

## EXHIBIT G

# WASHINGTON FORESTRY CONSULTANTS, INC.

FORESTRY AND VEGETATION MANAGEMENT SPECIALISTS



**W F C I**

O: 360/943-1723  
C: 360/561-4407

9136 Yelm Hwy SE  
Olympia, WA 98513

- Final Tree Protection Plan -

### CASCADE AT BOURNSTADT VILLAGE

38272 Hwy. 211  
Sandy, Oregon

Prepared for: Vaughn Bay Construction, Inc.

Prepared by: Washington Forestry Consultants, Inc.

Date: December 22, 2022

### Introduction

The project proponent is planning to subdivide 8.83 acres into multi-family residential (apartments) on 6.95 acres, while creating 1 lot for the existing home at 38272 Hwy 211 in Sandy, Oregon. The home to the west on this lot was demolished.

The proponent has retained WFCI to:

- Evaluate all trees on the site pursuant to the requirements of the Bournstadt Village Specific Area Plan.
- Make recommendations for retention of suitable trees in the buildable, open space or tree tract areas, along with required protection and cultural measures.
- Complete the required minimum stocking and tree replacement calculations.
- Prepare a Tree Protection Plan.

### Observations

#### Methodology

WFCI has individually evaluated 100% of the trees 3+ inches diameter at breast height (DBH) and larger in the proposed project area, and assessed their potential to be incorporated into the new project. A small tree number was painted at the base of each tree and the number shown on the aerial photos in Attachment 1 and Attachment 4.

**URBAN/RURAL FORESTRY • TREE APPRAISAL • TREE RISK ASSESSMENT**  
**RIGHT-OF-WAYS • VEGETATION MANAGEMENT • FOREST/TREE MGT. PLANS • EXPERT TESTIMONY**  
*Member of International Society of Arboriculture and Society of American Foresters*

## Cascade at Bournstadt Village – Final Tree Protection Plan

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Trees  $\geq 8$  inches DBH (diameter at breast height or 4.5 ft. above the groundline) which is equivalent to 25 inches circumference, are considered to be **significant trees**<sup>1</sup>, and all others non-significant. The health of the tree is not considered, just size – as per the code.

Multi-stemmed tree DBH's were calculated using our industry standard:

$$DBH = \sqrt{(\text{Stem } 1^2 + \text{Stem } 2^2 + \text{Stem } 3^2 + \dots \dots \text{Stem } X^2)^2}$$

The tree evaluation phase used methodology developed by Matheny and Clark (1998)<sup>3</sup>. While tree risk ratings are not provided, trees rated as being in 'Poor' or 'Very Poor' condition are in poor health, and often were structurally defective.

### Site History

The site now consists of 2 parcels. An existing home sat on each parcel along Hwy. 211. These house parcels will be subdivided with new lot lines. The areas around the existing homes are treed with native and planted tree species. The remainder of the land on the parcels was used for pasture and has a few trees and invasive brush. The site is flat to gently rolling. No streams or wetlands occur. Recently the westerly home was demolished. The easterly home will remain.

### Soil Depth and Productivity

There is 1 soil type as per the Natural Resource Conservation Service Web Soil Survey. It is the Cazadero well-drained, silty clay loam with slopes of 0 to 7%. This soil is formed from old mixed alluvium and is found on terraces. The top 21 inches is silty clay loam, then clay to 75 inches. There is no restrictive layer to tree roots down to at least 80 inches. There is moderate available water holding capacity for trees and plants. It is well-suited to the normal growth of trees and other vegetation.

### Existing Tree Conditions – Includes the Entire Ownership

The forest cover was stratified into 1 forest cover type for the purpose of description. It includes planted and natural trees and pasture.

Type I – All Trees. – This type includes residual, naturally established native tree species, along with many planted ornamental and native tree species. The inventory found 82 trees ranging from 3 to 45 inches DBH (See Attachment #2 – the Master Tree List).

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<sup>1</sup> Chapter 17.92.10 C. *Significant plant and tree specimens should be preserved to the greatest extent practicable and integrated into the design of a development. Trees of 25-inches or greater circumference measured at a height of 4-1/2 ft. above grade are considered significant.*

<sup>2</sup> *Directors Rule 16-2008* – City of Seattle, Page 3, 6 pages.

<sup>3</sup> Matheny, Nelda and James R. Clark. *Trees and Development: A Technical Guide to Preservation of Trees during Land Development.* International Society of Arboriculture, Champaign, IL 1998

Cascade at Bournstadt Village – Final Tree Protection Plan

The tree species included: Douglas-fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), Pacific Yew (*Taxus brevifolia*), cherry (*Prunus* spp.), bigleaf maple (*Acer macrophyllum*), hawthorne (*Crataegus* spp.), Austrian pine (*Pinus nigra*), Photinia (*Photinia serratifolia*), blue atlas cedar (*Cedrus atlantica*), western white pine (*Pinus monticola*), flowering plum (*Prunus cerasifera*), western redcedar (*Thuja plicata*), Pt. Orford Cedar (*Chamaecyparis lawsoniana*), deodar cedar (*Cedrus deodara*), shore pine (*Pinus contorta* var. *contorta*), apple (*Malus* spp.), and Scotch pine (*Pinus sylvestris*). Tree condition ranged from ‘Good’ to ‘Very Poor’. A list of the trees is provided in Attachment 2.

**Table 1.** Tree summary by area of the **entire** project site.

Tree Significance?	Area				Sum
	Buildable Area*	West Lot	East Lot	Rights-of-Way	
# Significant Trees	12	23	5	34	74
# Non-Significant Trees	0	2	2	4	8
<b>Sum</b>	<b>12</b>	<b>25</b>	<b>7</b>	<b>38</b>	<b>82</b>

\*Footprint of new construction excluding rights-of-ways.

In summary, of the 82 trees larger than 3 inches DBH, 74 are significant i.e. 8 inches DBH and larger, and 8 are non-significant i.e. smaller than 8 inches DBH.

A total of 36 (49%) of the 74 significant trees are in ‘Poor’ or ‘Very Poor’ condition due to poor health, and/or structural defects including decay in the stem, codominant stems, or multiple tops.

In short, only 38 healthy significant trees exist within the entire project area.

**Rights-of-Way Trees**

There are 38 significant trees and 4 non-significant trees that are growing on the existing and planned new rights-of-way. A list is provided in Attachment #2 as part of the ‘Master List’ and the separate ‘Rights-of-Way Tree List’.

**Buildable Area of the Parcel**

This includes the footprint of the new construction, excluding existing and new rights-of-way. It includes the newly created lot from what was the west and east house lots. This is where trees will be retained.

**Table 2.** Summary of planned tree retention by area.

Area	# Significant Trees	# Sign. Trees to be Saved	# Non-Significant Trees	# Non-Sign. Trees to be Saved
Buildable Area	12	0	0	0
East House Lot	5	3	2	2
West House Lot	23	17	2	2
<b>Sum</b>	<b>40</b>	<b>20</b>	<b>4</b>	<b>4</b>

The above Table 2 excludes rights-of-ways. The ‘Buildable Area’ includes the footprint of construction, excluding rights-of-ways. The East House Lot and the West House Lot are combined as 1 lot in the final project plan.

In summary, there are 40 significant trees within the footprint of the construction in this project, excluding existing and dedicated rights-of-ways. Twenty of these 40 trees will be saved, along with all (4) non-significant trees.

### **Off-Site Impacts**

There are 8 off-site trees that will require protection during construction. Seven are all located on the house lot east of the project and 1 on the existing house to the south. Trees D and E are in ‘Poor’ condition and appear to be at or very near the property line. I recommend that applicant negotiate ‘removal’ with landowner. Tree G is rated as ‘Poor’ in quality due to the multiple stems and the risk they pose is to the landowner – this is their issue, not the Cascade applicant. Table 4 in Attachment 2 provides a list of the off-site trees that potentially could be impacted along with our recommendations.

## **Discussion and Recommendations**

### **Potential for Tree Retention**

None of the 12 trees within the footprint of the new construction have the potential to be saved.

All 24 trees to be saved are on the 1 new house lot. It will be up to the landowners to perform their own tree maintenance.

No R/W trees will be saved.

### **Minimum Tree Protection Calculations**

The City of Sandy Bournstadt Village Specific Area Plan requires that 6 significant trees per acre be saved in the new project. They recommend that 2 of these 3 saved trees be conifers. The following is a summary of the proposed tree retention and replanting:

Total Buildable Area	6.95 acres
Required Tree Retention (6 trees/ac)	42 trees
Planned Sign. Tree Retention in Buildable Area and House Lots	20 trees
Shortfall on Sign. Tree Retention in Buildable Area	22 trees

In summary, 20 significant trees and 4 non-significant trees will be saved, causing a shortfall of 22 trees below the required 42 tree (6 trees/acre) minimum. Note: Tree stocking in the buildable area and new house lot today is only 32 significant trees, which is below the 42 tree retention requirement. **There is no requirement in the Sandy code for tree replacement for this**

**shortfall. If the 2:1 replacement ratio were applied, then 44 replacement trees would be required for this shortfall.**

Tree replacement will need to be done at a 2:1 ratio for each tree removed that is 11 inches DBH and larger within the buildable area and new house lot of the parcel. This will require **32 replacement trees** to be planted (See Attachment #2 – Onsite tree list table). Two-thirds of the new trees for replanting should be conifers. No replacement trees are required for non-significant trees or rights-of-way trees that are removed. See Attachment #2 – the Onsite Tree List for this calculation.

I recommend that western redcedar, incense cedar, and Douglas-fir species should be used for replanting. The trees should be 6-7 ft. tall balled and burlap stock that meet the ANSI Z60.1 standards for nursery stock. They should be planted according to industry standards to include mulching and staking.

### **Tree Protection Requirements**

Trees and tree tracts to be saved must be protected during construction by temporary orange mesh fencing on driven posts, located at the edge of the root protection zone (See Attachment #3).

There should be no equipment activity (including rototilling) within the critical root zone. No irrigation lines, trenches, or other utilities should be installed within the root protection zone. If roots are encountered outside the root protection zone, they should be cut cleanly with a saw and covered immediately with moist soil. Noxious vegetation within the root protection zone should be removed by hand. If a proposed save tree must be impacted by grading or fills, then the tree should be re-evaluated by WFCI to determine if the tree can be saved and mitigating measures, or if the tree should be removed.

### **Street Trees**

The street trees along the internal driveways will be specified in the landscape plan. Any other required street trees along street frontage improvements will be as per direction from the City of Sandy urban forestry department.

## **Sequence for Tree Protection Activity**

The following is the sequence for tree protection activity:

1. Stake the new lot lines and clearing limits. Communicate with the neighbor's to the east and south about off-site edge trees. Offsite trees to be removed must have landowner agreement.
2. Install tree protection fence as described and roughly shown on Attachment #3. Contact WFCI to inspect the fence prior to the start of land clearing.
3. Complete land clearing in the buildable area.
4. Maintain tree protection fences throughout construction.

5. It is recommended that replacement trees be planted in the fall between October 15<sup>th</sup> and April 1<sup>st</sup> to give them a better chance of establishment, survival, and early growth.
6. Contact WFCI should any questions arise regarding tree retention or protection on the project.

### Summary

There are 40 significant trees and 4 non-significant trees within the footprint of construction and new house lot. Twenty of these significant trees will be saved along with all 4 non-significant trees. These 24 trees are all located on the newly created house lot.

The Sandy tree code requires 6/trees per acre to be saved – however tree stocking is sparse within the footprint of the buildable area, so this plan falls 22 significant trees short of the requirement. The tree code calculates tree replacement based on the number of  $\geq 11$  inch DBH trees removed from the buildable area – this would require 32 new trees be planted.

The projected cost to purchase and install these 32 trees is \$5,600.

Please give us a call if you have any questions.

Respectfully submitted,

Washington Forestry Consultants, Inc.



Galen M. Wright, ACF, ASCA  
ISA Board Certified Master Arborist No. PN-0129  
Certified Forester No. 44  
ISA Tree Risk Assessor Qualified (TRAQ)  
ASCA Tree and Plant Appraisal Qualified (TPAQ)

**Attachment 1. Aerial photo showing relative tree locations and their painted numbers for the 1 new house lot, and new project buildable area.**

**(2 Pages Attached)**

Figure 1. North area - relative locations of trees on the 2 house lots (approximate dashed lot line) and the northeasterly portion of the buildable area.





Figure 2. South area - relative locations of trees in Buildable Area of Project.



**Attachment 2. Four Tree lists.**

**(8 Pages Attached)**

- **Table 3 - Master Tree List – All Trees on Project**
- **Table 4 - Offsite Tree List – Trees Potentially Impacted by the Project**
- **Table 5 - On-Site Tree List – Trees in Buildable Area and New House Lot (Includes Tree Replacement Calculations)**
- **Table 6 - Rights-of-Way Tree List – trees to be removed for new streets and improvements.**

Table 3  
Master Tree List for Entire Project Area

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Reason for Removal	Significant Tree ≥8" DBH? Yes or No
1	Douglas-fir	10,7,5	14.3	Very Poor; 3 stems;	Yes	Remove		On R/W	On R/W	Yes
2	Cherry	12		Fair; Never pruned;	Yes	Remove		Buildable Area	Footprint	Yes
3	Cherry	14		Fair; Never pruned;	Yes	Remove		Buildable Area	Footprint	Yes
4	Douglas-fir	11		Fair;	Yes	Remove	10 ft.	On R/W	Impacted by construction	Yes
5	Douglas-fir	45		Very Poor; Very severe decline;	No	Remove		Buildable Area	Footprint	Yes
6	Bigleaf maple	12,16,12,10	25.4	Very Poor; Decay in stems;	No	Remove		Buildable Area	Footprint	Yes
7	Hawthorne	4 to 8	19.9	11 stems; Very Poor;	No	Remove		Buildable Area	Footprint	Yes
8	Austrian pine	26		Poor;	No	Save		East House Lot		Yes
9	Photina	6,8	10	Fair;	Yes	Save		East House Lot		Yes
10	Blue atlas cedar	21		Good;	Yes	Remove		East House Lot	Wall impacts	Yes
11	Flowering Cherry	11.1		Good;	Yes	Remove		Buildable Area	Footprint	Yes
12	Flowering Cherry	15		Good;	Yes	Remove		On R/W	On R/W	Yes
13	Flowering Cherry	15		Good;	Yes	Remove		On R/W	On R/W	Yes
14	Douglas-fir	3		Good;	Yes	Remove		On R/W	On R/W	No
15	Ponderosa pine	10		Very Poor;	No	Remove		On R/W	On R/W	Yes
16	Ponderosa pine	13		Very Poor;	No	Remove		On R/W	On R/W	Yes
17	Ponderosa pine	15		Poor;	No	Remove		On R/W	On R/W	Yes
18	Ponderosa pine	14		Fair;	Yes	Remove		On R/W	On R/W	Yes
19	Ponderosa pine	9		Fair;	Yes	Remove		On R/W	On R/W	Yes
20	Ponderosa pine	11		Fair;	Yes	Remove		On R/W	On R/W	Yes
21	Ponderosa pine	21		Poor;	No	Remove		On R/W	On R/W	Yes
22	Ponderosa pine	16		Fair;	Yes	Remove		On R/W	On R/W	Yes
23	Ponderosa pine	11		Fair;	Yes	Remove		On R/W	On R/W	Yes
24	Ponderosa pine	10		Poor; Multiple tops;	No	Remove		On R/W	On R/W	Yes
25	Ponderosa pine	8		Very Poor;	No	Remove		On R/W	On R/W	Yes
26	Ponderosa pine	17		Fair;	Yes	Remove		On R/W	On R/W	Yes
27	Ponderosa pine	24		Fair;	Yes	Remove		On R/W	On R/W	Yes
28	Ponderosa pine	8,8,8	13.9	Very Poor;	No	Remove		On R/W	On R/W	Yes
29	Austrian pine	9,8	12	Very Poor;	No	Remove		On R/W	On R/W	Yes

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Reason for Removal	Significant Tree ≥8" DBH? Yes or No
30	Cherry	12,9	15	Very Poor; Decay in stem;	No	Remove		On R/W	On R/W	Yes
31	Austrian pine	9		Poor;	No	Remove		On R/W	On R/W	Yes
32	Douglas-fir	10		Good;	Yes	Remove		On R/W	On R/W	Yes
33	Douglas-fir	10		Good;	Yes	Remove		On R/W	On R/W	Yes
34	Douglas-fir	13		Good;	Yes	Remove		On R/W	On R/W	Yes
35	Douglas-fir	30		Good;	Yes	Save		East House Lot		Yes
36	Western white pine	25		Fair; Codom leader;	Yes	Remove		On R/W	On R/W	Yes
37	Douglas-fir	26		Fair; Pistil butt;	Yes	Remove		West House Lot	Grading	Yes
38	Pacific yew	6,6	8.5	Very Poor; Falling over;	No	Save		West House Lot		Yes
39	Ponderosa pine	13		Poor;	No	Remove		On R/W	On R/W	Yes
40	Ponderosa pine	16		Poor;	No	Save		West House Lot		Yes
41	Ponderosa pine	16		Poor; Codom stems;	No	Save		West House Lot		Yes
42	Ponderosa pine	12		Fair; Leaner;	Yes	Save		West House Lot		Yes
43	Ponderosa pine	10		Fair;	Yes	Save		West House Lot		Yes
44	Ponderosa pine	15		Poor; Codom stems;	No	Save		West House Lot		Yes
45	Ponderosa pine	17		Poor; Codom stems;	No	Save		West House Lot		Yes
46	Ponderosa pine	16		Poor; Codom stems;	No	Remove		West House Lot	Grading	Yes
47	Ponderosa pine	16		Poor; Codom stems;	No	Remove		West House Lot	Grading	Yes
48	Ponderosa pine	19		Very Poor; Codom stems;	No	Remove		West House Lot	Grading	Yes
49	Ponderosa pine	15		Poor; Codom stems;	No	Remove		Buildable Area	Footprint	Yes
50	Ponderosa pine	14		Poor;	No	Remove		Buildable Area	Footprint	Yes
51	Ponderosa pine	13		Very Poor; Top broken out;	No	Remove		Buildable Area	Footprint	Yes
52	Flowering plum	8.5		Very Poor;	No	Remove		East House Lot	Grading	Yes
53	Flowering plum	7.5		Very Poor;	No	Save		East House Lot		No
54	Flowering plum	7		Very Poor;	No	Save		East House Lot		No
55	Western redcedar	10		Good;	Yes	Remove		Buildable Area	Footprint	Yes
56	Deodar cedar	12		Fair;	Yes	Remove		Buildable Area	Footprint	Yes
57	Douglas-fir	12		Good;	Yes	Remove		Buildable Area	Footprint	Yes
58	Pt. Orford Cedar	17		Fair;	Yes	Save		West House Lot		Yes
59	Douglas-fir	8.9		Very Poor; Suppressed;	No	Save		West House Lot		Yes
60	Douglas-fir	21		Good;	Yes	Save		West House Lot		Yes

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Reason for Removal	Significant Tree ≥8" DBH? Yes or No
61	Blue atlas cedar	9		Fair;	Yes	Save		West House Lot		Yes
62	Blue atlas cedar	9		Fair;	Yes	Save		West House Lot		Yes
63	Blue atlas cedar	4,5	6.4	Very Poor;	No	Save		West House Lot		No
64	Flowering Cherry	8,7,8	13.3	Very Poor;	No	Save		West House Lot		Yes
65	Deodar cedar	8		Fair;	Yes	Save		West House Lot		Yes
66	Douglas-fir	11		Good;	Yes	Save		West House Lot		Yes
67	Douglas-fir	25		Good;	Yes	Remove		On R/W	On R/W	Yes
68	Douglas-fir	12		Good;	Yes	Save		West House Lot		Yes
69	Ponderosa pine	8.4	8.9	Fair;	Yes	Remove		West House Lot	Grading	Yes
70	Shore pine	6		Good;	Yes	Save		West House Lot		No
71	Douglas-fir	6		Good;	Yes	Remove		On R/W	On R/W	No
72	Flowering plum	6,6,4	9.4	Very Poor;	No	Remove		West House Lot	Grading	Yes
73	Douglas-fir	9		Fair;	Yes	Remove		On R/W	On R/W	Yes
74	Douglas-fir	9		Fair;	Yes	Save		West House Lot		Yes
75	Flowering Cherry	10,6	11.7	Very Poor;	No	Remove		On R/W	On R/W	Yes
76	Apple	12		Very Poor;	No	Remove		On R/W	On R/W	Yes
77	Apple	6		Very Poor;	No	Remove		On R/W	On R/W	No
78	Apple	9,6,6	12.4	Very Poor;	No	Remove		On R/W	On R/W	Yes
79	Ponderosa pine	17,16	23.3	Very Poor; Codom stems;	No	Remove		On R/W	On R/W	Yes
80	Scotch pine	9,6	10.8	Poor;	No	Remove		On R/W	On R/W	Yes
81	Scotch pine	17		Fair;	Yes	Remove		On R/W	On R/W	Yes
82	Ponderosa pine	7		Very Poor;	No	Remove		On R/W	On R/W	No

\*Calculated DBH for multi-stem trees = Square Root of the sums of the individual stem diameters squared.

\*\*Shaded trees are non-significant.

Table 4  
Offsite Tree List

#	Species	DBH (in)	Condition	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Comments
A	Leyland cypress	6 to 16	10 stems; Fair;	Save	10	2 ft from property line;
B	Flowering cherry	10	Fair;	Save	6	6 ft. from property line;
C	Flowering plum	12,10,8,4	Fair;	Save	6	6 ft. from property line;
D	Flowering cherry	6,8,8,6,6	Poor;	Save	6	1 ft. from property line;
E	Bigleaf maple	2 to 6	Poor; Sprouts;	Remove	0	0 ft. from property line;
F	Colorado blue spruce	15	Good;	Remove	12	6 ft. from property line;
G	Silver maple	16,11,6,18,10	Poor;	Remove	12	6 ft from property line;
H	Douglas-fir	32,30	Fair;	Remove	12	8 ft from property line;

Table 5  
Tree List - Buildable Area

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Comments	Significant Tree ≥8" DBH? Yes or No	≥11 Inches DBH Replacement Required at 2:1? # Trees**
2	Cherry	12		Fair; Never pruned;	Yes	Remove		Buildable Area	Footprint	Yes	2
3	Cherry	14		Fair; Never pruned;	Yes	Remove		Buildable Area	Footprint	Yes	2
5	Douglas-fir	45		Very Poor; Very severe decline;	No	Remove		Buildable Area	Footprint	Yes	2
6	Bigleaf maple	12,16,12,10	25.4	Very Poor; Decay in stems;	No	Remove		Buildable Area	Footprint	Yes	2
7	Hawthorne	4 to 8	19.9	11 stems; Very Poor;	No	Remove		Buildable Area	Footprint	Yes	2
11	Flowering Cherry	11.1		Good;	Yes	Remove		Buildable Area	Footprint	Yes	2
49	Ponderosa pine	15		Poor; Codom stems;	No	Remove		Buildable Area	Footprint	Yes	2
50	Ponderosa pine	14		Poor;	No	Remove		Buildable Area	Footprint	Yes	2
51	Ponderosa pine	13		Very Poor; Top broken out;	No	Remove		Buildable Area	Footprint	Yes	2
55	Western redcedar	10		Good;	Yes	Remove		Buildable Area	Footprint	Yes	0
56	Deodar cedar	12		Fair;	Yes	Remove		Buildable Area	Footprint	Yes	2
57	Douglas-fir	12		Good;	Yes	Remove		Buildable Area	Footprint	Yes	2
8	Austrian pine	26		Poor;	No	Save		East House Lot		Yes	0
9	Photinia	6,8	10	Fair;	Yes	Save		East House Lot		Yes	0
10	Blue atlas cedar	21		Good;	Yes	Remove		East House Lot		Yes	2
35	Douglas-fir	30		Good;	Yes	Save		East House Lot		Yes	0
52	Flowering plum	8.5		Very Poor;	No	Remove		East House Lot		Yes	0
53	Flowering plum	7.5		Very Poor;	No	Save		East House Lot		No	0
54	Flowering plum	7		Very Poor;	No	Save		East House Lot		No	0
37	Douglas-fir	26		Fair; Pistil butt;	Yes	Remove		West House Lot		Yes	2
38	Pacific yew	6,6	8.5	Very Poor; Falling over;	No	Save		West House Lot		Yes	0
40	Ponderosa pine	16		Poor;	No	Save		West House Lot		Yes	0
41	Ponderosa pine	16		Poor; Codom stems;	No	Save		West House Lot		Yes	0
42	Ponderosa pine	12		Fair; Leaner;	Yes	Save		West House Lot		Yes	0

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Comments	Significant Tree ≥8" DBH? Yes or No	≥11 Inches DBH Replacement Required at 2:1? # Trees**
43	Ponderosa pine	10		Fair;	Yes	Save		West House Lot		Yes	0
44	Ponderosa pine	15		Poor; Codom stems;	No	Save		West House Lot		Yes	0
45	Ponderosa pine	17		Poor; Codom stems;	No	Save		West House Lot		Yes	0
46	Ponderosa pine	16		Poor; Codom stems;	No	Remove		West House Lot		Yes	2
47	Ponderosa pine	16		Poor; Codom stems;	No	Remove		West House Lot		Yes	2
48	Ponderosa pine	19		Very Poor; Codom stems;	No	Remove		West House Lot		Yes	2
58	Pt. Orford Cedar	17		Fair;	Yes	Save		West House Lot		Yes	0
59	Douglas-fir	8.9		Very Poor; Suppressed;	No	Save		West House Lot		Yes	0
60	Douglas-fir	21		Good;	Yes	Save		West House Lot		Yes	0
61	Blue atlas cedar	9		Fair;	Yes	Save		West House Lot		Yes	0
62	Blue atlas cedar	9		Fair;	Yes	Save		West House Lot		Yes	0
63	Blue atlas cedar	4,5	6.4	Very Poor;	No	Save		West House Lot		No	0
64	Flowering Cherry	8,7,8	13.3	Very Poor;	No	Save		West House Lot		Yes	0
65	Deodar cedar	8		Fair;	Yes	Save		West House Lot		Yes	0
66	Douglas-fir	11		Good;	Yes	Save		West House Lot		Yes	0
68	Douglas-fir	12		Good;	Yes	Save		West House Lot		Yes	0
69	Ponderosa pine	8.4	8.9	Fair;	Yes	Remove		West House Lot		Yes	0
70	Shore pine	6		Good;	Yes	Save		West House Lot		No	0
72	Flowering plum	6,6,4	9.4	Very Poor;	No	Remove		West House Lot		Yes	0
74	Douglas-fir	9		Fair;	Yes	Save		West House Lot		Yes	0
	<b>Sum</b>										<b>32</b>
*Calculated DBH for multi-stem trees = Square Root of the sums of the individual stem diameters squared.											
**Replacement trees only needed for removals ≥11" DBH - Not needed for save trees and trees <11" DBH.											



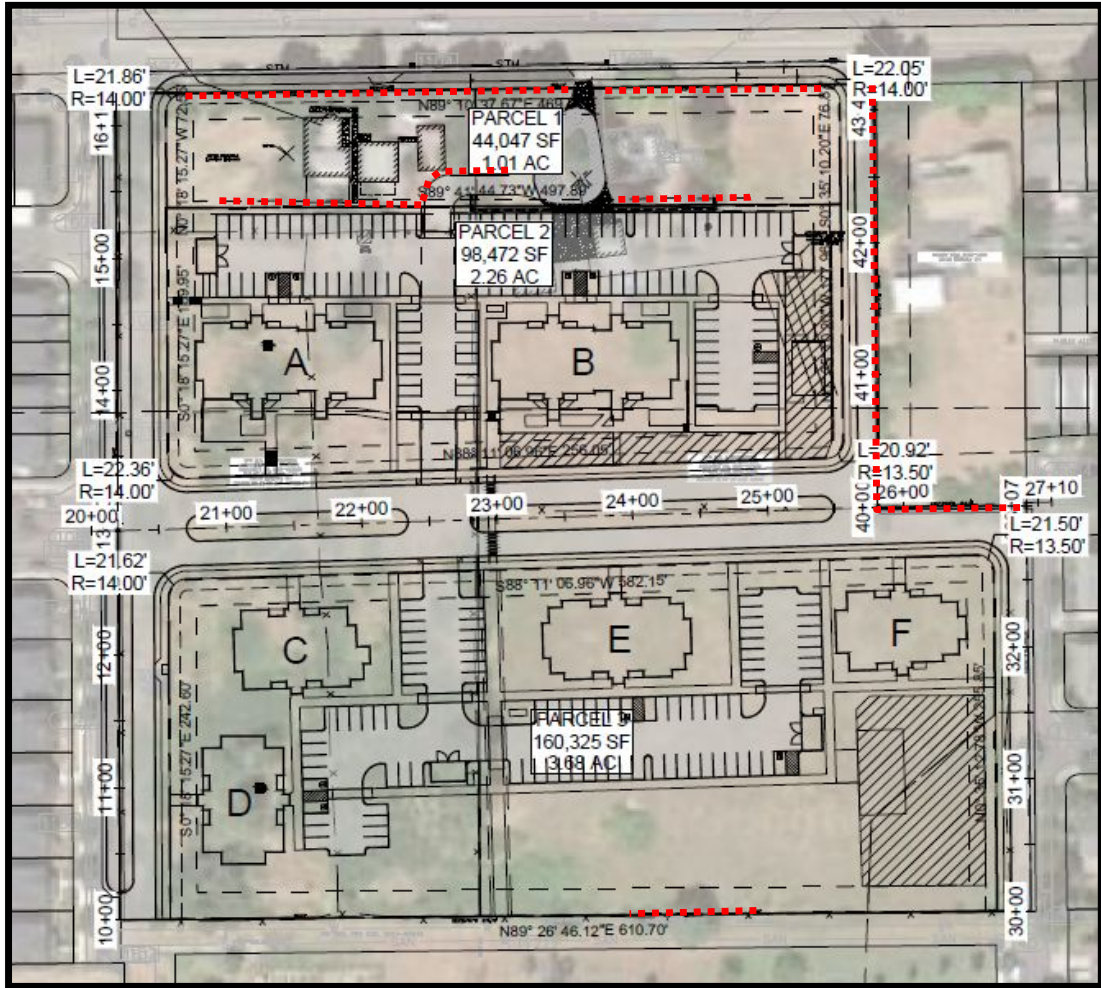
Table 6  
Trees on Rights-of-Ways

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Reason for Removal	Significant Tree ≥8" DBH? Yes or No
1	Douglas-fir	10,7,5	13.2	Very Poor; 3 stems;	Yes	Remove		On R/W	On R/W	Yes
4	Douglas-fir	11		Fair;	Yes	Remove	10 ft.	On R/W	Impacted by construction	Yes
12	Flowering Cherry	15		Good;	Yes	Remove		On R/W	On R/W	Yes
13	Flowering Cherry	15		Good;	Yes	Remove		On R/W	On R/W	Yes
14	Douglas-fir	3		Good;	Yes	Remove		On R/W	On R/W	No
15	Ponderosa pine	10		Very Poor;	No	Remove		On R/W	On R/W	Yes
16	Ponderosa pine	13		Very Poor;	No	Remove		On R/W	On R/W	Yes
17	Ponderosa pine	15		Poor;	No	Remove		On R/W	On R/W	Yes
18	Ponderosa pine	14		Fair;	Yes	Remove		On R/W	On R/W	Yes
19	Ponderosa pine	9		Fair;	Yes	Remove		On R/W	On R/W	Yes
20	Ponderosa pine	11		Fair;	Yes	Remove		On R/W	On R/W	Yes
21	Ponderosa pine	21		Poor;	No	Remove		On R/W	On R/W	Yes
22	Ponderosa pine	16		Fair;	Yes	Remove		On R/W	On R/W	Yes
23	Ponderosa pine	11		Fair;	Yes	Remove		On R/W	On R/W	Yes
24	Ponderosa pine	10		Poor; Multiple tops;	No	Remove		On R/W	On R/W	Yes
25	Ponderosa pine	8		Very Poor;	No	Remove		On R/W	On R/W	Yes
26	Ponderosa pine	17		Fair;	Yes	Remove		On R/W	On R/W	Yes
27	Ponderosa pine	24		Fair;	Yes	Remove		On R/W	On R/W	Yes
28	Ponderosa pine	8,8,8	13.9	Very Poor;	No	Remove		On R/W	On R/W	Yes
29	Austrian pine	9,8	12	Very Poor;	No	Remove		On R/W	On R/W	Yes
30	Cherry	12,9	15	Very Poor; Decay in stem;	No	Remove		On R/W	On R/W	Yes
31	Austrian pine	9		Poor;	No	Remove		On R/W	On R/W	Yes
32	Douglas-fir	10		Good;	Yes	Remove		On R/W	On R/W	Yes
33	Douglas-fir	10		Good;	Yes	Remove		On R/W	On R/W	Yes

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Reason for Removal	Significant Tree ≥8" DBH? Yes or No
34	Douglas-fir	13		Good;	Yes	Remove		On R/W	On R/W	Yes
36	Western white pine	25		Fair; Codom leader;	Yes	Remove		On R/W	On R/W	Yes
39	Ponderosa pine	13		Poor;	No	Remove		On R/W	On R/W	Yes
67	Douglas-fir	25		Good;	Yes	Remove		On R/W	On R/W	Yes
71	Douglas-fir	6		Good;	Yes	Remove		On R/W	On R/W	No
73	Douglas-fir	9		Fair;	Yes	Remove		On R/W	On R/W	Yes
75	Flowering Cherry	10,6	11.7	Very Poor;	No	Remove		On R/W	On R/W	Yes
76	Apple	12		Very Poor;	No	Remove		On R/W	On R/W	Yes
77	Apple	6		Very Poor;	No	Remove		On R/W	On R/W	No
78	Apple	9,6,6	12.4	Very Poor;	No	Remove		On R/W	On R/W	Yes
79	Ponderosa pine	17,16	23.3	Very Poor; Codom stems;	No	Remove		On R/W	On R/W	Yes
80	Scotch pine	9,6	10.8	Poor;	No	Remove		On R/W	On R/W	Yes
81	Scotch pine	17		Fair;	Yes	Remove		On R/W	On R/W	Yes
82	Ponderosa pine	7		Very Poor;	No	Remove		On R/W	On R/W	No

\*Calculated DBH for multi-stem trees = Square Root of the sums of the individual stem diameters squared.

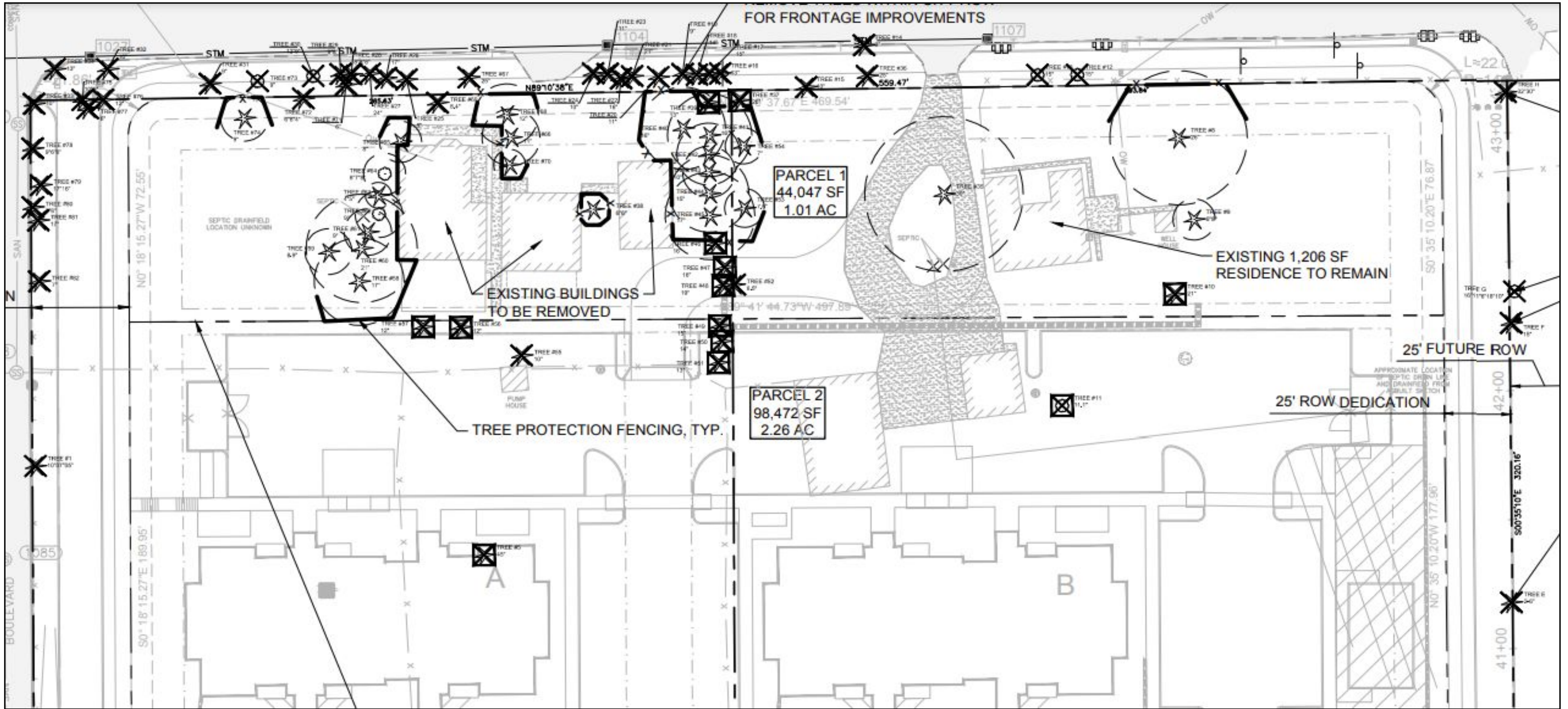
**Attachment 3. Site Plan – Cascade at Bournstadt Village – Current site plan with approximate tree protection fence locations shown.**

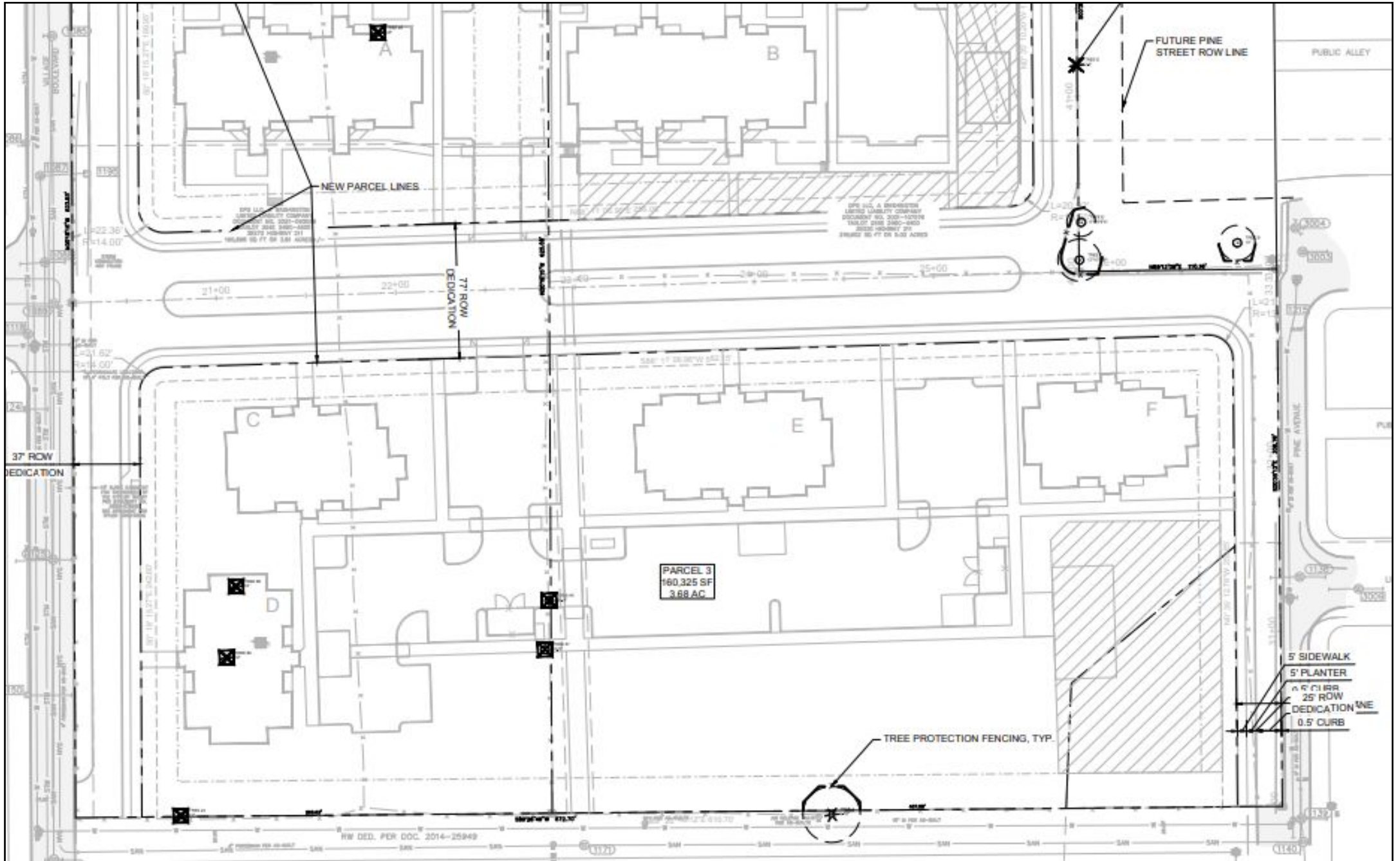


..... Approximate Tree Protection Fence Locations

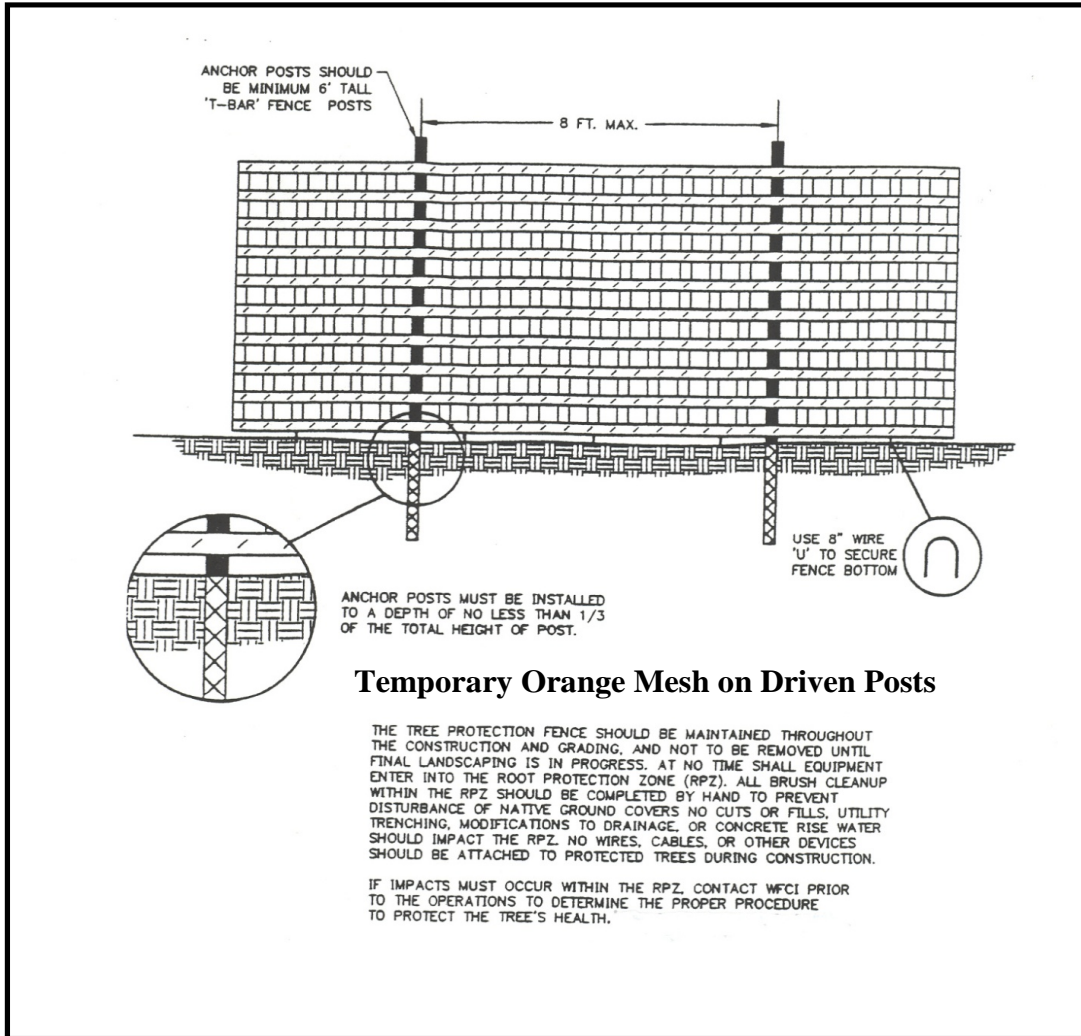
**Attachment 4. Tree Locations – Planned retention and removals. Ignore the tree protection fences shown – refer to Attachment 1 for Tree Protection Fence Locations.**

**(2 Pages Attached – North and South Project Areas)**





### Attachment 5. Tree Protection Fence Detail.



### Attachment 6. Individual Tree Rating Key for Tree Condition

RATING	SYMBOL	DEFINITION
<b>Very Good</b>	<b>VG</b>	<ul style="list-style-type: none"> <li>Balanced crown that is characteristic of the species</li> <li>Normal lateral and terminal branch growth rates for the species and soil type</li> <li>Stem sound, normal bark vigor</li> <li>No root problems</li> <li>No insect or disease problems</li> <li>Long-term, attractive tree</li> </ul>
<b>Good</b>	<b>G</b>	<ul style="list-style-type: none"> <li>Crown lacking symmetry but nearly balanced</li> <li>Normal lateral and terminal branch growth rates for the species and soil type</li> <li>Minor twig dieback O.K.</li> <li>Stem sound, normal bark vigor</li> <li>No root problems</li> <li>No or minor insect or disease problems – insignificant</li> <li>Long-term tree</li> </ul>
<b>Fair</b>	<b>F</b>	<ul style="list-style-type: none"> <li>Crown lacking symmetry due to branch loss</li> <li>Slow lateral and terminal branch growth rates for the species and soil type</li> <li>Minor and major twig dieback – starting to decline</li> <li>Stem partly unsound, slow diameter growth and low bark vigor</li> <li>Minor root problems</li> <li>Minor insect or disease problems</li> <li>Short-term tree 10-30 years</li> </ul>
<b>Poor</b>	<b>P</b>	<ul style="list-style-type: none"> <li>Major branch loss – unsymmetrical crown</li> <li>Greatly reduced growth</li> <li>Several structurally import dead or branch scaffold branches</li> <li>Stem has bark loss and significant decay with poor bark vigor</li> <li>Root damage</li> <li>Insect or disease problems – remedy required</li> <li>Short-term tree 1-10 years</li> </ul>
<b>Very Poor</b>	<b>VP</b>	<ul style="list-style-type: none"> <li>Lacking adequate live crown for survival and growth</li> <li>Severe decline</li> <li>Minor and major twig dieback</li> <li>Stem unsound, bark sloughing, previous stem or large branch failures, very poor bark vigor</li> <li>Severe root problems or disease</li> <li>No or minor insect or disease problems</li> <li>Mortality expected within the next few years</li> </ul>
<b>Dead</b>	<b>DEAD</b>	<ul style="list-style-type: none"> <li>Dead</li> </ul>



## Attachment 7. Tree Risk Assessment - A Description of the Process

The purpose of this document is to summarize the methodology of modern tree risk assessment for users of this type of information. This methodology has been put into place by the International Society of Arboriculture and has been in use in its present form since 2013. It updates the initial changes put into place in 2011.

**Tree risk assessment** is the systematic and qualitative process to identify, analyze, and evaluate tree risk. Tree risk evaluation is the process of comparing the assessed risk against given risk criteria to determine the significance of the risk. This methodology is based on the ANSI A300 standard<sup>4</sup> for tree risk assessment. This standard is supported by a best management practices guide<sup>5</sup>.

Those qualified to do tree risk assessment have the qualification from the International Society of Arboriculture called ‘**Tree Risk Assessor Qualified.**’ The methodology for tree risk assessment is more recently detailed in the authoritative tree risk assessment manual<sup>6</sup>, which provides the state of the art for tree risk assessment.

**Risk** is the evaluation and categorizing of both the likelihood (probability) of occurrence of a tree or tree part failure, and the severity of consequences (value of and damage to the target that is impacted). The magnitude of risk can be categorized and compared to the client’s tolerances to determine if the risk is acceptable.

**Tree risk management** is the application of policies, procedures and practices used to identify, evaluate, mitigate, monitor, and communicate tree risk. It is up to the tree owner to determine what level of risk they are able to tolerate, and to conduct any mitigation required when that risk is unacceptable.

There are 3 levels of tree risk assessment:

Level 1 – assessment is limited to a visual assessment of the tree(s) near specified targets, such as along roadways or utility rights-of-ways to identify specified conditions or obvious defects. Assessment shall be from a specified perspective such as foot, vehicle, or aerial patrol.

Level 2 – assessment shall include a 360 degree, ground based visual inspection of the tree crown, trunk, trunk flare, above-ground roots, and site conditions around the tree in relation to targets. It may include sounding the stem to look for internal decay and/or the use of hand tools, or binoculars to view the crown better. Surrounding site conditions are also evaluated.

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<sup>4</sup> ANSI A300 (Part 9 – 2011) – *American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices (Tree Risk Assessment a. Tree Structure Assessment)*. American National Standards Institute, Inc. Washington D.C. 14 pgs.

<sup>5</sup> Smiley, E. Thomas, Nelda Matheny, and Sharon Lilly. 2011. *Best Management Practices – Tree Risk Assessment*. International Society of Arboriculture. Champaign, IL.

<sup>6</sup> Dunster, Dr. Julian et al. 2013. *Tree Risk Assessment Manual*. International Society of Arboriculture. Champaign, IL.

Cascade at Bournstadt Village – Final Tree Protection Plan

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Level 3 – all of the level 2 techniques, plus advanced methodologies such as coring or drilling the tree stem or roots to look for decay, a climbing assessment, probing, pull testing, or radiation, sonic, or subsurface root assessments.

In tree risk assessment, **targets** are people who could be injured, property that may be damaged, or activities that could be disrupted by a tree failure. A tree must have a target for there to be a risk rating higher than ‘Low’. The target has a value and people are the highest value target, followed by structures, cars and other high value objects. Fences would be a low value target. As part of a target assessment, the assessor considers if the target can be moved out of reach of the tree or tree part that might fail, or if people could be excluded from the target area of the tree.

As part of the risk analysis, the assessor must conduct a site analysis. This may include looking for signs of recent tree removal that may expose a previously sheltered subject tree to winds, construction activity that severed roots of the tree, or other site or soils conditions/changes that affected drainage or tree health.

Defects often predispose a tree or part of a tree to failure. A key part of tree risk assessment is to categorize the likelihood of failure of the tree or a defective part. The tree or defect is examined, and the likelihood of failure is categorized in a matrix (below) as: **Improbable, Possible, Probable, or Imminent**. A tree with a lifting root plate would likely be categorized as ‘Imminent’ to fail. A tree with a broken and hanging branch that is still attached would likely be categorized as ‘Improbable’ or ‘Possible.’ Cracks in a trunk or branch would likely be categorized as ‘Probable’ or ‘Imminent’ to fail.

This rating of ‘**Likelihood of Failure**’ is then brought forward into the Likelihood of Failure and Impact matrix to assign a level of risk of the tree. The level of risk is then categorized as **Low, Moderate, High, or Extreme**.

The following 2 tables are used by Tree Risk Assessor Qualified professionals to rate the risk of the tree. Note: this system does not use a numerical rating system as old systems used.

Matrix 1. Likelihood matrix.

Likelihood of Failure	Likelihood of Impacting Target			
	Very low	Low	Medium	High
Imminent	Unlikely	Somewhat likely	Likely	Very likely
Probable	Unlikely	Unlikely	Somewhat likely	Likely
Possible	Unlikely	Unlikely	Unlikely	Somewhat likely
Improbable	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2. Risk rating matrix.

Likelihood of Failure & Impact	Consequences of Failure			
	Negligible	Minor	Significant	Severe
Very likely	Low	Moderate	High	Extreme
Likely	Low	Moderate	High	High
Somewhat likely	Low	Low	Moderate	Moderate
Unlikely	Low	Low	Low	Low

## **Attachment 8. Description of Tree Evaluation Methodology**

The evaluation of the tree condition on this site included the visual assessment of:

1. Live-crown ratio,
2. Lateral and terminal branch growth rates,
3. Presence of dieback in minor and major scaffold branches and twigs,
4. Foliage color,
5. Stem soundness and other structural defects,
6. Visual root collar examination,
7. Presence of insect or disease problems.
8. Windfirmness: if tree removal will expose this tree to failure.

In cases where signs of internal defect or disease were suspected, a core sample was taken to look for stain, decay, and diameter growth rates. Also, root collars were exposed to look for the presence of root disease.

In all cases, the overall appearance of the tree was considered relative to its ability to add value to either an individual lot or the entire subdivision. Also, the scale of the tree and its proximity to both proposed and existing houses was considered.

Lastly, the potential for incorporation into the project design is evaluated, as well as potential site plan modifications that may allow otherwise removed tree(s) to be both saved and protected in the development.

Trees that are preserved in a development must be carefully selected to make sure that they can survive construction impacts, adapt to a new environment, and perform well in the landscape. Healthy, vigorous trees are better able to tolerate impacts such as root injury, changes in soils moisture regimes, and soil compaction than are low vigor trees.

Structural characteristics are also important in assessing suitability. Trees with significant decay and other structural defects that cannot be treated are likely to fail. Such trees should not be preserved in areas where damage to people or property could occur.

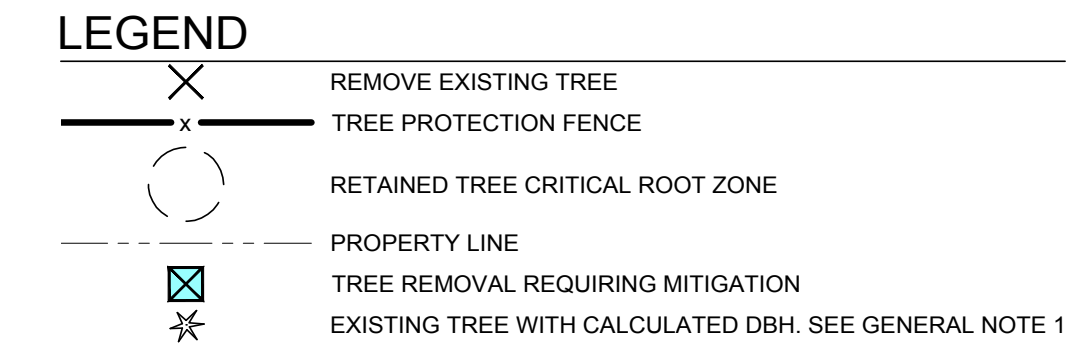
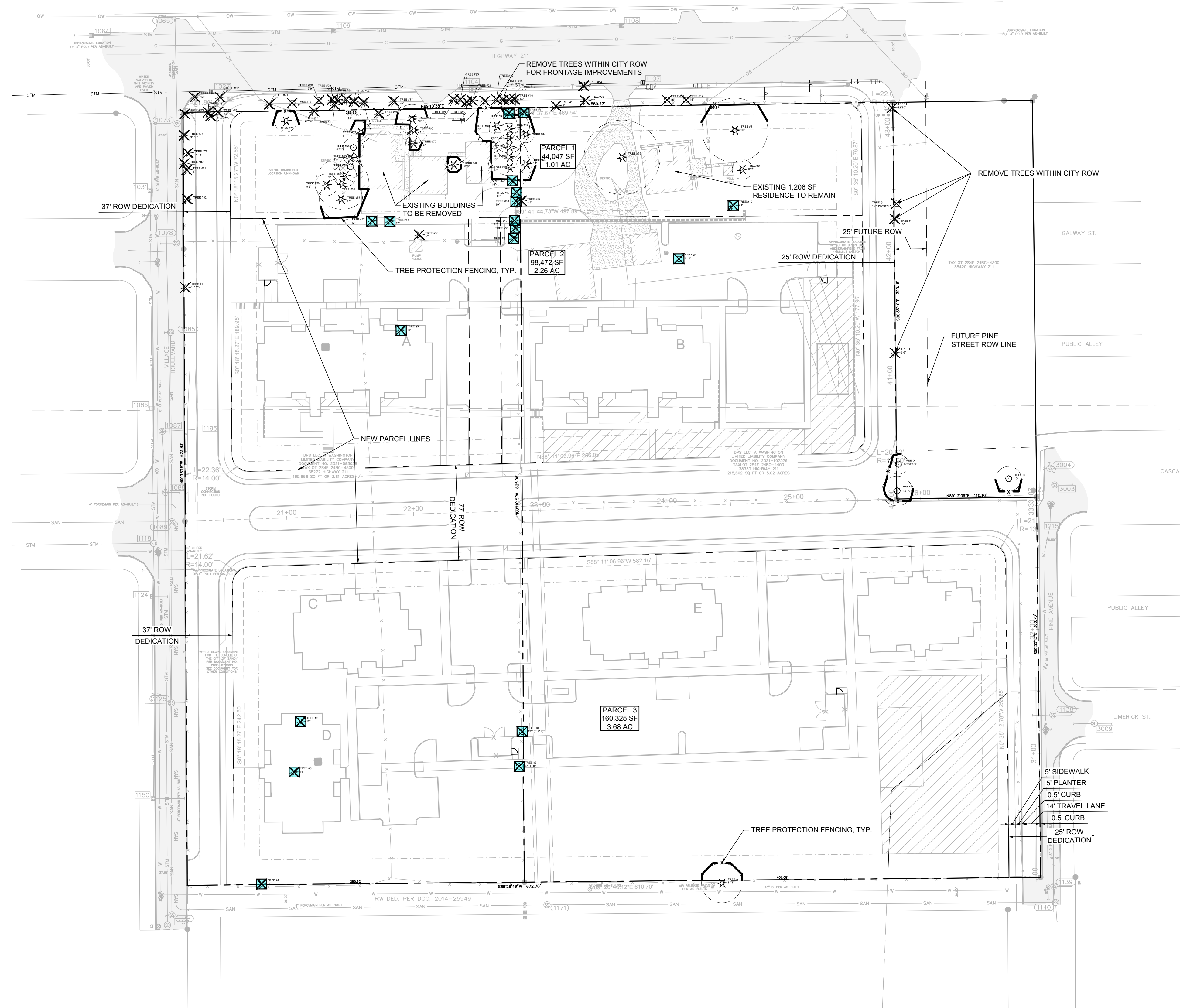
Trees that have developed in a forest stand are adapted to the close, dense conditions found in such stands. When surrounding trees are removed during clearing and grading, the remaining trees are exposed to extremes in wind, temperature, solar radiation, which causes sunscald, and other influences. Young, vigorous trees with well-developed crowns are best able to adapt to these changing site conditions.

## **Attachment 9. Assumptions and Limiting Conditions**

- 1) Any legal description provided to the Washington Forestry Consultants, Inc. is assumed to be correct. Any titles and ownership's to any property are assumed to be good and marketable. No responsibility is assumed for matters legal in character. Any and all property is appraised or evaluated as though free and clear, under responsible ownership and competent management.
- 2) It is assumed that any property is not in violation of any applicable codes, ordinances, statutes, or other governmental regulations, unless otherwise stated.
- 3) Care has been taken to obtain all information from reliable sources. All data has been verified insofar as possible; however, Washington Forestry Consultants, Inc. can neither guarantee nor be responsible for the accuracy of information.
- 4) Washington Forestry Consultants, Inc. shall not be required to give testimony or to attend court by reason of this report unless subsequent contractual arrangements are made, including payment of an additional fee for such services as described in the fee schedule and contract of engagement.
- 5) Loss or alteration of any part of this report invalidated the entire report.
- 6) Possession of this report or a copy thereof does not imply right of publication or use for any purpose by any other than the person to whom it is addressed, without the prior expressed written or verbal consent of Washington Forestry Consultants, Inc.
- 7) Neither all or any part of the contents of this report, nor copy thereof, shall be conveyed by anyone, including the client, to the public through advertising, public relations, news, sales or other media, without the prior expressed written or verbal consent of Washington Forestry Consultants, Inc. -- particularly as to value conclusions, identity of Washington Forestry Consultants, Inc., or any reference to any professional society or to any initialed designation conferred upon Washington Forestry Consultants, Inc. as stated in its qualifications.
- 8) This report and any values expressed herein represent the opinion of Washington Forestry Consultants, Inc., and the fee is in no way contingent upon the reporting of a specified value, a stipulated result, the occurrence neither of a subsequent event, nor upon any finding in to reported.
- 9) Sketches, diagrams, graphs, and photographs in this report, being intended as visual aids, are not necessarily to scale and should not be construed as engineering or architectural reports or surveys.
- 10) Unless expressed otherwise: 1) information contained in this report covers only those items that were examined and reflects the condition of those items at the time of inspection; and 2) the inspection is limited to visual examination of accessible items without dissection, excavation, probing, or coring. There is no warranty or guarantee, expressed or implied, that problems or deficiencies of the tree or other plant or property in question may not arise in the future.

*Note: Even healthy trees can fail under normal or storm conditions. The only way to eliminate all risk is to remove all trees within reach of all targets. Annual monitoring by an ISA Certified Arborist or Certified Forester will reduce the potential of tree failures. It is impossible to predict with certainty that a tree will stand or fail, or the timing of the failure. It is considered an 'Act of God' when a tree fails, unless it is directly felled or pushed over by man's actions.*

# EXHIBIT H



**GENERAL NOTE:**  
 1. TREE LOCATIONS ON PLAN HAVE NOT BEEN SURVEYED. LOCATIONS REFLECT TREE PROTECTION PLAN REPORT PREPARED BY WASHINGTON FORESTRY CONSULTANTS, INC., DATED 12/22/2022.

**CODE REQUIREMENTS:**  
 SMC 17.54.140  
 TREE RETENTION = 6 TREES/AC \* 6.95 AC = 42 TREES RETAINED WITH DBH >11"  
 A VARIANCE WILL BE REQUESTED PER SMC SEC. 17.102.70 TO FULFILL TREE RETENTION REQUIREMENTS AS TREE RETENTION REQUIREMENTS CANNOT BE MET ON-SITE.

SMC 17.102.10  
 TREES ARE DEFINED AS "ANY LIVING, STANDING, WOODY PLANT HAVING A TRUNK 11 INCHES DBH OR GREATER".  
 SMC 17.102.20.B.1

"TREE REMOVAL AS REQUIRED BY THE CITY OR PUBLIC UTILITY FOR THE INSTALLATION OR MAINTENANCE OR REPAIR OF ROADS, UTILITIES OR STRUCTURES" ARE "EXEMPT FROM TREE RETENTION REQUIREMENTS".

**EXISTING TREE COUNT:**  
 TREES IN RIGHT-OF-WAY: 36  
 TREES ON-SITE: 38  
 TREES OFF-SITE: 8  
 TOTAL TREES: 82

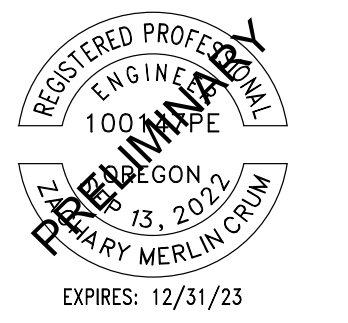
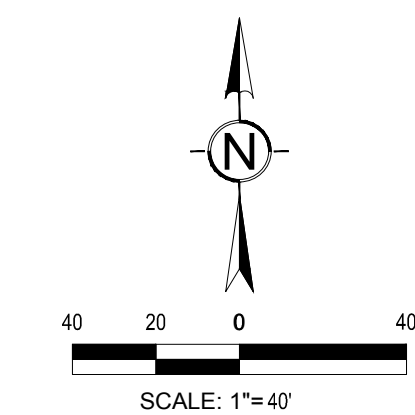
**PROPOSED TREE RETENTION/REMOVAL:**  
 TOTAL TREES ON-SITE: 82 TREES  
 TOTAL TREES REMOVED: 58 TREES  
 TOTAL TREES RETAINED: 24 TREES

**EXEMPTIONS (SEE TREE VARIANCE NARRATIVE FOR MORE INFORMATION):**  
 <11" DBH REMOVED (EXEMPT PER SMC 17.102.10): 17 TREES  
 RIGHT-OF-WAY REMOVED (EXEMPT PER SMC 17.102.20(B)(1)): 23 ADDITIONAL TREES, INCLUDES OFF-SITE TREES E, F, G, AND H.

TOTAL EXEMPT TREES: 17 + 23 = 40 TREES  
 TREE REMOVAL REQUIRING MITIGATION: 58 - 40 = 18 TREES

**TREE MITIGATION**  
 SMC 17.102.70  
 MINIMUM MITIGATION RATIO: 2:1 RATIO  
 MITIGATION TREES REQUIRED: 18 X 2 = 36 MITIGATION TREES

REFER TO LANDSCAPE PLANS FOR MITIGATION TREES TYPES AND PLACEMENT.



**PROJECT:**  
 SHEET SET CREATED BY RB 08.16.2022  
**CASCADE CREEK MULTI FAMILY**  
 38530 HWY 211  
 SANDY, OR 97055

**REVISIONS**

NO.	DESCRIPTION

**DATE:**  
 01.09.2023  
**BCSA NO.:**  
 21129  
**DRAWN BY:** RJB, SM  
**DESIGNED BY:** SM  
**REVIEWED BY:** ZMC  
**SHEET TITLE:**  
 TREE PROTECTION PLAN



**C-102**

LAND-USE

DATE PLOTTED: 3/7/2023 12:15:39 PM FILENAME: 21129C-01-102.DWG BY: [unreadable]

IF SHEET MEASURES LESS THAN 24"X36", IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY

Exhibit I



# GILL GROUP

May 4, 2021

Vaughn Bay Construction  
1911 65<sup>th</sup> Avenue West  
Tacoma, WA 98466

Attention: Zac Baker  
Subject: Geotechnical Report  
Bornstedt Village  
38272 SE Highway 211  
Sandy, Oregon  
Gill Project No. ET237V1028

Dear Mr. Baker,

Gill Group, Inc. (Gill) is pleased to provide you with this Geotechnical Report for the above referenced site. This report includes a summary of the activities conducted, a summary of the findings, and recommendations. We appreciate the opportunity to provide the above services. If you have any questions or comments, please contact the undersigned Gill Group participant at (800) 428-3320.

Sincerely,

**Gill Group, Inc.**

*Jacob G. Epperson*  
Jacob G. Epperson, P.G.

Director of Environmental Services

Expindex

DRAFT



**Foundation Engineering, Inc.**  
Professional Geotechnical Services

## Memorandum

**Date:** May 4, 2021  
**To:** Jake Epperson, P.G.  
Gill Group  
**From:** Nathan M. Villeneuve, C.E.G.  
Timothy J. Pfeiffer, P.E., G.E.  
**Subject:** Preliminary Geotechnical Investigation - DRAFT  
**Project:** Sandy Housing Development  
Project No. 2211038

We have completed the requested preliminary geotechnical investigation for the above-referenced project in Sandy, Oregon. This report provides a description of our work and a discussion of site conditions.

### BACKGROUND

Gill Group is assisting with the purchase of two parcels in Sandy, Oregon. The site is located south of Highway 211 (Eagle Creek-Sandy Highway), between Village Boulevard and Pine Avenue and is currently occupied by two residential homes and pasture. The site location is shown on Figure 1A (Appendix A). Should the purchase proceed, we understand a housing development consisting of 3-story buildings will be constructed on the properties. Some of the buildings may have daylight basements.

Gill Group is the lead designer for the project. The subject property is in the process of being purchased. Gill Group retained Foundation Engineering to complete a preliminary geotechnical investigation as part the pre-purchase due-diligence process. After the properties are purchased and the site plan is developed, Phase 2 geotechnical work will be needed to provide specific geotechnical recommendations for site grading and for the design and construction of foundations and pavements. Details of our current, Phase 1 scope of work were provided in a proposal dated March 30, 2021 and authorized by a signed agreement dated April 6, 2021.

### FIELD EXPLORATION

We excavated twelve (12) exploratory test pits (TP-1 through TP-12) at the site on April 27, 2021 using a CAT 306 excavator provided and operated by Wapiti Pacific Construction. The northwest quadrant of the site was not accessible during the preliminary investigation, so test pits were not excavated in this area. The approximate locations of the test pits are shown in Figure 2A (Appendix A) The test pits extended to maximum depths ranging from  $\pm 6$  to 10 feet.

The soil profiles were continuously logged during excavation and samples were collected where appropriate. Undrained shear strength measurements were made on

sampling depths, and strength measurements are shown on the test pit logs (Appendix B). The surface and subsurface conditions are discussed below.

## **SITE AND SUBSURFACE CONDITIONS**

### **Surface Conditions**

The site consists of sloping topography with the high elevations to the north and south and lowest elevations in the middle of the properties. The low elevations form a small drainage to the west where it intersects a road embankment. The lots are bordered on the north by Highway 211, on the east by Pine Avenue, on the south by Bornstedt Park, and on the west by Village Boulevard. Surface conditions at the time of our field exploration are shown in Photos 1 and 2 (Appendix A).

### **Subsurface Conditions**

A general discussion of the soil conditions encountered in the test pits is provided below. More detailed descriptions of conditions encountered in each test pit are provided on the test pit logs (Appendix B).

**Topsoil.** A topsoil layer was encountered in all the test pits, typically extending to depths of  $\pm 6$  to 18 inches. The topsoil consists of low to medium plasticity silty clay and silt with some organics. The organics consisted of roots up to 1/2 inch in diameter.

**Residual Soil.** Residual soil consisting of stiff to very stiff, high plasticity clay with scattered organics was encountered in all the test pits beneath the topsoil. The residual soil extended to the bottom of each test pit. In TP-1 to TP-5, the residual soil graded to a clay with some sand and a relict rock texture.

### **Groundwater**

No groundwater was encountered in the test pits. We anticipate perched water conditions may develop within a few feet of the ground surface during periods of prolonged rainfall based on the presence of low permeability, fine-grained soils encountered at shallow depths across the site.

## **PRELIMINARY CONCLUSIONS**

Based on the results of our field explorations, in our opinion the site is suitable for the planned development. We anticipate the new housing units can be supported on shallow foundations (e.g., spread and continuous wall footings). Preliminary considerations for site grading and construction are discussed below.

Site preparation should include stripping the upper  $\pm 6$  to 18 inches of topsoil and removing it from structural foundation areas. The native soil is typically stiff to very stiff and will be suitable to support new structures, foundations, and pavements.



The foundation soil is primarily fine-grained and sensitive to moisture. Site grading and earthwork should be performed during the dry season (typically June through September) when aeration, moisture conditioning, and compaction are possible. Construction during the wet season will require removal of soft soil and construction of thick rock sections underlain by a separation geotextile for the building pads, pavement areas, and haul roads to support construction traffic.

As discussed above, the surficial soil is predominantly fine-grained. During dry weather the excavated soils may be reused for general site grading under pavements and landscaping areas or reworked and used as general site fill outside building areas.

#### **ADDITIONAL GEOTECHNICAL WORK**

A second phase of geotechnical work should be completed after the property is purchased and the site layout and grading plan has been established. Phase 2 will consist of developing detailed recommendations for foundation design and construction, and new pavements.

#### **VARIATION OF SUBSURFACE CONDITIONS, USE OF THIS REPORT, AND WARRANTY**

The preliminary conclusions contained herein assume the soil profiles and groundwater conditions encountered in the test pits are representative of the overall site conditions. The current scope of work does not include recommendations for site grading or for foundation and pavement design. We assume a more detailed geotechnical investigation will be conducted prior to design and construction.

No changes in the enclosed recommendations should be made without our approval. We will assume no responsibility or liability for any engineering judgment, inspection or testing performed by others.

This report was prepared for the exclusive use of Gill Group for their due diligence investigation of the Sandy Housing Development project. Information contained herein should not be used for other sites or for unanticipated design or construction without our written consent. This report is intended solely for the stated purpose. Contractors using this information to estimate construction quantities or costs do so at their own risk. Our services do not include any survey or assessment of potential surface contamination or contamination of the soil or ground water by hazardous or toxic materials. We assume that those services, if needed, have been completed by others.

Our work was done in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

Attachments

DRAFT



# Appendix A

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## *Figures*

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**Foundation Engineering, Inc.**



NOTES:  
 1. Base map and contours from ESRI and USGS

N  
  
 SCALE: 1" = 2,400'

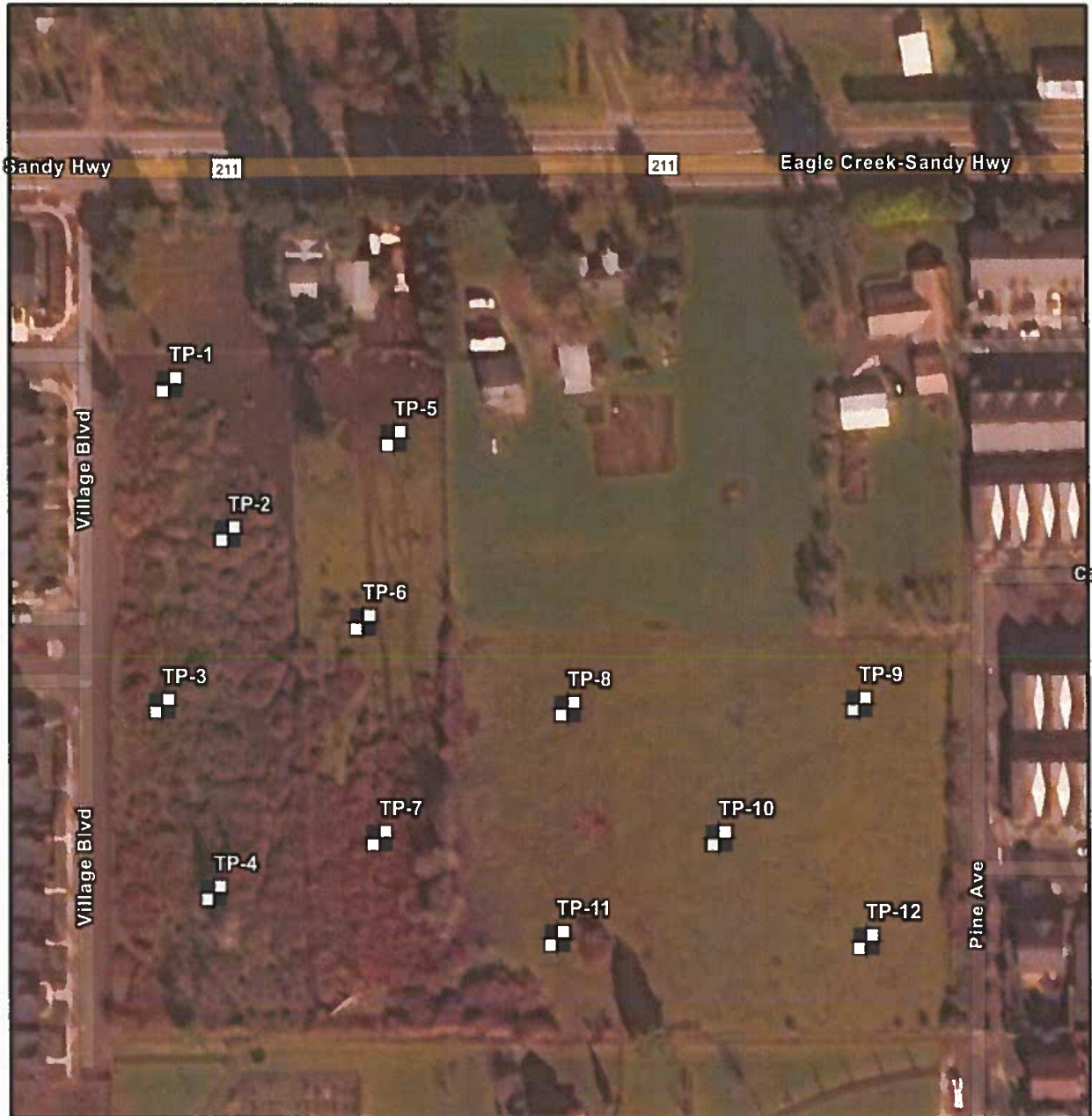
**Foundation Engineering, Inc.**  
 Professional Geotechnical Services

PROJECT NO. 2211038	DATE: 5/3/2021	DRAWN BY: NMV
------------------------	-------------------	------------------

**VICINITY MAP**

Sandy Housing Development  
 Sandy, Oregon

FIGURE NO.  
**1A**



**LEGEND**

 Approximate Test Pit Location

**NOTES:**

1. Test pit locations were collected with mobile GPS and are approximate.
2. Base map provided by ESRI.

N



SCALE: 1" = 160'



 **Foundation Engineering, Inc.**  
Professional Geotechnical Services

**SITE PLAN**

Sandy Housing Development  
Sandy, Oregon

FIGURE NO.

**2A**

PROJECT NO. 2211038	DATE: 5/3/2021	DRAWN BY: NMV
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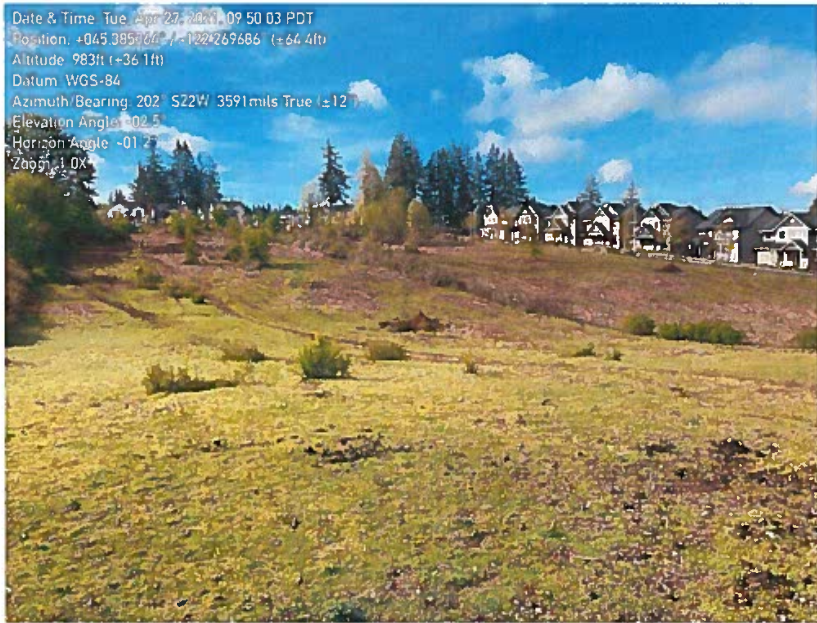


Photo 1: West side of the property, looking southwest.



Photo 2: East side of the property, looking north.

DRAFT



# Appendix B

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## *Test Pit Logs*

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**Foundation Engineering, Inc.**

### DISTINCTION BETWEEN FIELD LOGS AND FINAL LOGS

A field log is prepared for each boring or test pit by our field representative. The log contains information concerning sampling depths and the presence of various materials such as gravel, cobbles, and fill, and observations of ground water. It also contains our interpretation of the soil conditions between samples. The final logs presented in this report represent our interpretation of the contents of the field logs and the results of the sample examinations and laboratory test results. Our recommendations are based on the contents of the final logs and the information contained therein and not on the field logs.

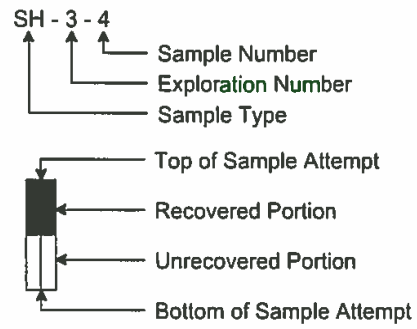
### VARIATION IN SOILS BETWEEN TEST PITS AND BORINGS

The final log and related information depict subsurface conditions only at the specific location and on the date indicated. Those using the information contained herein should be aware that soil conditions at other locations or on other dates may differ. Actual foundation or subgrade conditions should be confirmed by us during construction.

### TRANSITION BETWEEN SOIL OR ROCK TYPES

The lines designating the interface between soil, fill or rock on the final logs and on subsurface profiles presented in the report are determined by interpolation and are therefore approximate. The transition between the materials may be abrupt or gradual. Only at boring or test pit locations should profiles be considered as reasonably accurate and then only to the degree implied by the notes thereon.

### SAMPLE OR TEST SYMBOLS



- C - Pavement Core Sample
- CS - Rock Core Sample
- OS - Oversize Sample (3-inch O.D. split-spoon)
- S - Grab Sample
- SH - Thin-walled Shelby Tube Sample
- SS - Standard Penetration Test Sample (2-inch O.D. split-spoon)

- ▲ Standard Penetration Test Resistance equals the number of blows a 140 lb. weight falling 30 in. is required to drive a standard split-spoon sampler 1 ft. Practical refusal is equal to 50 or more blows per 6 in. of sampler penetration.
- Water Content (%)

**FIELD SHEAR STRENGTH TEST**

Shear strength measurements on test pit side walls, blocks of soil or Shelby tube samples are typically made with Torvane or Field Vane shear devices.

**WATER TABLE**

▼ Water Table Location

(1/31/16) Date of Measurement

**TYPICAL SOIL/ROCK SYMBOLS**

Concrete	Silt	Basalt
Organics	Sand	Sandstone
Clay	Gravel	Siltstone

**UNIFIED SOIL CLASSIFICATION SYMBOLS**

G - Gravel	W - Well Graded
S - Sand	P - Poorly Graded
M - Silt	L - Low Plasticity
C - Clay	H - High Plasticity
Pt - Peat	O - Organic

DRAFT

### Explanation of Common Terms Used in Soil Descriptions

Field Identification	Cohesive Soils			Granular Soils	
	SPT*	S <sub>u</sub> ** (tsf)	Term	SPT*	Term
Easily penetrated several inches by fist.	0 - 2	< 0.125	Very Soft	0 - 4	Very Loose
Easily penetrated several inches by thumb.	2 - 4	0.125 - 0.25	Soft	4 - 10	Loose
Can be penetrated several inches by thumb with moderate effort.	4 - 8	0.25 - 0.50	Medium Stiff	10 - 30	Medium Dense
Readily indented by thumb but penetrated only with great effort.	8 - 15	0.50 - 1.0	Stiff	30 - 50	Dense
Readily indented by thumbnail.	15 - 30	1.0 - 2.0	Very Stiff	> 50	Very Dense
Indented with difficulty by thumbnail.	> 30	> 2.0	Hard		

\* SPT N-value in blows per foot (bpf)  
 \*\* Undrained shear strength

Term	Soil Moisture Field Description
Dry	Absence of moisture. Dusty. Dry to the touch.
Damp	Soil has moisture. Cohesive soils are below plastic limit and usually moldable.
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grain surfaces. Sand and cohesionless silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is wetter than the optimum moisture content and above the plastic limit.

Term	PI	Plasticity Field Test
Non-plastic	0 - 3	Cannot be rolled into a thread at any moisture.
Low Plasticity	3 - 15	Can be rolled into a thread with some difficulty.
Medium Plasticity	15 - 30	Easily rolled into thread.
High Plasticity	> 30	Easily rolled and re-rolled into thread.

Term	Soil Structure Criteria
Stratified	Alternating layers at least ¼ inch thick.
Laminated	Alternating layers less than ¼ inch thick.
Fissured	Contains shears and partings along planes of weakness.
Slickensided	Partings appear glossy or striated.
Blocky	Breaks into small lumps that resist further breakdown.
Lensed	Contains pockets of different soils.

Term	Soil Cementation Criteria
Weak	Breaks under light finger pressure.
Moderate	Breaks under hard finger pressure.
Strong	Will not break with finger pressure.



DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-1-1		0.70	1.0		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to 1/2-inch diameter, (topsoil).
	2-	S-1-2		0.90	6.0		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, (residual soil).
	3-			>1.00			
	4-			±1.00			
	5-	S-1-3			9.0		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	6-						
	7-						
	8-						
	9-						

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021




Test Pit Log: TP- 1  
 Sandy Housing Development  
 Sandy, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description	
No seepage or groundwater encountered to the limit of exploration.	1-	S-2-1		0.86	1.0		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).	
	2-	S-2-2		0.90	8.0		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, (residual soil).	
	3-			±1.00				
	4-			>1.00				
	5-	S-2-3			10.0		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).	
	6-							
	7-							
	8-							
	9-							BOTTOM OF EXPLORATION
	10-							

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021






Test Pit Log: TP- 2  
 Sandy Housing Development  
 Sandy, Oregon

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-			0.56	1.0		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-			±1.00			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, (residual soil).
	3-			±1.00			
	4-			>1.00			
	5-						
	6-						
	7-						
	8-	S-3-1			8.0		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	9-						
	10-				10.0		BOTTOM OF EXPLORATION

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

Test Pit Log: TP- 3  
 Sandy Housing Development  
 Sandy, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description	
No seepage or groundwater encountered to the limit of exploration.	1-	S-4-1		0.50	1.5		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).	
	2-			0.84			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, blocky structure, (residual soil).	
	3-			0.92				
	4-	S-4-2		0.90				
	5-							
	6-					6.0		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	7-	S-4-3						
	8-							
	9-					9.0	BOTTOM OF EXPLORATION	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

Test Pit Log: TP- 4  
 Sandy Housing Development  
 Sandy, Oregon

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-5-1		0.40	0.6		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-	S-5-2		±1.00			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, blocky structure, (residual soil).
	3-			±1.00			
	4-			>1.00			
	5-						
	6-						
	7-	S-5-3			7.5		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	8-						
	9-					9.0	BOTTOM OF EXPLORATION

Project No.: 2211038

Test Pit Log: TP- 5

Surface Elevation: N/A (Approx.)

