5	Logged By JJW / Checked By BJH	Driller Dan Fischer Excavating	Drilling Method Solid-stem Auger

Surface Elevation (ft) 183 Vertical Datum NAVD88	Hammer Data: Manual Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment: Buck Rogers 160 Trailer Rig
Latitude 44° 59' 31.5888" Longitude 122° 59' 21.1416"	System OR Decimal Degrees Datum NAD83 (feet)	Groundwater not observed at time of exploration

Notes:

Elevation (feet)	Depth (feet)	Interval	Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0							TS	Brown silty top soil with organics (field grass) (medium stiff, moist) DCP-2 completed at 6" bgs			Surface Conditions: Brown silty top soil with organics (field grass) Till zone extends to 1.5' bgs
180		X	18	30		S-1			Brown silt (very stiff, moist) IT-2 completed 2' south of B-8 at 2.5' bgs			
	5	X	18	17		S-2						

B-8 completed at 6.5' bgs

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Google Earth. Vertical approximated based on Google Earth.

Log of Boring B-8/DCP-2/IT-2

GEOENGINEERS

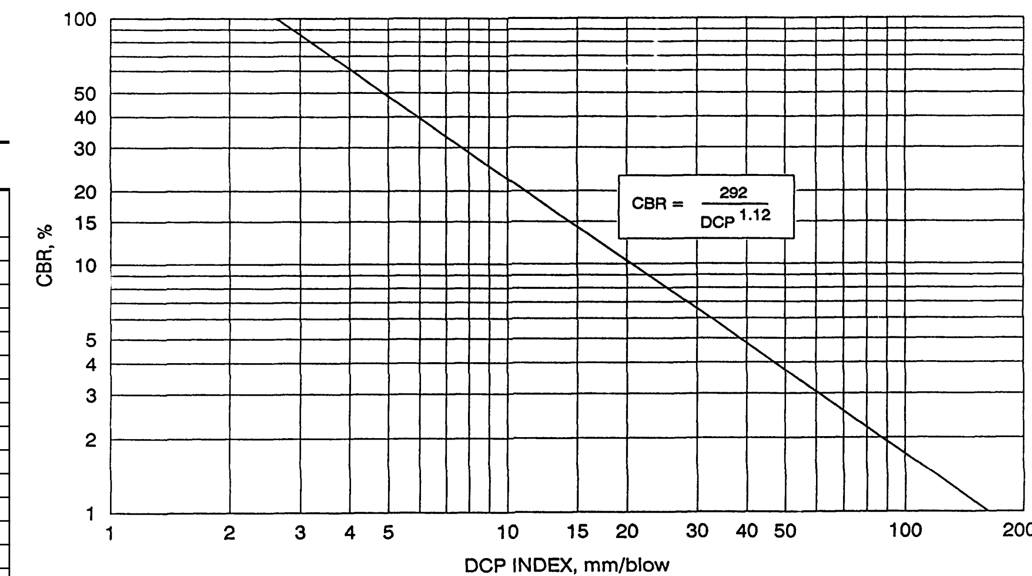
Project: Clutch Industries - Blossom Drive Apartments
Project Location: Salem, Oregon
Project Number: 23830-006-00

Location:	Blossom Drive NE, Salem, OR	Date:	7/14/2020
Depth to bottom:	43"		
Tester's Name:	Jason Weber		
Tester's Company:	GeoEngineers, Inc.	Tester's Contact No:	605-380-8841

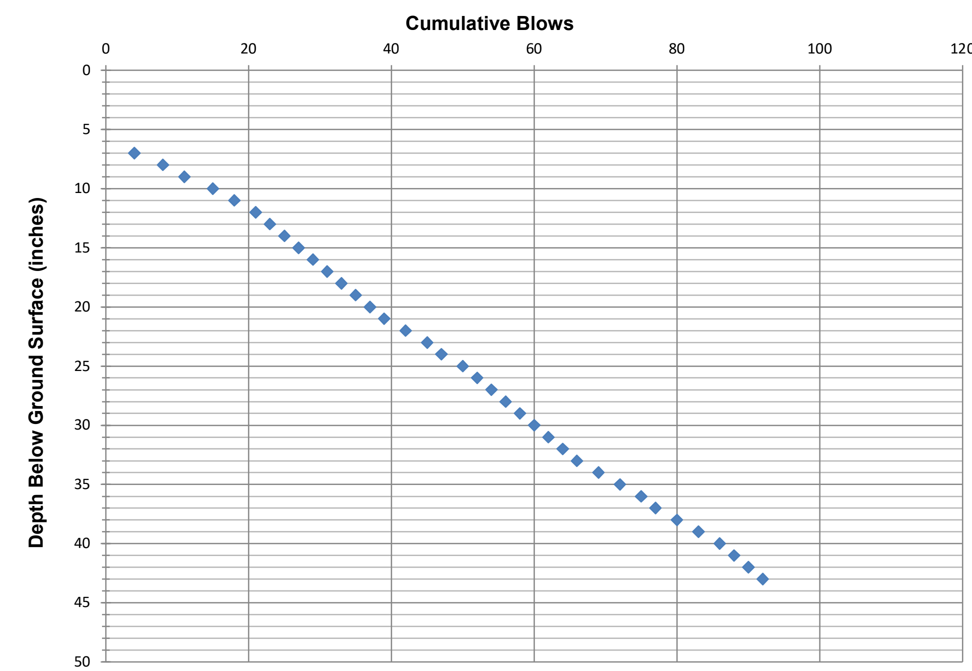
Test Hole Number: B-7 / DCP-1
Test Method: Dynamic Cone Penetration
GeoEngineers Job: 23830-006-00

Depth, feet	Soil Texture
0-12"	Brown silty top soil and brown-gray silty gravel with sand and organics (grass rootlets) (medium stiff to stiff, moist)
12"-43"	Brown silt (very stiff, moist)

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Penetration per increment	Cumulative penetration	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(mm)	(mm)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	4	4	7.0	25.4	25.4	1.0	1.0	0.25	2	0.50	12.70	17	6368
2	4	8	8.0	25.4	50.8	2.0	1.0	0.25	2	0.50	12.70	17	6368
3	3	11	9.0	25.4	76.2	3.0	1.0	0.33	2	0.67	16.93	12	5692
4	4	15	10.0	25.4	101.6	4.0	1.0	0.25	2	0.50	12.70	17	6368
5	3	18	11.0	25.4	127.0	5.0	1.0	0.33	2	0.67	16.93	12	5692
6	3	21	12.0	25.4	152.4	6.0	1.0	0.33	2	0.67	16.93	12	5692
7	2	23	13.0	25.4	177.8	7.0	1.0	0.50	2	1.00	25.40	8	4859
8	2	25	14.0	25.4	203.2	8.0	1.0	0.50	2	1.00	25.40	8	4859
9	2	27	15.0	25.4	228.6	9.0	1.0	0.50	2	1.00	25.40	8	4859
10	2	29	16.0	25.4	254.0	10.0	1.0	0.50	2	1.00	25.40	8	4859
11	2	31	17.0	25.4	279.4	11.0	1.0	0.50	2	1.00	25.40	8	4859
12	2	33	18.0	25.4	304.8	12.0	1.0	0.50	2	1.00	25.40	8	4859
13	2	35	19.0	25.4	330.2	13.0	1.0	0.50	2	1.00	25.40	8	4859
14	2	37	20.0	25.4	355.6	14.0	1.0	0.50	2	1.00	25.40	8	4859
15	2	39	21.0	25.4	381.0	15.0	1.0	0.50	2	1.00	25.40	8	4859
16	3	42	22.0	25.4	406.4	16.0	1.0	0.33	2	0.67	16.93	12	5692
17	3	45	23.0	25.4	431.8	17.0	1.0	0.33	2	0.67	16.93	12	5692
18	2	47	24.0	25.4	457.2	18.0	1.0	0.50	2	1.00	25.40	8	4859
19	3	50	25.0	25.4	482.6	19.0	1.0	0.33	2	0.67	16.93	12	5692
20	2	52	26.0	25.4	508.0	20.0	1.0	0.50	2	1.00	25.40	8	4859
21	2	54	27.0	25.4	533.4	21.0	1.0	0.50	2	1.00	25.40	8	4859
22	2	56	28.0	25.4	558.8	22.0	1.0	0.50	2	1.00	25.40	8	4859
23	2	58	29.0	25.4	584.2	23.0	1.0	0.50	2	1.00	25.40	8	4859
24	2	60	30.0	25.4	609.6	24.0	1.0	0.50	2	1.00	25.40	8	4859
25	2	62	31.0	25.4	635.0	25.0	1.0	0.50	2	1.00	25.40	8	4859
26	2	64	32.0	25.4	660.4	26.0	1.0	0.50	2	1.00	25.40	8	4859
27	2	66	33.0	25.4	685.8	27.0	1.0	0.50	2	1.00	25.40	8	4859
28	3	69	34.0	25.4	711.2	28.0	1.0	0.33	2	0.67	16.93	12	5692
29	3	72	35.0	25.4	736.6	29.0	1.0	0.33	2	0.67	16.93	12	5692
30	3	75	36.0	25.4	762.0	30.0	1.0	0.33	2	0.67	16.93	12	5692
31	2	77	37.0	25.4	787.4	31.0	1.0	0.50	2	1.00	25.40	8	4859
32	3	80	38.0	25.4	812.8	32.0	1.0	0.33	2	0.67	16.93	12	5692
33	3	83	39.0	25.4	838.2	33.0	1.0	0.33	2	0.67	16.93	12	5692
34	3	86	40.0	25.4	863.6	34.0	1.0	0.33	2	0.67	16.93	12	5692
35	2	88	41.0	25.4	889.0	35.0	1.0	0.50	2	1.00	25.40	8	4859
36	2	90	42.0	25.4	914.4	36.0	1.0	0.50	2	1.00	25.40	8	4859
37	2	92	43.0	25.4	939.8	37.0	1.0	0.50	2	1.00	25.40	8	4859



