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Wilsonville Tonkin Lamborghini

ADG-122

Preliminary Stormwater Management Report

June 2024

Prepared For:

Axis Design Group
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ADG-122

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Project Description

The project site is located at 25239 SW Parkway Ave in Wilsonville, Oregon (tax lot 3S102DA #1000). The property is approximately 2.30 acres in size and is designated as Planned Development Commercial (PDC) on the City of Wilsonville Zoning Map. The proposed project constructs a new luxury vehicle dealership which includes a showroom, service shop, and surface parking areas.

No public stormwater improvements are part of this project.

Low impact development site approaches (LID) are proposed to treat the entire site's impervious and pervious surface runoff. The LID facilities will also provide stormwater flow control for their respective basin areas.

Proposed stormwater management improvements are detailed further in this report. Refer to the Appendix for EX-1 proposed (post-development) basin map, and the WES BMP calculator printouts along with additional calculations and information.

The purpose of this stormwater memorandum is to present stormwater best management practices (BMP) for water quality treatment, flow control, and conveyance to be installed as part of this development project and designed to comply with the 2015 City of Wilsonville Stormwater & Surface Water Design & Construction Standards.

Existing Site Description

The existing site is moderately sloped, grassy land with trees throughout the property. The site is heavily impacted by existing wetlands lined with vegetation along the central and southern areas of the site. The western property line adjoins ODOT right-of-way (Interstate 5), while the eastern property line is SW Parkway Avenue right-of-way.

The site slopes to the south/southwest and generally varies between 3% - 10% grade. Slopes along the western property line drop off at approximately 4:1. Elevations on the property range from 277' to 264' (NAVD88).

There is currently an existing stormwater drainage ditch running along the southern property line, partially within the property boundary. An existing storm manhole at the southeast corner of the site is at the upstream end of this part of the system, and receives storm drainage from SW Parkway Ave, via existing catchbasins in the roadway. The storm manhole then outfalls to the southwest into the ditch, and drainage moves through an 18" culvert before continuing southwest and turning south near the southwest property corner. It is our understanding that stormwater continues to flow to the south/southwest and eventually travels west beneath the Interstate 5 corridor.

Soils Characteristics

The Natural Resources Conservation Service (NRCS) with the United States Department of Agriculture (USDA) has classified the soils within Washington County in the Web Soil Survey. Soils are categorized into Hydrologic Soil Groups based on estimated runoff from precipitation. These groupings assume the soils are saturated and receive precipitation from long-duration storms. This rainfall to runoff relationship is complex and includes the Drainage and

Permeability characteristics of the soil. Pre-developed conditions for the site are the existing site's landscape areas. According to the USDA web soil survey, the site consists of soil group: 4B – Briedwell Silt Loam (Soil Group B) and 43 – Wapato Silty Clay Loam (Soil Group C/D). Upon further exploration and site-specific geotechnical exploration and analysis, the site is underlain primarily by organic soil, silty sands, and clayey silts with varying proportions of sand and gravel. Please reference the geotechnical report and addendum for further information.

Groundwater

Refer to the geotechnical report for detailed boring logs and investigation. Per the report, "*groundwater was encountered at variable depths (ranging from 1 to 12 feet bgs).* The report also states that *"due to the presence on shallow groundwater, infiltration testing was not performed at the site,"* and that *"the relatively shallow groundwater effectively precludes infiltration of stormwater collected from new impervious areas of the site."*

Therefore, full stormwater infiltration is not considered feasible for the site. The proposed stormwater facilities will be impermeable lined due to the high groundwater, as well as planter locations adjacent to building foundations.

Proposed Conditions

Stormwater management improvements will include three LID vegetated filtration planters: one constructed adjacent to the proposed building, one near the drive aisle entry at the north, and one at the southwest corner of the drive aisle. Basins 1 and 2 will be piped to an outfall at the existing stormwater ditch running along the southern property border, while Basin 3 will be piped to connect to an existing stormwater manhole near the southeastern property corner. This existing structure routes stormwater to the existing stormwater ditch along the southern property border through an existing 18" culvert. This stormwater ditch continues southward beyond the property limits.

Table 1 – Stormwater Runoff Basins

Basin	Impervious Area (SF)	Facility Type and Required Size
1	12,835	Filtration Planter: 406 SF
2	6,565	Filtration Planter: 216 SF
3	17,780	Filtration Planter: 568 SF
TOTAL	37,180	

Table 2 – Stormwater Management Requirements

Table 2: City of Wilsonville Stormwater Management Requirements	
Design Requirement	City of Wilsonville Criteria
Conveyance Design Storm	10-Year; 24-hour SBUH Method for Pipe
Treatment Area	All Disturbed Impervious Area + New Impervious Area
Treatment Storm	1.0" / 24-hour storm per City of Wilsonville
Detention	Peak Flow Duration matching between 42% of the 2-year up through the 10-year storm event

Stormwater facility design calculations have been completed using the BMP Sizing Tool application. This tool addresses water quality treatment and flow control requirements when sizing stormwater management facilities. The design process includes separating the site into Discharge Management Areas (DMA) that are routed to BMP's. The application will adequately size the BMP's based on growing media infiltration rates and facility depth.

Proposed Basin Characteristics

The proposed site's stormwater management basins are broken into three basins, 1-3. See exhibit EX-1 in the Appendix for an illustration of these proposed management basin areas. See Table 1 above for a summary of the proposed basin areas.

Water Quality

The City of Wilsonville water quality treatment criteria will be met by treatment of the site runoff solely through LID vegetated facilities. Treatment will occur via biofiltration and is met using the WES BMP Calculator. The proposed LID planter facilities will consist of an overflow set 12 inches above the topsoil growing media elevation. This will allow for 12" of ponding depth and filtration through the soil media prior to overflow. The facilities consist of an 18" depth section of growing filtration soil media, with 15" of drain rock below. A PVC liner is placed at the bottom of the facilities due to high groundwater and proximity to building foundations. A perforated underdrain pipe is set at the bottom of each facility to ensure full drawdown. The water quality event has been routed through each LID facility in the WES BMP calculator to ensure that the event does not cause stormwater to enter the overflow structure during the water quality storm event. Treated stormwater will be collected in the underdrain system and routed to site conveyance. Studies from the International Stormwater BMP Database (July 2012) indicate that bio filtration BMPs are good candidates for treatment of phosphorus, TSS and algae and mercury / metals.

Landscaping and trees are retained and proposed throughout the site to the maximum extent feasible. Above-ground vegetated stormwater facilities will benefit from tree canopy during the summer months to mitigate stormwater temperature rise. Underdrain systems will be necessary for collecting and routing stormwater that will filter through the proposed soil media but will not infiltrate the underlying native soils.

The WES BMP calculations are located in the Appendix.

Proper delineation and erosion and sediment control will be installed to protect the proposed facilities from potentially being compacted and/or inundated with sediment during construction.

Following treatment and detention, stormwater will ultimately discharge to the drainage ditch along the southern edge of the property. See Table 1 above for a summary of stormwater management basins.

Detention / Flow Control

The project site will meet detention/flow control requirements solely with LID facilities. All proposed LID planter facilities are designed to allow for 12" of ponding to provide flow control while stormwater is filtrating through the soil media. Each planter overflow structure has an orifice cap on the incoming perforated underdrain to limit inflow and facilitate detention storage ponding within the basin. Flow control for the site is required to meet peak flow duration matching between 42% of the 2-year up through the 10-year storm event. The WES BMP calculator has been used to size the facilities to ensure that this requirement is met. See Table 1 above for a summary of stormwater management basins. See the WES BMP calculator printout in the appendix for additional information.

Conveyance

The proposed storm pipe system is designed to have the capacity to convey the runoff from a 10-year storm event return frequency storm event without ponding. The site storm system was designed to convey all of the impervious area and contributing pervious area for the entire site. A minimum pipe size and slope will be maintained throughout the system. The intent is to maintain a minimum free flow velocity of 3.0 fps in all pipes. See the Appendix for pipe sizing calculations (minimum pipe slopes & sizes required to meet these conditions).

A conduit Flow Mannings "n" = 0.013 for pipe flow is used in all calculations.

The time of concentration (tc) is defined as the time for runoff to travel from the furthermost point of the watershed to the point in question. Time of concentration can be estimated from several formulas. The minimum time of concentration is 5 minutes in developed urban areas and the maximum is 100 minutes in rural areas. A time of concentration of 5 minutes is used for design of the stormwater basins in this project.

Downstream Analysis

Per the City of Wilsonville Stormwater & Surface Water Design & Construction Standards, downstream analysis shall extend downstream to a point in the drainage system where the proposed development site constitutes 10% or less of the total tributary drainage flow. If the proposed development area is less than 10% of the total tributary drainage area at the approved point of discharge, the analysis will continue for one-quarter mile downstream of the approved point of discharge.

Per the WES BMP Calculator results in Appendix B, the site's stormwater facilities will release **0.132 cfs** during the 25-year event, post development. Total tributary flow for the overall basin was calculated using Wilsonville GIS mapping and the Hydraflow Hydrographs program. Sub-Basins 1000B, 1133A, and contributing portions of Sub-Basin 1000 (see Appendix F for basin information, delineation and hydrographs) were considered as the larger tributary to the project's discharge points. Drainage flow was estimated to be **45.84 cfs** during the 25-year event. This calculation assumes that developed areas within the basin consist of 85% impervious area and 15% pervious area, while undeveloped areas are entirely pervious forested/grassy area. This analysis does not consider any upstream detention, although there are existing LID and detention facilities present within this tributary area. Since **0.132 cfs < 10% of 45.84 cfs**, this analysis continues for one-quarter mile downstream of the approved discharge point.