Sandy Housing Development

Date of Test Pit: April 27, 2021

Sandy, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-6-1		0.50	1.0		Medium stiff to stiff silty CLAY, trace sand, scattered organics, (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-	S-6-2		0.84			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-			0.70			
	4-			±1.00			
	5-						
	6-	S-6-3			8.5		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	7-						
	8-						
	9-					8.5	BOTTOM OF EXPLORATION

Project No.: 2211038

Test Pit Log: TP- 6

Surface Elevation: N/A (Approx.)

Sandy Housing Development

Date of Test Pit: April 27, 2021

Sandy, Oregon

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-7-1		0.46	1.0		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-			0.88			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure (residual soil).
	3-	S-7-2		0.94			
	4-						
	5-						
	6-						
	7-	S-7-3					
	8-					8.0	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

Test Pit Log: TP- 7  
 Sandy Housing Development  
 Sandy, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-8-1		0.38	1.3		Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-	S-8-2		±1.00			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-			0.88			
	4-						
	5-						
	6-						
	7-	S-8-3					
	8-					9.0	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

Test Pit Log: TP- 8  
 Sandy Housing Development  
 Sandy, Oregon

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-9-1		0.40			Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-	S-9-2		0.72	1.5		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-			±1.00			
	4-						
	5-	S-9-3					
	6-						
	7-	S-9-4					
	8-						
	9-				9.0		BOTTOM OF EXPLORATION

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

Test Pit Log: TP- 9  
 Sandy Housing Development  
 Sandy, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-10-1		0.42			Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-	S-10-2		0.48	1.0		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-			0.70			
	4-	S-10-3					
	5-						
	6-						
	7-				±1.00	6.5	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

Test Pit Log: TP-10  
 Sandy Housing Development  
 Sandy, Oregon

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-11-1		0.40	1.0		Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-	S-11-2		±1.00			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-			0.74			
	4-			>1.00			
	5-						
	6-	S-11-3					
	7-						
	8-	S-11-4					
	9-					8.5	

Project No.: 2211038

Test Pit Log: TP-11

Surface Elevation: N/A (Approx.)

Sandy Housing Development

Date of Test Pit: April 27, 2021

Sandy, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-12-1		0.38	1.3		Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-			±1.00			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-	S-12-2		>1.00			
	4-			>1.00			
	5-						
	6-						
	7-						
	8-						
	9-	S-12-3					
	10-					9.5	

Project No.: 2211038

Test Pit Log: TP-12

Surface Elevation: N/A (Approx.)

Sandy Housing Development

Date of Test Pit: April 27, 2021

Sandy, Oregon

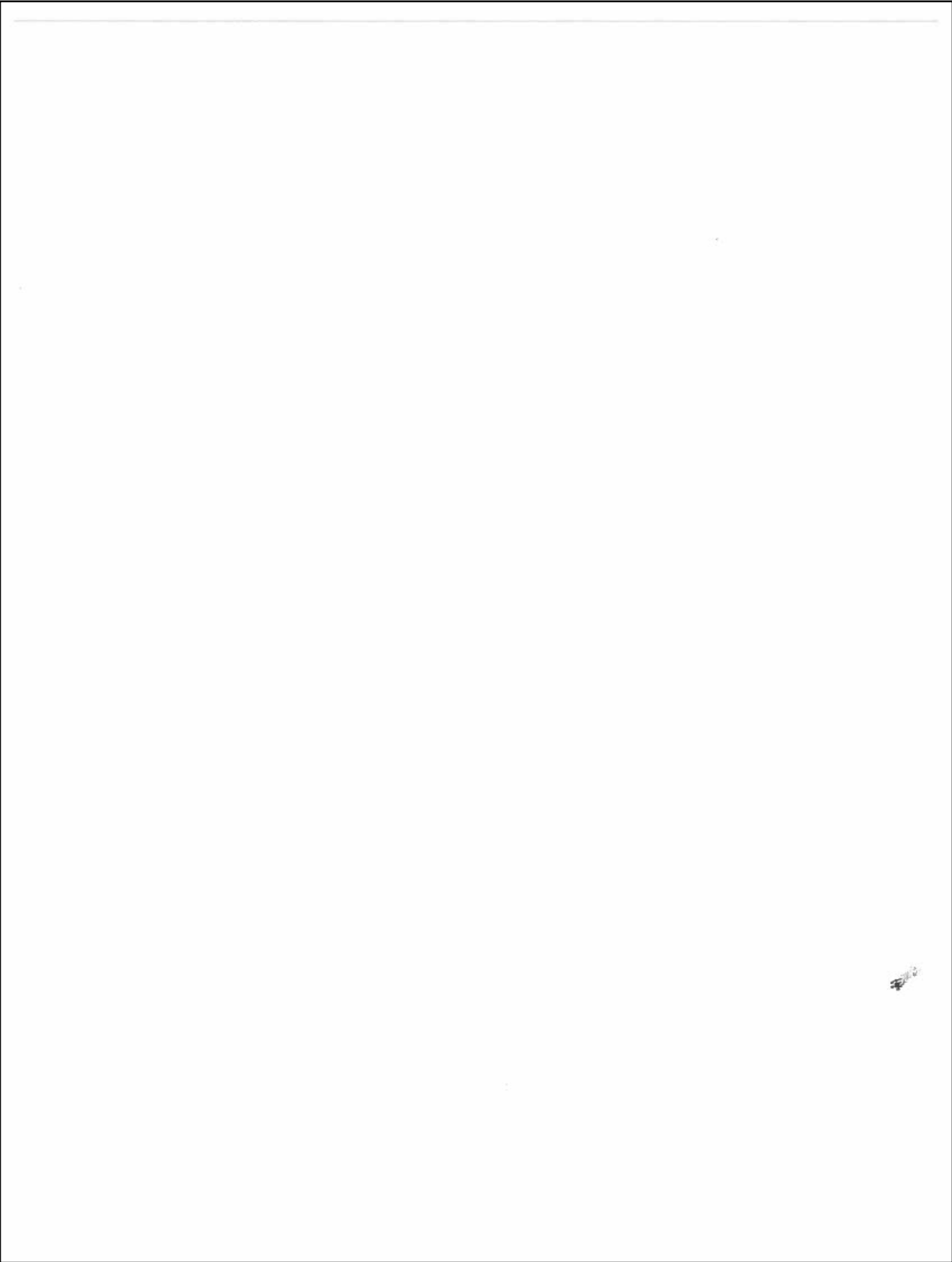


EXHIBIT J



# Preliminary Stormwater Report

Cascade Creek Apartments

38272 OR-11  
Sandy, OR 97055

Prepared by BCRA

**December 2022**

[bcradesign.com](http://bcradesign.com)





2106 Pacific Avenue, Suite 300  
Tacoma, WA 98402

## PRELIMINARY STORMWATER REPORT

December 2022

**PROJECT:**

Cascade Creek Apartments  
38272 OR-11  
Sandy, OR 97055

**ENGINEER:**

BCRA Civil Engineering  
2106 Pacific Avenue, Suite 300  
Tacoma, WA 98402

**OWNER:**

DPS, LLC  
1911 65<sup>th</sup> Ave W  
Tacoma, WA 98466

**PREPARED BY:**

Sam Morman  
smorman@bcradesign.com

**REVIEWED BY:**

Zachary Crum, PE  
zcrum@bcradesign.com

---

I hereby certify that this Stormwater Report for Cascade Creek Apartments has been prepared by me or under my supervision and meets minimum standards of the City of Portland and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me.



EXPIRES: 12/31/23



## TABLE OF CONTENTS

Section A – Project Overview and Description ..... 3  
 Section B – Methodology ..... 7  
 Section C – Analysis ..... 8  
 Section D – Engineering Conclusions ..... 13  
 Appendix A – Geotechnical Report ..... 14  
 Appendix B – Soil Survey Report ..... 15  
 Appendix C – Basin Analysis, Data, and Detention Sizing ..... 16

## LIST OF FIGURES AND TABLES

Figure 1.1 Site Vicinity Map ..... 4  
 Figure 1.2 Existing Basin Map ..... 5  
 Figure 1.3 Proposed Basin Map ..... 6

Table 3.1 24-Hour Rainfall Data ..... 8  
 Table 3.2 Existing Basin Areas ..... 8  
 Table 3.3 Proposed Basin Areas ..... 9  
 Table 3.4 Curve Number Table ..... 9  
 Table 3.5 Detention Facility Volumes With 10% Increase ..... 11  
 Table 3.6 TDA 1 Predeveloped Outflows ..... 11  
 Table 3.7 TDA 2 Predeveloped Outflows ..... 11  
 Table 3.8 TDA 1 Proposed System Outflows ..... 11  
 Table 3.9 TDA 2 Proposed System Outflows ..... 11  
 Table 3.10 Proposed System Orifices ..... 12  
 Table 3.11 Water Quality Flowrates ..... 12



## Section A – Project Overview and Description

The Cascade Creek Apartments project is located at 38272 and 38330 OR-11 Sandy, OR 97055. The project site is bordered by residences across Highway 211 on the north, residences on the east and west, and Bornstedt Park on the south. Generally, the site slopes toward a low point one located in the center of the western border. The site in the current condition consists of two parcels, with a total area of 8.84 acres. The parcel numbers are 00677173 and 00677164. The land will be divided into three new parcels. The northernmost parcel is zoned as Village Commercial. The parcel directly south of this is zoned mostly as Village Commercial, with a small section of Medium Density Residential on the southern portion of the parcel. The southernmost parcel is primarily zoned as Medium Density Residential, with a small zone around the southeast corner being zoned as Low Density Residential.

The existing site consists of two residences on the northern side of the site, with some cleared areas surrounding the residences, and the rest of the land in a natural vegetated condition with dense shrubbery and occasional trees. The site has slopes of 5-10%.

### Improvements

Frontage improvements for this project include half-street improvements along Highway 211, Village Boulevard, and Pine Street where they border the project site. In addition, a new portion of Cascadia Village Drive will be constructed between the south border of parcel 2, and the north border of parcel 3. This new portion of Cascadia Village Drive will connect with existing offsite intersections between the existing Cascadia Village Drive and SE Village Boulevard on the west, and the existing Cascadia Village Drive and the new Pine Street on the east.

The only on-site improvements being made to the northernmost parcel includes the installation of a new driveway so that the site is accessible, and a new sewer connection to be used instead of the existing on-site septic system. Improvements to the parcel directly south of this include two new buildings that contain both offices and apartments. There will be 5 offices and 16 apartments in each building, resulting in a total of 10 offices and 32 apartments on this parcel. Surrounding the buildings are a new parking lot, an open space, and a public plaza with connections to the right of way. On the parcel south of Cascade Village Drive, four new apartment buildings will be constructed. These buildings will contain a total of 46 apartments. Surrounding these buildings are parking lots and a large open space.

### Existing Drainage Basins

In the existing condition, the site has three separate drainage basins. The first basin is located on the north side of the site and consists mostly of Highway 211. Runoff from the highway runs into a series of catch basins located in the public right-of-way that runs off-site to the west. The runoff is then conveyed further west, turning south at the intersection of through the existing system until being dispersed across a forested area which likely connects to Tickle Creek. This basin is labeled as Basin 1 in Figure 1.2.

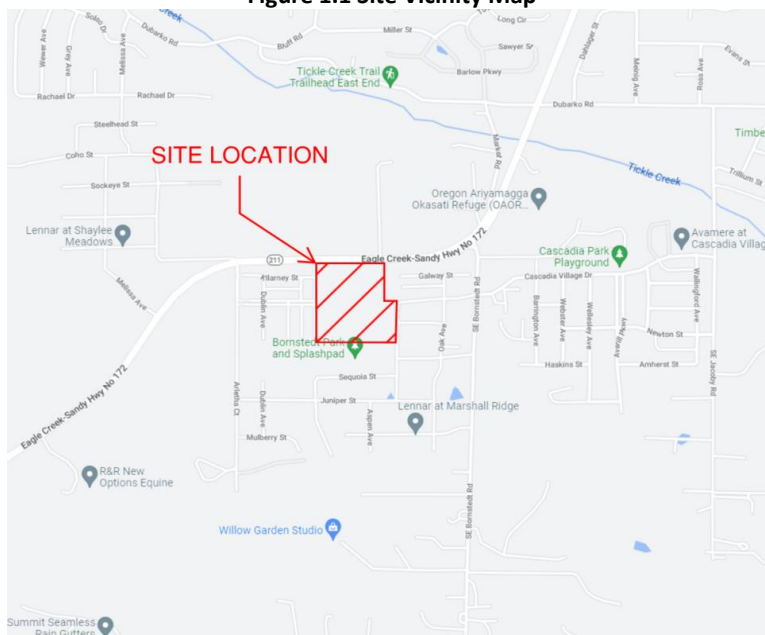
The second basin spans over the majority of the project site. It consists of two residences on the northern side, with some cleared areas surrounding the residences, and the rest of the land in a natural vegetated condition with dense shrubbery and occasional trees. The site has slopes of 5-10% to the west. It is labeled as Basin 2 in Figure 1.2. Runoff drains to a catch basin that is a part of a privately owned storm system located on the west border of the site, roughly 75 feet north of the intersection between Cascadia Village Drive and SE Village Boulevard. From here it is conveyed further west and combines with the runoff from Basin 1 around 1,000 feet downstream before being dispersed across a forested area and likely connecting to Tickle Creek.



The final basin is on the southeast corner of the site. It has slopes ranging mostly from 0-5%, with occasional slopes ranging from 5-10%. The land cover is a natural vegetated condition with dense shrubbery. Runoff from this basin drains toward a catch basin that is a part of a privately owned storm system to the east of the site, located in the intersection of Pine Street and Limerick Street. From here, runoff is sent east off-site and ends up in a separate branch of Tickle Creek than the previous two basins. This basin is labeled as Basin 3 in Figure 1.2. The two branches of Tickle Creek being discharged to, do not converge until around 3 miles downstream.

Due to the site discharging to two separate locations is the existing condition, the developed condition will match the flow rates of each discharge location in addition to matching the flow rates of the site as a whole. In the existing condition, basins 1 and 2 connect to conveyance systems that discharge to a forested area that likely connects to a branch of Tickle Creek to the west of the site. Throughout this report, the total area discharging to this location is referred to as Threshold Discharge Area (TDA) 1. Basin 3 connects to a conveyance system that discharges to a separate branch of Tickle Creek. Throughout this report, the total area discharging to this location is referred to as Threshold Discharge Area (TDA) 2.

**Figure 1.1 Site Vicinity Map**

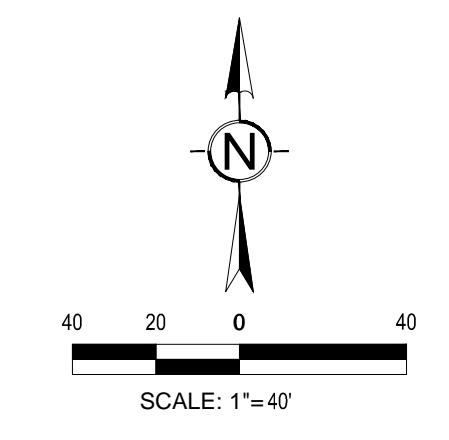
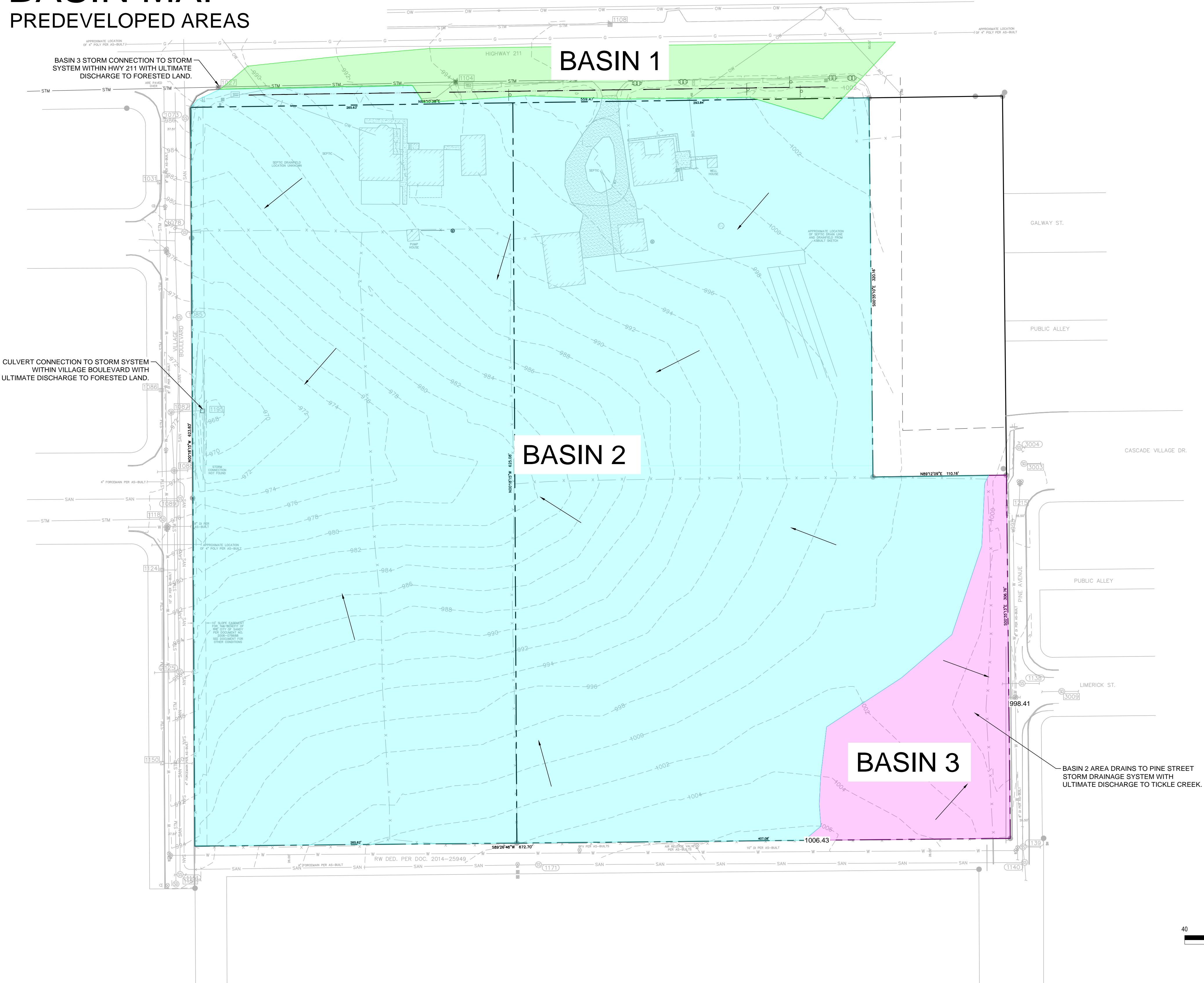


The intent of this preliminary report is to communicate the feasibility of the stormwater facility design to meet the minimum requirements of the City of Portland's Stormwater Management Manual, 2020 in support of the project's design review and tentative partition submittal.

DECEMBER 2022 / CASCADE CREEK

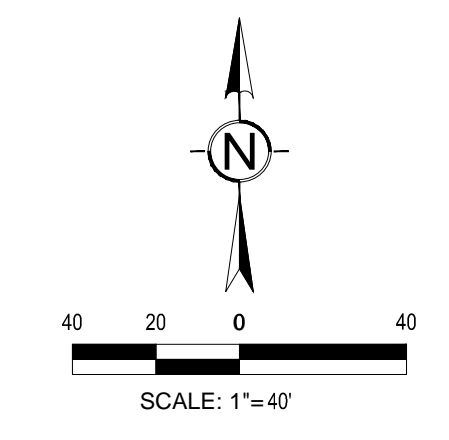
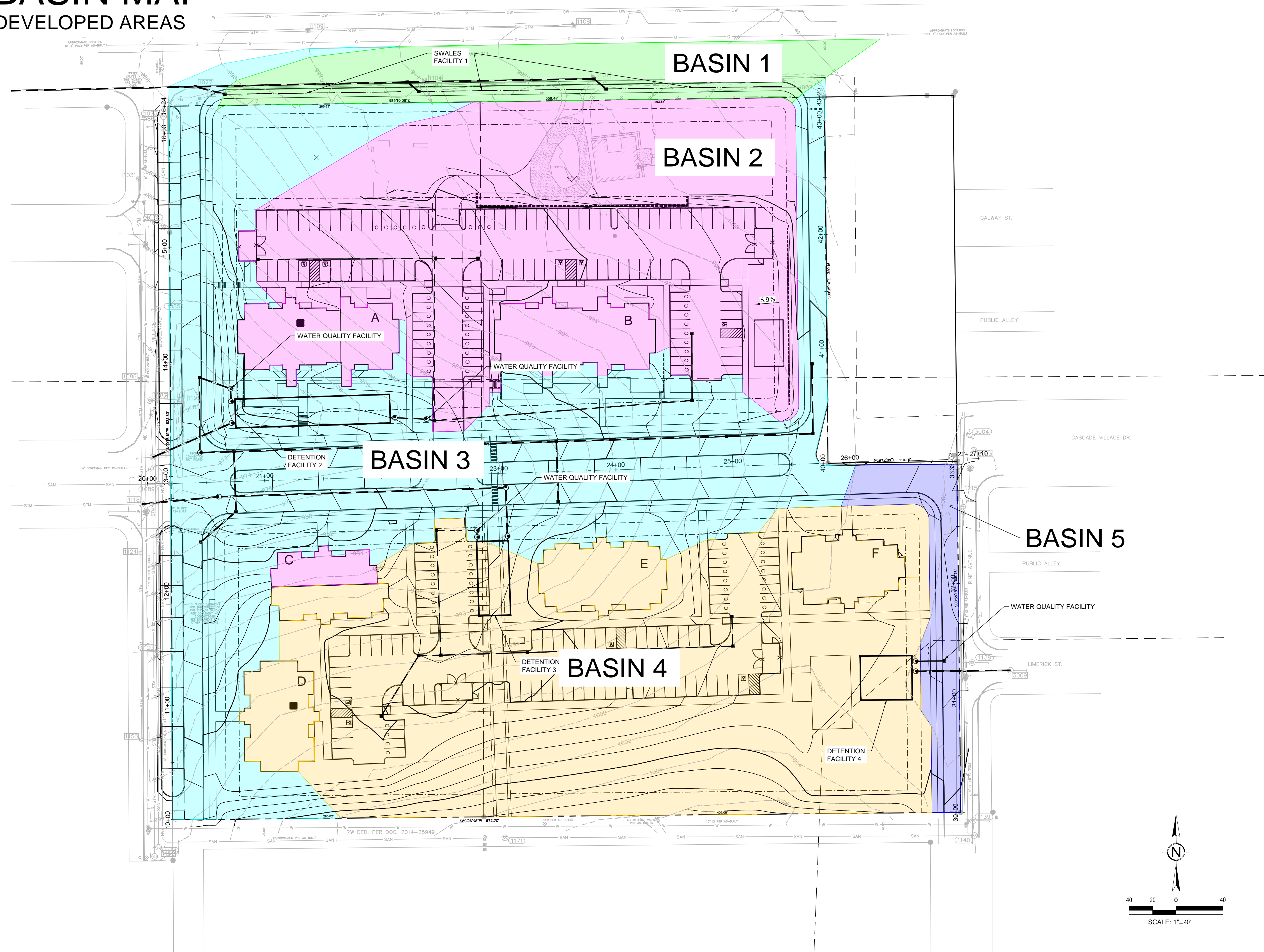
# BASIN MAP

PREDEVELOPED AREAS



# BASIN MAP

DEVELOPED AREAS





## Section B – Methodology

### Soils

A Geotechnical Engineering Report was prepared by Gill Group, Inc., dated 05/04/2021.

Gill found stiff to very stiff clay throughout the site. No groundwater was encountered in any of their explorations. Gill did not provide information about the infiltration rate for the site soils. The geotechnical report can be found in Appendix A of this document.

A soils report has been generated using the Web Soils Survey, showing that the soils on-site are type B. This report can be found in Appendix B of this document.

### Infiltration and Discharge Hierarchy

Although infiltration testing has not been conducted, infiltration rates are assumed to be less than 2 in/hr due to the soils being still to very still clay. Because of this, Level 1: Full Onsite Infiltration is not practicable per section 1.3.3 of the City of Portland 2020 Stormwater Management Manual. Level 2: Offsite Discharge to the Separated Stormwater System is practicable and will be followed for this project.

### Stormwater Management Techniques

Because this project falls under Level 2 in the infiltration and discharge hierarchy, it must follow pollution reduction and flow control requirements specified in Table 1-2 of the City of Portland Stormwater Management Manual. For pollution reduction, this project is required to remove 70% of the total suspended solids from 90% of the average annual rainfall. The project will meet this through the use of four Stormtech Jellyfish facilities. See Section C, subsection “Water Quality Design” of this report for further detail. For flow control, the project will be following the “smaller surface water bodies (hydromodification)” category specified in the Portland SWMM because it is not discharging to a major body of water. TDA 1 of the project site connects to a conveyance system that discharges to forested area that likely connects to Tickle Creek. TDA 2 of the project site connects to a conveyance system that discharges into Tickle Creek. The project must limit post-development peak runoff rates to pre-development rates for one-half of the 2-year event, and for the 5-, 10-, and 25-year design storm events. The project will meet this requirement through the use of three underground detention systems. The sizing of these systems can be found in Section C, subsection “Flow Control Facility Sizing” of this report.



## Section C – Analysis

### Design Assumptions

For this project, the presumptive approach has been used for analysis. The software selected to be used is HydroCAD. Tables summarizing the calculations and outputs from the HydroCAD software can be found throughout this section below. Full HydroCAD reports have been generated and attached to this report in Appendix C.

### Rainfall

The following rainfall numbers are taken from the City of Sandy Stormwater Website (<https://www.ci.sandy.or.us/publicworks/page/stormwater>), to be used for calculations:

**Table 3.1 24-Hour Rainfall Data**

Storm Recurrence Interval	Rainfall (inches)
2-year	3.50
5-year	4.50
10-year	4.80
25-year	5.50

### Basin Areas

The following basin areas are based on the basins shown in the Tables 3.2 and 3.3.

**Table 3.2 Existing Basin Areas**

Existing Basins		
	SF	Acres
TDA 1		
Basin 1 (Highway 211)		
Roof	0	0
Paved	15,191	0.349
Pervious	5,791	0.133
Basin 2 Total	20,982	0.482
Basin 2 (On-site Draining West)		
Roof	6,892	0.158
Paved	6,565	0.151
Pervious	348,054	7.990
Basin 1 Total	361,511	8.299
TDA 2		
Basin 3 (On-site Draining East)		
Roof	0	0
Paved	0	0
Pervious	25,882	0.594
Basin 2 Total	25,882	0.594





**Table 3.3 Proposed Basin Areas**

Proposed Basins		
	SF	Acres
TDA 1		
Basin 1 (Highway 211)		
Roof	0	0
Paved	20,624	0.473
Pervious	3,694	0.085
<b>Basin 1 Total</b>	<b>24,318</b>	<b>0.558</b>
Basin 2 (North Lot)		
Roof	18,844	0.433
Paved	46,939	1.078
Pervious	42,608	0.978
<b>Basin 2 Total</b>	<b>108,391</b>	<b>2.488</b>
Basin 3 (Right-of-Way)		
Roof	0	0
Paved	58,584	1.345
Pervious	75,049	1.723
<b>Basin 3 Total</b>	<b>133,633</b>	<b>3.068</b>
Basin 4 (South Lot)		
Roof	18,639	0.428
Paved	45,226	1.038
Pervious	70,076	1.609
<b>Basin 4 Total</b>	<b>133,941</b>	<b>3.075</b>
TDA 2		
Basin 5 (Southeast Area)		
Roof	0	0
Paved	9,134	0.210
Pervious	1,418	0.033
<b>Basin 5 Total</b>	<b>10,552</b>	<b>0.242</b>

**Curve Numbers**

The following curve numbers were taken from the City of Portland Stormwater Management Manual, and the City of Portland Sewer and Drainage Facilities Design Manual.

**Table 3.4 Curve Number Table**

Description	CN	Land Use Description
Pre-Developed Pervious	72	Soil Type "B" Portland SWMM Table A-8
Pre-Developed Impervious	98	Roofs, Pavement
Developed Pervious	56	Grass Lawn, Soil Group B Portland SDFDM Table 6-5
Developed Impervious	98	Roofs, Pavement



### **Flow Control Facility Sizing**

Hydrographs for the drainage basins were determined using HydroCAD, which uses the Santa Barbara Urban Hydrograph (SBUH) method. The flow control facilities and control structures were sized and designed to release water to match the pre-developed rates for half of the 2-year, and the 5-, 10-, and 25-year storm events as prescribed by the 2020 Portland Stormwater Management Manual, Chapter 1.3.5 under the section "Level 2 Flow Control Requirements", subsection "Smaller surface water bodies (hydromodification)". These values are specified in Table 3.1 of this document.

There are 4 flow control facilities being utilized in this project.

#### Facility 1:

Facility 1 consists of a series of 3 bioswales running parallel to Highway 211 on the northern border of the site. Swales are designed with 8 ft top width, 2 ft bottom width, and 3:1 side slopes. The length of each swale is 150 feet. The area contributing to this swale is described in Table 3.3 as Basin 1.

#### Facility 2:

Facility 2 is a detention system located at the southwest corner of parcel 2. The detention system used is a detention vault. The vault has internal storage dimensions of 119 ft L x 24 ft W x 7.5ft D. The walls, lid, and base all have a thickness of 1 foot. The vault has 6" of dead storage, 6ft of live storage, and 12" of freeboard. The vault has a total live capacity of 17,136 cf. The areas contributing to this facility are Basin 2 and 3 of Table 3.3.

#### Facility 3:

Facility 3 is a detention system located on the north side of parcel 3. The detention system used is a detention vault. The vault has a length of 58 ft L x 26 ft W x 7.5ft D. The walls, lid, and base all have a thickness of 1 foot. The vault has 6" of dead storage and 12" of freeboard. The vault has a total live capacity of 9,060 cf. The area contributing to this facility is Basin 4 of Table 3.3.

#### Facility 4:

Facility 4 is a detention system located on the east side of parcel 3. The detention system used is ADS StormTech SC-160LP underground chambers. The facility has 13 rows of chambers, with 4 chambers per row and has a total system capacity of 933 cf. The chambers are 12" in height, and have 6" of stone above and below, giving a total system depth of 2 feet. The area contributing to this facility is Basin 5 of Table 3.3.

Facilities 2-4 have been shown on the plans with minimum of 10% additional storage volume above what is necessary, as this project is still early in design. This 10% increase is reflected in the facility footprints and associated volume callouts on the plans. See Table 3.5 below for calculations. Tables 3.6 and 3.7 show the site's predeveloped outflow rates. Tables 3.8 and 3.9 show a summary of flows from the proposed facilities compared to the predeveloped outflow rates. Table 3.10 gives a summary of the orifices designed for each proposed facility. See Appendix C for a more detailed system analysis.

**Table 3.5 Detention Facility Volumes With 10% Increase**

Detention Facility	Volume Required (cf)	Volume with ~10% Increase (cf)
Facility 2	17,136	19,000
Facility 3	9,060	10,000
Facility 4	993	1,100

**Table 3.6 TDA 1 Predeveloped Outflows**

Recurrence Interval	Basin 1 Predeveloped Outflow (cfs)	Basin 2 Predeveloped Outflow (cfs)	TDA 1 Predeveloped Outflow (cfs)
½ of 2-year	0.32	1.75	1.035
5-year	0.43	3.18	3.61
10-year	0.46	3.65	4.11
25-year	0.54	4.79	5.33

**Table 3.7 TDA 2 Predeveloped Outflows**

Recurrence Interval	Basin 3 Predeveloped Outflow (cfs)	TDA 2 Predeveloped Outflow (cfs)
½ of 2-year	0.055	0.055
5-year	0.21	0.21
10-year	0.24	0.24
25-year	0.32	0.32

**Table 3.8 TDA 1 Proposed System Outflows**

Recurrence Interval	Facility 1 Proposed Outflow (cfs)	Facility 2 Proposed Outflow (cfs)	Facility 3 Proposed Outflow (cfs)	Proposed TDA 1 Total (cfs)	Predeveloped Outflow (cfs)
½ of 2-year	0.25	0.50	0.21	0.96	1.035
5-year	0.32	0.87	0.39	1.58	3.61
10-year	0.34	0.97	0.45	1.76	4.11
25-year	0.39	1.19	0.59	2.17	5.33

**Table 3.9 TDA 2 Proposed System Outflows**

Recurrence Interval	Facility 4 Proposed Outflow (cfs)	Proposed TDA 2 Total (cfs)	Predeveloped Outflow(cfs)
½ of 2-year	0.05	0.05	0.055
5-year	0.06	0.06	0.21
10-year	0.07	0.07	0.34
25-year	0.08	0.08	0.32

**Table 3.10 Proposed System Orifices**

Orifice	Height (ft)	Diameter (inches)
<b>Facility 1 (Highway 211 Bioswales)</b>		
Bottom	0	4
<b>Facility 2 (North Lot Detention)</b>		
Bottom	0	2
Middle	3.25	3
Top	4	4
Overflow Riser	6	12
<b>Facility 3 (South Lot Detention)</b>		
Bottom	0	1.5
Middle	4	1.75
Top	4.75	2.5
Overflow Riser	6	12
<b>Facility 4 (Southeast Area Detention)</b>		
Bottom	0	1.5
Overflow Riser	1.92	12

**Water Quality Design**Basin 1:

Due to no new pollution-generating hard surfaces being added within Basin 1, water quality treatment is not applicable.

Basin 2-5:

Four Jellyfish manholes by Contech Stormwater Solutions will be designed for water quality for this site, with one manhole being used for each of the remaining basins (Basins 2-5). The areas contributing to the water quality systems are the “paved” and “pervious” areas from Table 3.3. Areas from the roofs are conveyed separately to the detention system and do not mix with polluted runoff, therefore they do not need to receive treatment. The rational method was used for sizing the water quality systems where:

Q = flow (cfs)

C = runoff coefficient (from Table 6-3 of the Portland SDFDM)

I = Intensity = 0.11 in/hr (per SMC Section 13.18.60 for off-line facilities)

A = Drainage Area (acres)

**Table 3.11 Water Quality Flowrates**

Rational Method Flow Calculation				
Basin	Q (cfs)	C	I (in/hr)	A (acres)
2	0.16	0.58	0.11	2.488
3	0.22	0.64	0.11	3.068
4	0.24	0.72	0.11	3.075
5	0.01	0.37	0.11	0.242

The Contech Jellyfish JF4 model has a treatment capacity of 0.45 cfs, which is larger than any flow contributing in the “Q” column of Table 3.11.



## Section D – Engineering Conclusions

The design for on-site detention and water quality systems are in accordance with the City of Sandy requirements. For flow control, the four facilities (one series of bioswales, three detention tanks) have been designed for half of the 2-year design storm up to the 25-year storm as shown in tables 3.8 and 3.9. For water quality, the Highway 211 Basin does not require water quality treatment, as no pollution generating surfaces are being added. The remaining basins all receive treatment from Contech Jellyfish JF4 systems. Each system receives flow below the treatment flow capacity, as shown in Table 3.11.

Detailed calculations will be completed with the final engineering plans as needed. Stormwater facility details/exhibits and Manufactured Stormwater Treatment Technology Data will be provided under the engineering permit submittal.



## Appendix A – Geotechnical Report



# GILL GROUP

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May 4, 2021

Vaughn Bay Construction  
1911 65<sup>th</sup> Avenue West  
Tacoma, WA 98466

Attention: Zac Baker  
Subject: Geotechnical Report  
Bornstedt Village  
38272 SE Highway 211  
Sandy, Oregon  
Gill Project No. ET237V1028

Dear Mr. Baker,

Gill Group, Inc. (Gill) is pleased to provide you with this Geotechnical Report for the above referenced site. This report includes a summary of the activities conducted, a summary of the findings, and recommendations. We appreciate the opportunity to provide the above services. If you have any questions or comments, please contact the undersigned Gill Group participant at (800) 428-3320.

Sincerely,

**Gill Group, Inc.**

*Jacob G. Epperson*  
Jacob G. Epperson, P.G.

Director of Environmental Services



**Date:** May 4, 2021  
**To:** Jake Epperson, P.G.  
Gill Group  
**From:** Nathan M. Villeneuve, C.E.G.  
Timothy J. Pfeiffer, P.E., G.E.  
**Subject:** Preliminary Geotechnical Investigation - DRAFT  
**Project:** Sandy Housing Development  
Project No. 2211038

We have completed the requested preliminary geotechnical investigation for the above-referenced project in Sandy, Oregon. This report provides a description of our work and a discussion of site conditions.

## BACKGROUND

Gill Group is assisting with the purchase of two parcels in Sandy, Oregon. The site is located south of Highway 211 (Eagle Creek-Sandy Highway), between Village Boulevard and Pine Avenue and is currently occupied by two residential homes and pasture. The site location is shown on Figure 1A (Appendix A). Should the purchase proceed, we understand a housing development consisting of 3-story buildings will be constructed on the properties. Some of the buildings may have daylight basements.

Gill Group is the lead designer for the project. The subject property is in the process of being purchased. Gill Group retained Foundation Engineering to complete a preliminary geotechnical investigation as part the pre-purchase due-diligence process. After the properties are purchased and the site plan is developed, Phase 2 geotechnical work will be needed to provide specific geotechnical recommendations for site grading and for the design and construction of foundations and pavements. Details of our current, Phase 1 scope of work were provided in a proposal dated March 30, 2021 and authorized by a signed agreement dated April 6, 2021.

## FIELD EXPLORATION

We excavated twelve (12) exploratory test pits (TP-1 through TP-12) at the site on April 27, 2021 using a CAT 306 excavator provided and operated by Wapiti Pacific Construction. The northwest quadrant of the site was not accessible during the preliminary investigation, so test pits were not excavated in this area. The approximate locations of the test pits are shown in Figure 2A (Appendix A) The test pits extended to maximum depths ranging from  $\pm 6$  to 10 feet.

The soil profiles were continuously logged during excavation and samples were collected where appropriate. Undrained shear strength measurements were made on the side walls of the test pits using a field vane shear device. The soil profile,



sampling depths, and strength measurements are shown on the test pit logs (Appendix B). The surface and subsurface conditions are discussed below.

## **SITE AND SUBSURFACE CONDITIONS**

### **Surface Conditions**

The site consists of sloping topography with the high elevations to the north and south and lowest elevations in the middle of the properties. The low elevations form a small drainage to the west where it intersects a road embankment. The lots are bordered on the north by Highway 211, on the east by Pine Avenue, on the south by Bornstedt Park, and on the west by Village Boulevard. Surface conditions at the time of our field exploration are shown in Photos 1 and 2 (Appendix A).

### **Subsurface Conditions**

A general discussion of the soil conditions encountered in the test pits is provided below. More detailed descriptions of conditions encountered in each test pit are provided on the test pit logs (Appendix B).

***Topsoil.*** A topsoil layer was encountered in all the test pits, typically extending to depths of  $\pm 6$  to 18 inches. The topsoil consists of low to medium plasticity silty clay and silt with some organics. The organics consisted of roots up to 1/2 inch in diameter.

***Residual Soil.*** Residual soil consisting of stiff to very stiff, high plasticity clay with scattered organics was encountered in all the test pits beneath the topsoil. The residual soil extended to the bottom of each test pit. In TP-1 to TP-5, the residual soil graded to a clay with some sand and a relict rock texture.

### **Groundwater**

No groundwater was encountered in the test pits. We anticipate perched water conditions may develop within a few feet of the ground surface during periods of prolonged rainfall based on the presence of low permeability, fine-grained soils encountered at shallow depths across the site.

## **PRELIMINARY CONCLUSIONS**

Based on the results of our field explorations, in our opinion the site is suitable for the planned development. We anticipate the new housing units can be supported on shallow foundations (e.g., spread and continuous wall footings). Preliminary considerations for site grading and construction are discussed below.

Site preparation should include stripping the upper  $\pm 6$  to 18 inches of topsoil and removing it from structural foundation areas. The native soil is typically stiff to very stiff and will be suitable to support new structures, foundations, and pavements.

The foundation soil is primarily fine-grained and sensitive to moisture. Site grading and earthwork should be performed during the dry season (typically June through September) when aeration, moisture conditioning, and compaction are possible. Construction during the wet season will require removal of soft soil and construction of thick rock sections underlain by a separation geotextile for the building pads, pavement areas, and haul roads to support construction traffic.

As discussed above, the surficial soil is predominantly fine-grained. During dry weather the excavated soils may be reused for general site grading under pavements and landscaping areas or reworked and used as general site fill outside building areas.

### **ADDITIONAL GEOTECHNICAL WORK**

A second phase of geotechnical work should be completed after the property is purchased and the site layout and grading plan has been established. Phase 2 will consist of developing detailed recommendations for foundation design and construction, and new pavements.

### **VARIATION OF SUBSURFACE CONDITIONS, USE OF THIS REPORT, AND WARRANTY**

The preliminary conclusions contained herein assume the soil profiles and groundwater conditions encountered in the test pits are representative of the overall site conditions. The current scope of work does not include recommendations for site grading or for foundation and pavement design. We assume a more detailed geotechnical investigation will be conducted prior to design and construction.

No changes in the enclosed recommendations should be made without our approval. We will assume no responsibility or liability for any engineering judgment, inspection or testing performed by others.

This report was prepared for the exclusive use of Gill Group for their due diligence investigation of the Sandy Housing Development project. Information contained herein should not be used for other sites or for unanticipated design or construction without our written consent. This report is intended solely for the stated purpose. Contractors using this information to estimate construction quantities or costs do so at their own risk. Our services do not include any survey or assessment of potential surface contamination or contamination of the soil or ground water by hazardous or toxic materials. We assume that those services, if needed, have been completed by others.

Our work was done in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

### Attachments

DRAFT



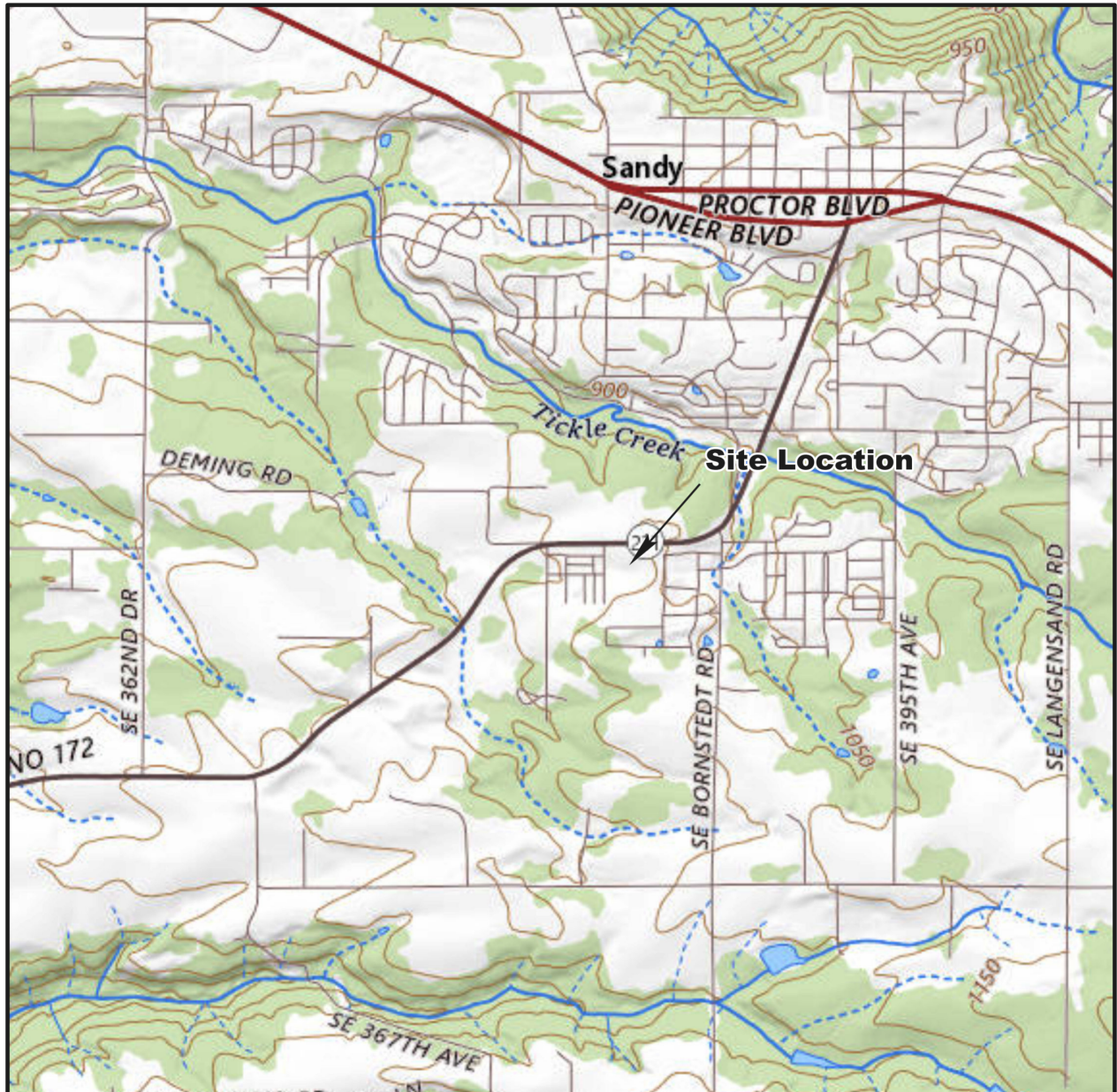
# Appendix A

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## *Figures*

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**Foundation Engineering, Inc.**  
Professional Geotechnical Services



**NOTES:**

1. Base map and contours from ESRI and USGS



SCALE: 1" = 2,400'



**VICINITY MAP**

Sandy Housing Development  
Sandy, Oregon

FIGURE NO.

**1A**

PROJECT NO. 2211038	DATE: 5/3/2021	DRAWN BY: NMV
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**LEGEND**



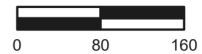
Approximate Test Pit Location

**NOTES:**

1. Test pit locations were collected with mobile GPS and are approximate.
2. Base map provided by ESRI.



SCALE: 1" = 160'



**SITE PLAN**

FIGURE NO.

Sandy Housing Development  
Sandy, Oregon

**2A**

PROJECT NO.  
2211038

DATE:  
5/3/2021

DRAWN BY:  
NMV




Date & Time: Tue, Apr 27, 2021, 09:50:03 PDT  
 Position: +045.385364° / -122.269686° (+64.4ft)  
 Altitude: 983ft (+36.1ft)  
 Datum: WGS-84  
 Azimuth/Bearing: 202° S22W 3591mils True (±12°)  
 Elevation Angle: -02.5°  
 Horizon Angle: -01.2°  
 Zoom: 1.0X

Photo 1: West side of the property, looking southwest.



Date & Time: Thu, Apr 22, 2021, 14:44:56 PDT  
 Position: +045.384186° / -122.268846° (+84.3ft)  
 Altitude: 1007ft (+57.3ft)  
 Datum: WGS-84  
 Azimuth/Bearing: 355° N05W 6311mils True (±12°)  
 Elevation Angle: -03.7°  
 Horizon Angle: +00.4°  
 Zoom: 1.0X

Photo 2: East side of the property, looking north.

 <b>Foundation Engineering, Inc.</b> Professional Geotechnical Services			PHOTOGRAPHS		FIGURE NO.:  <b>3A</b>
			Sandy Housing Development Sandy, Oregon		
PROJECT NO.:	DATE:	DRAWN BY:			
2211038	May 3, 2021	NMV			

DRAFT



# Appendix B

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## *Test Pit Logs*

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**Foundation Engineering, Inc.**  
Professional Geotechnical Services

### DISTINCTION BETWEEN FIELD LOGS AND FINAL LOGS

A field log is prepared for each boring or test pit by our field representative. The log contains information concerning sampling depths and the presence of various materials such as gravel, cobbles, and fill, and observations of ground water. It also contains our interpretation of the soil conditions between samples. The final logs presented in this report represent our interpretation of the contents of the field logs and the results of the sample examinations and laboratory test results. Our recommendations are based on the contents of the final logs and the information contained therein and not on the field logs.

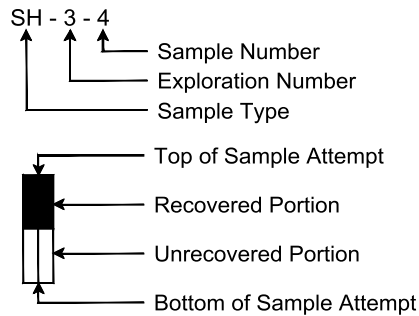
### VARIATION IN SOILS BETWEEN TEST PITS AND BORINGS

The final log and related information depict subsurface conditions only at the specific location and on the date indicated. Those using the information contained herein should be aware that soil conditions at other locations or on other dates may differ. Actual foundation or subgrade conditions should be confirmed by us during construction.

### TRANSITION BETWEEN SOIL OR ROCK TYPES

The lines designating the interface between soil, fill or rock on the final logs and on subsurface profiles presented in the report are determined by interpolation and are therefore approximate. The transition between the materials may be abrupt or gradual. Only at boring or test pit locations should profiles be considered as reasonably accurate and then only to the degree implied by the notes thereon.

### SAMPLE OR TEST SYMBOLS



- C - Pavement Core Sample
- CS - Rock Core Sample
- OS - Oversize Sample (3-inch O.D. split-spoon)
- S - Grab Sample
- SH - Thin-walled Shelby Tube Sample
- SS - Standard Penetration Test Sample (2-inch O.D. split-spoon)

▲ Standard Penetration Test Resistance equals the number of blows a 140 lb. weight falling 30 in. is required to drive a standard split-spoon sampler 1 ft. Practical refusal is equal to 50 or more blows per 6 in. of sampler penetration.

● Water Content (%)

**FIELD SHEAR STRENGTH TEST**

Shear strength measurements on test pit side walls, blocks of soil or Shelby tube samples are typically made with Torvane or Field Vane shear devices.

**WATER TABLE**

▼ Water Table Location

(1/31/16) Date of Measurement

**TYPICAL SOIL/ROCK SYMBOLS**

Concrete	Silt	Basalt
Organics	Sand	Sandstone
Clay	Gravel	Siltstone

**UNIFIED SOIL CLASSIFICATION SYMBOLS**

G - Gravel	W - Well Graded
S - Sand	P - Poorly Graded
M - Silt	L - Low Plasticity
C - Clay	H - High Plasticity
Pt - Peat	O - Organic



SYMBOL KEY  
EXPLORATION LOGS



**Explanation of Common Terms Used in Soil Descriptions**

Field Identification	Cohesive Soils			Granular Soils	
	SPT*	S <sub>u</sub> ** (tsf)	Term	SPT*	Term
Easily penetrated several inches by fist.	0 - 2	< 0.125	Very Soft	0 - 4	Very Loose
Easily penetrated several inches by thumb.	2 - 4	0.125 - 0.25	Soft	4 - 10	Loose
Can be penetrated several inches by thumb with moderate effort.	4 - 8	0.25 - 0.50	Medium Stiff	10 - 30	Medium Dense
Readily indented by thumb but penetrated only with great effort.	8 - 15	0.50 - 1.0	Stiff	30 - 50	Dense
Readily indented by thumbnail.	15 - 30	1.0 - 2.0	Very Stiff	> 50	Very Dense
Indented with difficulty by thumbnail.	> 30	> 2.0	Hard		

\* SPT N-value in blows per foot (bpf)  
 \*\* Undrained shear strength

Term	Soil Moisture Field Description
Dry	Absence of moisture. Dusty. Dry to the touch.
Damp	Soil has moisture. Cohesive soils are below plastic limit and usually moldable.
Moist	Grains appear darkened, but no visible water. Silt/clay will clump. Sand will bulk. Soils are often at or near plastic limit.
Wet	Visible water on larger grain surfaces. Sand and cohesionless silt exhibit dilatancy. Cohesive soil can be readily remolded. Soil leaves wetness on the hand when squeezed. Soil is wetter than the optimum moisture content and above the plastic limit.

Term	PI	Plasticity Field Test
Non-plastic	0 - 3	Cannot be rolled into a thread at any moisture.
Low Plasticity	3 - 15	Can be rolled into a thread with some difficulty.
Medium Plasticity	15 - 30	Easily rolled into thread.
High Plasticity	> 30	Easily rolled and re-rolled into thread.

Term	Soil Structure Criteria
Stratified	Alternating layers at least ¼ inch thick.
Laminated	Alternating layers less than ¼ inch thick.
Fissured	Contains shears and partings along planes of weakness.
Slickensided	Partings appear glossy or striated.
Blocky	Breaks into small lumps that resist further breakdown.
Lensed	Contains pockets of different soils.

Term	Soil Cementation Criteria
Weak	Breaks under light finger pressure.
Moderate	Breaks under hard finger pressure.
Strong	Will not break with finger pressure.

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-1-1		0.70	1.0		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to 1/2-inch diameter, (topsoil).
	2-	S-1-2		0.90	6.0		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, (residual soil).
	3-			>1.00			
	4-	S-1-3		±1.00	9.0		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	5-						
	6-						
	7-						
	8-						
	9-						
					9.0		BOTTOM OF EXPLORATION

Project No.: 2211038

Test Pit Log: TP- 1

Surface Elevation: N/A (Approx.)

Sandy Housing Development

Date of Test Pit: April 27, 2021

Sandy, Oregon

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-2-1		0.86	1.0		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-	S-2-2		0.90	8.0		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, (residual soil).
	3-			±1.00			
	4-	S-2-3		>1.00	10.0		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	5-						
	6-						
	7-						
	8-						
	9-						
10-					10.0		BOTTOM OF EXPLORATION

Project No.: 2211038

Test Pit Log: TP- 2

Surface Elevation: N/A (Approx.)

Sandy Housing Development

Date of Test Pit: April 27, 2021

Sandy, Oregon

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-3-1		0.56	1.0		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-			±1.00		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, (residual soil).	
	3-			±1.00			
	4-			>1.00			
	5-						
	6-						
	7-						
	8-			8.0			Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	9-			10.0		BOTTOM OF EXPLORATION	
	10-						

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

**Test Pit Log: TP- 3**  
**Sandy Housing Development**  
**Sandy, Oregon**

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-4-1		0.50	1.5		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-	S-4-2		0.84		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, blocky structure, (residual soil).	
	3-			0.92			
	4-			0.90			
	5-						
	6-	6.0		Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).			
	7-	S-4-3					
	8-						
	9-	9.0	BOTTOM OF EXPLORATION				

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

**Test Pit Log: TP- 4**  
**Sandy Housing Development**  
**Sandy, Oregon**

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-5-1		0.40	0.6		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-	S-5-2		±1.00			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, blocky structure, (residual soil).
	3-			±1.00			
	4-			>1.00			
	5-						
	6-						
	7-	S-5-3					
	8-					7.5	Very stiff to hard CLAY, some sand (CH); red-brown mottled light brown, moist, high plasticity, fine to medium sand, blocky structure, relict rock texture, (residual soil).
	9-					9.0	BOTTOM OF EXPLORATION

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021










**Test Pit Log: TP- 5**  
**Sandy Housing Development**  
**Sandy, Oregon**

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-6-1		0.50	1.0		Medium stiff to stiff silty CLAY, trace sand, scattered organics, (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).
	2-	S-6-2		0.84			Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-			0.70			
	4-			±1.00			
	5-						
	6-	S-6-3					
	7-						
	8-						
	9-					8.5	BOTTOM OF EXPLORATION

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021










**Test Pit Log: TP- 6**  
**Sandy Housing Development**  
**Sandy, Oregon**

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description	
No seepage or groundwater encountered to the limit of exploration.	1-	S-7-1		0.46	1.0		Medium stiff to stiff silty CLAY, some organics, trace sand (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of roots up to ±1/2-inch diameter, (topsoil).	
	2-	S-7-2		0.88	8.0		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure (residual soil).	
	3-			0.94				
	4-	S-7-3			8.0			
	5-							
	6-							
	7-							
	8-							
					8.0		BOTTOM OF EXPLORATION	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021








**Test Pit Log: TP- 7**  
**Sandy Housing Development**  
**Sandy, Oregon**

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description	
No seepage or groundwater encountered to the limit of exploration.	1-	S-8-1		0.38	1.3		Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).	
	2-	S-8-2		±1.00	9.0		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).	
	3-			0.88				
	4-	S-8-3			9.0			
	5-							
	6-							
	7-							
	8-							
9-					9.0		BOTTOM OF EXPLORATION	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021







**Test Pit Log: TP- 8**  
**Sandy Housing Development**  
**Sandy, Oregon**

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-9-1		0.40			Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-			0.72	1.5		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-	S-9-2		±1.00			
	4-						
	5-						
	6-	S-9-3					
	7-						
	8-	S-9-4					
	9-					9.0	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021








**Test Pit Log: TP- 9**  
**Sandy Housing Development**  
**Sandy, Oregon**

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-10-1		0.42			Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-			0.48	1.0		Stiff to very stiff CLAY, trace sand, scattered organics (CH); red-brown, dry to damp, high plasticity, fine sand, organics consist of black wood fragments and fine roots, lenses of brown clay, blocky structure, (residual soil).
	3-	S-10-2		0.70			
	4-				±1.00		
	5-						
	6-	S-10-3					
	7-					6.5	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021







**Test Pit Log: TP-10**  
**Sandy Housing Development**  
**Sandy, Oregon**

DRAFT

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-11-1		0.40	1.0		Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-	S-11-2		±1.00			
	3-			0.74			
	4-			>1.00			
	5-						
	6-	S-11-3					
	7-						
	8-	S-11-4					
	9-					8.5	

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

**Test Pit Log: TP-11**  
**Sandy Housing Development**  
**Sandy, Oregon**

Comments	Depth, Feet	Sample #	Location	C, TSF	Elev. Depth	Symbol	Soil and Rock Description
No seepage or groundwater encountered to the limit of exploration.	1-	S-12-1		0.38	1.3		Medium stiff to stiff silty CLAY, trace sand, scattered organics (CL); brown, dry to damp, low to medium plasticity, fine sand, organics consist of fine roots, (topsoil).
	2-			±1.00			
	3-	S-12-2		>1.00			
	4-			>1.00			
	5-						
	6-						
	7-						
	8-						
	9-	S-12-3					
10-					9.5		BOTTOM OF EXPLORATION

Project No.: 2211038  
 Surface Elevation: N/A (Approx.)  
 Date of Test Pit: April 27, 2021

**Test Pit Log: TP-12**  
**Sandy Housing Development**  
**Sandy, Oregon**



## Appendix B – Soil Survey Report




Soil Map—Clackamas County Area, Oregon  
(Cascade Creek Soils Report)



Soil Map—Clackamas County Area, Oregon  
(Cascade Creek Soils Report)


**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: Clackamas County Area, Oregon  
Survey Area Data: Version 18, Oct 27, 2021

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

Date(s) aerial images were photographed: Jun 22, 2020—Jun 26, 2020

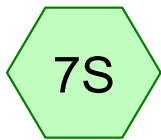
The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Map Unit Legend

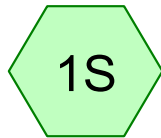
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
15B	Cazadero silty clay loam, 0 to 7 percent slopes	9.1	100.0%
<b>Totals for Area of Interest</b>		<b>9.1</b>	<b>100.0%</b>



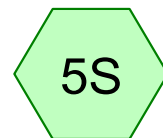
## Appendix C – Basin Analysis, Data, and Detention Sizing



Basin 1



Basin 2



Basin 3



**Routing Diagram for Cascade Creek Predeveloped**  
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**Cascade Creek Predeveloped**

Prepared by BCRA, Inc

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Page 2

**Rainfall Events Listing**

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-year	Type IA 24-hr		Default	24.00	1	3.50	2
2	5-year	Type IA 24-hr		Default	24.00	1	4.50	2
3	10-year	Type IA 24-hr		Default	24.00	1	4.80	2
4	25-year	Type IA 24-hr		Default	24.00	1	5.50	2

**Cascade Creek Predeveloped**

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Page 3

**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.658	98	Paved roads w/curbs & sewers, HSG B (1S, 7S)
0.594	72	Pre-Developed Pervious (5S)
8.123	72	Predeveloped Pervious (1S, 7S)
<b>9.375</b>	<b>74</b>	<b>TOTAL AREA</b>

**Cascade Creek Predeveloped**

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Page 4

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.658	HSG B	1S, 7S
0.000	HSG C	
0.000	HSG D	
8.717	Other	1S, 5S, 7S
<b>9.375</b>		<b>TOTAL AREA</b>



**Cascade Creek Predeveloped**

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Page 5

**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.658	0.000	0.000	0.000	0.658	Paved roads w/curbs & sewers	1S, 7S
0.000	0.000	0.000	0.000	0.594	0.594	Pre-Developed Pervious	5S
0.000	0.000	0.000	0.000	8.123	8.123	Predeveloped Pervious	1S, 7S
<b>0.000</b>	<b>0.658</b>	<b>0.000</b>	<b>0.000</b>	<b>8.717</b>	<b>9.375</b>	<b>TOTAL AREA</b>	

**Cascade Creek Predeveloped**

Type IA 24-hr 2-year Rainfall=3.50"

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Page 6

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Basin 2** Runoff Area=8.299 ac 3.72% Impervious Runoff Depth>0.98"  
Flow Length=685' Slope=0.0511 '/' Tc=10.1 min CN=72/98 Runoff=1.75 cfs 0.678 af

**Subcatchment5S: Basin 3** Runoff Area=0.594 ac 0.00% Impervious Runoff Depth>0.92"  
Flow Length=217' Slope=0.0370 '/' Tc=12.1 min CN=72/0 Runoff=0.11 cfs 0.045 af

**Subcatchment7S: Basin 1** Runoff Area=0.482 ac 72.41% Impervious Runoff Depth>2.15"  
Flow Length=565' Slope=0.0280 '/' Tc=2.8 min CN=72/98 Runoff=0.32 cfs 0.086 af

**Total Runoff Area = 9.375 ac Runoff Volume = 0.809 af Average Runoff Depth = 1.04"**  
**92.98% Pervious = 8.717 ac 7.02% Impervious = 0.658 ac**

**Cascade Creek Predeveloped**

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Type IA 24-hr 2-year Rainfall=3.50"

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Page 7

**Summary for Subcatchment 1S: Basin 2**

Runoff = 1.75 cfs @ 8.02 hrs, Volume= 0.678 af, Depth> 0.98"  
 Routed to nonexistent node 6P

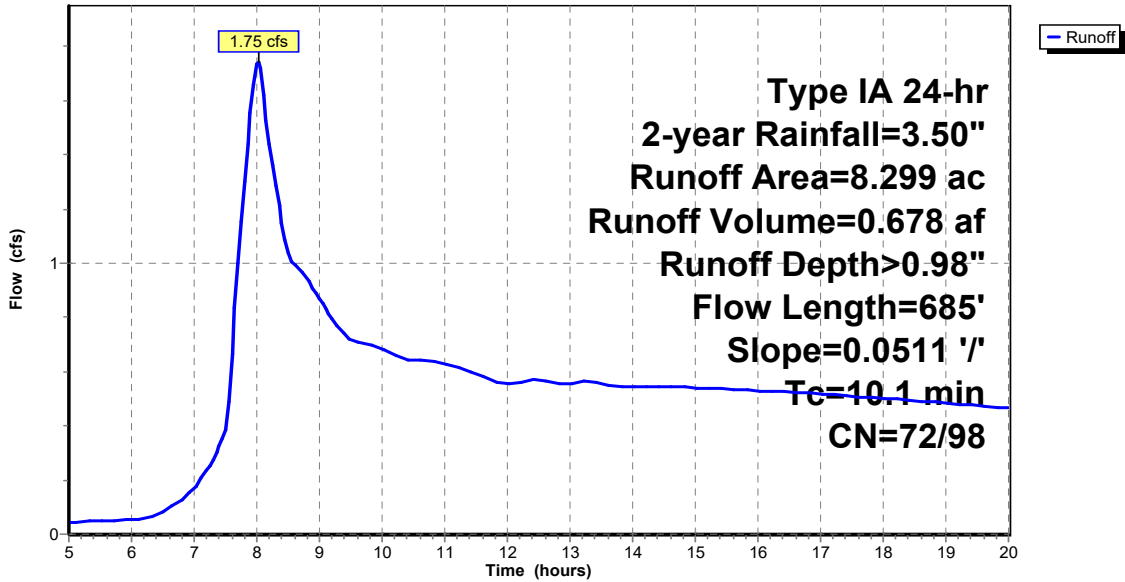
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-year Rainfall=3.50"

Area (ac)	CN	Description
0.309	98	Paved roads w/curbs & sewers, HSG B
* 7.990	72	Predeveloped Pervious
8.299	73	Weighted Average
7.990	72	96.28% Pervious Area
0.309	98	3.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	685	0.0511	1.13		Shallow Concentrated Flow, Northeast to "pond" Woodland Kv= 5.0 fps

**Subcatchment 1S: Basin 2**

Hydrograph



**Cascade Creek Predeveloped**

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Type IA 24-hr 2-year Rainfall=3.50"

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Page 8

**Summary for Subcatchment 5S: Basin 3**

Runoff = 0.11 cfs @ 8.03 hrs, Volume= 0.045 af, Depth> 0.92"

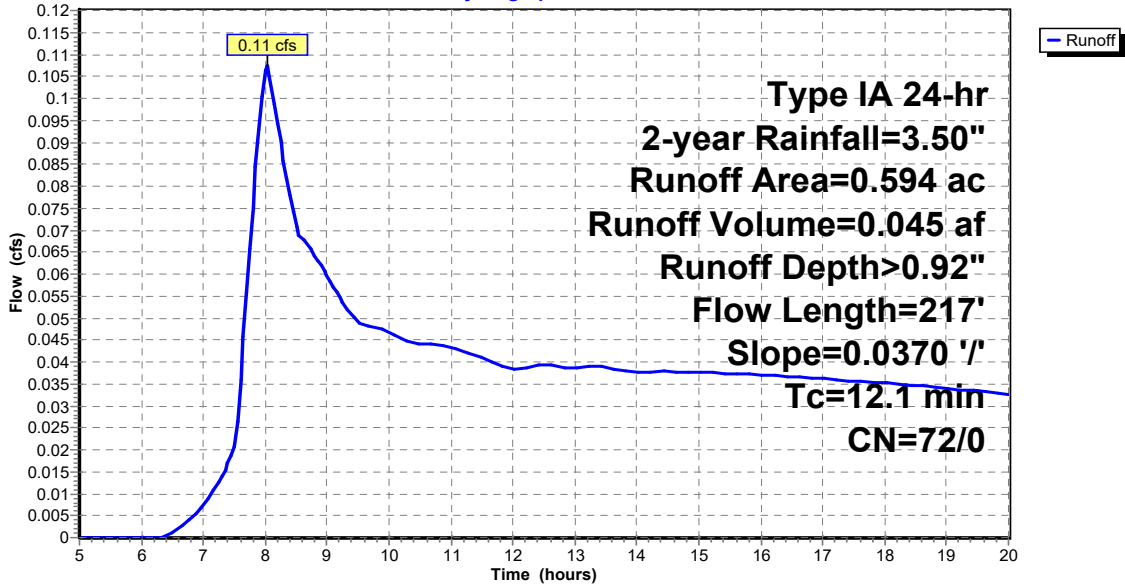
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type IA 24-hr 2-year Rainfall=3.50"

Area (ac)	CN	Description
* 0.594	72	Pre-Developed Pervious
0.594	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	217	0.0370	0.30		Sheet Flow, South high point to East exit point Range n= 0.130 P2= 3.50"

**Subcatchment 5S: Basin 3**

Hydrograph



**Cascade Creek Predeveloped**

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Type IA 24-hr 2-year Rainfall=3.50"

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Page 9

**Summary for Subcatchment 7S: Basin 1**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.32 cfs @ 7.87 hrs, Volume= 0.086 af, Depth> 2.15"  
 Routed to nonexistent node 6P

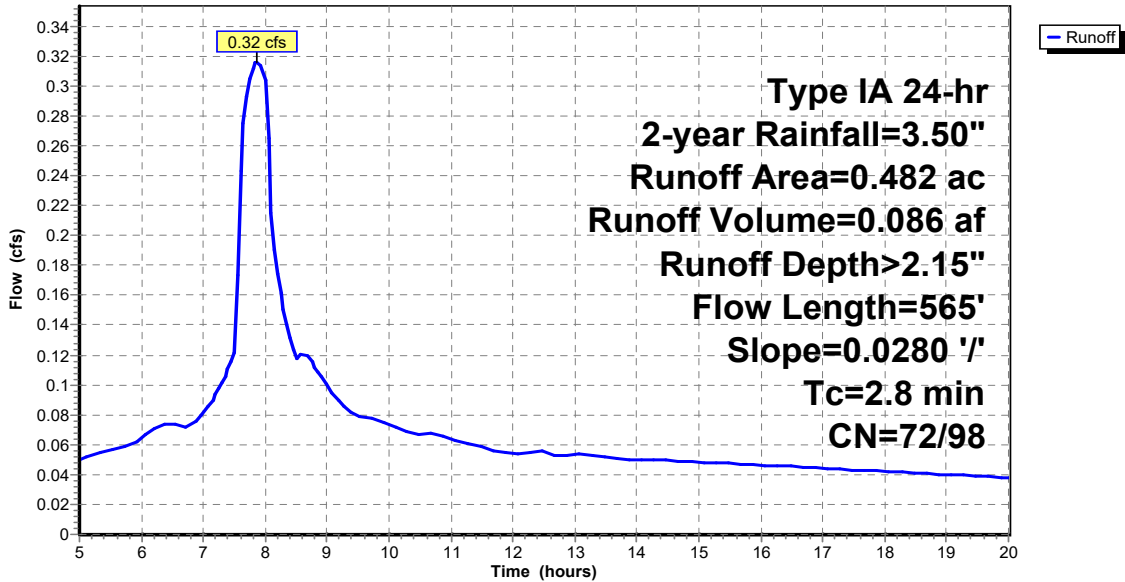
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-year Rainfall=3.50"

Area (ac)	CN	Description
0.349	98	Paved roads w/curbs & sewers, HSG B
* 0.133	72	Predeveloped Pervious
0.482	91	Weighted Average
0.133	72	27.59% Pervious Area
0.349	98	72.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	565	0.0280	3.40		<b>Shallow Concentrated Flow, Roadway</b> Paved Kv= 20.3 fps

**Subcatchment 7S: Basin 1**

Hydrograph



**Cascade Creek Predeveloped**

Type IA 24-hr 5-year Rainfall=4.50"

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Page 10

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Basin 2** Runoff Area=8.299 ac 3.72% Impervious Runoff Depth>1.59"  
Flow Length=685' Slope=0.0511 '/' Tc=10.1 min CN=72/98 Runoff=3.18 cfs 1.101 af

**Subcatchment5S: Basin 3** Runoff Area=0.594 ac 0.00% Impervious Runoff Depth>1.52"  
Flow Length=217' Slope=0.0370 '/' Tc=12.1 min CN=72/0 Runoff=0.21 cfs 0.075 af

**Subcatchment7S: Basin 1** Runoff Area=0.482 ac 72.41% Impervious Runoff Depth>2.87"  
Flow Length=565' Slope=0.0280 '/' Tc=2.8 min CN=72/98 Runoff=0.43 cfs 0.115 af

**Total Runoff Area = 9.375 ac Runoff Volume = 1.291 af Average Runoff Depth = 1.65"**  
**92.98% Pervious = 8.717 ac 7.02% Impervious = 0.658 ac**

**Cascade Creek Predeveloped**

Type IA 24-hr 5-year Rainfall=4.50"

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Page 11

**Summary for Subcatchment 1S: Basin 2**

Runoff = 3.18 cfs @ 8.01 hrs, Volume= 1.101 af, Depth> 1.59"  
 Routed to nonexistent node 6P

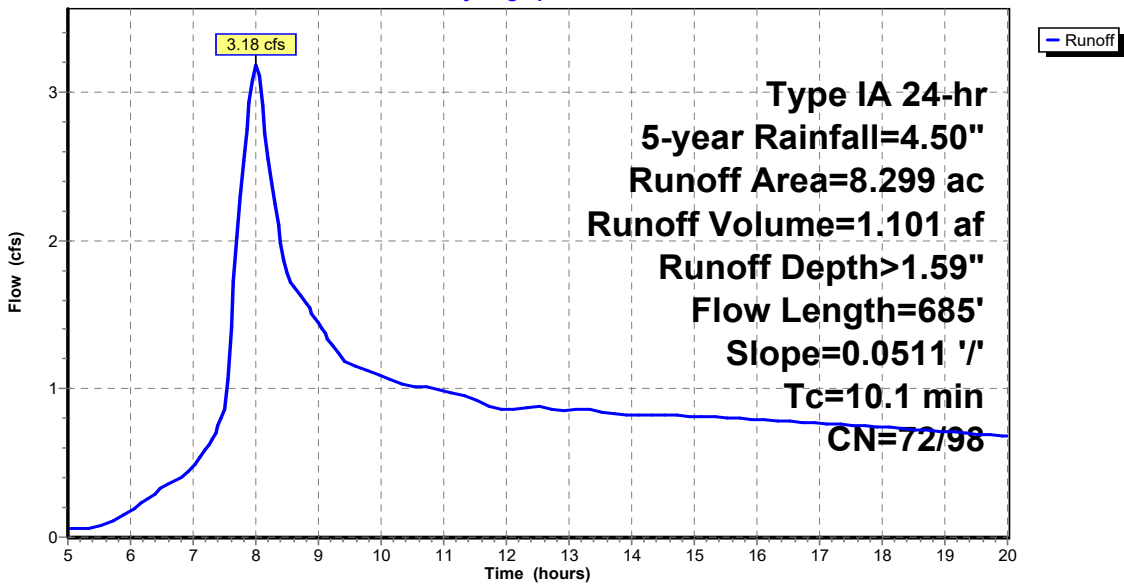
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 5-year Rainfall=4.50"

Area (ac)	CN	Description
0.309	98	Paved roads w/curbs & sewers, HSG B
* 7.990	72	Predeveloped Pervious
8.299	73	Weighted Average
7.990	72	96.28% Pervious Area
0.309	98	3.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	685	0.0511	1.13		Shallow Concentrated Flow, Northeast to "pond" Woodland Kv= 5.0 fps

**Subcatchment 1S: Basin 2**

Hydrograph



**Cascade Creek Predeveloped**

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Type IA 24-hr 5-year Rainfall=4.50"

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Page 12

**Summary for Subcatchment 5S: Basin 3**

Runoff = 0.21 cfs @ 8.02 hrs, Volume= 0.075 af, Depth> 1.52"

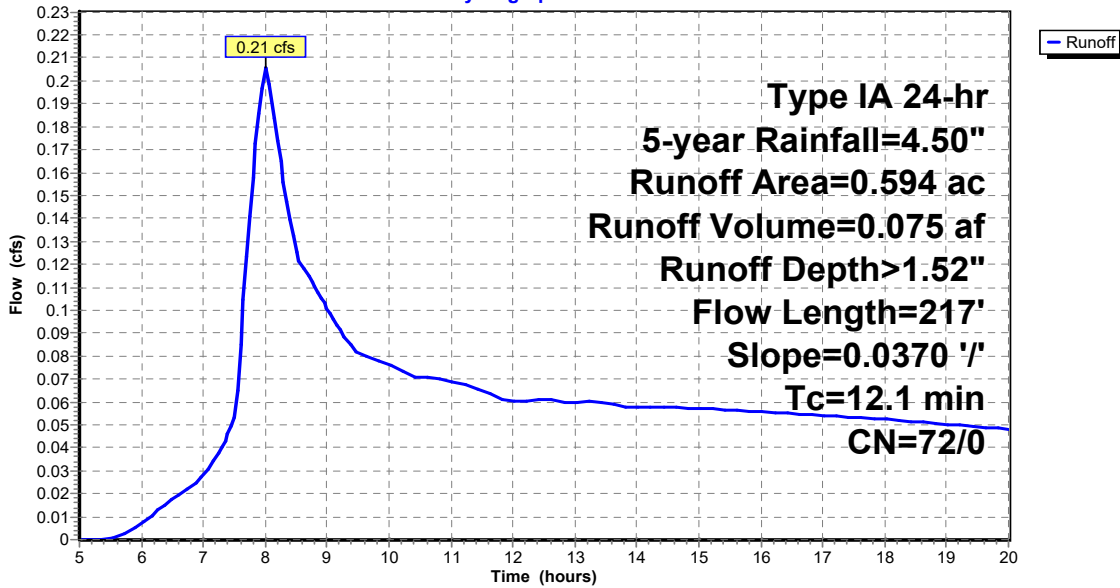
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type IA 24-hr 5-year Rainfall=4.50"

Area (ac)	CN	Description
* 0.594	72	Pre-Developed Pervious
0.594	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	217	0.0370	0.30		Sheet Flow, South high point to East exit point Range n= 0.130 P2= 3.50"

**Subcatchment 5S: Basin 3**

Hydrograph





**Cascade Creek Predeveloped**

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Type IA 24-hr 5-year Rainfall=4.50"

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Page 13

**Summary for Subcatchment 7S: Basin 1**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.43 cfs @ 7.87 hrs, Volume= 0.115 af, Depth> 2.87"  
 Routed to nonexistent node 6P

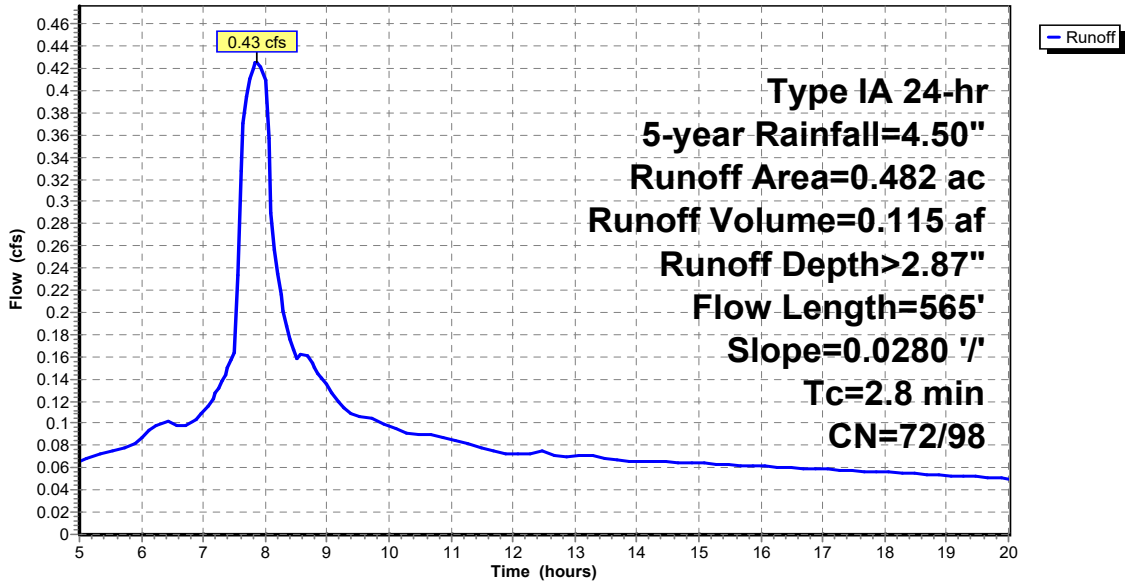
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 5-year Rainfall=4.50"

Area (ac)	CN	Description
0.349	98	Paved roads w/curbs & sewers, HSG B
* 0.133	72	Predeveloped Pervious
0.482	91	Weighted Average
0.133	72	27.59% Pervious Area
0.349	98	72.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	565	0.0280	3.40		Shallow Concentrated Flow, Roadway Paved Kv= 20.3 fps

**Subcatchment 7S: Basin 1**

Hydrograph



**Cascade Creek Predeveloped**

Type IA 24-hr 10-year Rainfall=4.80"

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Page 14

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Basin 2** Runoff Area=8.299 ac 3.72% Impervious Runoff Depth>1.79"  
Flow Length=685' Slope=0.0511 '/' Tc=10.1 min CN=72/98 Runoff=3.65 cfs 1.237 af

**Subcatchment5S: Basin 3** Runoff Area=0.594 ac 0.00% Impervious Runoff Depth>1.71"  
Flow Length=217' Slope=0.0370 '/' Tc=12.1 min CN=72/0 Runoff=0.24 cfs 0.085 af

**Subcatchment7S: Basin 1** Runoff Area=0.482 ac 72.41% Impervious Runoff Depth>3.09"  
Flow Length=565' Slope=0.0280 '/' Tc=2.8 min CN=72/98 Runoff=0.46 cfs 0.124 af

**Total Runoff Area = 9.375 ac Runoff Volume = 1.446 af Average Runoff Depth = 1.85"**  
**92.98% Pervious = 8.717 ac 7.02% Impervious = 0.658 ac**

**Cascade Creek Predeveloped**

Type IA 24-hr 10-year Rainfall=4.80"

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Page 15

**Summary for Subcatchment 1S: Basin 2**

Runoff = 3.65 cfs @ 8.00 hrs, Volume= 1.237 af, Depth> 1.79"  
 Routed to nonexistent node 6P

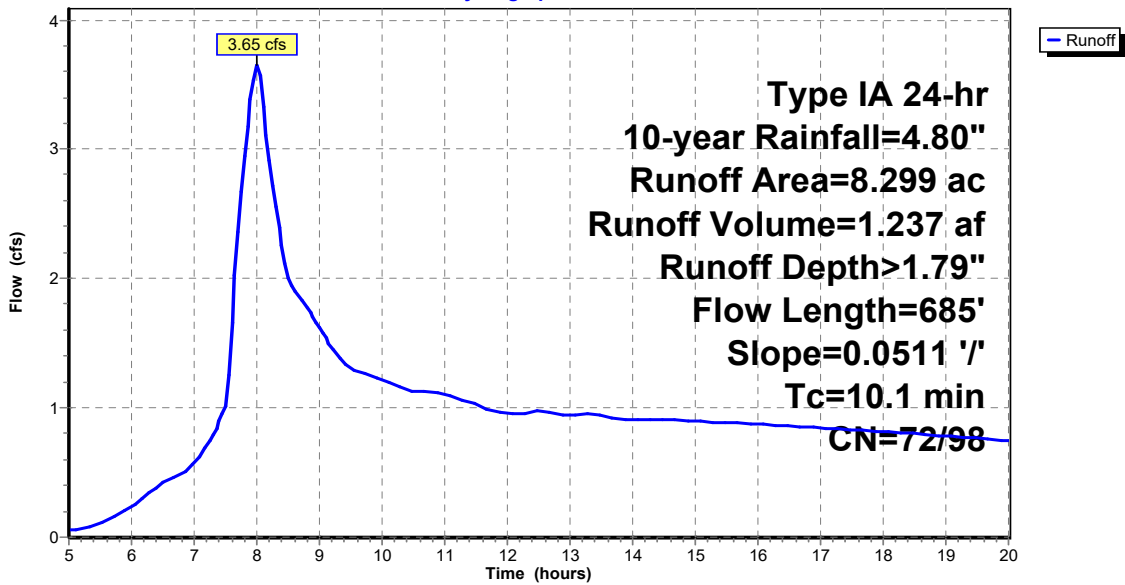
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 10-year Rainfall=4.80"

Area (ac)	CN	Description
0.309	98	Paved roads w/curbs & sewers, HSG B
* 7.990	72	Predeveloped Pervious
8.299	73	Weighted Average
7.990	72	96.28% Pervious Area
0.309	98	3.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	685	0.0511	1.13		Shallow Concentrated Flow, Northeast to "pond" Woodland Kv= 5.0 fps

**Subcatchment 1S: Basin 2**

Hydrograph



**Cascade Creek Predeveloped**

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Type IA 24-hr 10-year Rainfall=4.80"

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Page 16

**Summary for Subcatchment 5S: Basin 3**

Runoff = 0.24 cfs @ 8.02 hrs, Volume= 0.085 af, Depth> 1.71"