(after Webster et al., 1992)
Webster, S. L., Grau, R. H., and Williams, T. P. (1992). Description and application of dual mass dynamic cone penetrometer. Department of the Army Waterways Equipment Station, No. GL-92-3.



ODOT Pavement Design Guide. (2019). Pavement Sevices Unit, Oregon Department of Transportation.
$M_R = C_f \times 49023 \times S^{-0.39}$
M_R = resilient modulus (psi)
C_f = conversion coefficient
S = DCP Index (mm/blow)

Location: Blossom Drive NE, Salem, OR
Date: 7/14/2020
Test Hole Number: B-8 / DCP-2
Depth to bottom: 42"
Test Method: Dynamic Cone Penetration
Tester's Name: Jason Weber
GeoEngineers Job: 23830-006-00
Tester's Company: GeoEngineers, Inc.
Tester's Contact No: 605-380-8841

Depth, feet	Soil Texture
0-12"	Brown silty top soil with organics (grass rootlets) (medium stiff to stiff, moist)
12"-42"	Brown silt (very stiff, moist)

Test increment	Number of blows	Cumulative blows	Depth below ground surface	Penetration per increment	Cumulative penetration	Cummulative Penetration	Penetration per blow set	Penetration per blow	Hammer blow factor	DCP Index	DCP Index	CBR	M_R
#	#	#	(in)	(mm)	(mm)	(in)	(in)	(in)	1 for 8-kg 2 for 4.6-kg hammer	in/blow	mm/blow	%	psi
1	4	4	7.0	25.4	25.4	1.0	1.0	0.25	2	0.50	12.70	17	6368
2	2	6	8.0	25.4	50.8	2.0	1.0	0.50	2	1.00	25.40	8	4859
3	2	8	9.0	25.4	76.2	3.0	1.0	0.50	2	1.00	25.40	8	4859
4	4	12	10.0	25.4	101.6	4.0	1.0	0.25	2	0.50	12.70	17	6368
5	3	15	11.0	25.4	127.0	5.0	1.0	0.33	2	0.67	16.93	12	5692
6	5	20	12.0	25.4	152.4	6.0	1.0	0.20	2	0.40	10.16	22	6947
7	4	24	13.0	25.4	177.8	7.0	1.0	0.25	2	0.50	12.70	17	6368
8	4	28	14.0	25.4	203.2	8.0	1.0	0.25	2	0.50	12.70	17	6368
9	4	32	15.0	25.4	228.6	9.0	1.0	0.25	2	0.50	12.70	17	6368
10	5	37	16.0	25.4	254.0	10.0	1.0	0.20	2	0.40	10.16	22	6947
11	4	41	17.0	25.4	279.4	11.0	1.0	0.25	2	0.50	12.70	17	6368
12	4	45	18.0	25.4	304.8	12.0	1.0	0.25	2	0.50	12.70	17	6368
13	4	49	19.0	25.4	330.2	13.0	1.0	0.25	2	0.50	12.70	17	6368
14	4	53	20.0	25.4	355.6	14.0	1.0	0.25	2	0.50	12.70	17	6368
15	4	57	21.0	25.4	381.0	15.0	1.0	0.25	2	0.50	12.70	17	6368
16	5	62	22.0	25.4	406.4	16.0	1.0	0.20	2	0.40	10.16	22	6947
17	4	66	23.0	25.4	431.8	17.0	1.0	0.25	2	0.50	12.70	17	6368
18	4	70	24.0	25.4	457.2	18.0	1.0	0.25	2	0.50	12.70	17	6368
19	3	73	25.0	25.4	482.6	19.0	1.0	0.33	2	0.67	16.93	12	5692
20	4	77	26.0	25.4	508.0	20.0	1.0	0.25	2	0.50	12.70	17	6368
21	2	79	27.0	25.4	533.4	21.0	1.0	0.50	2	1.00	25.40	8	4859
22	2	81	28.0	25.4	558.8	22.0	1.0	0.50	2	1.00	25.40	8	4859
23	3	84	29.0	25.4	584.2	23.0	1.0	0.33	2	0.67	16.93	12	5692
24	2	86	30.0	25.4	609.6	24.0	1.0	0.50	2	1.00	25.40	8	4859
25	2	88	31.0	25.4	635.0	25.0	1.0	0.50	2	1.00	25.40	8	4859
26	2	90	32.0	25.4	660.4	26.0	1.0	0.50	2	1.00	25.40	8	4859
27	3	93	33.0	25.4	685.8	27.0	1.0	0.33	2	0.67	16.93	12	5692
28	2	95	34.0	25.4	711.2	28.0	1.0	0.50	2	1.00	25.40	8	4859
29	2	97	35.0	25.4	736.6	29.0	1.0	0.50	2	1.00	25.40	8	4859
30	2	99	36.0	25.4	762.0	30.0	1.0	0.50	2	1.00	25.40	8	4859
31	2	101	37.0	25.4	787.4	31.0	1.0	0.50	2	1.00	25.40	8	4859
32	2	103	38.0	25.4	812.8	32.0	1.0	0.50	2	1.00	25.40	8	4859
33	2	105	39.0	25.4	838.2	33.0	1.0	0.50	2	1.00	25.40	8	4859
34	2	107	40.0	25.4	863.6	34.0	1.0	0.50	2	1.00	25.40	8	4859
35	2	109	41.0	25.4	889.0	35.0	1.0	0.50	2	1.00	25.40	8	4859
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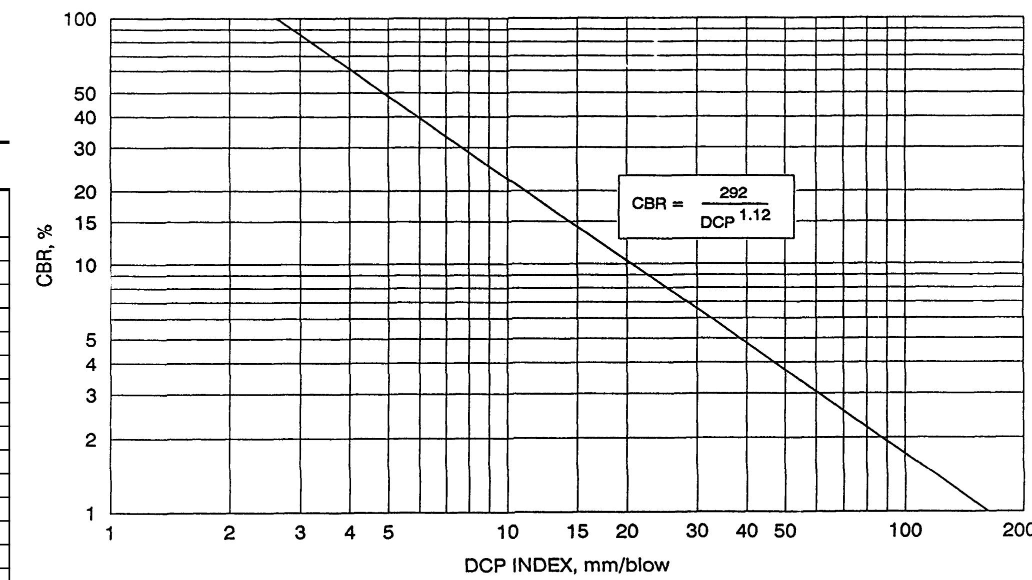
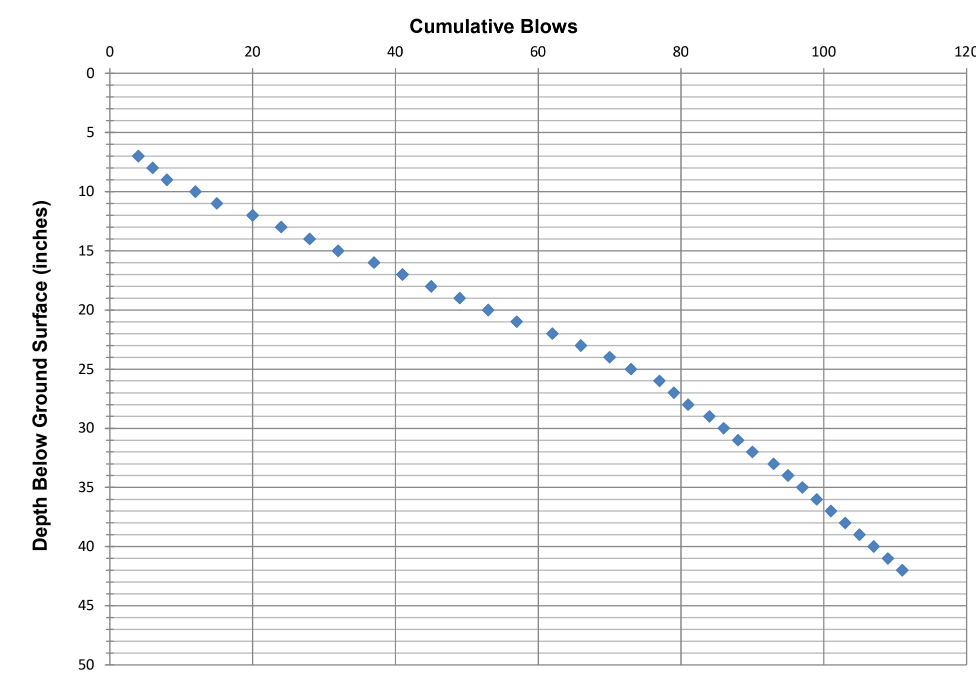