Once stormwater is collected and routed through stormwater filtration planters on the project site, there are two discharge points where stormwater leaves the site and enters the public system. Planters 1 and 2 discharge at the southwest corner of the property into the existing stormwater ditch (Discharge Point #1), while Planter 3 discharges into the existing public storm manhole at the southeast corner of the property (Discharge Point #2). Exhibit "Storm System Map" in the Appendix notes these discharge points and downstream facilities, and shows that both discharge points eventually outfall into the existing drainage ditch running southwest along the project property. At the southwest corner of the property, the ditch turns to the south/southeast and runs along the west side of the existing hotel property. South of the hotel, a 30" pipe collects and routes the stormwater under SW Elligsen Rd and outfalls into a swale within the ODOT Interstate 5 right-of-way. Stormwater runs roughly southwest and is collected by an existing grated manhole, which routes water west under the freeway and outfalls into a stormwater ditch/wetland area. The existing 30" concrete ODOT storm pipe crossing under Interstate 5 is the furthest downstream point of this analysis.

The first downstream point which was analyzed is immediately downstream of Discharge Point #1, where a cross-section of the existing drainage channel was taken based on topographic survey data. To determine the ditch's capacity, the cross-section was modeled in the Hydraflow Express program. Using the estimated tributary flow for Sub-Basins 1000B, 1133A, and contributing portions of Sub-Basin 1000, the model found that the ditch had sufficient conveyance capacity. See Appendix F for the Hydraflow Express Channel Report results.

The second downstream point which was studied is the 30" ODOT storm drain pipe running under Interstate 5. The pipe receives runoff from Sub-Basins 1000, 1000B, 1133A, 1133B and 2118, and has a tributary drainage flow estimated to be 70.66 cfs based on the assumptions and methods discussed earlier in this section. Conveyance calculations found in Appendix F estimate the capacity of this pipe is 41.03 cfs, assuming a 1% pipe slope. Although the pipe's assumed capacity is not great enough to manage the total calculated drainage flow, in speaking with City staff we are unaware of flooding, damage, or detrimental effects that occur at this specific culvert location. As noted earlier, existing LID and other detention facilities in the surrounding area that operate to lower peak flow rates have not been modeled as part of this report, so the actual peak drainage flow which the culvert experiences is theoretically lower than what was calculated. Since we have not observed or been provided evidence that this 30" ODOT pipe has been inundated during larger storms, this part of the storm system will not be greatly affected by the additional flows created by the proposed project. The proposed on-site LID facilities limit peak flow rates to a level that are expected to have a negligible impact on downstream facilities.

BMP Operation and Maintenance

Proposed stormwater management facilities will be maintained by the Owner, Ron Tonkin Gran Turismo. All facilities shall be maintained per the schedule and requirements listed in the O&M plan included in the Appendix and as recorded with Clackamas County.

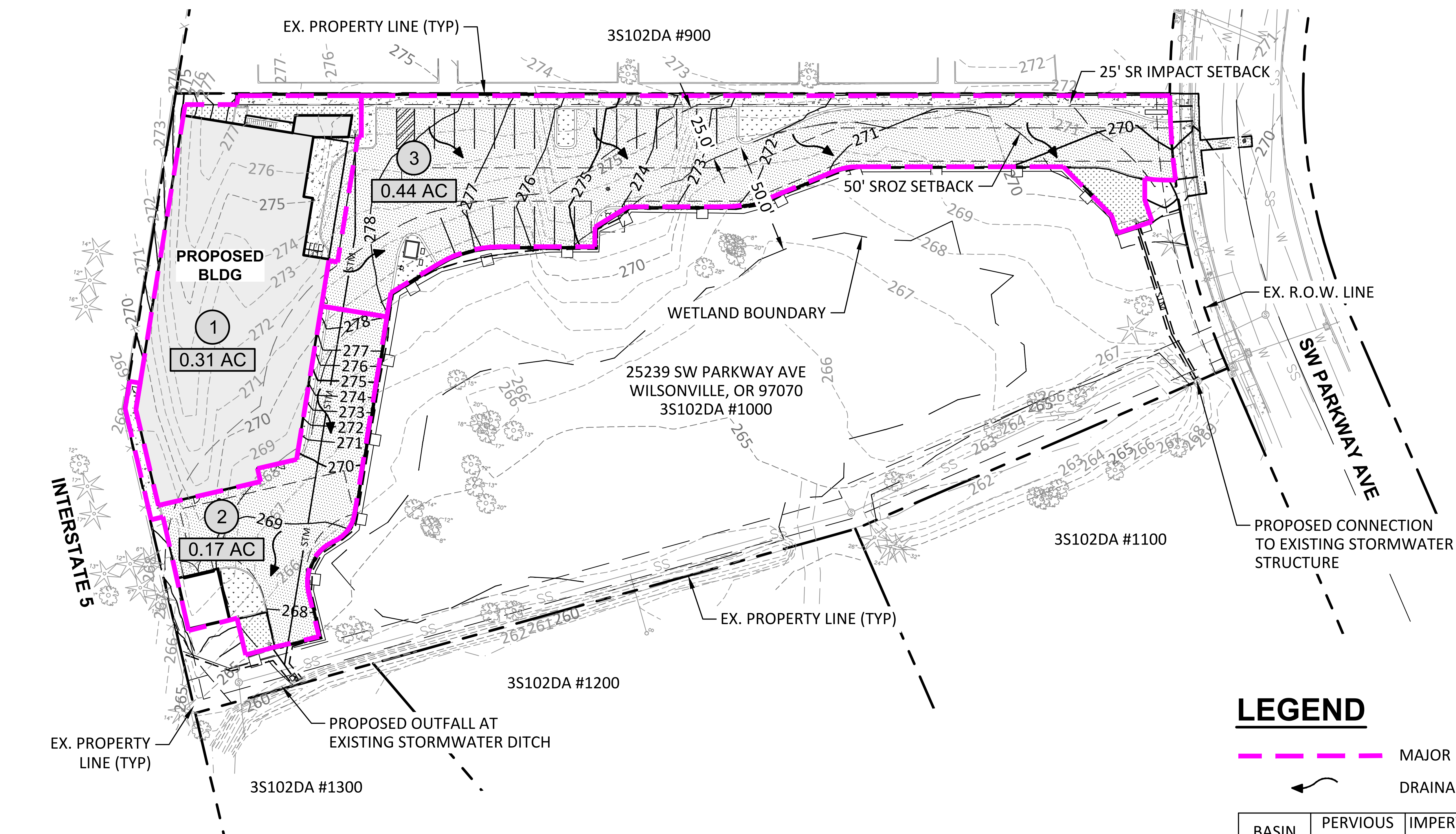
Contact Person: Celia Tonkin, 503-258-5608

See exhibits in the Appendix for stormwater planter locations and further information.

Conclusion

The proposed stormwater management plan will achieve pollutant removal and flow control to the maximum extent practicable via vegetated stormwater planters. The proposed facilities satisfy City of Wilsonville stormwater quality and water quantity requirements. As designed, this project shall not create any adverse impacts to the downstream storm system.

APPENDIX A – Basin Map



LEGEND

MAJOR DRAINAGE BASIN BOUNDARY

DRAINAGE ARROW

BASIN	PERVIOUS AREA	IMPERVIOUS AREA	TOTAL AREA
1	505 SF	12,835 SF	13,340 SF
2	835 SF	6,565 SF	7,400 SF
3	1,580 SF	17,780 SF	19,360 SF

DATE	NO.	DESCRIPTION

R E V I S I O N S

DESIGNED: HHPR
DRAWN: HHPR
CHECKED: HHPR
DATE: JUNE 2024

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PROPOSED BASIN MAP EXHIBIT

TONKIN LAMBORGHINI

WILSONVILLE, OREGON

SHEET NO. **EX-1**

JOB NO. ADG-122

APPENDIX B – WES BMP Data

WES BMP Sizing Report

Project Information

Project Name	ADG122 - Tonkin Lamborghini Wilsonville
Project Type	Commercial
Location	
Stormwater Management Area	39710
Project Applicant	
Jurisdiction	OutofDistrict

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
Basin 1 - Impervious	12,835	Grass	ConventionalConcrete	D	Basin 1 Planter
Basin 1 - Pervious	505	Grass	LandscapeDsoil	D	Basin 1 Planter
Basin 2 - Impervious	6,565	Grass	ConventionalConcrete	D	Basin 2 Planter
Basin 2 - Pervious	835	Grass	LandscapeDsoil	D	Basin 2 Planter
Basin 3 - Impervious	17,780	Grass	ConventionalConcrete	D	Basin 3 Planter
Basin 3 - Pervious	1,580	Grass	LandscapeDsoil	D	Basin 3 Planter

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)	Design flow (cfs)
Basin 1 Planter	FlowControlAndTreatment	Stormwater Planter - Filtration	Lined	395.7	406.0	1.3	0.044
Basin 2 Planter	FlowControlAndTreatment	Stormwater Planter - Filtration	Lined	214.5	216.0	1.0	0.024
Basin 3 Planter	FlowControlAndTreatment	Stormwater Planter - Filtration	Lined	566.6	568.0	1.6	0.064
						Total	**0.132 cfs**

Pond Sizing Details

1. FCWQT = Flow control and water quality treatment, WQT = Water quality treatment only

2. Depth is measured from the bottom of the facility and includes the three feet of media (drain rock, separation layer and growing media).

3. Maximum volume of the facility. Includes the volume occupied by the media at the bottom of the facility.

4. Maximum water storage volume of the facility. Includes water storage in the three feet of soil media assuming a 40 percent porosity.