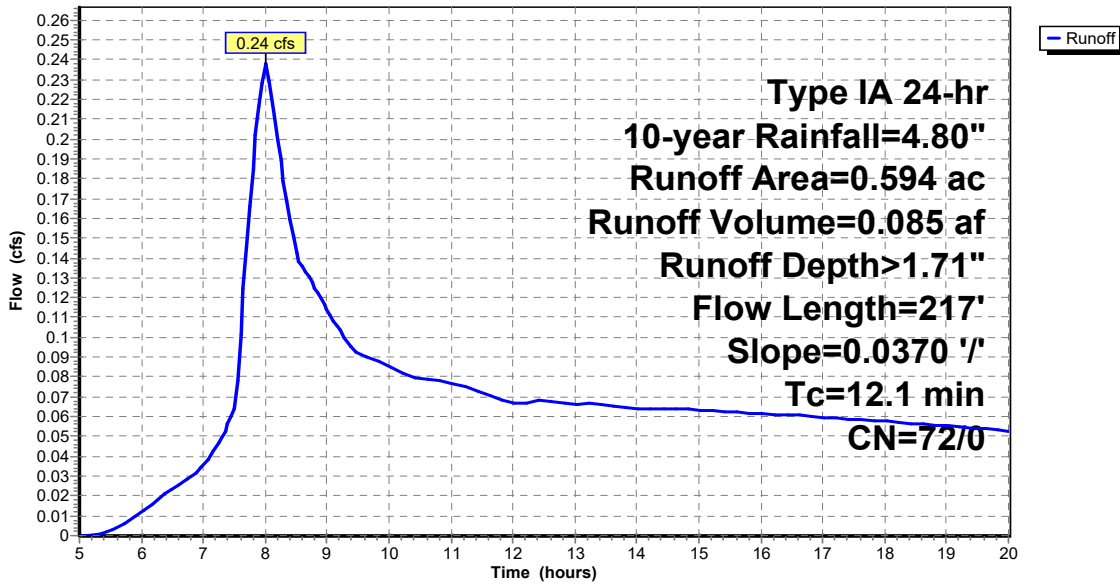
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type IA 24-hr 10-year Rainfall=4.80"

Area (ac)	CN	Description
* 0.594	72	Pre-Developed Pervious
0.594	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	217	0.0370	0.30		Sheet Flow, South high point to East exit point Range n= 0.130 P2= 3.50"

**Subcatchment 5S: Basin 3**

Hydrograph



**Cascade Creek Predeveloped**

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Type IA 24-hr 10-year Rainfall=4.80"

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Page 17

**Summary for Subcatchment 7S: Basin 1**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.46 cfs @ 7.87 hrs, Volume= 0.124 af, Depth> 3.09"  
 Routed to nonexistent node 6P

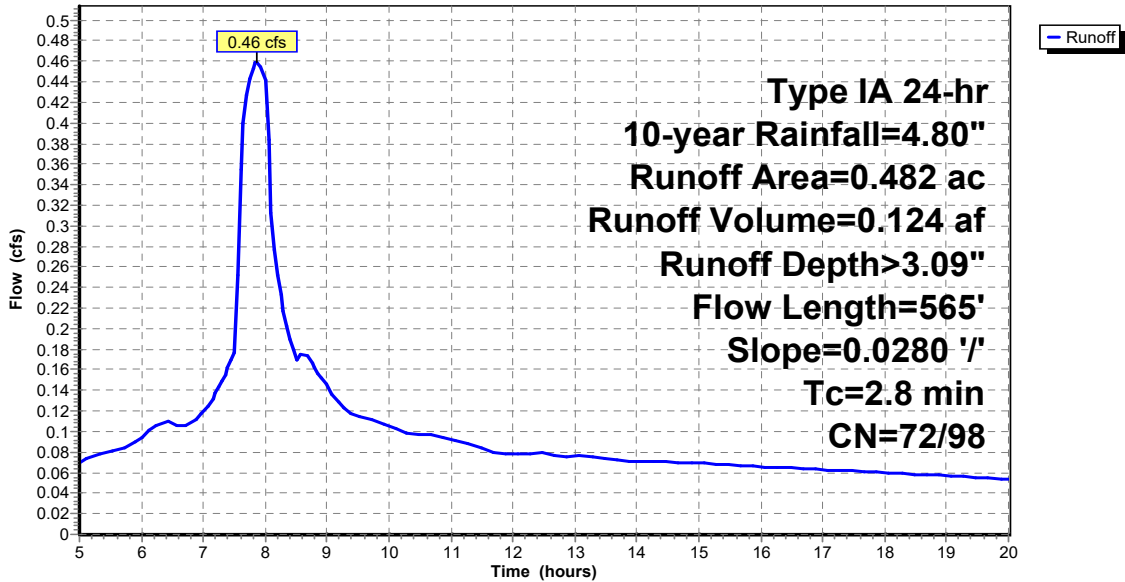
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 10-year Rainfall=4.80"

Area (ac)	CN	Description
0.349	98	Paved roads w/curbs & sewers, HSG B
* 0.133	72	Predeveloped Pervious
0.482	91	Weighted Average
0.133	72	27.59% Pervious Area
0.349	98	72.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	565	0.0280	3.40		Shallow Concentrated Flow, Roadway Paved Kv= 20.3 fps

**Subcatchment 7S: Basin 1**

Hydrograph



**Cascade Creek Predeveloped**

Type IA 24-hr 25-year Rainfall=5.50"

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Page 18

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Basin 2** Runoff Area=8.299 ac 3.72% Impervious Runoff Depth>2.27"  
Flow Length=685' Slope=0.0511 '/' Tc=10.1 min CN=72/98 Runoff=4.79 cfs 1.568 af

**Subcatchment5S: Basin 3** Runoff Area=0.594 ac 0.00% Impervious Runoff Depth>2.19"  
Flow Length=217' Slope=0.0370 '/' Tc=12.1 min CN=72/0 Runoff=0.32 cfs 0.108 af

**Subcatchment7S: Basin 1** Runoff Area=0.482 ac 72.41% Impervious Runoff Depth>3.61"  
Flow Length=565' Slope=0.0280 '/' Tc=2.8 min CN=72/98 Runoff=0.54 cfs 0.145 af

**Total Runoff Area = 9.375 ac Runoff Volume = 1.822 af Average Runoff Depth = 2.33"**  
**92.98% Pervious = 8.717 ac 7.02% Impervious = 0.658 ac**

**Cascade Creek Predeveloped**

Type IA 24-hr 25-year Rainfall=5.50"

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Page 19

**Summary for Subcatchment 1S: Basin 2**

Runoff = 4.79 cfs @ 8.00 hrs, Volume= 1.568 af, Depth> 2.27"  
 Routed to nonexistent node 6P

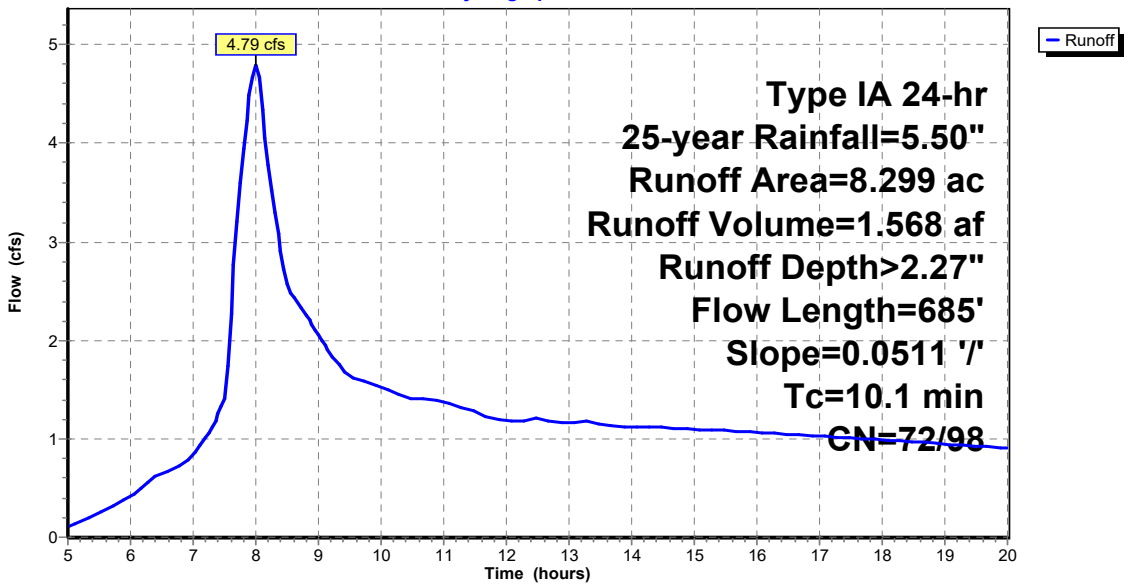
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
0.309	98	Paved roads w/curbs & sewers, HSG B
* 7.990	72	Predeveloped Pervious
8.299	73	Weighted Average
7.990	72	96.28% Pervious Area
0.309	98	3.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.1	685	0.0511	1.13		Shallow Concentrated Flow, Northeast to "pond" Woodland Kv= 5.0 fps

**Subcatchment 1S: Basin 2**

Hydrograph



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Type IA 24-hr 25-year Rainfall=5.50"

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Page 20

**Summary for Subcatchment 5S: Basin 3**

Runoff = 0.32 cfs @ 8.01 hrs, Volume= 0.108 af, Depth> 2.19"

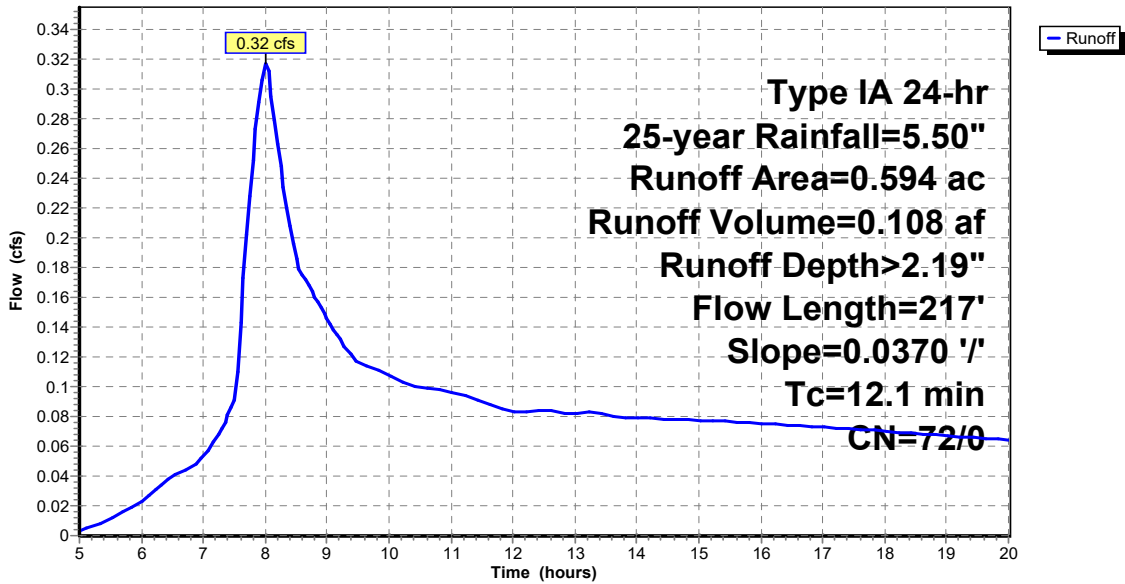
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
* 0.594	72	Pre-Developed Pervious
0.594	72	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.1	217	0.0370	0.30		Sheet Flow, South high point to East exit point Range n= 0.130 P2= 3.50"

**Subcatchment 5S: Basin 3**

Hydrograph





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Type IA 24-hr 25-year Rainfall=5.50"

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Page 21

**Summary for Subcatchment 7S: Basin 1**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.54 cfs @ 7.87 hrs, Volume= 0.145 af, Depth> 3.61"  
 Routed to nonexistent node 6P

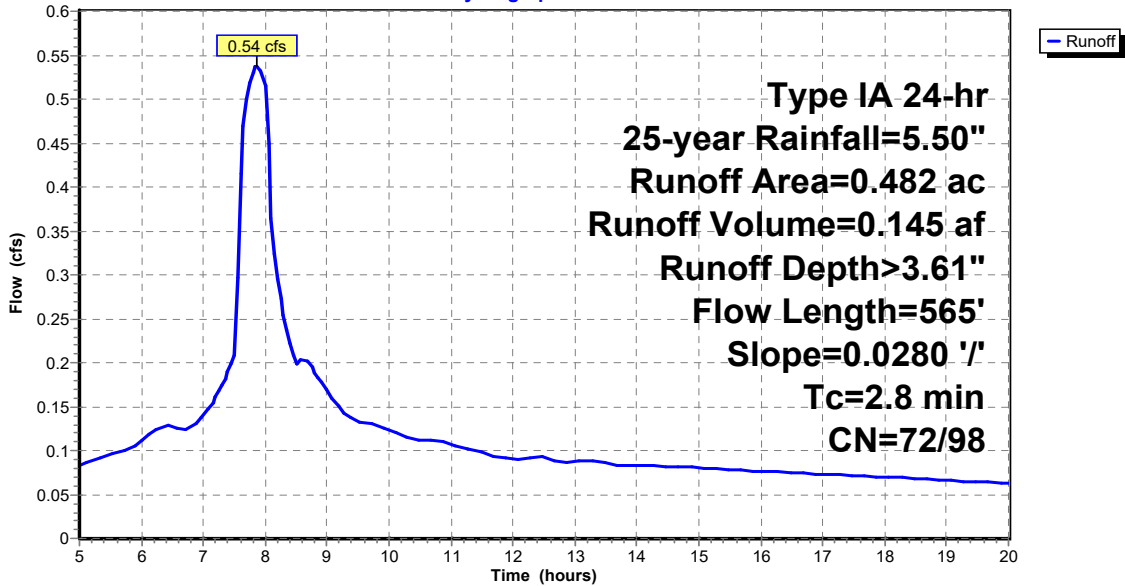
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
0.349	98	Paved roads w/curbs & sewers, HSG B
* 0.133	72	Predeveloped Pervious
0.482	91	Weighted Average
0.133	72	27.59% Pervious Area
0.349	98	72.41% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	565	0.0280	3.40		<b>Shallow Concentrated Flow, Roadway</b> Paved Kv= 20.3 fps

**Subcatchment 7S: Basin 1**

Hydrograph



## **Cascade Creek Predeveloped**

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*Table of Contents*

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### **TABLE OF CONTENTS**

#### **Project Reports**

- 1 Routing Diagram
- 2 Rainfall Events Listing
- 3 Area Listing (all nodes)
- 4 Soil Listing (all nodes)
- 5 Ground Covers (all nodes)

#### **2-year Event**

- 6 Node Listing
- 7 Subcat 1S: Basin 2
- 8 Subcat 5S: Basin 3
- 9 Subcat 7S: Basin 1

#### **5-year Event**

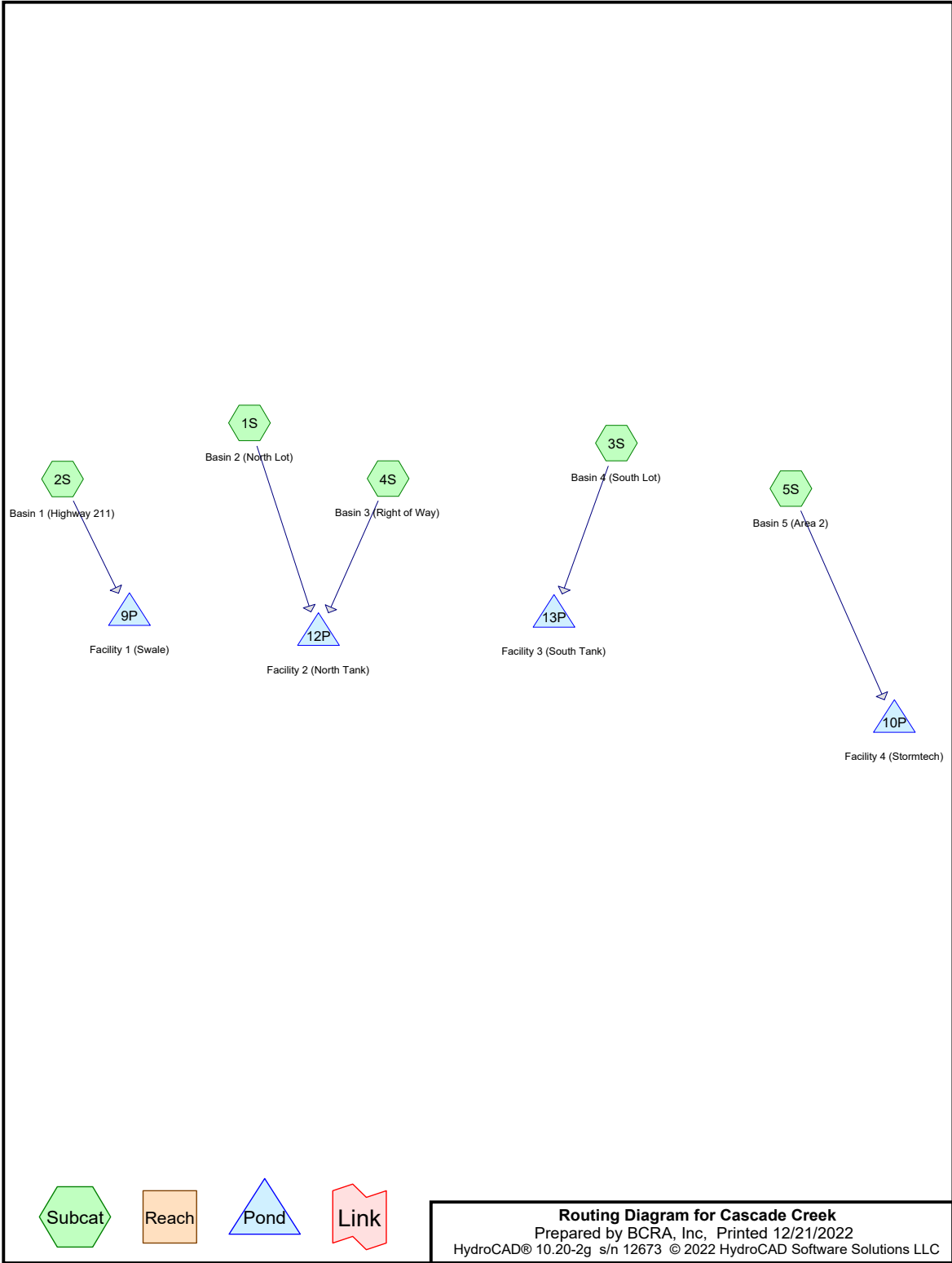
- 10 Node Listing
- 11 Subcat 1S: Basin 2
- 12 Subcat 5S: Basin 3
- 13 Subcat 7S: Basin 1

#### **10-year Event**

- 14 Node Listing
- 15 Subcat 1S: Basin 2
- 16 Subcat 5S: Basin 3
- 17 Subcat 7S: Basin 1

#### **25-year Event**

- 18 Node Listing
- 19 Subcat 1S: Basin 2
- 20 Subcat 5S: Basin 3
- 21 Subcat 7S: Basin 1



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Page 2

**Rainfall Events Listing**

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-year	Type IA 24-hr		Default	24.00	1	3.50	2
2	5-year	Type IA 24-hr		Default	24.00	1	4.50	2
3	10-year	Type IA 24-hr		Default	24.00	1	4.80	2
4	25-year	Type IA 24-hr		Default	24.00	1	5.50	2

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Page 3

**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.085	56	>75% Grass cover, Good, HSG B (2S)
4.343	56	Lawn (1S, 3S, 4S, 5S)
1.288	98	Paved parking, HSG B (1S, 5S)
2.383	98	Paved roads w/curbs & sewers, HSG B (3S, 4S)
0.473	98	Paved roads w/open ditches, 50% imp, HSG B (2S)
0.433	98	Roofs, HSG B (1S)
0.428	98	Unconnected roofs, HSG B (3S)
<b>9.433</b>	<b>78</b>	<b>TOTAL AREA</b>

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Page 4

**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
5.090	HSG B	1S, 2S, 3S, 4S, 5S
0.000	HSG C	
0.000	HSG D	
4.343	Other	1S, 3S, 4S, 5S
<b>9.433</b>		<b>TOTAL AREA</b>

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Page 5

**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.085	0.000	0.000	0.000	0.085	>75% Grass cover, Good	
0.000	0.000	0.000	0.000	4.343	4.343	Lawn	
0.000	1.288	0.000	0.000	0.000	1.288	Paved parking	
0.000	2.383	0.000	0.000	0.000	2.383	Paved roads w/curbs & sewers	
0.000	0.473	0.000	0.000	0.000	0.473	Paved roads w/open ditches, 50% imp	
0.000	0.433	0.000	0.000	0.000	0.433	Roofs	
0.000	0.428	0.000	0.000	0.000	0.428	Unconnected roofs	
<b>0.000</b>	<b>5.090</b>	<b>0.000</b>	<b>0.000</b>	<b>4.343</b>	<b>9.433</b>	<b>TOTAL AREA</b>	

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Page 6

**Pipe Listing (all nodes)**

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1S	0.00	0.00	230.0	0.0300	0.013	0.0	12.0	0.0
2	3S	0.00	0.00	365.0	0.0200	0.013	0.0	12.0	0.0
3	4S	0.00	0.00	25.0	0.0200	0.013	0.0	12.0	0.0
4	5S	0.00	0.00	36.0	0.0200	0.013	0.0	12.0	0.0



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Type IA 24-hr 2-year Rainfall=3.50"

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Page 7

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Basin 2 (North Lot)** Runoff Area=2.489 ac 60.71% Impervious Runoff Depth>1.70"  
Flow Length=544' Tc=13.0 min CN=56/98 Runoff=1.13 cfs 0.352 af

**Subcatchment2S: Basin 1 (Highway 211)** Runoff Area=0.558 ac 42.38% Impervious Runoff Depth>2.19"  
Flow Length=549' Slope=0.0250 '/' Tc=7.8 min CN=87/98 Runoff=0.36 cfs 0.102 af

**Subcatchment3S: Basin 4 (South Lot)** Runoff Area=3.075 ac 47.67% Impervious Runoff Depth>1.39"  
Flow Length=543' Tc=6.8 min CN=56/98 Runoff=1.18 cfs 0.356 af

**Subcatchment4S: Basin 3 (Right of Way)** Runoff Area=3.068 ac 43.84% Impervious Runoff Depth>1.30"  
Flow Length=365' Tc=10.1 min CN=56/98 Runoff=1.05 cfs 0.333 af

**Subcatchment5S: Basin 5 (Area 2)** Runoff Area=0.243 ac 86.42% Impervious Runoff Depth>2.29"  
Flow Length=116' Tc=0.9 min CN=56/98 Runoff=0.18 cfs 0.046 af

**Pond 9P: Facility 1 (Swale)** Peak Elev=-1.31' Storage=0.007 af Inflow=0.36 cfs 0.102 af  
Outflow=0.30 cfs 0.099 af

**Pond 10P: Facility 4 (Stormtech)** Peak Elev=0.91' Storage=0.010 af Inflow=0.18 cfs 0.046 af  
Outflow=0.05 cfs 0.045 af

**Pond 12P: Facility 2 (North Tank)** Peak Elev=4.19' Storage=0.275 af Inflow=2.18 cfs 0.684 af  
Outflow=0.50 cfs 0.430 af

**Pond 13P: Facility 3 (South Tank)** Peak Elev=4.03' Storage=0.139 af Inflow=1.18 cfs 0.356 af  
Outflow=0.21 cfs 0.223 af

**Total Runoff Area = 9.433 ac Runoff Volume = 1.189 af Average Runoff Depth = 1.51"**  
**49.45% Pervious = 4.665 ac 50.55% Impervious = 4.769 ac**

**Cascade Creek**

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Type IA 24-hr 2-year Rainfall=3.50"

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Page 8

**Summary for Subcatchment 1S: Basin 2 (North Lot)**

Runoff = 1.13 cfs @ 7.99 hrs, Volume= 0.352 af, Depth> 1.70"  
 Routed to Pond 12P : Facility 2 (North Tank)

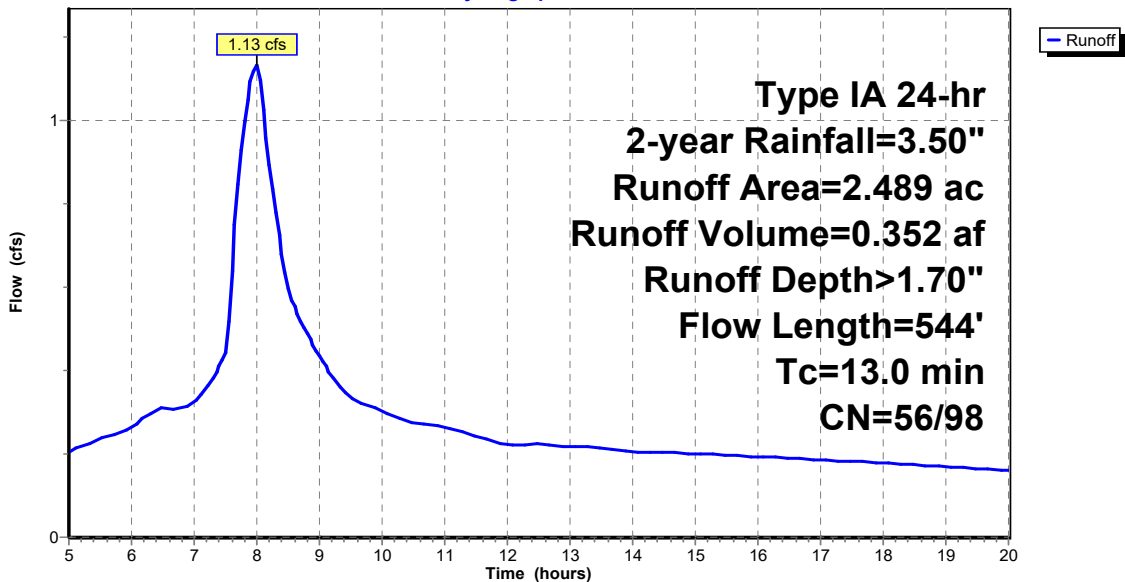
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-year Rainfall=3.50"

Area (ac)	CN	Description
0.433	98	Roofs, HSG B
1.078	98	Paved parking, HSG B
* 0.978	56	Lawn
2.489	81	Weighted Average
0.978	56	39.29% Pervious Area
1.511	98	60.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	146	0.0273	0.22		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
1.3	168	0.0420	2.15		<b>Sheet Flow, Lot</b> Smooth surfaces n= 0.011 P2= 3.50"
0.5	230	0.0300	7.86	6.17	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
13.0	544	Total			

**Subcatchment 1S: Basin 2 (North Lot)**

Hydrograph



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Type IA 24-hr 2-year Rainfall=3.50"

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Page 9

**Summary for Subcatchment 2S: Basin 1 (Highway 211)**

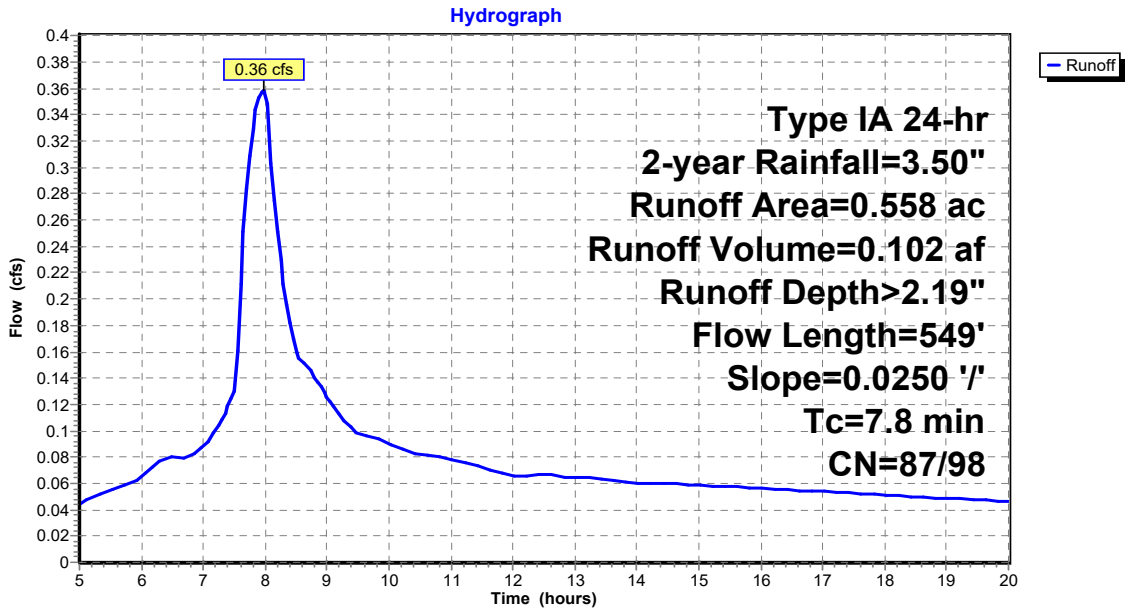
Runoff = 0.36 cfs @ 7.97 hrs, Volume= 0.102 af, Depth> 2.19"  
 Routed to Pond 9P : Facility 1 (Swale)

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-year Rainfall=3.50"

Area (ac)	CN	Description
* 0.473	98	Paved roads w/open ditches, 50% imp, HSG B
* 0.085	56	>75% Grass cover, Good, HSG B
0.558	92	Weighted Average
0.322	87	57.62% Pervious Area
0.237	98	42.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	65	0.0250	1.44		<b>Sheet Flow, Road</b> Smooth surfaces n= 0.011 P2= 3.50"
7.0	484	0.0250	1.15	5.73	<b>Channel Flow, Swale</b> Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.150 Sheet flow over Short Grass
7.8	549	Total			

**Subcatchment 2S: Basin 1 (Highway 211)**



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Type IA 24-hr 2-year Rainfall=3.50"

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Page 10

**Summary for Subcatchment 3S: Basin 4 (South Lot)**

Runoff = 1.18 cfs @ 7.93 hrs, Volume= 0.356 af, Depth> 1.39"  
 Routed to Pond 13P : Facility 3 (South Tank)

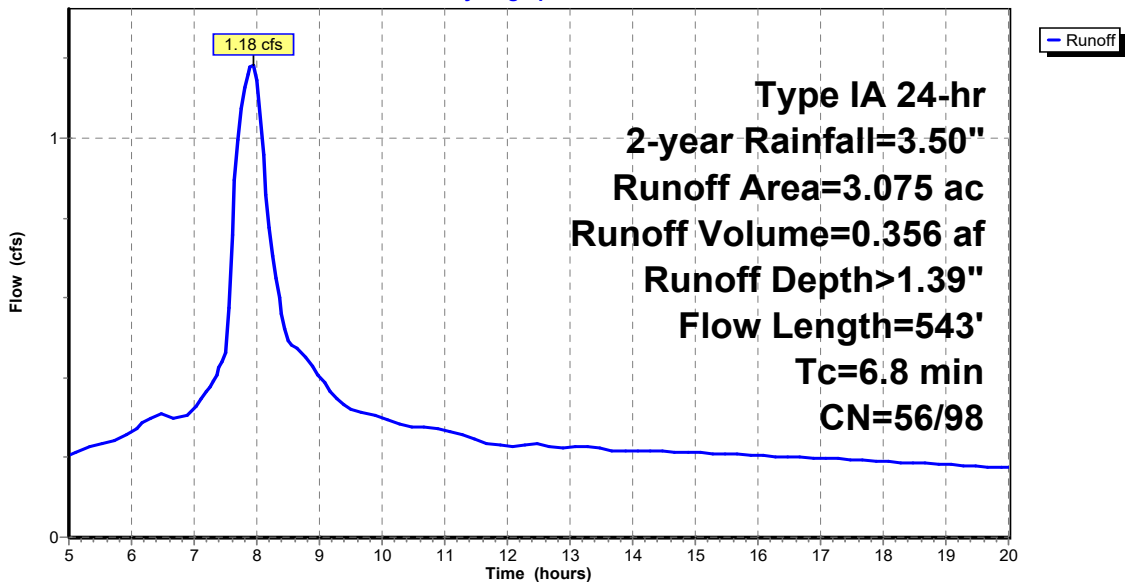
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-year Rainfall=3.50"

Area (ac)	CN	Description
1.038	98	Paved roads w/curbs & sewers, HSG B
0.428	98	Unconnected roofs, HSG B
* 1.609	56	Lawn
3.075	76	Weighted Average
1.609	56	52.33% Pervious Area
1.466	98	47.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	124	0.1200	0.38		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
0.5	54	0.0500	1.83		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.9	365	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.8	543	Total			

**Subcatchment 3S: Basin 4 (South Lot)**

Hydrograph



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Type IA 24-hr 2-year Rainfall=3.50"

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Page 11

**Summary for Subcatchment 4S: Basin 3 (Right of Way)**

Runoff = 1.05 cfs @ 7.98 hrs, Volume= 0.333 af, Depth> 1.30"  
 Routed to Pond 12P : Facility 2 (North Tank)

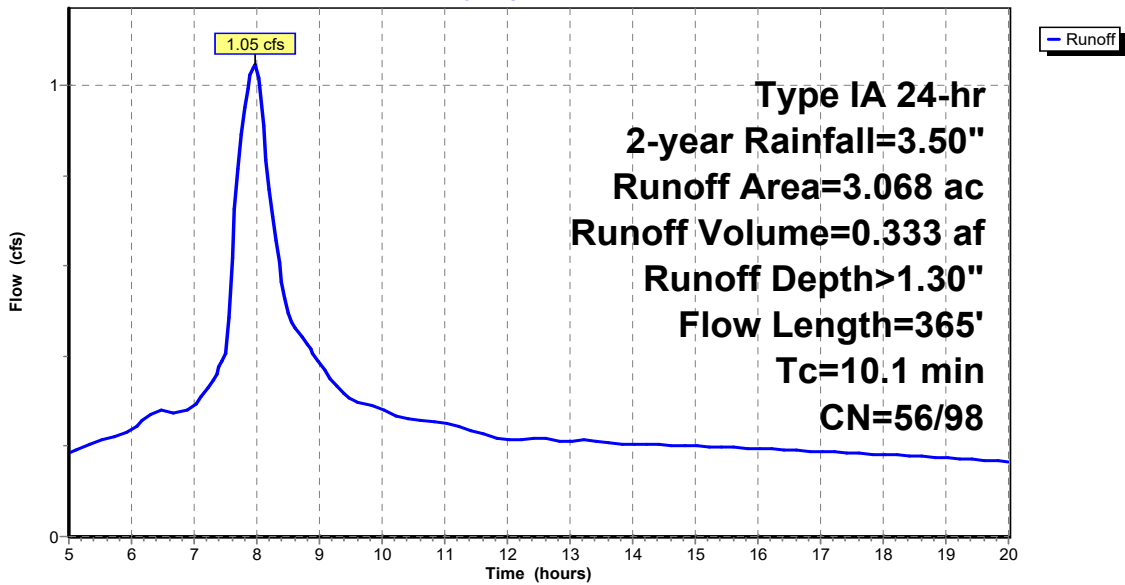
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-year Rainfall=3.50"

Area (ac)	CN	Description
1.345	98	Paved roads w/curbs & sewers, HSG B
* 1.723	56	Lawn
3.068	74	Weighted Average
1.723	56	56.16% Pervious Area
1.345	98	43.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	200	0.0866	0.37		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
0.9	140	0.0800	2.68		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.1	25	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
10.1	365	Total			

**Subcatchment 4S: Basin 3 (Right of Way)**

Hydrograph



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Type IA 24-hr 2-year Rainfall=3.50"

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Page 12

**Summary for Subcatchment 5S: Basin 5 (Area 2)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.18 cfs @ 7.82 hrs, Volume= 0.046 af, Depth> 2.29"  
 Routed to Pond 10P : Facility 4 (Stormtech)

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 2-year Rainfall=3.50"

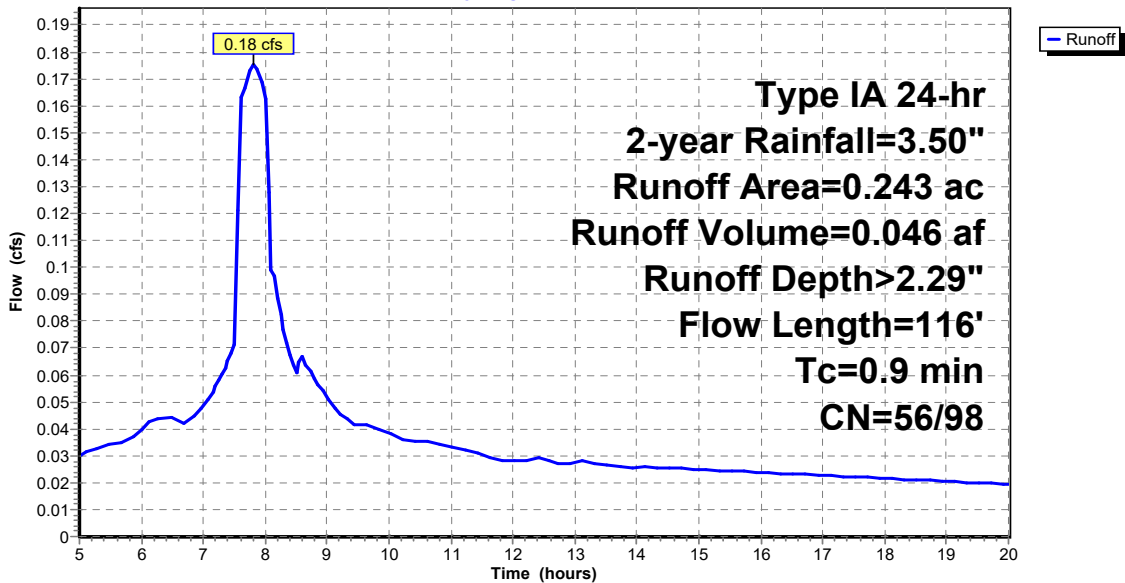
Area (ac)	CN	Description
0.210	98	Paved parking, HSG B
* 0.033	56	Lawn
0.243	92	Weighted Average
0.033	56	13.58% Pervious Area
0.210	98	86.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	80	0.0280	1.57		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.1	36	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.9	116	Total			

**Subcatchment 5S: Basin 5 (Area 2)**

Hydrograph



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Page 13

**Summary for Pond 9P: Facility 1 (Swale)**

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.558 ac, 42.38% Impervious, Inflow Depth > 2.19" for 2-year event  
 Inflow = 0.36 cfs @ 7.97 hrs, Volume= 0.102 af  
 Outflow = 0.30 cfs @ 8.11 hrs, Volume= 0.099 af, Atten= 16%, Lag= 7.8 min  
 Primary = 0.30 cfs @ 8.11 hrs, Volume= 0.099 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= -1.31' @ 8.11 hrs Surf.Area= 0.031 ac Storage= 0.007 af

Plug-Flow detention time= 29.4 min calculated for 0.098 af (97% of inflow)  
 Center-of-Mass det. time= 13.6 min ( 682.6 - 669.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	-1.00'	0.053 af	<b>2.00'W x 455.00'L x 1.00'H Swale Z=3.0</b>
#2	-1.50'	0.005 af	<b>2.00'W x 455.00'L x 0.50'H Prismatic</b> 0.010 af Overall x 46.6% Voids
#3	-2.00'	0.001 af	<b>4.0" Round Pipe Storage</b> Inside #4 L= 455.0'
#4	-2.50'	0.004 af	<b>1.00'W x 455.00'L x 1.00'H Prismatic</b> 0.010 af Overall - 0.001 af Embedded = 0.010 af x 40.0% Voids
		0.062 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	-2.00'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.30 cfs @ 8.11 hrs HW=-1.32' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 0.30 cfs @ 3.47 fps)

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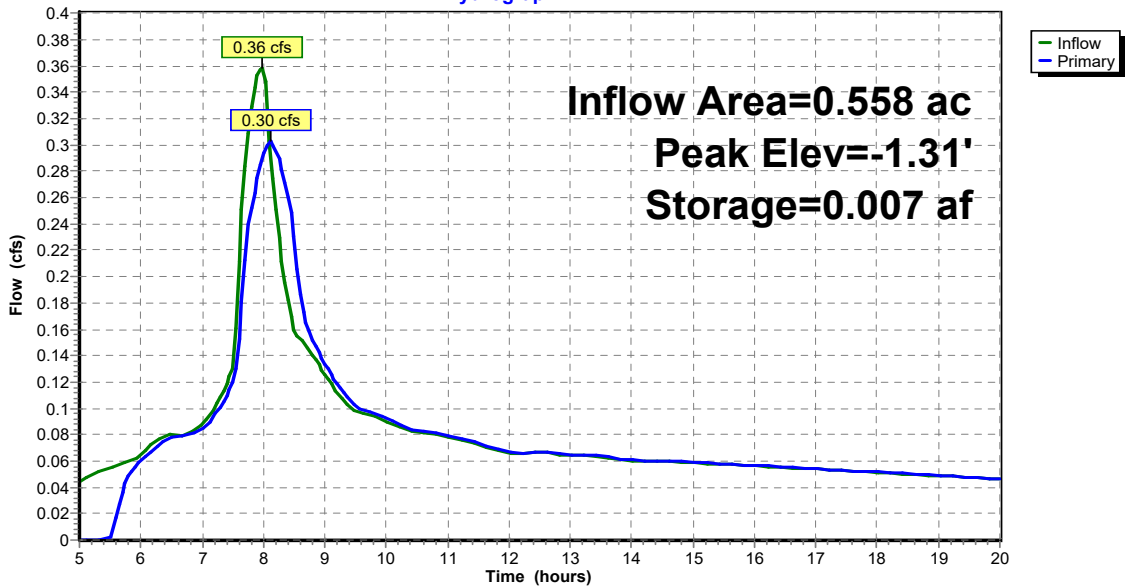
Type IA 24-hr 2-year Rainfall=3.50"

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Page 14

**Pond 9P: Facility 1 (Swale)**

Hydrograph





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Type IA 24-hr 2-year Rainfall=3.50"

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Page 15

**Summary for Pond 10P: Facility 4 (Stormtech)**

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.243 ac, 86.42% Impervious, Inflow Depth > 2.29" for 2-year event  
 Inflow = 0.18 cfs @ 7.82 hrs, Volume= 0.046 af  
 Outflow = 0.05 cfs @ 8.91 hrs, Volume= 0.045 af, Atten= 69%, Lag= 65.6 min  
 Primary = 0.05 cfs @ 8.91 hrs, Volume= 0.045 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 0.91' @ 8.91 hrs Surf.Area= 0.021 ac Storage= 0.010 af

Plug-Flow detention time= 95.0 min calculated for 0.045 af (96% of inflow)  
 Center-of-Mass det. time= 75.3 min ( 723.9 - 648.6 )

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.013 af	<b>29.08'W x 30.95'L x 2.00'H Field A</b> 0.041 af Overall - 0.008 af Embedded = 0.033 af x 40.0% Voids
#2A	0.50'	0.008 af	<b>ADS_StormTech SC-160LP +Cap</b> x 52 Inside #1 Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap 52 Chambers in 13 Rows
		0.021 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>1.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	1.92'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.05 cfs @ 8.91 hrs HW=0.91' (Free Discharge)  
 1=Orifice/Grate (Orifice Controls 0.05 cfs @ 4.44 fps)  
 2=Overflow Riser ( Controls 0.00 cfs)

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Type IA 24-hr 2-year Rainfall=3.50"

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Page 16

**Pond 10P: Facility 4 (Stormtech) - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTechSC-160LP+Cap (ADS StormTech®SC-160LP with cap length)**

Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf

Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap

4 Chambers/Row x 7.12' Long +0.23' Cap Length x 2 = 28.95' Row Length +12.0" End Stone x 2 = 30.95' Base Length

13 Rows x 25.0" Wide + 12.0" Side Stone x 2 = 29.08' Base Width

6.0" Stone Base + 12.0" Chamber Height + 6.0" Stone Cover = 2.00' Field Height

52 Chambers x 6.8 cf = 355.5 cf Chamber Storage

1,800.1 cf Field - 355.5 cf Chambers = 1,444.5 cf Stone x 40.0% Voids = 577.8 cf Stone Storage

Chamber Storage + Stone Storage = 933.3 cf = 0.021 af

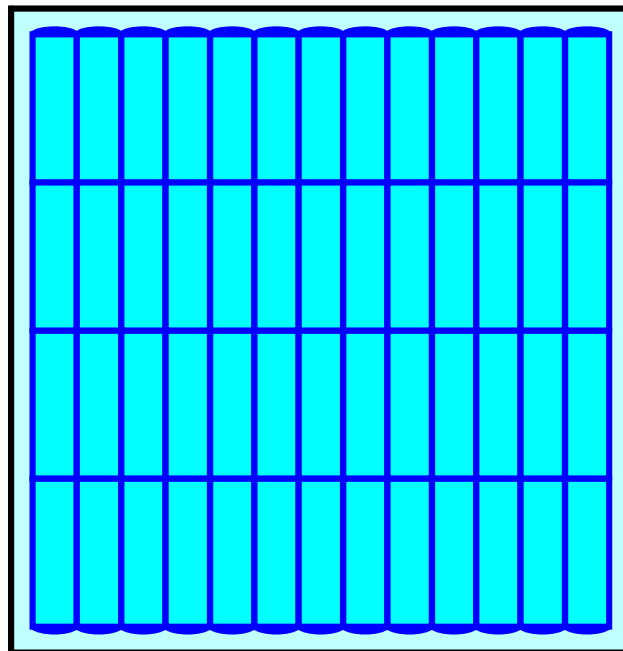
Overall Storage Efficiency = 51.9%

Overall System Size = 30.95' x 29.08' x 2.00'

52 Chambers

66.7 cy Field

53.5 cy Stone



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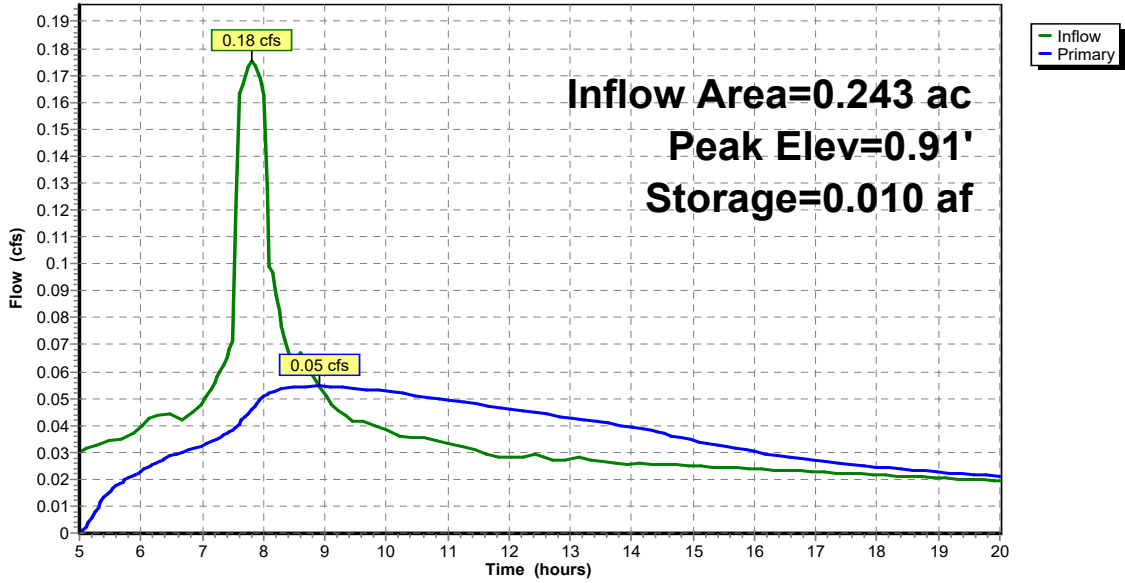
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Page 17

**Pond 10P: Facility 4 (Stormtech)**

Hydrograph



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Type IA 24-hr 2-year Rainfall=3.50"

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Page 18

**Summary for Pond 12P: Facility 2 (North Tank)**

[82] Warning: Early inflow requires earlier time span

[92] Warning: Device #4 is above defined storage

Inflow Area = 5.557 ac, 51.39% Impervious, Inflow Depth > 1.48" for 2-year event  
 Inflow = 2.18 cfs @ 7.98 hrs, Volume= 0.684 af  
 Outflow = 0.50 cfs @ 11.16 hrs, Volume= 0.430 af, Atten= 77%, Lag= 190.4 min  
 Primary = 0.50 cfs @ 11.16 hrs, Volume= 0.430 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 4.19' @ 11.16 hrs Surf.Area= 0.066 ac Storage= 0.275 af

Plug-Flow detention time= 316.4 min calculated for 0.428 af (62% of inflow)  
 Center-of-Mass det. time= 149.9 min ( 820.6 - 670.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.393 af	<b>24.00'W x 119.00'L x 6.00'H Prismatic</b>

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>2.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	3.25'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	4.00'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	6.00'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.50 cfs @ 11.16 hrs HW=4.19' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 0.21 cfs @ 9.76 fps)
- 2=Orifice/Grate (Orifice Controls 0.21 cfs @ 4.34 fps)
- 3=Orifice/Grate (Orifice Controls 0.08 cfs @ 1.48 fps)
- 4=Overflow Riser ( Controls 0.00 cfs)

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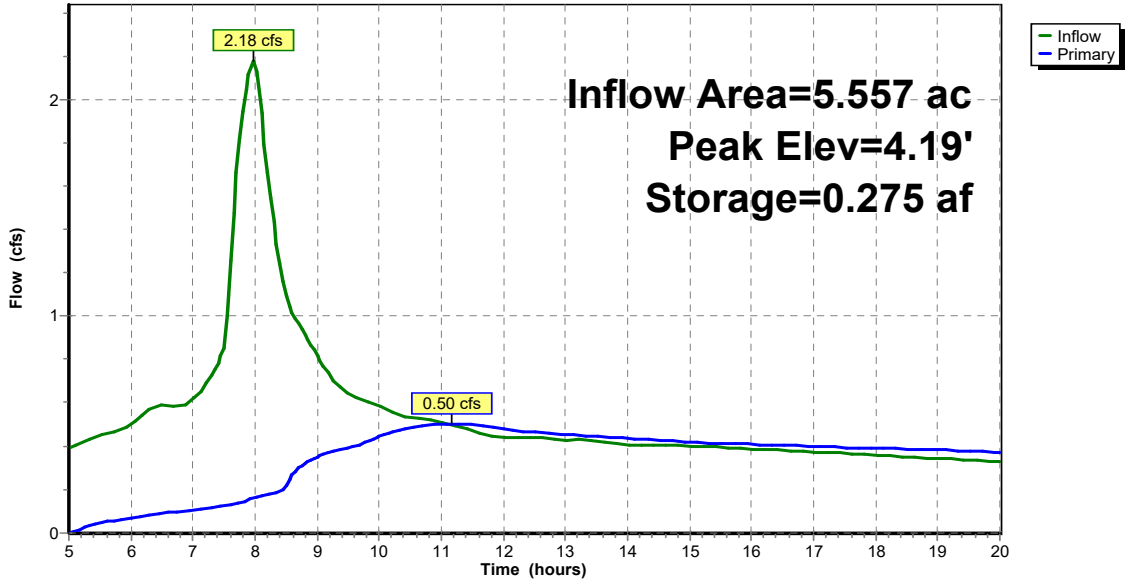
Type IA 24-hr 2-year Rainfall=3.50"

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Page 19

**Pond 12P: Facility 2 (North Tank)**

Hydrograph



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Type IA 24-hr 2-year Rainfall=3.50"

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Page 20

**Summary for Pond 13P: Facility 3 (South Tank)**

[82] Warning: Early inflow requires earlier time span

[92] Warning: Device #4 is above defined storage

Inflow Area = 3.075 ac, 47.67% Impervious, Inflow Depth > 1.39" for 2-year event  
 Inflow = 1.18 cfs @ 7.93 hrs, Volume= 0.356 af  
 Outflow = 0.21 cfs @ 14.99 hrs, Volume= 0.223 af, Atten= 82%, Lag= 423.5 min  
 Primary = 0.21 cfs @ 14.99 hrs, Volume= 0.223 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 4.03' @ 14.99 hrs Surf.Area= 0.035 ac Storage= 0.139 af

Plug-Flow detention time= 304.1 min calculated for 0.222 af (62% of inflow)  
 Center-of-Mass det. time= 135.4 min ( 807.5 - 672.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.208 af	<b>26.00'W x 58.00'L x 6.00'H Prismatic</b>

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>2.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	4.00'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	4.75'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	6.00'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.21 cfs @ 14.99 hrs HW=4.03' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 0.21 cfs @ 9.56 fps)
- 2=Orifice/Grate (Orifice Controls 0.00 cfs @ 0.58 fps)
- 3=Orifice/Grate ( Controls 0.00 cfs)
- 4=Overflow Riser ( Controls 0.00 cfs)

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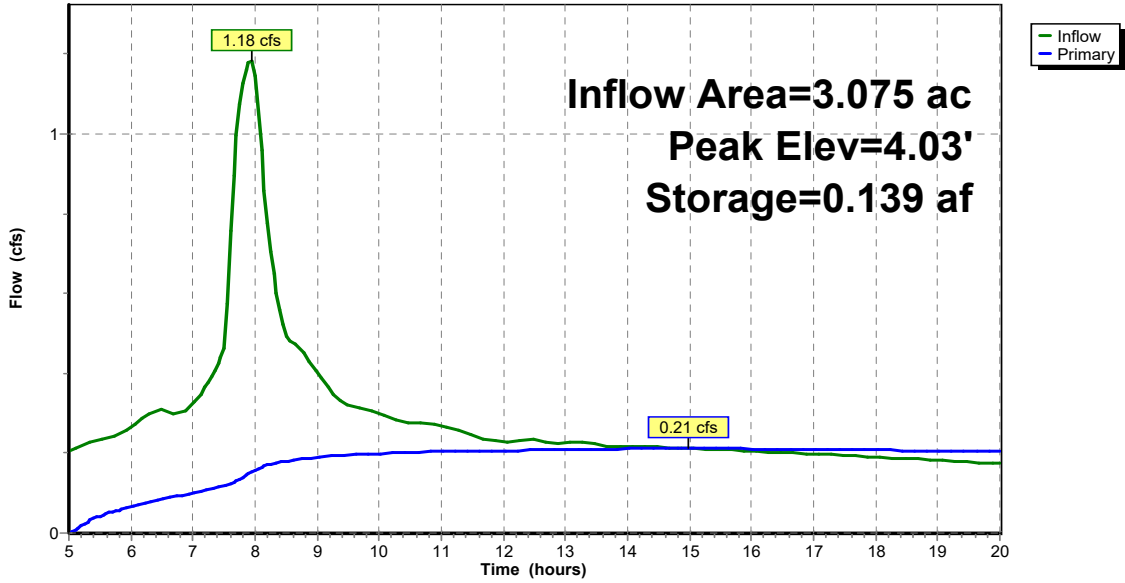
Type IA 24-hr 2-year Rainfall=3.50"

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Page 21

**Pond 13P: Facility 3 (South Tank)**

Hydrograph



**Cascade Creek**

Type IA 24-hr 5-year Rainfall=4.50"

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Page 22

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Basin 2 (North Lot)** Runoff Area=2.489 ac 60.71% Impervious Runoff Depth>2.30"  
Flow Length=544' Tc=13.0 min CN=56/98 Runoff=1.50 cfs 0.476 af

**Subcatchment2S: Basin 1 (Highway 211)** Runoff Area=0.558 ac 42.38% Impervious Runoff Depth>2.96"  
Flow Length=549' Slope=0.0250 '/ Tc=7.8 min CN=87/98 Runoff=0.49 cfs 0.138 af

**Subcatchment3S: Basin 4 (South Lot)** Runoff Area=3.075 ac 47.67% Impervious Runoff Depth>1.93"  
Flow Length=543' Tc=6.8 min CN=56/98 Runoff=1.60 cfs 0.496 af

**Subcatchment4S: Basin 3 (Right of Way)** Runoff Area=3.068 ac 43.84% Impervious Runoff Depth>1.83"  
Flow Length=365' Tc=10.1 min CN=56/98 Runoff=1.43 cfs 0.467 af

**Subcatchment5S: Basin 5 (Area 2)** Runoff Area=0.243 ac 86.42% Impervious Runoff Depth>3.00"  
Flow Length=116' Tc=0.9 min CN=56/98 Runoff=0.23 cfs 0.061 af

**Pond 9P: Facility 1 (Swale)** Peak Elev=-1.00' Storage=0.010 af Inflow=0.49 cfs 0.138 af  
Outflow=0.38 cfs 0.135 af

**Pond 10P: Facility 4 (Stormtech)** Peak Elev=1.26' Storage=0.015 af Inflow=0.23 cfs 0.061 af  
Outflow=0.06 cfs 0.058 af

**Pond 12P: Facility 2 (North Tank)** Peak Elev=4.87' Storage=0.320 af Inflow=2.93 cfs 0.944 af  
Outflow=0.87 cfs 0.671 af

**Pond 13P: Facility 3 (South Tank)** Peak Elev=5.00' Storage=0.173 af Inflow=1.60 cfs 0.496 af  
Outflow=0.39 cfs 0.336 af

**Total Runoff Area = 9.433 ac Runoff Volume = 1.638 af Average Runoff Depth = 2.08"**  
**49.45% Pervious = 4.665 ac 50.55% Impervious = 4.769 ac**



**Cascade Creek**

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Type IA 24-hr 5-year Rainfall=4.50"

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Page 23

**Summary for Subcatchment 1S: Basin 2 (North Lot)**

Runoff = 1.50 cfs @ 7.99 hrs, Volume= 0.476 af, Depth> 2.30"  
 Routed to Pond 12P : Facility 2 (North Tank)

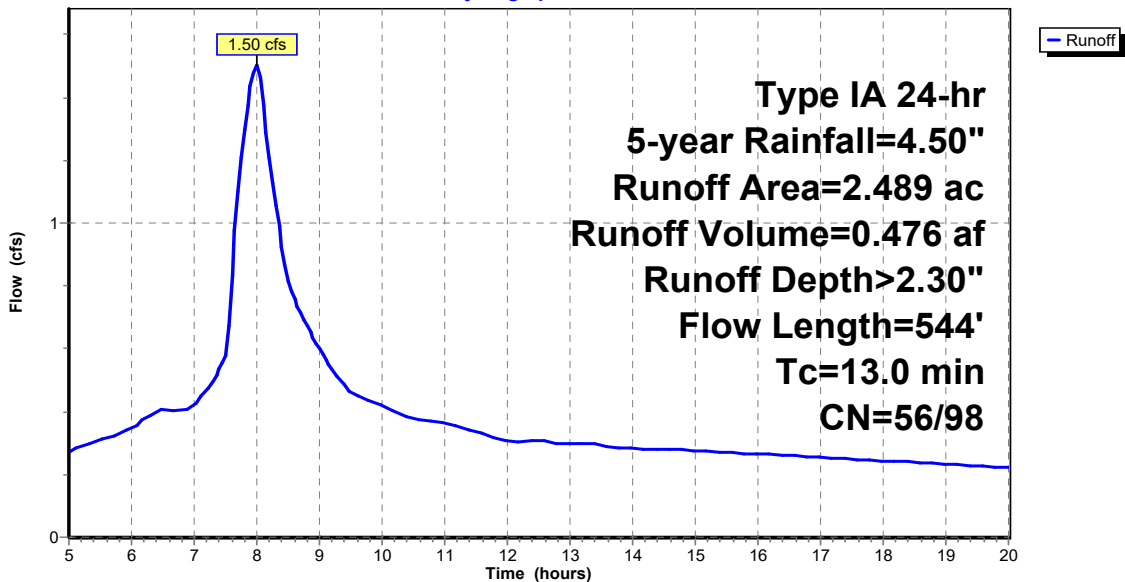
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 5-year Rainfall=4.50"

Area (ac)	CN	Description
0.433	98	Roofs, HSG B
1.078	98	Paved parking, HSG B
* 0.978	56	Lawn
2.489	81	Weighted Average
0.978	56	39.29% Pervious Area
1.511	98	60.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	146	0.0273	0.22		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
1.3	168	0.0420	2.15		<b>Sheet Flow, Lot</b> Smooth surfaces n= 0.011 P2= 3.50"
0.5	230	0.0300	7.86	6.17	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
13.0	544	Total			

**Subcatchment 1S: Basin 2 (North Lot)**

Hydrograph



**Cascade Creek**

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Type IA 24-hr 5-year Rainfall=4.50"

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Page 24

**Summary for Subcatchment 2S: Basin 1 (Highway 211)**

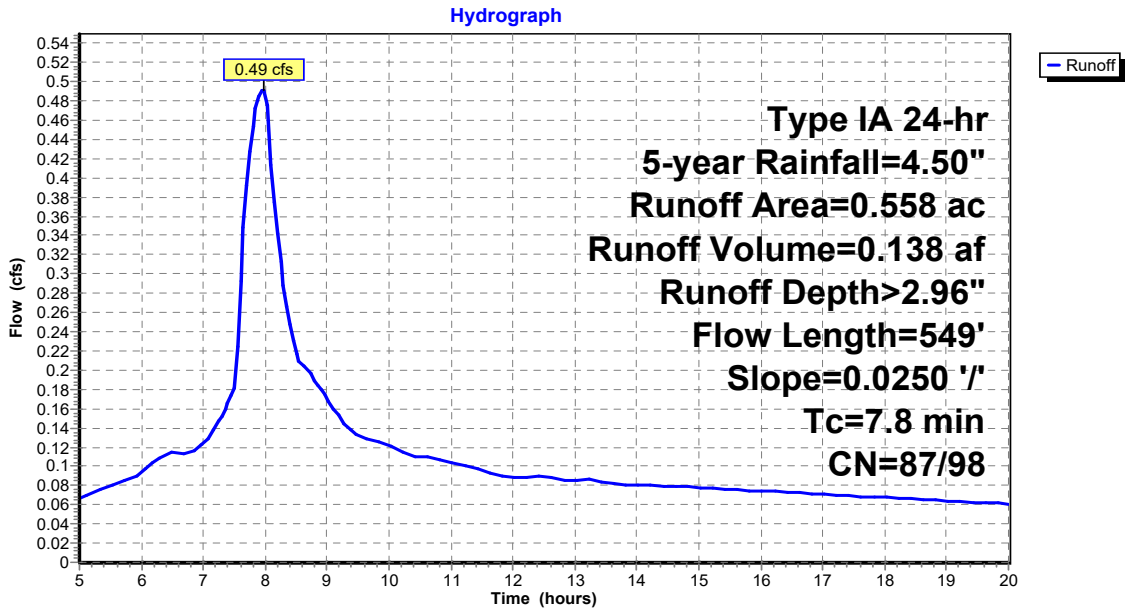
Runoff = 0.49 cfs @ 7.97 hrs, Volume= 0.138 af, Depth> 2.96"  
 Routed to Pond 9P : Facility 1 (Swale)

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 5-year Rainfall=4.50"

Area (ac)	CN	Description
* 0.473	98	Paved roads w/open ditches, 50% imp, HSG B
* 0.085	56	>75% Grass cover, Good, HSG B
0.558	92	Weighted Average
0.322	87	57.62% Pervious Area
0.237	98	42.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	65	0.0250	1.44		<b>Sheet Flow, Road</b> Smooth surfaces n= 0.011 P2= 3.50"
7.0	484	0.0250	1.15	5.73	<b>Channel Flow, Swale</b> Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.150 Sheet flow over Short Grass
7.8	549	Total			

**Subcatchment 2S: Basin 1 (Highway 211)**



**Cascade Creek**

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Type IA 24-hr 5-year Rainfall=4.50"

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Page 25

**Summary for Subcatchment 3S: Basin 4 (South Lot)**

Runoff = 1.60 cfs @ 7.97 hrs, Volume= 0.496 af, Depth> 1.93"  
 Routed to Pond 13P : Facility 3 (South Tank)

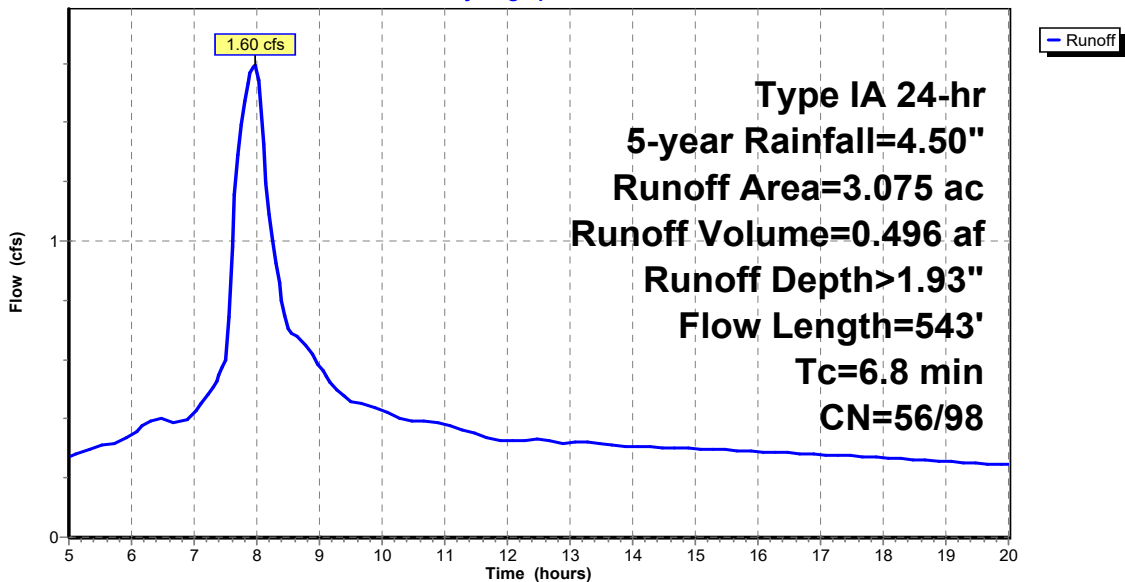
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 5-year Rainfall=4.50"

Area (ac)	CN	Description
1.038	98	Paved roads w/curbs & sewers, HSG B
0.428	98	Unconnected roofs, HSG B
* 1.609	56	Lawn
3.075	76	Weighted Average
1.609	56	52.33% Pervious Area
1.466	98	47.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	124	0.1200	0.38		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
0.5	54	0.0500	1.83		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.9	365	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.8	543	Total			

**Subcatchment 3S: Basin 4 (South Lot)**

Hydrograph



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Type IA 24-hr 5-year Rainfall=4.50"

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Page 26

**Summary for Subcatchment 4S: Basin 3 (Right of Way)**

Runoff = 1.43 cfs @ 7.99 hrs, Volume= 0.467 af, Depth> 1.83"  
 Routed to Pond 12P : Facility 2 (North Tank)

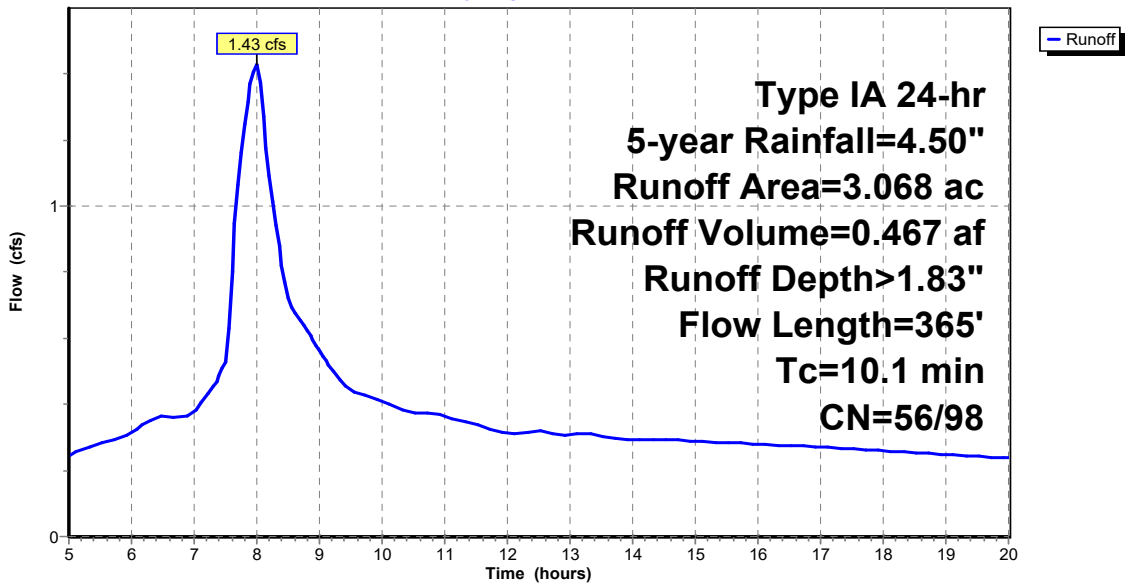
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 5-year Rainfall=4.50"

Area (ac)	CN	Description
1.345	98	Paved roads w/curbs & sewers, HSG B
* 1.723	56	Lawn
3.068	74	Weighted Average
1.723	56	56.16% Pervious Area
1.345	98	43.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	200	0.0866	0.37		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
0.9	140	0.0800	2.68		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.1	25	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
10.1	365	Total			

**Subcatchment 4S: Basin 3 (Right of Way)**

Hydrograph



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Type IA 24-hr 5-year Rainfall=4.50"

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Page 27

**Summary for Subcatchment 5S: Basin 5 (Area 2)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.23 cfs @ 7.83 hrs, Volume= 0.061 af, Depth> 3.00"  
 Routed to Pond 10P : Facility 4 (Stormtech)

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 5-year Rainfall=4.50"

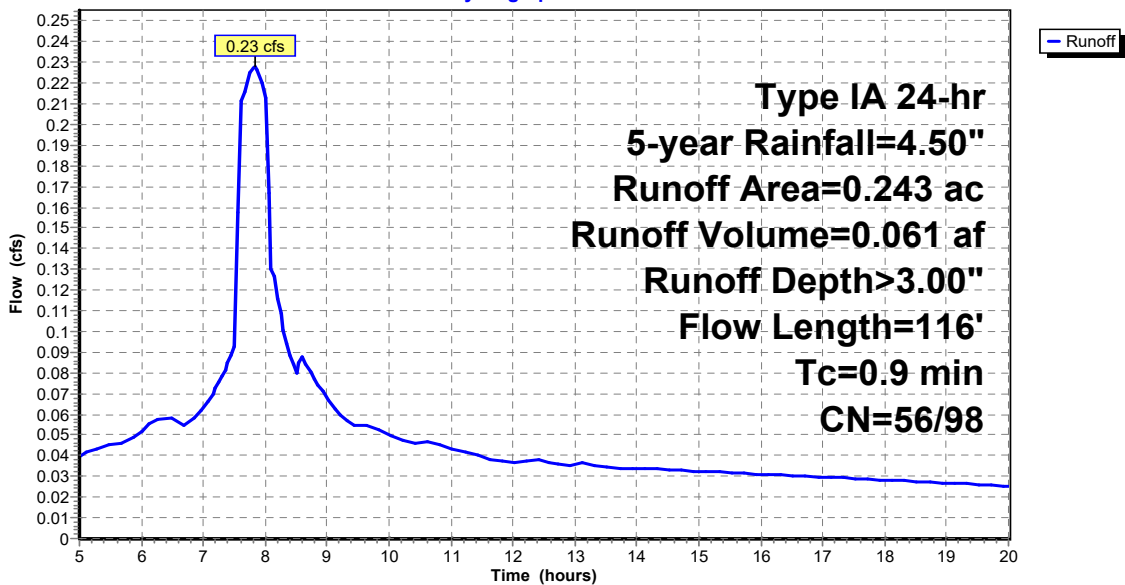
Area (ac)	CN	Description
0.210	98	Paved parking, HSG B
* 0.033	56	Lawn
0.243	92	Weighted Average
0.033	56	13.58% Pervious Area
0.210	98	86.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	80	0.0280	1.57		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.1	36	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.9	116	Total			

**Subcatchment 5S: Basin 5 (Area 2)**

Hydrograph



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Type IA 24-hr 5-year Rainfall=4.50"

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Page 28

**Summary for Pond 9P: Facility 1 (Swale)**

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.558 ac, 42.38% Impervious, Inflow Depth > 2.96" for 5-year event  
 Inflow = 0.49 cfs @ 7.97 hrs, Volume= 0.138 af  
 Outflow = 0.38 cfs @ 8.14 hrs, Volume= 0.135 af, Atten= 22%, Lag= 10.4 min  
 Primary = 0.38 cfs @ 8.14 hrs, Volume= 0.135 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= -1.00' @ 8.14 hrs Surf.Area= 0.031 ac Storage= 0.010 af

Plug-Flow detention time= 24.6 min calculated for 0.134 af (98% of inflow)  
 Center-of-Mass det. time= 12.0 min ( 675.5 - 663.6 )

Volume	Invert	Avail.Storage	Storage Description
#1	-1.00'	0.053 af	<b>2.00'W x 455.00'L x 1.00'H Swale Z=3.0</b>
#2	-1.50'	0.005 af	<b>2.00'W x 455.00'L x 0.50'H Prismaoid</b> 0.010 af Overall x 46.6% Voids
#3	-2.00'	0.001 af	<b>4.0" Round Pipe Storage</b> Inside #4 L= 455.0'
#4	-2.50'	0.004 af	<b>1.00'W x 455.00'L x 1.00'H Prismaoid</b> 0.010 af Overall - 0.001 af Embedded = 0.010 af x 40.0% Voids
		0.062 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	-2.00'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.38 cfs @ 8.14 hrs HW=-1.00' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 0.38 cfs @ 4.39 fps)

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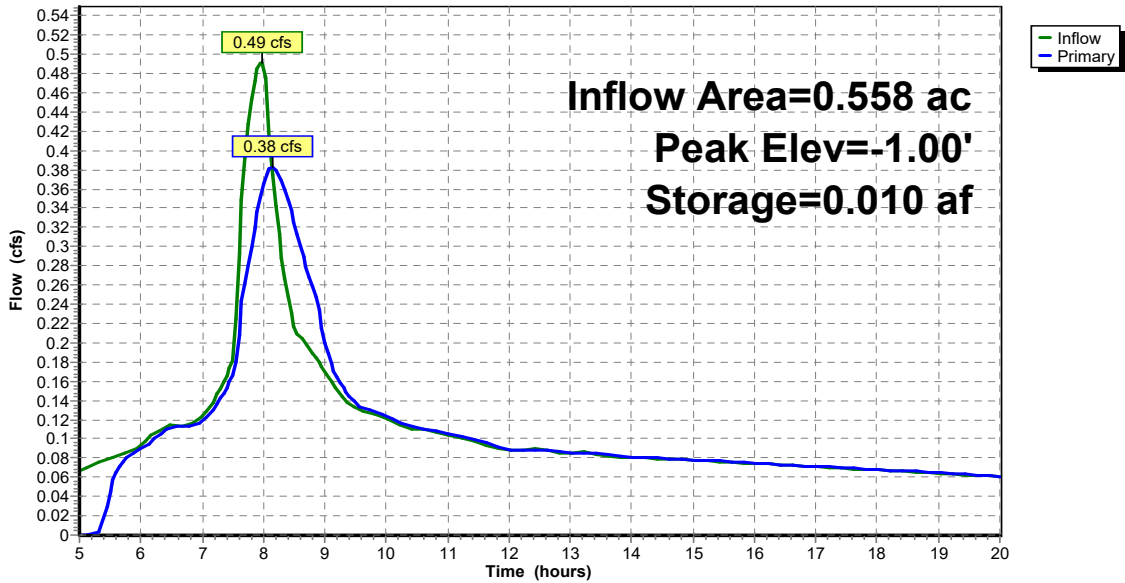
Type IA 24-hr 5-year Rainfall=4.50"

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Page 29

**Pond 9P: Facility 1 (Swale)**

Hydrograph



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Type IA 24-hr 5-year Rainfall=4.50"

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Page 30

**Summary for Pond 10P: Facility 4 (Stormtech)**

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.243 ac, 86.42% Impervious, Inflow Depth > 3.00" for 5-year event  
 Inflow = 0.23 cfs @ 7.83 hrs, Volume= 0.061 af  
 Outflow = 0.06 cfs @ 9.07 hrs, Volume= 0.058 af, Atten= 72%, Lag= 74.7 min  
 Primary = 0.06 cfs @ 9.07 hrs, Volume= 0.058 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 1.26' @ 9.07 hrs Surf.Area= 0.021 ac Storage= 0.015 af

Plug-Flow detention time= 122.4 min calculated for 0.058 af (95% of inflow)  
 Center-of-Mass det. time= 96.1 min ( 744.9 - 648.8 )

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.013 af	<b>29.08"W x 30.95"L x 2.00"H Field A</b> 0.041 af Overall - 0.008 af Embedded = 0.033 af x 40.0% Voids
#2A	0.50'	0.008 af	<b>ADS_StormTech SC-160LP +Cap</b> x 52 Inside #1 Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap 52 Chambers in 13 Rows
		0.021 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>1.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	1.92'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.06 cfs @ 9.07 hrs HW=1.26' (Free Discharge)  
 1=Orifice/Grate (Orifice Controls 0.06 cfs @ 5.28 fps)  
 2=Overflow Riser ( Controls 0.00 cfs)



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Page 31

**Pond 10P: Facility 4 (Stormtech) - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTechSC-160LP+Cap (ADS StormTech®SC-160LP with cap length)**

Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf

Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap

4 Chambers/Row x 7.12' Long +0.23' Cap Length x 2 = 28.95' Row Length +12.0" End Stone x 2 = 30.95' Base Length

13 Rows x 25.0" Wide + 12.0" Side Stone x 2 = 29.08' Base Width

6.0" Stone Base + 12.0" Chamber Height + 6.0" Stone Cover = 2.00' Field Height

52 Chambers x 6.8 cf = 355.5 cf Chamber Storage

1,800.1 cf Field - 355.5 cf Chambers = 1,444.5 cf Stone x 40.0% Voids = 577.8 cf Stone Storage

Chamber Storage + Stone Storage = 933.3 cf = 0.021 af

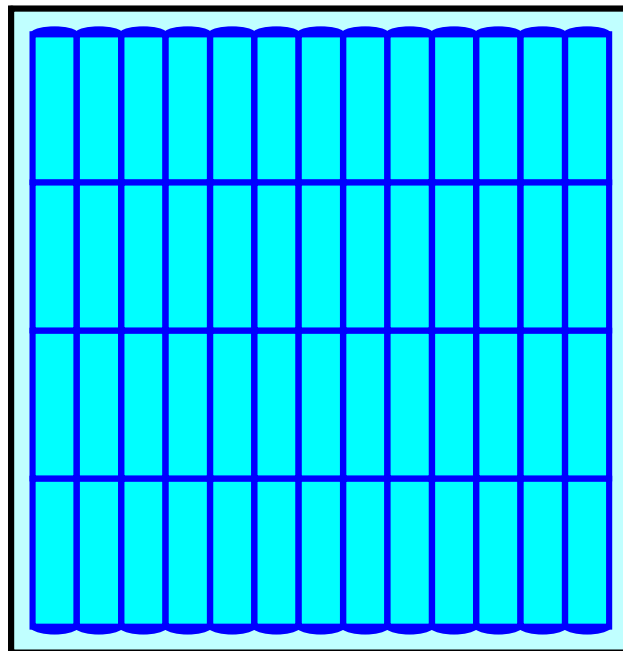
Overall Storage Efficiency = 51.9%

Overall System Size = 30.95' x 29.08' x 2.00'

52 Chambers

66.7 cy Field

53.5 cy Stone



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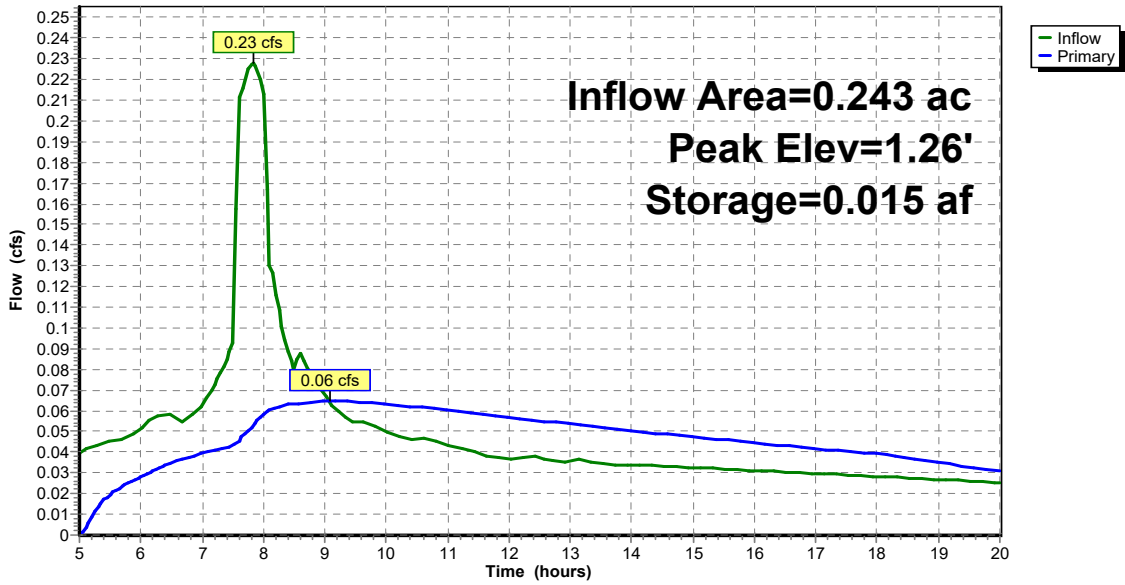
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Page 32

**Pond 10P: Facility 4 (Stormtech)**

Hydrograph



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Type IA 24-hr 5-year Rainfall=4.50"

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Page 33

**Summary for Pond 12P: Facility 2 (North Tank)**

[82] Warning: Early inflow requires earlier time span

[92] Warning: Device #4 is above defined storage

Inflow Area = 5.557 ac, 51.39% Impervious, Inflow Depth > 2.04" for 5-year event  
 Inflow = 2.93 cfs @ 7.99 hrs, Volume= 0.944 af  
 Outflow = 0.87 cfs @ 9.70 hrs, Volume= 0.671 af, Atten= 70%, Lag= 102.3 min  
 Primary = 0.87 cfs @ 9.70 hrs, Volume= 0.671 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 4.87' @ 9.70 hrs Surf.Area= 0.066 ac Storage= 0.320 af

Plug-Flow detention time= 253.7 min calculated for 0.668 af (71% of inflow)  
 Center-of-Mass det. time= 118.9 min ( 794.2 - 675.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.393 af	<b>24.00'W x 119.00'L x 6.00'H Prismatic</b>

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>2.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	3.25'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	4.00'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	6.00'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.87 cfs @ 9.70 hrs HW=4.87' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 0.23 cfs @ 10.54 fps)
- 2=Orifice/Grate (Orifice Controls 0.29 cfs @ 5.90 fps)
- 3=Orifice/Grate (Orifice Controls 0.35 cfs @ 4.05 fps)
- 4=Overflow Riser ( Controls 0.00 cfs)

**Cascade Creek**

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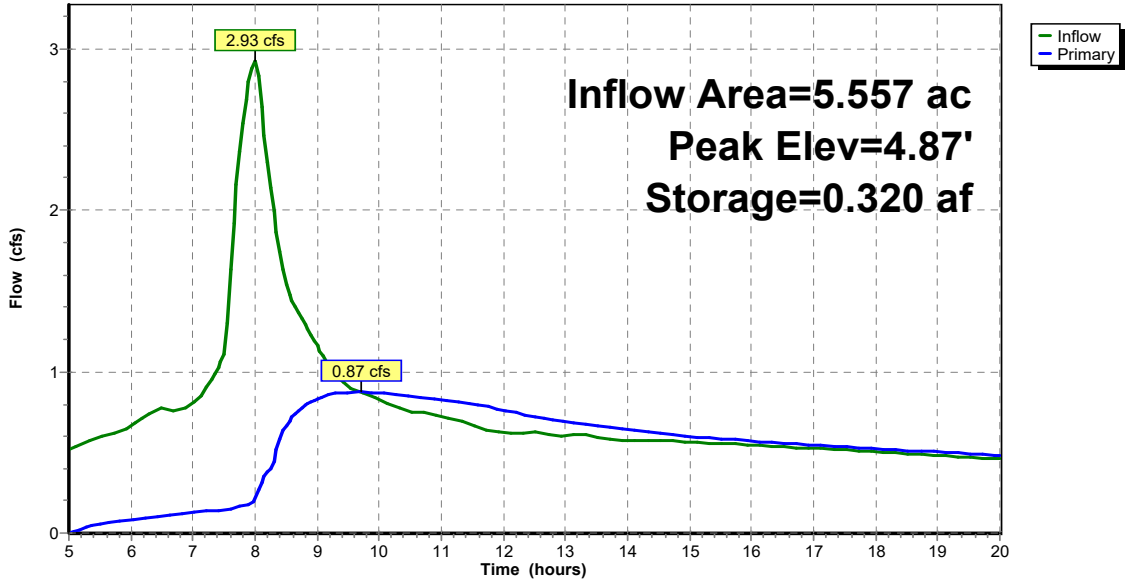
Type IA 24-hr 5-year Rainfall=4.50"

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Page 34

**Pond 12P: Facility 2 (North Tank)**

Hydrograph



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Type IA 24-hr 5-year Rainfall=4.50"