(after Webster et al., 1992)
Webster, S. L., Grau, R. H., and Williams, T. P. (1992). Description and application of dual mass dynamic cone penetrometer. Department of the Army Waterways Equipment Station, No. GL-92-3.



ODOT Pavement Design Guide. (2019). Pavement Sevices Unit, Oregon Department of Transportation.
$M_R = C_f \times 49023 \times S^{-0.39}$
M_R = resilient modulus (psi)
C_f = conversion coefficient
S = DCP Index (mm/blow)

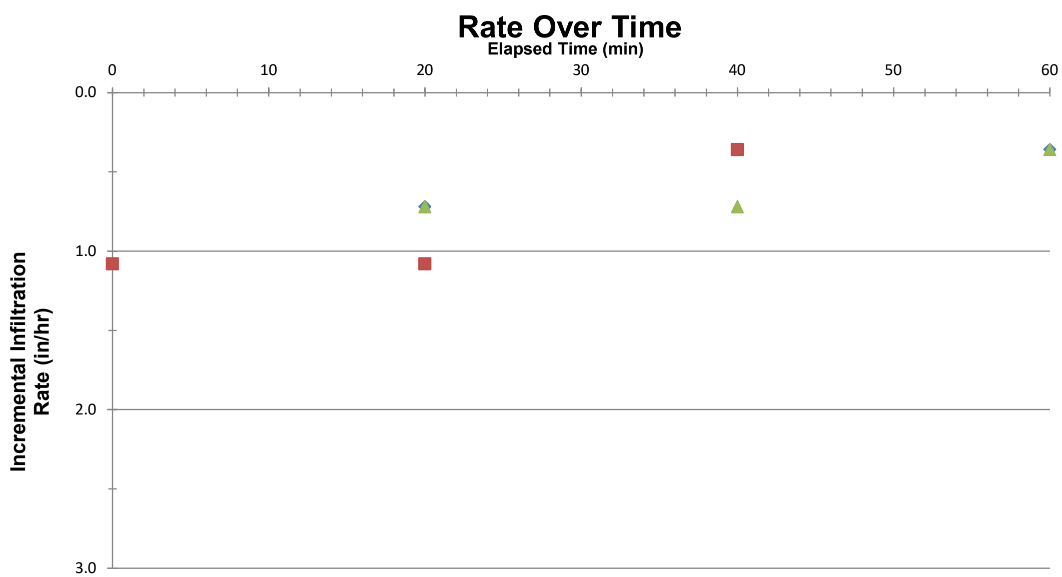
Location: Blossom Drive, Salem, OR
Depth to bottom: 3'
Tester's Name: Jason Weber
Tester's Company: GeoEngineers

Date: 7/14/2020
Dimension: 6-inch diameter
Tester's Contact No: 605-380-8841

Test Hole Number: B-7 / IT-1
Test Method: Encased Falling Head
GeoEngineers Job: 23830-006-00

	Depth	Soil Texture
	0-1'	Brown silty top soil with organics (grass rootlets) (medium stiff to stiff, moist)
	1' - 3'	Brown silt (very stiff, moist)

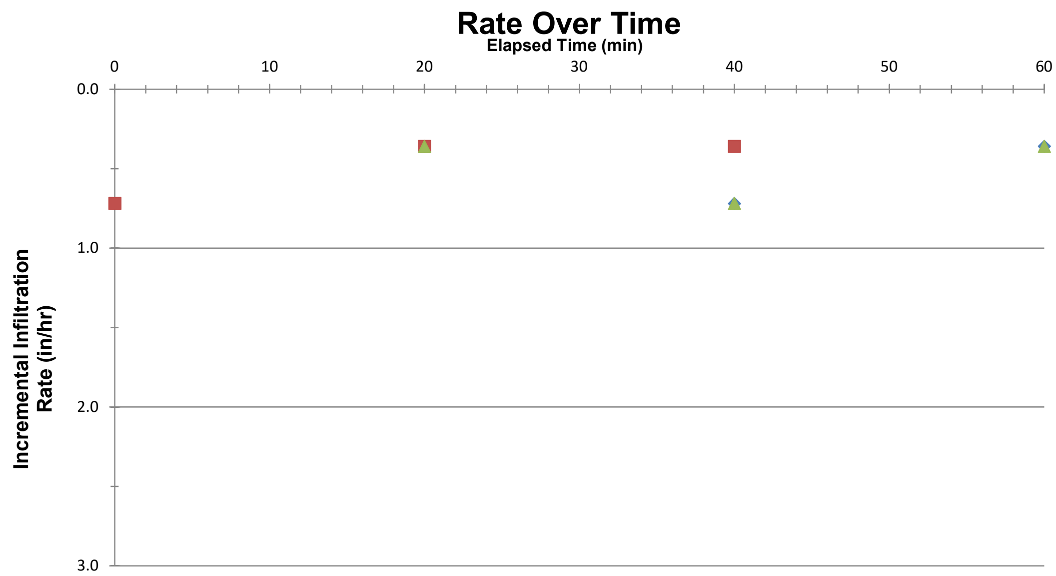
Time of Day	Time Interval (min)	Total Time (min)	Depth to Water from Top of Pipe (inches)	Dist. Interval (inches)	Infiltration (inches/hour)	
7/14/2020 7:52	0	0	26.0			Initial test (Saturation)
7/14/2020 8:39	47	47	26.8	0.7	0.9	
7/14/2020 13:00	0	0	16.8			Test #1
7/14/2020 13:20	20	20	17.2	0.4	1.1	
7/14/2020 13:40	20	40	17.5	0.4	1.1	
7/14/2020 14:00	20	60	17.6	0.1	0.4	
7/14/2020 14:00	0	0	17.6			Test #2
7/14/2020 14:20	20	20	17.9	0.2	0.7	
7/14/2020 14:40	20	40	18.1	0.2	0.7	
7/14/2020 15:00	20	60	18.2	0.1	0.4	
7/14/2020 15:00	0	0	18.2			Test #3
7/14/2020 15:20	20	20	18.5	0.2	0.7	
7/14/2020 15:40	20	40	18.6	0.1	0.4	
7/14/2020 16:00	20	60	18.7	0.1	0.4	