APPENDIX C – Conveyance Calculations

Wilsonville Tonkin Lamborghini

Pipe Conveyance Calculations

Prepared by Harper Houf Peterson Righellis, Inc.
HHPR Job No. ADG-122
April 1, 2024

Pipe Segment	Upstream Basin(s)	Area1 (ac)	C1 (--)	T_c (min)	Rainfall (10-year) (in/hr)	Pipe Size (in)	Area (sf)	Per. (ft)	N (--)	Q_{10} (cfs)	Slope (%)	$Q_{CAPACITY}$ (cfs)	Velocity Full (fps)	Capacity Met?
1	Basin 1	0.31	0.97	5.0	3.40	8	0.35	2.09	0.013	1.02	1.00%	1.21	3.46	YES
2	Basin 2	0.17	0.96	5.0	3.40	8	0.35	2.09	0.013	0.55	1.00%	1.21	3.46	YES
3	Basin 3	0.44	0.97	5.0	3.40	12	0.79	3.14	0.013	1.45	0.50%	2.52	3.21	YES
4	Basins 1 & 2	-	-	-	-	12	0.79	3.14	0.013	1.57	1.00%	3.56	4.54	YES

APPENDIX D – NRCS Web Soil Survey

United States Department of Agriculture

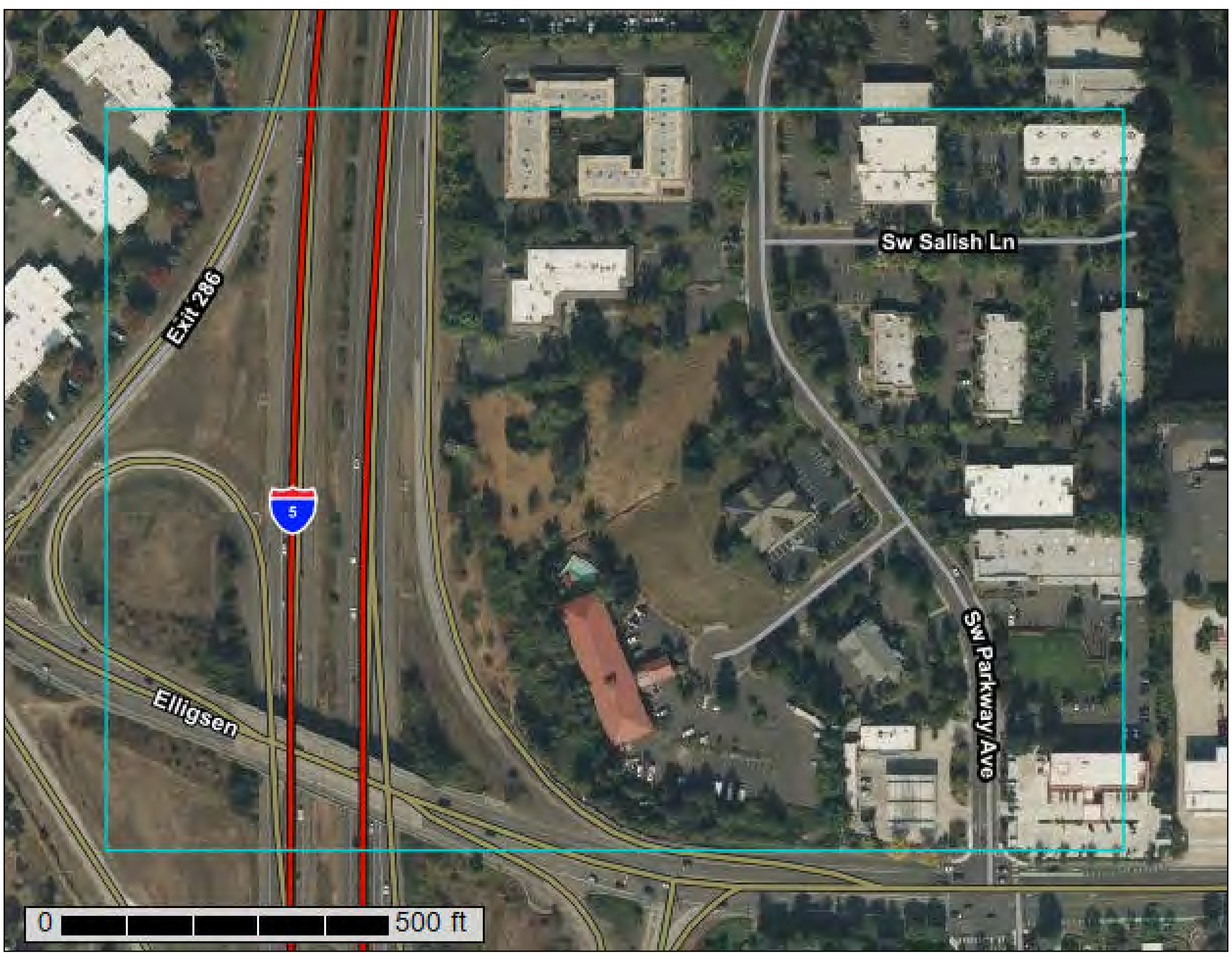
NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for

Washington County, Oregon



March 21, 2024

Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Soil Map


122° 46' 18" W
122° 45' 48" W
45° 20' 20" N
45° 20' 7" N
517910
517970
518030
518090
518150
518210
518270
518330
518390
518450
518510
5020620
5020560
5020500
5020440
5020380
5020320
5020260
5B
4B
43
45B
45A
Sw Salish Ln
Exit 286
Elligsen
5
Soil Map may not be valid at this scale.
Map Scale: 1:2,910 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0 40 80 160 240
Feet
0 100 200 400 600
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 23, Sep 7, 2023

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

Date(s) aerial images were photographed: Sep 26, 2022—Oct 11, 2022

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
4B	Briedwell silt loam, 0 to 7 percent slopes	18.9	46.7%
5B	Briedwell stony silt loam, 0 to 7 percent slopes	0.5	1.2%
43	Wapato silty clay loam	4.9	12.2%
45A	Woodburn silt loam, 0 to 3 percent slopes	9.7	24.0%
45B	Woodburn silt loam, 3 to 7 percent slopes	6.5	16.0%
Totals for Area of Interest		**40.4**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Washington County, Oregon

4B—Briedwell silt loam, 0 to 7 percent slopes

Map Unit Setting

National map unit symbol: 220g
Elevation: 200 to 320 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Briedwell

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty over gravelly alluvium

Typical profile

H1 - 0 to 12 inches: silt loam
H2 - 12 to 26 inches: clay loam
H3 - 26 to 60 inches: extremely cobbly clay loam

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 6.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: R002XC006OR - Stream Terrace Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

5B—Briedwell stony silt loam, 0 to 7 percent slopes

Map Unit Setting

National map unit symbol: 220h
Elevation: 200 to 320 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Briedwell

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty over gravelly alluvium

Typical profile

H1 - 0 to 12 inches: stony silt loam
H2 - 12 to 26 inches: clay loam
H3 - 26 to 60 inches: extremely cobbly clay loam

Properties and qualities

Slope: 0 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R002XC006OR - Stream Terrace Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)
Hydric soil rating: No

43—Wapato silty clay loam

Map Unit Setting

National map unit symbol: 2203
Elevation: 100 to 300 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

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

Description of Wapato

Setting

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

Typical profile

H1 - 0 to 14 inches: silty clay loam
H2 - 14 to 42 inches: silty clay loam
H3 - 42 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: Frequent
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: High (about 10.1 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: F002XC002OR - Backswamp Group
Forage suitability group: Poorly Drained (G002XY006OR)
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Minor Components

Cove, silty clay loam surface

Percent of map unit: 4 percent
Landform: Flood plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Labish

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

45A—Woodburn silt loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2208
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Woodburn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Old alluvium

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 31 inches: silty clay loam
H3 - 31 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent

Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Ecological site: R002XC008OR - Valley Terrace Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Dayton

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

45B—Woodburn silt loam, 3 to 7 percent slopes

Map Unit Setting

National map unit symbol: 2209
Elevation: 150 to 400 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Woodburn

Setting

Landform: Terraces
Landform position (three-dimensional): Tread

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Old alluvium

Typical profile

H1 - 0 to 16 inches: silt loam
H2 - 16 to 31 inches: silty clay loam
H3 - 31 to 60 inches: silt loam

Properties and qualities

Slope: 3 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 25 to 32 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R002XC008OR - Valley Terrace Group
Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Dayton

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

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APPENDIX E – Geotechnical Report

Carlson Geotechnical
A division of Carlson Testing, Inc.
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Bend Office **(541) 330-9155**
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Salem Office **(503) 589-1252**
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Report of
Geotechnical Investigation
Ron Tonkin Gran Turismo Lamborghini Dealership
Lot South of 25195 SW Parkway Avenue
Wilsonville, Oregon

CGT Project Number G2306033

Prepared for

Celia Tonkin
Ron Tonkin Gran Turismo
25300 SW Parkway Avenue
Wilsonville, Oregon 97070

December 27, 2023

Office: 18270 SW Boones Ferry Road, Suite 6, Durham, Oregon 97224
Mailing: P.O. Box 230997, Tigard, Oregon 97281

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December 27, 2023

Celia Tonkin
Ron Tonkin Gran Turismo
25300 SW Parkway Avenue
Wilsonville, Oregon 97070

Report of
Geotechnical Investigation
Ron Tonkin Gran Turismo Lamborghini Dealership
Lot South of 25195 SW Parkway Avenue
Wilsonville, Oregon

CGT Project Number G2306033

Dear Celia Tonkin:

Carlson Geotechnical (CGT), a division of Carlson Testing, Inc. (CTI), is pleased to submit this report summarizing the results of our geotechnical investigation for the proposed Ron Tonkin Gran Turismo Lamborghini Dealership project. The site is located directly south of 25195 SW Parkway Avenue in Wilsonville, Oregon. We performed our work in general accordance with CGT Proposal GP23-302R1, dated November 7, 2023. Written authorization for our services was received on November 9, 2023

We appreciate the opportunity to work with you on this project. Please contact us at (503) 601-8250 if you have any questions regarding this report.