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Page 35

**Summary for Pond 13P: Facility 3 (South Tank)**

[82] Warning: Early inflow requires earlier time span

[92] Warning: Device #4 is above defined storage

Inflow Area = 3.075 ac, 47.67% Impervious, Inflow Depth > 1.93" for 5-year event  
 Inflow = 1.60 cfs @ 7.97 hrs, Volume= 0.496 af  
 Outflow = 0.39 cfs @ 10.81 hrs, Volume= 0.336 af, Atten= 76%, Lag= 170.0 min  
 Primary = 0.39 cfs @ 10.81 hrs, Volume= 0.336 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 5.00' @ 10.81 hrs Surf.Area= 0.035 ac Storage= 0.173 af

Plug-Flow detention time= 273.9 min calculated for 0.335 af (68% of inflow)  
 Center-of-Mass det. time= 125.8 min ( 803.1 - 677.2 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.208 af	<b>26.00'W x 58.00'L x 6.00'H Prismatic</b>

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>2.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	4.00'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	4.75'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	6.00'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.39 cfs @ 10.81 hrs HW=5.00' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 0.23 cfs @ 10.68 fps)
- 2=Orifice/Grate (Orifice Controls 0.07 cfs @ 4.65 fps)
- 3=Orifice/Grate (Orifice Controls 0.08 cfs @ 1.72 fps)
- 4=Overflow Riser ( Controls 0.00 cfs)

**Cascade Creek**

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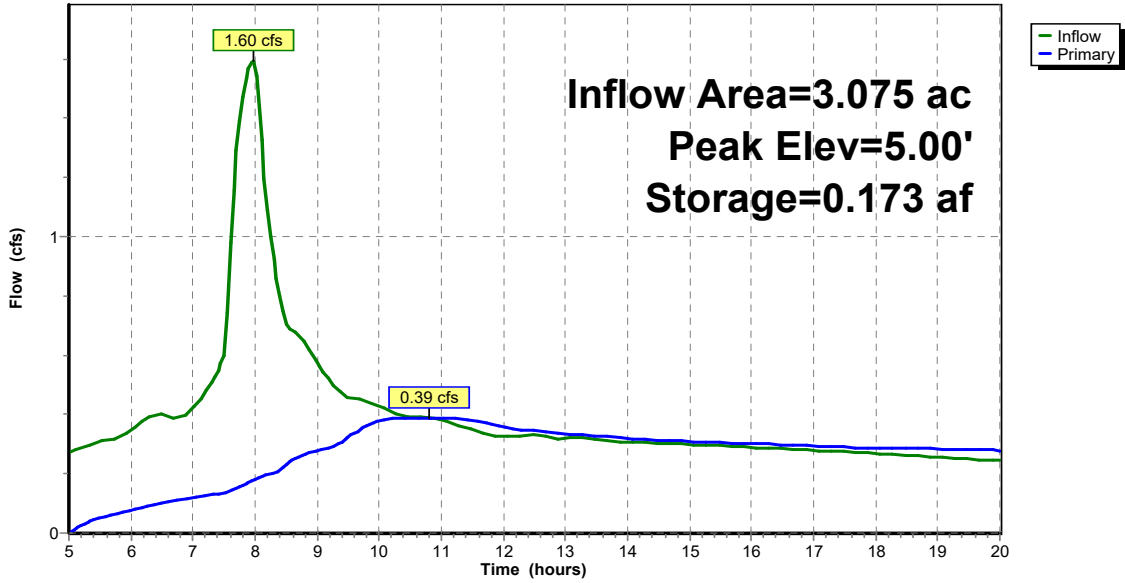
Type IA 24-hr 5-year Rainfall=4.50"

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Page 36

**Pond 13P: Facility 3 (South Tank)**

Hydrograph



**Cascade Creek**

Type IA 24-hr 10-year Rainfall=4.80"

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Page 37

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SBUH method, Split Pervious/Imperv.  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Basin 2 (North Lot)** Runoff Area=2.489 ac 60.71% Impervious Runoff Depth>2.48"  
Flow Length=544' Tc=13.0 min CN=56/98 Runoff=1.63 cfs 0.515 af

**Subcatchment2S: Basin 1 (Highway 211)** Runoff Area=0.558 ac 42.38% Impervious Runoff Depth>3.19"  
Flow Length=549' Slope=0.0250 '/ Tc=7.8 min CN=87/98 Runoff=0.53 cfs 0.149 af

**Subcatchment3S: Basin 4 (South Lot)** Runoff Area=3.075 ac 47.67% Impervious Runoff Depth>2.11"  
Flow Length=543' Tc=6.8 min CN=56/98 Runoff=1.76 cfs 0.540 af

**Subcatchment4S: Basin 3 (Right of Way)** Runoff Area=3.068 ac 43.84% Impervious Runoff Depth>2.00"  
Flow Length=365' Tc=10.1 min CN=56/98 Runoff=1.57 cfs 0.510 af

**Subcatchment5S: Basin 5 (Area 2)** Runoff Area=0.243 ac 86.42% Impervious Runoff Depth>3.22"  
Flow Length=116' Tc=0.9 min CN=56/98 Runoff=0.24 cfs 0.065 af

**Pond 9P: Facility 1 (Swale)** Peak Elev=-0.95' Storage=0.011 af Inflow=0.53 cfs 0.149 af  
Outflow=0.39 cfs 0.145 af

**Pond 10P: Facility 4 (Stormtech)** Peak Elev=1.40' Storage=0.016 af Inflow=0.24 cfs 0.065 af  
Outflow=0.07 cfs 0.062 af

**Pond 12P: Facility 2 (North Tank)** Peak Elev=5.16' Storage=0.339 af Inflow=3.19 cfs 1.026 af  
Outflow=0.97 cfs 0.750 af

**Pond 13P: Facility 3 (South Tank)** Peak Elev=5.20' Storage=0.180 af Inflow=1.76 cfs 0.540 af  
Outflow=0.45 cfs 0.376 af

**Total Runoff Area = 9.433 ac Runoff Volume = 1.779 af Average Runoff Depth = 2.26"**  
**49.45% Pervious = 4.665 ac 50.55% Impervious = 4.769 ac**

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Type IA 24-hr 10-year Rainfall=4.80"

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Page 38

**Summary for Subcatchment 1S: Basin 2 (North Lot)**

Runoff = 1.63 cfs @ 8.00 hrs, Volume= 0.515 af, Depth> 2.48"  
 Routed to Pond 12P : Facility 2 (North Tank)

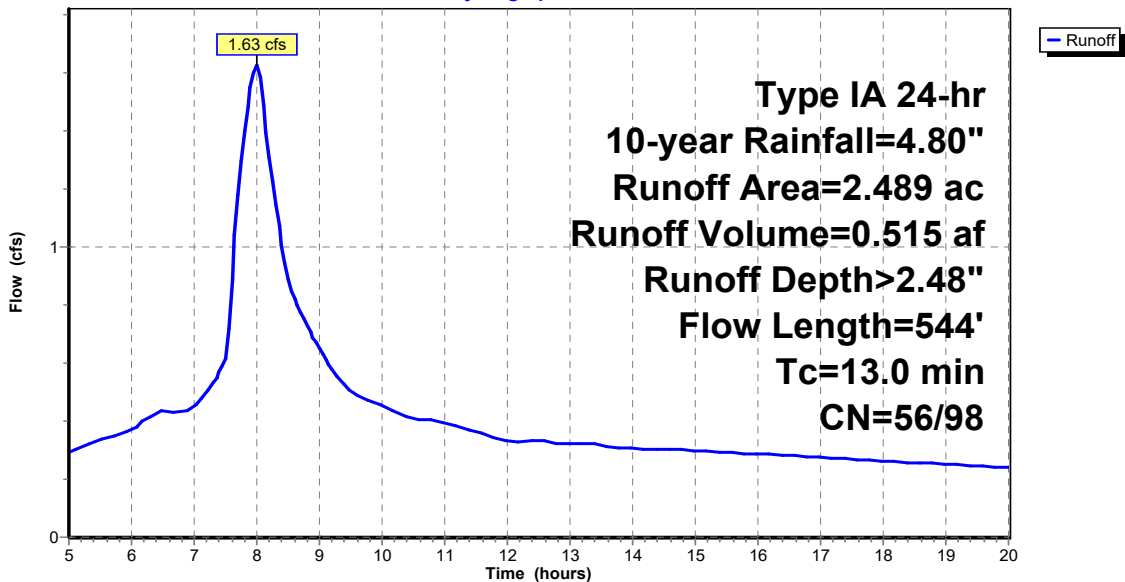
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 10-year Rainfall=4.80"

Area (ac)	CN	Description
0.433	98	Roofs, HSG B
1.078	98	Paved parking, HSG B
* 0.978	56	Lawn
2.489	81	Weighted Average
0.978	56	39.29% Pervious Area
1.511	98	60.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	146	0.0273	0.22		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
1.3	168	0.0420	2.15		<b>Sheet Flow, Lot</b> Smooth surfaces n= 0.011 P2= 3.50"
0.5	230	0.0300	7.86	6.17	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
13.0	544	Total			

**Subcatchment 1S: Basin 2 (North Lot)**

Hydrograph





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Type IA 24-hr 10-year Rainfall=4.80"

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Page 39

**Summary for Subcatchment 2S: Basin 1 (Highway 211)**

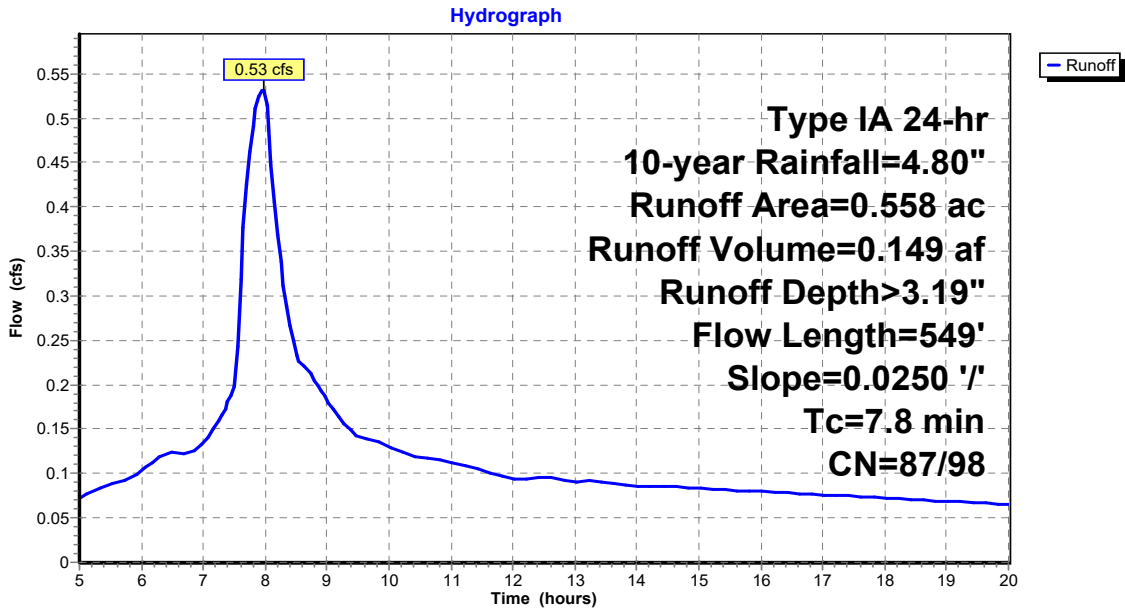
Runoff = 0.53 cfs @ 7.97 hrs, Volume= 0.149 af, Depth> 3.19"  
 Routed to Pond 9P : Facility 1 (Swale)

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 10-year Rainfall=4.80"

Area (ac)	CN	Description
* 0.473	98	Paved roads w/open ditches, 50% imp, HSG B
* 0.085	56	>75% Grass cover, Good, HSG B
0.558	92	Weighted Average
0.322	87	57.62% Pervious Area
0.237	98	42.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	65	0.0250	1.44		<b>Sheet Flow, Road</b> Smooth surfaces n= 0.011 P2= 3.50"
7.0	484	0.0250	1.15	5.73	<b>Channel Flow, Swale</b> Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.150 Sheet flow over Short Grass
7.8	549	Total			

**Subcatchment 2S: Basin 1 (Highway 211)**



**Cascade Creek**

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Type IA 24-hr 10-year Rainfall=4.80"

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Page 40

**Summary for Subcatchment 3S: Basin 4 (South Lot)**

Runoff = 1.76 cfs @ 7.98 hrs, Volume= 0.540 af, Depth> 2.11"  
 Routed to Pond 13P : Facility 3 (South Tank)

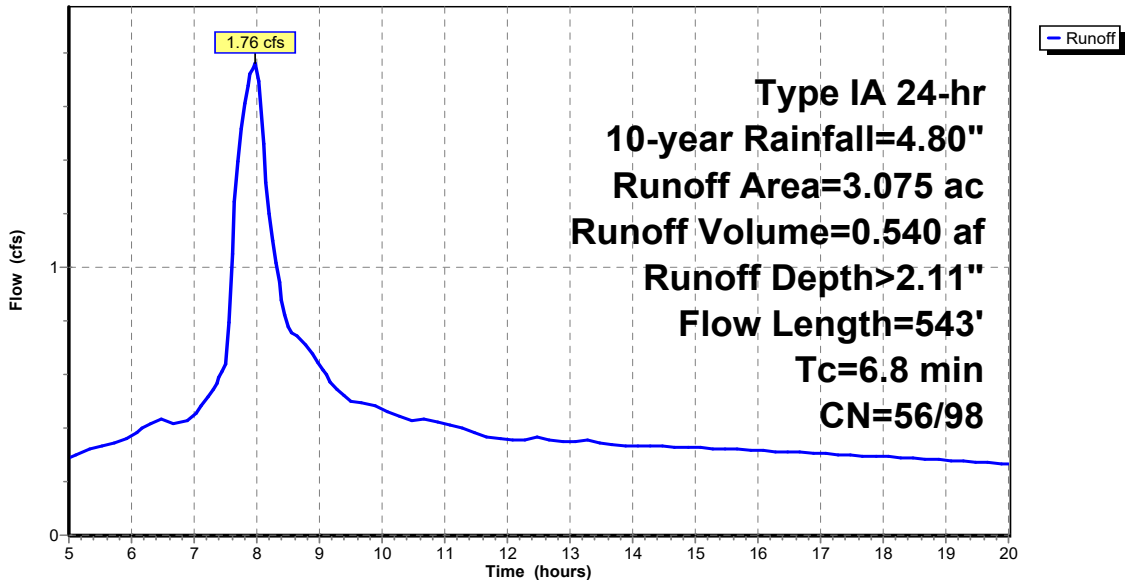
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 10-year Rainfall=4.80"

Area (ac)	CN	Description
1.038	98	Paved roads w/curbs & sewers, HSG B
0.428	98	Unconnected roofs, HSG B
* 1.609	56	Lawn
3.075	76	Weighted Average
1.609	56	52.33% Pervious Area
1.466	98	47.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	124	0.1200	0.38		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
0.5	54	0.0500	1.83		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.9	365	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.8	543	Total			

**Subcatchment 3S: Basin 4 (South Lot)**

Hydrograph



**Cascade Creek**

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Type IA 24-hr 10-year Rainfall=4.80"

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Page 41

**Summary for Subcatchment 4S: Basin 3 (Right of Way)**

Runoff = 1.57 cfs @ 7.99 hrs, Volume= 0.510 af, Depth> 2.00"  
 Routed to Pond 12P : Facility 2 (North Tank)

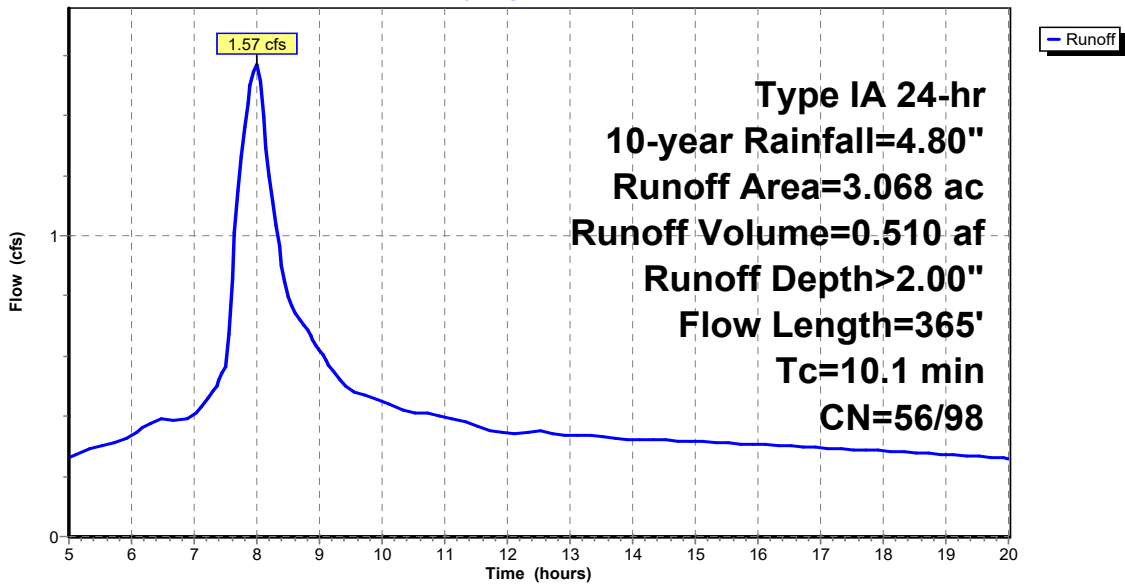
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 10-year Rainfall=4.80"

Area (ac)	CN	Description
1.345	98	Paved roads w/curbs & sewers, HSG B
* 1.723	56	Lawn
3.068	74	Weighted Average
1.723	56	56.16% Pervious Area
1.345	98	43.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	200	0.0866	0.37		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
0.9	140	0.0800	2.68		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.1	25	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
10.1	365	Total			

**Subcatchment 4S: Basin 3 (Right of Way)**

Hydrograph



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Type IA 24-hr 10-year Rainfall=4.80"

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Page 42

**Summary for Subcatchment 5S: Basin 5 (Area 2)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.24 cfs @ 7.83 hrs, Volume= 0.065 af, Depth> 3.22"  
 Routed to Pond 10P : Facility 4 (Stormtech)

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 10-year Rainfall=4.80"

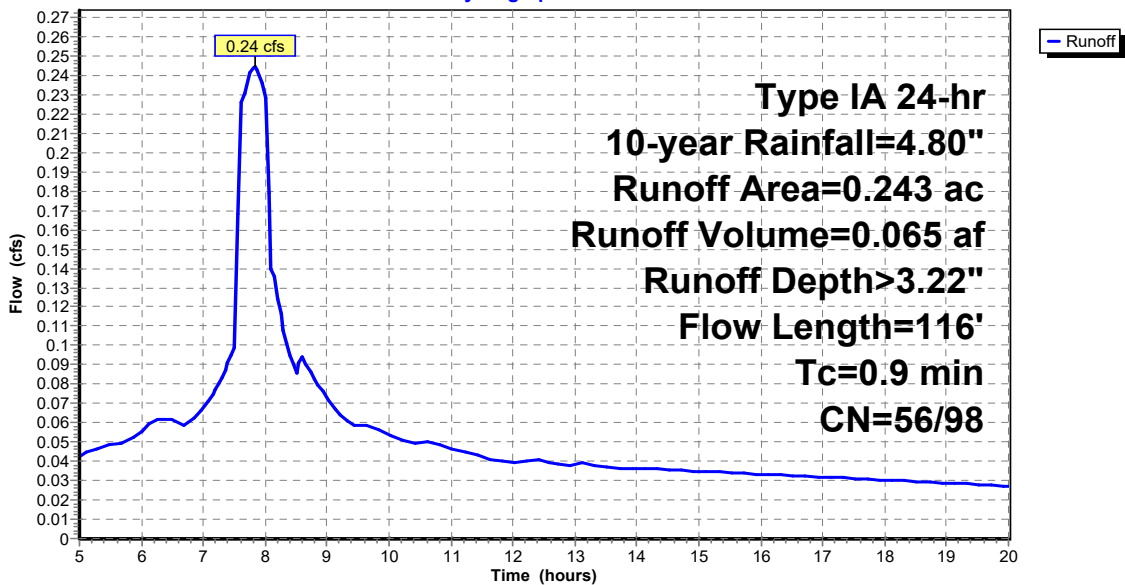
Area (ac)	CN	Description
0.210	98	Paved parking, HSG B
* 0.033	56	Lawn
0.243	92	Weighted Average
0.033	56	13.58% Pervious Area
0.210	98	86.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	80	0.0280	1.57		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.1	36	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.9	116	Total			

**Subcatchment 5S: Basin 5 (Area 2)**

Hydrograph



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Type IA 24-hr 10-year Rainfall=4.80"

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Page 43

**Summary for Pond 9P: Facility 1 (Swale)**

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.558 ac, 42.38% Impervious, Inflow Depth > 3.19" for 10-year event  
 Inflow = 0.53 cfs @ 7.97 hrs, Volume= 0.149 af  
 Outflow = 0.39 cfs @ 8.17 hrs, Volume= 0.145 af, Atten= 26%, Lag= 11.9 min  
 Primary = 0.39 cfs @ 8.17 hrs, Volume= 0.145 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= -0.95' @ 8.17 hrs Surf.Area= 0.055 ac Storage= 0.011 af

Plug-Flow detention time= 23.7 min calculated for 0.145 af (97% of inflow)  
 Center-of-Mass det. time= 11.8 min ( 674.1 - 662.3 )

Volume	Invert	Avail.Storage	Storage Description
#1	-1.00'	0.053 af	<b>2.00'W x 455.00'L x 1.00'H Swale Z=3.0</b>
#2	-1.50'	0.005 af	<b>2.00'W x 455.00'L x 0.50'H Prismatic</b> 0.010 af Overall x 46.6% Voids
#3	-2.00'	0.001 af	<b>4.0" Round Pipe Storage</b> Inside #4 L= 455.0'
#4	-2.50'	0.004 af	<b>1.00'W x 455.00'L x 1.00'H Prismatic</b> 0.010 af Overall - 0.001 af Embedded = 0.010 af x 40.0% Voids
		0.062 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	-2.00'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.39 cfs @ 8.17 hrs HW=-0.95' (Free Discharge)  
 ↑ **1=Orifice/Grate** (Orifice Controls 0.39 cfs @ 4.52 fps)

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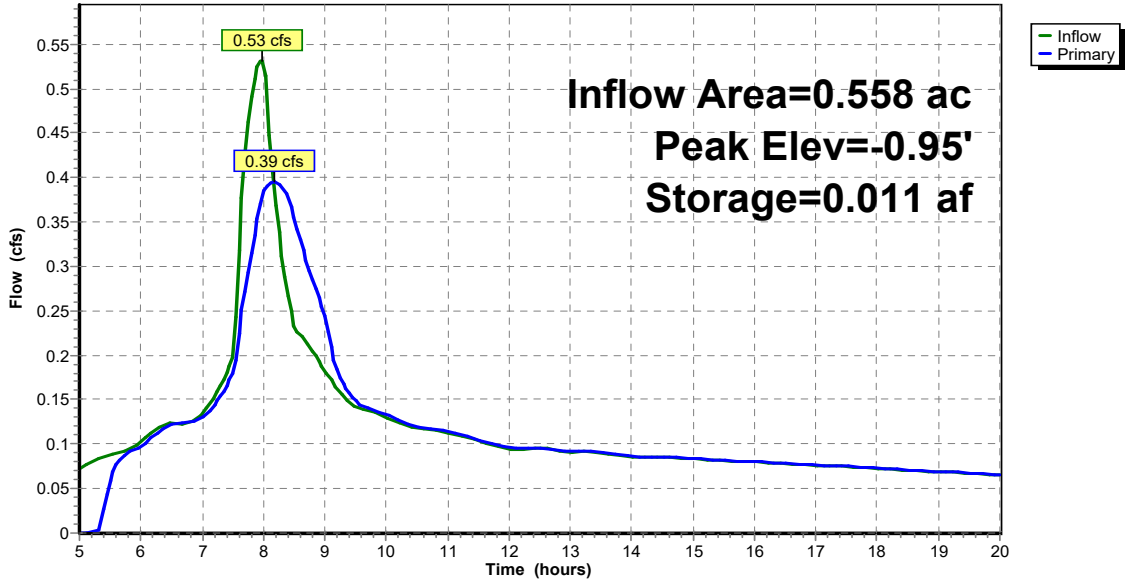
Type IA 24-hr 10-year Rainfall=4.80"

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Page 44

**Pond 9P: Facility 1 (Swale)**

Hydrograph



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Page 45

**Summary for Pond 10P: Facility 4 (Stormtech)**

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.243 ac, 86.42% Impervious, Inflow Depth > 3.22" for 10-year event  
 Inflow = 0.24 cfs @ 7.83 hrs, Volume= 0.065 af  
 Outflow = 0.07 cfs @ 9.10 hrs, Volume= 0.062 af, Atten= 72%, Lag= 76.1 min  
 Primary = 0.07 cfs @ 9.10 hrs, Volume= 0.062 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 1.40' @ 9.10 hrs Surf.Area= 0.021 ac Storage= 0.016 af

Plug-Flow detention time= 130.1 min calculated for 0.061 af (94% of inflow)  
 Center-of-Mass det. time= 99.9 min ( 748.8 - 648.9 )

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.013 af	<b>29.08'W x 30.95'L x 2.00'H Field A</b> 0.041 af Overall - 0.008 af Embedded = 0.033 af x 40.0% Voids
#2A	0.50'	0.008 af	<b>ADS_StormTech SC-160LP +Cap</b> x 52 Inside #1 Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap 52 Chambers in 13 Rows
		0.021 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>1.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	1.92'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.07 cfs @ 9.10 hrs HW=1.40' (Free Discharge)  
 1=Orifice/Grate (Orifice Controls 0.07 cfs @ 5.58 fps)  
 2=Overflow Riser ( Controls 0.00 cfs)

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Type IA 24-hr 10-year Rainfall=4.80"

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Page 46

**Pond 10P: Facility 4 (Stormtech) - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTechSC-160LP+Cap (ADS StormTech®SC-160LP with cap length)**

Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf

Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap

4 Chambers/Row x 7.12' Long +0.23' Cap Length x 2 = 28.95' Row Length +12.0" End Stone x 2 = 30.95' Base Length

13 Rows x 25.0" Wide + 12.0" Side Stone x 2 = 29.08' Base Width

6.0" Stone Base + 12.0" Chamber Height + 6.0" Stone Cover = 2.00' Field Height

52 Chambers x 6.8 cf = 355.5 cf Chamber Storage

1,800.1 cf Field - 355.5 cf Chambers = 1,444.5 cf Stone x 40.0% Voids = 577.8 cf Stone Storage

Chamber Storage + Stone Storage = 933.3 cf = 0.021 af

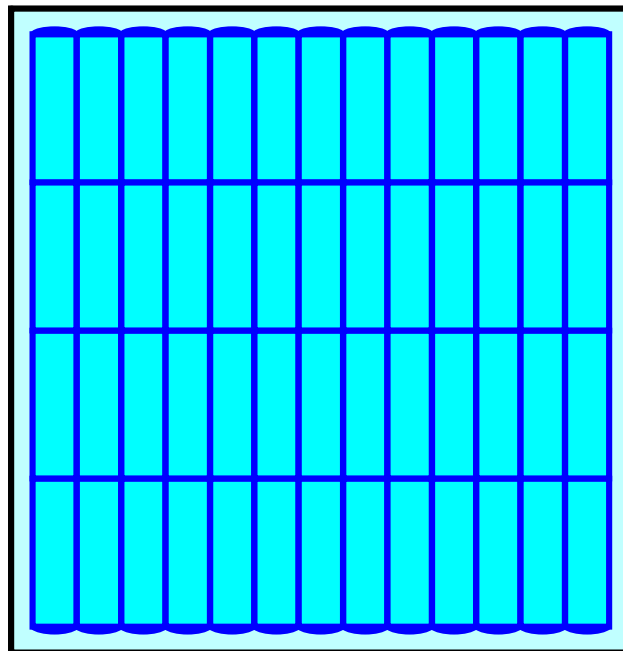
Overall Storage Efficiency = 51.9%

Overall System Size = 30.95' x 29.08' x 2.00'

52 Chambers

66.7 cy Field

53.5 cy Stone





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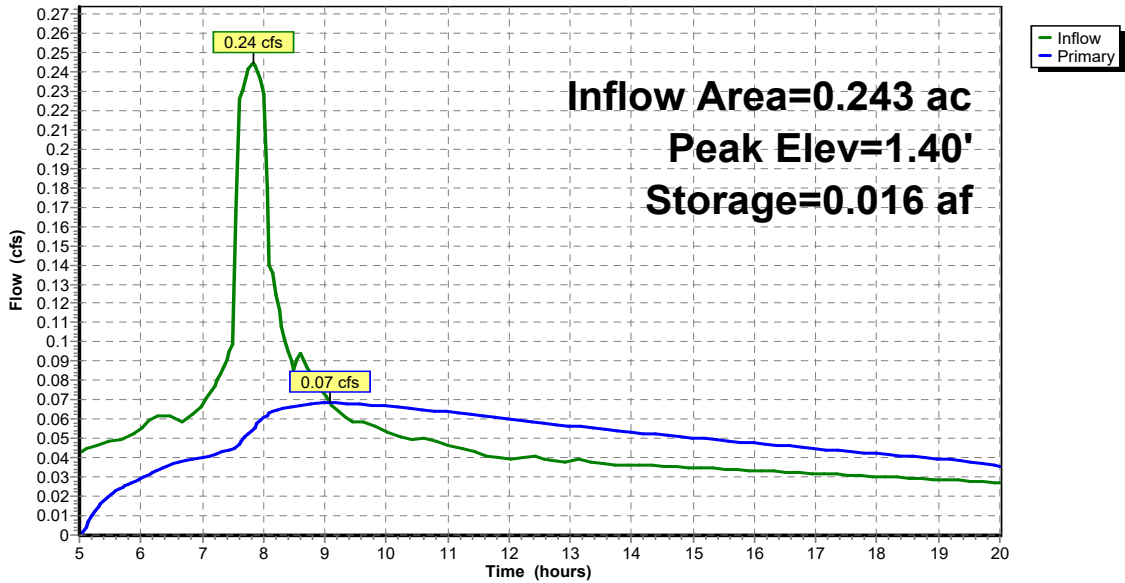
Type IA 24-hr 10-year Rainfall=4.80"

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Page 47

**Pond 10P: Facility 4 (Stormtech)**

Hydrograph



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Type IA 24-hr 10-year Rainfall=4.80"

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Page 48

**Summary for Pond 12P: Facility 2 (North Tank)**

[82] Warning: Early inflow requires earlier time span

[92] Warning: Device #4 is above defined storage

Inflow Area = 5.557 ac, 51.39% Impervious, Inflow Depth > 2.21" for 10-year event  
 Inflow = 3.19 cfs @ 7.99 hrs, Volume= 1.026 af  
 Outflow = 0.97 cfs @ 9.57 hrs, Volume= 0.750 af, Atten= 70%, Lag= 94.5 min  
 Primary = 0.97 cfs @ 9.57 hrs, Volume= 0.750 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 5.16' @ 9.57 hrs Surf.Area= 0.066 ac Storage= 0.339 af

Plug-Flow detention time= 242.5 min calculated for 0.746 af (73% of inflow)  
 Center-of-Mass det. time= 115.8 min ( 791.9 - 676.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.393 af	<b>24.00'W x 119.00'L x 6.00'H Prismatic</b>

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>2.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	3.25'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	4.00'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	6.00'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.97 cfs @ 9.57 hrs HW=5.16' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 0.24 cfs @ 10.85 fps)
- 2=Orifice/Grate (Orifice Controls 0.32 cfs @ 6.44 fps)
- 3=Orifice/Grate (Orifice Controls 0.42 cfs @ 4.81 fps)
- 4=Overflow Riser ( Controls 0.00 cfs)

**Cascade Creek**

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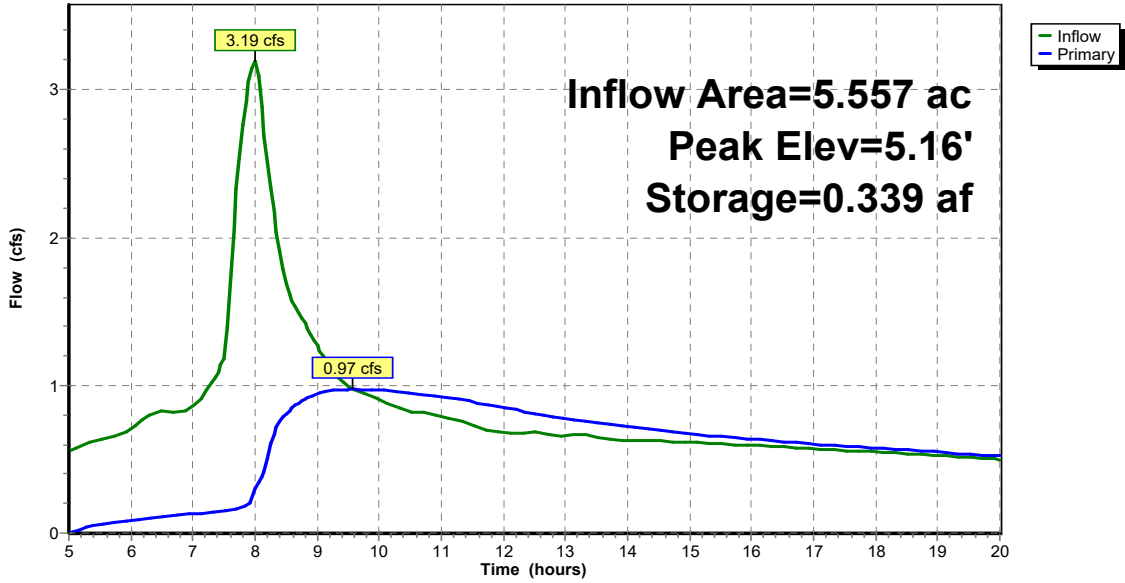
Type IA 24-hr 10-year Rainfall=4.80"

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Page 49

**Pond 12P: Facility 2 (North Tank)**

Hydrograph



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Type IA 24-hr 10-year Rainfall=4.80"

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Page 50

**Summary for Pond 13P: Facility 3 (South Tank)**

[82] Warning: Early inflow requires earlier time span

[92] Warning: Device #4 is above defined storage

Inflow Area = 3.075 ac, 47.67% Impervious, Inflow Depth > 2.11" for 10-year event  
 Inflow = 1.76 cfs @ 7.98 hrs, Volume= 0.540 af  
 Outflow = 0.45 cfs @ 10.15 hrs, Volume= 0.376 af, Atten= 74%, Lag= 130.5 min  
 Primary = 0.45 cfs @ 10.15 hrs, Volume= 0.376 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 5.20' @ 10.15 hrs Surf.Area= 0.035 ac Storage= 0.180 af

Plug-Flow detention time= 258.2 min calculated for 0.375 af (69% of inflow)  
 Center-of-Mass det. time= 116.8 min ( 794.9 - 678.0 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.208 af	<b>26.00'W x 58.00'L x 6.00'H Prismatic</b>

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>2.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	4.00'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	4.75'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	6.00'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.45 cfs @ 10.15 hrs HW=5.20' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 0.24 cfs @ 10.89 fps)
- 2=Orifice/Grate (Orifice Controls 0.08 cfs @ 5.12 fps)
- 3=Orifice/Grate (Orifice Controls 0.14 cfs @ 2.76 fps)
- 4=Overflow Riser ( Controls 0.00 cfs)

**Cascade Creek**

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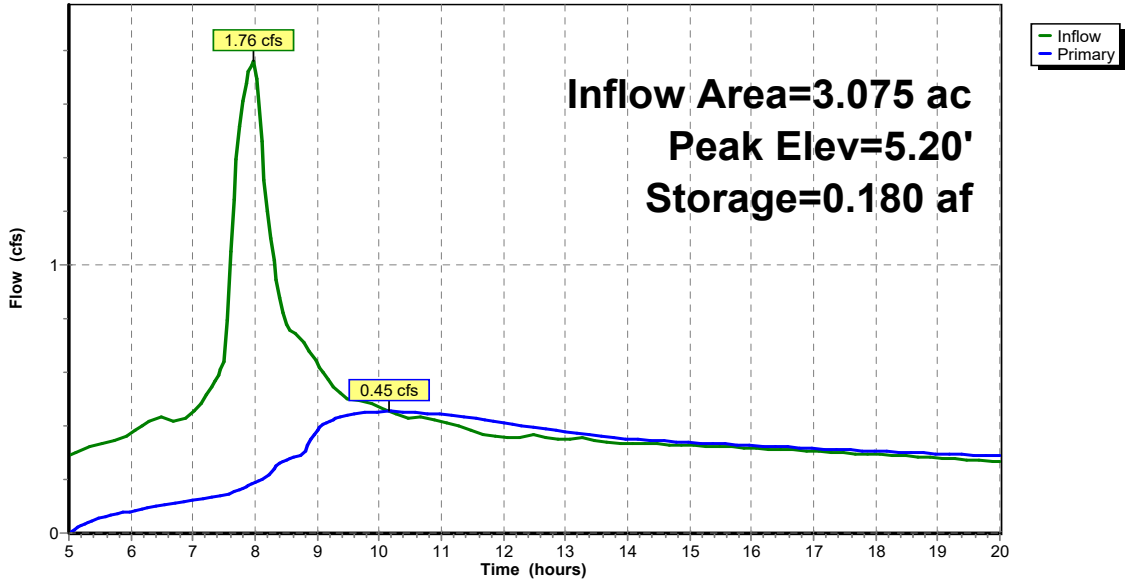
Type IA 24-hr 10-year Rainfall=4.80"

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Page 51

**Pond 13P: Facility 3 (South Tank)**

Hydrograph



**Cascade Creek**

Type IA 24-hr 25-year Rainfall=5.50"

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Page 52

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SBUH method, Split Pervious/Imperv.

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Basin 2 (North Lot)** Runoff Area=2.489 ac 60.71% Impervious Runoff Depth>2.93"  
Flow Length=544' Tc=13.0 min CN=56/98 Runoff=1.93 cfs 0.608 af

**Subcatchment2S: Basin 1 (Highway 211)** Runoff Area=0.558 ac 42.38% Impervious Runoff Depth>3.74"  
Flow Length=549' Slope=0.0250 '/' Tc=7.8 min CN=87/98 Runoff=0.62 cfs 0.174 af

**Subcatchment3S: Basin 4 (South Lot)** Runoff Area=3.075 ac 47.67% Impervious Runoff Depth>2.52"  
Flow Length=543' Tc=6.8 min CN=56/98 Runoff=2.14 cfs 0.647 af

**Subcatchment4S: Basin 3 (Right of Way)** Runoff Area=3.068 ac 43.84% Impervious Runoff Depth>2.41"  
Flow Length=365' Tc=10.1 min CN=56/98 Runoff=1.92 cfs 0.615 af

**Subcatchment5S: Basin 5 (Area 2)** Runoff Area=0.243 ac 86.42% Impervious Runoff Depth>3.72"  
Flow Length=116' Tc=0.9 min CN=56/98 Runoff=0.28 cfs 0.075 af

**Pond 9P: Facility 1 (Swale)** Peak Elev=-0.84' Storage=0.014 af Inflow=0.62 cfs 0.174 af  
Outflow=0.42 cfs 0.171 af

**Pond 10P: Facility 4 (Stormtech)** Peak Elev=1.80' Storage=0.020 af Inflow=0.28 cfs 0.075 af  
Outflow=0.08 cfs 0.070 af

**Pond 12P: Facility 2 (North Tank)** Peak Elev=5.94' Storage=0.390 af Inflow=3.86 cfs 1.223 af  
Outflow=1.19 cfs 0.937 af

**Pond 13P: Facility 3 (South Tank)** Peak Elev=5.85' Storage=0.202 af Inflow=2.14 cfs 0.647 af  
Outflow=0.59 cfs 0.478 af

**Total Runoff Area = 9.433 ac Runoff Volume = 2.119 af Average Runoff Depth = 2.70"**  
**49.45% Pervious = 4.665 ac 50.55% Impervious = 4.769 ac**

**Cascade Creek**

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Type IA 24-hr 25-year Rainfall=5.50"

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Page 53

**Summary for Subcatchment 1S: Basin 2 (North Lot)**

Runoff = 1.93 cfs @ 8.00 hrs, Volume= 0.608 af, Depth> 2.93"  
 Routed to Pond 12P : Facility 2 (North Tank)

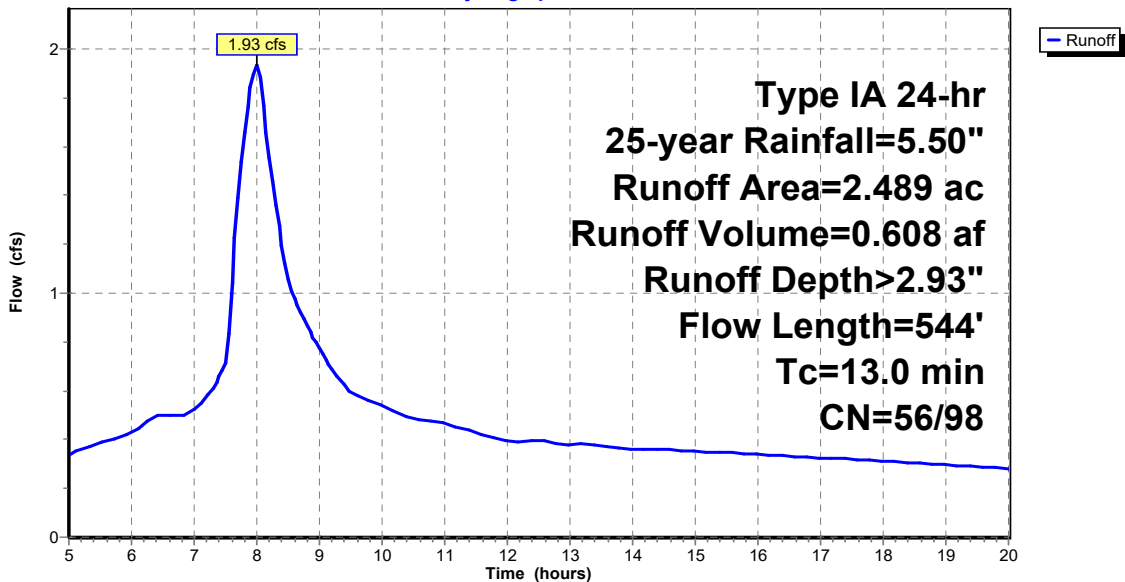
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
0.433	98	Roofs, HSG B
1.078	98	Paved parking, HSG B
* 0.978	56	Lawn
2.489	81	Weighted Average
0.978	56	39.29% Pervious Area
1.511	98	60.71% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.2	146	0.0273	0.22		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
1.3	168	0.0420	2.15		<b>Sheet Flow, Lot</b> Smooth surfaces n= 0.011 P2= 3.50"
0.5	230	0.0300	7.86	6.17	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
13.0	544	Total			

**Subcatchment 1S: Basin 2 (North Lot)**

Hydrograph



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Type IA 24-hr 25-year Rainfall=5.50"

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Page 54

**Summary for Subcatchment 2S: Basin 1 (Highway 211)**

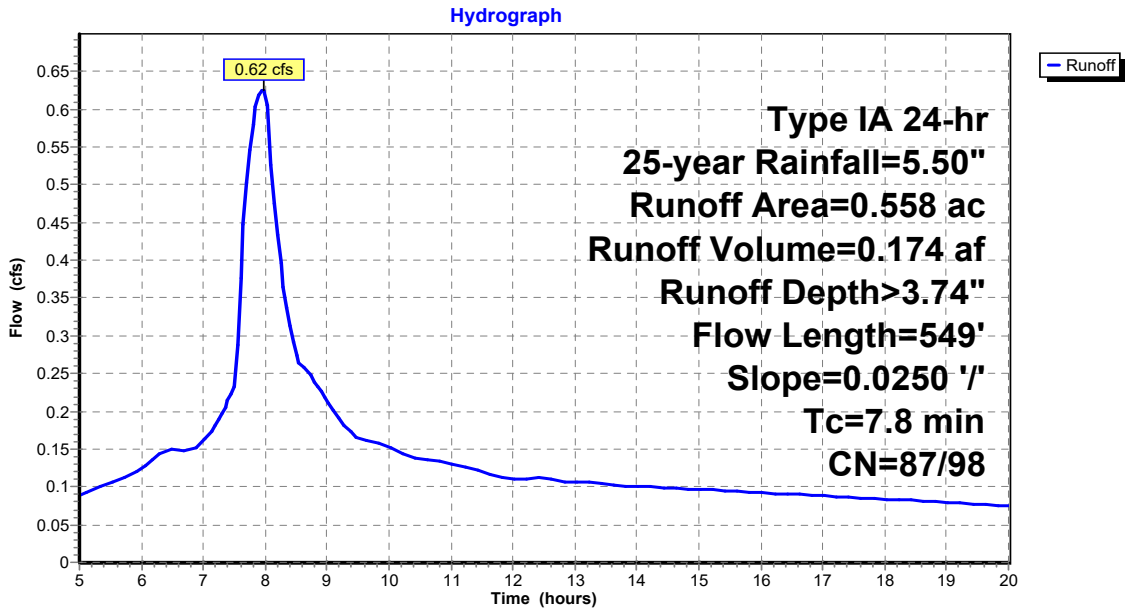
Runoff = 0.62 cfs @ 7.96 hrs, Volume= 0.174 af, Depth> 3.74"  
 Routed to Pond 9P : Facility 1 (Swale)

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
* 0.473	98	Paved roads w/open ditches, 50% imp, HSG B
* 0.085	56	>75% Grass cover, Good, HSG B
0.558	92	Weighted Average
0.322	87	57.62% Pervious Area
0.237	98	42.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	65	0.0250	1.44		<b>Sheet Flow, Road</b> Smooth surfaces n= 0.011 P2= 3.50"
7.0	484	0.0250	1.15	5.73	<b>Channel Flow, Swale</b> Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.150 Sheet flow over Short Grass
7.8	549	Total			

**Subcatchment 2S: Basin 1 (Highway 211)**





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Type IA 24-hr 25-year Rainfall=5.50"

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Page 55

**Summary for Subcatchment 3S: Basin 4 (South Lot)**

Runoff = 2.14 cfs @ 7.98 hrs, Volume= 0.647 af, Depth> 2.52"  
 Routed to Pond 13P : Facility 3 (South Tank)

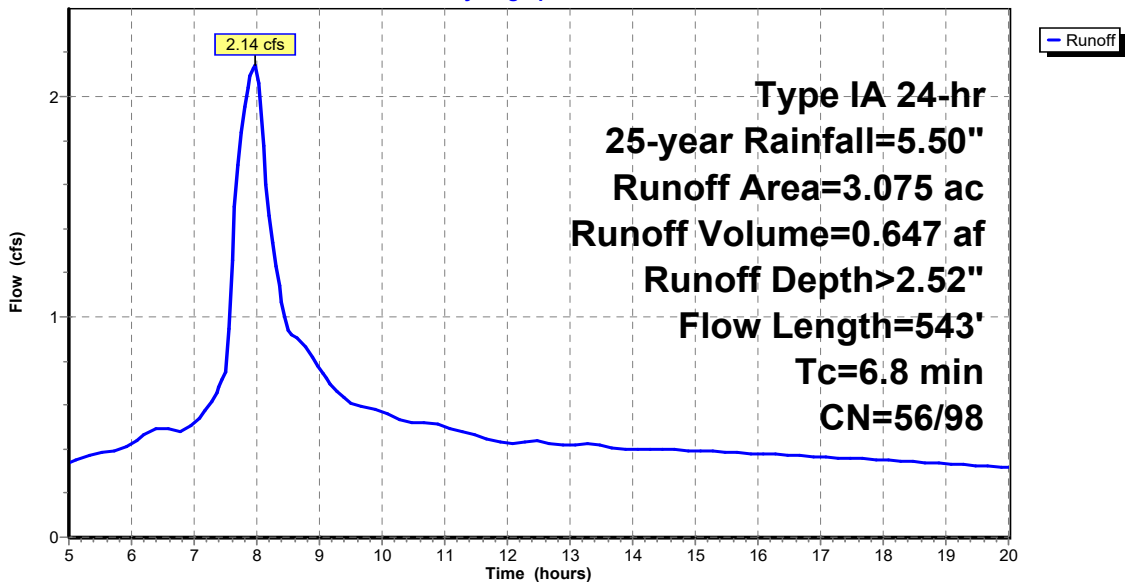
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
1.038	98	Paved roads w/curbs & sewers, HSG B
0.428	98	Unconnected roofs, HSG B
* 1.609	56	Lawn
3.075	76	Weighted Average
1.609	56	52.33% Pervious Area
1.466	98	47.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	124	0.1200	0.38		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
0.5	54	0.0500	1.83		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.9	365	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
6.8	543	Total			

**Subcatchment 3S: Basin 4 (South Lot)**

Hydrograph



**Cascade Creek**

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Type IA 24-hr 25-year Rainfall=5.50"

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Page 56

**Summary for Subcatchment 4S: Basin 3 (Right of Way)**

Runoff = 1.92 cfs @ 7.99 hrs, Volume= 0.615 af, Depth> 2.41"  
 Routed to Pond 12P : Facility 2 (North Tank)

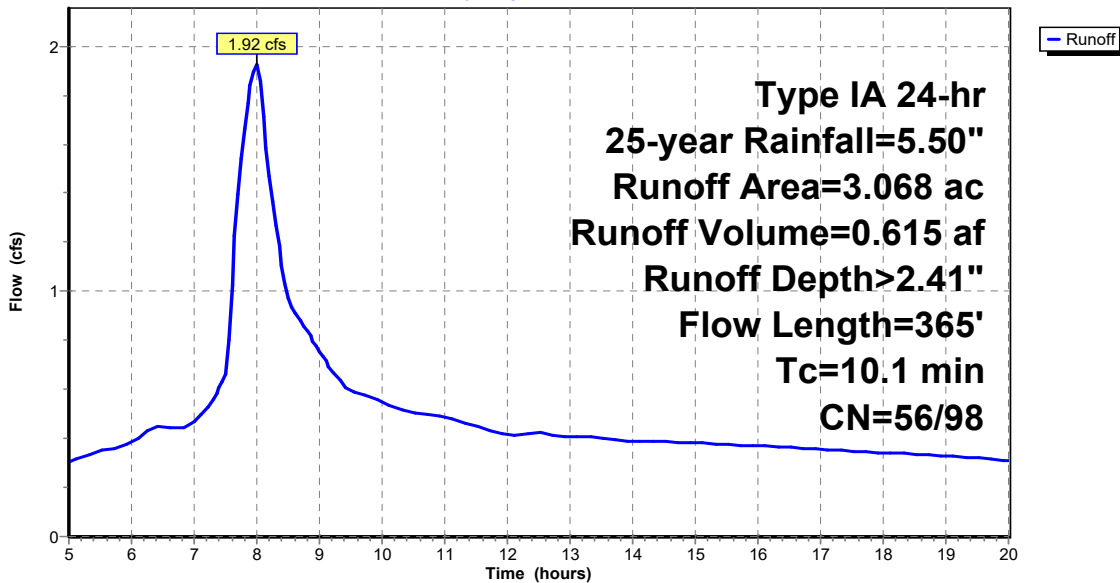
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-year Rainfall=5.50"

Area (ac)	CN	Description
1.345	98	Paved roads w/curbs & sewers, HSG B
* 1.723	56	Lawn
3.068	74	Weighted Average
1.723	56	56.16% Pervious Area
1.345	98	43.84% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	200	0.0866	0.37		<b>Sheet Flow, Lawn</b> Grass: Short n= 0.150 P2= 3.50"
0.9	140	0.0800	2.68		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.1	25	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
10.1	365	Total			

**Subcatchment 4S: Basin 3 (Right of Way)**

Hydrograph



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Page 57

**Summary for Subcatchment 5S: Basin 5 (Area 2)**

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.28 cfs @ 7.83 hrs, Volume= 0.075 af, Depth> 3.72"  
 Routed to Pond 10P : Facility 4 (Stormtech)

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type IA 24-hr 25-year Rainfall=5.50"

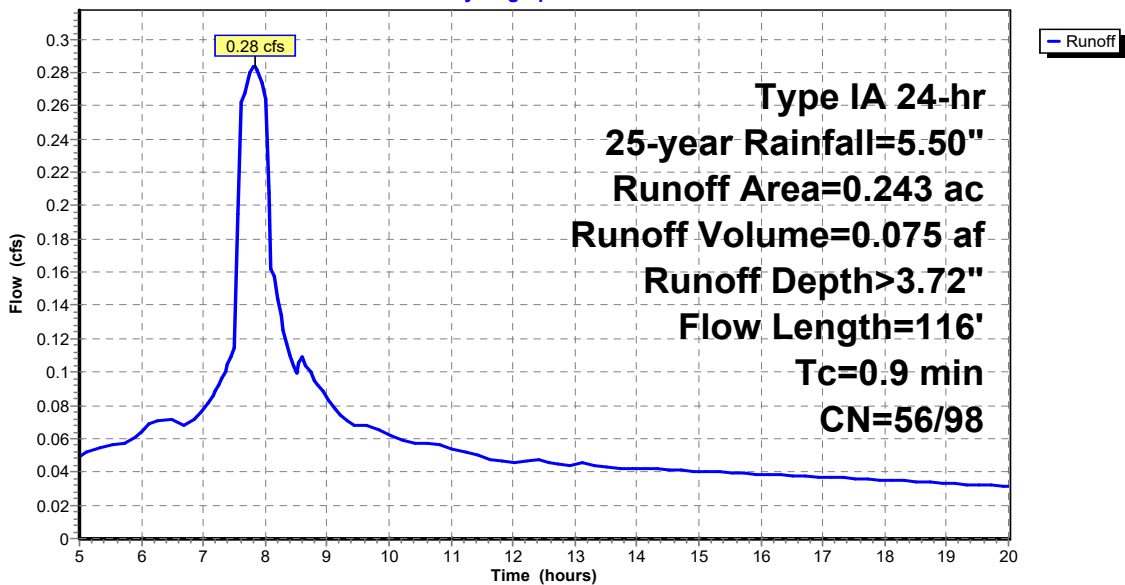
Area (ac)	CN	Description
0.210	98	Paved parking, HSG B
* 0.033	56	Lawn
0.243	92	Weighted Average
0.033	56	13.58% Pervious Area
0.210	98	86.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	80	0.0280	1.57		<b>Sheet Flow, Pavement</b> Smooth surfaces n= 0.011 P2= 3.50"
0.1	36	0.0200	6.42	5.04	<b>Pipe Channel, Conveyance</b> 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
0.9	116	Total			

**Subcatchment 5S: Basin 5 (Area 2)**

Hydrograph



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Page 58

**Summary for Pond 9P: Facility 1 (Swale)**

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.558 ac, 42.38% Impervious, Inflow Depth > 3.74" for 25-year event  
 Inflow = 0.62 cfs @ 7.96 hrs, Volume= 0.174 af  
 Outflow = 0.42 cfs @ 8.22 hrs, Volume= 0.171 af, Atten= 33%, Lag= 15.3 min  
 Primary = 0.42 cfs @ 8.22 hrs, Volume= 0.171 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= -0.84' @ 8.22 hrs Surf.Area= 0.063 ac Storage= 0.014 af

Plug-Flow detention time= 22.6 min calculated for 0.170 af (98% of inflow)  
 Center-of-Mass det. time= 11.8 min ( 671.7 - 659.9 )

Volume	Invert	Avail.Storage	Storage Description
#1	-1.00'	0.053 af	<b>2.00'W x 455.00'L x 1.00'H Swale Z=3.0</b>
#2	-1.50'	0.005 af	<b>2.00'W x 455.00'L x 0.50'H Prismatic</b> 0.010 af Overall x 46.6% Voids
#3	-2.00'	0.001 af	<b>4.0" Round Pipe Storage</b> Inside #4 L= 455.0'
#4	-2.50'	0.004 af	<b>1.00'W x 455.00'L x 1.00'H Prismatic</b> 0.010 af Overall - 0.001 af Embedded = 0.010 af x 40.0% Voids
		0.062 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	-2.00'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.42 cfs @ 8.22 hrs HW=-0.84' (Free Discharge)

↑ **1=Orifice/Grate** (Orifice Controls 0.42 cfs @ 4.80 fps)

**Cascade Creek**

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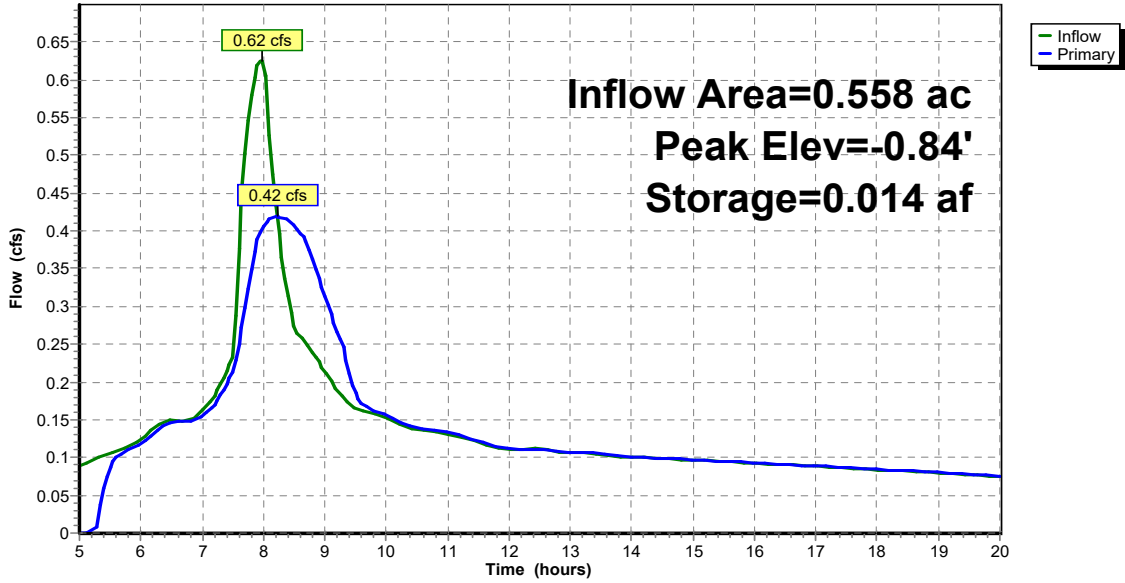
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Page 59

**Pond 9P: Facility 1 (Swale)**

Hydrograph



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Page 60

**Summary for Pond 10P: Facility 4 (Stormtech)**

[82] Warning: Early inflow requires earlier time span

Inflow Area = 0.243 ac, 86.42% Impervious, Inflow Depth > 3.72" for 25-year event  
 Inflow = 0.28 cfs @ 7.83 hrs, Volume= 0.075 af  
 Outflow = 0.08 cfs @ 9.13 hrs, Volume= 0.070 af, Atten= 73%, Lag= 78.0 min  
 Primary = 0.08 cfs @ 9.13 hrs, Volume= 0.070 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 1.80' @ 9.13 hrs Surf.Area= 0.021 ac Storage= 0.020 af

Plug-Flow detention time= 144.6 min calculated for 0.070 af (92% of inflow)  
 Center-of-Mass det. time= 103.1 min ( 752.1 - 649.0 )

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.013 af	<b>29.08'W x 30.95'L x 2.00'H Field A</b> 0.041 af Overall - 0.008 af Embedded = 0.033 af x 40.0% Voids
#2A	0.50'	0.008 af	<b>ADS_StormTech SC-160LP +Cap</b> x 52 Inside #1 Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap 52 Chambers in 13 Rows
		0.021 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>1.5" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	1.92'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.08 cfs @ 9.13 hrs HW=1.80' (Free Discharge)  
 1=Orifice/Grate (Orifice Controls 0.08 cfs @ 6.35 fps)  
 2=Overflow Riser ( Controls 0.00 cfs)

**Cascade Creek**

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Page 61

**Pond 10P: Facility 4 (Stormtech) - Chamber Wizard Field A**

**Chamber Model = ADS\_StormTechSC-160LP+Cap (ADS StormTech®SC-160LP with cap length)**

Effective Size= 18.0"W x 12.0"H => 0.96 sf x 7.12'L = 6.8 cf

Overall Size= 25.0"W x 12.0"H x 7.56'L with 0.44' Overlap

4 Chambers/Row x 7.12' Long +0.23' Cap Length x 2 = 28.95' Row Length +12.0" End Stone x 2 = 30.95' Base Length

13 Rows x 25.0" Wide + 12.0" Side Stone x 2 = 29.08' Base Width

6.0" Stone Base + 12.0" Chamber Height + 6.0" Stone Cover = 2.00' Field Height

52 Chambers x 6.8 cf = 355.5 cf Chamber Storage

1,800.1 cf Field - 355.5 cf Chambers = 1,444.5 cf Stone x 40.0% Voids = 577.8 cf Stone Storage

Chamber Storage + Stone Storage = 933.3 cf = 0.021 af

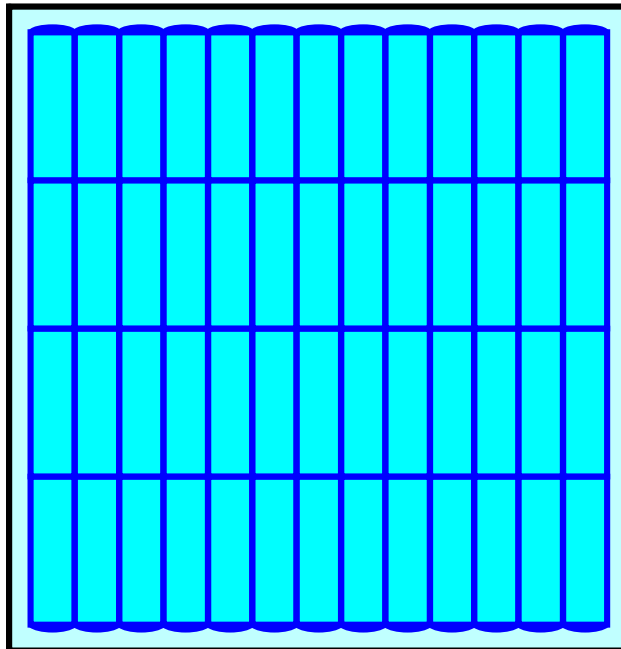
Overall Storage Efficiency = 51.9%

Overall System Size = 30.95' x 29.08' x 2.00'

52 Chambers

66.7 cy Field

53.5 cy Stone



**Cascade Creek**

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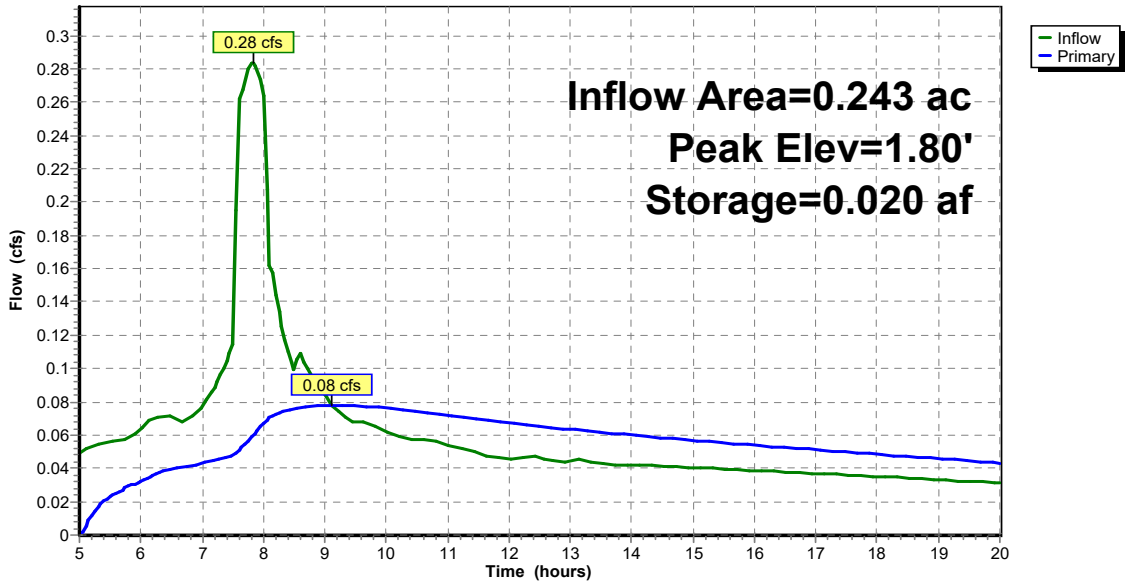
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Page 62

**Pond 10P: Facility 4 (Stormtech)**

Hydrograph





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Page 63

**Summary for Pond 12P: Facility 2 (North Tank)**

[82] Warning: Early inflow requires earlier time span

[92] Warning: Device #4 is above defined storage

Inflow Area = 5.557 ac, 51.39% Impervious, Inflow Depth > 2.64" for 25-year event  
 Inflow = 3.86 cfs @ 7.99 hrs, Volume= 1.223 af  
 Outflow = 1.19 cfs @ 9.49 hrs, Volume= 0.937 af, Atten= 69%, Lag= 90.0 min  
 Primary = 1.19 cfs @ 9.49 hrs, Volume= 0.937 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 5.94' @ 9.49 hrs Surf.Area= 0.066 ac Storage= 0.390 af

Plug-Flow detention time= 225.8 min calculated for 0.936 af (76% of inflow)  
 Center-of-Mass det. time= 113.8 min ( 790.9 - 677.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.393 af	<b>24.00'W x 119.00'L x 6.00'H Prisma</b>

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>2.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	3.25'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	4.00'	<b>4.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	6.00'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=1.19 cfs @ 9.49 hrs HW=5.94' (Free Discharge)

1=Orifice/Grate (Orifice Controls 0.25 cfs @ 11.65 fps)

2=Orifice/Grate (Orifice Controls 0.38 cfs @ 7.71 fps)

3=Orifice/Grate (Orifice Controls 0.56 cfs @ 6.41 fps)

4=Overflow Riser ( Controls 0.00 cfs)

**Cascade Creek**

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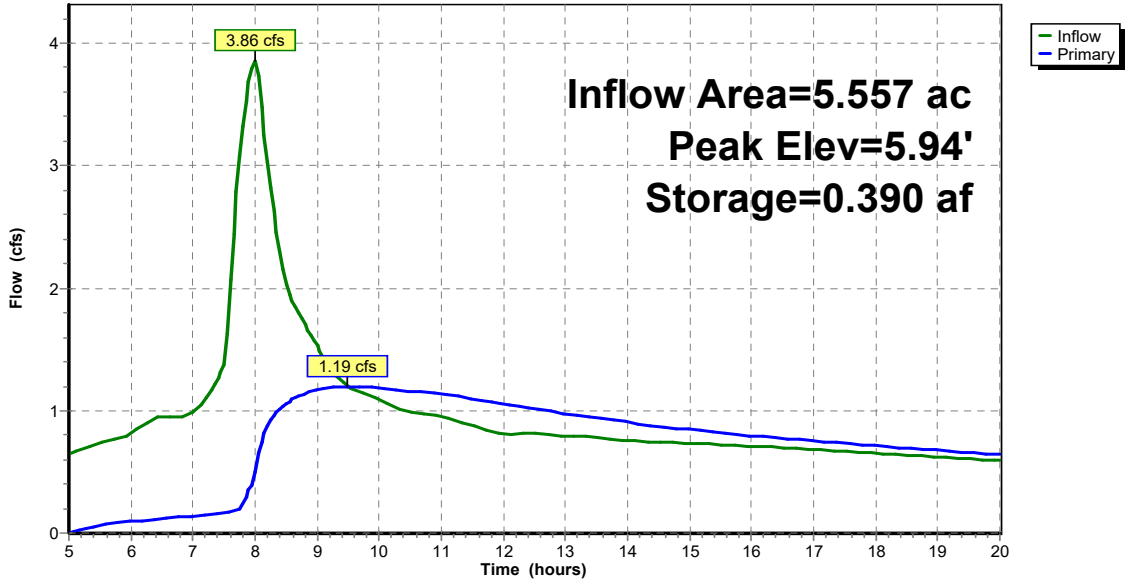
Type IA 24-hr 25-year Rainfall=5.50"

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Page 64

**Pond 12P: Facility 2 (North Tank)**

Hydrograph



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Type IA 24-hr 25-year Rainfall=5.50"

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Page 65

**Summary for Pond 13P: Facility 3 (South Tank)**

[82] Warning: Early inflow requires earlier time span

[92] Warning: Device #4 is above defined storage

Inflow Area = 3.075 ac, 47.67% Impervious, Inflow Depth > 2.52" for 25-year event  
 Inflow = 2.14 cfs @ 7.98 hrs, Volume= 0.647 af  
 Outflow = 0.59 cfs @ 9.83 hrs, Volume= 0.478 af, Atten= 73%, Lag= 111.6 min  
 Primary = 0.59 cfs @ 9.83 hrs, Volume= 0.478 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 5.85' @ 9.83 hrs Surf.Area= 0.035 ac Storage= 0.202 af

Plug-Flow detention time= 231.8 min calculated for 0.477 af (74% of inflow)  
 Center-of-Mass det. time= 108.2 min ( 787.3 - 679.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	0.208 af	<b>26.00'W x 58.00'L x 6.00'H Prismatic</b>

Device	Routing	Invert	Outlet Devices
#1	Primary	0.00'	<b>2.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#2	Primary	4.00'	<b>1.7" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#3	Primary	4.75'	<b>3.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads
#4	Primary	6.00'	<b>12.0" Vert. Overflow Riser</b> C= 0.600 Limited to weir flow at low heads

**Primary OutFlow** Max=0.59 cfs @ 9.83 hrs HW=5.85' (Free Discharge)

- 1=Orifice/Grate (Orifice Controls 0.25 cfs @ 11.56 fps)
- 2=Orifice/Grate (Orifice Controls 0.10 cfs @ 6.41 fps)
- 3=Orifice/Grate (Orifice Controls 0.23 cfs @ 4.74 fps)
- 4=Overflow Riser ( Controls 0.00 cfs)

**Cascade Creek**

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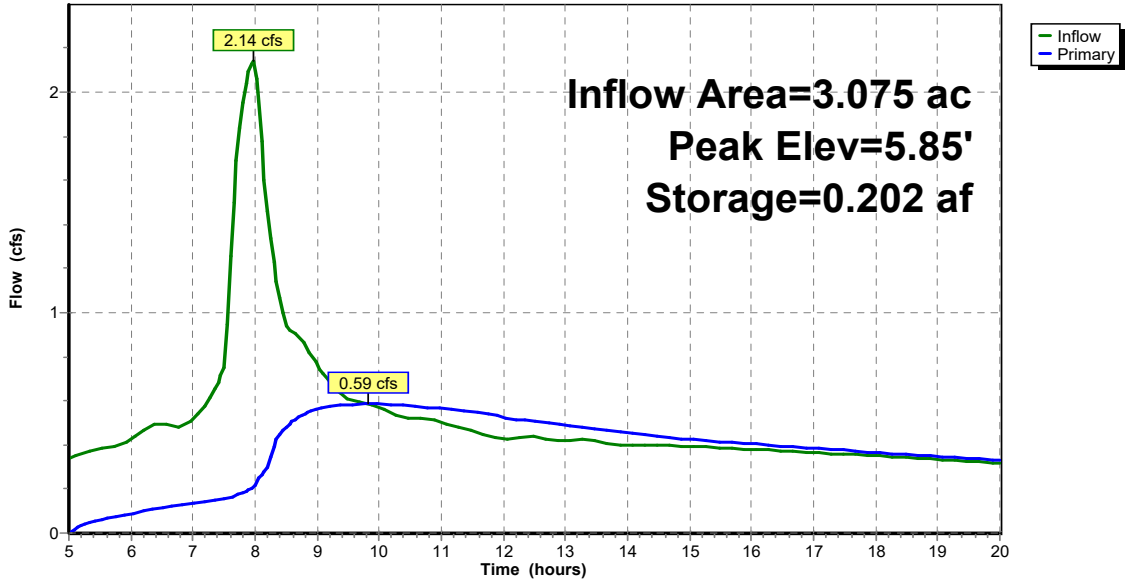
Type IA 24-hr 25-year Rainfall=5.50"

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Page 66

**Pond 13P: Facility 3 (South Tank)**

Hydrograph



**EXHIBIT K**

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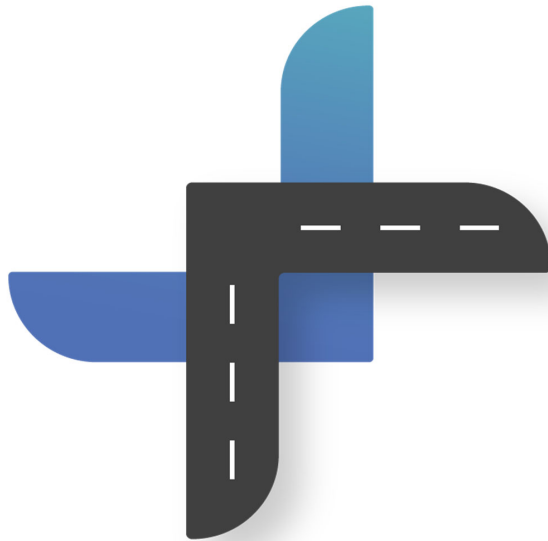
**CASCADE CREEK**

Sandy, OR

TRAFFIC IMPACT ANALYSIS (TIA)

May 22, 2023

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**HEATH&ASSOCIATES**  
Transportation Planning & Engineering

# CASCADE CREEK TRAFFIC IMPACT ANALYSIS

Prepared for:

Mr. Zac Baker  
Vaughn Bay Construction

Prepared by:

Heath & Associates  
PO Box 397  
Puyallup, WA 98371  
(253) 770 1401  
Heathtraffic.com

License:



# CASCADE CREEK TRAFFIC IMPACT ANALYSIS

## CONTENTS

- 1. Introduction..... 4
- 2. Project Description..... 4
- 3. Existing Conditions ..... 6
- 4. Forecast Traffic Demand and Analysis ..... 14
- 5. Conclusions & Mitigation ..... 28

## TABLES

- 1. Existing 2023 Peak Hour Level of Service ..... 11
- 2. Transportation Improvement Projects..... 12
- 3. Collision History..... 13
- 4. Collision History..... 13
- 5. Project Trip Generation ..... 14
- 6. Forecast 2025 Peak Hour Level of Service ..... 27

## FIGURES

- 1. Vicinity Map & Roadway System..... 4
- 2. Site Plan ..... 5
- 3. Existing AM Peak Hour Volumes ..... 9
- 4. Existing PM Peak Hour Volumes..... 10
- 5. AM Peak Hour Trip Distribution & Assignment ..... 17
- 6. PM Peak Hour Trip Distribution & Assignment..... 18
- 7. Expected Rerouted Traffic..... 19
- 8. Forecast 2025 AM Peak Hour Volumes without Project..... 20
- 9. Forecast 2025 PM Peak Hour Volumes without Project ..... 21
- 10. Forecast 2025 AM Peak Hour Volumes with Project ..... 22
- 11. Forecast 2025 PM Peak Hour Volumes with Project..... 23



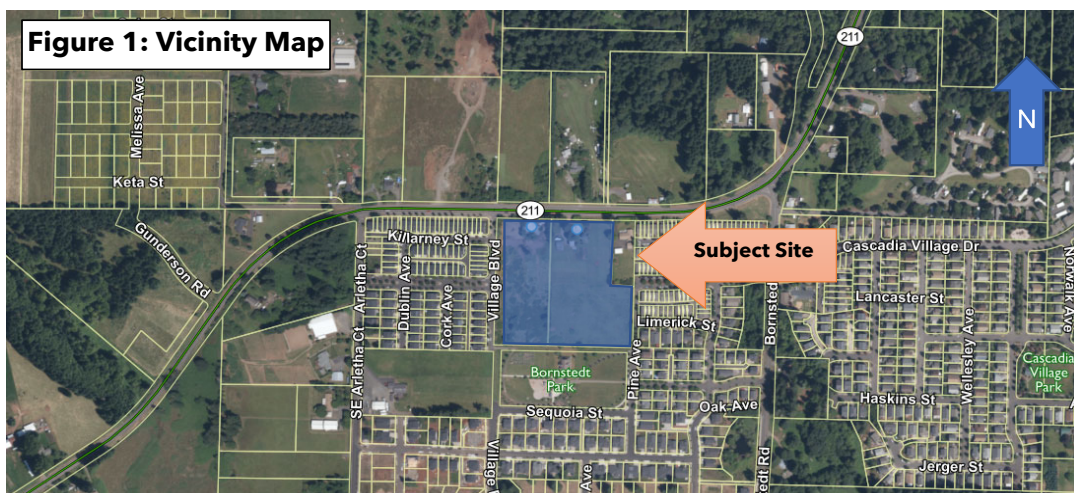
# CASCADE CREEK TRAFFIC IMPACT ANALYSIS

## 1. INTRODUCTION

Heath & Associates has been retained to prepare a Traffic Impact Analysis (TIA) for the proposed Cascade Creek Development in Sandy, Oregon. It was determined, after review of our 8/10/2022 Traffic Analysis Letter that further evaluation was required. The scope herein reflects requirements provided by the City and City's Transportation Engineer reviewer.

## 2. PROJECT DESCRIPTION

Cascade Creek proposes for the construction of a residential development consisting of 78 multi-family, low-income dwelling units and 11,142 square feet of commercial/office space in the city of Sandy. The subject site, with an address of 38272/38330 Highway 211, is situated on a cumulative 8.84-acres within tax parcel #'s: 00677-173 & -164. The subject site is bordered to the west by SE Village Boulevard and to the north by Highway 211. Two existing single-family structures exist in the northern portion of the subject site. Only the western unit will be demolished while the other is to remain. All existing on-site structures located within the development footprint are to be demolished prior to new construction. Primary access to the site is to be provided via SE Village Boulevard at Cascadia Village Drive and via Pine Street (a newly constructed roadway connection). Figure 1 below provides an aerial depiction of the surrounding roadway system. A conceptual site plan is presented in Figure 2.

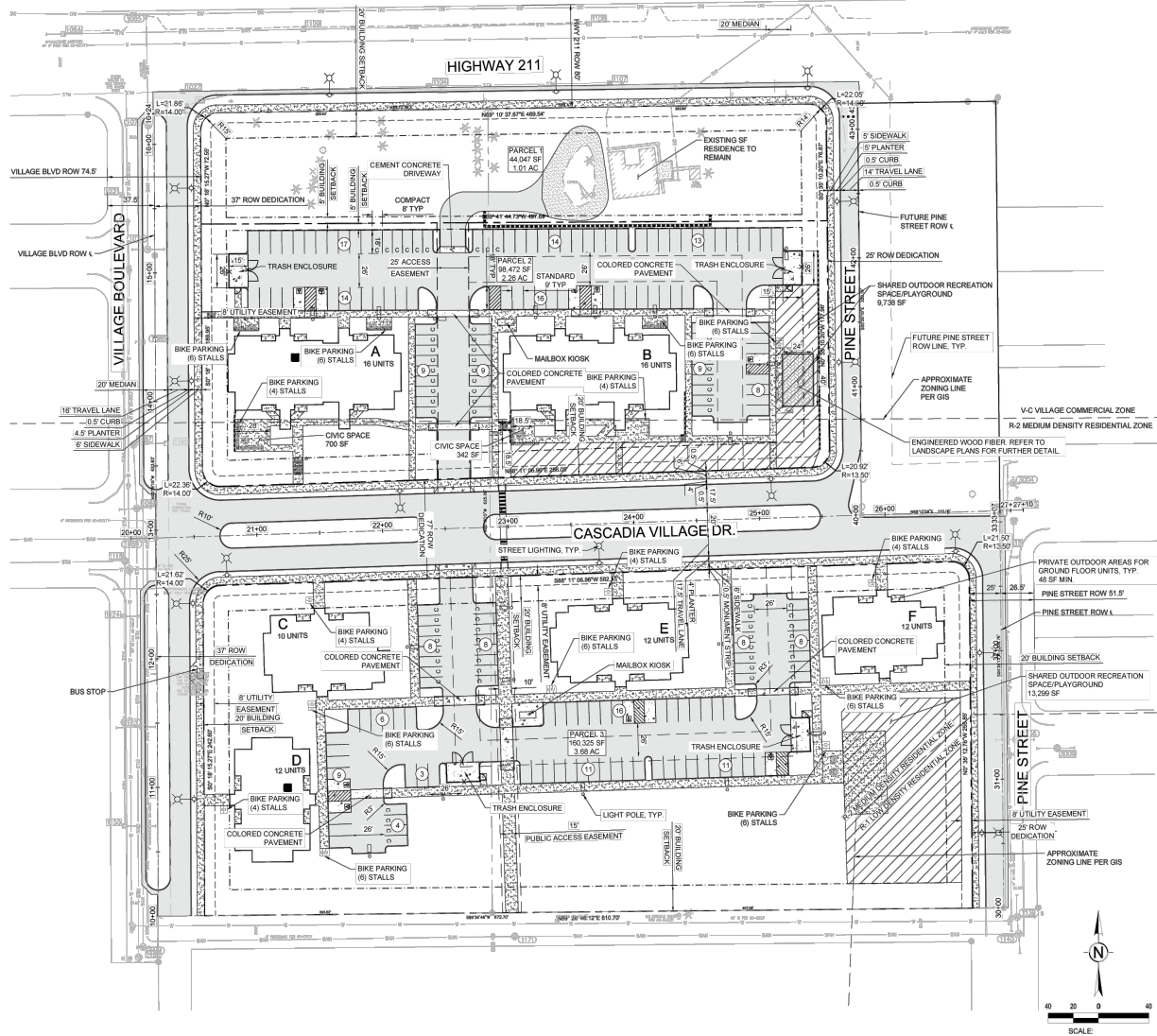


HeathTraffic.com

Cascade Creek TIA

4





## 3. EXISTING CONDITIONS

### 3.1 Existing Street System

*Highway 211 (Eagle Creek-Sandy Hwy 172):* is a two-lane, east-west minor arterial located north of the subject property. Left-turn lanes are provided at major intersections—including SE Village Boulevard. The posted speed limit is 40-mph south of Highway 26 and increases to 45-mph south of Dubarko Road. No pedestrian infrastructure is available.

SE Village Boulevard: is a two-lane, north-south local roadway bordering the subject site to the west. The roadway is partially built out spanning approximately 680-feet south of Highway 211. Curb, gutter, planter strip and sidewalk are available along the western side of the roadway. As part of site development, Cascade Creek would improve the eastern side of the roadway up to city standards.

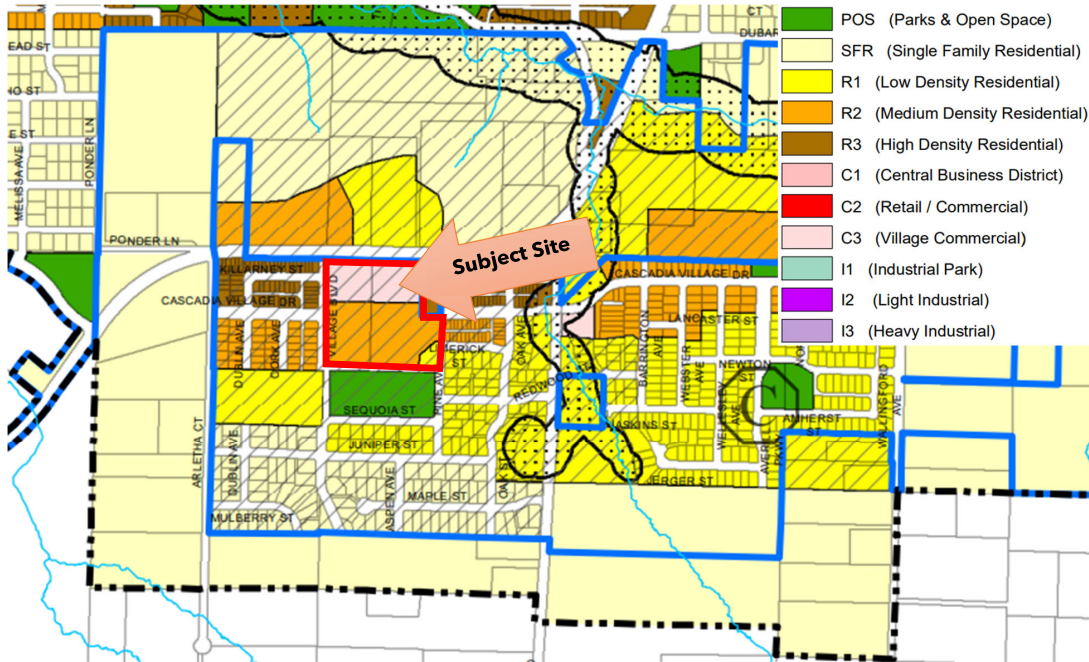
### 3.2 Transit Service

A review of the city of Sandy transit service indicates transit is provided in the vicinity of the proposed project. Route Sandy Estacada is provided at the nearby intersection of Highway 211 & SE Village Boulevard just northwest of the subject property. Service is provided from the Estacada City Hall to the Sandy Transit Center between 7:00 AM to 7:27 PM with approximately two-hour headways on weekdays and Saturdays. No Sunday service is provided.