Location: Blossom Drive, Salem, OR	Date: 7/14/2020	Test Hole Number: B-8 / IT-2
Depth to bottom: 2.5'	Dimension: 6-inch diameter	Test Method: Encased Falling Head
Tester's Name: Jason Weber		GeoEngineers Job: 23830-006-00
Tester's Company: GeoEngineers	Tester's Contact No: 605-380-8841	

	Depth	Soil Texture
	0-1'	Brown silty top soil with organics (grass rootlets) (medium stiff to stiff, moist)
	1' - 2.5'	Brown silt (very stiff, moist)

Time of Day	Time Interval (min)	Total Time (min)	Depth to Water from Top of Pipe (inches)	Dist. Interval (inches)	Infiltration (inches/hour)	
7/14/2020 9:22	0	0	26.8			Initial test (Saturation)
7/14/2020 10:24	62	62	27.8	1.1	1.0	
7/14/2020 13:04	0	0	17.0			Test #1
7/14/2020 13:24	20	20	17.3	0.2	0.7	
7/14/2020 13:44	20	40	17.4	0.1	0.4	
7/14/2020 14:04	20	60	17.5	0.1	0.4	
7/14/2020 14:04	0	0	17.5			Test #2
7/14/2020 14:24	20	20	17.6	0.1	0.4	
7/14/2020 14:44	20	40	17.9	0.2	0.7	
7/14/2020 15:04	20	60	18.0	0.1	0.4	
7/14/2020 15:04	0	0	18.0			Test #3
7/14/2020 15:24	20	20	18.1	0.1	0.4	
7/14/2020 15:44	20	40	18.4	0.2	0.7	
7/14/2020 16:04	20	60	18.5	0.1	0.4	



APPENDIX B
Report Limitations and Guidelines for Use

APPENDIX B
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Read These Provisions Closely

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for Clutch Industries, Inc., and their agents for the Project specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures its services to meet the specific needs of its clients. No party other than the party to whom this report is addressed may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with our Agreement with Clutch Industries, Inc. dated June 4, 2020, and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or projects other than those identified in the report.

A Geotechnical Engineering or Geologic Report is Based on a Unique Set of Project-Specific Factors

This report has been prepared for the proposed Blossom Drive Apartments project in Salem, Oregon. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

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[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

Environmental Concerns Are Not Covered

Unless environmental services were specifically included in our scope of services, this report does not provide any environmental findings, conclusions, or recommendations, including but not limited to, the likelihood of encountering underground storage tanks or regulated contaminants.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical and Geologic Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted, or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

Geotechnical Engineering Report Recommendations Are Not Final

We have developed the following recommendations based on data gathered from subsurface investigation(s). These investigations sample just a small percentage of a site to create a snapshot of the subsurface conditions elsewhere on the site. Such sampling on its own cannot provide a complete and accurate view of subsurface conditions for the entire site. Therefore, the recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. The logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Photographic or electronic reproduction is acceptable, but separating logs from the report can create a risk of misinterpretation.

Give Contractors a Complete Report and Guidance

To help reduce the risk of problems associated with unanticipated subsurface conditions, GeoEngineers recommends giving contractors the complete geotechnical engineering or geologic report, including these "Report Limitations and Guidelines for Use." When providing the report, you should preface it with a clearly written letter of transmittal that:

- advises contractors that the report was not prepared for purposes of bid development and that its accuracy is limited; and
- encourages contractors to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and adjacent properties.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants, and no conclusions or inferences should be drawn regarding Biological Pollutants as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria and viruses, and/or any of their byproducts.

A Client that desires these specialized services is advised to obtain them from a consultant who offers services in this specialized field.

GeoEngineers

APPENDIX E

OPERATIONS AND MAINTENANCE

Appendix B to 109-011 – Facility Maintenance Forms

2. Rain Garden

A rain garden is a **vegetated infiltration basin** or depression created by excavation, berms, or small dams to provide for short-term ponding of surface water until it percolates into the soil. The basin should infiltrate stormwater within 24 hours.

Inspections

All facility components and vegetation shall be inspected for proper operations and structural stability. *These inspections shall occur, at a minimum, quarterly for the first two years from the date of installation, and two times per year thereafter.* It is recommended that a visual inspection be made within 48 hours after each major storm event to ensure proper function. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

Date: ____/____/_________ Inspector's Name: ______________________________

Basin inlet shall ensure unrestricted stormwater flow to the vegetated basin.

- □ Sources of erosion shall be identified and controlled when native soil is exposed or erosion channels are present.
- □ Inlet shall be kept clear at all times.
- □ Rock splash pads shall be replenished to prevent erosion.

Inspection Comments: ______________________________

____

Embankment, dikes, berms, and side slopes retain water in the infiltration basin.

- □ Structural deficiencies shall be corrected upon discovery.
- □ Slopes shall be stabilized using appropriate erosion control measures when soil is exposed/flow channels are forming.
- □ Sources of erosion damage shall be identified and controlled.

Inspection Comments: ______________________________

____

Overflow or emergency spillway conveys flow exceeding reservoir capacity to an approved stormwater receiving system.

- □ Overflow shall be kept clear at all times.
- □ Sources of erosion damage shall be identified and controlled when soil is exposed.
- □ Rocks or other armament shall be replaced when only one layer of rock exists.

Inspection Comments: ______________________________

____

Amended soils shall allow stormwater to percolate uniformly through the infiltration basin. If water remains 36 hours after a storm, sources of possible clogging shall be identified and corrected.

- □ Basin shall be raked and, if necessary, soil shall be excavated and cleaned or replaced.

Inspection Comments: ______________________________

____

Appendix B to 109-011 – Facility Maintenance Forms

2. Rain Garden (continued)

Sediment/Basin debris management shall prevent loss of infiltration basin volume caused by sedimentation.

- □ Sediment exceeding 3 inches in depth, or so thick as to damage or kill vegetation, shall be removed.
- □ Sediment accumulation shall be hand-removed with minimum damage to vegetation using proper erosion control measures.

Inspection Comments: ______________________________

____

Debris and litter shall be removed to ensure stormwater infiltration and to prevent clogging of overflow drains and interference with plant growth.

- □ Restricted sources of sediment and debris, such as discarded lawn clippings, shall be identified and prevented.

Inspection Comments: ______________________________

____

Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion. Proper horticultural practices shall be employed to ensure that plants are vigorous and healthy.

- □ Mulch shall be replenished as needed, but not inhibiting water flow.
- □ Vegetation, large shrubs, or trees that interfere with rain garden operation shall be pruned.
- □ Fallen leaves and debris from deciduous plant foliage shall be raked and removed.
- □ Nuisance or prohibited vegetation from the City of Salem Non-Native Invasive Plant list shall be removed when discovered. Invasive vegetation shall be removed immediately upon discovery.
- □ Dead vegetation shall be removed upon discovery.
- □ Vegetation shall be replaced as soon as possible to maintain cover density and control erosion where soils are exposed.

Inspection Comments: ______________________________

____

Spill prevention measures shall be exercised when handling substances that contaminate stormwater.

- □ Releases of pollutants shall be corrected as soon as identified.

Inspection Comments: ______________________________

Training and/or written guidance information for operating and maintaining vegetated infiltration basins shall be provided to all property owners and tenants. This Facility Maintenance Form can be used to meet this requirement.

Inspection Comments: ______________________________

Access to the infiltration basin shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.

- □ Obstacles preventing maintenance personnel and/or equipment access to the infiltration basin shall be removed.
- □ Gravel or ground cover shall be added if erosion has occurred.

Inspection Comments: ______________________________

____

Appendix B to 109-011 – Facility Maintenance Forms

2. Rain Garden (continued)

Nuisance insects and rodents shall not be harbored in the infiltration basin. Pest control measures shall be taken when nuisance insects/rodents are found to be present.

- □ Holes in the ground located in and around the infiltration basin shall be filled.

Inspection Comments: ______________________________

____

If used at this site, the following will be applicable:

Fences shall be maintained to preserve their functionality and appearance.