Respectfully Submitted,
CARLSON GEOTECHNICAL

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ATTACHMENTS

1.0 INTRODUCTION

Carlson Geotechnical (CGT), a division of Carlson Testing, Inc. (CTI), is pleased to submit this report summarizing the results of our geotechnical investigation for the proposed Ron Tonkin Gran Turismo Lamborghini Dealership project. The site is located directly south of 25195 SW Parkway Avenue in Wilsonville, Oregon, as shown on the attached Site Location, Figure 1.

1.1 Project Information

CGT developed an understanding of the proposed project based on our correspondence with the project architect, Axis Design Group (Axis), and review of the provided preliminary project plan set prepared by Axis, dated October 4, 2023, and a survey map, prepared by Westlake Consultants, Inc. Based on our review, we understand the project will include:

- Construction of a new showroom and service building within the northwest portion of the site. The building will be three-stories, metal- and steel-framed, will incorporate a slab on grade ground floor, and include a partially below-grade vehicle storage level. For the purposes of this report, we have assumed maximum column, continuous wall, and uniform floor slab loads will be on the order of 100 kips, 4.5 kips per lineal foot (klf), and 250 pounds per square foot (psf), respectively.
- Construction of paved passenger car parking areas located east of the showroom and service building, and along the north and east margins of the site. We assume new pavements will be surfaced with asphalt concrete (AC), while loading docks and driveway aprons will be surfaced with Portland Cement Concrete (PCC).
- If conditions allow, stormwater collected from new impervious areas at the site will be disposed of, at least in part, via onsite infiltration. Infiltration testing was requested at three locations as part of this assignment. As described later in this report, due to the presence of shallow groundwater, infiltration testing was not performed at the site.
- Although no grading plans have been provided, we anticipate permanent grade changes at the site will include minimal fills. Cuts up to about 6 feet in depth are anticipated in the planned building pad to achieve desired ground floor elevations.
- No development or grading is anticipated to occur within a designated wetland (identified by others) within the south central portion of the site.

1.2 Scope of Services

Our scope of work included the following:

- Contact the Oregon Utilities Notification Center to mark the locations of public utilities within a 20-foot radius of our explorations at the site.
- Explore subsurface conditions at the site by advancing five drilled borings to depths of up to about 26½ feet below ground surface (bgs). Details of the subsurface investigation are presented in Appendix A.
- Classify the soils encountered in the explorations in general accordance with ASTM D2488 (Visual-Manual Procedure).
- Provide a technical narrative describing surface and subsurface deposits, and local geology of the site, based on the results of our explorations and published geologic mapping.
- Provide recommendations for the Seismic Site Class, mapped maximum considered earthquake spectral response accelerations, and site seismic coefficients.

- Provide a qualitative evaluation of seismic hazards at the site, including earthquake-induced liquefaction, landsliding, and surface rupture due to faulting or lateral spread.
- Provide geotechnical recommendations for site preparation and earthwork.
- Provide geotechnical engineering recommendations for use in design and construction of shallow foundations, floor slabs, retaining walls, and pavements.
- Provide this written report summarizing the results of our geotechnical investigation and recommendations for the project.

2.0 SITE DESCRIPTION

2.1 Site Geology

Based on available geologic mapping[1,2] of the area, the site is underlain by basalt bedrock. The basalt bedrock unit is composed of lava flows associated with the Columbia River Basalt group. The Columbia River basalt group consists of numerous fine-grained lava flows that primarily erupted from fissures in eastern Washington and Oregon and western Idaho during the Miocene (23.8 to 5.3 million years ago). Many individual flows are interbedded with thin paleosols that consist of clay-rich soils or sediments formed during period of volcanic inactivity. The basalt can weather in place to form clay and silt rich residual soils that overly the intact basalt bedrock. When intact, the basalt features jointed patterns ranging from columnar to entablature/colonnade, and is described as having fresh exposures that are dark gray to black, while weathered exposures area greenish-gray to grayish-black. Based on results of the drilled borings advanced at the site (described below) and review of local well logs, we anticipate that residual soils (fully decomposed bedrock) extend to depths of about 30 to 60 feet bgs, and are underlain by intact basalt bedrock.

2.2 Site Surface Conditions

The site is bordered by SW Parkway Avenue to the east, an on-ramp to Interstate 5 to the west, and commercial properties to the north and south. At the time of our field investigation, the north, west, and east perimeters of the site descended towards its center at gradients up to 4 horizontal:1 vertical (4H:1V). The south-central portion of the site is mapped (by others) as a wetlands. Vegetation on the southern portion of the site consisted of grasses and scattered coniferous and deciduous trees. The northern and western portions of the site were densely vegetated with brush and trees. The western portion of the site exhibited moderately dense vegetation and resulted in limited access for exploration equipment. Site layout and surface conditions at the time of our field investigation are shown on the attached Site Plan (Figure 2) and Site Photographs (Figure 3).

2.3 Subsurface Conditions

2.3.1 <u>Subsurface Investigation & Laboratory Testing</u>

Our subsurface investigation consisted of five drilled borings (B-1 through B-5) completed on December 4, 2023. The approximate boring locations are shown on the Site Plan, attached as Figure 2. In summary, the borings were advanced to depths ranging from about 6½ to 26½ feet bgs. Details regarding the subsurface

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1 Madin, I.P., 2004. Geologic mapping and database for the Portland area fault studies: Final report, Clackamas, Multnomah, and Washington Counties, Oregon: Oregon Department of Geology and Mineral Industries, Open-File Report O-04-02, scale 1:100,000.

2 Beeson, M.H., Tolan, T.L., and Madin, I.P., 1991. Geologic map of the Portland quadrangle, Multnomah and Washington counties, Oregon, and Clark County, Washington: Oregon Department of Geology and Mineral Industries, Geological Map Series 75, scale 1:24,000.

investigation, logs of the explorations, and results of laboratory testing are presented in Appendix A. Subsurface conditions encountered during our investigation are summarized below.

2.3.2 Subsurface Materials

Logs of the explorations are presented in Appendix A. The following describes each of the subsurface materials encountered at the site.

Organic Soil (OL)
Organic soil was encountered at the surface of each boring. The organic soil was typically dark brown, moist, exhibited low plasticity, and contained varying amounts of rootlets. This soil extended to depths of about ¼-foot bgs in the borings.

Elastic Silt (MH)
Elastic silt was encountered below the organic soil in each boring. The elastic silt was typically brown, moist, exhibited medium plasticity, and contained varying amounts of weathered rock fragments up to ¼-inch in diameter. In terms of consistency, this soil was very soft in the upper 5 feet in borings B-1 and B-2. Below that depth and in the remaining borings, this soil was typically medium stiff to stiff. This soil extended to depths of about 7 to 10 feet bgs in borings B-1 through B-4, and to the full depth explored in boring B-5, about 6½ feet bgs.

Silty Sand (SM)
Underlying the elastic silt in borings B-1 through B-4 was silty sand. The silty sand was typically medium dense, multicolored, moist to wet, fine- to coarse-grained, and contained medium plasticity fines and varying amounts of weathered rock fragments up to ½-inch in diameter. This soil extended to the full depths explored in those borings, about 9 to 26½ feet bgs. This soil was interpreted to consist of residual soils.

2.3.3 Groundwater

As shown on the attached logs and on the attached Site Plan, Figure 2, the groundwater level (phreatic surface) was encountered at variable depths (ranging from 1 to 12 feet bgs) within borings B-1 through B-5 during our investigation in early December 2023. To determine approximate regional groundwater levels in the area, we researched well logs available on the Oregon Water Resources Department (OWRD)[3] website for wells located within Section 02, Township 03 South, Range 01 West, Willamette Meridian. Our review indicated that groundwater levels in the area generally ranged from about 12½ to 25 feet bgs. It should be noted groundwater levels vary with local topography. In addition, the groundwater levels reported on the OWRD logs often reflect the purpose of the well, so water well logs may only report deeper, confined groundwater, while geotechnical or environmental borings will often report any groundwater encountered, including shallow, unconfined groundwater. Therefore, the levels reported on the OWRD well logs referenced above are considered generally indicative of local water levels and may not reflect actual groundwater levels at the project site. We anticipate that groundwater levels will fluctuate due to seasonal and annual variations in precipitation, changes in site utilization, or other factors. Additionally, the on-site fine-grained (silty) soils are conducive to formation of perched groundwater.

[3] Oregon Water Resources Department, 2023. Well Log Records, *accessed December 2023*, from OWRD web site: http://apps.wrd.state.or.us/apps/gw/well_log/.

3.0 SEISMIC CONSIDERATIONS

3.1 Seismic Design

Section 1613.2.2 of the 2022 Oregon Structural Specialty Code (2022 OSSC) requires that the determination of the seismic site class be in accordance with Chapter 20 of the American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures (ASCE 7-16). We have assigned the site as Site Class D ("Stiff Soil") based on geologic mapping and subsurface conditions encountered during our investigation.

Earthquake ground motion parameters for the site were obtained in accordance with the 2022 OSSC using the Seismic Hazards by Location calculator on the ATC website[4]. The site Latitude 45.337419° North and Longitude 122.767954° West were input as the site location. The following table shows the recommended seismic design parameters for the site.