Route SAM Shopper is also located under one mile from the proposed development located at the Cascadia Village Park approximately 2,000 feet east of the development. Route SAM Shopper provides service from Fred Myers to the Sandy Market Place. The transit route provides two shuttle buses (Shuttle A and B) which provide service Monday-Friday. Weekday service for Shuttle A is provided from 12:00 PM to 6:44 PM with approximately one-hour headways (except for 5:25 PM shuttle). Weekday service for Shuttle B is provided from 12:25 PM to 7:18 PM with approximately one-hour headways (except for the 5:50 PM shuttle). Refer to the Sandy Transit website for more detailed information. It is important to note that given the low-income restriction of the project, transit use could be expected.

### 3.3 Zoning

The subject property is located within the City's C3 (Village Commercial), R2 (Medium Density Residential) and R1 (Low Density) zoning as portrayed in the exhibit below.



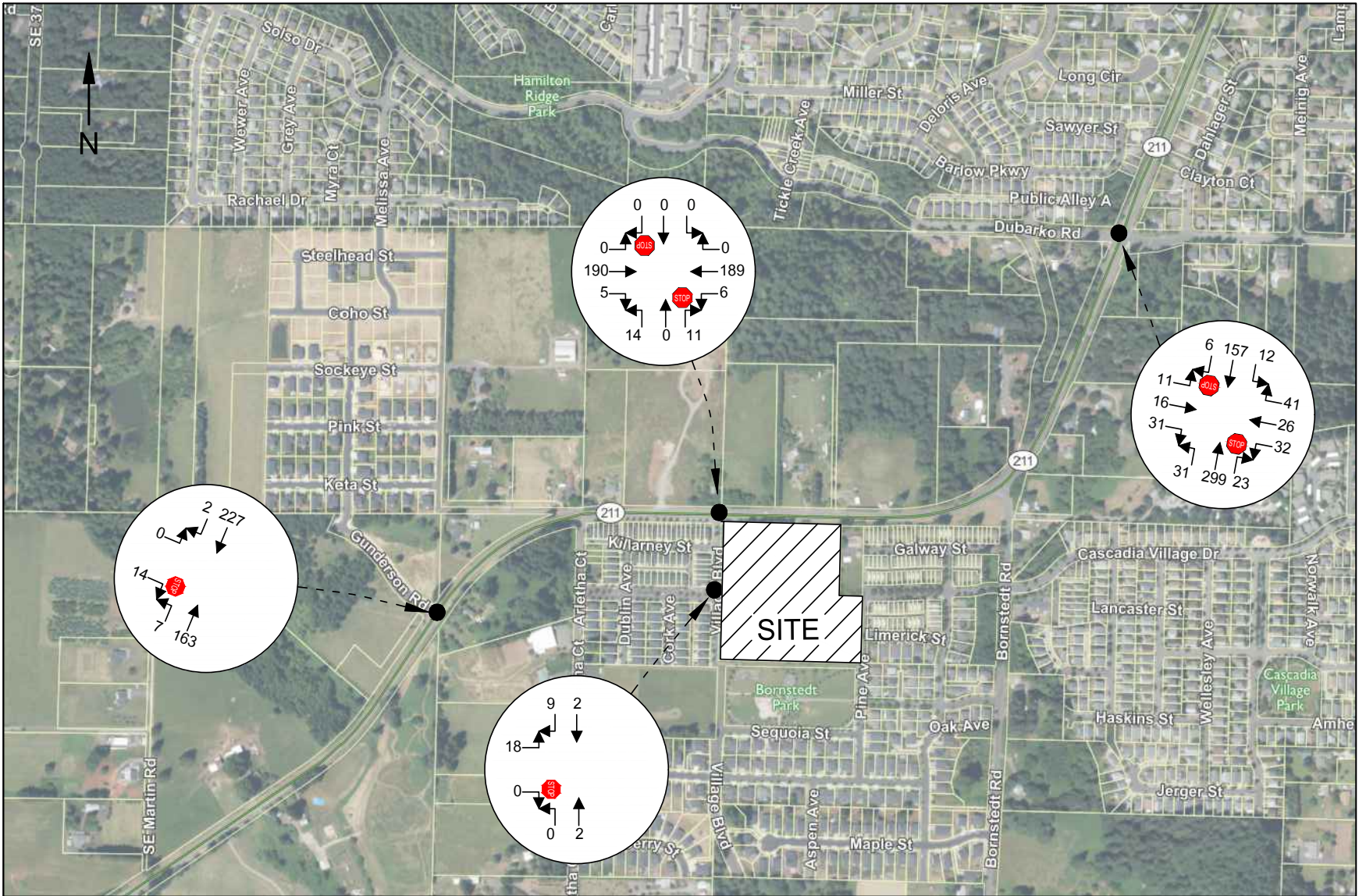
Moreover, the site location is situated within the "Village" designation per the City's Comprehensive Plan Map.

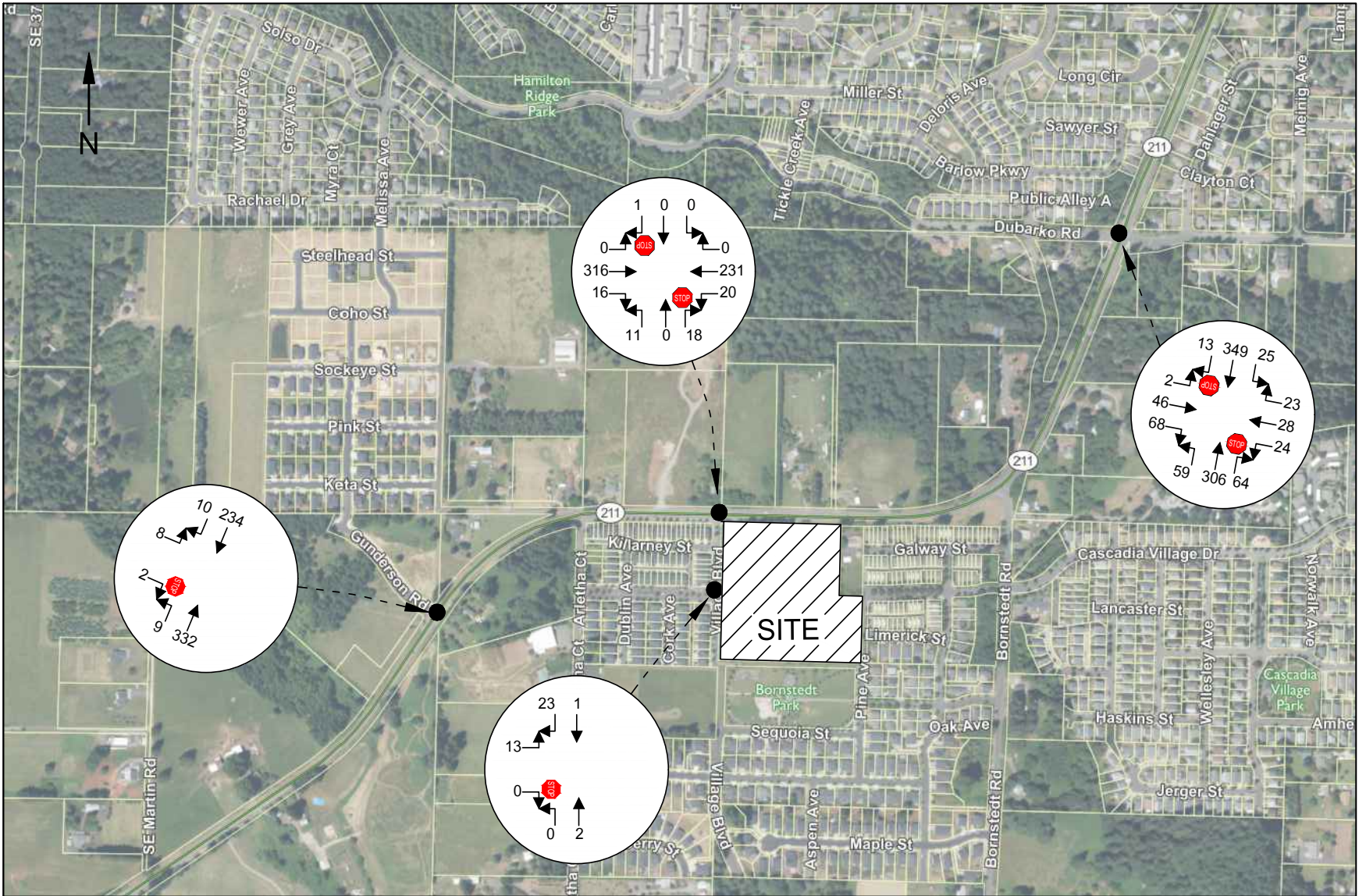
### 3.4 Existing Peak Hour Volumes

Field data for this study was collected in May of 2023 at four study intersections directed by the City. See list below for reference.

- Highway 211 & Gunderson Road
  - AM Peak Hour: 7:10-8:10
  - PM Peak Hour: 4:40-5:40
- Highway 211 & SE Village Boulevard
  - AM Peak Hour: 7:40-8:40
  - PM Peak Hour: 4:40-5:40
- SE Village Boulevard & Cascadia Village Drive
  - AM Peak Hour: 7:55-8:55
  - PM Peak Hour: 4:35-4:45
- Highway 211 & Dubarko Road
  - AM Peak Hour: 7:55-8:55
  - PM Peak Hour: 4:40-5:40

The traffic counts were administered by Quality Counts, a data collection firm, between 7:00-9:00 AM and 4:00-6:00 PM. The one hour exhibiting highest overall vehicular activity (peak hour displayed above) for each time period is then used for capacity and delay analysis. Respective AM and PM peak hour volumes are illustrated in Figures 3 and 4. Full-count sheets are provided in the appendix.





### 3.5 Existing Level of Service

Existing AM and PM peak hour delays were determined through the use of the *Highway Capacity Manual* 6th Edition. Capacity analysis is used to determine Level of Service (LOS) which is an established measure of congestion for transportation facilities. The range<sup>1</sup> for intersection level of service is LOS A to LOS F with the former indicating the best operating conditions with low control delays and the latter indicating the worst conditions with heavy control delays. Level of service calculations were made through the use of the *Synchro 11* analysis program. For side-street stop-controlled intersections, LOS is determined by the movement with the highest delay. Table 1 below summarizes LOS delay for the four study intersections.

**Table 1: Existing 2023 Peak Hour Level of Service**

*Delays Given in Seconds per Vehicle*

Intersection	Control	Peak Hour	Crit. Mvmt.	LOS	Delay	v/c
Hwy 211 & Gunderson Road	Stop	AM	SEB*	A	9.8	0.02
		PM		B	12.7	0.02
Hwy 211 & SE Village Blvd	Stop	AM	NB	B	11.0	0.04
		PM		B	12.2	0.06
Cascadia Village Dr & SE Village Blvd	Stop	AM	EB	A	8.7	0.03
		PM		A	8.8	0.02
Hwy 211 & Dubarko Road	Stop	AM	WB-TL*	C	17.2	0.18
		PM		D	31.2	0.29

\*SEB - Southeast Bound; WB-TL - Westbound Through-Left

**City of Sandy Level of Service Standards:** Sandy has adopted an LOS standard of D or better for all city intersections<sup>2</sup>.

Existing AM and PM peak hour delays are shown to operate with LOS D conditions or better for all study intersections. All study intersections are shown to have sufficient capacity given the reported volume to capacity (v/c) ratios. No level of service deficiencies are identified with existing conditions.

<sup>1</sup> *Signalized Intersections - Level of Service*

Level of Service	Control Delay per Vehicle (sec)
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

*Stop Controlled Intersections - Level of Service*

Level of Service	Control Delay per Vehicle (sec)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

Highway Capacity Manual, 6th Edition

<sup>2</sup> 2011 City of Sandy Transportation System Plan



### 3.6 Roadway Improvement

A review of the City of Sandy's/Oregon State's Transportation Improvements were reviewed to determine if any projects are planned in the vicinity of the Cascade Creek development. Table 2 below highlights each improvement project in the vicinity of the subject site.

**Table 2: Transportation Improvement Projects**

Name	Location	Improvement	Cost (2009 \$)
Bornstedt Road (ID: P4)	Cascadia Village Dr to UGB	Infill sidewalk gaps.	\$1,420,000
Dubarko Road (ID: P5)	E/O Melissa Ave to E/O OR 211	Infill sidewalk gaps.	\$3,240,000
Jacoby Road (ID: P8)	Dubarko Road to Cascadia Village Dr	Infill sidewalk gaps.	\$40,000
OR 211 (ID: P23)	OR 211 Parkway Path	Construct new bike/ped accessway.	\$325,000
OR 211 (ID: P24/B11)	South UGB to US 26	Construct sidewalks and widen shoulder to 6 feet.	\$28,200,000
Bornstedt Road (ID: B3)	OR 211 to UGB	Re-stripe/widen road.	\$32,000
Various Roads (ID: M21)	N/A	Gunderson Road, 370th Ave, Cascadia Village Dr., Cascadia Village Blvd, new collector.	\$20,000,000
OR 211 at Dubarko Rd (ID: M9)	OR 211 & Dubarko Rd	Construction northbound right turn lane, southbound left turn lane, northbound left turn lane, and install a traffic signal.	\$10,150,000

Multiple planned improvements in the vicinity of the project would further improve non-motorist mobility in the area along with the implementation of a signal at one study intersection along Highway 211 (at Dubarko Road).



### 3.7 Collision History

A list of the recorded collision history from the beginning of 2017 through 2021 (latest data available) for all study locations was obtained through the Oregon Department of Transportation's (ODOT) *TDS Crash Reports* system. A summary of the collisions per year at the study intersections are listed in Table 3.

**Table 3: Collision History**

Intersection/Corridor	2017	2018	2019	2020	2021	Avg/Yr
Hwy 211 & Dubarko	6	3	7	4	3	4.6

The only intersection with reported crash history was Highway 211 (Eagle Creek Sandy-Highway) & Dubarko Road with a total of 23 incidents yielding an average of 4.6 collisions per year. Out of the 23 reported collisions, no fatalities occurred; 6 were property damage only, and a total of 31 people were injured. A summary of the collision type listed from highest to lowest frequency is shown in the table below.

**Table 4: Collision History**

Intersection/Corridor	Angle	Turning Mvmt	Rear-End	Pedestrian	Fixed Object
Hwy 211 & Dubarko	16	3	2	1	1

The predominate collision type was in the form of "angle" accounting for ~70 percent of total occurrences. One collision involved a pedestrian which was non-fatal and occurred in 2018.

The only other collision within the study area (Gunderson Road, SE Village Boulevard, Cascadia Village) occurred along Highway 211 at milepost 4.6 in 2018 which is around the intersection of Gunderson Road. However, Gunderson Road was not constructed until 2021. No other incidents were identified.

## 4. FORECAST TRAFFIC DEMAND & ANALYSIS

### 4.1 Project Trip Generation

Trip generation is defined as the number of vehicle movements that enter or exit the respective project site during a designated time period, such as a specific peak hour (AM or PM) or an entire day. The magnitude of the anticipated vehicle trip generation for the proposed project was derived from the Institute of Transportation Engineers (ITE) publication, *Trip Generation*, 11th Edition. The residential use on-site is classified under LUC 220 - *Multifamily Housing Low-Rise*. While the project is intended to be affordable housing, the City requested a more conservative assumption of market-rate units should future plans change. Dwelling units was used as the input variable with ITE's average rates to determine trip ends.

Site development, per the zoning requirements, includes ground-level commercial space totaling ~11,142 square feet. The space is intended to be marketed and occupied as general office. However, per City direction, a broader land use assumption of LUC 822 - *Strip Retail* was utilized. This LUC could account for a variety of users/tenants that could occupy the space. Though with limited visibility along Highway 211 from the building's proposed location, most tenants are likely to be lower generating uses such as professional office. Consistent with LUC 822, pass-by trips were accounted for. Pass-by trips are motorists already traveling along the site who decide to make an intermediate stop before proceeding to their primary destination. These trips are not considered as new trips but will impact the site's access points. Table 5 below summarizes trip generation for the site. ITE trip generation sheets have been attached in the appendix for reference.

**Table 5: Project Trip Generation**

Land Use	Size	Type	AWDT	AM Peak-Hour Trips			PM Peak-Hour Trips		
				In	Out	Total	In	Out	Total
LUC 220 - Multifamily Low-Rise	78 DU's	Primary	526	7	24	<b>31</b>	25	15	<b>40</b>
LUC 822 - Strip Retail Plaza (<40k)	11,142 sq. ft.	Primary	364	10	6	<b>16</b>	22	22	<b>44</b>
		Pass-by <sup>3</sup>	243	6	4	<b>10</b>	15	14	<b>29</b>
Total Primary Trips			890	17	30	<b>47</b>	47	37	<b>84</b>
Total Pass-By Trips			243	6	4	<b>10</b>	15	14	<b>29</b>

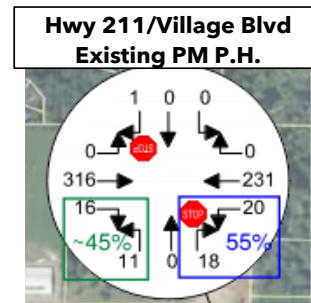
Based on the data presented in Table 5, the project is expected to conservatively generate 890 average weekday daily primary trips with 47 primary trips occurring in

<sup>3</sup> As no pass-by data is available for LUC 822, LUC 821 pass-by data has been applied (40%).

the AM peak hour and 84 primary trips occurring in the PM peak hour. Pass-by trips are anticipated at 10 AM peak hour trips and 29 PM peak hour trips.

#### 4.2 Distribution & Assignment

Trip distribution describes the process by which project generated trips are dispersed on the street network surrounding the subject site. The basis of the percentages is from the existing field counts from the intersection of Highway 211 & SE Village Boulevard. See right:



Pass-by trips were estimated with a 50/50 west/east split along Highway 211 and a 55/45 west/east split based on existing peak hour counts. See Figure 5 (AM peak hour) and Figure 6 (PM peak hour) for reference.

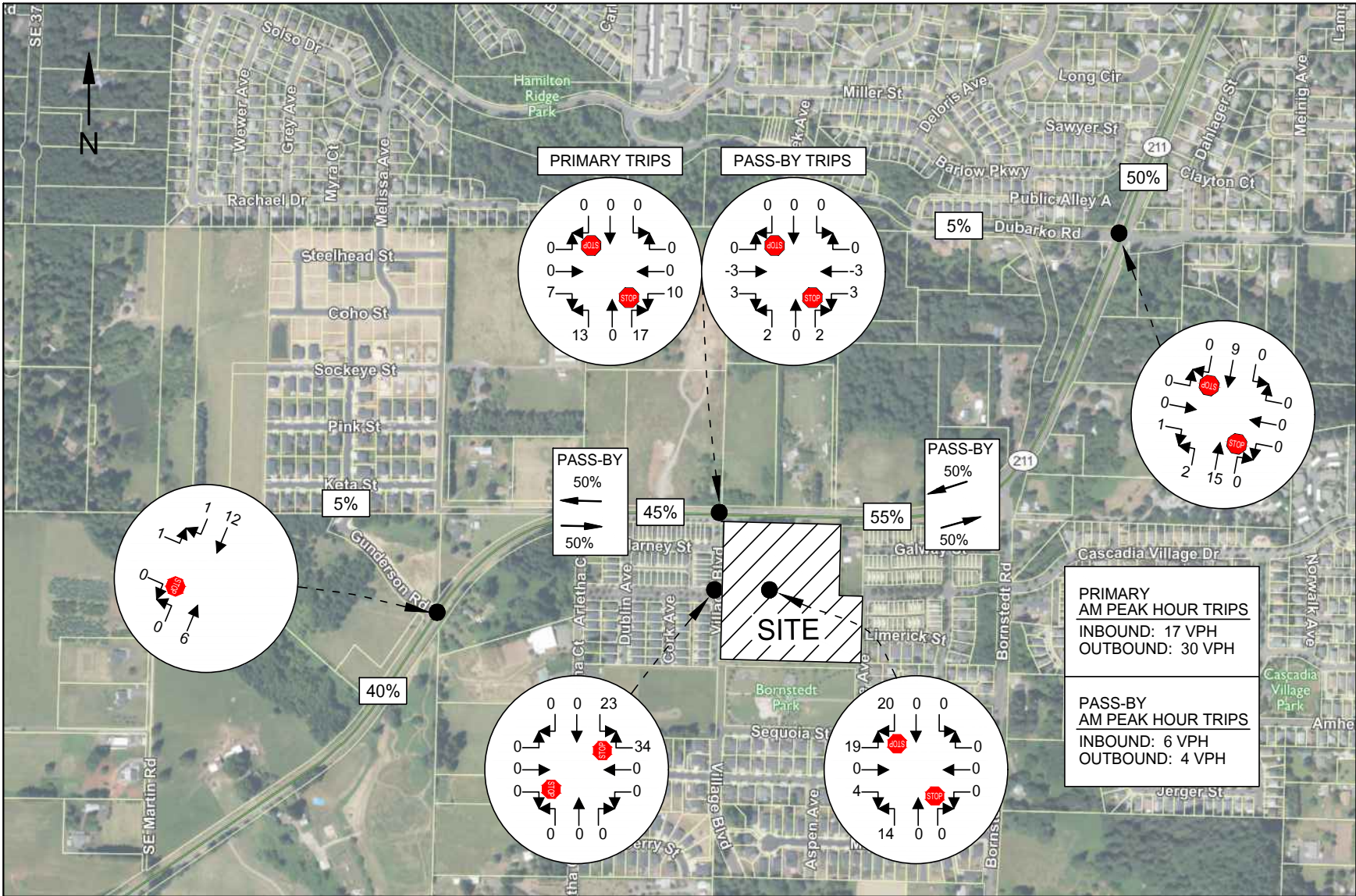
At the point of access via the newly constructed easterly extension of Cascadia Village Drive, approximately 32 apartment units and all proposed commercial space is provided to the north (40% of all dwelling units). The southern portion of the property will allow access to the remaining 46 units. Trip distribution has been assigned accordingly.

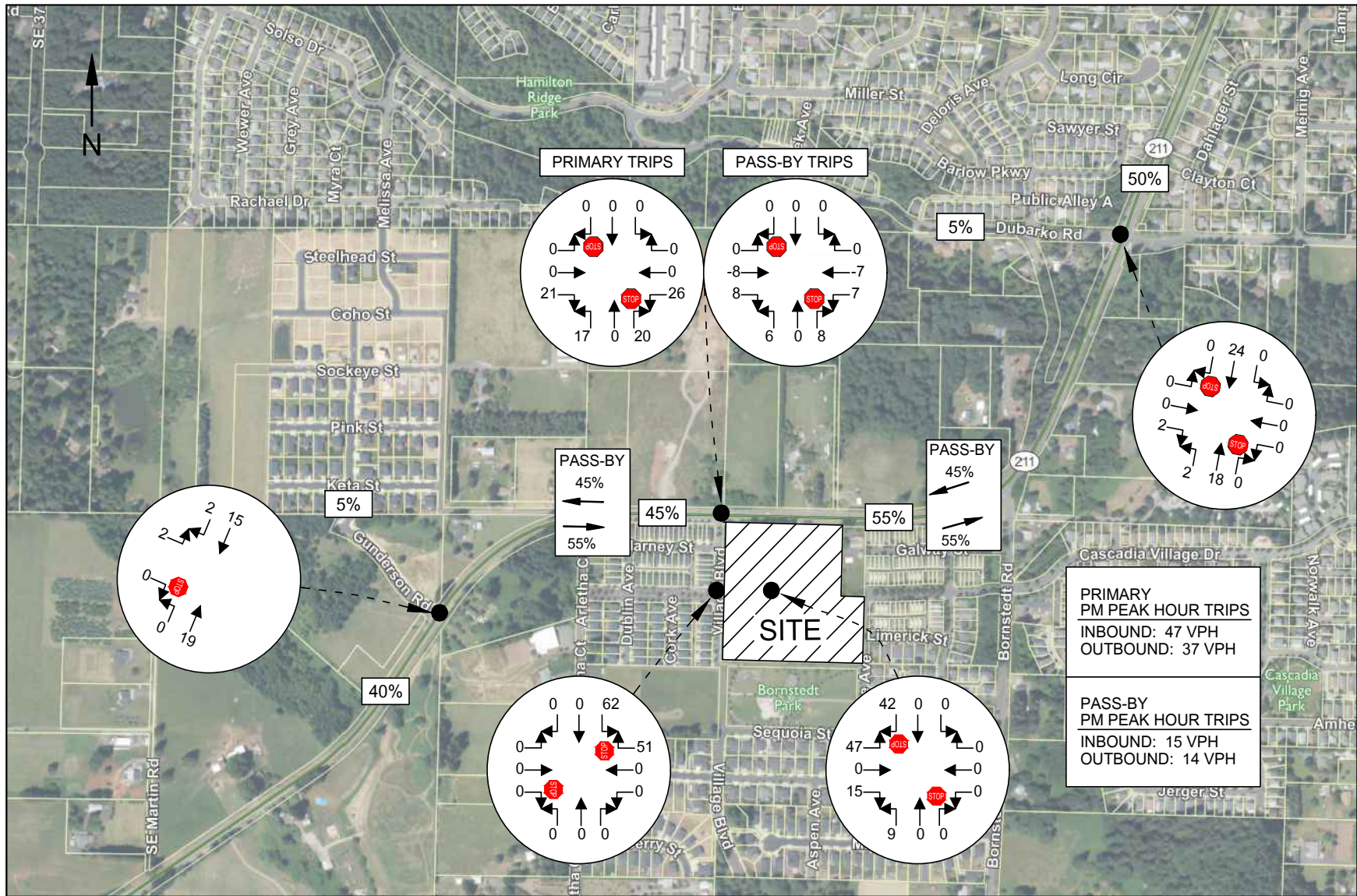
Additionally, due to the extension of Cascadia Village Drive to Pine Street as part of site development, it is anticipated that minor rerouting of local traffic could occur. The extension would provide a more direct route for a cluster of approximately 27 dwelling units (see Figure 7 for reference). However, only inbound traffic from Highway 211 could use the extension due to an approximate 100-foot unbuildable westbound portion of the roadway (no right-of-way). Consequently, no outbound rerouting was accounted for. Rerouted volumes were derived using ITE data using similar trip distribution percentages.

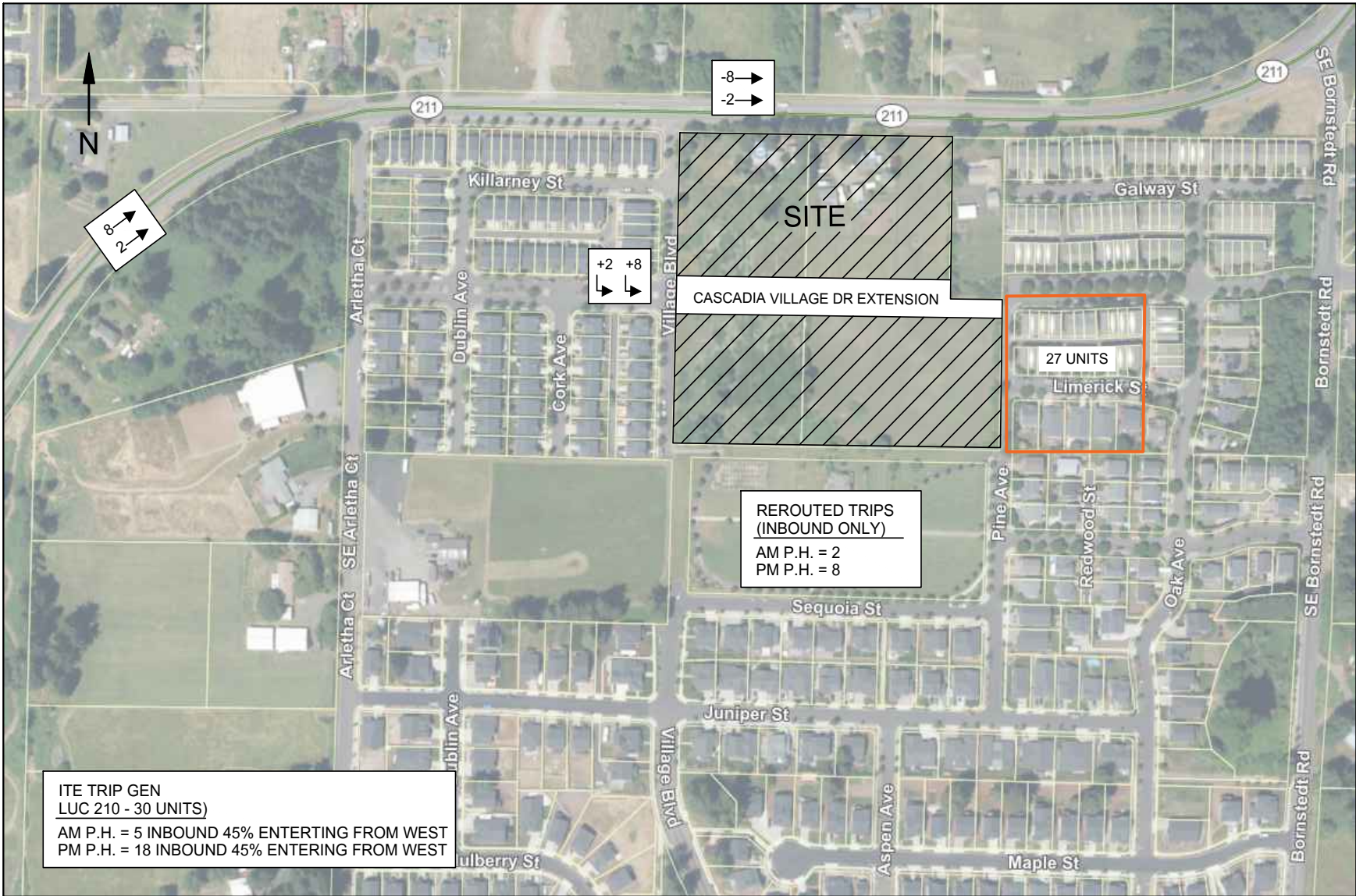
Lastly, as part of frontage improvements, Pine Street is required to be constructed from Highway 211 and south ~300-feet before connecting to Cascadia Village Drive. Due to right-of-way constraints, only half-width (14-feet) will be constructed which accommodates only southbound, one-way flow (upon full-build at a later date, the intersection would be restricted to right-in, right-out at Highway 211). Therefore, only eastbound right-turns could use this new roadway in which there would be little if any project traffic as they would first pass SE Village Boulevard. Therefore, trip distribution does not consider Pine Street extension as a travel route.

### **4.3 Future Peak Hour Volumes**

A two-year horizon of 2025 was used for future analysis and reflecting buildout conditions. Future 2025 traffic volumes without the project were derived by applying a 2.0 percent annual growth rate to existing traffic volumes shown in Figures 3 and 4. AM and PM forecast 2025 volumes without project traffic are illustrated in Figures 8 and 9. Figures 10 and 11 illustrates forecast 2025 AM and PM peak hour volumes with project-generated traffic. Again, given the limited functionality and little to no use expected from the Pine Street extension, this roadway segment was not considered in the forecast analysis.

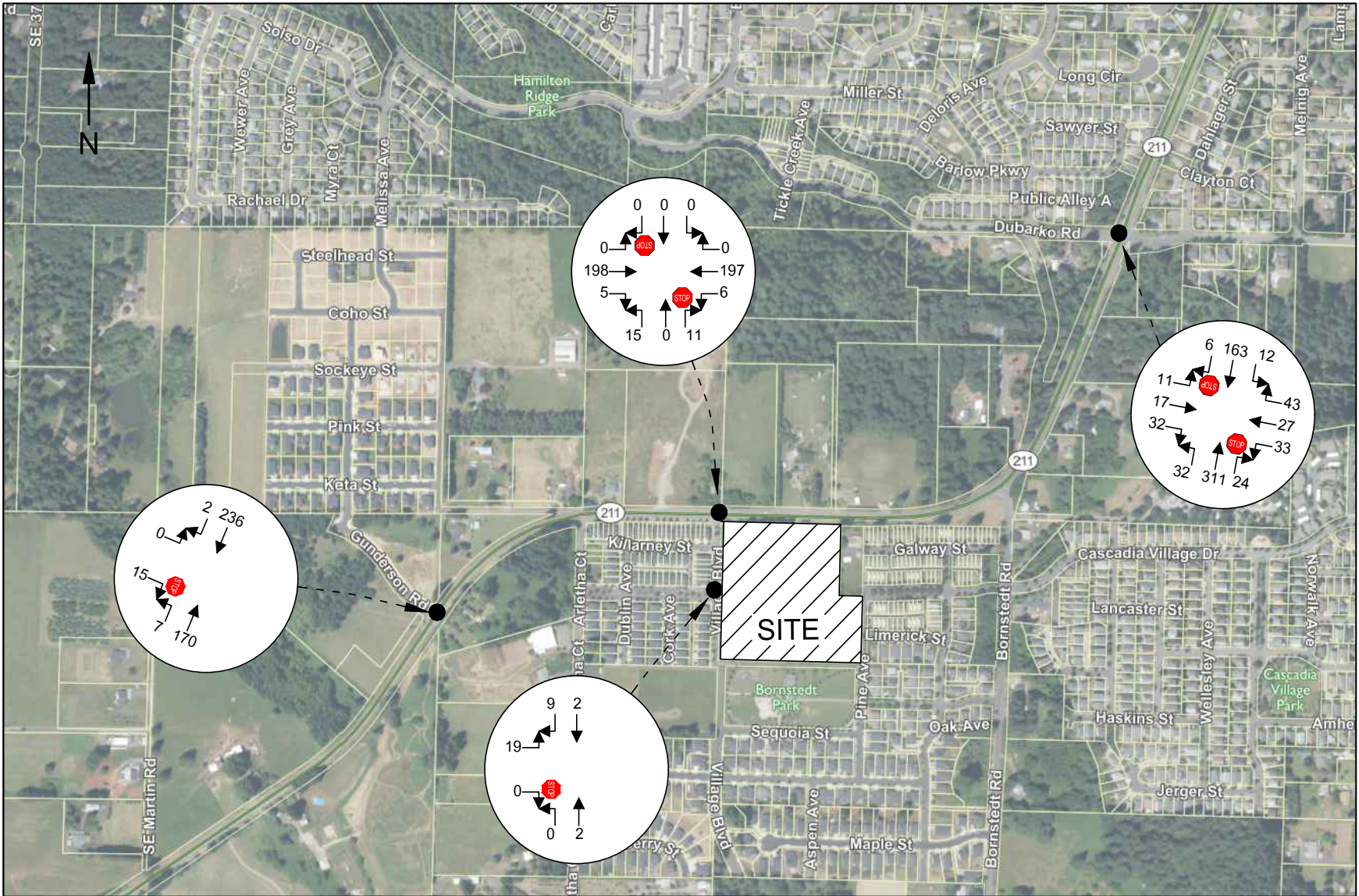




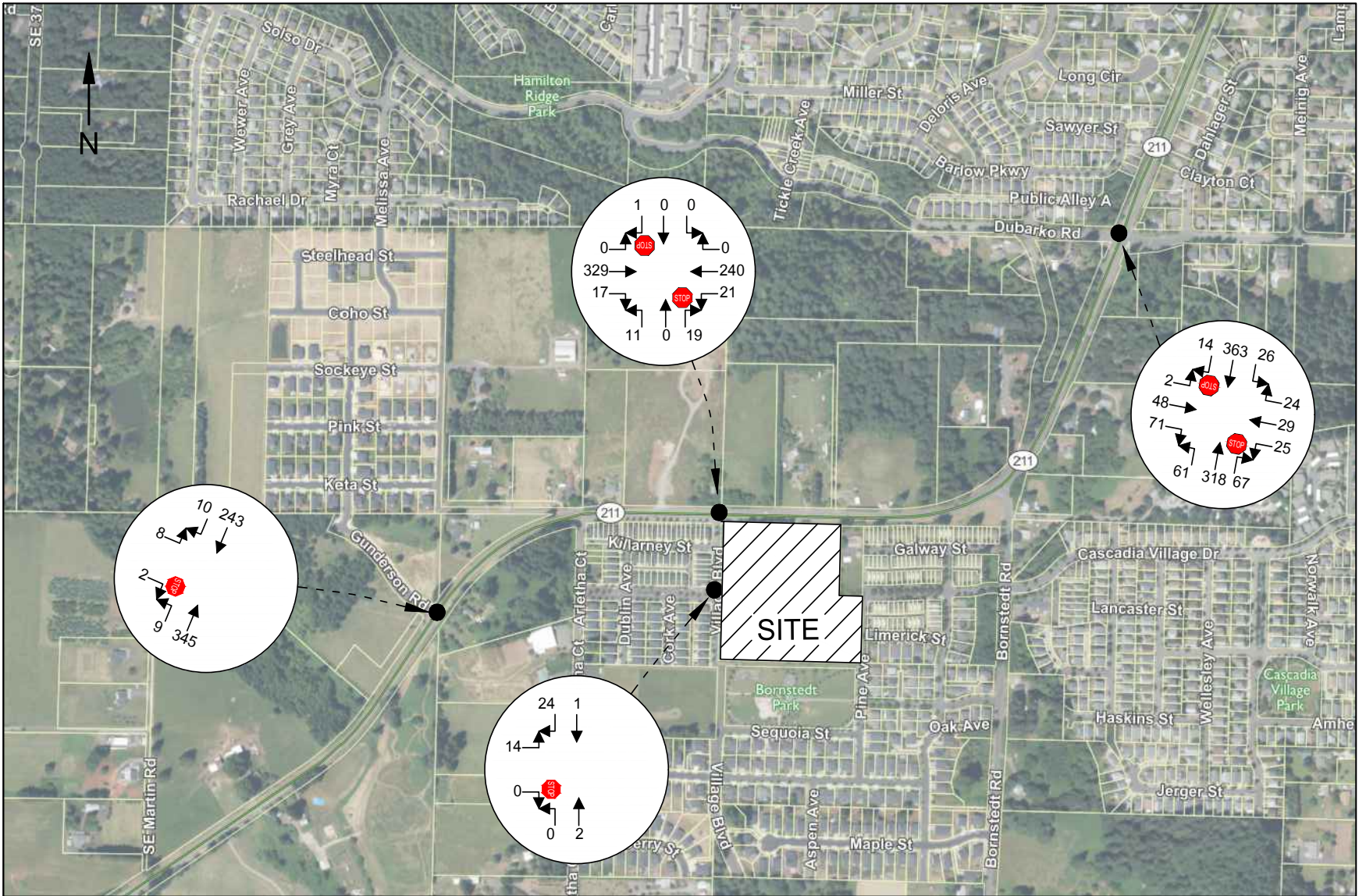


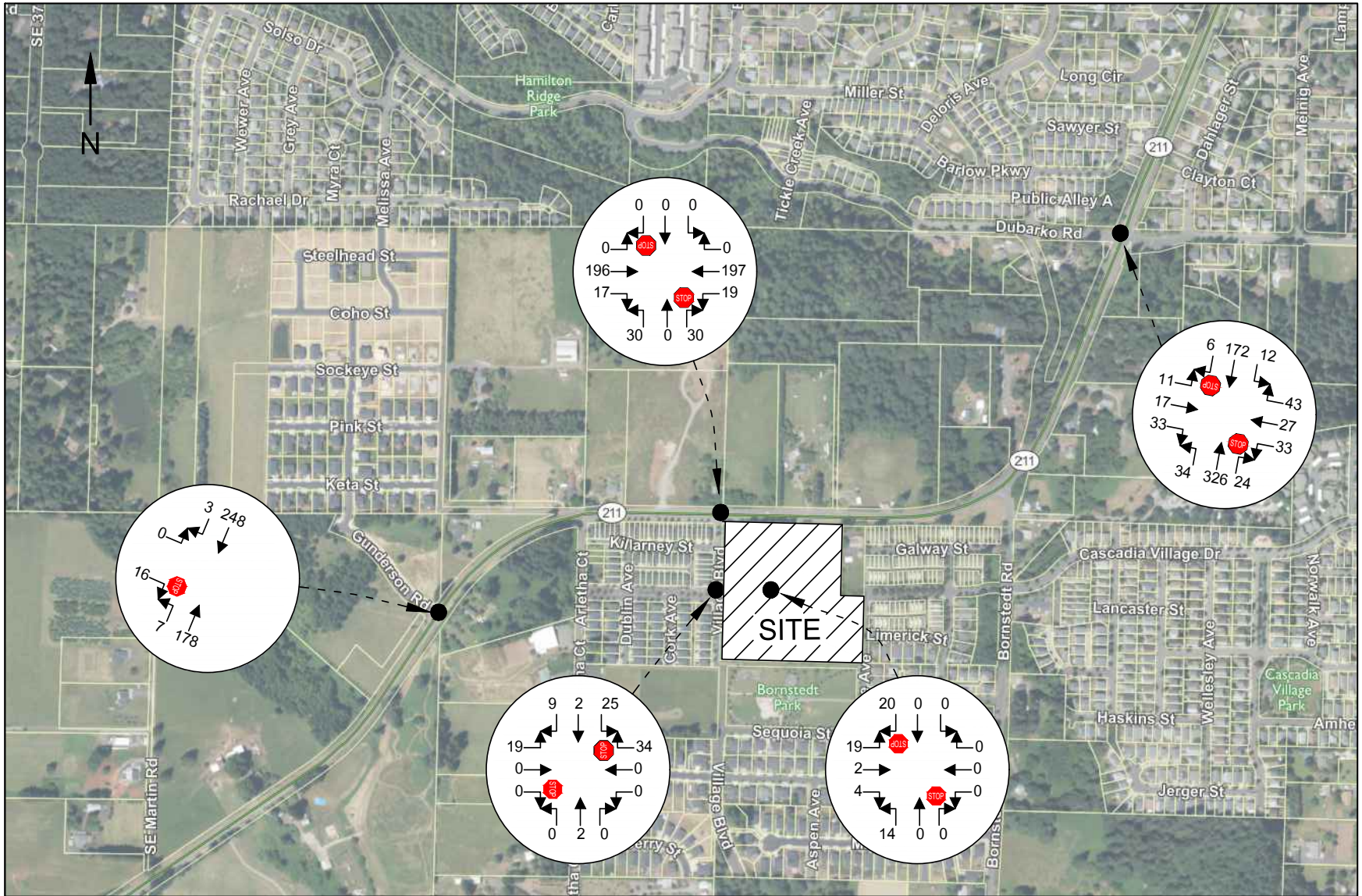
ITE TRIP GEN  
 LUC 210 - 30 UNITS)  
 AM P.H. = 5 INBOUND 45% ENTERING FROM WEST  
 PM P.H. = 18 INBOUND 45% ENTERING FROM WEST

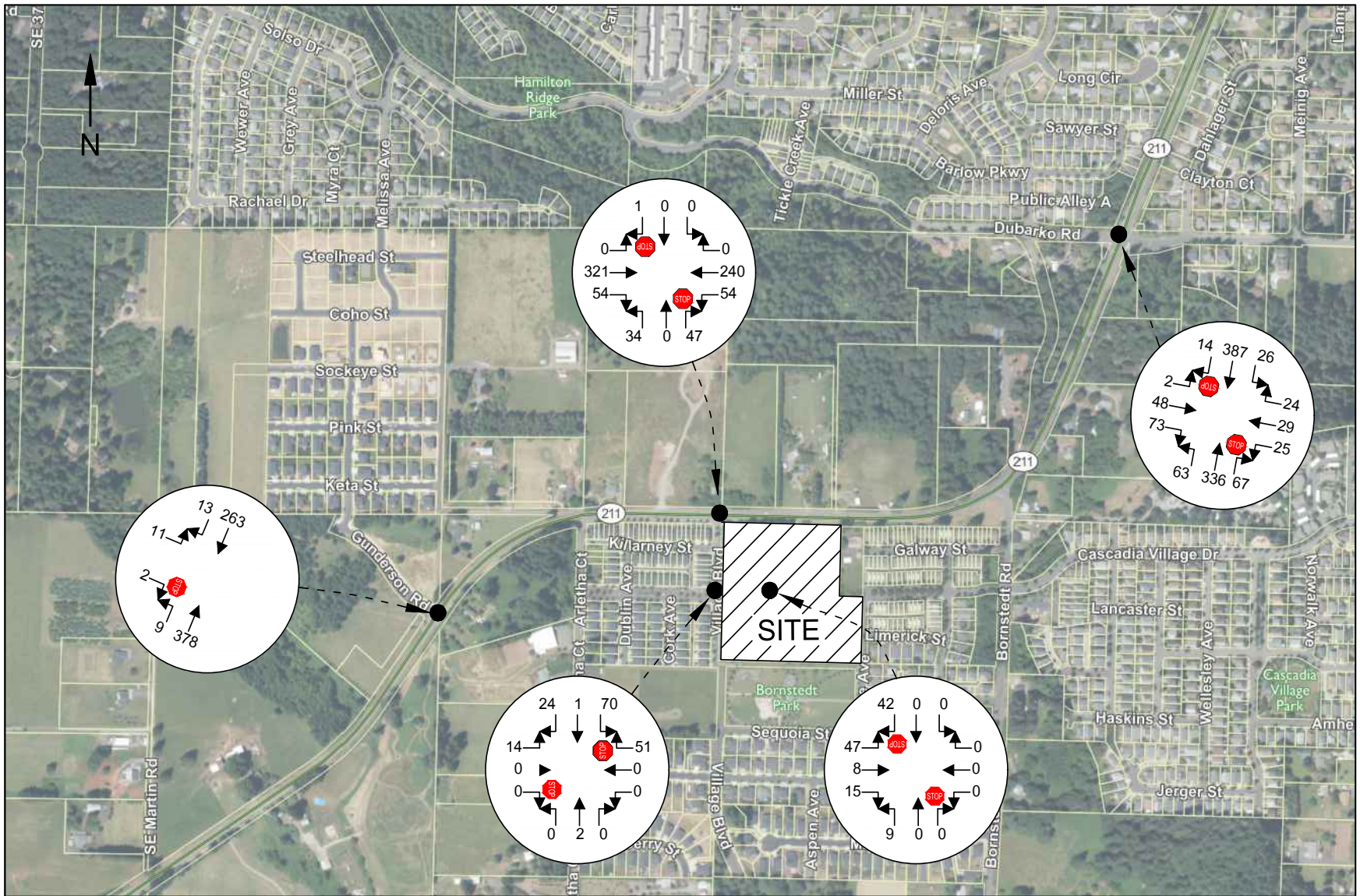
REROUTED TRIPS  
 (INBOUND ONLY)  
 AM P.H. = 2  
 PM P.H. = 8







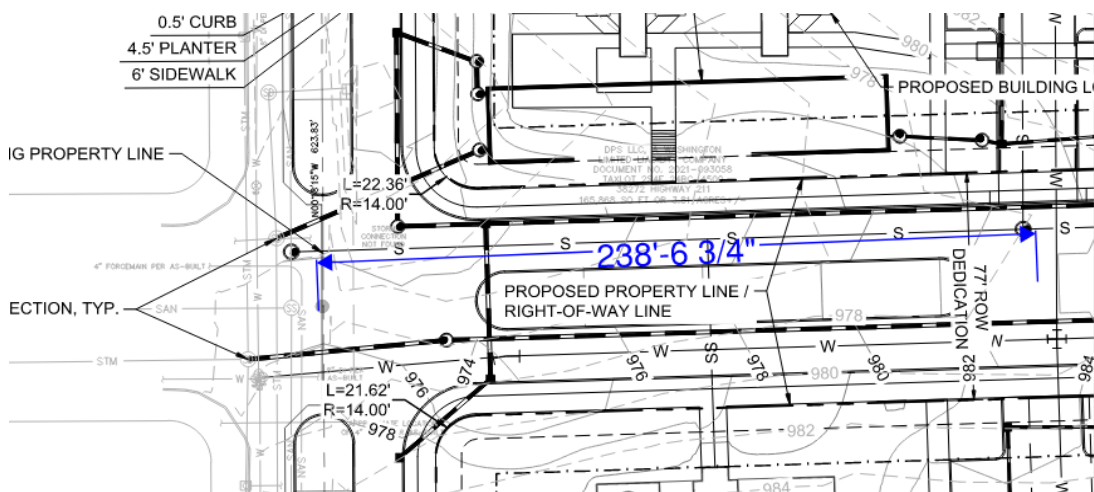




#### 4.4 Access & Sight Distance

##### Access

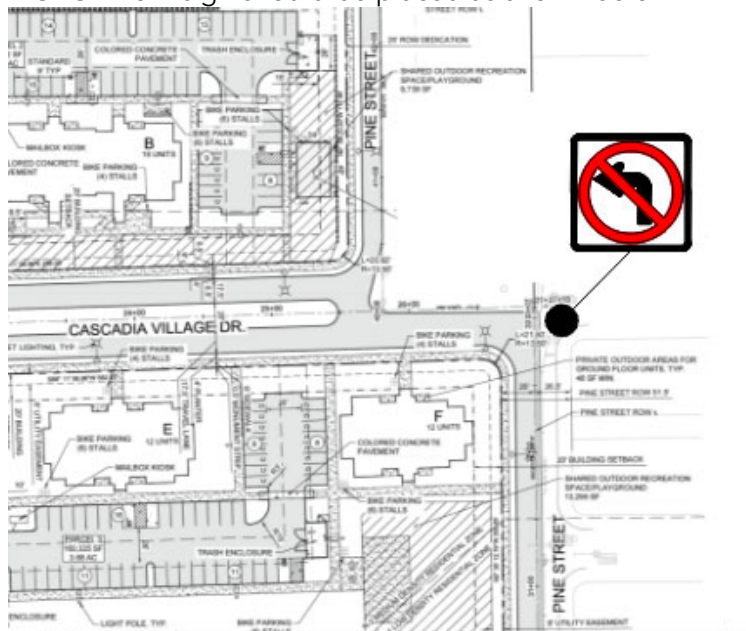
Primary access to the proposed development is to occur via one new easterly extension of Cascadia Village Drive from SE Village Boulevard, bisecting the subject site. Refer to the site plan in Figure 2 for further details, which illustrates all project accesses, roadways internal to the development and adjacent driveways. The Sandy Transportation System Plan classifies Cascadia Village Drive as a future collector roadway. A collector classification requires accesses on the roadway to be located a minimum of 150 feet from any other access or street intersection. The single proposed access extending both north and south from Cascadia Village Drive internal to the subject property is located in excess of 150 feet from SE Village Boulevard, meeting City standards.



It should be noted that the site plan illustrates a new Pine Street connection and roadway along the eastern portion of the subject site. This is a future roadway per City's Transportation Plan. However, nearby existing development has precluded Pine Street from contiguous north/south construction. Consequently, the roadway would have discontinuity with an approximate 135-foot offset between the existing Pine Street centerline.

Given the misalignment, the following are recommendations:

1. Post a "No Left Turn" sign at the existing northern terminus of Pine Street.
  - a. Due to a 135-foot unimproved segment, no northbound left turns traveling westbound could be accommodated.
  - b. MUTCD R3-2 sign should be placed as shown below.



2. With little benefit as a one-way, southbound right-in only from Highway 211, Pine Street could be blocked off at both ends with barricades.
  - a. The roadway may lead to driver confusion as a one-way and could be open to the public once fully constructed with two-travel lanes.
3. Forego Pine Street construction.
  - a. In its full build conditions, new Pine Street would not be aligned opposite the existing Pine Street. Design considerations would be needed for how to best operate the two Pine Street segments.

### Sight Distance

Any new driveway shall be designed so as to allow sufficient sight lines in accordance with *American Association of State Highway and Transportation Officials (AASHTO)* standards. As previously noted, primary sight access is to occur via an easterly extension of Cascadia Village Drive from SE Village Boulevard. With no posted speed limit on SE Village Boulevard, the standard City local speed limit of 25-mph was assumed, which would require 280 feet of entering sight distance. Sight lines looking south are clear in excess of 300-feet, available to where the roadway currently dead-ends. Looking north, sight lines are clear to the roadway's intersection with Highway 211. As such, no sight line deficiencies are identified as a result of the development proposal.

Should Pine Street be constructed, sight distance would need to comply with City/ODOT standards. As a right-in only, no sight distance departure is identified. Once fully constructed, sight lines would need to be verified in the westerly direction.

### **TRANSPORTATION SYSTEM PLAN REVIEW**

The development proposal includes the construction of an east-west collector roadway connection, Cascadia Village Drive, linking SE Village Boulevard to development west of the subject site. This improvement is consistent with connectivity plans outlined in the City of Sandy's Transportation System Plan. Moreover, coordination is being made with the City regarding the construction of a new north-south Pine Street improvement. Final design of the Pine Street improvement will be coordinated with the City. Lastly, all frontage improvements should comply with any applicable standards regarding functional classification, typical sections, access management, and other attributes as appropriate.

#### 4.5 Future Level of Service

Level of service analyses were made of the future peak hour volumes without (background) and with project related trips added to the key roadways and intersections. This analysis once again involved the use of the *Synchro 11* analysis program. Delays and v/c ratios for each study intersection under future 2025 conditions are shown in Table 6.

**Table 6: Forecast 2025 Peak Hour Level of Service**

*Delays given in Seconds Per Vehicle*

Intersection	Control	Peak-Hour	Crt. Mvmt.	<i>Without Project</i>			<i>With Project</i>		
				LOS	Delay	V/C	LOS	Delay	V/C
Hwy 211 & Gunderson Road	Stop	AM	SEB	A	9.9	0.02	B	10.0	0.02
		PM		B	12.9	0.02	B	13.8	0.03
Hwy 211 & SE Village Blvd	Stop	AM	NB	B	11.2	0.05	B	11.6	0.11
		PM		B	12.3	0.06	B	14.6	0.19
Cascadia Village Dr & SE Village Blvd	Stop	AM	EB	A	8.7	0.03	A	9.6	0.03
		PM		A	8.8	0.02	B	11.2	0.07
Hwy 211 & Dubarko Road	Stop	AM	WB-TL	C	17.8	0.19	C	18.6	0.20
		PM		D	34.6	0.32	E	39.0	0.36
Cascadia Village Dr & Access	Stop	AM	NB	--	--	--	A	9.0	0.02
		PM		--	--	--	A	9.7	0.04

All intersections with the exception of the westbound through/left-turn movement from Dubarko to Highway 211 is projected to operate with LOS C or better indicating no operational deficiencies.

**Highway 211 & Dubarko Road:** is projected to operate with LOS D without and LOS E with project under the forecast 2025 PM peak hour conditions. It should be noted that the westbound approach as a whole (both left/through and right turn lanes) operates at LOS D (30.3 sec), the v/c ratio is 0.36, and the 95<sup>th</sup> queue is two vehicles—all indicating no significant impact. Moreover, this intersection is scheduled for the installation of a traffic signal per the City's planned improvements. No mitigation is therefore identified.

#### 4.6 Left Turn Warrants

Based on inspection, the volumes do not meet with minimum thresholds to require a left-turn lane at Cascadia Village Drive from SE Village Boulevard.

## 5. CONCLUSIONS & MITIGATION

The Cascade Creek project proposes for the construction of 78 multi-family, income restricted apartment units and approximately 11,142 square feet of office/commercial space located within the city of Sandy. The subject site is bordered to the west by SE SE Village Boulevard and located south of Highway 211 on 8.84-acres within two tax parcels. Primary access to and from the site is proposed via an easterly extension of Cascadia Village Drive. Frontage improvements may also require an extension of Pine Street from Highway 211 as shown in the site plan. Existing AM and PM peak hour level of service is shown to meet city LOS standards operating with LOS D conditions or better.

Based on ITE data, and a conservative trip generation assessment, the project is estimated to generate 890 primary average weekday daily trips with 47 primary AM peak hour trips and 84 primary PM peak hour trips. Pass-by trips have also been considered for the commercial portion of the project as summarized in Table 5.

Forecast 2025 peak hour delays are shown to operate with LOS C conditions or better with the exception of the study intersection of Highway 211 & Dubarko Road which was shown to operate with LOS E conditions during the PM peak hour. According to the City's planned improvements, the intersection is scheduled for the installation of a signal which would improve LOS. Moreover, the maximum v/c ratio is 0.36 indicating acceptable conditions. A left turn lane would not be warranted at the project access via SE village Boulevard given the low north/south volumes.

Proposed mitigation for the project is as follows:

1. Depending on city review, if required for construction, the Pine Street roadway extending south from Highway 211 should consider temporary blockades due to insufficient right-of-way of constructing two travel lanes. The one-way southbound road could lead to driver confusion and does not offer operational benefit. The roadway could be opened subsequent to buildout of the eastern portion.
2. A MUTCD R3-2 sign "No Left Turn" or equivalent is recommended at the existing northern Pine Street terminus. See Section 4.4 for details.
3. The development may be subject to Traffic Impact Fees. Fees are assessed by the City prior to building permit issuance.



# CASCADE CREEK TRAFFIC IMPACT ANALYSIS

## *APPENDIX*

### 1. INTERSECTION COUNT SHEETS



HeathTraffic.com

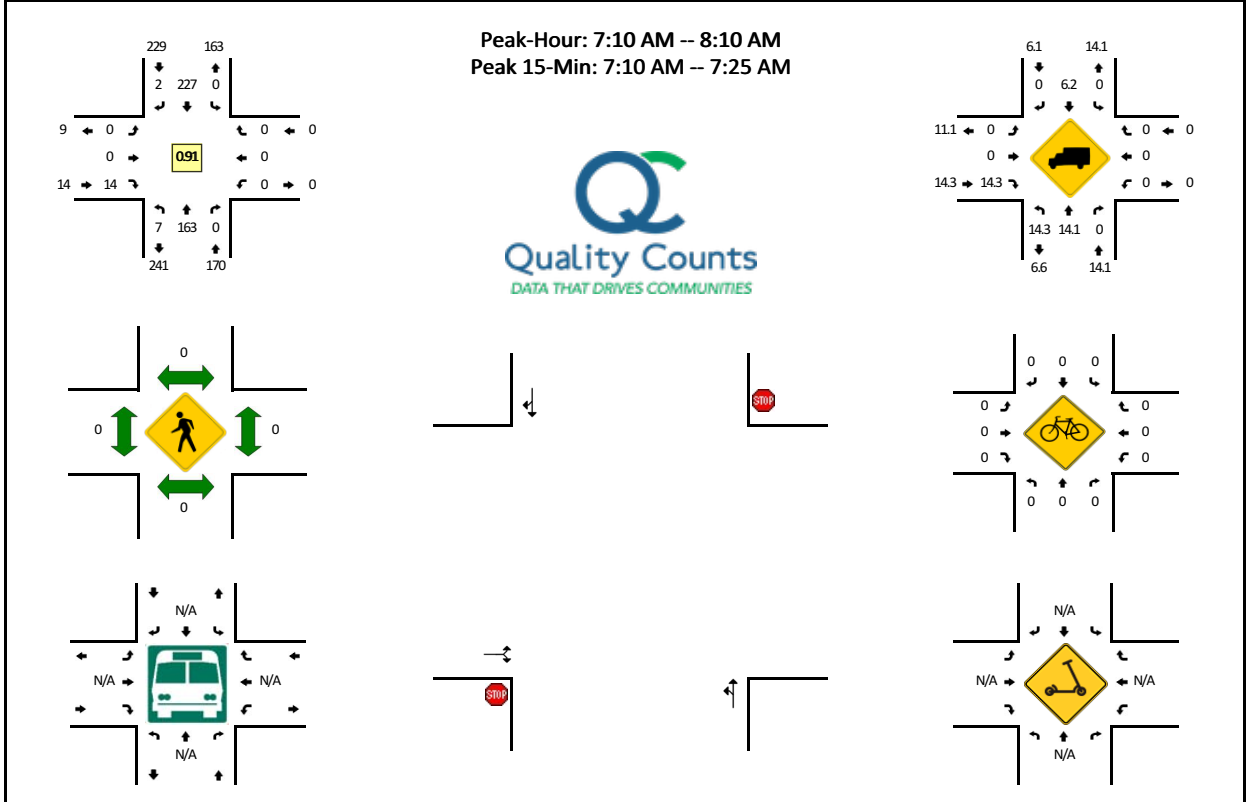
Cascade Creek TIA  
29

Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

LOCATION: Hwy 211 -- Gunderson Rd  
CITY/STATE: Clackamas, OR

QC JOB #: 16204001  
DATE: Wed, May 10 2023



5-Min Count Period Beginning At	Hwy 211 (Northbound)				Hwy 211 (Southbound)				Gunderson Rd (Eastbound)				Gunderson Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	6	0	0	0	14	0	0	0	0	0	0	0	0	0	0	20	
7:05 AM	0	6	0	0	0	19	0	0	0	0	1	0	0	0	0	0	26	
7:10 AM	1	17	0	0	0	17	0	0	0	0	0	0	0	0	0	0	35	
7:15 AM	1	6	0	0	0	25	1	0	0	0	2	0	0	0	0	0	35	
7:20 AM	2	18	0	0	0	19	0	0	0	0	4	0	0	0	0	0	43	
7:25 AM	2	8	0	0	0	20	0	0	0	0	0	0	0	0	0	0	30	
7:30 AM	0	9	0	0	0	16	1	0	0	0	0	0	0	0	0	0	26	
7:35 AM	0	11	0	0	0	20	0	0	0	0	3	0	0	0	0	0	34	
7:40 AM	0	20	0	0	0	17	0	0	0	0	1	0	0	0	0	0	38	
7:45 AM	0	8	0	0	0	18	0	0	0	0	3	0	0	0	0	0	29	
7:50 AM	0	17	0	0	0	20	0	0	0	0	0	0	0	0	0	0	37	
7:55 AM	0	24	0	0	0	18	0	0	0	0	1	0	0	0	0	0	43	
8:00 AM	1	11	0	0	0	14	0	0	0	0	0	0	0	0	0	0	26	396
8:05 AM	0	14	0	0	0	23	0	0	0	0	0	0	0	0	0	0	37	402
8:10 AM	0	14	0	0	0	12	0	0	2	0	1	0	0	0	0	0	29	407
8:15 AM	3	12	0	0	0	15	0	0	0	0	0	0	0	0	0	0	30	402
8:20 AM	0	19	0	0	0	17	0	0	0	0	0	0	0	0	0	0	36	395
8:25 AM	0	16	0	0	0	12	0	0	0	0	0	0	0	0	0	0	28	393
8:30 AM	0	14	0	0	0	19	0	0	0	0	1	0	0	0	0	0	34	401
8:35 AM	0	15	0	0	0	12	1	0	3	0	0	0	0	0	0	0	31	398
8:40 AM	0	22	0	0	0	13	1	0	0	0	1	0	0	0	0	0	37	397
8:45 AM	0	14	0	0	0	15	0	0	0	0	0	0	0	0	0	0	29	397
8:50 AM	1	13	0	0	0	10	1	0	1	0	1	0	0	0	0	0	27	387
8:55 AM	0	9	0	0	0	15	0	0	1	0	1	0	0	0	0	0	26	370
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	16	164	0	0	0	244	4	0	0	0	24	0	0	0	0	0	452	
Heavy Trucks	0	16	0	0	0	8	0	0	0	0	4	0	0	0	0	0	28	
Buses																		
Pedestrians	0	0			0	0			0	0			0	0			0	
Bicycles	0	0			0	0			0	0			0	0			0	
Scooters																		

Comments:

Report generated on 5/16/2023 8:28 AM

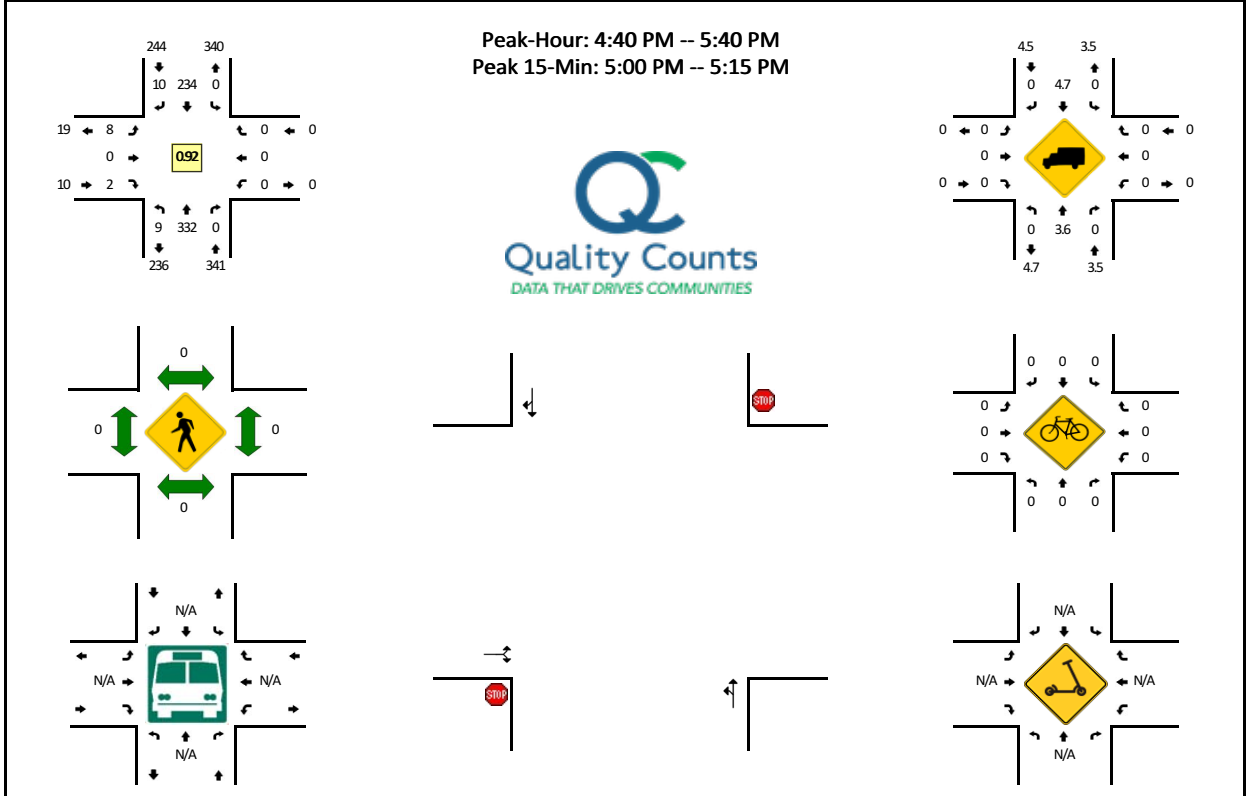
SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

LOCATION: Hwy 211 -- Gunderson Rd  
 CITY/STATE: Clackamas, OR

QC JOB #: 16204002  
 DATE: Wed, May 10 2023



5-Min Count Period Beginning At	Hwy 211 (Northbound)				Hwy 211 (Southbound)				Gunderson Rd (Eastbound)				Gunderson Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	0	24	0	0	0	20	0	0	0	0	0	0	0	0	0	0	44	
4:05 PM	0	22	0	0	0	13	1	0	0	1	0	1	0	0	0	0	38	
4:10 PM	1	29	0	0	0	21	1	0	0	0	0	1	0	0	0	0	53	
4:15 PM	0	35	0	0	0	17	0	0	0	0	0	3	0	0	0	0	55	
4:20 PM	1	24	0	0	0	14	0	0	0	0	0	1	0	0	0	0	40	
4:25 PM	1	18	0	0	0	16	1	0	0	0	0	1	0	0	0	0	37	
4:30 PM	0	19	0	0	0	16	0	0	0	1	0	0	0	0	0	0	36	
4:35 PM	2	16	0	0	0	21	1	0	0	0	0	0	0	0	0	0	40	
4:40 PM	1	28	0	0	0	26	3	0	0	0	0	1	0	0	0	0	59	
4:45 PM	0	31	0	0	0	25	0	0	0	1	0	0	0	0	0	0	57	
4:50 PM	1	20	0	0	0	22	0	0	0	0	0	0	0	0	0	0	43	
4:55 PM	0	21	0	0	0	24	0	0	0	0	0	0	0	0	0	0	45	547
5:00 PM	2	38	0	0	0	22	0	0	0	1	0	0	0	0	0	0	63	566
5:05 PM	4	27	0	0	0	17	1	0	0	0	0	0	0	0	0	0	49	577
5:10 PM	0	25	0	0	0	22	1	0	0	1	0	1	0	0	0	0	50	574
5:15 PM	1	22	0	0	0	13	0	0	0	0	0	0	0	0	0	0	36	555
5:20 PM	0	31	0	0	0	18	2	0	0	1	0	0	0	0	0	0	52	567
5:25 PM	0	24	0	0	0	13	0	0	0	2	0	0	0	0	0	0	39	569
5:30 PM	0	33	0	0	0	16	1	0	0	2	0	0	0	0	0	0	52	585
5:35 PM	0	32	0	0	0	16	2	0	0	0	0	0	0	0	0	0	50	595
5:40 PM	0	30	0	0	0	12	1	0	0	0	0	1	0	0	0	0	44	580
5:45 PM	0	19	0	0	0	21	0	0	0	1	0	0	0	0	0	0	41	564
5:50 PM	1	36	0	0	0	14	0	0	0	0	0	1	0	0	0	0	52	573
5:55 PM	1	19	0	0	0	13	1	0	0	0	0	1	0	0	0	0	35	563
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	24	360	0	0	0	244	8	0	8	0	4	0	0	0	0	0	648	
Heavy Trucks	0	20	0	0	0	12	0	0	0	0	0	0	0	0	0	0	32	
Buses																		
Pedestrians	0	0			0				0	0			0	0			0	
Bicycles	0	0			0	0	0		0	0	0		0	0	0		0	
Scooters																		

Comments:

Report generated on 5/16/2023 8:28 AM

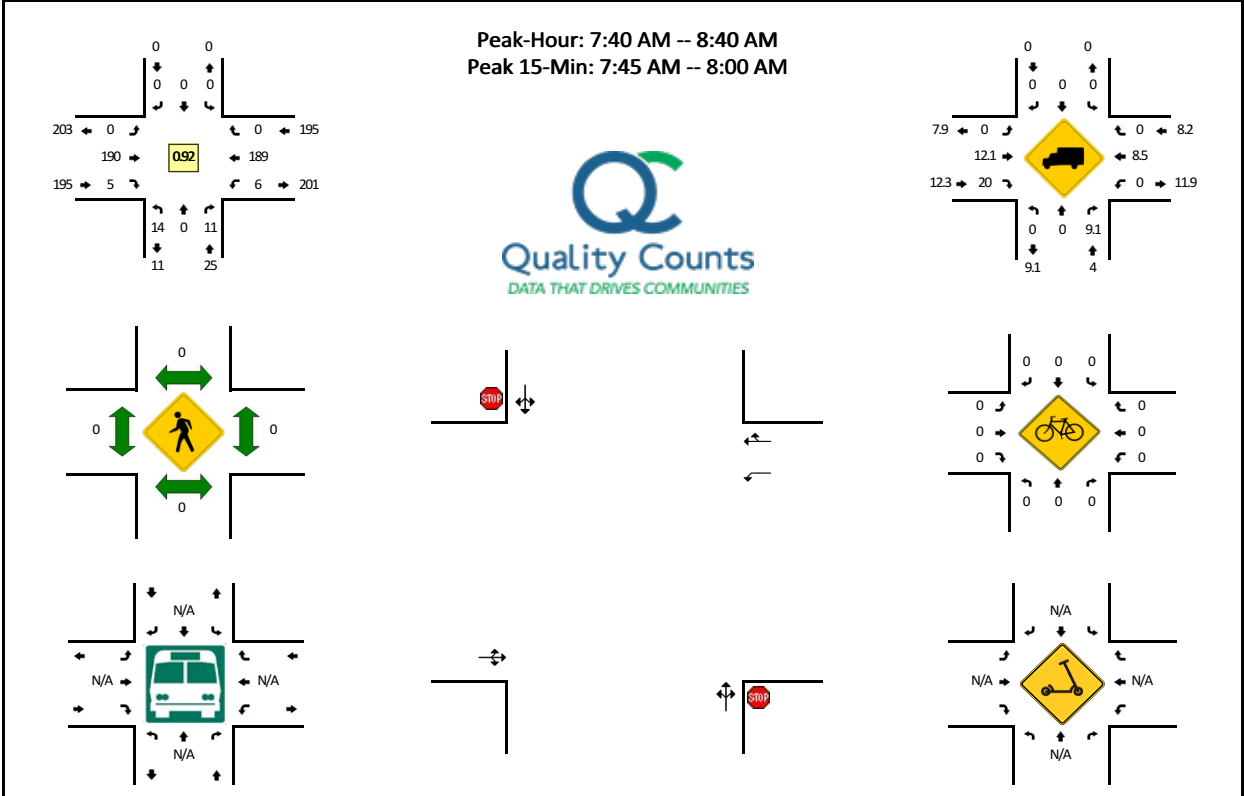
SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

**LOCATION:** SE Village Blvd -- Hwy 211  
**CITY/STATE:** Sandy, OR

**QC JOB #:** 16204003  
**DATE:** Wed, May 10 2023



**Peak-Hour: 7:40 AM -- 8:40 AM**  
**Peak 15-Min: 7:45 AM -- 8:00 AM**



5-Min Count Period Beginning At	SE Village Blvd (Northbound)				SE Village Blvd (Southbound)				Hwy 211 (Eastbound)				Hwy 211 (Westbound)				Total	Hourly Totals		
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U				
7:00 AM	1	0	0	0	0	0	0	0	0	6	0	0	0	0	10	0	0	17		
7:05 AM	1	0	5	0	0	0	0	0	0	6	0	0	0	0	17	0	0	29		
7:10 AM	1	0	2	0	0	0	0	0	0	17	0	0	0	1	20	0	0	41		
7:15 AM	3	0	1	0	0	0	0	0	0	6	0	0	0	1	21	0	0	32		
7:20 AM	1	0	0	0	0	0	0	0	0	18	0	0	0	0	18	0	0	37		
7:25 AM	2	0	0	0	0	0	0	0	0	8	0	0	0	1	21	0	0	32		
7:30 AM	0	0	2	0	0	0	0	0	0	10	0	0	0	0	15	0	0	27		
7:35 AM	0	0	2	0	0	0	0	0	0	11	0	0	0	0	15	0	0	28		
7:40 AM	2	0	1	0	0	0	0	0	0	20	0	0	0	0	16	0	0	39		
7:45 AM	0	0	0	0	0	0	0	0	0	8	0	0	0	0	20	0	0	28		
7:50 AM	1	0	1	0	0	0	0	0	0	18	0	0	0	0	18	0	0	38		
7:55 AM	1	0	1	0	0	0	0	0	0	24	1	0	0	2	18	0	0	47	395	
8:00 AM	3	0	1	0	0	0	0	0	0	10	1	0	0	0	12	0	0	27	405	
8:05 AM	2	0	0	0	0	0	0	0	0	13	0	0	0	1	21	0	0	37	413	
8:10 AM	1	0	1	0	0	0	0	0	0	16	0	0	0	1	13	0	0	32	404	
8:15 AM	0	0	2	0	0	0	0	0	0	14	0	0	0	0	16	0	0	32	404	
8:20 AM	1	0	0	0	0	0	0	0	0	18	0	0	0	1	12	0	0	32	399	
8:25 AM	1	0	1	0	0	0	0	0	0	17	2	0	0	1	13	0	0	35	402	
8:30 AM	1	0	2	0	0	0	0	0	0	13	1	0	0	0	17	0	0	34	409	
8:35 AM	1	0	1	0	0	0	0	0	0	19	0	0	0	0	13	0	0	34	415	
8:40 AM	2	0	0	0	0	0	0	0	0	20	1	0	0	1	11	0	0	35	411	
8:45 AM	2	0	1	0	0	0	0	0	0	13	1	0	0	1	13	0	0	31	414	
8:50 AM	1	0	1	0	0	0	0	0	0	16	0	0	0	0	12	0	0	30	406	
8:55 AM	2	0	1	0	0	0	0	0	0	9	0	0	0	2	11	0	0	25	384	
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total			
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U				
All Vehicles	8	0	8	0	0	0	0	0	0	200	4	0	0	8	224	0	0	452		
Heavy Trucks	0	0	0	0	0	0	0	0	0	28	0	0	0	0	12	0	0	40		
Buses																				
Pedestrians										0					0			0		
Bicycles	0	0	0		0	0	0			0	0	0		0	0	0		0		
Scooters																				

Comments:

Report generated on 5/16/2023 8:28 AM

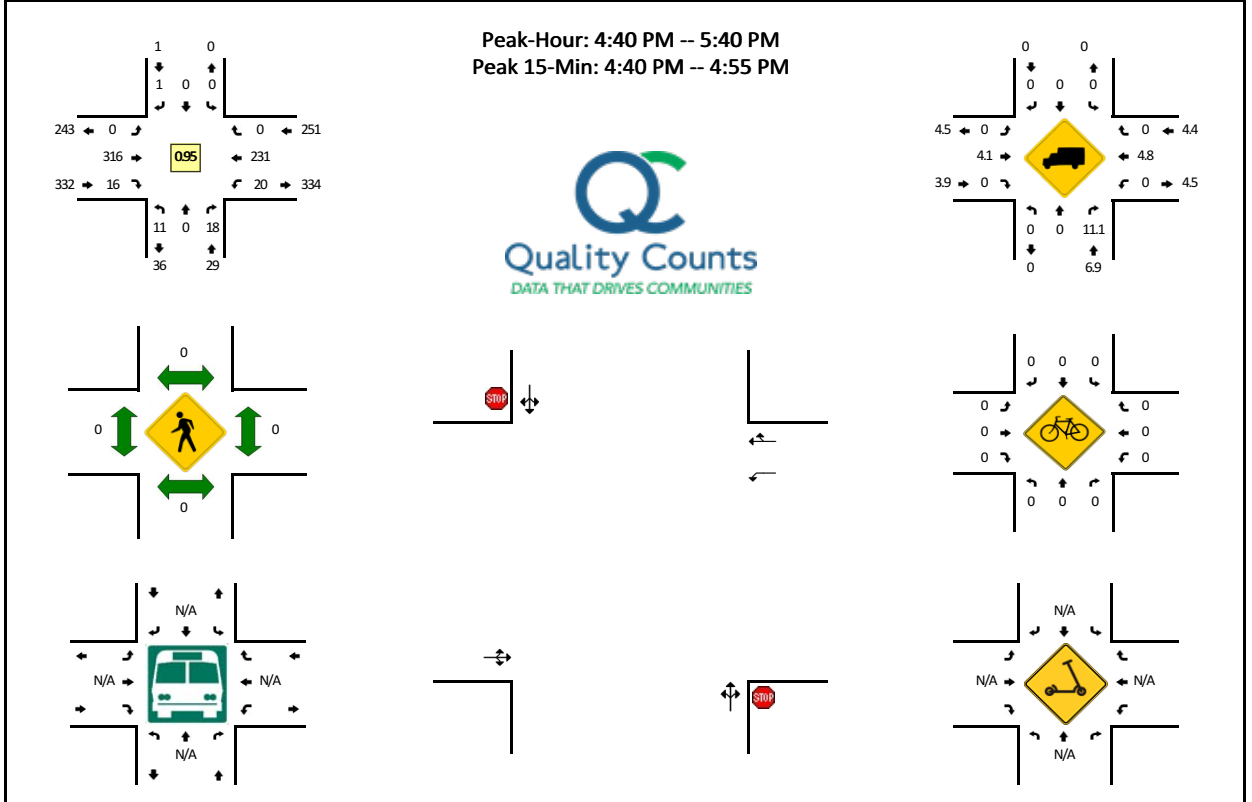
SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

LOCATION: SE Village Blvd -- Hwy 211  
 CITY/STATE: Sandy, OR

QC JOB #: 16204004  
 DATE: Wed, May 10 2023



5-Min Count Period Beginning At	SE Village Blvd (Northbound)				SE Village Blvd (Southbound)				Hwy 211 (Eastbound)				Hwy 211 (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	1	0	2	0	0	0	0	0	0	21	0	0	1	19	0	0	44	
4:05 PM	1	0	1	0	0	0	0	0	0	25	1	0	0	12	0	0	40	
4:10 PM	0	0	1	0	0	0	0	0	0	31	0	0	1	19	0	0	52	
4:15 PM	1	0	1	0	0	0	0	0	0	25	4	0	1	16	0	0	48	
4:20 PM	0	0	1	0	0	0	0	0	0	27	1	0	5	16	0	0	50	
4:25 PM	0	0	1	0	0	0	0	0	0	15	0	0	3	17	0	0	36	
4:30 PM	0	0	0	0	0	0	0	0	0	18	2	0	1	17	1	0	39	
4:35 PM	2	0	1	0	0	0	0	0	0	17	1	0	2	18	1	0	42	
4:40 PM	0	0	1	0	0	0	1	0	0	26	0	0	4	29	0	0	61	
4:45 PM	2	0	1	0	0	0	0	0	0	33	1	0	1	24	0	0	62	
4:50 PM	0	0	1	0	0	0	0	0	0	17	2	0	0	19	0	0	39	
4:55 PM	2	0	1	0	0	0	0	0	0	15	0	0	4	27	0	0	49	
5:00 PM	0	0	1	0	0	0	0	0	0	41	2	0	1	20	0	0	65	
5:05 PM	1	0	1	0	0	0	0	0	0	25	1	0	2	17	0	0	47	
5:10 PM	0	0	0	0	0	0	0	0	0	24	3	0	0	22	0	0	49	
5:15 PM	1	0	3	0	0	0	0	0	0	19	3	0	2	11	0	0	39	
5:20 PM	2	0	2	0	0	0	0	0	0	28	1	0	2	16	0	0	51	
5:25 PM	1	0	2	0	0	0	0	0	0	26	1	0	2	15	0	0	47	
5:30 PM	0	0	2	0	0	0	0	0	0	29	2	0	1	19	0	0	53	
5:35 PM	2	0	3	0	0	0	0	0	0	33	0	0	1	12	0	0	51	
5:40 PM	0	0	0	0	0	0	0	0	0	29	1	0	1	13	0	0	44	
5:45 PM	1	0	0	0	0	0	0	0	0	18	3	0	3	17	0	0	42	
5:50 PM	1	0	0	0	0	0	0	0	0	33	1	0	0	13	0	0	48	
5:55 PM	0	0	0	0	0	0	0	0	0	22	2	0	1	15	0	0	40	
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	8	0	12	0	0	0	4	0	0	304	12	0	20	288	0	0	648	
Heavy Trucks	0	0	4	0	0	0	0	0	0	12	0	0	0	20	0	0	36	
Buses										0	0	0		0	0	0	0	
Pedestrians	0	0	0		0	0	0		0	0	0		0	0	0	0	0	
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0	0	0	
Scooters																		

Comments:

Report generated on 5/16/2023 8:28 AM

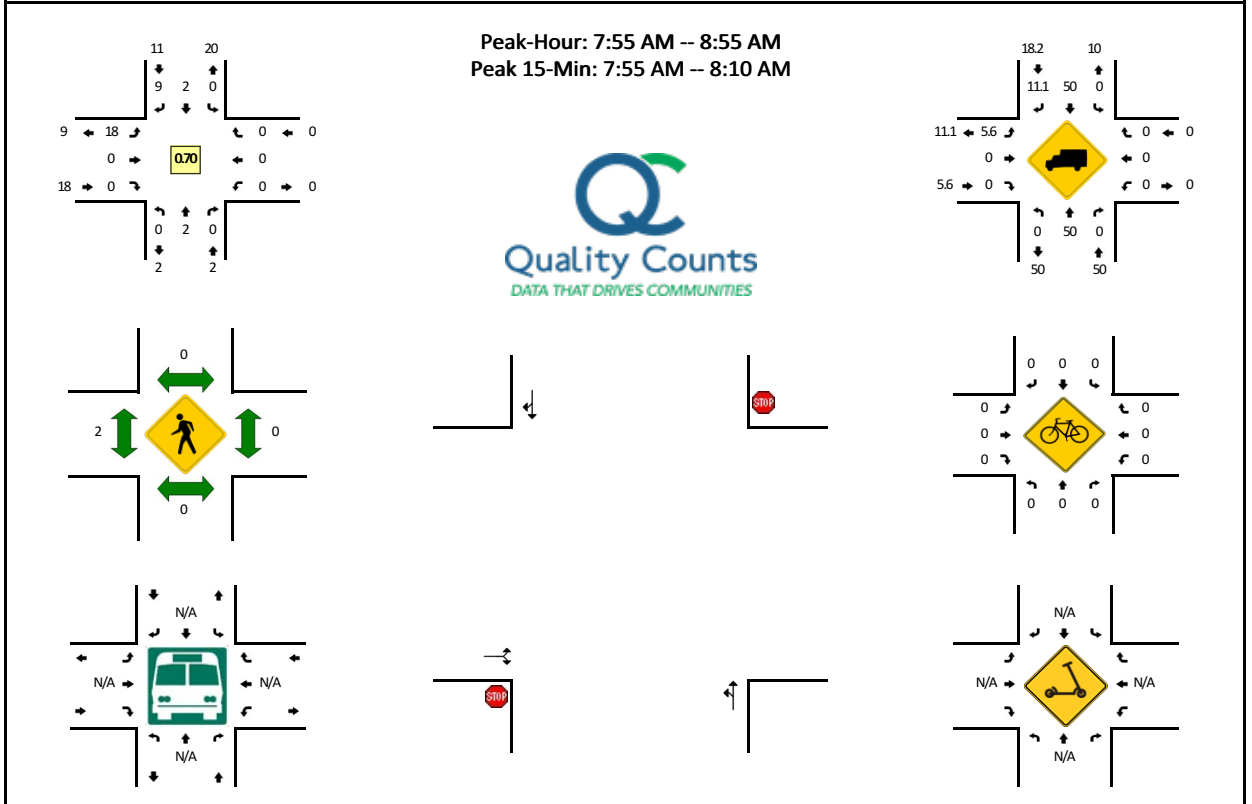
SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