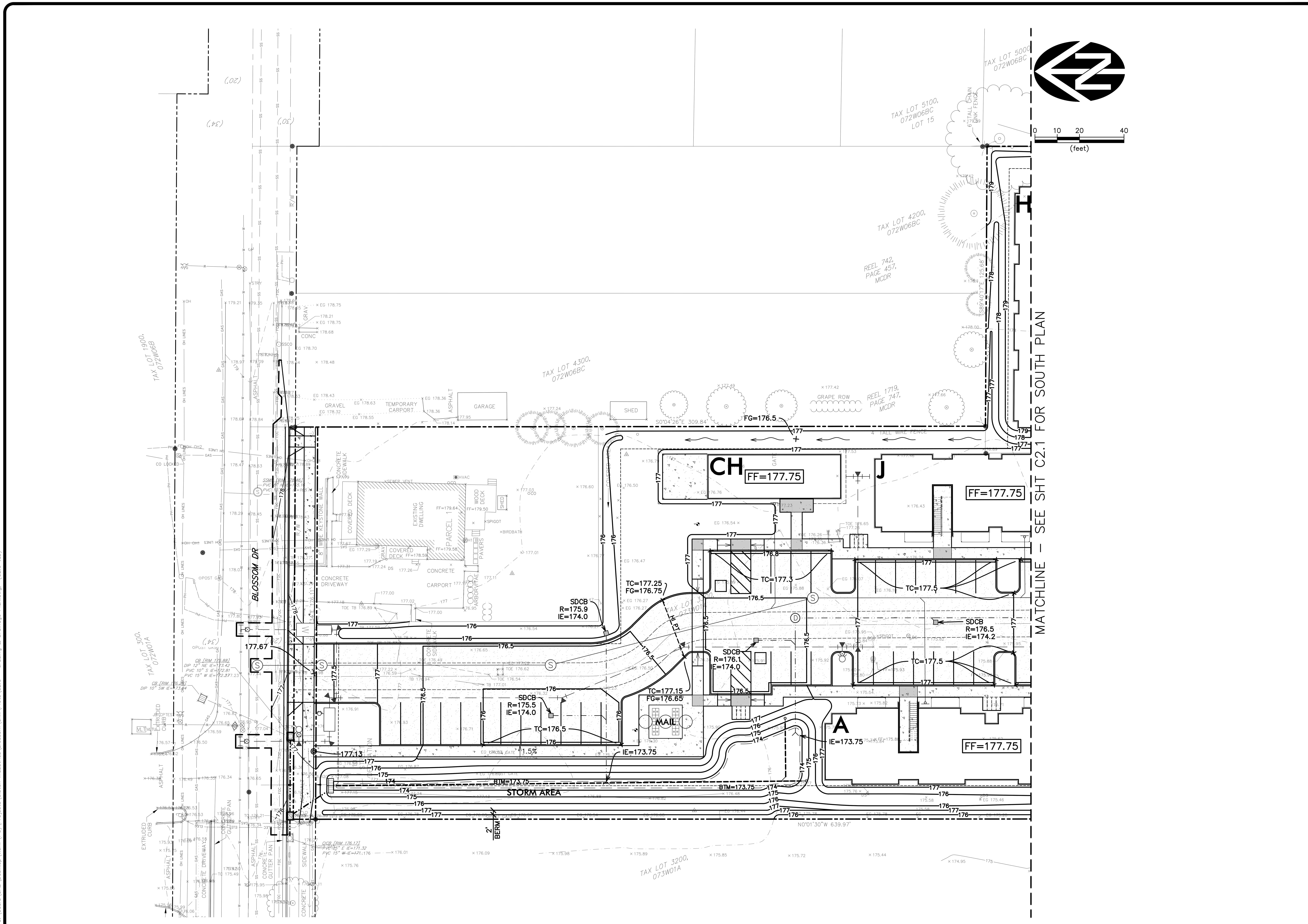
- □ Collapsed fences shall be restored to an upright position.
- □ Jagged edges and damaged fences shall be repaired or replaced.

Inspection Comments: ______________________________

____

APPENDIX F

CIVIL DRAWINGS



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1			

REVISIONS

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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSN. JW
DRN. AK
CKD. JW
DATE: 06/2022

REVIEW
REGISTERED PROFESSIONAL ENGINEER
OREGON
NOV. 12, 20..
WILLIAM J. WELLS
RENEWS: 6/30/2024

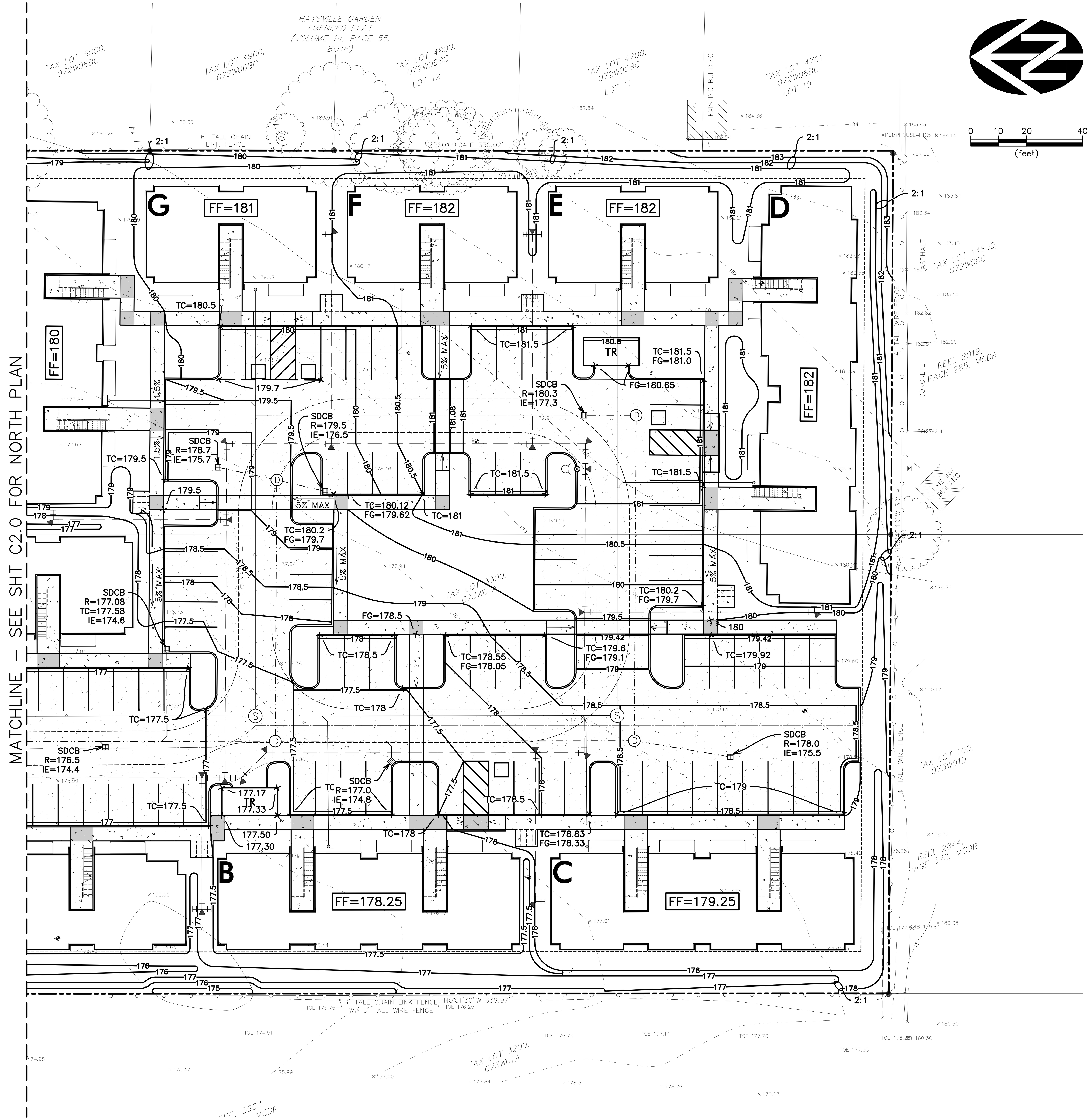
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

CLUTCH INDUSTRIES
BLOSSOM APARTMENTS

GRADING PLAN (N)

DRAWING
C2.0

JOB NUMBER
3366.0000.0



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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSN. JW
DRN. AK
CKD. JW
DATE: 06/2022

REVIEW
REGISTERED PROFESSIONAL ENGINEER
OREGON
NOV. 12, 20..
WILLIAM J. WELLS
RENEWS: 6/30/2024

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

CLUTCH INDUSTRIES
BLOSSOM APARTMENTS

GRADING PLAN (S)