Table 1 Seismic Ground Motion Values

Parameter		Value
Mapped Acceleration Parameters	Spectral Acceleration, 0.2 second (S_s)	0.826g
	Spectral Acceleration, 1.0 second (S_1)	0.384g
Coefficients (Site Class D)	Site Coefficient, 0.2 second (F_A)	1.169
	Site Coefficient, 1.0 second (F_V)[1]	1.916
Adjusted MCE Spectral Response Parameters	MCE Spectral Acceleration, 0.2 second (S_{MS})	0.966g
	MCE Spectral Acceleration, 1.0 second (S_{M1})	0.736g
Design Spectral Response Accelerations	Design Spectral Acceleration, 0.2 second (S_{DS})	0.644g
	Design Spectral Acceleration, 1.0 second (S_{D1})	0.491g
Seismic Design Category (Risk Category II)		D

[1]Value determined from 2022 OSSC Table 1613.2.3(2).

3.2 Seismic Hazards

3.2.1 Liquefaction

In general, liquefaction occurs when deposits of loose/soft, saturated, cohesionless soils, generally sands and silts, are subjected to strong earthquake shaking. If these deposits cannot drain quickly enough, pore water pressures can increase, approaching the value of the overburden pressure. The shear strength of a cohesionless soil is directly proportional to the effective stress, which is equal to the difference between the overburden pressure and the pore water pressure. When the pore water pressure increases to the value of the overburden pressure, the shear strength of the soil approaches zero, and the soil can liquefy. The liquefied soils can undergo rapid consolidation or, if unconfined, can flow as a liquid. Structures supported by the liquefied soils can experience rapid, excessive settlement, shearing, or even catastrophic failure.

For fine-grained soils, susceptibility to liquefaction is evaluated based on penetration resistance and plasticity, among other characteristics. Criteria for identifying non-liquefiable, fine-grained soils are constantly evolving. Current practice to identify non-liquefiable, fine-grained soils is based on moisture content and

[4] Applied Technology Council (ATC), 2023. USGS seismic design parameters determined using "Seismic Hazards by Location," *accessed December 2023*, from the ATC website https://hazards.atcouncil.org/.

plasticity characteristics of the soils[5,6,7]. The susceptibility of sands, gravels, and sand-gravel mixtures to liquefaction is typically assessed based on penetration resistance, as measured using SPTs, CPTs, or Becker Hammer Penetration tests (BPTs).

The Oregon Department of Geology and Mineral Industries' Oregon Statewide Geohazards Viewer (HazVu)[8] shows a *low* hazard for liquefaction at the site. The Oregon Hazard Explorer for Lifelines Program (O-HELP)[9] show a *very low* hazard for liquefaction for the site or immediate vicinity due to a M9.0 Cascadia Subduction Zone earthquake.

Based on its plasticity, the native elastic silt (MH) is not susceptible to liquefaction. Based on the plasticity characteristics of the fines and its classification as residual sols (fully decomposed rock), the silty sand (SM) encountered within our explorations is considered non-liquefiable. Based on review of geologic mapping and our previous experience in the area, we do not anticipate liquefiable conditions are present at depths below those explored as part of this assignment.

3.2.2 Slope Instability

We did not observe any obvious signs of past or on-going slope instability at the site. Review of the Statewide Landslide Information Database for Oregon (SLIDO), available at the DOGAMI website[10], shows no historic or prehistoric landslides at or in the immediate vicinity of the site. HazVu shows a *low* hazard for landslides at the site. O-HELP shows a *very low* probability of seismically-induced landslides at the site due to a M9.0 Cascadia Subduction Zone earthquake. Given the relatively gentle site grades, the lack of evidence of previous landslides in the vicinity, and the generally low hazard indicated by the hazard mapping, the risk of seismically-induced slope instability occurring at the site is considered very low. The proposed grading includes relatively minimal planned changes in site grades and is not anticipated to significantly increase this risk.

3.2.3 Surface Rupture

3.2.3.1 Faulting

Although the site is situated in a region of the country with known active faults and historic seismic activity, no known faults exist on or immediately adjacent to the site. Therefore, the risk of surface rupture at the site due to faulting is considered low.

3.2.3.2 Lateral Spread

Surface rupture due to lateral spread can occur on sites underlain by liquefiable soils that are located on or immediately adjacent to slopes steeper than about 3 degrees (20H:1V), and/or adjacent to a free face, such as a stream bank or the shore of an open body of water. During lateral spread, the materials overlying the

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5 Seed, R.B. et al., 2003. Recent Advances in Soil Liquefaction Engineering: A Unified and Consistent Framework. Earthquake Engineering Research Center Report No. EERC 2003-06.

6 Bray, Jonathan D., Sancio, Rodolfo B., et al., 2006. Liquefaction Susceptibility of Fine-Grained Soils, Journal of Geotechnical and Geoenvironmental Engineering, Volume 132, Issue 9, September 2006.

7 Idriss, I.M., Boulanger, R.W., 2008. Soil Liquefaction During Earthquakes, Earthquakes Engineering Research Institute Monograph MNO-12.

8 Oregon Department of Geology and Mineral Industries, 2023. Oregon Statewide Geohazards Viewer, *accessed December 2023*, from DOGAMI web site: http://www.oregongeology.org/sub/hazvu/index.htm.

9 Oregon State University College of Engineering, 2023. Oregon Hazard Explorer for Lifelines Program (O-HELP), *accessed December 2023*, from O-HELP web site: http://ohelp.oregonstate.edu/#&ui-state=dialog.

10 Oregon Department of Geology and Mineral Industries, 2023. Statewide Landslide Information Database for Oregon (SLIDO), *accessed December 2023*, from DOGAMI web site: https://gis.dogami.oregon.gov/maps/slido/.

liquefied soils are subject to lateral movement downslope or toward the free face. Based on the relatively level topography at the site and the discontinuous nature of the liquefiable soil layers, the risk of damage associated with lateral spread is negligible.

4.0 CONCLUSIONS

Based on the results of our field explorations and analyses, the site may be developed as described in Section 1.1 of this report, provided the recommendations presented in this report are incorporated into the design and development. Satisfactory subgrade support for shallow foundations, floor slabs, retaining walls, and pavements can be achieved from the native, medium stiff to better elastic silt (MH), the native, medium dense to better silty sand (SM), or new structural fill that is properly placed and compacted on these materials during construction.

The near surface fine-grained silty soils (MH, SM) are susceptible to disturbance during wet weather. Trafficability of these soils may be difficult, and significant damage to the subgrade could occur, if earthwork is undertaken without proper precautions at times when the exposed soils are more than a few percentage points above optimum moisture content. In the event that construction occurs during wet weather, CGT recommends that measures be implemented to protect the fine-grained subgrade in areas of repeated construction traffic and within footing excavations. Geotechnical recommendations for wet weather construction are presented in Section 5.3 of this report.

As indicated in Section 2.3.3 above, the groundwater level (phreatic surface) was encountered at depths of about 1 to 12 feet bgs in the borings advanced at the site in early December 2023. The following geotechnical conclusions are presented relative to the groundwater levels observed at this site:

- Some seasonal and annual fluctuation[11] of the groundwater level should be anticipated at this site. With regard to the building pad, we recommend the “seasonal high groundwater level” be assigned at an elevation of 265 feet. In the event the building ground floor will be established within 2 feet of that elevation, the geotechnical engineer should be consulted to review the proposed construction and provide supplemental recommendations for waterproofing and/or underslab drainage, if warranted.
- Within planned pavement areas, we recommend site grades be maintained at their current elevations to the extent possible. Permanent cuts at the site extending below a depth of 1-foot bgs, if proposed, should be reviewed by the geotechnical engineer.
- The relatively shallow groundwater effectively precludes infiltration of stormwater collected from new impervious areas of the site. Notwithstanding the preceding, in the event stormwater infiltration facilities(ies) are to be pursued at this site, the geotechnical engineer should be consulted to review potential siting and depth(s) of those facilities.
- With regard to construction, depending on the time of year (and the area of the site) that site work takes place, groundwater may be encountered when excavations extend below a few feet below existing ground surface and should be factored. Dewatering plans will rest with the project contractor. Additional discussion of dewatering considerations is presented in Section 5.2.2 of this report.

[11] The client is advised that monitoring of the groundwater level at the site could be performed at the site via periodic explorations (e.g. hand auger borings) and/or through the installation of piezometers. Such services are outside the scope of this current assignment, but could be provided, upon request, for an additional fee.

5.0 RECOMMENDATIONS

The recommendations presented in this report are based on the information provided to us, results of our field investigation and analyses, laboratory data, and professional judgment. CGT has observed only a small portion of the pertinent subsurface conditions. The recommendations are based on the assumptions that the subsurface conditions do not deviate appreciably from those found during the field investigation. CGT should be consulted for further recommendations if the design of the proposed development changes and/or variations or undesirable geotechnical conditions are encountered during site development.

5.1 Site Preparation

5.1.1 Stripping & Grubbing

Existing vegetation, topsoil, and rooted soils (OL) should be removed from within, and for a minimum 5-foot margin around, proposed building pad, structural fill, and pavement areas. Based on the results of our field explorations, topsoil stripping depths are anticipated to be on the order of about ¼-foot bgs. These materials may be deeper or shallower at locations away from the completed explorations. The geotechnical engineer's representative should provide recommendations for actual stripping depths based on observations during site stripping. Stripped surface vegetation and rooted soils should be transported off-site for disposal, or stockpiled for later use in landscaped areas.

Grubbing of trees should include the removal of the root mass and roots greater than ½ inch in diameter. Grubbed materials should be transported off-site for disposal. Root masses from larger trees may extend greater than 3 feet bgs. Where root masses are removed, the resulting excavation should be properly backfilled with structural fill in conformance with Section 5.4 of this report.