LOCATION: SE Village Blvd -- Cascadia Village Dr  
 CITY/STATE: Sandy, OR

QC JOB #: 16204005  
 DATE: Wed, May 10 2023



5-Min Count Period Beginning At	SE Village Blvd (Northbound)				SE Village Blvd (Southbound)				Cascadia Village Dr (Eastbound)				Cascadia Village Dr (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	
7:05 AM	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	5	
7:10 AM	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	4	
7:15 AM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	
7:20 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7:25 AM	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	
7:30 AM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	
7:35 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	
7:40 AM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7:50 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7:55 AM	0	0	0	0	0	0	2	0	3	0	0	0	0	0	0	0	5	24
8:00 AM	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	0	4	27
8:05 AM	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	24
8:10 AM	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	22
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20
8:20 AM	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	22
8:25 AM	0	0	0	0	0	1	2	0	2	0	0	0	0	0	0	0	5	25
8:30 AM	0	1	0	0	0	0	1	0	2	0	0	0	0	0	0	0	4	27
8:35 AM	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	26
8:40 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	25
8:45 AM	0	1	0	0	0	1	1	0	2	0	0	0	0	0	0	0	5	30
8:50 AM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	31
8:55 AM	0	1	0	0	0	1	0	0	2	0	0	0	0	0	0	0	4	30
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	0	0	0	0	0	0	16	0	28	0	0	0	0	0	0	0	44	
Heavy Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Buses																		
Pedestrians	0	0			0	0			0	0			0	0			0	
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0	
Scooters																		

Comments:

Report generated on 5/16/2023 8:28 AM

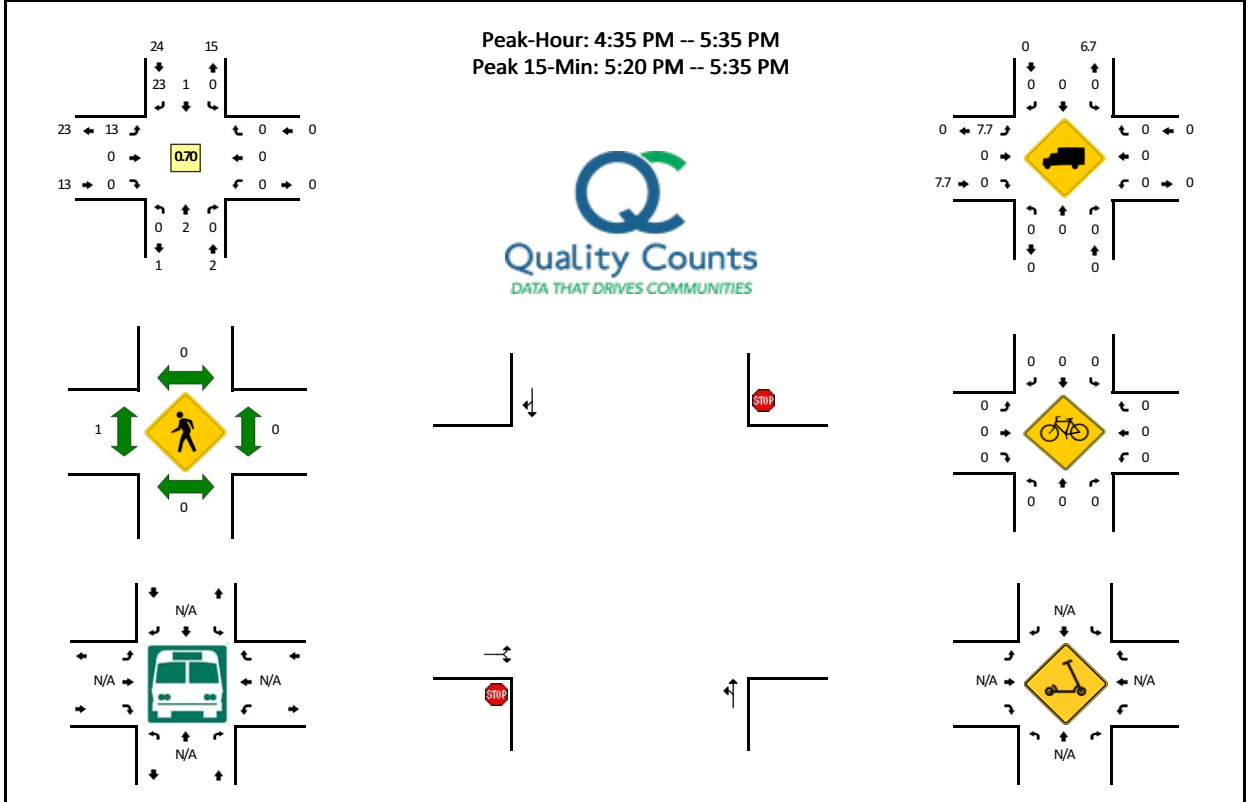
SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

LOCATION: SE Village Blvd -- Cascadia Village Dr  
 CITY/STATE: Sandy, OR

QC JOB #: 16204006  
 DATE: Wed, May 10 2023



Peak-Hour: 4:35 PM -- 5:35 PM  
 Peak 15-Min: 5:20 PM -- 5:35 PM



5-Min Count Period Beginning At	SE Village Blvd (Northbound)				SE Village Blvd (Southbound)				Cascadia Village Dr (Eastbound)				Cascadia Village Dr (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	3	
4:05 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	
4:10 PM	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	
4:15 PM	0	0	0	0	0	0	3	0	2	0	0	0	0	0	0	0	5	
4:20 PM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	
4:25 PM	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	3	
4:30 PM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	
4:35 PM	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	3	
4:40 PM	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	2	
4:45 PM	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	3	
4:50 PM	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	2	
4:55 PM	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	
5:00 PM	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	31
5:05 PM	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	4	34
5:10 PM	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	33
5:15 PM	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	4	32
5:20 PM	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	4	34
5:25 PM	0	0	0	0	0	0	2	0	2	0	0	0	0	0	0	0	4	35
5:30 PM	0	0	0	0	0	0	3	0	3	0	0	0	0	0	0	0	6	39
5:35 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	37
5:40 PM	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	37
5:45 PM	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	38
5:50 PM	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	37
5:55 PM	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	36
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	0	0	0	0	0	0	28	0	28	0	0	0	0	0	0	0	56	
Heavy Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Buses																		
Pedestrians	0	0			0	0			0	4			0	0			4	
Bicycles	0	0	0		0	0	0		0	0	0		0	0	0		0	
Scooters																		

Comments:

Report generated on 5/16/2023 8:28 AM

SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

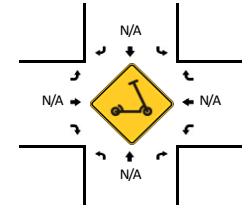
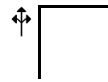
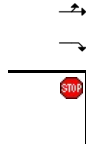
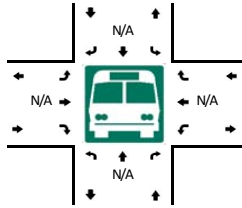
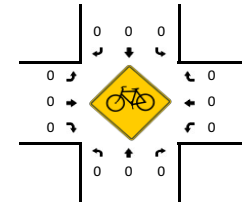
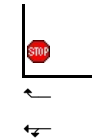
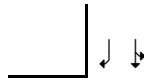
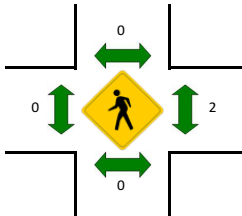
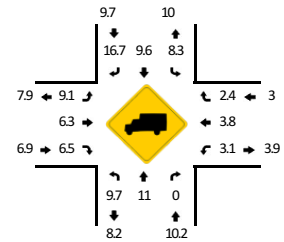
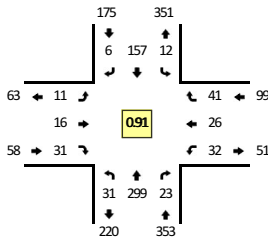
Type of peak hour being reported: Intersection Peak

Method for determining peak hour: Total Entering Volume

LOCATION: Hwy 211 -- Dubarko Rd  
CITY/STATE: Sandy, OR

QC JOB #: 16204007  
DATE: Wed, May 10 2023

Peak-Hour: 7:55 AM -- 8:55 AM  
Peak 15-Min: 7:55 AM -- 8:10 AM



5-Min Count Period Beginning At	Hwy 211 (Northbound)				Hwy 211 (Southbound)				Dubarko Rd (Eastbound)				Dubarko Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
7:00 AM	3	15	3	0	1	3	0	0	0	0	3	0	1	3	2	0	34	
7:05 AM	3	20	0	0	0	9	0	0	0	1	2	0	4	5	0	0	44	
7:10 AM	2	30	0	0	0	11	1	0	1	0	5	0	1	2	3	0	56	
7:15 AM	1	17	1	0	0	13	1	0	1	0	1	0	5	3	4	0	47	
7:20 AM	3	29	1	0	0	11	0	0	0	0	4	0	3	3	3	0	57	
7:25 AM	2	25	0	0	1	17	0	0	0	0	1	0	1	3	6	0	56	
7:30 AM	4	24	0	0	0	11	0	0	1	0	0	0	3	2	5	0	50	
7:35 AM	2	31	0	0	0	8	1	0	1	1	4	0	4	4	1	0	57	
7:40 AM	5	19	3	0	1	8	0	0	2	1	2	0	3	7	4	0	55	
7:45 AM	3	17	2	0	1	14	0	0	0	1	3	0	4	5	4	0	54	
7:50 AM	4	18	1	0	0	14	0	0	1	3	2	0	3	6	2	0	54	
7:55 AM	2	37	2	0	0	6	0	0	1	3	4	0	4	2	5	0	66	630
8:00 AM	3	33	2	0	1	18	0	0	1	1	2	0	2	3	2	0	68	664
8:05 AM	6	20	1	0	1	11	0	0	3	2	2	0	5	0	3	0	54	674
8:10 AM	3	20	1	0	0	17	4	0	3	3	5	0	1	2	1	0	60	678
8:15 AM	4	19	3	0	1	15	0	0	0	0	2	0	2	1	3	0	50	681
8:20 AM	1	28	1	0	2	17	0	0	0	0	2	0	0	2	1	0	54	678
8:25 AM	2	19	1	0	2	13	1	0	1	0	1	0	1	2	2	0	45	667
8:30 AM	3	20	3	0	0	13	0	0	1	2	2	0	6	5	5	0	60	677
8:35 AM	4	22	2	0	1	14	0	0	1	2	6	0	2	1	3	0	58	678
8:40 AM	1	32	4	0	3	8	0	0	0	1	3	0	3	0	2	0	57	680
8:45 AM	0	24	2	0	0	10	1	0	0	1	2	0	3	4	11	0	58	684
8:50 AM	2	25	1	0	1	15	0	0	0	1	0	0	3	4	3	0	55	685
8:55 AM	5	14	2	0	0	9	0	0	0	0	1	0	4	2	2	0	39	658
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	44	360	20	0	8	140	0	0	20	24	32	0	44	20	40	0	752	
Heavy Trucks	8	32	0	0	0	12	0	0	4	0	0	0	0	0	0	0	56	
Buses																		
Pedestrians	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Bicycles																		
Scooters																		

Comments:

Report generated on 5/16/2023 8:28 AM

SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

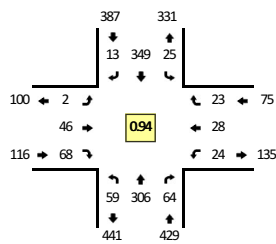


Type of peak hour being reported: Intersection Peak

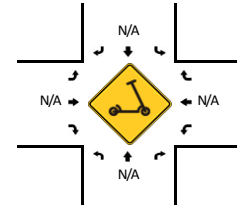
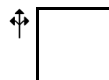
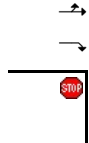
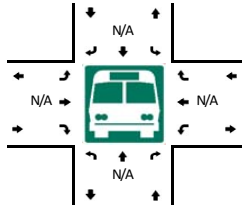
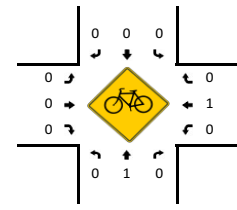
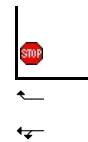
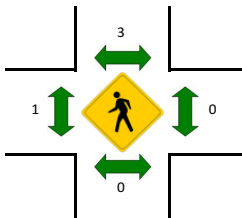
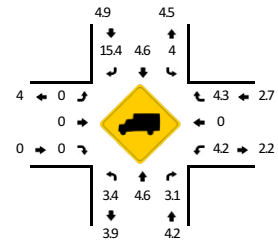
Method for determining peak hour: Total Entering Volume

LOCATION: Hwy 211 -- Dubarko Rd  
CITY/STATE: Sandy, OR

QC JOB #: 16204008  
DATE: Wed, May 10 2023



Peak-Hour: 4:40 PM -- 5:40 PM  
Peak 15-Min: 4:40 PM -- 4:55 PM



5-Min Count Period Beginning At	Hwy 211 (Northbound)				Hwy 211 (Southbound)				Dubarko Rd (Eastbound)				Dubarko Rd (Westbound)				Total	Hourly Totals
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
4:00 PM	4	21	3	0	3	22	0	0	0	1	2	0	3	5	2	0	66	
4:05 PM	6	15	5	0	1	18	0	0	0	2	0	0	2	3	6	0	58	
4:10 PM	4	32	7	0	1	22	1	0	0	4	2	0	1	0	2	0	76	
4:15 PM	5	19	6	0	1	24	0	0	0	3	2	0	1	4	2	0	67	
4:20 PM	5	25	3	0	2	35	0	0	0	5	2	0	3	3	1	0	84	
4:25 PM	6	11	6	0	1	27	0	0	2	6	3	0	2	0	0	0	64	
4:30 PM	2	23	4	0	2	40	1	0	0	4	4	0	1	1	2	0	84	
4:35 PM	1	18	2	0	6	23	1	0	1	4	2	0	3	3	4	0	68	
4:40 PM	6	22	5	0	2	35	1	0	0	6	7	0	5	3	3	0	95	
4:45 PM	8	27	6	0	1	29	2	0	0	2	4	0	0	2	2	0	95	
4:50 PM	3	33	5	0	5	34	1	0	0	4	2	0	1	1	2	0	83	
4:55 PM	4	18	1	0	1	35	1	0	0	7	9	0	0	3	4	0	83	919
5:00 PM	3	27	10	0	2	32	1	0	0	1	7	0	2	2	1	0	88	941
5:05 PM	3	25	4	0	2	27	0	0	1	5	2	0	2	1	0	0	72	955
5:10 PM	4	17	6	0	4	31	3	0	0	3	7	0	3	2	3	0	83	962
5:15 PM	6	22	1	0	0	24	0	0	0	5	5	0	1	4	0	0	68	963
5:20 PM	5	28	5	0	6	29	1	0	0	6	4	0	5	1	3	0	93	972
5:25 PM	9	24	4	0	0	20	0	0	1	5	4	0	2	2	2	0	73	981
5:30 PM	1	17	6	0	1	32	0	0	0	2	9	0	2	3	1	0	74	971
5:35 PM	7	46	11	0	1	21	3	0	0	0	8	0	1	4	2	0	104	1007
5:40 PM	10	32	3	0	5	24	2	0	1	3	3	0	0	4	0	0	87	999
5:45 PM	5	17	2	0	2	24	1	0	0	3	6	0	6	2	10	0	78	994
5:50 PM	4	26	4	0	0	22	0	0	0	4	3	0	1	1	3	0	68	971
5:55 PM	3	24	4	0	1	23	1	0	1	4	2	0	2	2	4	0	71	959
Peak 15-Min Flowrates	Northbound				Southbound				Eastbound				Westbound				Total	
	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U	Left	Thru	Right	U		
All Vehicles	68	328	64	0	32	392	16	0	0	48	52	0	24	24	28	0	1076	
Heavy Trucks	0	16	0	0	4	36	8	0	0	0	0	0	0	0	0	0	64	
Buses	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Pedestrians	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	8	
Bicycles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Scooters	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Comments:

Report generated on 5/16/2023 8:28 AM

SOURCE: Quality Counts, LLC (<http://www.qualitycounts.net>) 1-877-580-2212

CASCADE CREEK  
TRAFFIC IMPACT ANALYSIS

*APPENDIX*  
*2. COLLISION HISTORY*

DUBARKO RD at EAGLE CRK-SANDY HY, City of Sandy, Clackamas County, 01/01/2017 to 12/31/2021

COLLISION TYPE	FATAL CRASHES	NON- FATAL CRASHES	PROPERTY DAMAGE ONLY	TOTAL CRASHES	PEOPLE KILLED	PEOPLE INJURED	TRUCKS	DRY SURF	WET SURF	DAY	DARK	INTER- SECTION	INTER- SECTION RELATED	OFF- ROAD
<b>YEAR: 2021</b>														
ANGLE	0	2	1	3	0	7	0	1	2	2	1	3	0	0
<b>YEAR 2021 TOTAL</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>1</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>3</b>	<b>0</b>	<b>0</b>
<b>YEAR: 2020</b>														
ANGLE	0	1	1	2	0	1	0	1	1	2	0	2	0	0
FIXED / OTHER OBJECT	0	0	1	1	0	0	0	1	0	1	0	1	0	1
TURNING MOVEMENTS	0	1	0	1	0	2	0	1	0	1	0	1	0	0
<b>YEAR 2020 TOTAL</b>	<b>0</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>1</b>
<b>YEAR: 2019</b>														
ANGLE	0	6	0	6	0	10	1	5	1	2	4	6	0	0
REAR-END	0	0	1	1	0	0	0	1	0	1	0	1	0	0
<b>YEAR 2019 TOTAL</b>	<b>0</b>	<b>6</b>	<b>1</b>	<b>7</b>	<b>0</b>	<b>10</b>	<b>1</b>	<b>6</b>	<b>1</b>	<b>3</b>	<b>4</b>	<b>7</b>	<b>0</b>	<b>0</b>
<b>YEAR: 2018</b>														
PEDESTRIAN	0	1	0	1	0	1	0	0	1	0	1	1	0	0
REAR-END	0	1	0	1	0	2	0	1	0	1	0	1	0	0
TURNING MOVEMENTS	0	1	0	1	0	1	0	1	0	0	1	1	0	0
<b>YEAR 2018 TOTAL</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>3</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>0</b>	<b>0</b>
<b>YEAR: 2017</b>														
ANGLE	0	3	2	5	0	6	0	3	2	3	2	5	0	0

**DUBARKO RD at EAGLE CRK-SANDY HY, City of Sandy, Clackamas County, 01/01/2017 to 12/31/2021**

COLLISION TYPE	FATAL CRASHES	NON- PROPERTY		TOTAL CRASHES	PEOPLE KILLED	PEOPLE INJURED	TRUCKS	DRY SURF	WET SURF	DAY	DARK	INTER-		OFF- ROAD
		FATAL CRASHES	DAMAGE ONLY									SECTION RELATED	SECTION RELATED	
TURNING MOVEMENTS	0	1	0	1	0	1	0	1	0	1	0	1	0	0
<b>YEAR 2017 TOTAL</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>6</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>4</b>	<b>2</b>	<b>4</b>	<b>2</b>	<b>6</b>	<b>0</b>	<b>0</b>
<b>FINAL TOTAL</b>	<b>0</b>	<b>17</b>	<b>6</b>	<b>23</b>	<b>0</b>	<b>31</b>	<b>1</b>	<b>16</b>	<b>7</b>	<b>14</b>	<b>9</b>	<b>23</b>	<b>0</b>	<b>1</b>

*Disclaimer: The information contained in this report is compiled from individual driver and police crash reports submitted to the Oregon Department of Transportation as required in ORS 811.720. The Crash Analysis and Reporting Unit is committed to providing the highest quality crash data to customers. However, because submittal of crash report forms is the responsibility of the individual driver, the Crash Analysis and Reporting Unit can not guarantee that all qualifying crashes are represented nor can assurances be made that all details pertaining to a single crash are accurate. Note: Legislative changes to DMV's vehicle crash reporting requirements, effective 01/01/2004, may result in fewer property damage only crashes being eligible for inclusion in the Statewide Crash Data File.*

Highway 172 ALL ROAD TYPES, MP 4.5 to 5.0 01/01/2017 to 12/31/2021, Both Add and Non-Add mileage

Route OR-211, Name: Eagle Creek-Sandy Highway

1 - 1 of 1 Crash records shown.

SERIAL NO	DATE	M A *COUNTY OR E Y CITY NAME	C R O C L D M O G W P N T	Y N N Y # T # P	HWY#	MP#	LRS VALUE	LAT	LONG	COLL TYPE	EVENT	CAUSE	ERROR	T O S T U V	PEOPLE					
															I I C U E D	K L R P	L N O G E P	L J H S D T		
01322	04/19/2018	8A TH *Clackamas	1 MN	R 172	4.60		017200100S00			FIX	079,010	27		DRY 1 010	0	0	N	N	N	Y

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VILLAGE BLVD at CASCADIA VILLAGE DR, City of Sandy, Clackamas County, 01/01/2017 to 12/31/2021

COLLISION TYPE	FATAL CRASHES	NON- FATAL CRASHES	PROPERTY DAMAGE ONLY	TOTAL CRASHES	PEOPLE KILLED	PEOPLE INJURED	TRUCKS	DRY SURF	WET SURF	DAY	DARK	INTER- SECTION	INTER- SECTION RELATED	OFF- ROAD
FINAL TOTAL														

Disclaimer: The information contained in this report is compiled from individual driver and police crash reports submitted to the Oregon Department of Transportation as required in ORS 811.720. The Crash Analysis and Reporting Unit is committed to providing the highest quality crash data to customers. However, because submittal of crash report forms is the responsibility of the individual driver, the Crash Analysis and Reporting Unit can not guarantee that all qualifying crashes are represented nor can assurances be made that all details pertaining to a single crash are accurate. Note: Legislative changes to DMV's vehicle crash reporting requirements, effective 01/01/2004, may result in fewer property damage only crashes being eligible for inclusion in the Statewide Crash Data File.

VILLAGE BLVD and Intersectional Crashes at VILLAGE BLVD, City of Sandy, Clackamas County, 01/01/2017 to 12/31/2021

COLLISION TYPE	FATAL CRASHES	NON- FATAL CRASHES	PROPERTY DAMAGE ONLY	TOTAL CRASHES	PEOPLE KILLED	PEOPLE INJURED	TRUCKS	DRY SURF	WET SURF	DAY	DARK	INTER- SECTION	INTER- SECTION RELATED	OFF- ROAD
FINAL TOTAL														

Disclaimer: The information contained in this report is compiled from individual driver and police crash reports submitted to the Oregon Department of Transportation as required in ORS 811.720. The Crash Analysis and Reporting Unit is committed to providing the highest quality crash data to customers. However, because submittal of crash report forms is the responsibility of the individual driver, the Crash Analysis and Reporting Unit can not guarantee that all qualifying crashes are represented nor can assurances be made that all details pertaining to a single crash are accurate. Note: Legislative changes to DMV's vehicle crash reporting requirements, effective 01/01/2004, may result in fewer property damage only crashes being eligible for inclusion in the Statewide Crash Data File.

Cascade Creek IPA

CASCADE CREEK  
TRAFFIC IMPACT ANALYSIS

*APPENDIX*  
*3. ITE SHEETS*



## Multifamily Housing (Low-Rise) Not Close to Rail Transit (220)

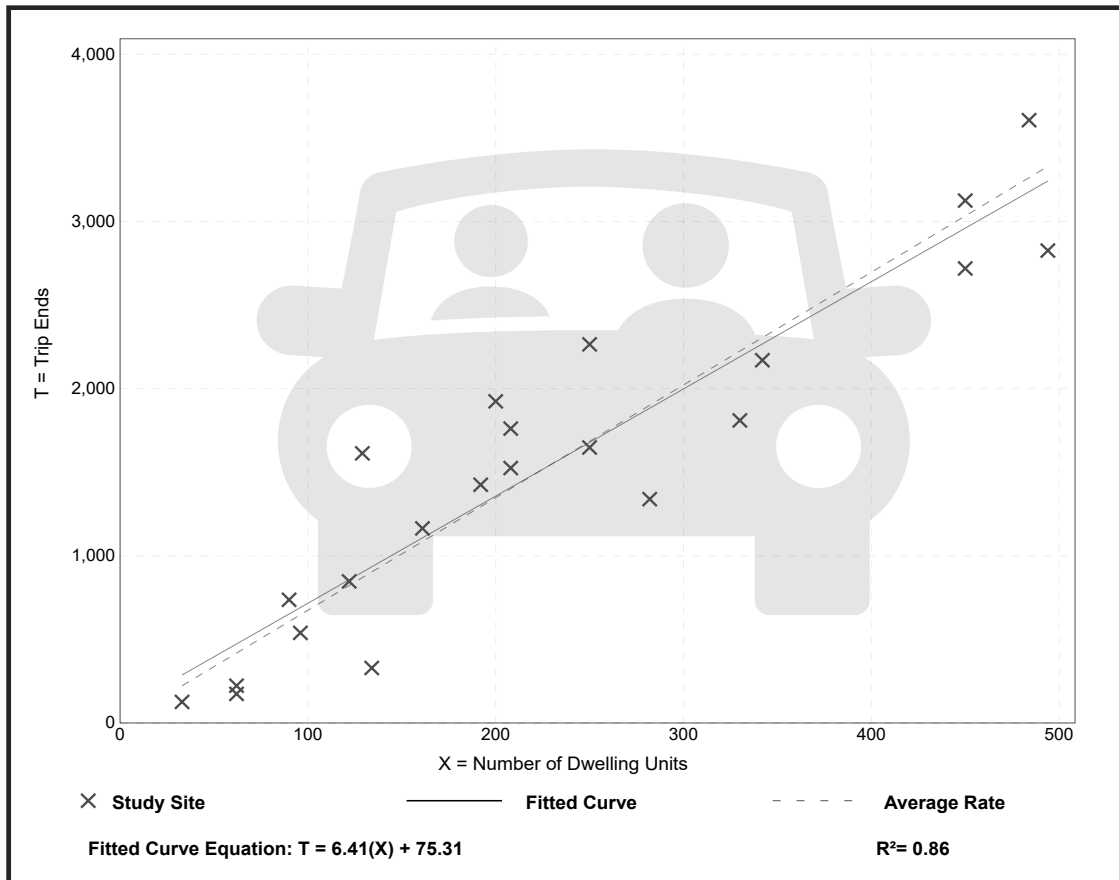
**Vehicle Trip Ends vs: Dwelling Units**  
**On a: Weekday**

**Setting/Location: General Urban/Suburban**  
Number of Studies: 22  
Avg. Num. of Dwelling Units: 229  
Directional Distribution: 50% entering, 50% exiting

### Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
6.74	2.46 - 12.50	1.79

### Data Plot and Equation



Trip Gen Manual, 11th Edition

• Institute of Transportation Engineers

## Multifamily Housing (Low-Rise) Not Close to Rail Transit (220)

**Vehicle Trip Ends vs: Dwelling Units**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 7 and 9 a.m.**

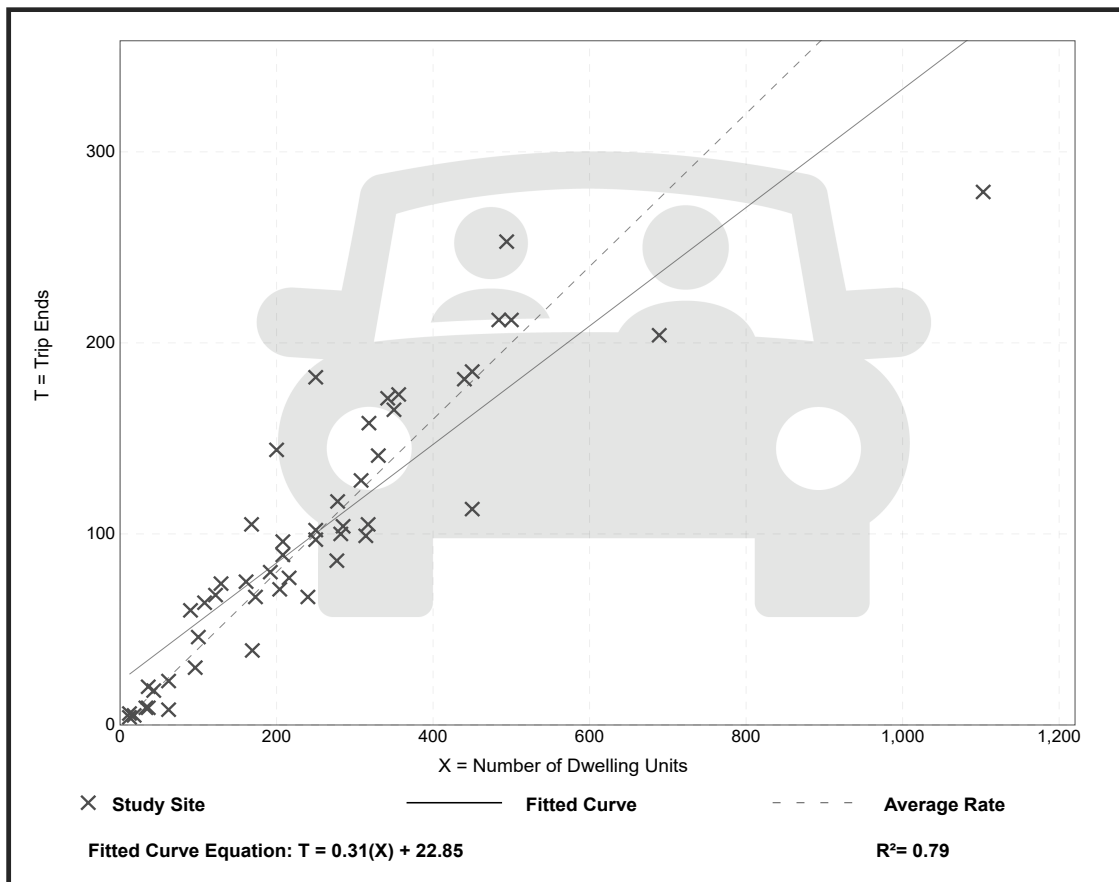
**Setting/Location: General Urban/Suburban**

Number of Studies: 49  
 Avg. Num. of Dwelling Units: 249  
 Directional Distribution: 24% entering, 76% exiting

### Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.40	0.13 - 0.73	0.12

### Data Plot and Equation



x Study Site
— Fitted Curve
--- Average Rate  
**Fitted Curve Equation:  $T = 0.31(X) + 22.85$** 
 **$R^2 = 0.79$**

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## Multifamily Housing (Low-Rise) Not Close to Rail Transit (220)

**Vehicle Trip Ends vs: Dwelling Units**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 4 and 6 p.m.**

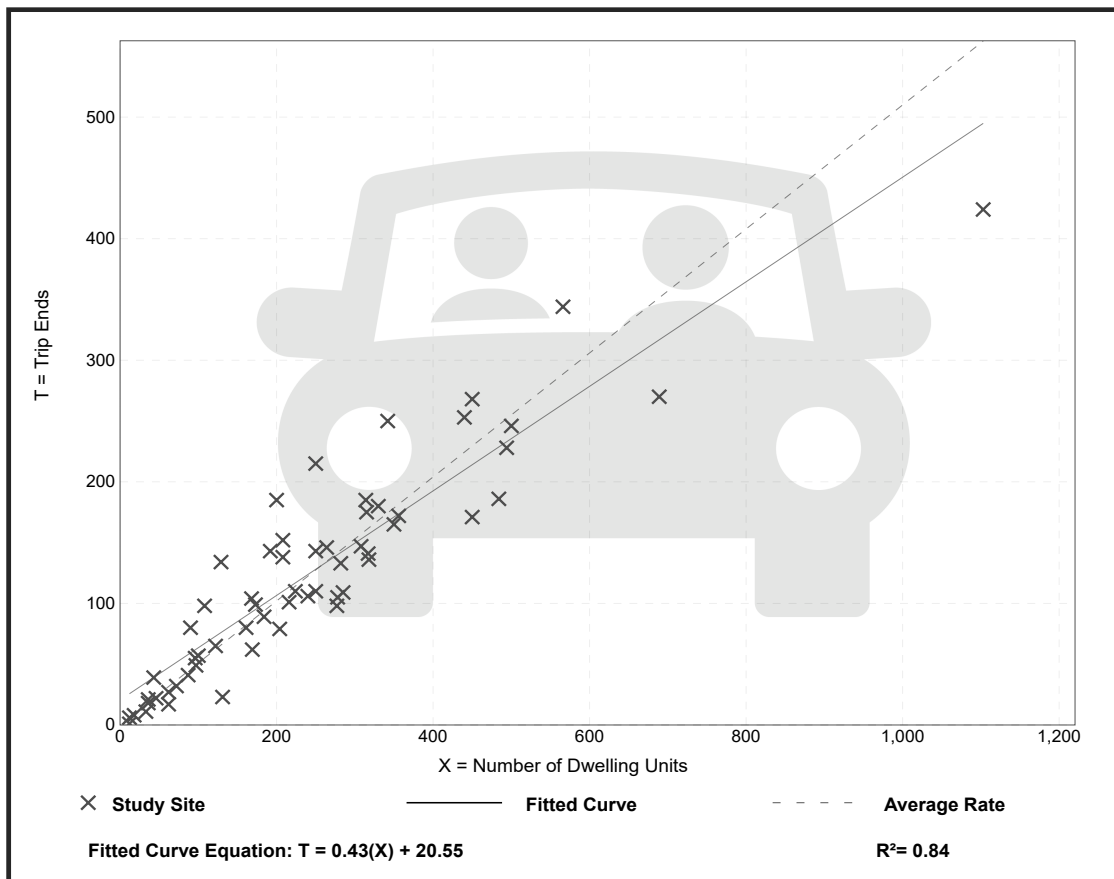
**Setting/Location: General Urban/Suburban**

Number of Studies: 59  
 Avg. Num. of Dwelling Units: 241  
 Directional Distribution: 63% entering, 37% exiting

### Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.51	0.08 - 1.04	0.15

### Data Plot and Equation



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## Strip Retail Plaza (<40k) (822)

**Vehicle Trip Ends vs: 1000 Sq. Ft. GLA**  
**On a: Weekday**

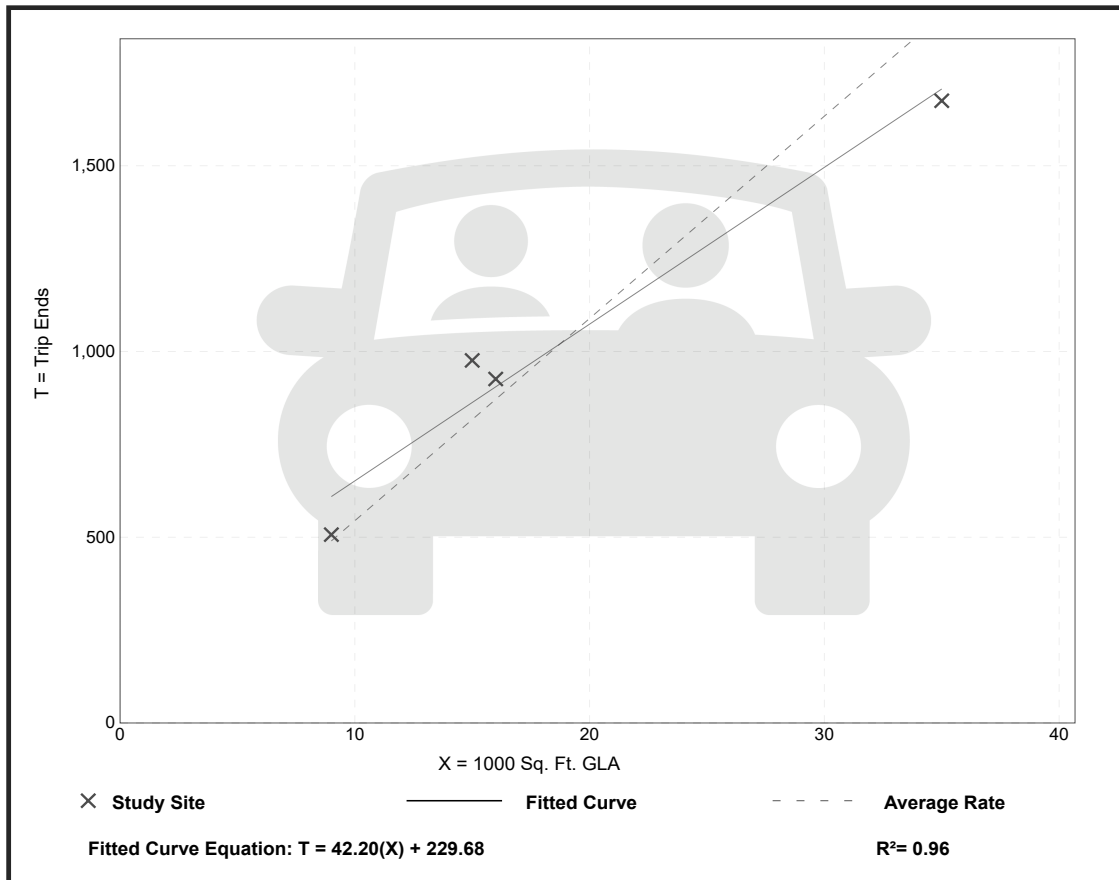
**Setting/Location: General Urban/Suburban**  
Number of Studies: 4  
Avg. 1000 Sq. Ft. GLA: 19  
Directional Distribution: 50% entering, 50% exiting

### Vehicle Trip Generation per 1000 Sq. Ft. GLA

Average Rate	Range of Rates	Standard Deviation
54.45	47.86 - 65.07	7.81

### Data Plot and Equation

*Caution – Small Sample Size*



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Cascade Creek TIA

## Strip Retail Plaza (<40k) (822)

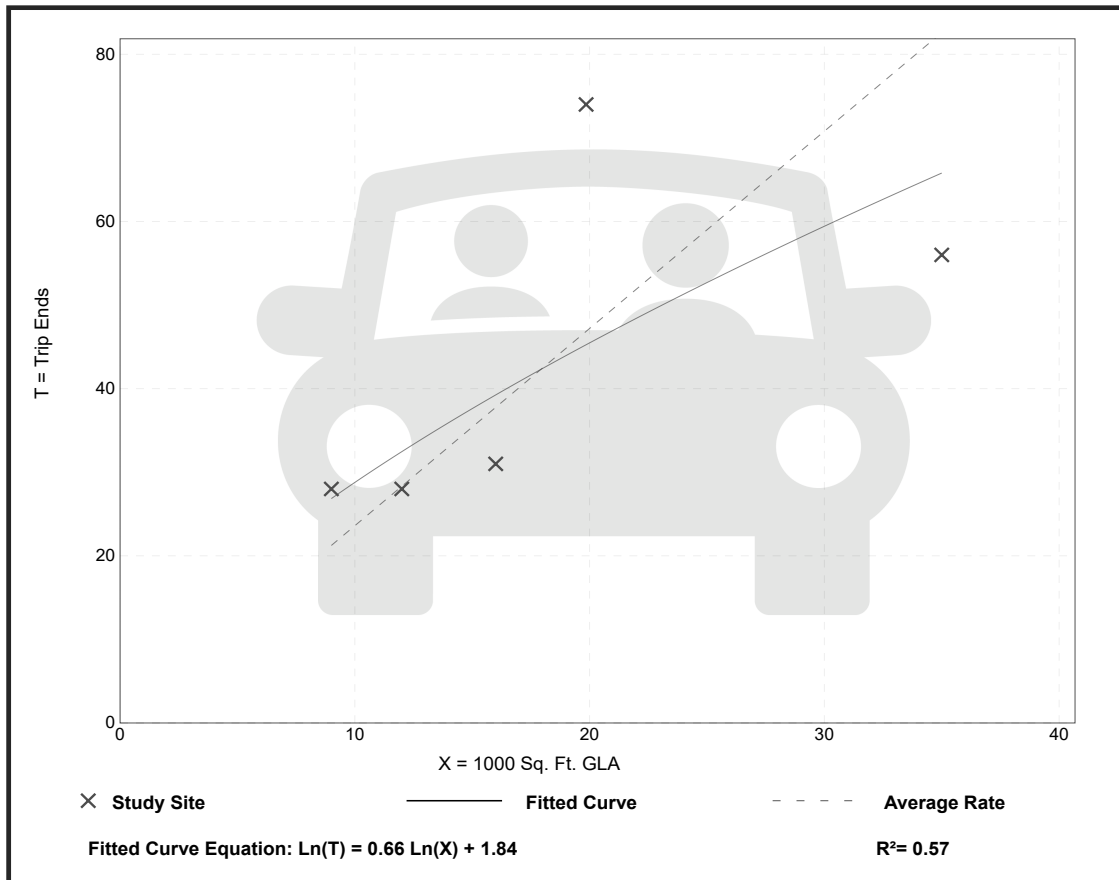
**Vehicle Trip Ends vs: 1000 Sq. Ft. GLA**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 7 and 9 a.m.**  
**Setting/Location: General Urban/Suburban**  
 Number of Studies: 5  
 Avg. 1000 Sq. Ft. GLA: 18  
 Directional Distribution: 60% entering, 40% exiting

### Vehicle Trip Generation per 1000 Sq. Ft. GLA

Average Rate	Range of Rates	Standard Deviation
2.36	1.60 - 3.73	0.94

### Data Plot and Equation

*Caution – Small Sample Size*



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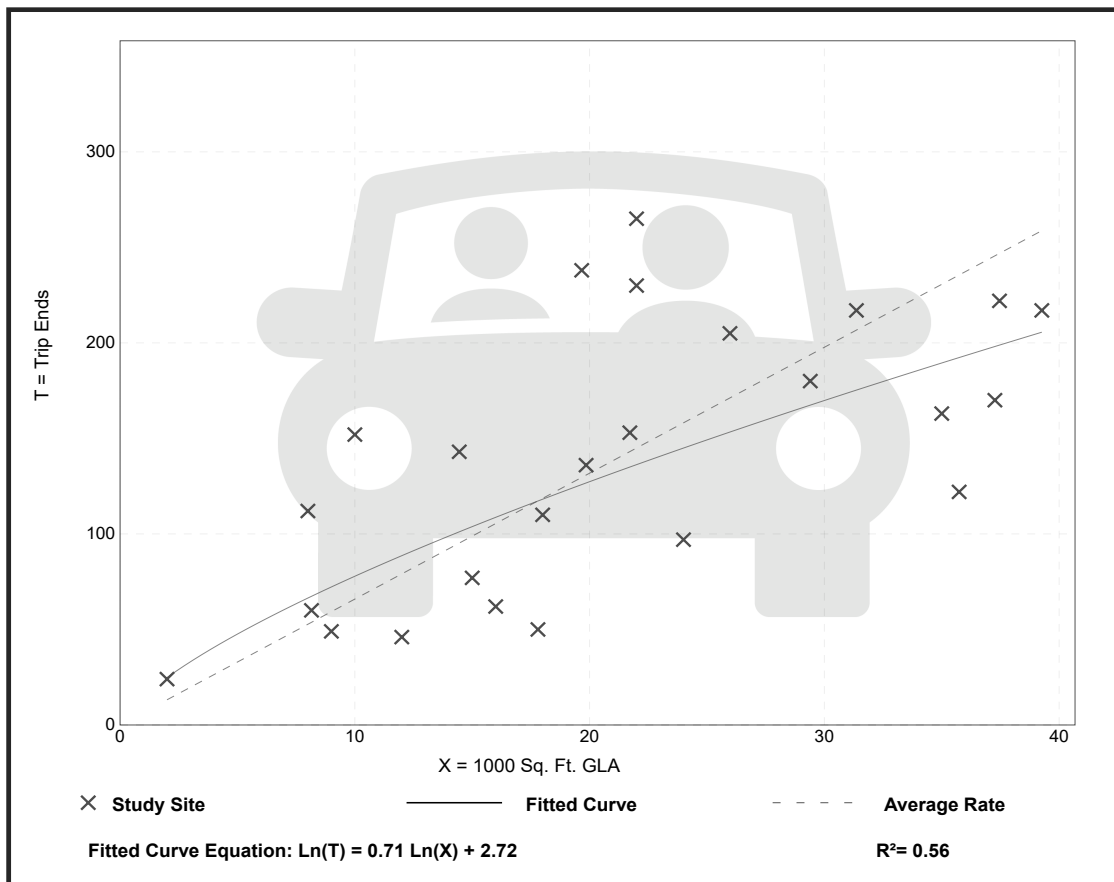
## Strip Retail Plaza (<40k) (822)

**Vehicle Trip Ends vs: 1000 Sq. Ft. GLA**  
**On a: Weekday,**  
**Peak Hour of Adjacent Street Traffic,**  
**One Hour Between 4 and 6 p.m.**  
**Setting/Location: General Urban/Suburban**  
 Number of Studies: 25  
 Avg. 1000 Sq. Ft. GLA: 21  
 Directional Distribution: 50% entering, 50% exiting

### Vehicle Trip Generation per 1000 Sq. Ft. GLA

Average Rate	Range of Rates	Standard Deviation
6.59	2.81 - 15.20	2.94

### Data Plot and Equation



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### Vehicle Pass-By Rates by Land Use

Source: ITE Trip Generation Manual, 11th Edition

Land Use Code	821								
Land Use	Shopping Plaza (40 - 150k)								
Setting	General Urban/Suburban								
Time Period	Weekday PM Peak Period								
# Data Sites	15								
Average Pass-By Rate	40%								
	Pass-By Characteristics for Individual Sites								
						Non-Pass-By Trips			
GLA (000)	State or Province	Survey Year	# Interviews	Pass-By Trip (%)	Primary (%)	Diverted (%)	Total (%)	Adj Street Peak Hour Volume	Source
45	Florida	1992	844	56	24	20	44	—	30
50	Florida	1992	555	41	41	18	59	—	30
52	Florida	1995	665	42	33	25	58	—	30
53	Florida	1993	162	59	—	—	41	—	30
57.23	Kentucky	1993	247	31	53	16	69	2659	34
60	Florida	1995	1583	40	38	22	60	—	30
69.4	Kentucky	1993	109	25	42	33	75	1559	34
77	Florida	1992	365	46	—	—	54	—	30
78	Florida	1991	702	55	23	22	45	—	30
82	Florida	1992	336	34	—	—	66	—	30
92.857	Kentucky	1993	133	22	50	28	78	3555	34
100.888	Kentucky	1993	281	28	50	22	72	2111	34
121.54	Kentucky	1993	210	53	30	17	47	2636	34
144	New Jersey	1990	176	32	44	24	68	—	24
146.8	Kentucky	1993	—	36	39	25	64	—	34

CASCADE CREEK  
TRAFFIC IMPACT ANALYSIS

*APPENDIX*  
*4. FORECAST 2025 EXCEL SHEET*



**Peak Hour Forecast Intersection Volumes**

Annual Growth Rate: 2 % 2025  
 # of Years to Horizon: 2

**AM PEAK HOUR**

**1. Hwy 211 & Dubarko Rd**

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	6	157	12	41	26	32	23	299	31	31	16	11
Project Trips	0	9	0	0	0	0	0	15	2	1	0	0
Rerouted	0	0	0	0	0	0	0	0	0	0	0	0
Without	6	163	12	43	27	33	24	311	32	32	17	11
With	6	172	12	43	27	33	24	326	34	33	17	11

**2. SE Village Blvd & Hwy 211**

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	0	0	0	0	189	6	11	0	14	5	190	0
Project Trips	0	0	0	0	0	13	19	0	15	10	0	0
Rerouted	0	0	0	0	0	0	0	0	0	2	-2	0
Without	0	0	0	0	197	6	11	0	15	5	198	0
With	0	0	0	0	197	19	30	0	30	17	196	0

**3. SE Village Blvd & Cascadia Village Dr**

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	9	2	0	0	0	0	0	2	0	0	0	18
Project Trips	0	0	23	34	0	0	0	0	0	0	0	0
Rerouted	0	0	2	0	0	0	0	0	0	0	0	0
Without	9	2	0	0	0	0	0	2	0	0	0	19
With	9	2	25	34	0	0	0	2	0	0	0	19

**4. Hwy 211 & Gunderson Rd**

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	2	227	0	0	0	0	0	163	7	14	0	0
Project Trips	1	12	0	0	0	0	0	6	0	1	0	0
Rerouted	0	0	0	0	0	0	0	2	0	0	0	0
Without	2	236	0	0	0	0	0	170	7	15	0	0
With	3	248	0	0	0	0	0	178	7	16	0	0

**PM PEAK HOUR**

**1. Hwy 211 & Dubarko Rd**

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	13	349	25	23	28	24	64	306	59	68	46	2
Project Trips	0	24	0	0	0	0	0	18	2	2	0	0
Rerouted	0	0	0	0	0	0	0	0	0	0	0	0
Without	14	363	26	24	29	25	67	318	61	71	48	2
With	14	387	26	24	29	25	67	336	63	73	48	2

**2. SE Village Blvd & Hwy 211**

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	1	0	0	0	231	20	18	0	11	16	316	0
Project Trips	0	0	0	0	0	33	28	0	23	29	0	0
Rerouted	0	0	0	0	0	0	0	0	0	8	-8	0
Without	1	0	0	0	240	21	19	0	11	17	329	0
With	1	0	0	0	240	54	47	0	34	54	321	0

**3. SE Village Blvd & Cascadia Village Dr**

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	23	1	0	0	0	0	0	2	0	0	0	13
Project Trips	0	0	62	51	0	0	0	0	0	0	0	0
Rerouted	0	0	8	0	0	0	0	0	0	0	0	0
Without	24	1	0	0	0	0	0	2	0	0	0	14
With	24	1	70	51	0	0	0	2	0	0	0	14

**4. Hwy 211 & Gunderson Rd**

	SBR	SBT	SBL	WBR	WBT	WBL	NBR	NBT	NBL	EBR	EBT	EBL
Existing	10	234	0	0	0	0	0	332	9	2	0	8
Project Trips	3	20	0	0	0	0	0	25	0	0	0	3
Rerouted	0	0	0	0	0	0	0	8	0	0	0	0
Without	10	243	0	0	0	0	0	345	9	2	0	8
With	13	263	0	0	0	0	0	378	9	2	0	11

CASCADE CREEK  
TRAFFIC IMPACT ANALYSIS

*APPENDIX*  
*5. LEVEL OF SERVICE*

HCM 6th TWSC  
1: Hwy 211 & Gunderson Road

Existing AM Peak Hour

Intersection						
Int Delay, s/veh	0.5					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	7	163	227	2	0	14
Future Vol, veh/h	7	163	227	2	0	14
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	14	14	6	1	0	14
Mvmt Flow	8	179	249	2	0	15
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	251	0	-	0	445	250
Stage 1	-	-	-	-	250	-
Stage 2	-	-	-	-	195	-
Critical Hdwy	4.24	-	-	-	6.4	6.34
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.326	-	-	-	3.5	3.426
Pot Cap-1 Maneuver	1248	-	-	-	574	760
Stage 1	-	-	-	-	796	-
Stage 2	-	-	-	-	843	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1248	-	-	-	570	760
Mov Cap-2 Maneuver	-	-	-	-	570	-
Stage 1	-	-	-	-	790	-
Stage 2	-	-	-	-	843	-
Approach	EB	WB	SB			
HCM Control Delay, s	0.3	0	9.8			
HCM LOS			A			
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1248	-	-	-	760	
HCM Lane V/C Ratio	0.006	-	-	-	0.02	
HCM Control Delay (s)	7.9	0	-	-	9.8	
HCM Lane LOS	A	A	-	-	A	
HCM 95th %tile Q(veh)	0	-	-	-	0.1	

HCM 6th TWSC  
2: SE Village Blvd & Hwy 211

Existing AM Peak Hour

Intersection												
Int Delay, s/veh	0.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↖	↗			↔			↔	
Traffic Vol, veh/h	0	190	5	6	189	0	14	0	11	0	0	0
Future Vol, veh/h	0	190	5	6	189	0	14	0	11	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	375	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	12	20	1	9	2	1	2	9	2	2	2
Mvmt Flow	0	207	5	7	205	0	15	0	12	0	0	0

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	205	0	0	212	0	0	429	429	210	435	431	205
Stage 1	-	-	-	-	-	-	210	210	-	219	219	-
Stage 2	-	-	-	-	-	-	219	219	-	216	212	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.11	6.52	6.29	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.509	4.018	3.381	3.518	4.018	3.318
Pot Cap-1 Maneuver	1366	-	-	1364	-	-	538	518	813	531	517	836
Stage 1	-	-	-	-	-	-	794	728	-	783	722	-
Stage 2	-	-	-	-	-	-	786	722	-	786	727	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1366	-	-	1364	-	-	536	515	813	521	514	836
Mov Cap-2 Maneuver	-	-	-	-	-	-	536	515	-	521	514	-
Stage 1	-	-	-	-	-	-	794	728	-	783	718	-
Stage 2	-	-	-	-	-	-	782	718	-	774	727	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.2	11	0
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	631	1366	-	-	1364	-	-	-
HCM Lane V/C Ratio	0.043	-	-	-	0.005	-	-	-
HCM Control Delay (s)	11	0	-	-	7.7	-	-	0
HCM Lane LOS	B	A	-	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	-

HCM 6th TWSC  
3: SE Village Blvd & Cascadia Village Dr

Existing AM Peak Hour

Intersection												
Int Delay, s/veh	5.1											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔			↔			↔			↔	
Traffic Vol, veh/h	18	0	0	0	0	0	0	2	0	0	2	9
Future Vol, veh/h	18	0	0	0	0	0	0	2	0	0	2	9
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	70	92	70	92	92	92	70	70	92	92	70	70
Heavy Vehicles, %	6	2	0	2	2	2	0	50	2	2	50	11
Mvmt Flow	26	0	0	0	0	0	0	3	0	0	3	13
Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	13	13	10	13	19	3	16	0	0	3	0	0
Stage 1	10	10	-	3	3	-	-	-	-	-	-	-
Stage 2	3	3	-	10	16	-	-	-	-	-	-	-
Critical Hdwy	7.16	6.52	6.2	7.12	6.52	6.22	4.1	-	-	4.12	-	-
Critical Hdwy Stg 1	6.16	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.16	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3	3.518	4.018	3.318	2.2	-	-	2.218	-	-
Pot Cap-1 Maneuver	993	881	1077	1004	875	1081	1615	-	-	1619	-	-
Stage 1	1001	887	-	1020	893	-	-	-	-	-	-	-
Stage 2	1009	893	-	1011	882	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	993	881	1077	1004	875	1081	1615	-	-	1619	-	-
Mov Cap-2 Maneuver	993	881	-	1004	875	-	-	-	-	-	-	-
Stage 1	1001	887	-	1020	893	-	-	-	-	-	-	-
Stage 2	1009	893	-	1011	882	-	-	-	-	-	-	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	8.7			0			0			0		
HCM LOS	A			A								
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1615	-	-	993	-	1619	-	-				
HCM Lane V/C Ratio	-	-	-	0.026	-	-	-	-				
HCM Control Delay (s)	0	-	-	8.7	0	0	-	-				
HCM Lane LOS	A	-	-	A	A	A	-	-				
HCM 95th %tile Q(veh)	0	-	-	0.1	-	0	-	-				

HCM 6th TWSC  
4: Hwy 211 & Dubarko Road

Existing AM Peak Hour

Intersection												
Int Delay, s/veh	3.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕	↕		↕			↕	↕
Traffic Vol, veh/h	11	16	31	32	26	41	31	299	23	12	157	6
Future Vol, veh/h	11	16	31	32	26	41	31	299	23	12	157	6
Conflicting Peds, #/hr	2	0	2	2	0	2	2	0	2	2	0	2
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	80	-	-	110	-	-	-	-	-	315
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	9	6	7	3	4	3	10	11	1	8	10	17
Mvmt Flow	12	18	34	35	29	45	34	329	25	13	173	7
Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	650	625	177	643	620	346	182	0	0	356	0	0
Stage 1	201	201	-	412	412	-	-	-	-	-	-	-
Stage 2	449	424	-	231	208	-	-	-	-	-	-	-
Critical Hdwy	7.19	6.56	6.27	7.13	6.54	6.23	4.2	-	-	4.18	-	-
Critical Hdwy Stg 1	6.19	5.56	-	6.13	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.19	5.56	-	6.13	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.581	4.054	3.363	3.527	4.036	3.327	2.29	-	-	2.272	-	-
Pot Cap-1 Maneuver	373	396	853	385	401	695	1346	-	-	1170	-	-
Stage 1	785	727	-	615	591	-	-	-	-	-	-	-
Stage 2	576	580	-	770	726	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	317	377	850	343	382	693	1344	-	-	1168	-	-
Mov Cap-2 Maneuver	317	377	-	343	382	-	-	-	-	-	-	-
Stage 1	758	717	-	594	571	-	-	-	-	-	-	-
Stage 2	494	560	-	711	716	-	-	-	-	-	-	-
Approach	EB		WB		NB			SB				
HCM Control Delay, s	12.6		14.5		0.7			0.6				
HCM LOS	B		B									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR		
Capacity (veh/h)	1344	-	-	350	850	359	693	1168	-	-		
HCM Lane V/C Ratio	0.025	-	-	0.085	0.04	0.178	0.065	0.011	-	-		
HCM Control Delay (s)	7.7	0	-	16.2	9.4	17.2	10.6	8.1	0	-		
HCM Lane LOS	A	A	-	C	A	C	B	A	A	-		
HCM 95th %tile Q(veh)	0.1	-	-	0.3	0.1	0.6	0.2	0	-	-		

HCM 6th TWSC  
1: Hwy 211 & Gunderson Road

Existing PM Peak Hour

Intersection						
Int Delay, s/veh	0.3					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	9	332	234	10	8	2
Future Vol, veh/h	9	332	234	10	8	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	1	4	5	1	1	1
Mvmt Flow	10	361	254	11	9	2
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	265	0	-	0	641	260
Stage 1	-	-	-	-	260	-
Stage 2	-	-	-	-	381	-
Critical Hdwy	4.11	-	-	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	2.209	-	-	-	3.509	3.309
Pot Cap-1 Maneuver	1305	-	-	-	441	781
Stage 1	-	-	-	-	786	-
Stage 2	-	-	-	-	693	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1305	-	-	-	437	781
Mov Cap-2 Maneuver	-	-	-	-	437	-
Stage 1	-	-	-	-	778	-
Stage 2	-	-	-	-	693	-
Approach	EB	WB	SB			
HCM Control Delay, s	0.2	0	12.7			
HCM LOS			B			
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1305	-	-	-	479	
HCM Lane V/C Ratio	0.007	-	-	-	0.023	
HCM Control Delay (s)	7.8	0	-	-	12.7	
HCM Lane LOS	A	A	-	-	B	
HCM 95th %tile Q(veh)	0	-	-	-	0.1	

HCM 6th TWSC  
2: SE Village Blvd & Hwy 211

Existing PM Peak Hour

Intersection												
Int Delay, s/veh	0.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↖	↗			↔			↔	
Traffic Vol, veh/h	0	316	16	20	231	0	11	0	18	0	0	1
Future Vol, veh/h	0	316	16	20	231	0	11	0	18	0	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	375	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	95	95	95	95	92	95	92	95	92	92	92
Heavy Vehicles, %	2	12	20	1	9	2	1	2	9	2	2	2
Mvmt Flow	0	333	17	21	243	0	12	0	19	0	0	1
Major/Minor	Major1	Major2			Minor1			Minor2				
Conflicting Flow All	243	0	0	350	0	0	628	627	342	636	635	243
Stage 1	-	-	-	-	-	-	342	342	-	285	285	-
Stage 2	-	-	-	-	-	-	286	285	-	351	350	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.11	6.52	6.29	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.509	4.018	3.381	3.518	4.018	3.318
Pot Cap-1 Maneuver	1323	-	-	1214	-	-	397	400	685	391	396	796
Stage 1	-	-	-	-	-	-	675	638	-	722	676	-
Stage 2	-	-	-	-	-	-	724	676	-	666	633	-
Platoon blocked, %		-	-	-	-	-						
Mov Cap-1 Maneuver	1323	-	-	1214	-	-	391	393	685	375	389	796
Mov Cap-2 Maneuver	-	-	-	-	-	-	391	393	-	375	389	-
Stage 1	-	-	-	-	-	-	675	638	-	722	665	-
Stage 2	-	-	-	-	-	-	711	665	-	648	633	-
Approach	EB	WB			NB			SB				
HCM Control Delay, s	0	0.6			12.2			9.5				
HCM LOS					B			A				
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	533	1323	-	-	1214	-	-	796				
HCM Lane V/C Ratio	0.057	-	-	-	0.017	-	-	0.001				
HCM Control Delay (s)	12.2	0	-	-	8	-	-	9.5				
HCM Lane LOS	B	A	-	-	A	-	-	A				
HCM 95th %tile Q(veh)	0.2	0	-	-	0.1	-	-	0				



HCM 6th TWSC  
3: SE Village Blvd & Cascadia Village Dr

Existing PM Peak Hour

Intersection												
Int Delay, s/veh	2.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕			↕			↕			↕	
Traffic Vol, veh/h	13	0	0	0	0	0	0	2	0	0	1	23
Future Vol, veh/h	13	0	0	0	0	0	0	2	0	0	1	23
Conflicting Peds, #/hr	1	0	1	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	70	92	70	92	92	92	70	70	92	92	70	70
Heavy Vehicles, %	8	2	0	2	2	2	0	1	2	2	1	1
Mvmt Flow	19	0	0	0	0	0	0	3	0	0	1	33
Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	23	22	20	22	38	4	35	0	0	3	0	0
Stage 1	19	19	-	3	3	-	-	-	-	-	-	-
Stage 2	4	3	-	19	35	-	-	-	-	-	-	-
Critical Hdwy	7.18	6.52	6.2	7.12	6.52	6.22	4.1	-	-	4.12	-	-
Critical Hdwy Stg 1	6.18	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.18	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.572	4.018	3.3	3.518	4.018	3.318	2.2	-	-	2.218	-	-
Pot Cap-1 Maneuver	974	872	1064	990	854	1080	1589	-	-	1619	-	-
Stage 1	985	880	-	1020	893	-	-	-	-	-	-	-
Stage 2	1003	893	-	1000	866	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	972	871	1062	989	853	1079	1587	-	-	1619	-	-
Mov Cap-2 Maneuver	972	871	-	989	853	-	-	-	-	-	-	-
Stage 1	984	879	-	1020	893	-	-	-	-	-	-	-
Stage 2	1002	893	-	999	865	-	-	-	-	-	-	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	8.8			0			0			0		
HCM LOS	A			A								
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1587	-	-	972	-	1619	-	-				
HCM Lane V/C Ratio	-	-	-	0.019	-	-	-	-				
HCM Control Delay (s)	0	-	-	8.8	0	0	-	-				
HCM Lane LOS	A	-	-	A	A	A	-	-				
HCM 95th %tile Q(veh)	0	-	-	0.1	-	0	-	-				

HCM 6th TWSC  
4: Hwy 211 & Dubarko Road

Existing PM Peak Hour

Intersection												
Int Delay, s/veh	4.4											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕	↕		↕			↕	↕
Traffic Vol, veh/h	2	46	68	24	28	23	59	306	64	25	349	13
Future Vol, veh/h	2	46	68	24	28	23	59	306	64	25	349	13
Conflicting Peds, #/hr	3	0	3	3	0	3	3	0	3	3	0	3
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	80	-	-	110	-	-	-	-	-	315
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	1	1	1	4	1	4	3	5	3	4	5	15
Mvmt Flow	2	49	72	26	30	24	63	326	68	27	371	14

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	944	951	377	985	931	366	388	0	0	397	0	0
Stage 1	428	428	-	489	489	-	-	-	-	-	-	-
Stage 2	516	523	-	496	442	-	-	-	-	-	-	-
Critical Hdwy	7.11	6.51	6.21	7.14	6.51	6.24	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.11	5.51	-	6.14	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.11	5.51	-	6.14	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.509	4.009	3.309	3.536	4.009	3.336	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	243	261	672	225	268	675	1165	-	-	1151	-	-
Stage 1	607	586	-	557	551	-	-	-	-	-	-	-
Stage 2	544	532	-	552	578	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	195	234	668	155	240	671	1162	-	-	1148	-	-
Mov Cap-2 Maneuver	195	234	-	155	240	-	-	-	-	-	-	-
Stage 1	563	567	-	517	511	-	-	-	-	-	-	-
Stage 2	458	493	-	435	559	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	16.7	24.9	1.1	0.5
HCM LOS	C	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1162	-	-	232	668	192	671	1148	-	-
HCM Lane V/C Ratio	0.054	-	-	0.22	0.108	0.288	0.036	0.023	-	-
HCM Control Delay (s)	8.3	0	-	24.8	11	31.2	10.6	8.2	0	-
HCM Lane LOS	A	A	-	C	B	D	B	A	A	-
HCM 95th %tile Q(veh)	0.2	-	-	0.8	0.4	1.1	0.1	0.1	-	-

HCM 6th TWSC  
1: Hwy 211 & Gunderson Road

Forecast 2025 AM Peak Hour Without Project

Intersection						
Int Delay, s/veh	0.5					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	7	170	236	2	0	15
Future Vol, veh/h	7	170	236	2	0	15
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	14	14	6	1	0	14
Mvmt Flow	8	187	259	2	0	16
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	261	0	-	0	463	260
Stage 1	-	-	-	-	260	-
Stage 2	-	-	-	-	203	-
Critical Hdwy	4.24	-	-	-	6.4	6.34
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.326	-	-	-	3.5	3.426
Pot Cap-1 Maneuver	1237	-	-	-	561	750
Stage 1	-	-	-	-	788	-
Stage 2	-	-	-	-	836	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1237	-	-	-	557	750
Mov Cap-2 Maneuver	-	-	-	-	557	-
Stage 1	-	-	-	-	782	-
Stage 2	-	-	-	-	836	-
Approach	EB	WB	SB			
HCM Control Delay, s	0.3	0	9.9			
HCM LOS			A			
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1237	-	-	-	750	
HCM Lane V/C Ratio	0.006	-	-	-	0.022	
HCM Control Delay (s)	7.9	0	-	-	9.9	
HCM Lane LOS	A	A	-	-	A	
HCM 95th %tile Q(veh)	0	-	-	-	0.1	

HCM 6th TWSC  
2: SE Village Blvd & Hwy 211

Forecast 2025 AM Peak Hour Without Project

Intersection												
Int Delay, s/veh	0.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕			↕			↕	
Traffic Vol, veh/h	0	198	5	6	197	0	15	0	11	0	0	0
Future Vol, veh/h	0	198	5	6	197	0	15	0	11	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	375	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	12	20	1	9	2	1	2	9	2	2	2
Mvmt Flow	0	215	5	7	214	0	16	0	12	0	0	0

Major/Minor	Major1		Major2		Minor1		Minor2					
Conflicting Flow All	214	0	0	220	0	0	446	446	218	452	448	214
Stage 1	-	-	-	-	-	-	218	218	-	228	228	-
Stage 2	-	-	-	-	-	-	228	228	-	224	220	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.11	6.52	6.29	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.509	4.018	3.381	3.518	4.018	3.318
Pot Cap-1 Maneuver	1356	-	-	1355	-	-	524	507	805	518	506	826
Stage 1	-	-	-	-	-	-	787	723	-	775	715	-
Stage 2	-	-	-	-	-	-	777	715	-	779	721	-
Platoon blocked, %		-	-		-	-						
Mov Cap-1 Maneuver	1356	-	-	1355	-	-	522	504	805	508	503	826
Mov Cap-2 Maneuver	-	-	-	-	-	-	522	504	-	508	503	-
Stage 1	-	-	-	-	-	-	787	723	-	775	711	-
Stage 2	-	-	-	-	-	-	773	711	-	767	721	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.2	11.2	0
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	613	1356	-	-	1355	-	-	-
HCM Lane V/C Ratio	0.046	-	-	-	0.005	-	-	-
HCM Control Delay (s)	11.2	0	-	-	7.7	-	-	0
HCM Lane LOS	B	A	-	-	A	-	-	A
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	-

HCM 6th TWSC  
3: SE Village Blvd & Cascade Village Dr

Forecast 2025 AM Peak Hour Without Project

Intersection						
Int Delay, s/veh	5.2					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↑	↑	
Traffic Vol, veh/h	19	0	0	2	2	9
Future Vol, veh/h	19	0	0	2	2	9
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	6	0	0	50	50	11
Mvmt Flow	27	0	0	3	3	13
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	13	10	16	0	0	
Stage 1	10	-	-	-	-	
Stage 2	3	-	-	-	-	
Critical Hdwy	6.46	6.2	4.1	-	-	
Critical Hdwy Stg 1	5.46	-	-	-	-	
Critical Hdwy Stg 2	5.46	-	-	-	-	
Follow-up Hdwy	3.554	3.3	2.2	-	-	
Pot Cap-1 Maneuver	996	1077	1615	-	-	
Stage 1	1003	-	-	-	-	
Stage 2	1010	-	-	-	-	
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	996	1077	1615	-	-	
Mov Cap-2 Maneuver	996	-	-	-	-	
Stage 1	1003	-	-	-	-	
Stage 2	1010	-	-	-	-	
Approach	EB	NB		SB		
HCM Control Delay, s	8.7	0		0		
HCM LOS	A					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1615	-	996	-	-	
HCM Lane V/C Ratio	-	-	0.027	-	-	
HCM Control Delay (s)	0	-	8.7	-	-	
HCM Lane LOS	A	-	A	-	-	
HCM 95th %tile Q(veh)	0	-	0.1	-	-	

HCM 6th TWSC  
4: Hwy 211 & Dubarko Road

Forecast 2025 AM Peak Hour Without Project

Intersection												
Int Delay, s/veh	3.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕	↕		↕	↕		↕	↕
Traffic Vol, veh/h	11	17	32	33	27	43	32	311	24	12	163	6
Future Vol, veh/h	11	17	32	33	27	43	32	311	24	12	163	6
Conflicting Peds, #/hr	2	0	2	2	0	2	2	0	2	2	0	2
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	80	-	-	110	-	-	-	-	-	315
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	9	6	7	3	4	3	10	11	1	8	10	17
Mvmt Flow	12	19	35	36	30	47	35	342	26	13	179	7
Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	673	647	183	665	641	359	188	0	0	370	0	0
Stage 1	207	207	-	427	427	-	-	-	-	-	-	-
Stage 2	466	440	-	238	214	-	-	-	-	-	-	-
Critical Hdwy	7.19	6.56	6.27	7.13	6.54	6.23	4.2	-	-	4.18	-	-
Critical Hdwy Stg 1	6.19	5.56	-	6.13	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.19	5.56	-	6.13	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.581	4.054	3.363	3.527	4.036	3.327	2.29	-	-	2.272	-	-
Pot Cap-1 Maneuver	360	385	847	372	390	683	1339	-	-	1156	-	-
Stage 1	779	723	-	604	582	-	-	-	-	-	-	-
Stage 2	564	571	-	763	722	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	303	366	844	330	371	681	1337	-	-	1154	-	-
Mov Cap-2 Maneuver	303	366	-	330	371	-	-	-	-	-	-	-
Stage 1	752	712	-	583	562	-	-	-	-	-	-	-
Stage 2	480	551	-	702	711	-	-	-	-	-	-	-
Approach	EB		WB			NB			SB			
HCM Control Delay, s	12.9		14.8			0.7			0.5			
HCM LOS	B		B									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR		
Capacity (veh/h)	1337	-	-	338	844	347	681	1154	-	-		
HCM Lane V/C Ratio	0.026	-	-	0.091	0.042	0.19	0.069	0.011	-	-		
HCM Control Delay (s)	7.8	0	-	16.7	9.5	17.8	10.7	8.2	0	-		
HCM Lane LOS	A	A	-	C	A	C	B	A	A	-		
HCM 95th %tile Q(veh)	0.1	-	-	0.3	0.1	0.7	0.2	0	-	-		

HCM 6th TWSC  
1: Hwy 211 & Gunderson Road

Forecast 2025 PM Peak Hour Without Project

Intersection						
Int Delay, s/veh	0.3					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	9	345	243	10	8	2
Future Vol, veh/h	9	345	243	10	8	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	1	4	5	1	1	1
Mvmt Flow	10	375	264	11	9	2
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	275	0	-	0	665	270
Stage 1	-	-	-	-	270	-
Stage 2	-	-	-	-	395	-
Critical Hdwy	4.11	-	-	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	2.209	-	-	-	3.509	3.309
Pot Cap-1 Maneuver	1294	-	-	-	427	771
Stage 1	-	-	-	-	778	-
Stage 2	-	-	-	-	683	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1294	-	-	-	423	771
Mov Cap-2 Maneuver	-	-	-	-	423	-
Stage 1	-	-	-	-	770	-
Stage 2	-	-	-	-	683	-
Approach	EB	WB	SB			
HCM Control Delay, s	0.2	0	12.9			
HCM LOS			B			
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1294	-	-	-	465	
HCM Lane V/C Ratio	0.008	-	-	-	0.023	
HCM Control Delay (s)	7.8	0	-	-	12.9	
HCM Lane LOS	A	A	-	-	B	
HCM 95th %tile Q(veh)	0	-	-	-	0.1	

HCM 6th TWSC  
2: SE Village Blvd & Hwy 211

Forecast 2025 PM Peak Hour Without Project

Intersection												
Int Delay, s/veh	0.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↖	↗			↔			↔	
Traffic Vol, veh/h	0	329	17	21	240	0	11	0	19	0	0	1
Future Vol, veh/h	0	329	17	21	240	0	11	0	19	0	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	375	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	12	20	1	9	2	1	2	9	2	2	2
Mvmt Flow	0	346	18	22	253	0	12	0	20	0	0	1

Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	253	0	0	364	0	0	653	652	355	662	661	253
Stage 1	-	-	-	-	-	-	355	355	-	297	297	-
Stage 2	-	-	-	-	-	-	298	297	-	365	364	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.11	6.52	6.29	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.509	4.018	3.381	3.518	4.018	3.318
Pot Cap-1 Maneuver	1312	-	-	1200	-	-	382	387	673	375	383	786
Stage 1	-	-	-	-	-	-	664	630	-	712	668	-
Stage 2	-	-	-	-	-	-	713	668	-	654	624	-
Platoon blocked, %		-	-	-	-	-						
Mov Cap-1 Maneuver	1312	-	-	1200	-	-	376	380	673	359	376	786
Mov Cap-2 Maneuver	-	-	-	-	-	-	376	380	-	359	376	-
Stage 1	-	-	-	-	-	-	664	630	-	712	656	-
Stage 2	-	-	-	-	-	-	699	656	-	635	624	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	0	0.6	12.3	9.6
HCM LOS			B	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	522	1312	-	-	1200	-	-	786
HCM Lane V/C Ratio	0.06	-	-	-	0.018	-	-	0.001
HCM Control Delay (s)	12.3	0	-	-	8.1	-	-	9.6
HCM Lane LOS	B	A	-	-	A	-	-	A
HCM 95th %tile Q(veh)	0.2	0	-	-	0.1	-	-	0



HCM 6th TWSC  
3: SE Village Blvd & Cascade Village Dr

Forecast 2025 PM Peak Hour Without Project

Intersection						
Int Delay, s/veh	3					
Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	Y			↑	↑	
Traffic Vol, veh/h	14	0	0	2	1	24
Future Vol, veh/h	14	0	0	2	1	24
Conflicting Peds, #/hr	1	1	1	0	0	1
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	70	70	70	70	70	70
Heavy Vehicles, %	8	0	0	1	1	1
Mvmt Flow	20	0	0	3	1	34
Major/Minor	Minor2	Major1		Major2		
Conflicting Flow All	23	20	36	0	0	
Stage 1	19	-	-	-	-	
Stage 2	4	-	-	-	-	
Critical Hdwy	6.48	6.2	4.1	-	-	
Critical Hdwy Stg 1	5.48	-	-	-	-	
Critical Hdwy Stg 2	5.48	-	-	-	-	
Follow-up Hdwy	3.572	3.3	2.2	-	-	
Pot Cap-1 Maneuver	978	1064	1588	-	-	
Stage 1	988	-	-	-	-	
Stage 2	1004	-	-	-	-	
Platoon blocked, %				-	-	
Mov Cap-1 Maneuver	976	1062	1587	-	-	
Mov Cap-2 Maneuver	976	-	-	-	-	
Stage 1	987	-	-	-	-	
Stage 2	1003	-	-	-	-	
Approach	EB	NB		SB		
HCM Control Delay, s	8.8	0		0		
HCM LOS	A					
Minor Lane/Major Mvmt	NBL	NBT	EBLn1	SBT	SBR	
Capacity (veh/h)	1587	-	976	-	-	
HCM Lane V/C Ratio	-	-	0.02	-	-	
HCM Control Delay (s)	0	-	8.8	-	-	
HCM Lane LOS	A	-	A	-	-	
HCM 95th %tile Q(veh)	0	-	0.1	-	-	

HCM 6th TWSC  
4: Hwy 211 & Dubarko Road

Forecast 2025 PM Peak Hour Without Project

Intersection												
Int Delay, s/veh	4.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕	↕		↕			↕	↕
Traffic Vol, veh/h	2	48	71	25	29	24	61	318	67	26	363	14
Future Vol, veh/h	2	48	71	25	29	24	61	318	67	26	363	14
Conflicting Peds, #/hr	3	0	3	3	0	3	3	0	3	3	0	3
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	80	-	-	110	-	-	-	-	-	315
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	1	1	1	4	1	4	3	5	3	4	5	15
Mvmt Flow	2	51	76	27	31	26	65	338	71	28	386	15
Major/Minor	Minor2	Minor1			Major1			Major2				
Conflicting Flow All	980	987	392	1023	967	380	404	0	0	412	0	0
Stage 1	445	445	-	507	507	-	-	-	-	-	-	-
Stage 2	535	542	-	516	460	-	-	-	-	-	-	-
Critical Hdwy	7.11	6.51	6.21	7.14	6.51	6.24	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.11	5.51	-	6.14	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.11	5.51	-	6.14	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.509	4.009	3.309	3.536	4.009	3.336	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	230	248	659	212	255	663	1149	-	-	1136	-	-
Stage 1	594	576	-	544	541	-	-	-	-	-	-	-
Stage 2	531	522	-	538	568	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	182	221	656	142	227	660	1146	-	-	1133	-	-
Mov Cap-2 Maneuver	182	221	-	142	227	-	-	-	-	-	-	-
Stage 1	549	556	-	503	499	-	-	-	-	-	-	-
Stage 2	442	482	-	417	548	-	-	-	-	-	-	-
Approach	EB	WB			NB			SB				
HCM Control Delay, s	17.6	27.2			1.1			0.5				
HCM LOS	C	D										
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR		
Capacity (veh/h)	1146	-	-	219	656	178	660	1133	-	-		
HCM Lane V/C Ratio	0.057	-	-	0.243	0.115	0.323	0.039	0.024	-	-		
HCM Control Delay (s)	8.3	0	-	26.6	11.2	34.6	10.7	8.3	0	-		
HCM Lane LOS	A	A	-	D	B	D	B	A	A	-		
HCM 95th %tile Q(veh)	0.2	-	-	0.9	0.4	1.3	0.1	0.1	-	-		

HCM 6th TWSC  
1: Hwy 211 & Gunderson Road

Forecast 2025 AM Peak Hour With Project

Intersection						
Int Delay, s/veh	0.5					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	7	178	248	3	0	16
Future Vol, veh/h	7	178	248	3	0	16
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	91	91	91	91	91	91
Heavy Vehicles, %	14	14	6	1	0	14
Mvmt Flow	8	196	273	3	0	18
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	276	0	-	0	487	275
Stage 1	-	-	-	-	275	-
Stage 2	-	-	-	-	212	-
Critical Hdwy	4.24	-	-	-	6.4	6.34
Critical Hdwy Stg 1	-	-	-	-	5.4	-
Critical Hdwy Stg 2	-	-	-	-	5.4	-
Follow-up Hdwy	2.326	-	-	-	3.5	3.426
Pot Cap-1 Maneuver	1221	-	-	-	543	736
Stage 1	-	-	-	-	776	-
Stage 2	-	-	-	-	828	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1221	-	-	-	539	736
Mov Cap-2 Maneuver	-	-	-	-	539	-
Stage 1	-	-	-	-	771	-
Stage 2	-	-	-	-	828	-
Approach	EB	WB	SB			
HCM Control Delay, s	0.3	0	10			
HCM LOS			B			
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1221	-	-	-	736	
HCM Lane V/C Ratio	0.006	-	-	-	0.024	
HCM Control Delay (s)	8	0	-	-	10	
HCM Lane LOS	A	A	-	-	B	
HCM 95th %tile Q(veh)	0	-	-	-	0.1	

HCM 6th TWSC  
2: SE Village Blvd & Hwy 211

Forecast 2025 AM Peak Hour With Project

Intersection												
Int Delay, s/veh	1.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕		↕	↕			↕			↕	
Traffic Vol, veh/h	0	196	17	19	197	0	30	0	30	0	0	0
Future Vol, veh/h	0	196	17	19	197	0	30	0	30	0	0	0
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	375	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	12	20	1	9	2	1	2	9	2	2	2
Mvmt Flow	0	213	18	21	214	0	33	0	33	0	0	0
Major/Minor	Major1			Major2			Minor1			Minor2		
Conflicting Flow All	214	0	0	231	0	0	478	478	222	495	487	214
Stage 1	-	-	-	-	-	-	222	222	-	256	256	-
Stage 2	-	-	-	-	-	-	256	256	-	239	231	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.11	6.52	6.29	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.509	4.018	3.381	3.518	4.018	3.318
Pot Cap-1 Maneuver	1356	-	-	1343	-	-	499	486	800	485	481	826
Stage 1	-	-	-	-	-	-	783	720	-	749	696	-
Stage 2	-	-	-	-	-	-	751	696	-	764	713	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1356	-	-	1343	-	-	493	478	800	460	473	826
Mov Cap-2 Maneuver	-	-	-	-	-	-	493	478	-	460	473	-
Stage 1	-	-	-	-	-	-	783	720	-	749	685	-
Stage 2	-	-	-	-	-	-	739	685	-	733	713	-
Approach	EB			WB			NB			SB		
HCM Control Delay, s	0			0.7			11.6			0		
HCM LOS							B			A		
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	610	1356	-	-	1343	-	-	-				
HCM Lane V/C Ratio	0.107	-	-	-	0.015	-	-	-				
HCM Control Delay (s)	11.6	0	-	-	7.7	-	-	0				
HCM Lane LOS	B	A	-	-	A	-	-	A				
HCM 95th %tile Q(veh)	0.4	0	-	-	0	-	-	-				

HCM 6th TWSC  
3: SE Village Blvd & Cascadia Village Dr

Forecast 2025 AM Peak Hour With Project

Intersection												
Int Delay, s/veh	7.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↕			↕			↕			↕		
Traffic Vol, veh/h	19	0	0	0	0	34	0	2	0	25	2	9
Future Vol, veh/h	19	0	0	0	0	34	0	2	0	25	2	9
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	70	70	70	70	70	70	70	70	70	70	70	70
Heavy Vehicles, %	6	2	0	2	2	2	0	50	2	2	50	11
Mvmt Flow	27	0	0	0	0	49	0	3	0	36	3	13
Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	110	85	10	85	91	3	16	0	0	3	0	0
Stage 1	82	82	-	3	3	-	-	-	-	-	-	-
Stage 2	28	3	-	82	88	-	-	-	-	-	-	-
Critical Hdwy	7.16	6.52	6.2	7.12	6.52	6.22	4.1	-	-	4.12	-	-
Critical Hdwy Stg 1	6.16	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.16	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.554	4.018	3.3	3.518	4.018	3.318	2.2	-	-	2.218	-	-
Pot Cap-1 Maneuver	859	805	1077	901	799	1081	1615	-	-	1619	-	-
Stage 1	916	827	-	1020	893	-	-	-	-	-	-	-
Stage 2	979	893	-	926	822	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	807	787	1077	886	781	1081	1615	-	-	1619	-	-
Mov Cap-2 Maneuver	807	787	-	886	781	-	-	-	-	-	-	-
Stage 1	916	809	-	1020	893	-	-	-	-	-	-	-
Stage 2	935	893	-	906	804	-	-	-	-	-	-	-
Approach	EB		WB			NB			SB			
HCM Control Delay, s	9.6		8.5			0			5.1			
HCM LOS	A		A									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1615	-	-	807	1081	1619	-	-				
HCM Lane V/C Ratio	-	-	-	0.034	0.045	0.022	-	-				
HCM Control Delay (s)	0	-	-	9.6	8.5	7.3	0	-				
HCM Lane LOS	A	-	-	A	A	A	A	-				
HCM 95th %tile Q(veh)	0	-	-	0.1	0.1	0.1	-	-				