DRAWING
C2.1

JOB NUMBER
3366.0000.0

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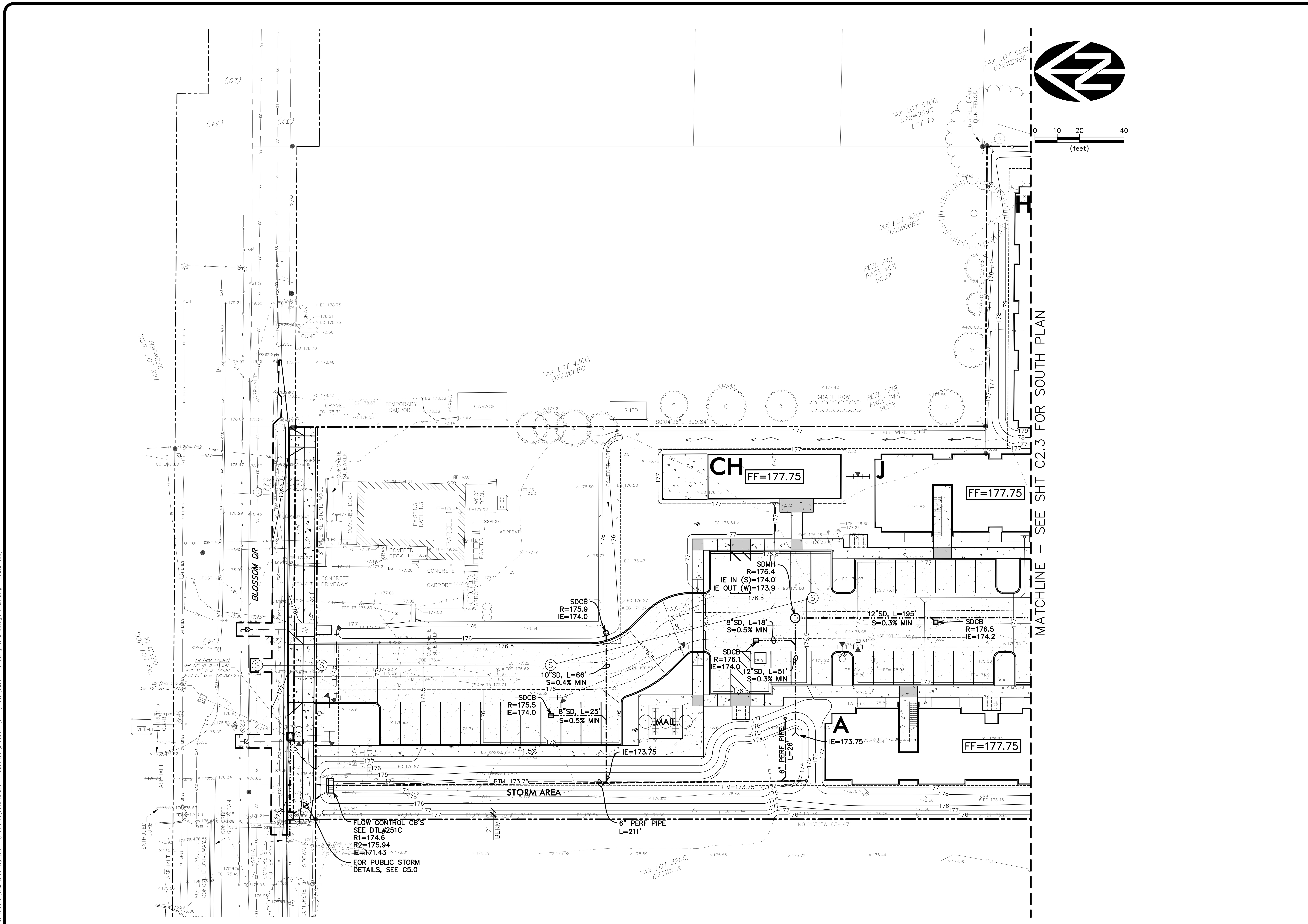

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REVISIONS

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DSN. JW
DRN. AK
CKD. JW
DATE: 06/2022

REGISTERED PROFESSIONAL ENGINEER
OREGON
NOV. 12, 2008
WILLIAM J. WELLS
REVIEW
RENEWS: 6/30/2024

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

CLUTCH INDUSTRIES

BLOSSOM APARTMENTS

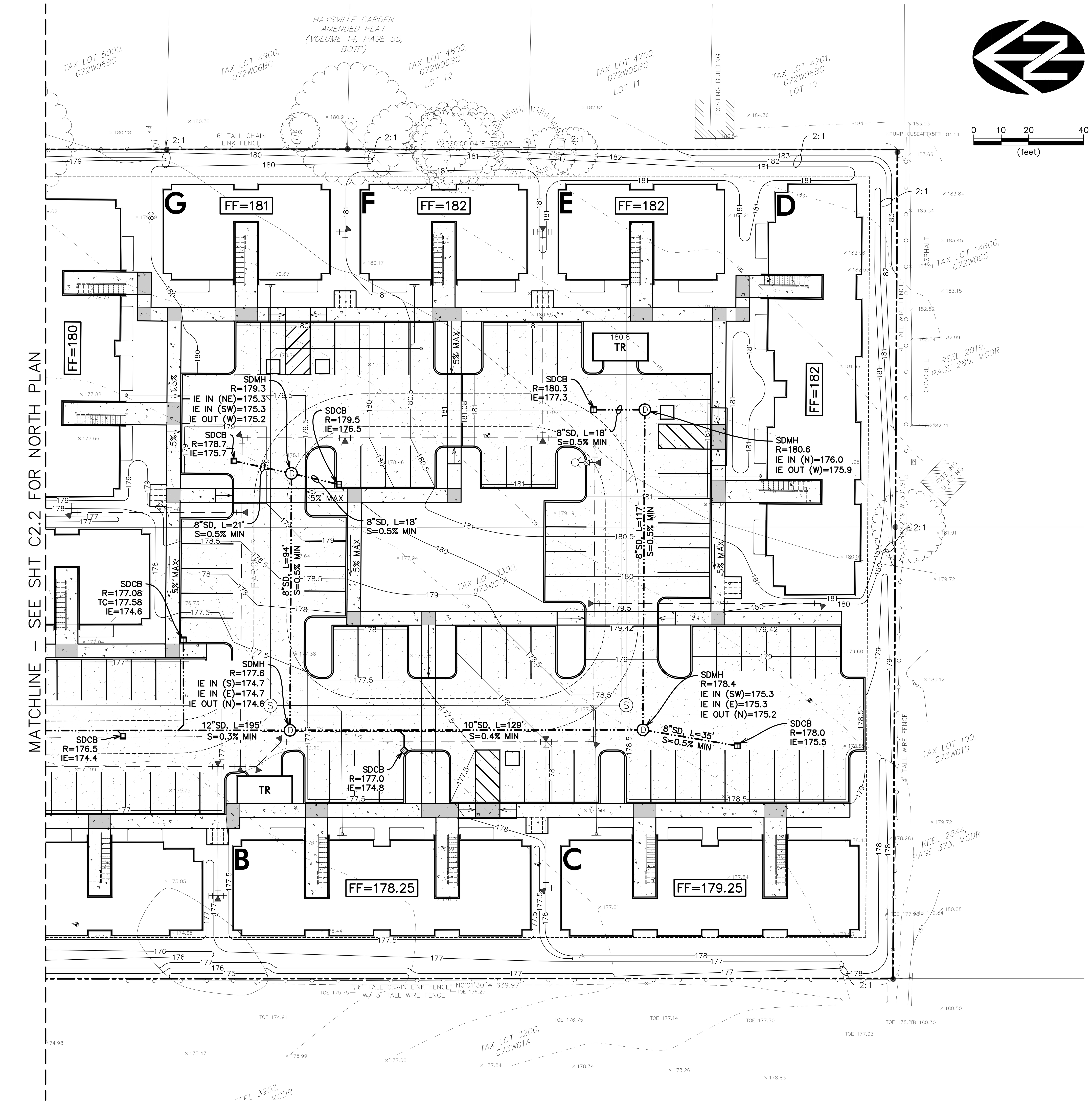
DRAINAGE PLAN (N)

DRAWING

C2.2

JOB NUMBER

3366.0000.0



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DSN. JW
DRN. AK
CKD. JW
DATE: 06/2022