5.1.2 Existing Utilities & Below-Grade Structures

All existing utilities at the site should be identified prior to excavation. Abandoned utility lines beneath the new building, pavements, and hardscaping features should be completely removed or grouted full. Soft, loose, or otherwise unsuitable soils encountered in utility trench excavations should be removed and replaced with structural fill in conformance with Section 5.4 this report. Buried structures (i.e. footings, foundation walls, retaining walls, slabs-on-grade, tanks, etc.), if encountered during site development, should be completely removed and replaced with structural fill in conformance with Section 5.4 of this report.

5.1.3 Subgrade Preparation - Building Pad & Pavement Areas

After site preparation as recommended above, but prior to placement of structural fill and/or aggregate base, the geotechnical engineer's representative should observe the exposed subgrade soils in order to identify areas of excessive yielding through either proof rolling or probing. Proof rolling of subgrade soils is typically conducted during dry weather using a fully-loaded, 10- to 12-cubic-yard, tandem-axle, tire-mounted, dump truck or equivalent weighted water truck. Areas of limited access or that appear too soft or wet to support proof rolling equipment should be evaluated by probing. During wet weather, subgrade preparation should be performed in general accordance with the recommendations presented in Section 5.3 of this report. If areas of soft soil or excessive yielding are identified, the affected material should be over-excavated to firm, unyielding subgrade, and replaced with imported granular structural fill in conformance with Section 5.4.2 of this report.

The elastic silt (MH) soils should be kept moist, near optimum moisture content, and not allowed to dry out. If allowed to dry below optimum moisture content, to a point where surface cracking appears in the subgrade, the affected material should be over-excavated and replaced with imported granular structural fill.

5.1.4 Erosion Control

Erosion and sedimentation control measures should be employed in accordance with applicable City, County, and State regulations.

5.2 Temporary Excavations

5.2.1 Overview

Conventional earthmoving equipment in proper working condition should be capable of making necessary excavations for the anticipated site cuts as described earlier in this report. All excavations should be in accordance with applicable OSHA and state regulations. It is the contractor's responsibility to select the excavation methods, to monitor site excavations for safety, and to provide any shoring required to protect personnel and adjacent improvements. A “competent person,” as defined by OR-OSHA, should be on-site during construction in accordance with regulations presented by OR-OSHA. CGT’s current role on the project does not include review or oversight of excavation safety.

5.2.2 Dewatering

As indicated in Section 2.3.3 above, groundwater was encountered at depths of approximately 1 to 12 feet bgs within the borings advanced at the site in early December 2023. The soils encountered at these depths exhibited relatively high fines content and are anticipated to exhibit low to moderate rates of transmissivity. Accordingly, we would expect low to moderate seepage when excavations extend below the groundwater level. Pumping from sumps may be effective in removing groundwater within shallow or localized excavations at the site. Pumping from multiple well points will likely be required for larger excavations and those extending below the groundwater level. The sumps or wells should be installed to remove water to a depth of at least 2 feet below the lowest elevation of the excavation, and should be installed and put into operation prior to commencing excavation. With regards to temporary dewatering, the contractor or his representative should determine the appropriate size, number, and location of sump pumps or wells. The project civil engineer should evaluate requirements for disposal of the resultant discharge.

5.2.3 OSHA Soil Type

For use in the planning and construction of temporary excavations up to 10 feet in depth, an OSHA soil type “A” may be used for the native elastic silt (MH) encountered near the surface of the site. In the event groundwater seepage is observed within temporary excavations within this soil, the sidewalls should be flattened in accordance with OSHA soil type “C”. Similarly, an OSHA soil type “C” should be used for the native silty sand (SM) encountered at depth in the borings.

5.2.4 Utility Trenches

Temporary trench cuts should stand near vertical to depths of approximately 4 feet in the native, elastic silt (MH) encountered near the surface of the site. If groundwater seepage undermines the stability of the trench, or if sidewall caving is observed during excavation, the sidewalls should be flattened or shored. Depending on the time of year trench excavations occur, trench dewatering may be required in order to maintain dry working conditions. A discussion of dewatering of temporary excavations is presented in Section 5.2.2

above. If groundwater is encountered, we recommend placing trench stabilization material at the base of the excavations. Trench stabilization material should be in conformance with Section 5.4.3.

5.2.5 Excavations Near Foundations

Excavations near footings should not extend within a 1 horizontal to 1 vertical (1H:1V) plane projected out and down from the outside, bottom edge of the footings. In the event excavation needs to extend below the referenced plane, temporary shoring of the excavation and/or underpinning of the subject footing may be required. The geotechnical engineer should be consulted to review proposed excavation plans for this design case to provide specific recommendations.

5.3 Wet Weather Considerations

For planning purposes, the wet season should be considered to extend from late September to late June. It is our experience that dry weather working conditions should prevail between early July and mid-September. Notwithstanding the above, soil conditions should be evaluated in the field by the geotechnical engineer's representative at the initial stage of site preparation to determine whether the recommendations within this section should be incorporated into construction.

5.3.1 Overview

Due to their fines content, the on-site silty soils (MH, SM) are susceptible to disturbance during wet weather. Trafficability of these soils may be difficult, and significant damage to subgrade soils could occur, if earthwork is undertaken without proper precautions at times when the exposed soils are more than a few percentage points above optimum moisture content. For wet weather construction, site preparation activities may need to be accomplished using track-mounted equipment, loading removed material onto trucks supported on granular haul roads, or other methods to limit soil disturbance. The geotechnical engineer's representative should evaluate the subgrade during excavation by probing rather than proof rolling. Soils that have been disturbed during site preparation activities, or soft or loose areas identified during probing, should be over-excavated to firm, unyielding subgrade, and replaced with imported granular structural fill in conformance with Section 5.4.2.

5.3.2 Geotextile Separation Fabric

We recommend a geotextile separation fabric be placed to serve as a barrier between the prepared subgrade and granular fill/base rock in areas of repeated or heavy construction traffic. The geotextile fabric should meet the requirements presented in the current Oregon Department of Transportation (ODOT) Standard Specification for Construction (ODOT SSC), Section 02320.

5.3.3 Granular Working Surfaces (Haul Roads & Staging Areas)

Haul roads subjected to repeated heavy, tire-mounted, construction traffic (e.g. dump trucks, concrete trucks, etc.) will require a minimum of 18 inches of imported granular material. For light staging areas, 12 inches of imported granular material is typically sufficient. Additional granular material or geo-grid reinforcement may be recommended based on site conditions and/or loading at the time of construction. The imported granular material should be in conformance with Section 5.4.2 and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. The prepared subgrade should be covered with geotextile fabric (Section 5.3.2) prior to placement of the imported granular material. The imported granular material should be placed in a single lift (up to 24 inches deep) and compacted using a smooth-drum, non-vibratory roller until well-keyed.

5.3.4 Footing Subgrade Protection

A minimum of 3 inches of imported granular material (crushed rock) is recommended to protect fine-grained (silty), footing subgrades from foot traffic during inclement weather. The imported granular material should be in conformance with Section 5.4.2. The maximum particle size should be limited to 1 inch. The imported granular material should be placed in one lift over the prepared, undisturbed subgrade, and compacted using non-vibratory equipment until well keyed.

Surface water should not be allowed to collect in footing excavations. The excavations should be draped and/or provided with sumps to preclude water accumulation during inclement weather.

5.4 Structural Fill

The geotechnical engineer should be provided the opportunity to review all materials considered for use as structural fill (prior to placement). Samples of the proposed fill materials should be submitted to the geotechnical engineer a minimum of 5 business days prior their use on site[12]. The geotechnical engineer's representative should be contacted to evaluate compaction of structural fill as the material is being placed. Evaluation of compaction may take the form of in-place density tests and/or proof roll tests with suitable equipment. Structural fill should be evaluated at intervals not exceeding every 2 vertical feet as the fill is being placed.

5.4.1 On-Site Soils – General Use

5.4.1.1 Elastic Silt (MH), Silty Sand (SM)

Re-use of these soils as structural fill may be difficult because these soils are sensitive to small changes in moisture content and are difficult, if not impossible, to adequately compact during wet weather. We anticipate the moisture content of these soils will be higher than the optimum moisture content for satisfactory compaction. Therefore, moisture conditioning (drying) should be expected in order to achieve adequate compaction. If used as structural fill, these soils should be free of organic matter, debris, and particles larger than 4 inches. When used as structural fill, these soils should be placed in lifts with a maximum pre-compaction thickness of about 8 inches at moisture contents within –1 and +3 percent of optimum, and compacted to not less than 92 percent of the material's maximum dry density, as determined in general accordance with ASTM D1557 (Modified Proctor).

If the on-site materials cannot be properly moisture-conditioned and/or processed, we recommend using imported granular material for structural fill.

5.4.2 Imported Granular Structural Fill – General Use

Imported granular structural fill should consist of angular pit or quarry run rock, crushed rock, or crushed gravel that is fairly well graded between coarse and fine particle sizes. The granular fill should contain no organic matter, debris, or particles larger than 4 inches, and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. For fine-grading purposes, the maximum particle size should be limited to 1½ inches. The percentage of fines can be increased to 12 percent of the material passing the U.S. Standard No. 200 Sieve if placed during dry weather, and provided the fill material is moisture-conditioned, as necessary, for proper compaction. Imported granular fill material should be placed in lifts with a maximum thickness of about 12 inches, and compacted to not less than 95 percent of the material's maximum dry

[12] Laboratory testing for moisture density relationship (Proctor) is required. Tests for gradation may be required.

density, as determined in general accordance with ASTM D1557 (Modified Proctor). Proper moisture conditioning and the use of vibratory equipment will facilitate compaction of these materials.