HCM 6th TWSC  
4: Hwy 211 & Dubarko Road

Forecast 2025 AM Peak Hour With Project

Intersection												
Int Delay, s/veh	3.7											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕	↕		↕			↕	↕
Traffic Vol, veh/h	11	17	33	33	27	43	34	326	24	12	172	6
Future Vol, veh/h	11	17	33	33	27	43	34	326	24	12	172	6
Conflicting Peds, #/hr	2	0	2	2	0	2	2	0	2	2	0	2
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	80	-	-	110	-	-	-	-	-	315
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	91	91	91	91	91	91	91	91	91	91	91	91
Heavy Vehicles, %	9	6	7	3	4	3	10	11	1	8	10	17
Mvmt Flow	12	19	36	36	30	47	37	358	26	13	189	7
Major/Minor	Minor2		Minor1			Major1			Major2			
Conflicting Flow All	703	677	193	695	671	375	198	0	0	386	0	0
Stage 1	217	217	-	447	447	-	-	-	-	-	-	-
Stage 2	486	460	-	248	224	-	-	-	-	-	-	-
Critical Hdwy	7.19	6.56	6.27	7.13	6.54	6.23	4.2	-	-	4.18	-	-
Critical Hdwy Stg 1	6.19	5.56	-	6.13	5.54	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.19	5.56	-	6.13	5.54	-	-	-	-	-	-	-
Follow-up Hdwy	3.581	4.054	3.363	3.527	4.036	3.327	2.29	-	-	2.272	-	-
Pot Cap-1 Maneuver	343	370	836	355	375	669	1328	-	-	1140	-	-
Stage 1	770	716	-	589	570	-	-	-	-	-	-	-
Stage 2	550	559	-	754	715	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	286	351	833	313	356	667	1326	-	-	1138	-	-
Mov Cap-2 Maneuver	286	351	-	313	356	-	-	-	-	-	-	-
Stage 1	741	705	-	567	548	-	-	-	-	-	-	-
Stage 2	465	538	-	692	704	-	-	-	-	-	-	-
Approach	EB		WB			NB			SB			
HCM Control Delay, s	13.1		15.3			0.7			0.5			
HCM LOS	B		C									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR		
Capacity (veh/h)	1326	-	-	322	833	331	667	1138	-	-		
HCM Lane V/C Ratio	0.028	-	-	0.096	0.044	0.199	0.071	0.012	-	-		
HCM Control Delay (s)	7.8	0	-	17.4	9.5	18.6	10.8	8.2	0	-		
HCM Lane LOS	A	A	-	C	A	C	B	A	A	-		
HCM 95th %tile Q(veh)	0.1	-	-	0.3	0.1	0.7	0.2	0	-	-		

HCM 6th TWSC

Forecast 2025 AM Peak Hour With Project

5: South Access/North Access & Cascadia Village Dr

Intersection												
Int Delay, s/veh	7.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔			↕			↔			↕		
Traffic Vol, veh/h	19	2	4	0	0	0	14	0	0	0	0	20
Future Vol, veh/h	19	2	4	0	0	0	14	0	0	0	0	20
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	21	2	4	0	0	0	15	0	0	0	0	22
Major/Minor	Major1	Major2		Minor1			Minor2					
Conflicting Flow All	1	0	0	6	0	0	58	47	4	47	49	1
Stage 1	-	-	-	-	-	-	46	46	-	1	1	-
Stage 2	-	-	-	-	-	-	12	1	-	46	48	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1622	-	-	1615	-	-	939	845	1080	954	843	1084
Stage 1	-	-	-	-	-	-	968	857	-	1022	895	-
Stage 2	-	-	-	-	-	-	1009	895	-	968	855	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1622	-	-	1615	-	-	911	834	1080	944	832	1084
Mov Cap-2 Maneuver	-	-	-	-	-	-	911	834	-	944	832	-
Stage 1	-	-	-	-	-	-	955	846	-	1009	895	-
Stage 2	-	-	-	-	-	-	989	895	-	955	844	-
Approach	EB	WB		NB			SB					
HCM Control Delay, s	5.5	0		9			8.4					
HCM LOS				A			A					
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	911	1622	-	-	1615	-	-	1084				
HCM Lane V/C Ratio	0.017	0.013	-	-	-	-	-	0.02				
HCM Control Delay (s)	9	7.2	0	-	0	-	-	8.4				
HCM Lane LOS	A	A	A	-	A	-	-	A				
HCM 95th %tile Q(veh)	0.1	0	-	-	0	-	-	0.1				

HCM 6th TWSC  
1: Hwy 211 & Gunderson Road

Forecast 2025 PM Peak Hour With Project

Intersection						
Int Delay, s/veh	0.4					
Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↕	↕		↕	
Traffic Vol, veh/h	9	378	263	13	11	2
Future Vol, veh/h	9	378	263	13	11	2
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	None
Storage Length	-	-	-	-	0	-
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	1	4	5	1	1	1
Mvmt Flow	10	411	286	14	12	2
Major/Minor	Major1	Major2	Minor2			
Conflicting Flow All	300	0	-	0	724	293
Stage 1	-	-	-	-	293	-
Stage 2	-	-	-	-	431	-
Critical Hdwy	4.11	-	-	-	6.41	6.21
Critical Hdwy Stg 1	-	-	-	-	5.41	-
Critical Hdwy Stg 2	-	-	-	-	5.41	-
Follow-up Hdwy	2.209	-	-	-	3.509	3.309
Pot Cap-1 Maneuver	1267	-	-	-	394	749
Stage 1	-	-	-	-	759	-
Stage 2	-	-	-	-	657	-
Platoon blocked, %	-	-	-	-	-	-
Mov Cap-1 Maneuver	1267	-	-	-	390	749
Mov Cap-2 Maneuver	-	-	-	-	390	-
Stage 1	-	-	-	-	751	-
Stage 2	-	-	-	-	657	-
Approach	EB	WB	SB			
HCM Control Delay, s	0.2	0	13.8			
HCM LOS			B			
Minor Lane/Major Mvmt	EBL	EBT	WBT	WBR	SBLn1	
Capacity (veh/h)	1267	-	-	-	421	
HCM Lane V/C Ratio	0.008	-	-	-	0.034	
HCM Control Delay (s)	7.9	0	-	-	13.8	
HCM Lane LOS	A	A	-	-	B	
HCM 95th %tile Q(veh)	0	-	-	-	0.1	



HCM 6th TWSC  
2: SE Village Blvd & Hwy 211

Forecast 2025 PM Peak Hour With Project

Intersection												
Int Delay, s/veh	2.2											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔		↔	↔			↔			↔	
Traffic Vol, veh/h	0	321	54	54	240	0	34	0	47	0	0	1
Future Vol, veh/h	0	321	54	54	240	0	34	0	47	0	0	1
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	375	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	95	95	95	95	95	95	95	95	95	95	95	95
Heavy Vehicles, %	2	12	20	1	9	2	1	2	9	2	2	2
Mvmt Flow	0	338	57	57	253	0	36	0	49	0	0	1
Major/Minor	Major1	Major2			Minor1			Minor2				
Conflicting Flow All	253	0	0	395	0	0	735	734	367	758	762	253
Stage 1	-	-	-	-	-	-	367	367	-	367	367	-
Stage 2	-	-	-	-	-	-	368	367	-	391	395	-
Critical Hdwy	4.12	-	-	4.11	-	-	7.11	6.52	6.29	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.11	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.209	-	-	3.509	4.018	3.381	3.518	4.018	3.318
Pot Cap-1 Maneuver	1312	-	-	1169	-	-	337	347	663	324	335	786
Stage 1	-	-	-	-	-	-	655	622	-	653	622	-
Stage 2	-	-	-	-	-	-	654	622	-	633	605	-
Platoon blocked, %		-	-	-	-	-						
Mov Cap-1 Maneuver	1312	-	-	1169	-	-	324	330	663	289	319	786
Mov Cap-2 Maneuver	-	-	-	-	-	-	324	330	-	289	319	-
Stage 1	-	-	-	-	-	-	655	622	-	653	592	-
Stage 2	-	-	-	-	-	-	621	592	-	586	605	-
Approach	EB	WB			NB			SB				
HCM Control Delay, s	0	1.5			14.6			9.6				
HCM LOS					B			A				
Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1				
Capacity (veh/h)	461	1312	-	-	1169	-	-	786				
HCM Lane V/C Ratio	0.185	-	-	-	0.049	-	-	0.001				
HCM Control Delay (s)	14.6	0	-	-	8.2	-	-	9.6				
HCM Lane LOS	B	A	-	-	A	-	-	A				
HCM 95th %tile Q(veh)	0.7	0	-	-	0.2	-	-	0				

HCM 6th TWSC  
3: SE Village Blvd & Cascadia Village Dr

Forecast 2025 PM Peak Hour With Project

Intersection												
Int Delay, s/veh	6.8											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↔			↕			↔			↕		
Traffic Vol, veh/h	14	0	0	0	0	51	0	2	0	70	1	24
Future Vol, veh/h	14	0	0	0	0	51	0	2	0	70	1	24
Conflicting Peds, #/hr	1	0	1	0	0	0	1	0	0	0	0	1
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	70	70	70	70	70	70	70	70	70	70	70	70
Heavy Vehicles, %	8	2	0	2	2	2	0	1	2	2	1	1
Mvmt Flow	20	0	0	0	0	73	0	3	0	100	1	34
Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	260	222	20	222	239	4	36	0	0	3	0	0
Stage 1	219	219	-	3	3	-	-	-	-	-	-	-
Stage 2	41	3	-	219	236	-	-	-	-	-	-	-
Critical Hdwy	7.18	6.52	6.2	7.12	6.52	6.22	4.1	-	-	4.12	-	-
Critical Hdwy Stg 1	6.18	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.18	5.52	-	6.12	5.52	-	-	-	-	-	-	-
Follow-up Hdwy	3.572	4.018	3.3	3.518	4.018	3.318	2.2	-	-	2.218	-	-
Pot Cap-1 Maneuver	681	677	1064	734	662	1080	1588	-	-	1619	-	-
Stage 1	770	722	-	1020	893	-	-	-	-	-	-	-
Stage 2	959	893	-	783	710	-	-	-	-	-	-	-
Platoon blocked, %								-	-	-	-	-
Mov Cap-1 Maneuver	603	634	1062	698	620	1079	1586	-	-	1619	-	-
Mov Cap-2 Maneuver	603	634	-	698	620	-	-	-	-	-	-	-
Stage 1	769	676	-	1020	893	-	-	-	-	-	-	-
Stage 2	894	893	-	733	665	-	-	-	-	-	-	-
Approach	EB		WB		NB			SB				
HCM Control Delay, s	11.2		8.6		0			5.4				
HCM LOS	B		A									
Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR				
Capacity (veh/h)	1586	-	-	603	1079	1619	-	-				
HCM Lane V/C Ratio	-	-	-	0.033	0.068	0.062	-	-				
HCM Control Delay (s)	0	-	-	11.2	8.6	7.4	0	-				
HCM Lane LOS	A	-	-	B	A	A	A	-				
HCM 95th %tile Q(veh)	0	-	-	0.1	0.2	0.2	-	-				

HCM 6th TWSC  
4: Hwy 211 & Dubarko Road

Forecast 2025 PM Peak Hour With Project

Intersection												
Int Delay, s/veh	4.9											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↕		↕	↕		↕			↕	↕
Traffic Vol, veh/h	2	48	73	25	29	24	63	336	67	26	387	14
Future Vol, veh/h	2	48	73	25	29	24	63	336	67	26	387	14
Conflicting Peds, #/hr	3	0	3	3	0	3	3	0	3	3	0	3
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	80	-	-	110	-	-	-	-	-	315
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	94	94	94	94	94	94	94	94	94	94	94	94
Heavy Vehicles, %	1	1	1	4	1	4	3	5	3	4	5	15
Mvmt Flow	2	51	78	27	31	26	67	357	71	28	412	15

Major/Minor	Minor2		Minor1		Major1			Major2				
Conflicting Flow All	1029	1036	418	1073	1016	399	430	0	0	431	0	0
Stage 1	471	471	-	530	530	-	-	-	-	-	-	-
Stage 2	558	565	-	543	486	-	-	-	-	-	-	-
Critical Hdwy	7.11	6.51	6.21	7.14	6.51	6.24	4.13	-	-	4.14	-	-
Critical Hdwy Stg 1	6.11	5.51	-	6.14	5.51	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.11	5.51	-	6.14	5.51	-	-	-	-	-	-	-
Follow-up Hdwy	3.509	4.009	3.309	3.536	4.009	3.336	2.227	-	-	2.236	-	-
Pot Cap-1 Maneuver	213	232	637	196	239	646	1124	-	-	1118	-	-
Stage 1	575	561	-	529	528	-	-	-	-	-	-	-
Stage 2	516	510	-	520	553	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	166	205	634	127	212	643	1121	-	-	1115	-	-
Mov Cap-2 Maneuver	166	205	-	127	212	-	-	-	-	-	-	-
Stage 1	528	541	-	486	485	-	-	-	-	-	-	-
Stage 2	426	468	-	399	533	-	-	-	-	-	-	-

Approach	EB		WB		NB		SB	
HCM Control Delay, s	18.6		30.3		1.1		0.5	
HCM LOS	C		D					

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	EBLn2	WBLn1	WBLn2	SBL	SBT	SBR
Capacity (veh/h)	1121	-	-	203	634	162	643	1115	-	-
HCM Lane V/C Ratio	0.06	-	-	0.262	0.122	0.355	0.04	0.025	-	-
HCM Control Delay (s)	8.4	0	-	28.9	11.5	39	10.8	8.3	0	-
HCM Lane LOS	A	A	-	D	B	E	B	A	A	-
HCM 95th %tile Q(veh)	0.2	-	-	1	0.4	1.5	0.1	0.1	-	-

HCM 6th TWSC

Forecast 2025 PM Peak Hour With Project

5: South Access/North Access & Cascadia Village Dr

Intersection												
Int Delay, s/veh	6.5											
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↕			↕			↕			↕		
Traffic Vol, veh/h	47	8	15	0	0	0	9	0	0	0	0	42
Future Vol, veh/h	47	8	15	0	0	0	9	0	0	0	0	42
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	-	-	-
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	92	92	92	92	92	92	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2	2	2	2
Mvmt Flow	51	9	16	0	0	0	10	0	0	0	0	46

Major/Minor	Major1		Major2			Minor1		Minor2				
Conflicting Flow All	1	0	0	25	0	0	143	120	17	120	128	1
Stage 1	-	-	-	-	-	-	119	119	-	1	1	-
Stage 2	-	-	-	-	-	-	24	1	-	119	127	-
Critical Hdwy	4.12	-	-	4.12	-	-	7.12	6.52	6.22	7.12	6.52	6.22
Critical Hdwy Stg 1	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Critical Hdwy Stg 2	-	-	-	-	-	-	6.12	5.52	-	6.12	5.52	-
Follow-up Hdwy	2.218	-	-	2.218	-	-	3.518	4.018	3.318	3.518	4.018	3.318
Pot Cap-1 Maneuver	1622	-	-	1589	-	-	826	770	1062	855	763	1084
Stage 1	-	-	-	-	-	-	885	797	-	1022	895	-
Stage 2	-	-	-	-	-	-	994	895	-	885	791	-
Platoon blocked, %	-	-	-	-	-	-	-	-	-	-	-	-
Mov Cap-1 Maneuver	1622	-	-	1589	-	-	771	745	1062	834	739	1084
Mov Cap-2 Maneuver	-	-	-	-	-	-	771	745	-	834	739	-
Stage 1	-	-	-	-	-	-	857	771	-	989	895	-
Stage 2	-	-	-	-	-	-	952	895	-	857	766	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	4.9	0	9.7	8.5
HCM LOS			A	A

Minor Lane/Major Mvmt	NBLn1	EBL	EBT	EBR	WBL	WBT	WBR	SBLn1
Capacity (veh/h)	771	1622	-	-	1589	-	-	1084
HCM Lane V/C Ratio	0.013	0.031	-	-	-	-	-	0.042
HCM Control Delay (s)	9.7	7.3	0	-	0	-	-	8.5
HCM Lane LOS	A	A	A	-	A	-	-	A
HCM 95th %tile Q(veh)	0	0.1	-	-	0	-	-	0.1

CASCADE CREEK  
TRAFFIC IMPACT ANALYSIS

*APPENDIX  
6. SITE PLAN*

# CASCADE CREEK APARTMENTS

38272 OR-211 SANDY, OR 97055



VICINITY MAP  
SCALE: NTS

## ABBREVIATIONS

AC	ACRE	G	GAS	R	RADIUS
APPROX	APPROXIMATELY	GRVL	GRAVEL	ROW	RIGHT-OF-WAY
APWA	AMERICAN PUBLIC WORKS ASSOCIATION	GV	GAS VALVE	RT	RIGHT
ARCH	ARCHITECTURAL	H	HEIGHT	S	SOUTH
ASPH	ASPHALT	HDPE	HIGH DENSITY POLYETHYLENE	SC	SCHEDULE
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS	HMA	HOT MIX ASPHALT	SD	STORM DRAIN
AVE	AVENUE	HORIZ	HORIZONTAL	SDMH	STORM DRAIN MANHOLE
B/D	BUILDING	ID	INSIDE DIAMETER	SDR	STANDARD DIMENSION RATIO
BMP	BEST MANAGEMENT PRACTICE	IE	INVERT ELEVATION	SF	SQUARE FEET
BG	BOTTOM OF GRADE	IN	INCH	SG	SPECIFICATIONS
BTM	BOTTOM OF PIPE	L	LENGTH	SO YD	SQUARE YARD
BW	BOTTOM OF WALL	LAT	LATITUDE	SS	SANITARY SEWER CLEANOUT
¢	CENTERLINE	LF	LINEAR FEET	SSCO	SANITARY SEWER STATION
CB	CATCH BASIN	LN	LONGITUDE	STA	STREET
CF	CUBIC FEET	LT	LEFT	STD	STANDARD
CI	CAST IRON	LON	LONGITUDE	STD	STANDARD
CL	CLASS	LT	LEFT	SWPPP	STORM WATER POLLUTION PREVENTION PLAN
CMP	CORRUGATED METAL PIPE	MAX	MAXIMUM	T	TELEPHONE
CO	CLEAN OUT	MH	MANHOLE	TC	TOP OF CURB
CONC	CONCRETE	MIN	MINIMUM	TEMP	TEMPORARY
COS	CITY OF SANDY	MISC	MISCELLANEOUS	TESS	TEMPORARY EROSION & SEDIMENT CONTROL
CPEP	CORRUGATED POLYETHYLENE PIPE	MJ	MECHANICAL JOINT	TOP	TOP OF GRADE
CR	CROWN OF PIPE	MON	MONUMENT	TG	TEMPORARY EROSION & SEDIMENT CONTROL
CSTC	CRUSHED SURFACING TOP COURSE	N	NORTH	TP	TOP OF PAVEMENT
DEPT	DEPARTMENT	NC	NO CURB	TW	TOP OF WALL
DI	DUCTILE IRON	NTS	NOT TO SCALE	TYP	TYPICAL
E	EAST	OC	ON CENTER	UG	UNDER GROUND
ECC	EXTRUDED CURB	OD	OUTSIDE DIAMETER	UIC	UNDER GROUND INJECTION CONTROL
ELEV	EXISTING GRADE	OFF	OFFSET	U.O.N.	UNLESS OTHERWISE NOTED UTILITY POLE
EP	EDGE OF PAVEMENT	PC	POINT OF CURVATURE	UP	UTILITY
ESC	EROSION & SEDIMENT CONTROL	PCC	POINT OF COMPOUND CURVE	V	VERTICAL
EXIST	EXISTING	PL	POINT OF INTERSECTION	W	WEST
FFE	FINISH FLOOR ELEVATION	PL	PROPERTY LINE	W	WITH
FG	FINISHED GRADE	PP	POINT OF REVERSE CURVE	WV	WATER VALVE
FH	FIRE HYDRANT	PRC	PROPOSED	YD	YARD DRAIN
FL	FLANGED	PVC	POLYVINYL CHLORIDE		
		PVMT	PAVEMENT		

## SURVEY INFORMATION

FROM HARPER HOUF PETERSON RIGHELLIS, INC. DATED 08.22.2022

## LEGAL DESCRIPTION (BY OTHERS)

THE WEST 4 ACRES OF THE NORTHWEST QUARTER OF THE SOUTHWEST QUARTER OF THE NORTHWEST QUARTER OF SECTION 24, TOWNSHIP 2 SOUTH, RANGE 4 EAST OF THE WILLAMETTE MERIDIAN, IN THE CITY OF SANDY, COUNTY OF CLACKAMAS AND STATE OF OREGON.

EXCEPT THEREFROM THAT PORTION CONVEYED TO THE STATE OF OREGON, BY AND THROUGH ITS STATE HIGHWAY COMMISSION, BY DEED RECORDED FEBRUARY 5, 1947, IN BOOK 384, PAGE 393.

## HORIZONTAL DATUM (BY OTHERS)

ASSUMED HORIZONTAL DATUM BASED UPON ALTA SURVEY PROVIDED BY "ALL COUNTY SURVEYOR & PLANNERS, INC"

## VERTICAL DATUM (BY OTHERS)

ELEVATION DATUM: NAVD88 PER GPS METHODS  
BENCHMARK: CONTROL POINT #1  
LOCATION: SOUTH SIDE HWY 211  
ELEVATION: 996.71



SITE LOCATION AND FUTURE STREET PLAN

## PROJECT CONTACTS:

**OWNER/APPLICANT**  
DPS, LLC  
1911 65TH AVE W.  
TACOMA, WA 98466  
CONTACT: ZAC BAKER  
PHONE: 253.460.3000  
EMAIL: ZBAKER@SPHOM.COM

**ARCHITECTS**  
ROSS DECKMAN & ASSOCIATES INC.  
207 4TH AVENUE SE  
PUYALLUP, WA 98472  
CONTACT: BILL BOWDISH  
PHONE: 253.840.9405  
EMAIL: BILL@RDARCHITECT.COM

**LANDSCAPE ARCHITECT**  
NATURE BY DESIGN  
1320 ALAMEDA AVENUE, SUITE B  
FIRCREST, WA 98466  
CONTACT: KATHERINE OWENS  
PHONE: 253.460.6067  
EMAIL: NATUREBYDESIGNINC.COM

**TRAFFIC ENGINEER**  
HEATH & ASSOCIATES  
PO BOX 397  
PUYALLUP, WA 98471  
CONTACT: AARON VAN AKEN, PE  
PHONE: 253.770.1401  
EMAIL: AVANAKEN@HEATHTRAFFIC.COM

**GEOTECHNICAL ENGINEER**  
GILL GROUP  
820 NW CORNELL AVENUE  
CORVALLIS, OR 97330  
CONTACT: JACOB EPPERSON, PG  
PHONE: 541.757.7645

**ARBORIST**  
WASHINGTON FORESTRY CONSULTANTS, INC  
9136 YELM HWY SE  
OLYMPIA, WA 98513  
CONTACT: GALEN WRIGHT, ACF, ASCA  
PHONE: 360.943.1723

SHEET INDEX	
SHEET NO.	SHEET TITLE
C-001	COVER SHEET
C-101	TENTATIVE PARTITION PLAN
C-102	TREE PROTECTION PLAN
C-201	SITE PLAN
C-301	GRADING PLAN
C-302	ROADWAY PROFILES
C-401	STORM DRAINAGE PLAN
C-501	UTILITY PLAN

## SITE INFORMATION TABLE

**PROPERTY OWNER:**  
ZAC BAKER  
DPS, LLC  
1911 65TH AVE W  
TACOMA, WA 98466

**SITE ADDRESSES:** 38272 HWY 211 & 38330 HWY 211 SANDY, OR 97055

**PARCEL NUMBERS (TO BE PARTITIONED):** 00677173 & 00677164

**ZONING/DENSITY REQUIREMENTS:**  
VC - VILLAGE COMMERCIAL, NO MIN/MAX DENSITY  
R-2 - MEDIUM DENSITY RESIDENTIAL, 8 UNITS/AC MIN & 14 UNITS/AC MAX  
R-1 - LOW DENSITY RESIDENTIAL, 5 UNITS/AC MIN & 8 UNITS/AC MAX

**EXISTING PARCEL AREAS:**  
677173: 3.81 AC  
677164: 5.02 AC

**TOTAL PARCEL AREA:** 8.83 AC

**ROW DEDICATION AREAS FOR HWY 211, VILLAGE BLVD, CASCADIA VILLAGE DR. AND PINE STREET:** 1.7 AC

**PROPOSED PARCELS UNITS/DENSITY**

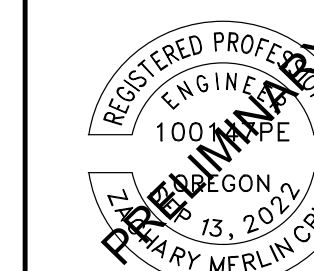
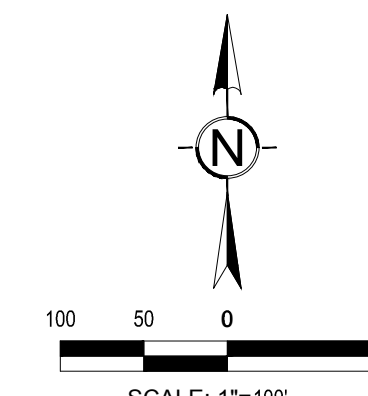
**PARCEL 1 -**  
ZONING: VC  
AREA: 1.01 AC  
UNITS: 1 SF RESIDENCE TO REMAIN  
DENSITY: 1 UNIT/AC

**PARCEL 2 -**  
ZONING: VC  
AREA: 2.26 AC  
UNITS PROPOSED: 32 MF UNITS  
DENSITY: 14.2 UNITS/AC

**PARCEL 3 -**  
ZONING: R-1 AND R-2  
AREA: 3.68 AC  
UNITS PROPOSED: 48 MF UNITS  
DENSITY: 13.04 UNITS/AC

**TOTAL DEVELOPMENT AREA:** 6.95 AC

**TOTAL UNITS PROPOSED:** 78 UNITS



PROJECT  
SHEET SET CREATED BY RB 08.16.2022  
CASCADE CREEK MULTI FAMILY  
38330 HWY 211  
SANDY, OR 97055

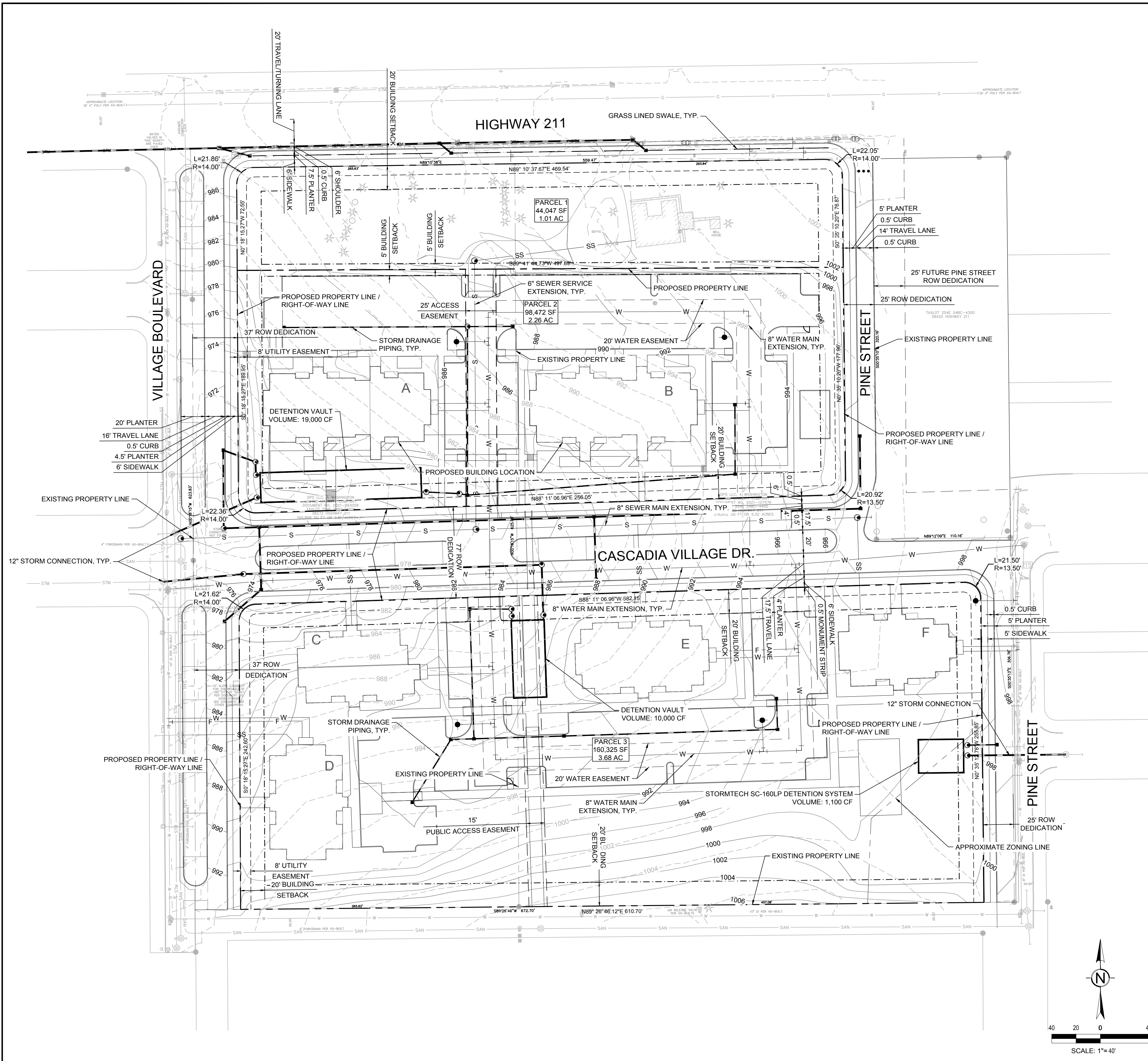
DATE  
01.09.2023  
BOOK NO.  
21129  
DRAWN BY: RJB, SM  
CHECKED BY: ZMC  
SHEET TITLE  
COVER SHEET



C-001

LAND-USE  
Cascade Creek TIA  
82

IF SHEET MEASURES LESS THAN 24"X36", IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY



**PROJECT CONTACTS:**

**OWNER/APPLICANT**  
DPS, LLC  
1911 65TH AVE W.  
TACOMA, WA 98466  
CONTACT: ZAC BAKER  
PHONE: 253.460.3000  
EMAIL: ZBAKER@SPHOMECOM

**CIVIL ENGINEER**  
BCRA  
2106 PACIFIC AVENUE, SUITE 300  
TACOMA, WA 98402  
CONTACT: ZACHARY CRUM, PE  
PHONE: 253.627.4367  
EMAIL: ZCRUM@BCRADESIGN.COM

**SITE INFORMATION:**

SITE ADDRESSES: 38272 HWY 211 & 38330 HWY 211 SANDY, OR 97055  
PARCEL NUMBERS TO BE PARTITIONED: 00677173 & 00677164  
ZONING/DENSITY:  
VC - VILLAGE COMMERCIAL, NO MIN/MAX DENSITY  
R-2 - MEDIUM DENSITY RESIDENTIAL, 8 UNITS/AC MIN & 14 UNITS/AC MAX  
R-1 - LOW DENSITY RESIDENTIAL, 5 UNITS/AC MIN & 8 UNITS/AC MAX  
EXISTING PARCEL AREA  
00677173: 3.81 AC  
00677164: 5.02 AC  
TOTAL AREA: 8.83 AC  
ROW DEDICATION AREA FOR HWY 211, VILLAGE BLVD, CASCADIA VILLAGE DR. AND PINE STREET: 1.7 AC

**PROPOSED PARCELS UNITS/DENSITY**

**PARCEL 1 -**  
ZONING: VC  
AREA: 1.01 AC  
UNITS: 1 SF RESIDENCE TO REMAIN  
DENSITY: 1 UNIT/AC

**PARCEL 2 -**  
ZONING: VC  
AREA: 2.26 AC  
UNITS PROPOSED: 32 MF UNITS  
DENSITY: 14.2 UNITS/AC

**PARCEL 3 -**  
ZONING: R-1 AND R-2  
AREA: 3.68 AC  
UNITS PROPOSED: 46 MF UNITS  
DENSITY: 12.5 UNITS/AC

TOTAL DEVELOPMENT AREA: 6.95 AC  
TOTAL UNITS PROPOSED: 78 UNITS

**EXISTING PARCELS LEGAL DESCRIPTIONS:**

CLACKAMAS CO. PARCEL NO. 00677173:  
THE WEST 4 ACRES OF THE NORTHWEST QUARTER OF THE SOUTHWEST QUARTER OF THE NORTHWEST QUARTER OF SECTION 24, TOWNSHIP 2 SOUTH, RANGE 4 EAST OF THE WILLAMETTE MERIDIAN, IN THE CITY OF SANDY, COUNTY OF CLACKAMAS AND STATE OF OREGON.  
EXCEPT THEREFROM THAT PORTION CONVEYED TO THE STATE OF OREGON, AND BY AND THROUGH ITS STATE HIGHWAY COMMISSION, BY DEED RECORDED FEBRUARY 5, 1947, IN BOOK 384, PAGE 393.  
CLACKAMAS CO. PARCEL NO. 00677164:

**PROPOSED PARCELS LEGAL DESCRIPTIONS:**

THREE TRACTS OF LAND LOCATED IN THE NORTHWEST ONE-QUARTER OF SECTION 24, TOWNSHIP 2 SOUTH, RANGE 4 EAST, WILLAMETTE MERIDIAN, CITY OF SANDY, CLACKAMAS COUNTY, OREGON, AND BEING PORTIONS OF THOSE PROPERTIES DESCRIBED IN STATUTORY WARRANTY DEEDS TO DPS LLC, A WASHINGTON LIMITED LIABILITY COMPANY, RECORDED IN DEED DOCUMENTS 2021-093058 AND 2021-107576 OF CLACKAMAS COUNTY DEED RECORDS, SAID TRACTS BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

**PROPOSED PARCEL 1 LEGAL DESCRIPTION:**

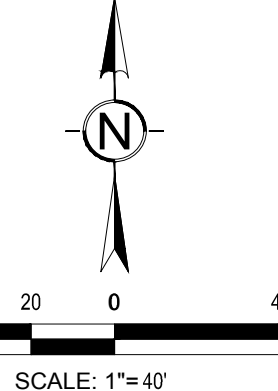
COMMENCING AT A 5/8" IRON ROD WITH A YELLOW PLASTIC CAP STAMPED "MARX ASSOC. INC." MARKING THE INITIAL POINT OF "BLUFF AT BORNSTEDT VILLAGE" A SUBDIVISION OF RECORDED IN PLAT BOOK 132, PAGE 020, CLACKAMAS COUNTY PLAT RECORDS, SAID POINT ALSO BEING THE SOUTHEAST CORNER OF THAT PROPERTY DESCRIBED IN DOCUMENT 2021-107576 OF CLACKAMAS COUNTY DEED RECORDS;  
THENCE ALONG THE NORTH LINE OF SAID DOCUMENT 2021-107576 AND THE SOUTH LINE OF DOCUMENT 2021-093058, S 89°26'46" W, 672.70 FEET TO THE SOUTHWEST CORNER OF SAID DOCUMENT 2021-093058;  
THENCE ALONG THE WEST LINE OF SAID DOCUMENT 2021-093058, N 00°18'15" E, 537.75 FEET;  
THENCE N 89°41'45" E, 37.00 FEET TO THE POINT OF BEGINNING;  
THENCE N 00°18'15" E, 13.71 FEET TO THE BEGINNING OF A 14.00 FOOT RADIUS CURVE TO THE RIGHT HAVING A CENTRAL ANGLE OF 89°28'53";  
THENCE NORTHEASTERLY ALONG THE ARC OF SAID CURVE TO THE RIGHT, (THE LONG CHORD OF WHICH BEARS N 41°20'11" E, 18.99 FEET) AN ARC DISTANCE OF 20.92 FEET TO THE SOUTH RIGHT OF WAY LINE OF HIGHWAY 211;  
THENCE NORTHEASTERLY ALONG THE ARC OF SAID CURVE TO THE RIGHT, (THE LONG CHORD OF WHICH BEARS S 45°12'18" E, 19.94 FEET) AN ARC DISTANCE OF 22.08 FEET;  
THENCE S 00°35'10" E, 76.87 FEET TO THE POINT OF BEGINNING;  
THENCE S 89°41'45" W, 497.89 FEET TO THE POINT OF BEGINNING.  
CONTAINING 44,047 SQUARE FEET, MORE OR LESS.  
BEARINGS ARE BASED ON SURVEY NUMBER SN2006-342, CLACKAMAS COUNTY SURVEY RECORDS.

**PROPOSED PARCEL 2 LEGAL DESCRIPTION:**

COMMENCING AT A 5/8" IRON ROD WITH A YELLOW PLASTIC CAP STAMPED "MARX ASSOC. INC." MARKING THE INITIAL POINT OF "BLUFF AT BORNSTEDT VILLAGE" A SUBDIVISION OF RECORDED IN PLAT BOOK 132, PAGE 020, CLACKAMAS COUNTY PLAT RECORDS, SAID POINT ALSO BEING THE SOUTHEAST CORNER OF THAT PROPERTY DESCRIBED IN DOCUMENT 2021-107576 OF CLACKAMAS COUNTY DEED RECORDS;  
THENCE ALONG THE SOUTH LINE OF SAID DOCUMENT 2021-107576 AND THE SOUTH LINE OF DOCUMENT 2021-093058, S 89°26'46" W, 672.70 FEET TO THE SOUTHWEST CORNER OF SAID DOCUMENT 2021-093058;  
THENCE ALONG THE WEST LINE OF SAID DOCUMENT 2021-093058, N 00°18'15" E, 537.75 FEET;  
THENCE CONTINUING N 89°41'45" E, 497.89 FEET;  
THENCE S 00°35'10" E, 177.96 FEET TO THE BEGINNING OF A 13.50 FOOT RADIUS CURVE TO THE RIGHT HAVING A CENTRAL ANGLE OF 88°46'17";  
THENCE SOUTHWESTERLY ALONG THE ARC OF SAID CURVE TO THE RIGHT, (THE LONG CHORD OF WHICH BEARS S 43°47'58" W, 18.89 FEET) AN ARC DISTANCE OF 20.92 FEET;  
THENCE S 88°11'07" W, 471.42 FEET TO THE BEGINNING OF A 14.00 FOOT RADIUS CURVE TO THE RIGHT HAVING A CENTRAL ANGLE OF 91°30'38";  
THENCE NORTHEASTERLY ALONG THE ARC OF SAID CURVE TO THE RIGHT, (THE LONG CHORD OF WHICH BEARS N 48°03'34" W, 20.06 FEET) AN ARC DISTANCE OF 22.36 FEET;  
THENCE N 00°18'15" W, 169.95 FEET TO THE POINT OF BEGINNING.  
CONTAINING 98,472 SQUARE FEET, MORE OR LESS.

**PROPOSED PARCEL 3 LEGAL DESCRIPTION:**

COMMENCING AT A 5/8" IRON ROD WITH A YELLOW PLASTIC CAP STAMPED "MARX ASSOC. INC." MARKING THE INITIAL POINT OF "BLUFF AT BORNSTEDT VILLAGE" A SUBDIVISION OF RECORDED IN PLAT BOOK 132, PAGE 020, CLACKAMAS COUNTY PLAT RECORDS, SAID POINT ALSO BEING THE SOUTHEAST CORNER OF THAT PROPERTY DESCRIBED IN DOCUMENT 2021-107576 OF CLACKAMAS COUNTY DEED RECORDS;  
THENCE ALONG THE SOUTH LINE OF SAID DOCUMENT 2021-107576, S 89°26'46" W, 25.00 FEET TO THE POINT OF BEGINNING;  
THENCE CONTINUING ALONG THE SOUTH LINE OF SAID DOCUMENT 2021-107576 AND THE SOUTH LINE OF DOCUMENT 2021-093058, S 89°26'46" W, 610.70 FEET;  
THENCE N 00°18'15" W, 242.50 FEET TO THE BEGINNING OF A 14.00 FOOT RADIUS CURVE TO THE RIGHT HAVING A CENTRAL ANGLE OF 89°29'22";  
THENCE NORTHEASTERLY ALONG THE ARC OF SAID CURVE TO THE RIGHT, (THE LONG CHORD OF WHICH BEARS N 43°39'07" E, 19.54 FEET) AN ARC DISTANCE OF 21.62 FEET;  
THENCE N 88°11'07" E, 582.15 FEET TO THE BEGINNING OF A 13.50 FOOT RADIUS CURVE TO THE RIGHT HAVING A CENTRAL ANGLE OF 91°13'40";  
THENCE SOUTHEASTERLY ALONG THE ARC OF SAID CURVE TO THE RIGHT, (THE LONG CHORD OF WHICH BEARS S 46°12'03" E, 18.30 FEET) AN ARC DISTANCE OF 21.50 FEET;  
THENCE S 00°38'13" E, 225.95 FEET TO THE POINT OF BEGINNING.  
CONTAINING 160,325 SQUARE FEET, MORE OR LESS.



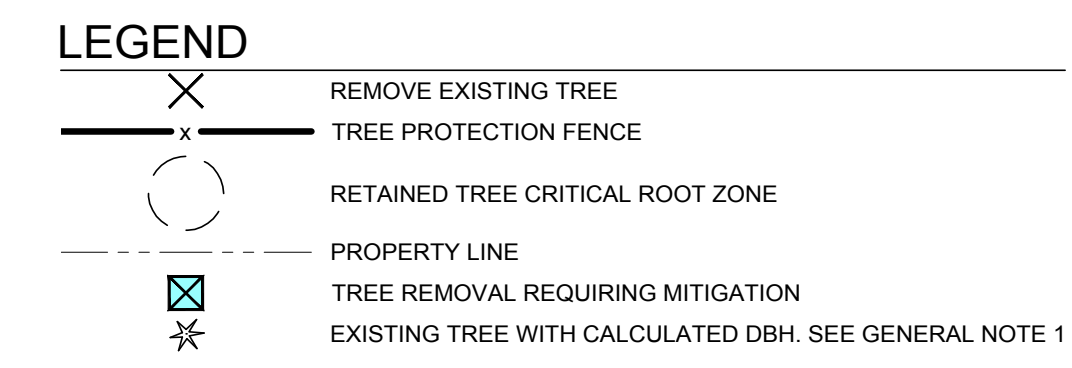
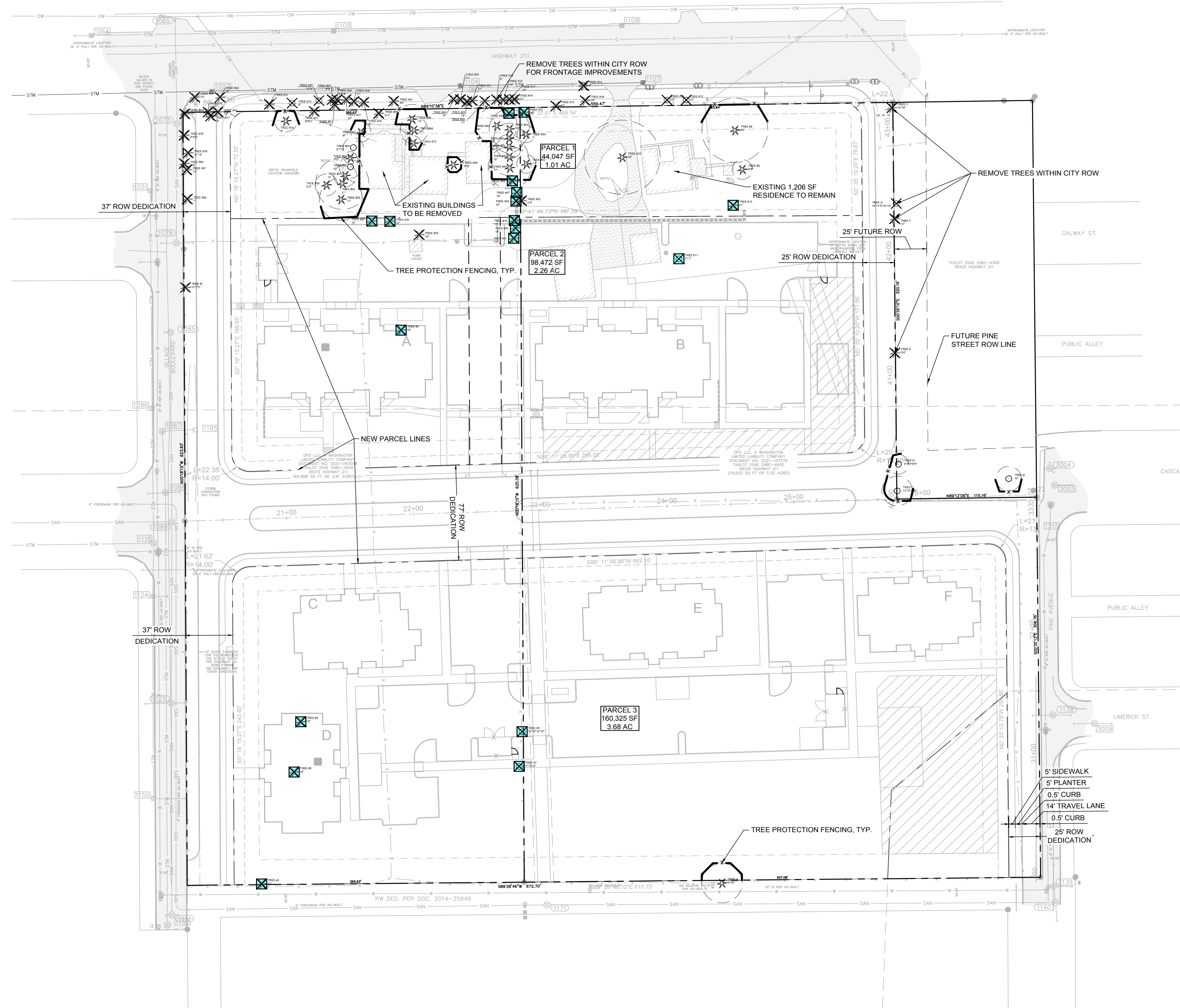
PROJECT  
SHEET SET CREATED BY RB 08.16.2022  
CASCADE CREEK MULTI FAMILY  
38330 HWY 211  
SANDY, OR 97055

NO.	DATE	REVISION



C-101  
LAND-USE  
Cascade Creek TIA  
83

DATE PLOTTED: 3/7/2023 12:15:39 PM FILENAME: 21129C-01-102.DWG BY: [redacted]



**GENERAL NOTE:**  
 1. TREE LOCATIONS ON PLAN HAVE NOT BEEN SURVEYED. LOCATIONS REFLECT TREE PROTECTION PLAN REPORT PREPARED BY WASHINGTON FORESTRY CONSULTANTS, INC., DATED 12/22/2022.

**CODE REQUIREMENTS:**  
 SMC 17.54.140  
 TREE RETENTION = 6 TREES/AC \* 6.95 AC = 42 TREES RETAINED WITH DBH >11"  
 A VARIANCE WILL BE REQUESTED PER SMC SEC. 17.102.70 TO FULFILL TREE RETENTION REQUIREMENTS AS TREE RETENTION REQUIREMENTS CANNOT BE MET ON-SITE.  
 SMC 17.102.10  
 TREES ARE DEFINED AS "ANY LIVING, STANDING, WOODY PLANT HAVING A TRUNK 11 INCHES DBH OR GREATER."  
 SMC 17.102.20.B.1  
 "TREE REMOVAL AS REQUIRED BY THE CITY OR PUBLIC UTILITY FOR THE INSTALLATION OR MAINTENANCE OR REPAIR OF ROADS, UTILITIES OR STRUCTURES" ARE "EXEMPT FROM TREE RETENTION REQUIREMENTS".

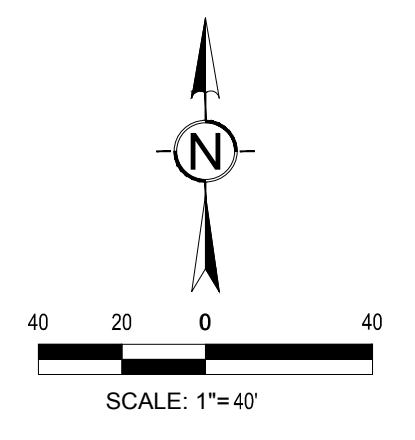
**EXISTING TREE COUNT:**  
 TREES IN RIGHT-OF-WAY: 36  
 TREES ON-SITE: 38  
 TREES OFF-SITE: 8  
 TOTAL TREES: 82

**PROPOSED TREE RETENTION/REMOVAL:**  
 TOTAL TREES ON-SITE: 82 TREES  
 TOTAL TREES REMOVED: 58 TREES  
 TOTAL TREES RETAINED: 24 TREES

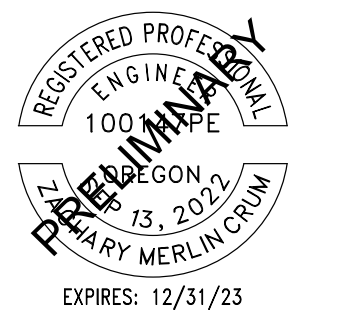
**EXEMPTIONS (SEE TREE VARIANCE NARRATIVE FOR MORE INFORMATION):**  
 <11" DBH REMOVED (EXEMPT PER SMC 17.102.10): 17 TREES  
 RIGHT-OF-WAY REMOVED (EXEMPT PER SMC 17.102.20(B)(1)): 23 ADDITIONAL TREES, INCLUDES OFF-SITE TREES E, F, G, AND H.  
 TOTAL EXEMPT TREES: 17 + 23 = 40 TREES

TREE REMOVAL REQUIRING MITIGATION: 58 - 40 = 18 TREES

**TREE MITIGATION**  
 SMC 17.102.70  
 MINIMUM MITIGATION RATIO: 2:1 RATIO  
 MITIGATION TREES REQUIRED: 18 X 2 = 36 MITIGATION TREES  
 REFER TO LANDSCAPE PLANS FOR MITIGATION TREES TYPES AND PLACEMENT.



T: 206.272.6877 F: 206.272.2586 WWW.BCRADESIGN.COM  
 414 STEWART STREET, SUITE 200, SEATTLE, WA 98101



**PROJECT:**  
 SHEET SET CREATED BY RB 08.16.2022  
**CASCADE CREEK MULTI FAMILY**  
 38530 HWY 211  
 SANDY, OR 97055

REVISIONS

NO.	DATE	DESCRIPTION

DATE: 01.09.2023  
 BCSA NO.: 21129  
 DRAWN BY: RJB, SM  
 CHECKED BY: ZMC  
 SHEET TITLE: TREE PROTECTION PLAN



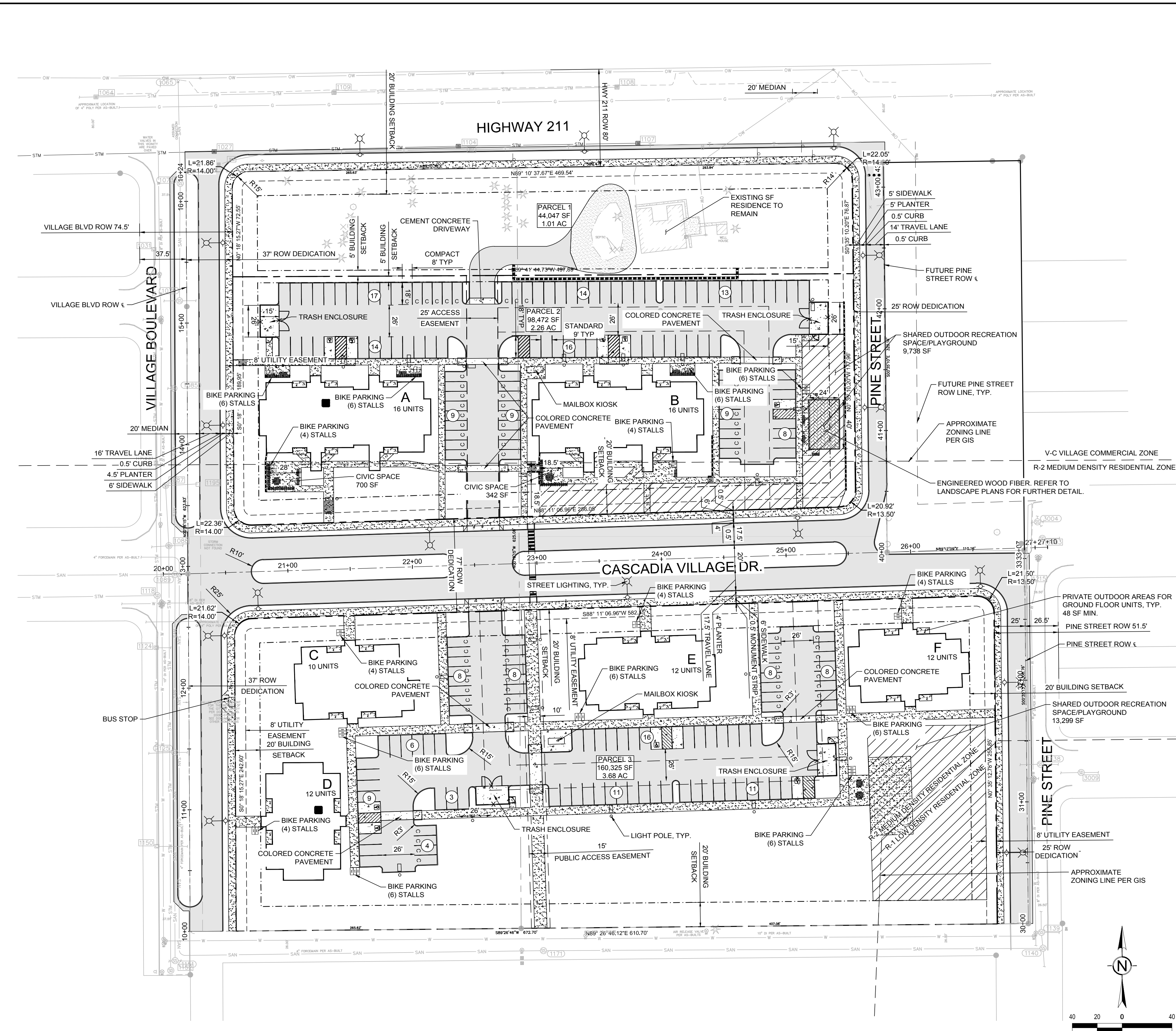
**C-102**

LAND-USE  
 Cascade Creek TIA  
 84

IF SHEET MEASURES LESS THAN 24"X36", IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY



DATE PLOTTED: 3/7/2023 12:15:45 PM FILENAME: 21129C-201-202.DWG BY: [redacted]



### LEGEND

- PROPERTY/BOUNDARY LINE
- RIGHT-OF-WAY LINE
- SETBACK LINE
- ACCESS EASEMENT
- ROAD CENTERLINE
- BUILDING FOOTPRINT
- ASPHALT PAVEMENT
- ASPHALT PAVEMENT - HEAVY DUTY
- CEMENT CONCRETE SIDEWALK
- CEMENT CONCRETE PAVEMENT
- CURB & GUTTER
- PRECAST CONCRETE WHEELSTOP
- RETAINING WALL
- (55) NUMBER OF PARKING STALLS PER ROW

### SITE INFORMATION TABLE

PROPERTY OWNER:  
ZAC BAKER  
DPS, LLC  
1911 65th AVE W  
TACOMA, WA 98466

SITE ADDRESSES: 38272 HWY 211 & 38330 HWY 211 SANDY, OR 97055  
PARCEL NUMBERS TO BE PARTITIONED: 00677173 & 00677164  
ZONING/DENSITY:  
VC - VILLAGE COMMERCIAL, NO MIN/MAX DENSITY  
R-2 - MEDIUM DENSITY RESIDENTIAL, 8 UNITS/AC MIN & 14 UNITS/AC MAX  
R-1 - LOW DENSITY RESIDENTIAL, 5 UNITS/AC MIN & 8 UNITS/AC MAX

EXISTING PARCEL AREA  
00677173: 3.81 AC  
00677164: 5.02 AC  
TOTAL AREA: 8.83 AC

ROW DEDICATION AREA FOR HWY 211, VILLAGE BLVD, CASCADIA VILLAGE DR. AND PINE STREET: 1.7 AC

PROPOSED PARCELS UNITS/DENSITY

PARCEL 1 -  
ZONING: VC  
AREA: 1.01 AC  
UNITS: 1 SF RESIDENCE TO REMAIN  
DENSITY: 1 UNIT/AC

PARCEL 2 -  
ZONING: VC  
AREA: 2.26 AC  
UNITS PROPOSED: 32 MF UNITS  
DENSITY: 14.2 UNITS/AC

PARCEL 3 -  
ZONING: R-1 AND R-2  
AREA: 3.68 AC  
UNITS PROPOSED: 46 MF UNITS  
DENSITY: 12.5 UNITS/AC

TOTAL DEVELOPMENT AREA: 6.95 AC  
TOTAL UNITS PROPOSED: 78 UNITS

SMC 17.86.10 PARKLAND DEDICATION  
PARKLAND DEDICATION = 0.0068AC \* 78 UNITS \* 2.0 PERSONS/UNIT = 1.0608 AC  
DEVELOPER SEEKING FEE-IN-LIEU PER SMC 17.86.40

SMC 17.90.110 VILLAGE COMMERCIAL DESIGN STANDARDS - CIVIC SPACE  
AT LEAST 3% OF GROUND FLOOR AREA PER SMC 17.90.110 G

PARCEL 2:  
TOTAL BUILDING GROUND FLOOR AREA = 13,034 SF  
3% OF GROUND FLOOR AREA = 391 SF  
TOTAL CIVIC SPACE PROVIDED = 800 SF

SMC 17.98 PARKING, LOADING, AND ACCESS REQUIREMENTS  
MULTIFAMILY DWELLINGS - 2 PER DWELLING UNIT (2BDRM+)  
PROFESSIONAL OFFICES - 1 PER 400SF, PLUS 1 PER 2 EMPLOYEES  
COMPACT PARKING - 40% MAX  
BICYCLE PARKING - 1 PER DWELLING UNIT

PARCEL 1: NOT APPLICABLE  
PARCEL 2: 32 UNITS  
MULTIFAMILY: 32 UNITS \* 2 = 64 SPACES  
OFFICE: 11,142 SF OFFICE (400 SF = 28 SPACES)  
EMPLOYEES: 20 TOTAL MAX SHIFT = 20 / 2 = 10 SPACES

TOTAL PARKING REQUIRED: 102 SPACES  
TOTAL PARKING PROVIDED: 109 SPACES  
COMPACT PARKING PROVIDED: 36 SPACES = 33.0%

BICYCLE SPACES REQUIRED: 32 \* 1 = 32 SPACES  
BICYCLE SPACES PROVIDED = 32 SPACES

PARCEL 3: 46 UNITS  
MULTIFAMILY: 46 UNITS \* 2 = 92 STALLS  
OFFICE: NOT APPLICABLE  
EMPLOYEES: NOT APPLICABLE

TOTAL REQUIRED: 92 STALLS  
TOTAL PROVIDED: 92 STALLS  
COMPACT PROVIDED: 35 STALLS = 38.0%

BICYCLE SPACES REQUIRED: 46 \* 1 = 46 SPACES  
BICYCLE SPACES PROVIDED = 46 SPACES

TOTAL PARKING ALL PARCELS: 201 SPACES  
TOTAL BICYCLE SPACES ALL PARCELS: 78 SPACES

SITE COVERAGE  
PARCEL 2  
IMPERVIOUS = 62,524 SF (1.43 AC)  
LANDSCAPE = 35,948 SF (0.83 AC)

PARCEL 3  
IMPERVIOUS = 69,198 SF (1.59 AC)  
LANDSCAPE = 91,127 SF (2.09 AC)



PROJECT SHEET SET CREATED BY RB 08.16.2022  
**CASCADE CREEK MULTI FAMILY**  
38330 HWY 211  
SANDY, OR 97055

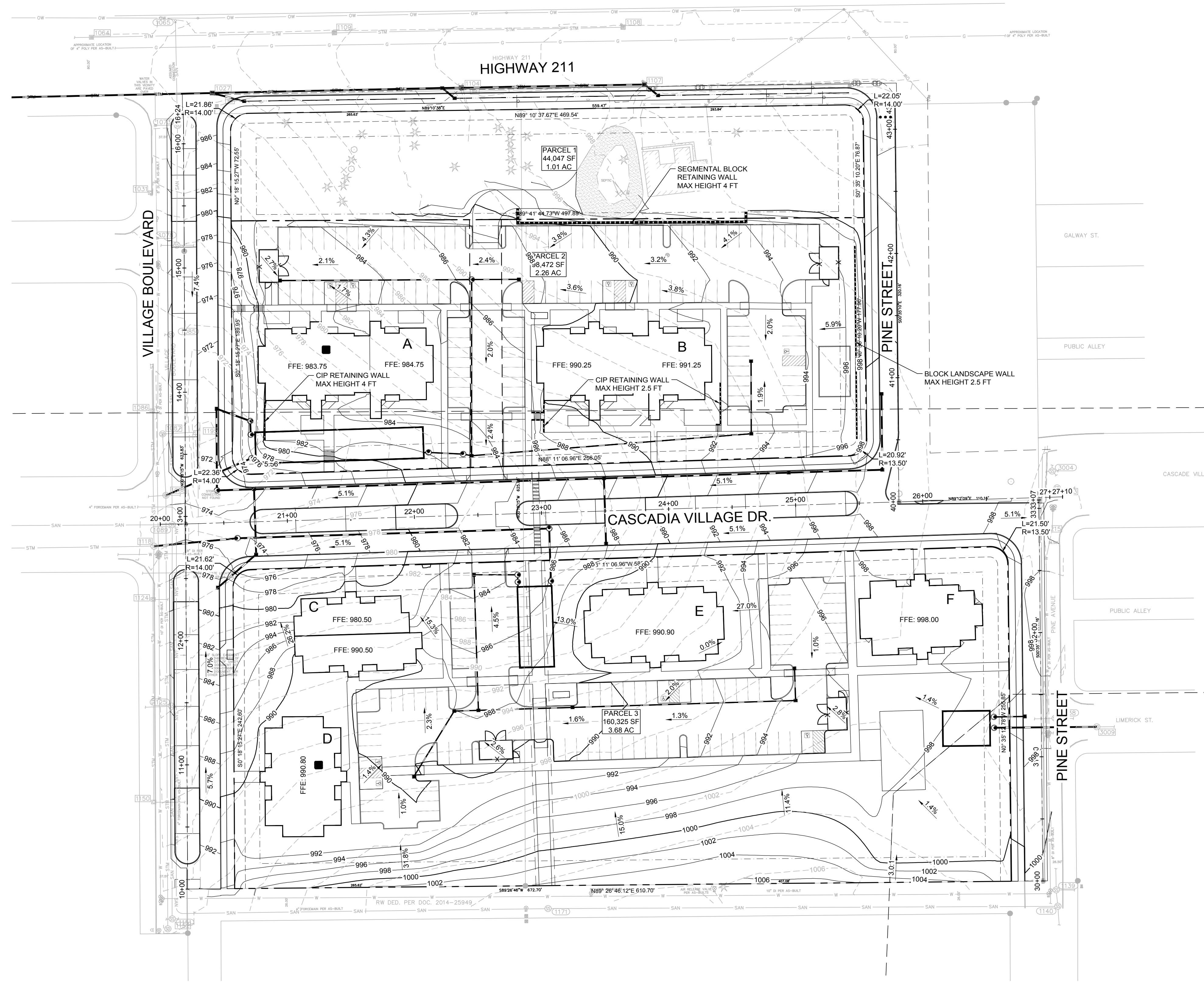
NO.	REVISION	DATE

DATE: 01.09.2023  
BOOK NO.: 21129  
DRAWN BY: RJB, SM  
REVIEWED BY: ZMC  
SHEET TITLE: SITE PLAN

**C-201**  
LAND-USE  
Cascade Creek TIA  
85

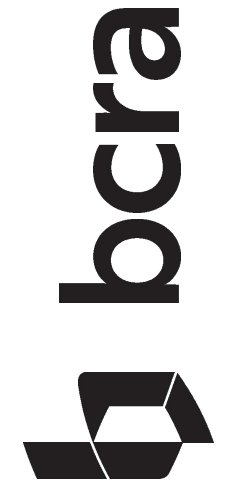
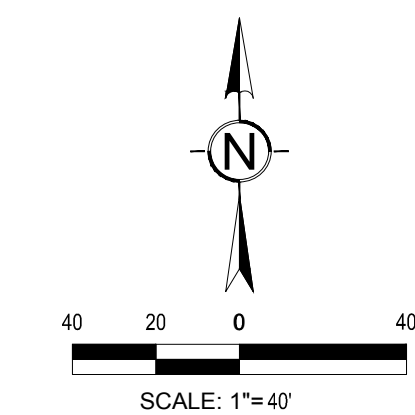
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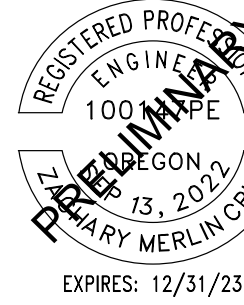


**LEGEND**

- 210 — MAJOR CONTOUR
- 213 — MINOR CONTOUR
- 2.0% — SLOPE ARROW



T 262 627 687 F 262 627 298 WWW.BCRADESIGN.COM  
414 STEWART STREET SUITE 200 SEATTLE WA 98101



**PROJECT**  
SHEET SET CREATED BY RB 08.16.2022  
**CASCADE CREEK MULTI FAMILY**  
38530 HWY 211  
SANDY, OR 97055

REVISIONS

NO.	DESCRIPTION	DATE

DATE: 01.09.2023  
BCSA NO.: 21129  
DRAWN BY: RJB, SM DESIGNED BY: SM  
REVIEWED BY: ZMC  
SHEET TITLE: GRADING AND DRAINAGE PLAN



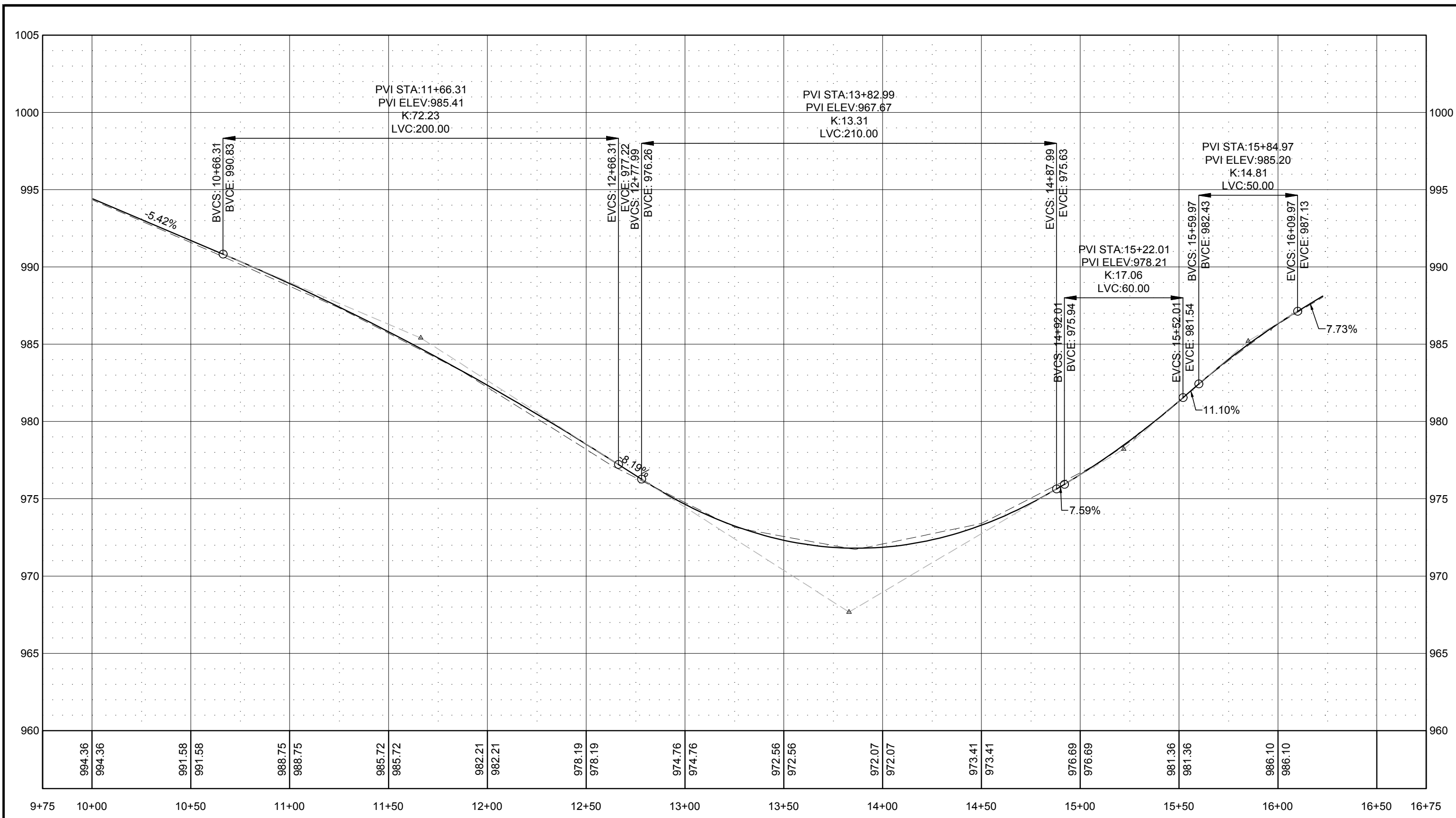
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**C-301**

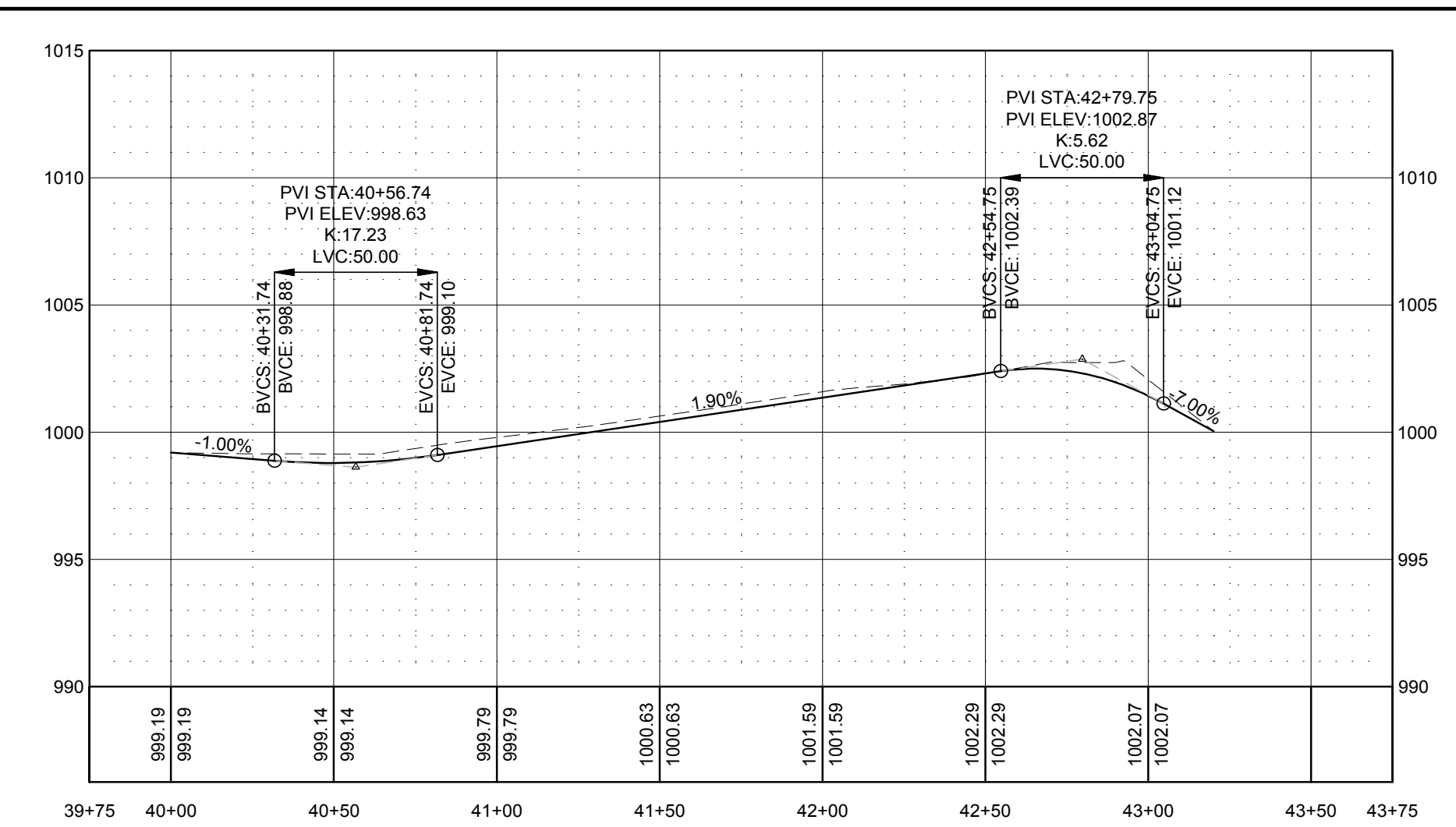
LAND-USE  
Cascade Creek TIA  
86

IF SHEET MEASURES LESS THAN 24"X36", IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY

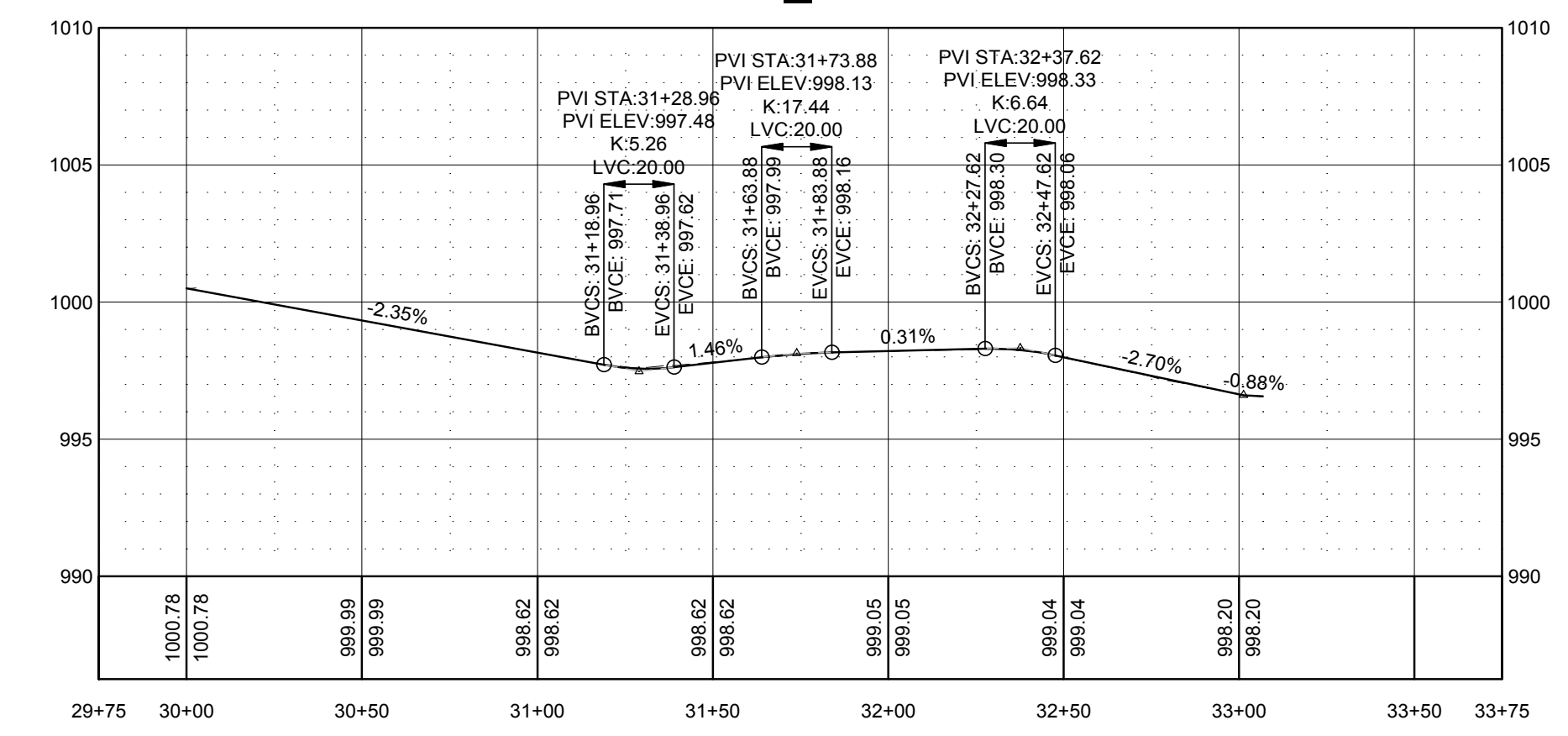
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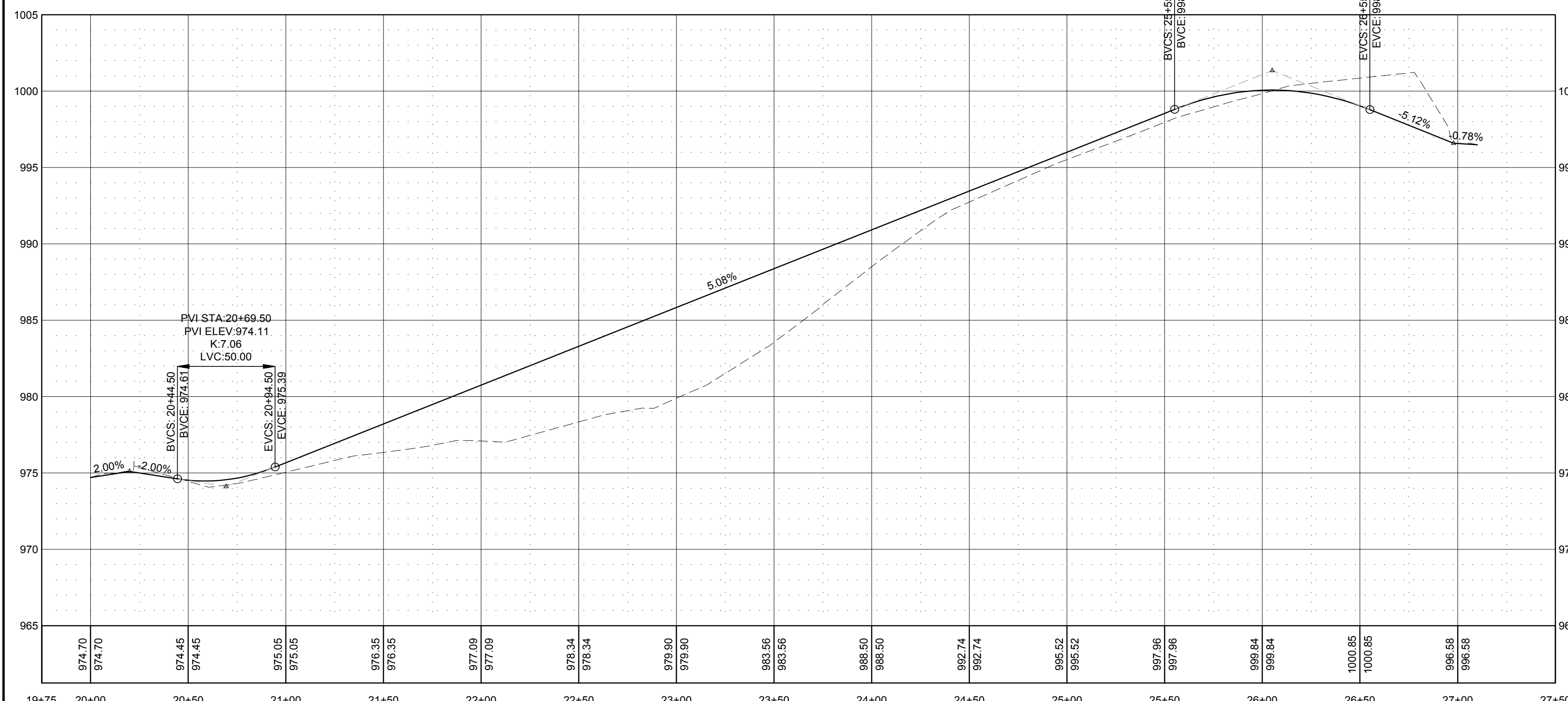
VILLAGE BLVD CL PROFILE



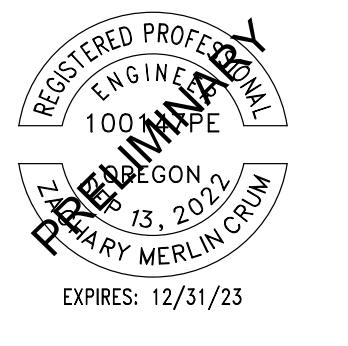
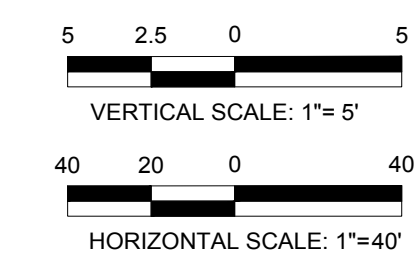
PINE STREET CL\_NORTH PROFILE



PINE STREET CL\_SOUTH PROFILE



CASCADIA VILLAGE DR CL PROFILE



PROJECT:  
SHEET SET CREATED BY RB 08.16.2022  
**CASCADE CREEK MULTI FAMILY**  
38300 HWY 311  
SANDY, OR 97055

NO.	DATE	DESCRIPTION

DATE: 01.09.2023  
BCSA NO: 21129  
DRAWN BY: RJB, SM  
REVIEWED BY: ZMC  
SHEET TITLE: ROADWAY PROFILES

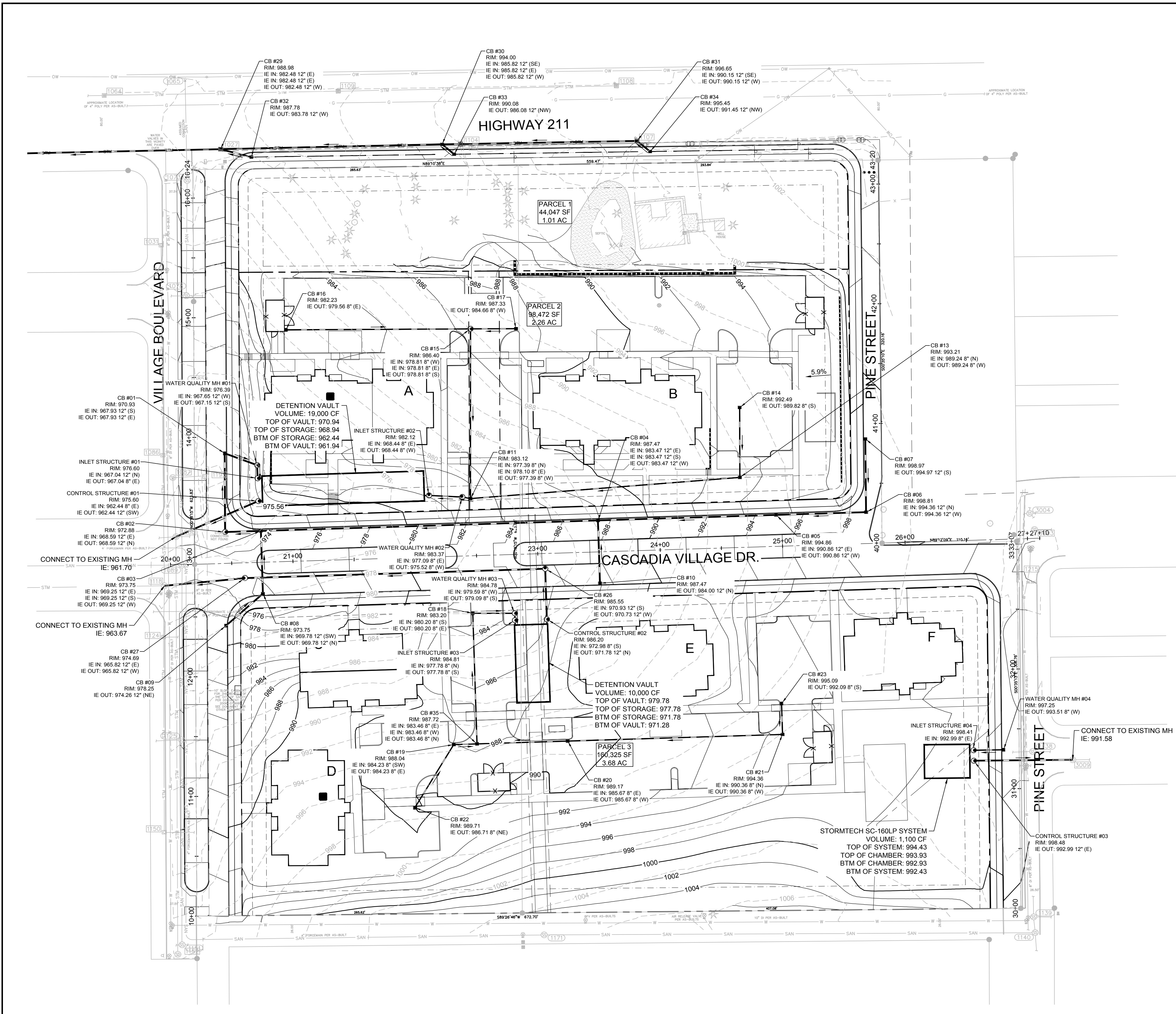


**C-302**

LAND-USE  
Cascade Creek TIA  
87

IF SHEET MEASURES LESS THAN 24"X36", IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY

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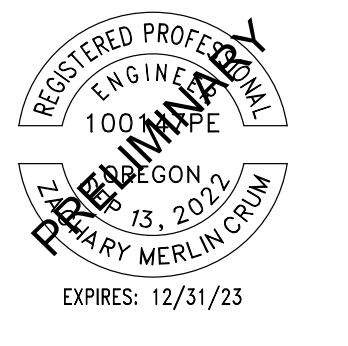


**LEGEND**

- 210 MAJOR CONTOUR
- 213 MINOR CONTOUR
- SLOPE ARROW
- 2.0% STORM DRAIN LINE
- SWALE/DITCH
- CATCH BASIN TYPE 1
- CATCH BASIN TYPE 2



T 262 627 687 F 262 627 258 WWW.BCRADESIGN.COM  
44 STEWART STREET, SUITE 200, SEATTLE, WA 98101



PROJECT  
SHEET SET CREATED BY RB 08.16.2022  
**CASCADE CREEK MULTI FAMILY**  
38300 HWY 211  
SANDY, OR 97055

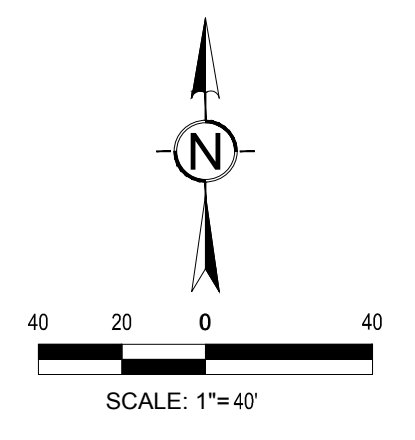
NO.	DATE	DESCRIPTION

DATE: 01.09.2023  
SHEET NO.: 21129  
DRAWN BY: RJB, SM DESIGNED BY: SM  
REVIEWED BY: ZMC  
SHEET TITLE: STORM DRAINAGE PLAN



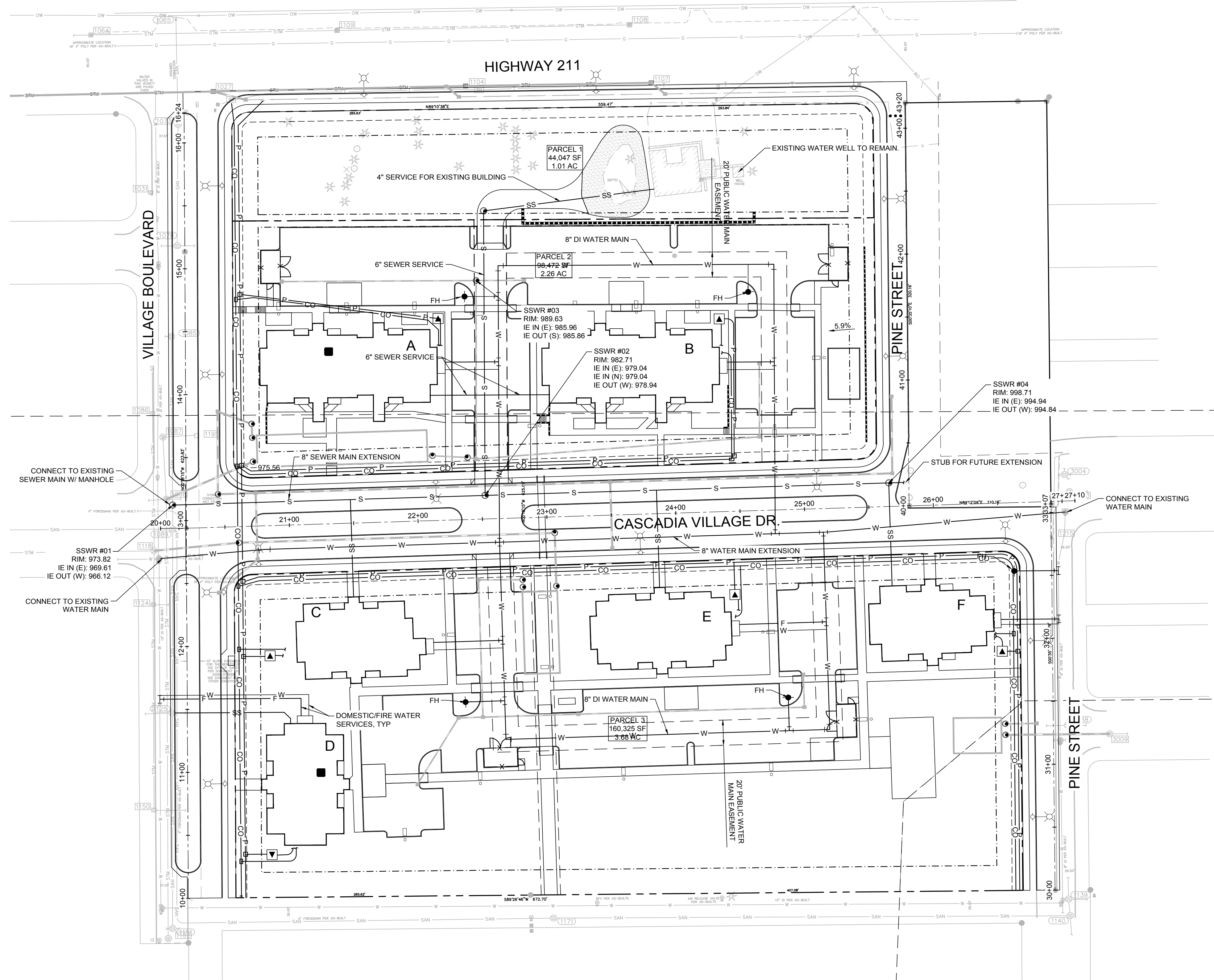
**C-401**

LAND-USE  
Cascade Creek TIA  
88



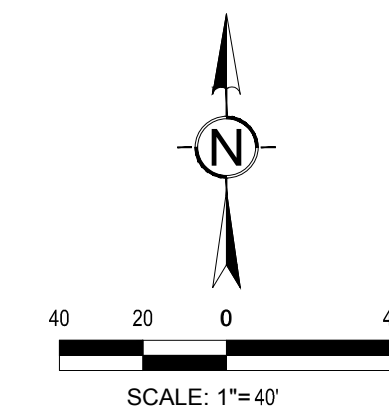
IF SHEET MEASURES LESS THAN 24"X36", IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY

DATE PLOTTED: 3/7/2023 12:17:25 PM FILENAME: 2112RC-C-501-402.DWG BY: ---

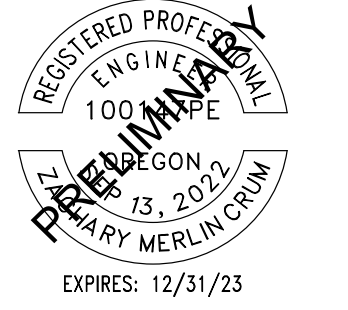


**LEGEND**

- P — POWER LINE
- △ — ELECTRICAL TRANSFORMER
- CO — COMMUNICATION LINE
- W — WATER MAIN LINE
- T— — TEE
- — FIRE HYDRANT
- L— — 90° BEND
- F — FIRE WATER LINE
- S — SANITARY SEWER LINE
- SS — SANITARY SEWER SERVICE LINE
- — SANITARY SEWER MANHOLE



T: 206.627.6377 F: 206.627.2596 WWW.BCRADESIGN.COM  
414 STEWART STREET, SUITE 200, SEATTLE, WA 98101



PROJECT: SHEET SET CREATED BY RB 08.16.2022  
**CASCADE CREEK MULTI FAMILY**  
 38530 HWY 211  
 SANDY, OR 97055

NO.	DATE	REVISION



**C-501**

LAND-USE  
 Cascade Creek TIA  
 89

IF SHEET MEASURES LESS THAN 24"X36", IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY

# EXHIBIT L

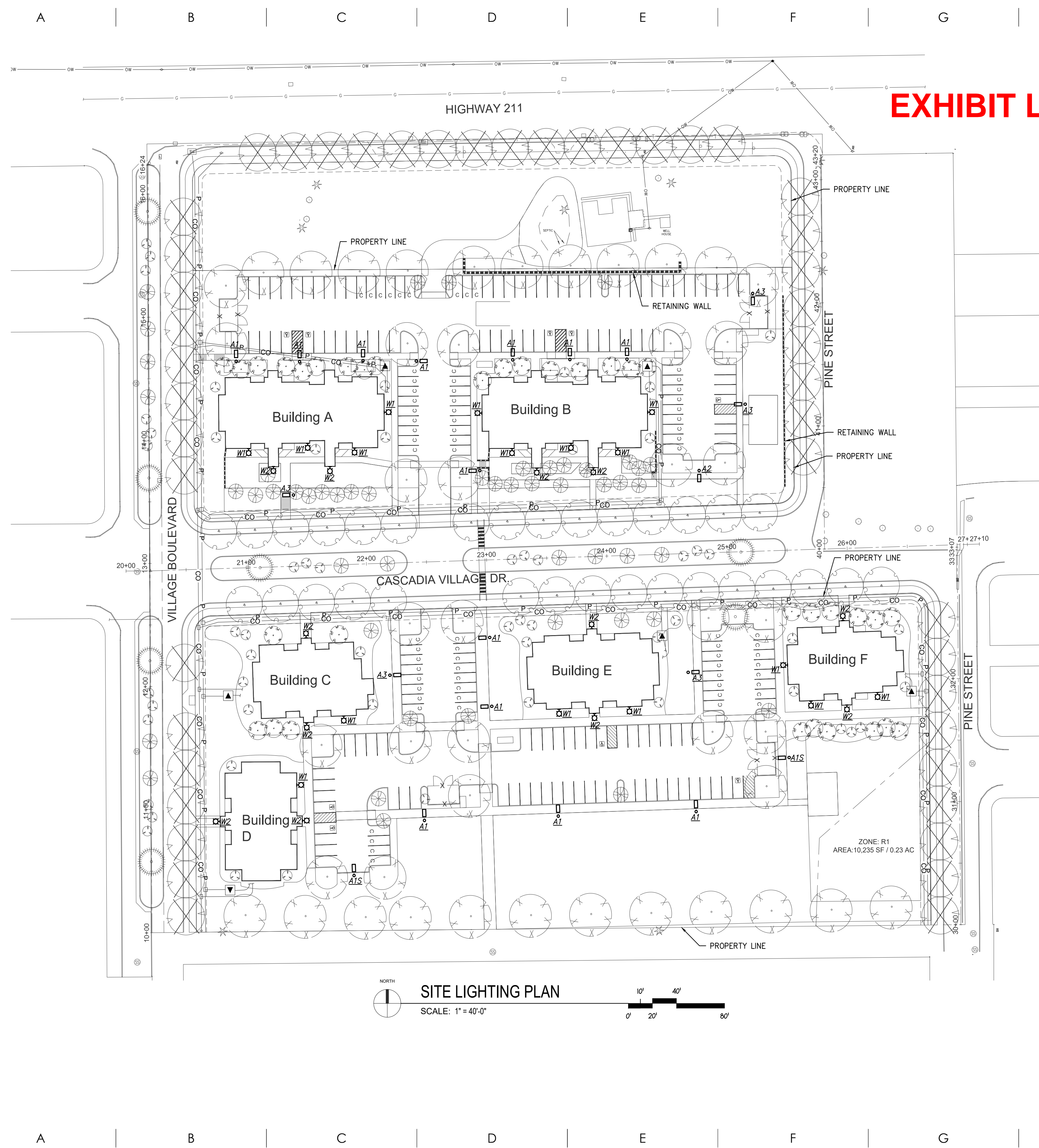
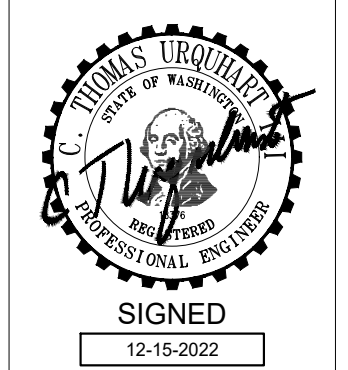


Image	Label	Manufacturer	Description	Light Loss Factor	Mounting Height	Wattage
	A1	COOPER LIGHTING SOLUTIONS - MCGRAW-EDISON (FORMERLY EATON)	GALLEON PEDESTRIAN LUMINAIRE (2) 70 CRI, 3000K, 615mA LIGHTSQUARES WITH 16 LEDS EACH AND TYPE IV FORWARD THROW OPTICS	0.85	16'	66
	A1S	COOPER LIGHTING SOLUTIONS - MCGRAW-EDISON (FORMERLY EATON)	GALLEON PEDESTRIAN LUMINAIRE (2) 70 CRI, 3000K, 615mA LIGHTSQUARES WITH 16 LEDS EACH AND TYPE IV FORWARD THROW OPTICS WITH HOUSE SIDE SHIELD	0.85	16'	66
	A2	COOPER LIGHTING SOLUTIONS - MCGRAW-EDISON (FORMERLY EATON)	GALLEON PEDESTRIAN LUMINAIRE (2) 70 CRI, 3000K, 615mA LIGHTSQUARES WITH 16 LEDS EACH AND TYPE II OPTICS Retail, Roadway, Sidewalk, Site, Street, Substation, Security, Corrosion Resistant, Vandal Resistant, Wet Location ABSOLUTE PHOTOMETRY IS BASED ON CALIBRATION FACTORS CREATED USING LAB LUMEN STANDARDS IN GONIPHOTOMETER WITH TEST DISTANCE OF 28.75 FEET	0.85	16'	66
	A3	COOPER LIGHTING SOLUTIONS - MCGRAW-EDISON (FORMERLY EATON)	GALLEON PEDESTRIAN LUMINAIRE (2) 70 CRI, 3000K, 615mA LIGHTSQUARES WITH 16 LEDS EACH AND TYPE III OPTICS	0.85	16'	66
	W1	COOPER LIGHTING SOLUTIONS - MCGRAW-EDISON (FORMERLY EATON)	GALLEON WALL LUMINAIRE (2) 70 CRI, 3000K, 615mA LIGHTSQUARES WITH 16 LEDS EACH AND TYPE IV FORWARD THROW OPTICS	0.85	16'	66
	W2	COOPER LIGHTING SOLUTIONS - MCGRAW-EDISON (FORMERLY EATON)	IMPACT ELITE LED TRAPEZOID LUMINAIRE (1) 70 CRI, 3000K, 300mA LIGHTSQUARE WITH 18 LEDS AND TYPE IV FORWARD THROW OPTICS Retail, Roadway, Sidewalk, Site, Street, Substation, Security, Corrosion Resistant, Vandal Resistant, Wet Location ABSOLUTE PHOTOMETRY IS BASED ON CALIBRATION FACTORS CREATED USING LAB LUMEN STANDARDS IN GONIPHOTOMETER WITH TEST DISTANCE OF 28.75 FEET	0.85	8'	20.1

**HULTZ BHU**  
engineers inc  
1111 Fawcett Ave Suite 100 Tacoma, WA 98402  
Phone: (253) 383-3257 Fax: (253) 383-3283  
general@hultzbhu.com Job Number: 22-185

**CASCADE CREEK MULTI FAMILY**  
38330 HWY 211 SANDY, OR 97055



SHEET TITLE: SITE LIGHTING PLAN  
DRAWN: AD  
CHECKED: CTU  
DATE: 10/14/2022  
REVISIONS:

**E1.1**

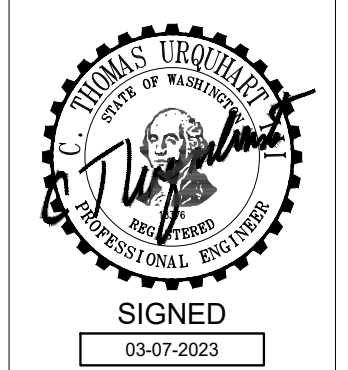
SHEET SIZE IS TRUE SCALE WHEN ABOVE LINE MEASURES AS NOTED

ILLUMINATION STATISTICS				
DESCRIPTION	AVG.	MAX.	MIN.	REMARK
PARCEL 2 (NORTH)				
SITE	1.8 fc	6.6 fc	0.1 fc	NOTE 2
N BOUNDARY 10'	0.0 fc	0.0 fc	0.0 fc	NOTE 1
S/E/W BOUNDARY 10'	0.3 fc	1.9 fc	0.0 fc	
PARCEL 3 (SOUTH)				
SITE	1.7 fc	5.7 fc	0.1 fc	NOTE 2
S BOUNDARY 10'	0.0 fc	0.0 fc	0.0 fc	NOTE 2
N/E/W BOUNDARY 10'	0.1 fc	0.7 fc	0.0 fc	

Note:  
 1. Calculation is based on 4' high retaining and mature landscape shrubs.  
 2. Site includes parking, walks and building entrances.

**HULTZ + BHU**  
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 1111 E. West Ave. Suite 100 Tacoma, WA 98402  
 Phone: (253) 383-3257 Fax: (253) 383-3283  
 general@hultzbhu.com Job Number: 22-185

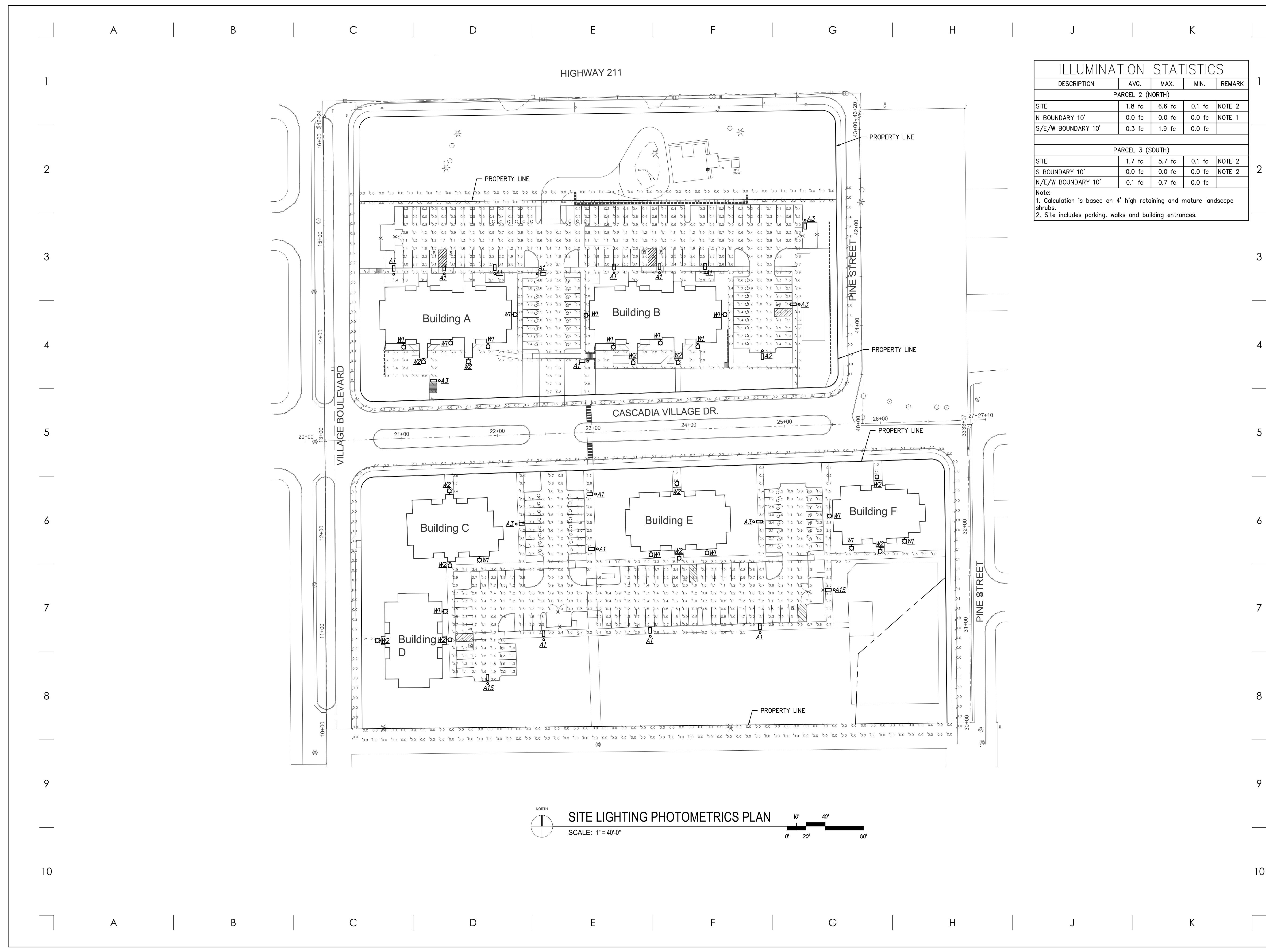
**CASCADE CREEK MULTI FAMILY**  
 38330 HWY 211 SANDY, OR 97055



SHEET TITLE: SITE LIGHTING PHOTOMETRICS PLAN  
 DRAWN: AD CHECKED: CTU DATE: 10/14/2022  
 REVISIONS:

**E1.2**

SHEET SIZE IS TRUE SCALE WHEN ABOVE LINE MEASURES AS NOTED



**EXHIBIT M**

STREET LIGHT SCHEDULE			
FIXTURE TYPE	MODEL NO.	MOUNTING HEIGHT	COMMENTS
A1	GCL1-80G-MV-WW-3R-GY-610-PCR7-RWG-WL-FDC-PGE	35FT	35FT AASTO-SPEC TAPERED STEEL POLE W/ 6FT ARM
A2			
A3			
B1	GCM2-40H-MV-WW-2R-GY-700-PCR7-RWG-WL-FDC-PGE	30FT	35FT DIRECT BURIED COMPOSITE POLE W/ 6FT ARM
B2			
B3			
B4			
B5			
C1	GCJ1-20H-MV-WW-2R-DB-700-PCR7-RWG-WL-FDC-PGE	30FT	35FT DIRECT BURIED COMPOSITE POLE W/ 6FT ARM
C2			
C3			
C4			
D1	GCJ1-20H-MV-WW-2R-DB-450-PCR7-RWG-WL-FDC-PGE	25FT	30FT DIRECT BURIED COMPOSITE POLE W/ 6FT ARM
D2			
D3			
D4			

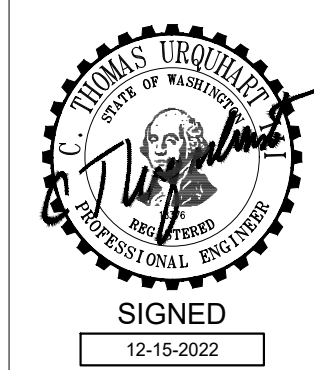
NOTE:  
1. SCHEDULED STREET LIGHT FIXTURES AND POLE ARE TAKEN FROM PGE APPROVED MATERIALS LIST.

ELECTRICAL LEGEND (SOME SYMBOLS MAY NOT BE USED ON DRAWINGS)	
SYMBOL	DESCRIPTION
○	UTILITY POLE
◻	HANDHOLE TYPE 1 W/ LOCKING LID PER WSDOT STANDARD PLAN J-40.10-03
#	CONDUIT OR FEEDER SYMBOL: (SEE RACEWAY SCHEDULE) # - IDENTIFYING NUMBER
○-○	STREET LIGHT - POLE AND FIXTURE
⊙	PHOTOCELL
—	BURRIED CONDUIT

- GENERAL NOTES
- REGULATORY REQUIREMENTS: COMPLY WITH OREGON STATE AND LOCAL ELECTRICAL AND BUILDING CODES. OBTAIN AND PAY FOR REQUIRED PERMITS. ALL WORK SHALL CONFORM TO CITY OF SANDY STREET LIGHTING STANDARDS AND SPECIFICATIONS.
  - SUBMITTALS: PROVIDE SUBMITTALS FOR ALL PRODUCTS AND BASIC MATERIALS FURNISHED FOR ELECTRICAL WORK.
  - EXISTING UNDERGROUND UTILITIES SHOWN ON PLANS ARE APPROXIMATE. VERIFY AND LOCATE ALL UNDERGROUND UTILITIES PRIOR TO EXCAVATION. CALL 811 FOR UTILITY LOCATE SERVICES.
  - CONDUCTORS SHALL BE COPPER #10 3-CONDUCTOR, CLASS B STRANDING, TYPE TC, THWN.
  - JUNCTION BOX AND OTHER EQUIPMENT LOCATIONS SHOWN ARE APPROXIMATE. FINAL LOCATION TO BE VERIFIED BY THE ENGINEER.

**HULTZ BHU**  
e n g i n e e r s i n c  
1111 Everett Ave Suite 100 Tacoma, WA 98402  
Phone: (253) 383-3257 Fax: (253) 383-3283  
general@hultzbhu.com Job Number: 22-185

**CASCADE CREEK  
MULTI FAMILY**  
38330 HWY 211  
SANDY, OR 97055

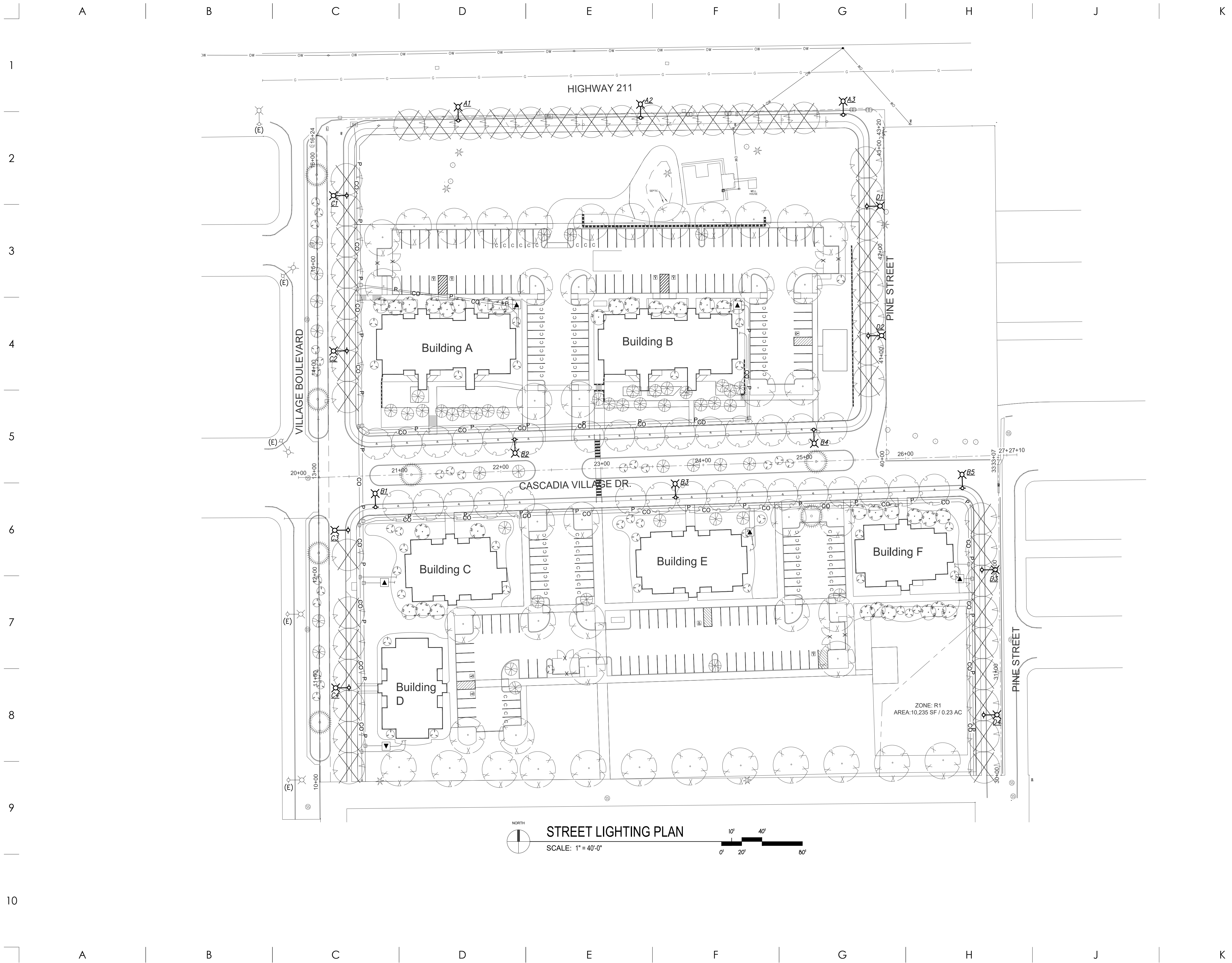


SHEET TITLE: LEGEND, NOTES & SCHEDULES	DATE: 10/14/2022
DRAWN: AD	CHECKED: CTU
REVISIONS:	

**EL1.0**

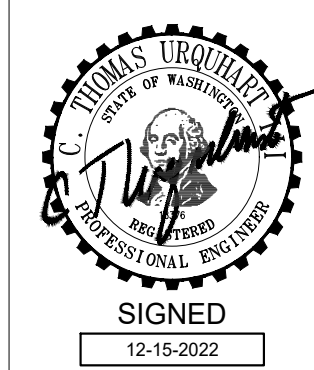
SHEET SIZE IS TRUE SCALE WHEN ABOVE LINE MEASURES AS NOTED





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1111 Everett Ave Suite 100 Tacoma, WA 98402  
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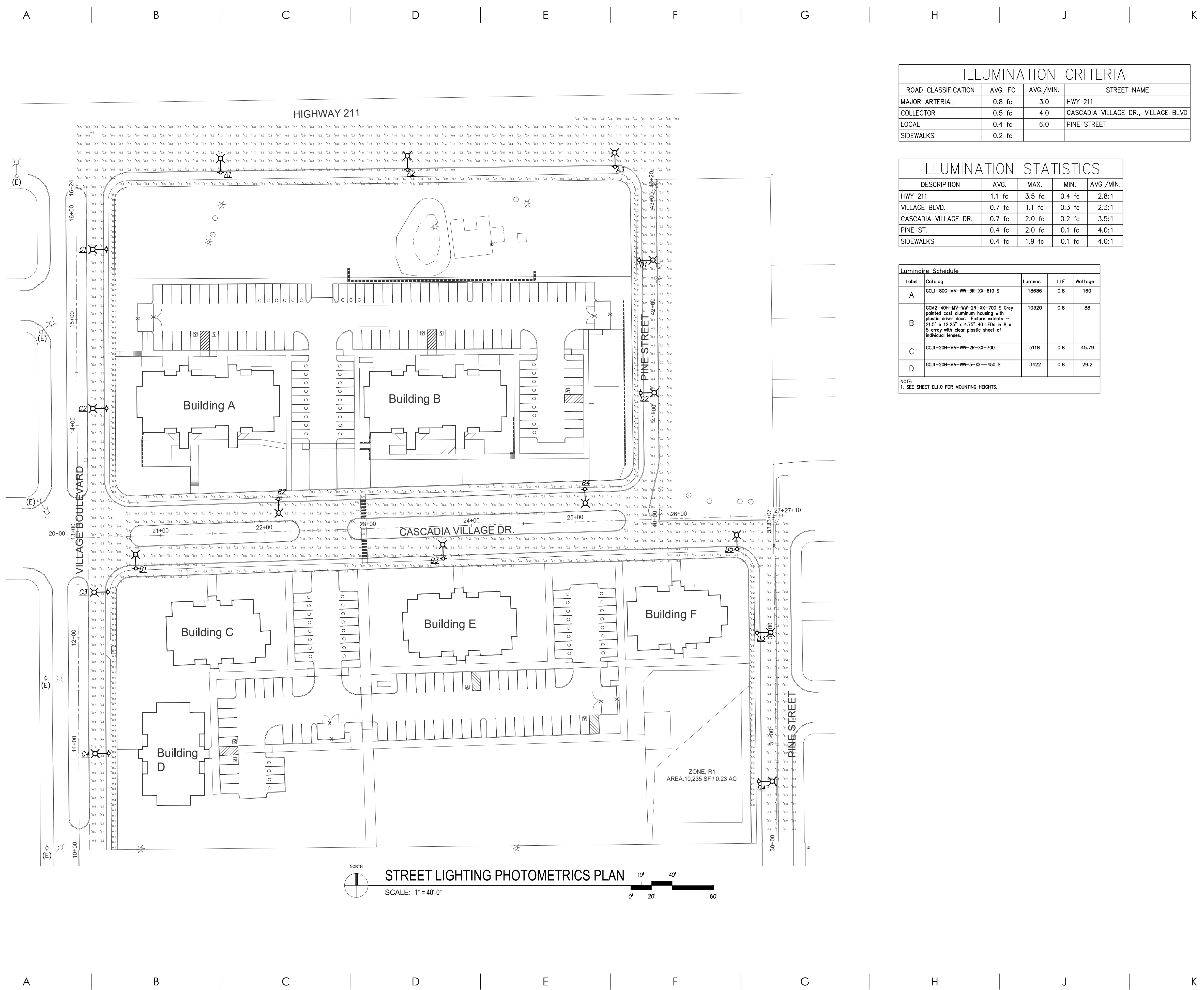
**CASCADE CREEK  
MULTI FAMILY**  
38330 HWY 211  
SANDY, OR 97055



SHEET TITLE: STREET LIGHTING PLAN  
DRAWN: AD  
CHECKED: CTU  
DATE: 10/14/2022  
REVISIONS:

**EL1.1**

SHEET SIZE IS TRUE SCALE WHEN ABOVE LINE MEASURES AS NOTED



ILLUMINATION CRITERIA			
ROAD CLASSIFICATION	AVG. FC	AVG./MIN.	STREET NAME
MAJOR ARTERIAL	0.8 fc	3.0	HWY 211
COLLECTOR	0.5 fc	4.0	CASCADIA VILLAGE DR., VILLAGE BLVD
LOCAL	0.4 fc	6.0	PINE STREET
SIDEWALKS	0.2 fc		

ILLUMINATION STATISTICS				
DESCRIPTION	AVG.	MAX.	MIN.	AVG./MIN.
HWY 211	1.1 fc	3.5 fc	0.4 fc	2.8:1
VILLAGE BLVD.	0.7 fc	1.1 fc	0.3 fc	2.3:1
CASCADIA VILLAGE DR.	0.7 fc	2.0 fc	0.2 fc	3.5:1
PINE ST.	0.4 fc	2.0 fc	0.1 fc	4.0:1
SIDEWALKS	0.4 fc	1.9 fc	0.1 fc	4.0:1

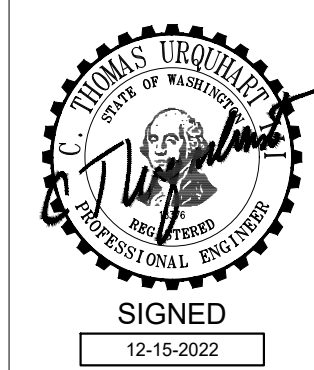
Luminaire Schedule				
Label	Catalog	Lumens	LLF	Wattage
A	GGL1-80G-MV-WW-3R-XX-610 S	18666	0.8	160
B	GCM2-40H-MV-WW-2R-XX-700 S Grey painted cast aluminum housing with plastic driver door. Fixture extends ~ 21.5" x 12.25" x 4.75" 40 LEDw in 8 x 5 array with clear plastic sheet of individual lenses.	10320	0.8	88
C	GCJ1-20H-MV-WW-2R-XX-700	5118	0.8	45.79
D	GCJ1-20H-MV-WW-5-XX-450 S	3422	0.8	29.2

NOTE:  
1. SEE SHEET EL1.0 FOR MOUNTING HEIGHTS.



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engineers inc  
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Phone: (253) 383-3257 Fax: (253) 383-3283  
general@hultzbhu.com Job Number: 22-185

**CASCADE CREEK  
MULTI FAMILY**  
38330 HWY 211  
SANDY, OR 97055



SHEET TITLE: STREET LIGHTING PHOTOMETRICS PLAN  
DRAWN: AD CHECKED: CTU DATE: 10/14/2022  
REVISIONS:

**EL2.1**

SHEET SIZE IS TRUE SCALE WHEN ABOVE LINE MEASURES AS NOTED



**EXHIBIT N**

38348 Pioneer Blvd.,  
Sandy, OR 97055  
503-668-5569

**To: Planning Commission**

**Date: Sept. 15, 2022**

**From: The Parks & Trails Advisory Board**

**Subject: Cascade Creek Apartments**

**Attachment A: Excerpt from Parks and Trails Master Plan (Bornstedt Park Phase 2)**

I am sending this communication on behalf of the Parks & Trails Advisory Board.

The board met on Sept. 14, 2022 and reviewed the proposed development Cascade Creek Apartments located at 38272 and 38330 Highway 211.

The Parks Board reviewed the proposed development and are recommending two items.

- 1) Acceptance of fee in lieu of parkland dedication
- 2) The Parks Board supports the Parks Department in exploring the option to establish a development agreement to build certain amenities as listed in the Bornstedt Park Phase 2 master plan.

The Parks Board recommends a fee-in-lieu of parkland due to the proximity of Bornstedt Park and because the existing park satisfies the proposed park system requirements as listed in the Parks and Trails Master Plan. The Parks Board also supports the development of a sidewalk on the east side of village blvd. right-of-way to meet the trail requirements of Trail 44 as listed in the Parks and Trails Master Plan.

At this time, an official recommendation was not possible due to a lack of a quorum. If necessary, the Parks Board will reconvene to supply an official recommendation.

Thank you for your consideration of this matter.

**Staff Contact:**

Rochelle Anderholm-Parsch  
503-489-2157  
randerholmparsch@ci.sandy.or.us

## Attachment A

### Bornstedt Park Phase 2

Phase 1 is complete and includes a looped path, splash pad, playground, picnic tables, a community garden, and two picnic shelters. As depicted in Figure 9 below, Phase 2 will include a half-sized basketball court, viewing mound, a community center, and parking, and half street improvements along the north and west sides. This park offers the only splash pad in the city, and even without the planned parking lot, there is ample street parking. These factors combine to make this a destination park and the city should consider including a plumbed restroom as surrounding development continues and use intensifies.



Figure 9 Bornstedt Park Master Plan

5/5/23, 11:24 AM

City of Sandy Mail - Re: Transmittal + Civil Plans - Cascade Creek Apartments



**EXHIBIT O**

Kelly O'Neill <koneill@ci.sandy.or.us>

**Re: Transmittal + Civil Plans - Cascade Creek Apartments**

Gary Boyles <fboyles.sandyfire@gmail.com>  
To: Sandy Planning <planning@cityofsandy.com>

Mon, Apr 17, 2023 at 11:28 AM

All future construction activities shall comply with the applicable Oregon Fire Code and the [Fire Code Application Guide](#). Construction documents detailing compliance with fire apparatus access and fire protection water supply requirements shall be provided to the Sandy Fire District for review and approval concurrently with building permit submittal (see comments submitted to Sandy Planning Division on April 4, 2022).

Thank you,

Gary Boyles  
Fire Marshal  
**Sandy Fire District No. 72**  
PO Box 518  
[17460 SE Bruns Ave.](#)  
Sandy, Oregon 97055

**Business line: 503-668-8093**  
**Cell number: 503-891-7042**

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On Tue, Apr 11, 2023 at 11:20 AM Sandy Planning <[planning@cityofsandy.com](mailto:planning@cityofsandy.com)> wrote:  
Morning all, please find and read the attached "Transmittal" and "Civil Plans" for Cascade Creek Apartments.

We'd like comments by Friday May 5th but reach out if you need additional time.

--  
*Rebecca Markham*  
*Executive Assistant*

Planning Division  
[planning@cityofsandy.com](mailto:planning@cityofsandy.com)  
(503)489-2160

39250 Pioneer Blvd  
Sandy, OR 97055

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Memorandum (May 5, 2023)

To: Kelly O'Neill, Development Services Director

From: AJ Thorne, Assistant Public Works Director

Re: 22-039 Cascade Creek Mixed Use

Please see Public Works comments below.

**Water**

Please show one Mueller Super Centurion hydrant for the hydrant at the lowest elevation. Provide meter locations. Waterlines out of the public ROW should be private, with a master-metering system. Show meter locations on plan set.

**Sanitary Sewer**

Confirm that upstream manhole on the East end of the property is deep enough to provide service to and through the property. Confirm that downstream PS has adequate capacity for this development. Provide details for any connections to manholes including lateral connections. Existing septic must be abandoned with coordination with Clackamas County.

**Street**

Please add asphalt on Village Blvd to facilitate turnarounds at the dead end. Provide cross sections of the east end of Cascadia Village Dr. Is a retaining wall included in this section?

**Storm**

Provide specifications and details on stormwater detention and quality facilities.

**Site**

5' Planter strips are to be used on all streets, with the exception of Hwy 211 where planter strips will be 8' in width. Please provide information on street lights and their associated infrastructure.

**AJ Thorne, PE**

Assistant Public Works Director

City of Sandy

503-489-2162





**EXHIBIT Q**

Kelly O'Neill <koneill@ci.sandy.or.us>

**RE: Transmittal - Cascade Creek Apartments Revised Comments**

Curt McLeod <cjm@curran-mcleod.com>

Mon, May 8, 2023 at 12:34 PM

To: Sandy Planning <planning@cityofsandy.com>, Thomas Fisher <tfisher@ci.sandy.or.us>, "A.J. Thorne" <ajthorne@ci.sandy.or.us>, Ryan Wood <rwood@ci.sandy.or.us>, "PW@cityofsandy.com" <PW@cityofsandy.com>

We have completed a review of the preliminary information submitted for the Cascade Creek Multifamily improvements and have the following comments:

1. The Foundation Engineering Inc. preliminary geotechnical report is acceptable and will need to be updated and finalized for design of the public improvements.
2. The BCRA Engineering draft stormwater report is acceptable but will need to be finalized for design of the public improvements. A summary of the existing downstream capacity needs to be included in the report. The stormwater collection system needs to distinguish the public pipelines from the private lines. The public system will need manholes at all pipe intersections as opposed to catch basins in the mainline conveyance design. Two catch basins in series is the acceptable limit with manholes at catch basin connections to the main lines.
3. A detailed plan review of all utility and street improvements will be completed after construction plans are submitted.
4. The preliminary sanitary sewer shown to serve Parcel 2 will need to be an 8" public line in an easement, terminating with a manhole to serve Parcel 1.
5. Hwy 211 storm and frontage improvements will be reviewed once the detailed design is provided.
6. The 14' Pine Street travel lane improvements are less than the minimum required width for fire access and will require approved by the Fire Department.
7. The 16' travel lanes on Village Blvd are less than the minimum required for fire access and will require approval by the fire department.
8. The 17.5' travel lanes on Cascadia Village Drive are less than the minimum required for fire access and will require approval by the fire department. Collector street standards require a 5' planter strip as opposed to the 4' shown on the preliminary plans.
9. The connection of the western Pine Street alignment to Cascadia Village Drive may need to encroach into Parcel 2 to provide acceptable street width, or the two trees noted to be protected should be removed.

Let me know if you have any questions

.....  
Curt McLeod P.E.

CURRAN-McLEOD, INC.

6655 S.W. Hampton Street, Suite 210

Portland, Oregon 97223

T: (503) 684-3478

F: (503) 624-8247

C: (503) 475-0431

email: [cjm@curran-mcleod.com](mailto:cjm@curran-mcleod.com)

Upload files: <https://www.hightail.com/u/Curran-McLeod>

5/8/23, 1:33 PM

City of Sandy Mail - RE: Transmittal - Cascade Creek Apartments Revised Comments

**From:** Sandy Planning <[planning@cityofsandy.com](mailto:planning@cityofsandy.com)>

**Sent:** Tuesday, April 11, 2023 11:10 AM

**To:** Curt McLeod <[cjm@curran-mcleod.com](mailto:cjm@curran-mcleod.com)>; Thomas Fisher <[tfisher@ci.sandy.or.us](mailto:tfisher@ci.sandy.or.us)>; A.J. Thorne <[ajthorne@ci.sandy.or.us](mailto:ajthorne@ci.sandy.or.us)>; Ryan Wood <[rwood@ci.sandy.or.us](mailto:rwood@ci.sandy.or.us)>

**Subject:** Transmittal - Cascade Creek Apartments

Morning all, please find the attached transmittal, stormwater report, traffic report, and geotech report for Cascade Creek Apartments.

Kelly would like comments by May 5th but reach out if you need additional time.

Have a great day everyone!!

--

*Rebecca Markham*  
*Executive Assistant*

Planning Division  
[planning@cityofsandy.com](mailto:planning@cityofsandy.com)

(503)489-2160

39250 Pioneer Blvd  
Sandy, OR 97055

 [Stormwater Report - Cascade Creek Apartments - ...](#)

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**SandyNet Comments for Cascade Creek Development**

I have attached our boiler plate explanation for new developments below, outlining intent and code requirement sections for reference.

SandyNet is a department of the City of Sandy which operates a dry public utility. SandyNet design requirements are similar to other broadband and telecommunications standards, such as depth, type of pipe, hand hole size, etc. The main differences for SandyNet infrastructure are that the materials, their cost, and the installation of the conduit and vaults are placed solely on the developer, much like the other public utilities. Conduit should follow the plans provided by SandyNet; however, modification can be arranged with approval from SandyNet. Vaults should be set within the PUE at finished grade and all conduits should sweep into vaults and up to sides of the homes. Please see design requirements for full list of standards. Below are the relevant code sections of the development code that contain broadband infrastructure.

17.84.20A

17.84.60A

17.84.70

17.100.260

17.100.310K

Once the developer receives a preliminary or final power plan from PGE, SandyNet will be able to provide a development plan following PGE's path. SandyNet will attempt to follow the proposed common trench as much as possible. When common trenches are not optimal or possible, SandyNet may require alternate lines be placed or adjusted. SandyNet is open to exploring and changing the layout so long as it falls within our design guidelines. Upon placement of the conduit, a SandyNet representative will verify the conduit path before the trench is filled or closed. Please reach out to one of the following contacts below if you have any questions or need to schedule an inspection. Please send the PGE power plans to both contacts.

## **Contacts**

Ron Yow

SandyNet Construction Lead

541-514-9771

[ryow@ci.sandy.or.us](mailto:ryow@ci.sandy.or.us)

Greg Brewster

IT Director

503-489-0937

[gbrewster@ci.sandy.or.us](mailto:gbrewster@ci.sandy.or.us)

## **Infrastructure Standards (After PGE Preliminary Design is Provided to SandyNet)**

### **Last updated on 7/26/2022**

Install 2-inch Schedule 40 or 2-inch or 1.25" HDPE conduit from existing SandyNet Pedestal and throughout neighborhood as shown on the SandyNet infrastructure requirements plan.

Maintain minimum 36" radius on all conduit sweeps and bends

Install vaults and hand holes of varying types as specified. Vault part numbers are referenced in map legend.

Vaults to be set with minimum of 4" crushed rock below rim/skirt of vault.

Vault lids to be labeled with FIBEROPTIC if supplied from provider

Place 210lb Polyline pull string in each conduit and secure ends.

Top of vault lids to be set at final grade and approved by SandyNet staff

Install 1-inch schedule 40 or minimum 3/4" HDPE conduit to the service demarcation point of each home premise from the appropriate serving vault/hand hole as defined in the design.

### **Additional Vault Requirement Modification**

Due to high costs and low availability of service vaults, SandyNet has a range of models available for deployment. If possible SandyNet requests that the same manufacture and model be used for each group

of vault types. SandyNet is also flexible if another model is available but not listed below. Please reach out to Ron Yow to verify before ordering.

For mainline vaults, please make sure the following conditions are met when ordering and placing vaults. Vaults are only required to be (20k) traffic rated when the vault exists within Sandy/Clackamas County/ODOT ROW or is not buffered with a sidewalk. Vaults behind a sidewalk or within the PUE are not required to be traffic rated unless otherwise specified by SandyNet staff.

Newbasis FCA243624T-00006

Channel BULKU2436240011009

OLD24361722

For distribution vaults, please make sure the following conditions are met when ordering and placing vaults. Vaults are not required to be traffic rated (20k), so long as vault is placed in the PUE and not in any ROW. Boxes must be at least 13" x 19" x12" or larger. All 20k rated vaults must be 13" x 24" x18".

Newbasis FCA173024T-00006

Channel BULKU1324180061001

OLD17301737

Carson Green Handhole CAR1419-12 W/CAR1419T



**Todd Prager & Associates**  
LLC

**MEMORANDUM**

**DATE:** May 10, 2023

**TO:** Kelly O’Neill Jr. (City of Sandy)

**FROM:** Todd Prager, RCA #597, ISA Board Certified Master Arborist

**RE:** Tree Variance Review for Cascade Creek Apartments

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**Background**

This memorandum is a summary of my review of the proposed tree variance for the Cascade Creek Apartments project at 38272 OR-211 in Sandy, Oregon.

The City of Sandy requested a third-party review of the proposed tree variance to address the following items:

- The proposed preservation and removal of trees, with particular attention to the area around the existing structures and along Highway 211; and
- A review of the proposed landscaping plan and recommendations regarding the proposed tree replacement plan for tree removal.

My review is based on the arborist report dated December 22, 2022 by Washington Forestry Consultants, Inc. along with the tree removal variance narrative dated January 2, 2023 by BCRA, the civil plan set dated January 9, 2023, and the landscape plan set dated February 17, 2023 by Nature by Design, Inc. I excerpted sheet C-102 from the civil plan set and Table 3 from the arborist report and added the following markups in Attachment 1 of this memorandum to aid in my review:

-  - Save tree in poor condition
-  - Potential retention tree (11-inch+ DBH and good condition)
-  - Typical root protection zone radius of one foot per inch of DBH
-  - Typical minimum construction setback radius of 0.5 feet per inch of DBH

---

*Todd Prager & Associates, LLC*  
 601 Atwater Road · Lake Oswego, OR 97034  
 Phone: 971.295.4835 · Email: todd@toddparger.com · Website: toddprager.com

## Tree Preservation and Removal Review

The arborist report dated December 22, 2022 by Washington Forestry Consultants, Inc. includes the size (trunk diameter, DBH), species, conditions, and locations of the trees within and directly adjacent to the site. This data was used as the basis for my review of the proposed tree preservation and removal.

### Eligible Retention Trees

Sandy Municipal Code (SMC) Sec. 17.54.140(C) – *BVO environmental standards* supersedes Chapter 17.102 - *Urban Forestry*. The BVO standards require the preservation of six trees over 11-inch DBH per acre. City of Sandy staff practice is to apply the preservation standard to the gross site acreage (rather than the net acreage after right-of-way dedication). The gross site acreage is 8.83 acres, and not the net acreage of 6.95 acres. Therefore, a total of 53 preservation trees are required to be retained.

The City of Sandy's administrative practice is to require preservation trees to be in good health condition. In reviewing Table 3 of the arborist report, there are 11 potential preservation trees at the site (trees 10, 11, 12, 13, 34, 35, 57, 60, 66, 67, and 68, which I highlighted in yellow in Attachment 1). Four of these trees (trees 35, 60, 66, and 68) are proposed for preservation while the remaining seven trees will be removed. Of the seven trees proposed for removal, four are not practicable to retain because they are within the footprint of right-of-way improvements along Highway 211 (trees 12, 13, 34, and 67) and one is not practicable to retain because it is near the center of a proposed parking lot (tree 11). Two of the trees may be practicable to retain because they are at the edges of a proposed parking lot (trees 10 and 57). These trees should be further evaluated by the applicant for retention with a modified site design which could include reducing adjacent parking stall depth, eliminating adjacent parking stalls, and/or shifting or adding parking lot islands so they are adjacent to the trees.

*Findings and Recommendations:* The gross site acreage is 8.83 acres and the BVO standards require the preservation of six trees per acre. Therefore, a total of 53 preservation trees are required to be retained. There are 11 possible preservation trees at the site. Four are proposed for retention, five are not practicable to retain based on their locations relative to right of way and parking lot improvements, and two may be practicable to retain with minor design changes. The applicant should further evaluate design options to retain trees 10 and 57.

### Trees to be Retained Around Existing Structures and Along Highway 211

In addition to the preservation trees listed as saved by the applicant, there are several other trees that are currently proposed to be retained around the existing structures and along Highway 211. These trees are not eligible preservation trees because they are either not in good condition or they are less than 11-inch DBH. The applicant may decide to retain these additional trees, but they also have the option of removing them.

Ten of the trees to be retained are currently in poor condition. These trees are highlighted in red in Attachment 1. The applicant team should coordinate with the

project arborist to evaluate whether trees in poor condition should be retained or if they should take the opportunity to remove them with proposed construction. Consideration should be given to the risks to people and property associated with retaining these and other trees at the site.

*Findings and Recommendations:* Ten trees to be retained are in poor condition and eligible for removal. The applicant team should coordinate with the project arborist to evaluate whether trees in poor condition should be retained or if they should take the opportunity to remove them with proposed construction.

### **Protection of Tree 35**

Tree 35 is proposed to be retained but does not have tree protection fencing shown for its root protection zone. In reviewing sheet C-501 from the civil plan set, there is a new sanitary sewer service line proposed within its root protection zone. Based on the potential impacts to the tree, tree protection fencing should be provided for tree 35. The applicant team should also coordinate with the project arborist to determine if an alternate route for the sanitary sewer service line is possible to better protect the tree.

*Findings and Recommendations:* Tree 35 does not have tree protection fencing and there is a sanitary sewer service line proposed within its root protection zone. Tree protection fencing should be provided for tree 35. The applicant team should determine if an alternate route for the sanitary sewer service line is possible to better protect the tree.

### **Tree Replacement Plan Review**

Tree replacement is required at a 2:1 ratio by Sec. 17.102.70.A - *Variances* when the retention standards of Sec. 17.54.140(C) – *BVO environmental standards* cannot be met. For this site, there are a total of 53 preservation trees required but only 11 possible preservation trees are at the site. The current proposal is to retain four preservation trees and potentially retain an additional two preservation trees. Therefore, there are 49 to 47 additional preservation trees required.

City of Sandy staff's administrative practice is to require a 2:1 tree replacement ratio for deficient sites based on the preservation tree deficit. Therefore, 94 to 98 replacement trees are required based on the final number of preservation trees (i.e., 49 or 47 tree deficit  $\times$  2).

Staff allows retained trees that are less than 11-inch DBH and in good condition to be eligible for mitigation credit. Tree 70 is the only retained tree on site that fits these criteria and is therefore eligible for replacement tree credit. However, this tree has a sidewalk to be removed within its root zone. For this tree to receive mitigation credit, the project arborist should be required to be onsite and document the proper protection of the tree during demolition work in its root zone. If tree 70 is retained and properly protected during demolition, 93 to 97 replacement trees would be required to be planted.

The proposed landscape plan includes 56 native replacement trees that are proposed for meeting the criteria of Sec. 17.102.70.A. This results in a deficit of 37 to 41 replacement trees depending on the final tree preservation plan. In addition, several of the replacement trees are closely spaced and will result in excessive competition for space and light that will impact their long-term viability. Spacing of trees should be increased to at least 15 feet on center to be eligible for replacement tree credit. Tree spacing at 15 feet on center is the average minimum spacing required for reforestation according to Oregon's Forest Practices Act for high site classes which include the subject site.<sup>1</sup>

*Findings and Recommendations:* Four to six preservation trees will be retained for a site which requires 53 preservation trees. Therefore 47 to 49 additional preservation trees are required depending on the final number of preservation trees that are retained. A 2:1 tree replacement ratio applies to deficient sites, so 94 to 98 replacement trees are required. The applicant has proposed 56 native replacement trees and will preserve one tree that is less than 11-inch DBH and in good condition that may serve as a replacement tree if protected under arborist supervision during demolition work. Therefore, 37 to 41 additional replacement trees are required. The applicant should provide 37 to 41 additional native replacement trees and ensure a minimum spacing of at least 15 feet on center. Non-native trees in the proposed landscape plan could be replaced with suitable native species to meet the tree replacement requirement.

## Conclusion

Based on my review of the tree variance for Cascade Creek Apartments, I recommend the following:

- Further evaluate design options to retain trees 10 and 57;
- Coordinate with the project arborist to evaluate whether trees in poor condition should be retained;
- Provide protection fencing for tree 35 and determine if an alternate route for the sanitary sewer service line to avoid the tree's root zone is possible;
- Require the project arborist to be onsite and document the proper protection of tree 70 during demolition work in its root zone for it to receive credit as a mitigation tree; and
- Provide 37 to 41 additional native replacement trees and ensure a minimum spacing of at least 15 feet on center for all replacement trees.

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<sup>1</sup> Logan, R. 2018. Oregon's Forest Protection Laws – An Illustrated Manual, 3rd Edition. Available from the Oregon Forest Resources Institute, 317 SW Sixth Ave., Suite 400, Portland OR 97204, and <https://oregonforests.org/publications>.

Please contact me if you have questions, concerns, or need any additional information.

Sincerely,



**Todd Prager**  
*ASCA Registered Consulting Arborist*  
*ISA Board Certified Master Arborist, WE-6723B*  
*ISA Qualified Tree Risk Assessor*  
*AICP, American Planning Association*

Attachment 1 – Redlined sheet C-102 from civil plans and Table 3 from arborist report



# Attachment 1



### LEGEND

- REMOVE EXISTING TREE
- TREE PROTECTION FENCE
- RETAINED TREE CRITICAL ROOT ZONE
- PROPERTY LINE
- TREE REMOVAL REQUIRING MITIGATION
- EXISTING TREE WITH CALCULATED DBH. SEE GENERAL NOTE 1

### GENERAL NOTE:

1. TREE LOCATIONS ON PLAN HAVE NOT BEEN SURVEYED. LOCATIONS REFLECT TREE PROTECTION PLAN REPORT PREPARED BY WASHINGTON FORESTRY CONSULTANTS, INC., DATED 12/22/2022.

### CODE REQUIREMENTS:

SMC 17.54.140  
 TREE RETENTION = 6 TREES/AC \* 6.95 AC = 42 TREES RETAINED WITH DBH >11"  
 A VARIANCE WILL BE REQUESTED PER SMC SEC. 17.102.70 TO FULFILL TREE RETENTION REQUIREMENTS AS TREE RETENTION REQUIREMENTS CANNOT BE MET ON-SITE.  
 SMC 17.102.10  
 TREES ARE DEFINED AS "ANY LIVING, STANDING, WOODY PLANT HAVING A TRUNK 11 INCHES DBH OR GREATER".  
 SMC 17.102.20.B.1  
 "TREE REMOVAL AS REQUIRED BY THE CITY OR PUBLIC UTILITY FOR THE INSTALLATION OR MAINTENANCE OR REPAIR OF ROADS, UTILITIES OR STRUCTURES" ARE "EXEMPT FROM TREE RETENTION REQUIREMENTS".

### EXISTING TREE COUNT:

TREES IN RIGHT-OF-WAY: 36  
 TREES ON-SITE: 38  
 TREES OFF-SITE: 8  
 TOTAL TREES: 82

### PROPOSED TREE RETENTION/REMOVAL:

TOTAL TREES ON-SITE: 82 TREES  
 TOTAL TREES REMOVED: 58 TREES  
 TOTAL TREES RETAINED: 24 TREES

### EXEMPTIONS (SEE TREE VARIANCE NARRATIVE FOR MORE INFORMATION):

<11" DBH REMOVED (EXEMPT PER SMC 17.102.10): 17 TREES  
 RIGHT-OF-WAY REMOVED (EXEMPT PER SMC 17.10.20(B)(1)): 23 ADDITIONAL TREES, INCLUDES OFF-SITE TREES E, F, G, AND H.  
 TOTAL EXEMPT TREES: 17 + 23 = 40 TREES

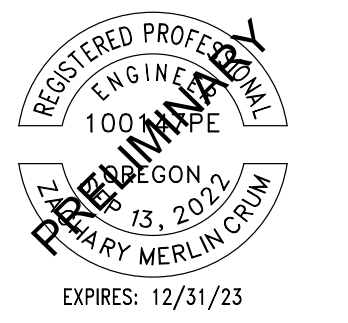
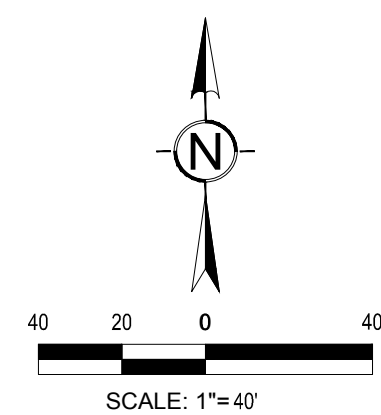
TREE REMOVAL REQUIRING MITIGATION: 58 - 40 = 18 TREES

### TREE MITIGATION

SMC 17.102.70  
 MINIMUM MITIGATION RATIO: 2:1 RATIO  
 MITIGATION TREES REQUIRED: 18 X 2 = 36 MITIGATION TREES

REFER TO LANDSCAPE PLANS FOR MITIGATION TREES TYPES AND PLACEMENT.

- Save tree in poor condition
- Potential retention tree (11-inch+ DBH and good condition)
- Typical root protection zone radius of one foot per inch of DBH
- Typical minimum construction setback radius of 0.5 feet per inch of DBH



PROJECT  
 SHEET SET CREATED BY RB 08.16.2022  
**CASCADE CREEK MULTI FAMILY**  
 38530 HAWY 211  
 SANDY, OR 97055

NO.	DATE	DESCRIPTION

DATE  
01.09.2023  
 BCSA NO.  
21129  
 DRAWN BY RJB, SM  
 CHECKED BY ZMC  
 SHEET TITLE  
**TREE PROTECTION PLAN**



**C-102**

LAND-USE

IF SHEET MEASURES LESS THAN 24"X36", IT IS A REDUCED PRINT. REDUCE SCALE ACCORDINGLY

Table 3  
 Master Tree List for Entire Project Area

Attachment 1

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Reason for Removal	Significant Tree ≥8" DBH? Yes or No
1	Douglas-fir	10,7,5	14.3	Very Poor; 3 stems;	Yes	Remove		On R/W	On R/W	Yes
2	Cherry	12		Fair; Never pruned;	Yes	Remove		Buildable Area	Footprint	Yes
3	Cherry	14		Fair; Never pruned;	Yes	Remove		Buildable Area	Footprint	Yes
4	Douglas-fir	11		Fair;	Yes	Remove	10 ft.	On R/W	Impacted by construction	Yes
5	Douglas-fir	45		Very Poor; Very severe decline;	No	Remove		Buildable Area	Footprint	Yes
6	Bigleaf maple	12,16,12,10	25.4	Very Poor; Decay in stems;	No	Remove		Buildable Area	Footprint	Yes
7	Hawthorne	4 to 8	19.9	11 stems; Very Poor;	No	Remove		Buildable Area	Footprint	Yes
8	Austrian pine	26		Poor;	No	Save		East House Lot		Yes
9	Photina	6,8	10	Fair;	Yes	Save		East House Lot		Yes
10	Blue atlas cedar	21		Good;	Yes	Remove		East House Lot	Wall impacts	Yes
11	Flowering Cherry	11.1		Good;	Yes	Remove		Buildable Area	Footprint	Yes
12	Flowering Cherry	15		Good;	Yes	Remove		On R/W	On R/W	Yes
13	Flowering Cherry	15		Good;	Yes	Remove		On R/W	On R/W	Yes
14	Douglas-fir	3		Good;	Yes	Remove		On R/W	On R/W	No
15	Ponderosa pine	10		Very Poor;	No	Remove		On R/W	On R/W	Yes
16	Ponderosa pine	13		Very Poor;	No	Remove		On R/W	On R/W	Yes
17	Ponderosa pine	15		Poor;	No	Remove		On R/W	On R/W	Yes
18	Ponderosa pine	14		Fair;	Yes	Remove		On R/W	On R/W	Yes
19	Ponderosa pine	9		Fair;	Yes	Remove		On R/W	On R/W	Yes
20	Ponderosa pine	11		Fair;	Yes	Remove		On R/W	On R/W	Yes
21	Ponderosa pine	21		Poor;	No	Remove		On R/W	On R/W	Yes
22	Ponderosa pine	16		Fair;	Yes	Remove		On R/W	On R/W	Yes
23	Ponderosa pine	11		Fair;	Yes	Remove		On R/W	On R/W	Yes
24	Ponderosa pine	10		Poor; Multiple tops;	No	Remove		On R/W	On R/W	Yes
25	Ponderosa pine	8		Very Poor;	No	Remove		On R/W	On R/W	Yes
26	Ponderosa pine	17		Fair;	Yes	Remove		On R/W	On R/W	Yes
27	Ponderosa pine	24		Fair;	Yes	Remove		On R/W	On R/W	Yes
28	Ponderosa pine	8,8,8	13.9	Very Poor;	No	Remove		On R/W	On R/W	Yes
29	Austrian pine	9,8	12	Very Poor;	No	Remove		On R/W	On R/W	Yes

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Reason for Removal	Significant Tree ≥8" DBH? Yes or No
30	Cherry	12,9	15	Very Poor; Decay in stem;	No	Remove		On R/W	On R/W	Yes
31	Austrian pine	9		Poor;	No	Remove		On R/W	On R/W	Yes
32	Douglas-fir	10		Good;	Yes	Remove		On R/W	On R/W	Yes
33	Douglas-fir	10		Good;	Yes	Remove		On R/W	On R/W	Yes
34	Douglas-fir	13		Good;	Yes	Remove		On R/W	On R/W	Yes
35	Douglas-fir	30		Good;	Yes	Save		East House Lot		Yes
36	Western white pine	25		Fair; Codom leader;	Yes	Remove		On R/W	On R/W	Yes
37	Douglas-fir	26		Fair; Pistil butt;	Yes	Remove		West House Lot	Grading	Yes
38	Pacific yew	6,6	8.5	Very Poor; Falling over;	No	Save		West House Lot		Yes
39	Ponderosa pine	13		Poor;	No	Remove		On R/W	On R/W	Yes
40	Ponderosa pine	16		Poor;	No	Save		West House Lot		Yes
41	Ponderosa pine	16		Poor; Codom stems;	No	Save		West House Lot		Yes
42	Ponderosa pine	12		Fair; Leaner;	Yes	Save		West House Lot		Yes
43	Ponderosa pine	10		Fair;	Yes	Save		West House Lot		Yes
44	Ponderosa pine	15		Poor; Codom stems;	No	Save		West House Lot		Yes
45	Ponderosa pine	17		Poor; Codom stems;	No	Save		West House Lot		Yes
46	Ponderosa pine	16		Poor; Codom stems;	No	Remove		West House Lot	Grading	Yes
47	Ponderosa pine	16		Poor; Codom stems;	No	Remove		West House Lot	Grading	Yes
48	Ponderosa pine	19		Very Poor; Codom stems;	No	Remove		West House Lot	Grading	Yes
49	Ponderosa pine	15		Poor; Codom stems;	No	Remove		Buildable Area	Footprint	Yes
50	Ponderosa pine	14		Poor;	No	Remove		Buildable Area	Footprint	Yes
51	Ponderosa pine	13		Very Poor; Top broken out;	No	Remove		Buildable Area	Footprint	Yes
52	Flowering plum	8.5		Very Poor;	No	Remove		East House Lot	Grading	Yes
53	Flowering plum	7.5		Very Poor;	No	Save		East House Lot		No
54	Flowering plum	7		Very Poor;	No	Save		East House Lot		No
55	Western redcedar	10		Good;	Yes	Remove		Buildable Area	Footprint	Yes
56	Deodar cedar	12		Fair;	Yes	Remove		Buildable Area	Footprint	Yes
57	Douglas-fir	12		Good;	Yes	Remove		Buildable Area	Footprint	Yes
58	Pt. Orford Cedar	17		Fair;	Yes	Save		West House Lot		Yes
59	Douglas-fir	8-9		Very Poor; Suppressed;	No	Save		West House Lot		Yes
60	Douglas-fir	21		Good;	Yes	Save		West House Lot		Yes

#	Species	DBH (in)	Calculated DBH for Multi-Stem Trees (in)*	Condition	Savable Based on Tree Condition Only? Yes or No	Project Plan Save or Remove	Minimum Root Protection Zone Radius if Saved (ft)	Location	Reason for Removal	Significant Tree ≥8" DBH? Yes or No
61	Blue atlas cedar	9		Fair;	Yes	Save		West House Lot		Yes
62	Blue atlas cedar	9		Fair;	Yes	Save		West House Lot		Yes
63	Blue atlas cedar	4,5	6.4	Very Poor;	No	Save		West House Lot		No
64	Flowering Cherry	8,7,8	13.3	Very Poor;	No	Save		West House Lot		Yes
65	Deodar cedar	8		Fair;	Yes	Save		West House Lot		Yes
66	Douglas-fir	11		Good;	Yes	Save		West House Lot		Yes
67	Douglas-fir	25		Good;	Yes	Remove		On R/W	On R/W	Yes
68	Douglas-fir	12		Good;	Yes	Save		West House Lot		Yes
69	Ponderosa pine	8.4	8.9	Fair;	Yes	Remove		West House Lot	Grading	Yes
70	Shore pine	6		Good;	Yes	Save		West House Lot		No
71	Douglas-fir	6		Good;	Yes	Remove		On R/W	On R/W	No
72	Flowering plum	6,6,4	9.4	Very Poor;	No	Remove		West House Lot	Grading	Yes
73	Douglas-fir	9		Fair;	Yes	Remove		On R/W	On R/W	Yes
74	Douglas-fir	9		Fair;	Yes	Save		West House Lot		Yes
75	Flowering Cherry	10,6	11.7	Very Poor;	No	Remove		On R/W	On R/W	Yes
76	Apple	12		Very Poor;	No	Remove		On R/W	On R/W	Yes
77	Apple	6		Very Poor;	No	Remove		On R/W	On R/W	No
78	Apple	9,6,6	12.4	Very Poor;	No	Remove		On R/W	On R/W	Yes
79	Ponderosa pine	17,16	23.3	Very Poor; Codom stems;	No	Remove		On R/W	On R/W	Yes
80	Scotch pine	9,6	10.8	Poor;	No	Remove		On R/W	On R/W	Yes
81	Scotch pine	17		Fair;	Yes	Remove		On R/W	On R/W	Yes
82	Ponderosa pine	7		Very Poor;	No	Remove		On R/W	On R/W	No

\*Calculated DBH for multi-stem trees = Square Root of the sums of the individual stem diameters squared.

\*\*Shaded trees are non-significant.



## EXHIBIT T

Sandy Transit  
16610 Champion Way  
Sandy, OR 97055

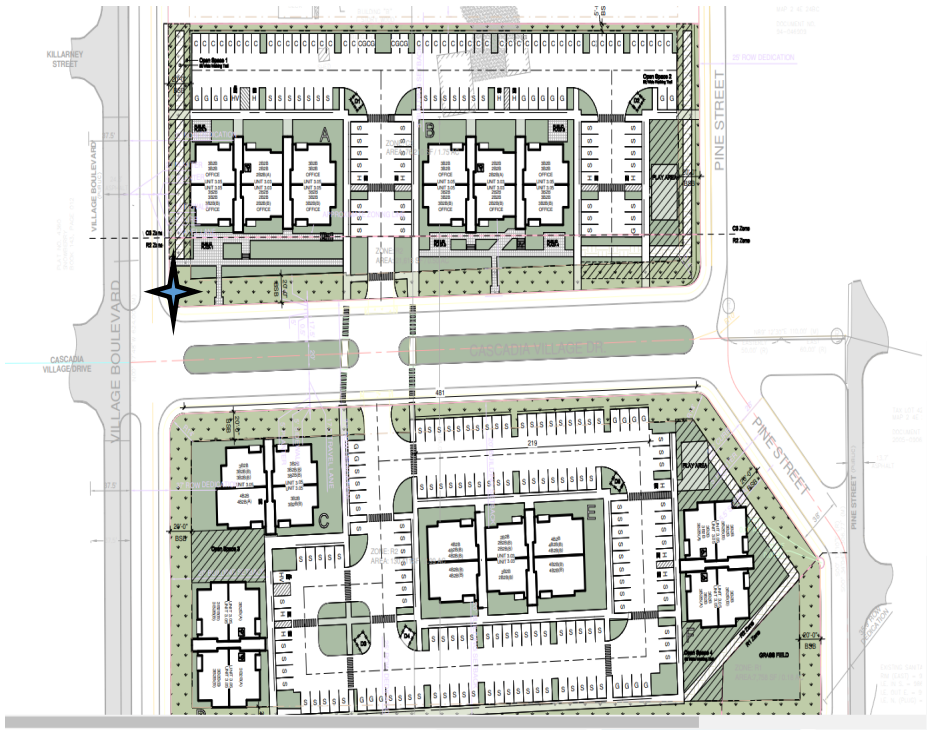
### Memorandum

**Date:** May 11, 2023  
**To:** Kelly O'Neill, Planning Director;  
**From:** Andi Howell, Transit Director  
**Re:** Transit Request Cascade Creek Apartments

Per review of Cascade Creek Apartments, the Transit Department requests the addition of a bus stop and shelter. The bus stop design should be at minimum a 7' X 9.5' pad with a 5' X 7.5' bus shelter. The stop location is marked in this memo and is on Cascadia Village Dr. at the intersection of Village Boulevard.

Please contact the Transit Department for specific location, amenity information and pad engineering specifications at 503-489-0925 or [ahowell@ci.sandy.or.us](mailto:ahowell@ci.sandy.or.us).

Andi Howell  
Transit Director





DATE: June 14, 2023

REQUEST: Cascade Creek Apartments, Transportation Review

FILE NO: 22-041 DR/ADJ

REVIEWER: Dock Rosenthal, PE, DKS Associates

DKS Associates has reviewed the traffic impact analysis<sup>1</sup> and site plan for the Cascade Creek Apartments. The proposed development application would construct 78 multi-family, low-income dwelling units and 11,142 feet of commercial/office space. The project site is located just south of Highway 211 and east of Village Boulevard. The development will connect with the transportation system via an extension of Cascadia Village Drive and an extension of Pine Street which provides direct access to Highway 211.

The general comments and listing of recommended conditions of approval are based on a review of the impact study and site plan.

## DEVELOPMENT TRANSPORTATION IMPACT REVIEW

Key comments and issues related to the proposed development's transportation impact analysis include:

### Existing

- Study Intersections
  - Highway 211 & Gunderson Road
  - Highway 211 and SE Village Boulevard
  - SE Village Boulevard & Cascadia Village Drive
  - Highway 211 & Dubarko Road
- Traffic operations were evaluated using HCM 6<sup>th</sup> edition. All study intersections operate at an acceptable level of service during the 2022 AM and PM peak hours.
- Crash data from January 2017 to December 2021 was analyzed. At the intersection of Highway 211 and Dubarko Road there were 23 crashes. Of these 16 were angle crashes. This intersection

<sup>1</sup> Cascade Creek Traffic Analysis Letter, Heath & Associates, INC, May 22, 2023.

has been identified through the Transportation System Plan update process as a location where safety is a concern.

#### **Future (2025) Background Condition**

- A growth rate of 2.0 percent per year was applied to the existing 2023 volumes to account for background growth. The Bull Run Terrace in-process development was not included in the background conditions. This development is expected to add trips to the Highway 211 and Dubarko Road intersection.
- Both study intersections operate at an acceptable volume to capacity ratios during the 2024 AM and PM peak hours

#### **Future (2025) With Project Condition**

- ITE Trip Generation Codes 220 Multifamily Low-Rise and 822 Strip Retail Plaza were used for the trip generation estimation. A 40 percent pass by rate was applied to trips generated by the Strip Retail Plaza.
- The proposed project would result in additional vehicle trips: 47 (17 in/30 out) AM peak hour vehicle trips, 84 (47 in/37 out) PM peak hour vehicle trips and 890 weekday trips.
- Trip distribution was based on existing traffic counts.
- 2025 Total Traffic Conditions – The intersection of Highway 211 and Dubarko Road will exceed the City of Sandy’s LOS standard with project conditions in the p.m. peak in 2025. Other study intersections will meet the LOS standard. This deficiency has been noted in the Transportation System Plan and a proportional share fee is being collected to address the deficiency.
- Turn warrants were considered but turning movement traffic does not meet the minimum volume to warrant turn lanes from SE Village Boulevard to Cascadia Village Drive.
- Over 300 feet of sight distance is available to the south from the intersection of Cascadia Village Drive and SE Village Boulevard, this exceeds the required 280 feet. To the north, the intersection of Highway 211 and SE Village Boulevard is visible from the proposed intersection.
- Analyzed as a right-in only, southbound road the future Pine Street half street connection with Highway 211 is not expected to attract any trips. Based on turning movements from the site at the intersection of Highway 211 and SE Village Boulevard the future Pine Street connection could attract around 40 bidirectional peak hour site trips or approximately 400 daily vehicles. With full access to the southern leg of Pine Street (south of Cascadia Village Drive) existing trips may shift to Pine Street from SE Bornstedt Road. The amount of volume shift would likely be related to the amount of on street parking along Pine Street which would act as a traffic calming measure.
- The proposed development will access the transportation network via two collector facilities, Cascadia Village Drive and SE Village Boulevard. These connections are expected to attract a majority, if not all, the trips generated by the development resulting in a negligible impact to local streets.

#### **Mitigation**

- The future Pine Street connection, to be constructed by the development, is recommended to be closed until the full street can be constructed. As a half street, a one-way configuration may cause confusion for drivers.
- A “No Left Turn” sign is recommended at the northbound approach of the future intersection of Pine Street and Cascadia Village Drive.



## RECOMMENDED CONDITIONS OF APPROVAL

The following conditions of approval are recommended based on a review of the traffic impact study and site plan:

1. The development shall contribute Transportation System Development Charges toward citywide impacts.
2. The development shall contribute a proportional share fee for trips through the Highway 211 and Dubarko Road intersection. The cost per trip is \$15,785, based on the planned improvement project of intersection widening and installation of a traffic signal. As shown on page 18 in Figure 6 of the TIA, 46 PM peak hour trips are expected to use the Highway 211 & Dubarko Road intersection. These trips are based on the estimated trip generation from the Multifamily Low-rise and Strip Retail land use codes. Non-residential trip fees shall be assessed when final approvals are granted and specific non-residential uses are identified. The breakdown of fees follows:
  - a. Multifamily Low-rise trips at the intersection constitute 35 percent of the trips through the intersection or 16 PM peak hour trips, resulting in a fee of \$252,560.
  - b. Primary non-residential trips, currently estimated by the Strip Retail trip rate, constitute 39 percent of the trips through the intersection or 18 PM peak hour trips<sup>2</sup>, resulting in a fee of \$284,130. The total fee for residential and non-residential uses is \$536,690.
    - i. Should *all* of the non-residential square footage be used as office space, as approved by the City, the resulting fee shall be based on the reduced trip rate appropriate for Small Office Building (ITE code 712) land use. The expected trip generation for this use is 33 percent of the trip generation for Strip Retail and results in 6 trips<sup>3</sup> through the intersection resulting in a fee of \$94,710. The total fee for residential and non-residential uses is \$347,270.
3. Half street improvements at Collector standards shall be constructed along SE Village Boulevard.
4. Half street improvements at Minor Arterial standards shall be constructed along Highway 211.
5. The Cascadia Village Drive extension within the site shall be constructed at Collector standards.
6. The portion of trails project T44 along the southern boundary of the site, as shown in the Parks and Trails Master Plan, shall be constructed to connect from SE Village Boulevard to Pine Street.
7. The Pine Street connection to Highway 211 shall not be constructed. The offset distance between the north and south legs of Pine Street is too large to function as a single intersection and the spacing of the two legs violates the public road spacing standards for a Collector street. Even as a right-in-right-out intersection with Highway 211 the Pine Street connect could potentially serve a significant amount of outbound traffic volume

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<sup>2</sup> A portion of the trips passing through the Hwy 211 and Dubarko Road intersection from the Strip Retail land use are not new trips but pass-by trips. While they contribute to the site trips, they do not add new volume to the intersection and are not assessed a fee. These trips constitute the remaining 26% of trips passing through the intersection.

<sup>3</sup> No pass-by trips apply to office land use.

depending on the amount of shift from Bornstedt Road. When the parcel to east of the development site is developed the Pine Street connection can be constructed without an offset.

- a. The half street improvement of Cascadia Village Drive on the eastern portion of the site shall be signed as one-way eastbound and a "No left turn" sign shall be installed at the northbound approach of the existing Pine Street stub.
8. Minimum sight distance requirements shall be met at all site driveways. Sight distances should be verified in the final engineering/construction stages of development.

5/9/23, 8:31 AM

City of Sandy Mail - 22-039 DR/MP/VAR/TREE

## EXHIBIT V



Kelly O'Neill <koneill@ci.sandy.or.us>

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### 22-039 DR/MP/VAR/TREE

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Eric Walland <eric.walland@gmail.com>  
To: planning@ci.sandy.or.us

Mon, May 8, 2023 at 4:30 PM

I would like to address the above. We have lived on Pine Ave for almost 19yrs. Over time the neighborhood has grown and we saw a wonderful park across the street. We have a lot of concerns about this style of living and business offices placed in the middle of a residential neighborhood.

There has been a large increase with unwanted behavior in the park and nearby townhomes. We have made several complaints throughout the past three years to code enforcement and Sandy PD about the off leash aggressive dogs, owners not picking up after their animals and traffic concerns. I think it's great that Pine will be finished, but you have narrowed the streets, with the thought of slowing traffic, it's only increased the amount of near miss accidents, speeding and concerns for our children. There are only two stop signs in the entire neighborhood, Oak and Redwood. Other vehicles do not stop or yield to other vehicles. Myself and my neighbors have been complaining for over three years about the increase in traffic and we were told to obtain signatures to put in speed bumps. It's not our job to do the job of the city.

Everyday, there are dogs running loose through Bornstedt Park and there is no enforcement. Several of us have called and made numerous complaints and no enforcement. Where are the residents going to walk their dogs, let them go potty? As with the residents in the town homes they will use the park.

How about the increase in noise complaints, traffic complaints, parking complaints and animal complaints. The city does not have the resources to address these issues. We would like to live in peace. We have been in discussions about moving due to this notice. We move into this neighborhood, wanting to grow within the community, but along with growth comes the increase in complaints. There is no one to answer for these complaints and there will be no one to answer to the increase in complaints with this development.

We do not want to be forced out of our home due to this development.

--  
Sincerely,  
Eric Walland



**EXHIBIT W**

39250 Pioneer Blvd  
Sandy, OR 97055  
503-668-5533

RECEIVED  
MAY 16 2023  
City of Sandy

**Comment Sheet for file number 22-039 DR/MP/VAR/TREE**

To Whom it may concern,

I am writing you as a property owner near the proposed development on Highway 211. I am not in favor of this project, and I request that the community affected by this development be allowed to voice our opinions at a public hearing. You will find the applicable code criteria listed below. I thank you in advance for your quick response to this request on behalf of myself and all of the other tax payers and registered voters within the Sandy area.

Your name: Shiba Z Paul Your phone number: 949-226-9260

Your address: 37935 Killarney st. Sandy OR 97055

**Applicable code criteria:** Sandy Municipal Code: 17.12 Procedures for Decision Making; 17.18 Processing Applications; 17.20 Public Hearings; 17.22 Notices; 17.30 Zoning Districts; 17.36 Low Density Residential (R-1); 17.38 Medium Density Residential (R-2); 17.46 Village Commercial (C-3); 17.54 Specific Area Plan Overlay; 17.66 Adjustments and Variances; 17.74 Accessory Development; 17.80 Additional Setbacks on Collector and Arterial Streets; 17.82 Special Setbacks on Transit Streets; 17.84 Improvements Required with Development; 17.86 Parkland and Open Space; 17.90 Design Standards; 17.92 Landscaping and Screening; 17.98 Parking, Loading, and Access Requirements; 17.100 Land Division; 17.102 Urban Forestry; 15.30 Dark Sky; and, 15.44 Erosion Control Regulations.



RECEIVED  
MAY 25 2023  
City of Sandy

EXHIBIT X

39250 Pioneer Blvd  
Sandy, OR 97055  
503-668-5533

Comment Sheet for file number 22-039 DR/MP/VAR/TREE

I would like the safety of the existing neighborhood children & families considered. All of the variances seem like unsafe asks for the community. Borstedt park is a popular park & the snowberry neighborhood uses the gravel walkway off village (right in front of my house) to walk to the park, yet I see no improvements for pedestrians. Since village Blvd. is a dead end it has been safe to cross the park, and some children have been crossing their entire lives. There needs to be a safe walking path, and ways to slow down traffic when the road is extended (roundabouts, speed bumps, new no parking signs (that people can see to obey). Extending streets is the opposite of what needs to happen by a park. The increased amount of traffic & people to hook up to sewer seems like a bad decision as well. I think the number of

units needs to strongly be reconsidered. Apartments & bus stops is going to increase & one low income ~~apartment~~ right next to a nice

Your name: Delaney Herbst Your phone number: (503) 702-8260

Your address: 19141 village Blvd. Sandy, OR 97055

park.  
I worry  
about  
crime,  
predators,  
etc...

Applicable code criteria: Sandy Municipal Code: 17.12 Procedures for Decision Making; 17.18 Processing Applications; 17.20 Public Hearings; 17.22 Notices; 17.30 Zoning Districts; 17.36 Low Density Residential (R-1); 17.38 Medium Density Residential (R-2); 17.46 Village Commercial (C-3); 17.54 Specific Area Plan Overlay; 17.66 Adjustments and Variances; 17.74 Accessory Development; 17.80 Additional Setbacks on Collector and Arterial Streets; 17.82 Special Setbacks on Transit Streets; 17.84 Improvements Required with Development; 17.86 Parkland and Open Space; 17.90 Design Standards; 17.92 Landscaping and Screening; 17.98 Parking, Loading, and Access Requirements; 17.100 Land Division; 17.102 Urban Forestry; 15.30 Dark Sky; and, 15.44 Erosion Control Regulations.