REGISTERED PROFESSIONAL ENGINEER
OREGON
NOV. 12, 20..
WILLIAM J. WELLS
REVIEW
RENEWS: 6/30/2024

WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
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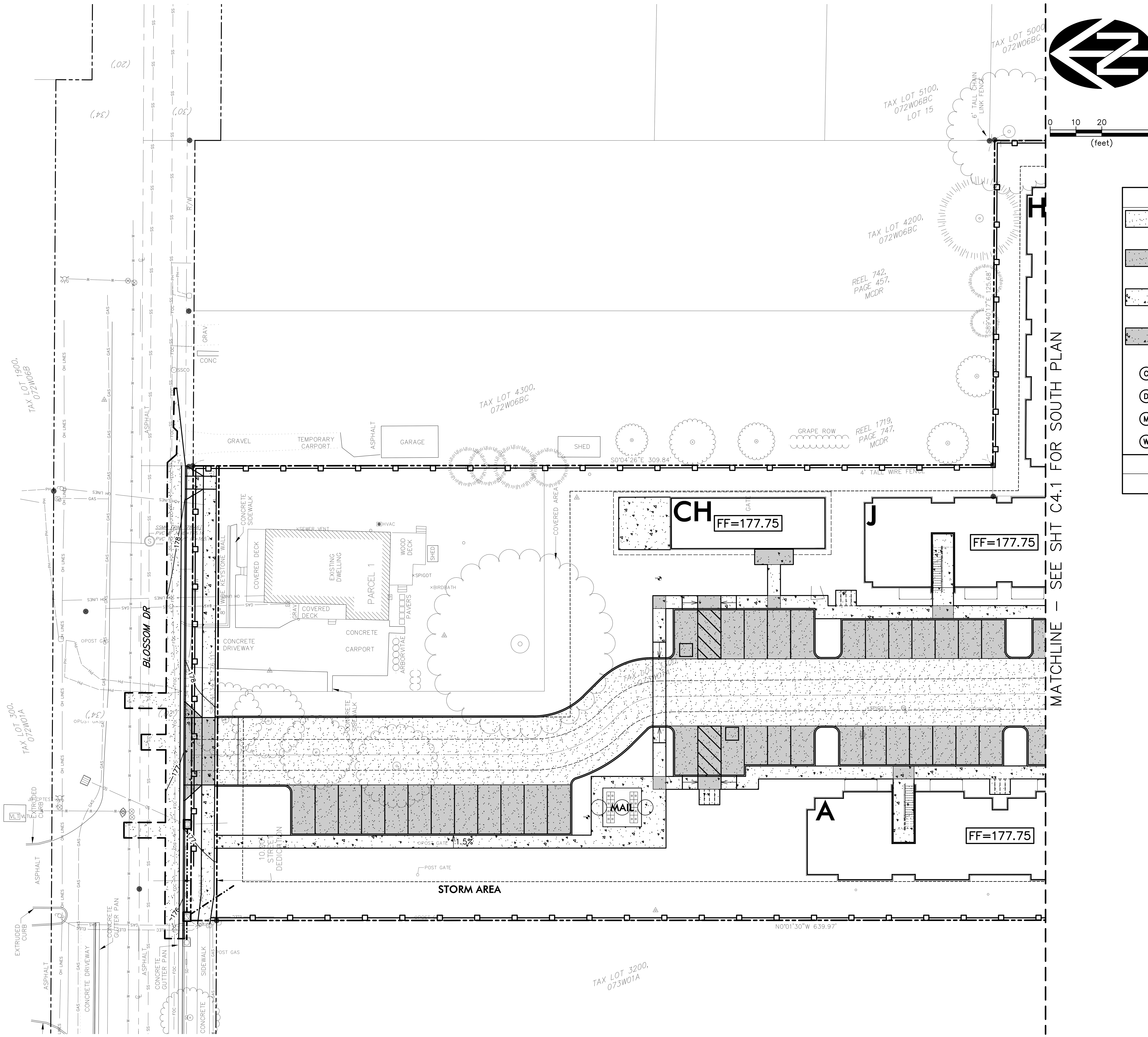
E-mail: westech@westech-eng.com

CLUTCH INDUSTRIES
BLOSSOM APARTMENTS

DRAINAGE PLAN (S)

DRAWING
C2.3

JOB NUMBER
3366.0000.0



SURFACING LEGEND

(pattern)	HEAVY DUTY ASPHALT __" OF LEVEL II HMAC OVER __" OF COMPACTED 1"–0 OVER APPROVED SUBGRADE
(pattern)	LIGHT DUTY ASPHALT __" OF LEVEL II HMAC OVER __" OF COMPACTED 1"–0 OVER APPROVED SUBGRADE
(pattern)	PEDESTRIAN CONCRETE __" PCC OVER __" OF COMPACTED 1"–0 OVER APPROVED SUBGRADE
(pattern)	HEAVY DUTY CONCRETE __" PCC OVER __" OF COMPACTED 1"–0 OVER APPROVED SUBGRADE
(C)	TYPE 'C' CURB
(D)	NEW DRIVEWAY PER CITY DTL #ST-25
(M)	MONOLITHIC CURB
(W)	WHEELSTOPS

NOTES

1. SEE STREET PLANS FOR HARDSCAPE IN ROW

NO.	DATE	DESCRIPTION	BY
1		REVISIONS	

VERIFY SCALE
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSN. JW
DRN. AK
CKD. JW
DATE: 06/2022

REGISTERED PROFESSIONAL ENGINEER
OREGON
NOV. 12, 20..
WILLIAM A. WELLS
RENEWS: 6/30/2024
REVIEW

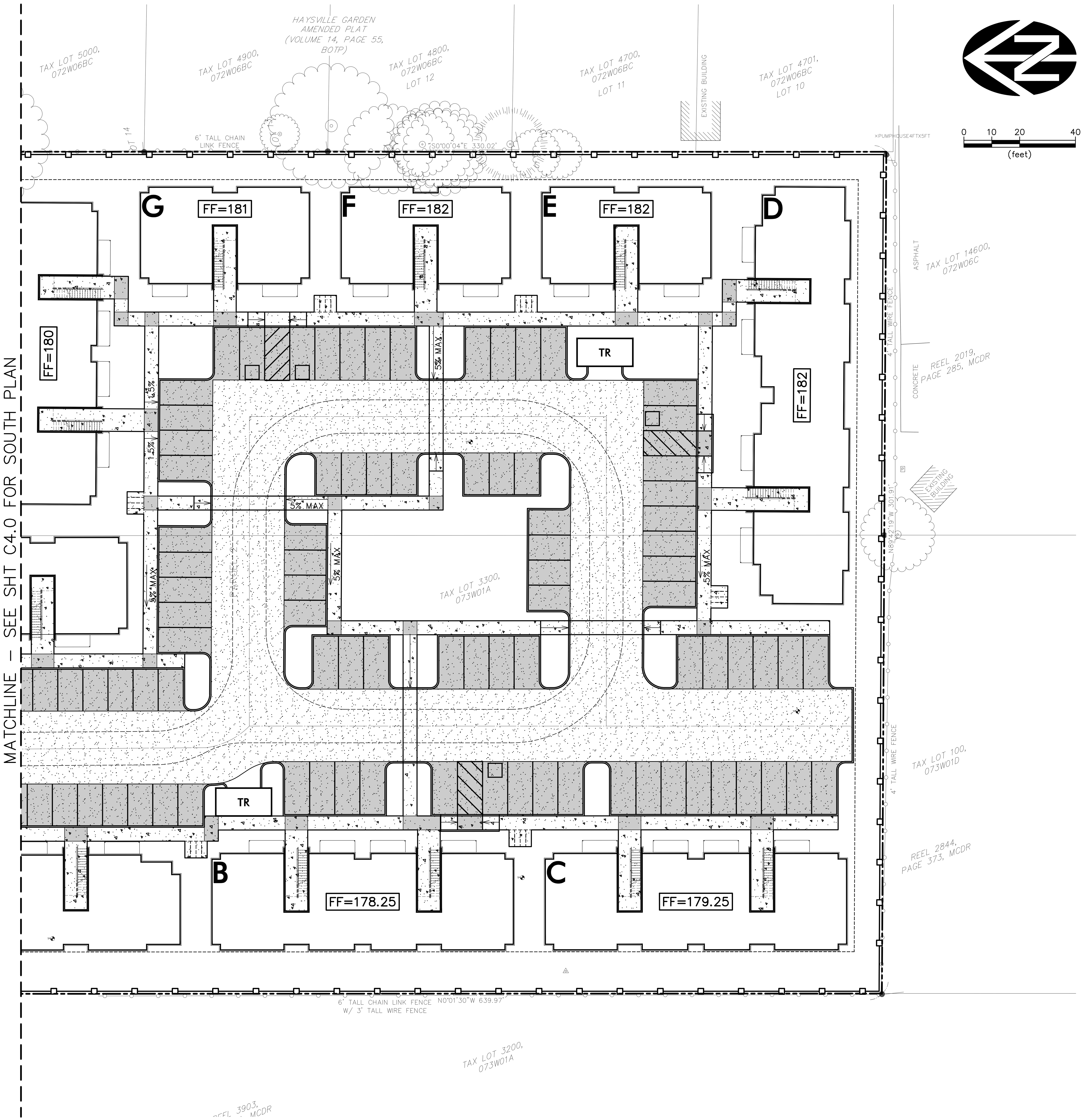
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