Granular fill materials with high percentages of particle sizes in excess of 1½ inches are considered non-moisture-density testable materials. As an alternative to conventional density testing, compaction of these materials should be evaluated by proof roll test observation (deflection tests), where accepted by the geotechnical engineer.

5.4.3 Trench Base Stabilization Material

If groundwater is present at the base of utility excavations, trench base stabilization material should be placed. Trench base stabilization material should consist of a minimum of 1 foot of well-graded granular material with a maximum particle size of 4 inches and less than 5 percent material passing the U.S. Standard No. 4 Sieve. The material should be free of organic matter and other deleterious material, placed in one lift, and compacted until well-keyed.

5.4.4 Trench Backfill Material

Trench backfill for the utility pipe base and pipe zone should consist of granular material as recommended by the utility pipe manufacturer. Trench backfill above the pipe zone should consist of well-graded granular material containing no organic matter or debris, have a maximum particle size of ¾ inch, and have less than 8 percent material passing the U.S. Standard No. 200 Sieve. As a guideline, trench backfill should be placed in maximum 12-inch-thick lifts. The earthwork contractor may elect to use alternative lift thicknesses based on their experience with specific equipment and fill material conditions during construction in order to achieve the required compaction. The following table presents recommended relative compaction percentages for utility trench backfill.

Table 2 Utility Trench Backfill Compaction Recommendations

Backfill Zone	Recommended Minimum Relative Compaction	
	Structural Areas[1,2]	Landscaping Areas
Pipe Base and Within Pipe Zone	90% ASTM D1557 or pipe manufacturer's recommendation	85% ASTM D1557 or pipe manufacturer's recommendation
Above Pipe Zone	92% ASTM D1557	88% ASTM D1557
Within 3 Feet of Design Subgrade	95% ASTM D1557	90% ASTM D1557

1 Includes proposed building, pavement areas, structural fill areas, exterior hardscaping, etc.
2 Or as specified by the local jurisdiction where located within the public right of way.

5.4.5 Controlled Low-Strength Material (CLSM)

CLSM is a self-compacting, cementitious material that is typically considered when backfilling localized areas. CLSM is sometimes referred to as "controlled density fill" or CDF. Due to its flowable characteristics, CLSM typically can be placed in restricted-access excavations where placing and compacting fill is difficult. If chosen for use at this site, we recommend the CLSM be in conformance with Section 00442 of the most recent, ODOT SSC. The geotechnical engineer's representative should observe placement of the CLSM and obtain samples for compression testing in accordance with ASTM D4832. As a guideline, for each day's placement, two compressive strength specimens from the same CLSM sample should be tested. The results of the two individual compressive strength tests should be averaged to obtain the reported 28-day compressive strength. If CLSM is considered for use on this site, please contact the geotechnical engineer for site-specific and application-specific recommendations.

5.5 Shallow Foundations

5.5.1 Subgrade Preparation

Satisfactory subgrade support for shallow foundations can be obtained from the native, medium stiff to better elastic silt (MH), the native, medium dense to better silty sand (SM), or new structural fill that is properly placed and compacted on these materials during construction. These materials were first encountered at depths of about 5 feet bgs within our borings (B-1 and B-2) advanced in the vicinity of the building pad. The geotechnical engineer's representative should be contacted to observe subgrade conditions prior to placement of forms, reinforcement steel, or granular backfill (if required). If soft, loose, or otherwise unsuitable soils are encountered, they should be over-excavated as recommended by the geotechnical representative at the time of construction. The resulting over-excavation should be brought back to grade with imported granular structural fill in conformance with Section 5.4.2. The maximum particle size of over-excavation backfill should be limited to 1½ inches. All granular pads for footings should be constructed a minimum of 6 inches wider on each side of the footing for every vertical foot of over-excavation.

5.5.2 Minimum Footing Width & Embedment

Minimum footing widths should be in conformance with the current OSSC. As a guideline, CGT recommends individual spread footings have a minimum width of 24 inches. For one- to two-story, light-framed buildings, we recommend continuous wall footings have a minimum width of 12 and 15 inches, respectively. All footings should be founded at least 18 inches below the lowest, permanent adjacent grade to develop lateral capacity and for frost protection.

5.5.3 Bearing Pressure & Settlement

Footings founded as recommended above should be proportioned for a maximum allowable soil bearing pressure of 2,000 pounds per square foot (psf). This bearing pressure is a net bearing pressure, applies to the total of dead and long-term live loads, and may be increased by one-third when considering seismic or wind loads. For foundations founded as recommended above, total settlement of foundations is anticipated to be less than 1 inch. Differential settlements between adjacent columns and/or bearing walls should not exceed ½ inch. If an increased allowable soil bearing pressure is desired, the geotechnical engineer should be consulted.

5.5.4 Lateral Capacity

A maximum passive (equivalent fluid) earth pressure of 150 pounds per cubic foot (pcf) is recommended for design of footings cast neat into excavations in suitable native soil or confined by imported granular structural fill that is properly placed and compacted during construction. The recommended earth pressure was computed using a factor of safety of 1½, which is appropriate due to the amount of movement required to develop full passive resistance. In order to develop the above capacity, the following should be understood:

1. Concrete must be poured neat in excavations or the foundations must be backfilled with imported granular structural fill,
2. The adjacent grade must be level,
3. The static ground water level must remain below the base of the footings throughout the year.

4. Adjacent floor slabs, pavements, or the upper 12-inch-depth of adjacent, unpaved areas should not be considered when calculating passive resistance.

An ultimate coefficient of friction equal to 0.35 may be used when calculating resistance to sliding for footings founded as described above. An ultimate coefficient of friction equal to 0.45 may be used when calculating resistance to sliding for footings founded on a minimum of 6 inches of imported granular structural fill (crushed rock) that is properly placed and compacted during construction.

5.5.5 Subsurface Drainage

Recognizing the near-surface fine-grained (silty) soils encountered at this site, we recommend placing foundation drains at the exterior, base elevations of perimeter continuous wall footings. Foundation drains should consist of a minimum 4-inch diameter, perforated, PVC drainpipe wrapped with a non-woven geotextile filter fabric. The drains should be backfilled with a minimum of 2 cubic feet of open graded drain rock per lineal foot of pipe. The drain rock should also be encased in a geotextile fabric in order to provide separation from the surrounding fine-grained soils. Foundation drains should be positively sloped and should outlet to a suitable discharge point. The geotechnical engineer's representative should observe the drains prior to backfilling. Roof drains should not be tied into foundation drains.

5.6 Rigid Retaining Walls

5.6.1 Footings

Retaining wall footings should be designed and constructed in conformance with the recommendations presented in Section 5.5, as applicable.

5.6.2 Wall Drains

We recommend placing retaining wall drains[13] at the base elevation of the heel of retaining wall footings. Retaining wall drains should consist of a minimum 4-inch-diameter, perforated, HDPE (High Density Polyethylene) drainpipe wrapped with a non-woven geotextile filter fabric. The drains should be backfilled with a minimum of 2 cubic feet of open graded drain rock per lineal foot of pipe. The drain rock should be encased in a geotextile fabric in order to provide separation from the surrounding soils. Retaining wall drains should be positively sloped and should outlet to a suitable discharge point. The geotechnical engineer's representative should be contacted to observe the drains prior to backfilling. Roof or area drains should not be tied into retaining wall drains.

5.6.3 Wall Backfill

Retaining walls should be backfilled with imported granular structural fill in conformance with Section 5.4.2 and contain less than 5 percent passing the U.S. Standard No. 200 Sieve. The backfill should be compacted to a minimum of 90 percent of the material's maximum dry density as determined in general accordance with ASTM D1557 (Modified Proctor). When placing fill behind walls, care must be taken to minimize undue lateral loads on the walls. Heavy compaction equipment should be kept at least "H" feet from the back of the walls, where "H" is the height of the wall. Light mechanical or hand tamping equipment should be used for compaction of backfill materials within "H" feet of the back of the walls.

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[13] Building retaining walls that will be fully (or partially) constructed below the groundwater level, if any, should be waterproofed and designed to accommodate hydrostatic loading conditions. The geotechnical engineer should be contacted to provide supplemental recommendations for this design case, if warranted.

5.6.4 Design Parameters & Limitations

For rigid retaining walls founded, backfilled, and drained as recommended above, the following table presents parameters recommended for design.

Table 3 Design Parameters for Rigid Retaining Walls

Retaining Wall Condition	Modeled Backfill Condition	Static Equivalent Fluid Pressure (S_A)[1]	Seismic Equivalent Fluid Pressure (S_{AE})[1,2]	Surcharge from Uniform Load, q, Acting on Backfill Behind Retaining Wall
Not Restrained from Rotation	Level (i=0)	28 pcf	38 pcf	0.22*q
Restrained from Rotation	Level (i=0)	50 pcf	52 pcf	0.38*q

[1] Refer to the attached Figure 4 for a graphical representation of static and seismic loading conditions. Seismic resultant force acts at 0.6H above the base of the wall.

[2] Seismic (dynamic) lateral loads were computed using the Mononobe-Okabe Equation as presented in the 1997 Federal Highway Administration (FHWA) design manual. Static and seismic equivalent fluid pressures are not additive.

The above design recommendations are based on the assumptions that:

- The walls consist of concrete cantilevered retaining walls (β = 0 and δ = 24 degrees, see Figure 4).
- The walls are 10 feet or less in height.
- The backfill is drained and consists of imported granular structural fill (ϕ = 38 degrees).
- No point, line, or strip load surcharges are imposed behind the walls.
- The grade behind the wall is level, or sloping down and away from the wall, for a distance of 15 feet or more from the wall.
- The grade in front of the walls is level or ascending for a distance of at least 5 feet from the wall.