CLUTCH INDUSTRIES
BLOSSOM APARTMENTS

SURFACING PLAN (N)

DRAWING
C4.0

JOB NUMBER
3366.0000.0



SURFACING LEGEND
HEAVY DUTY ASPHALT __" OF LEVEL II HMAC OVER __" OF COMPACTED 1"–0 OVER APPROVED SUBGRADE
LIGHT DUTY ASPHALT __" OF LEVEL II HMAC OVER __" OF COMPACTED 1"–0 OVER APPROVED SUBGRADE
PEDESTRIAN CONCRETE __" PCC OVER __" OF COMPACTED 1"–0 OVER APPROVED SUBGRADE
HEAVY DUTY CONCRETE __" PCC OVER __" OF COMPACTED 1"–0 OVER APPROVED SUBGRADE
(C) TYPE 'C' CURB
(D) NEW DRIVEWAY PER CITY DTL #ST-25
(M) MONOLITHIC CURB
(W) WHEELSTOPS

NOTES
1. SEE STREET PLANS FOR HARDSCAPE IN ROW

NO.	DATE	DESCRIPTION	BY
1			
		REVISIONS	

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSN: JW
DRN: AK
CKD: JW
DATE: 06/2022

REVIEW
REGISTERED PROFESSIONAL ENGINEER
OREGON
NOV. 12, 20__
WILLIAM A. WELLS
RENEWS: 6/30/2024

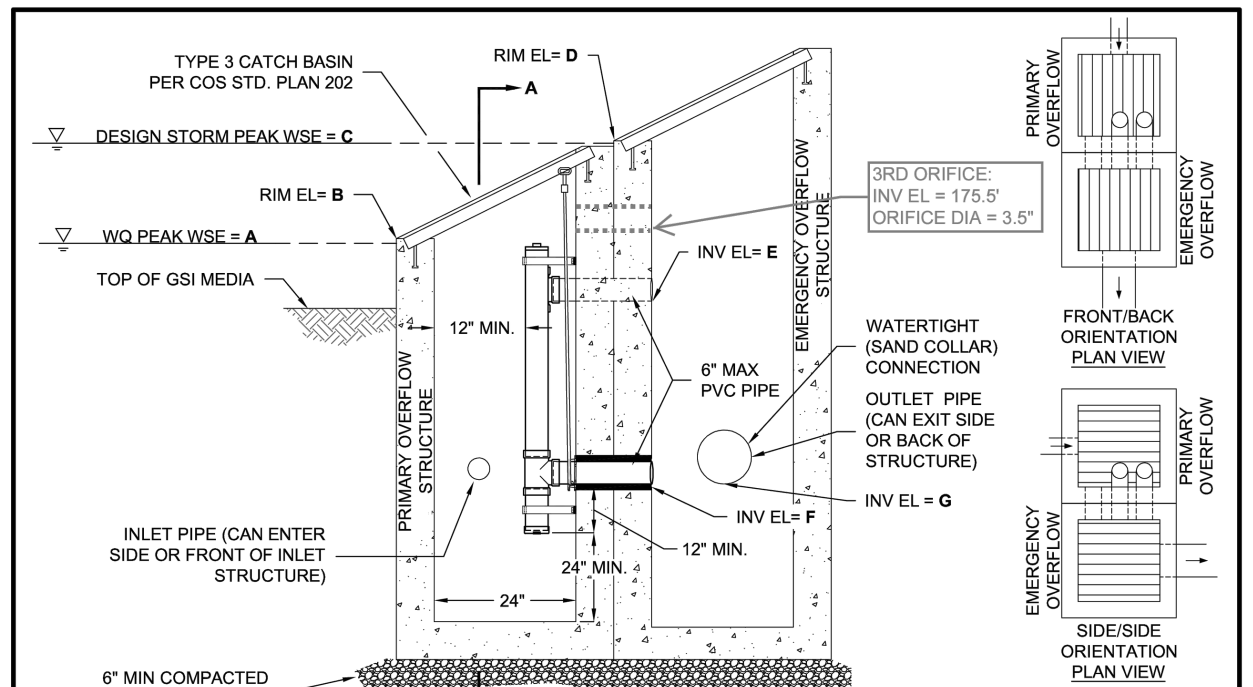
WESTECH ENGINEERING, INC.
CONSULTING ENGINEERS AND PLANNERS
3841 Fairview Industrial Dr. S.E., Suite 100, Salem, OR 97302
Phone: (503) 585-2474 Fax: (503) 585-3986
E-mail: westech@westech-eng.com

CLUTCH INDUSTRIES
BLOSSOM APARTMENTS

SURFACING PLAN (S)

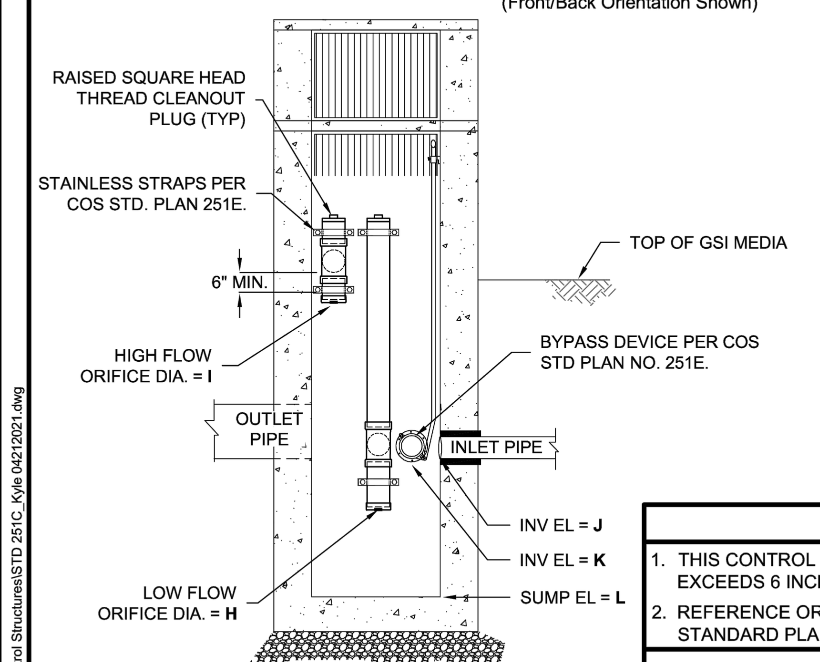
DRAWING
C4.1

JOB NUMBER
3366.0000.0



PROFILE VIEW
(Front/Back Orientation Shown)

DATA TO BE COMPUTED BY DESIGN ENGINEER
A= 171.85'
B= 174.60'
C= 176.00'
D= 175.94'
E= 174.80'
F= 171.43'
G= 171.43'
H= 2.0"
I= 1.0"
J= 168.25'
K= 171.43'
L= 168.43'



SECTION A-A
NTS

GENERAL NOTES

1. THIS CONTROL STRUCTURE NOT FOR USE WHEN ORIFICE SIZE EXCEEDS 6 INCHES.
2. REFERENCE ORIFICE MEASUREMENT TABLE ON COS STANDARD PLAN 251E FOR ORIFICE SIZE REQUIREMENTS.

CITY OF SALEM
DEPARTMENT OF PUBLIC WORKS

STANDARD PLAN
FLOW CONTROL STRUCTURE-TYPE 3

CHANGES

APPROVED — CITY ENGINEER — 6/8/2021 DATE

DRAWN BY	KLA	4/2021	NO.251C
CHECKED BY	JDL	4/2021	

NO.	DATE	DESCRIPTION	BY
—			

REVISIONS

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSN. JW
DRN. AK
CKD. JW
DATE: 06/2022

REGISTERED PROFESSIONAL ENGINEER — OREGON — NOV. 12, 20.. — WILLIAM J. WELLS — RENEWS: 6/30/2024
REVIEW

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CLUTCH INDUSTRIES
BLOSSOM APARTMENTS

DETAILS

DRAWING
C7.0

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11/11/2022 11:40:03 AM
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