Re-evaluation of our recommendations will be required if the retaining wall design criteria for the project vary from these assumptions.

5.6.5 Surcharge Loads

Where present, surcharges from adjacent site features (i.e. buildings, slabs, pavements, etc.) should be evaluated in design of retaining walls at the site. Methods for calculating lateral pressures on rigid retaining walls from strip, line, and vertical point loads are presented on the attached Figure 5.

5.7 Floor Slabs

5.7.1 Subgrade Preparation

Satisfactory subgrade support for slabs constructed on grade, supporting up to 150 psf area loading, can be obtained from the native, medium stiff to better elastic silt (MH), the native, medium dense to better silty sand (SM), or new structural fill that is properly placed and compacted on these materials during construction. The geotechnical engineer's representative should be contacted to observe subgrade conditions prior to placement of structural fill or aggregate base. If soft, loose, or otherwise unsuitable soils are encountered, they should be over-excavated as recommended by the geotechnical representative at the time of construction. The resulting over-excavation should be brought back to grade with imported granular structural fill in conformance with Section 5.4.2.

5.7.2 Crushed Rock Base

Concrete floor slabs should be supported on a minimum 6-inch-thick layer of crushed rock (base rock). Floor slab base rock should consist of well-graded granular material (crushed rock) containing no organic matter or debris, have a maximum particle size of ¾ inch, and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. Floor slab base rock should be placed in one lift and compacted to not less than 95 percent of the material's maximum dry density as determined in general accordance with ASTM D1557 (Modified Proctor). We recommend "choking" the surface of the base rock with sand just prior to concrete placement. Choking means the voids between the largest aggregate particles are filled with sand, but does not provide a layer of sand above the base rock. Choking the base rock surface reduces the lateral restraint on the bottom of the concrete during curing. Choking the base rock also reduces punctures in vapor retarding membranes due to foot traffic where such membranes are used.

5.7.3 Design Considerations

For floor slabs constructed as recommended, an effective modulus of subgrade reaction of 150 pounds per cubic inch (pci) is recommended for the design of the floor slab. A higher effective modulus of subgrade reaction can be obtained by increasing the base rock thickness. Please contact the geotechnical engineer for additional recommendations if a higher modulus is desired. Floor slabs constructed as recommended will likely settle less than ½ inch. For general floor slab construction, slabs should be jointed around columns and walls to permit slabs and foundations to settle differentially.

5.7.4 Subgrade Moisture Considerations

Liquid moisture and moisture vapor should be expected at the subgrade surface. The recommended crushed rock base is anticipated to provide protection against liquid moisture. Where moisture vapor emission through the slab must be minimized, e.g. impervious floor coverings, storage of moisture sensitive materials directly on the slab surface, etc., a vapor retarding membrane or vapor barrier below the slab should be considered. Factors such as cost, special considerations for construction, floor coverings, and end use suggest that the decision regarding a vapor retarding membrane or vapor barrier be made by the architect and owner.

If a vapor retarder or vapor barrier is placed below the slab, its location should be based on current American Concrete Institute (ACI) guidelines, ACI 302 Guide for Concrete Floor and Slab Construction. In some cases, this indicates placement of concrete directly on the vapor retarder or barrier. Please note that the placement of concrete directly on impervious membranes increases the risk of plastic shrinkage cracking and slab curling in the concrete. Construction practices to reduce or eliminate such risk, as described in ACI 302, should be employed during concrete placement.

5.8 Pavements

5.8.1 Subgrade Preparation

Satisfactory subgrade support for pavements can be obtained from the native, medium stiff to better elastic silt (MH), the native, medium dense to better silty sand (SM), or new structural fill that is properly placed and compacted on these materials during construction. Pavement subgrade preparation should be in conformance with Section 5.1.3 of this report. Pavement subgrade surfaces should be crowned (or sloped) for proper drainage in accordance with specifications provided by the project civil engineer.

5.8.2 Traffic Classifications

Recognizing that traffic data has not been provided, CGT has considered four levels of traffic demand for review and design of pavement sections. We modeled the following four design cases (traffic levels) developed from the Asphalt Pavement Association of Oregon (APAO):

- *APAO Level I (Very Light):* This design case considers typical average daily truck traffic (ADTT) of 1 per day over 20 years. Among others, examples under this loading consist of passenger car parking stalls, residential driveways, and seasonal recreational roads.
- *APAO Level II (Light):* This design case considers typical ADTT of 2 to 7 per day over 20 years. Examples under this loading consist of residential streets and parking lots of less than 500 stalls.
- *APAO Level III (Low Moderate):* This design case considers typical ADTT of 7 to 14 per day over 20 years. Among others, examples under this loading consist of urban minor collector streets and parking lots with more than 500 stalls.
- *APAO Level IV (Moderate):* This design case considers typical ADTT of 14 to 35 per day over 20 years. Among others, examples under this loading consist of urban minor arterial streets and residential streets with bus routes.

We recommend the owner and design team review the traffic levels presented above and select those that most accurately represent anticipated daily truck traffic for select new pavements.

5.8.3 Asphalt Concrete Pavements

5.8.3.1 Input Parameters

Design of the asphalt concrete (AC) pavement sections presented below were based on the parameters presented in the following table, the American Association of State Highway and Transportation Officials (AASHTO) 1993 "Design of Pavement Structures" manual, and pavement design manuals presented by APAO and ODOT[14]. If any of the items listed need revision, please contact us and we will reassess the provided design sections.

Table 4 Input Parameters Used in AC Pavement Design

Input Parameter	Design Value[1]	Input Parameter		Design Value[1]
Pavement Design Life	20 years	Resilient Modulus	Subgrade (Native Soils)[4]	5,000 psi
Annual Percent Growth	0 percent		Crushed Aggregate Base[2]	20,000 psi
Initial Serviceability[2]	4.2	Structural Coefficient[2]	Crushed Aggregate Base	0.10
Terminal Serviceability[2]	2.5		Asphalt	0.42
Reliability[2]	75 percent	Vehicle Traffic[4] (range in ESAL[5])	APAO Level I (Very Light)	Less than 10,000
Standard Deviation[2]	0.49		APAO Level II (Light)	Less than 50,000
Drainage Factor[3]	1.0		APAO Level III (Low Moderate)	Less than 100,000
---	---		APAO Level IV (Moderate)	Less than 250,000

1 If any of the above parameters are incorrect, please contact us so that we may revise our recommendations, if warranted.
2 Value based on guidelines presented in the ODOT Pavement Design Guide.
3 Assumes good drainage away from pavement, base, and subgrade is achieved by proper crowning of subgrades.

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

[4] Values based on experience with similar soils in the region.
[5] ESAL = Total 18-Kip equivalent single axle load. Traffic levels taken from Table 3.1 of APAO manual. If actual traffic levels will be above those identified above, the geotechnical engineer should be consulted.

5.8.3.2 Recommended Minimum Sections

The following table presents the minimum AC pavement sections for various traffic loads indicated in the preceding table, based on the referenced AASHTO procedures.

Table 5 Recommended Minimum AC Pavement Sections

Material	APAO Traffic Loading			
	Level I	Level II	Level III	Level IV
Asphalt Pavement (inches)	3	3½	4	4½
Crushed Aggregate Base (inches)[1]	6	8	10	11
Subgrade Soils	Prepared in conformance with Section 5.8.1 of this report.			

[1] Thickness shown assumes dry weather construction. A granular sub-base section and/or a geotextile separation fabric may be required in wet conditions in order to support construction traffic and protect the subgrade. Refer to Section 5.3 for additional discussion.

5.8.3.3 AC Pavement Materials

Aggregate Base: We recommend pavement aggregate base consist of dense-graded aggregate in conformance with Section 02630.10 of the most recent ODOT SSC, with the following additional considerations. We recommend the material consist of crushed rock or gravel, have a maximum particle size of 1½ inches, and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. Aggregate base should be compacted to not less than 95 percent of the material's maximum dry density as determined in general accordance with ASTM D1557 (Modified Proctor).

Asphalt Concrete: We recommend asphalt pavement consist of Level 2, ½-inch, dense-graded AC in conformance with the most recent ODOT SSC. Asphalt pavement should be compacted to at least 91 percent of the material's theoretical maximum density as determined in general accordance with ASTM D2041 (Rice Specific Gravity).

5.8.4 Rigid (Concrete) Pavements

5.8.4.1 Input Parameters

Design of the rigid (Portland Cement Concrete, PCC) pavement sections presented below was based on the parameters presented in the following table and the referenced AASHTO design manual. If any of the items listed need revision, please contact us and we will reassess the provided design sections. Jointing, reinforcement, and surface finish should be performed in accordance with the project civil engineer, architect, and owner requirements.

Table 6 Input Parameters Used in PCC Pavement Design

Parameter / Discussion		Design Value
Subgrade Modulus (k-value)		150 pci
Standard Deviation[1]		0.39
Load Transfer Devices incorporated?		Yes; Load Transfer Coefficient = 3.2
Minimum Concrete Modulus of Rupture		600 psi
Concrete Elastic Modulus		5.0×10^6 psi
Minimum Air-Entrained Concrete Compressive Strength		4,000 psi
Vehicle Traffic[2] (range in ESAL)	APAO Level I (Very Light)	Less than 10,000
	APAO Level II (Light)	Less than 50,000
	APAO Level III (Low Moderate)	Less than 100,000
	APAO Level IV (Moderate)	Less than 250,000

1 Value based on guidelines presented in the ODOT Pavement Design Guide.
2 ESAL = Total 18-Kip equivalent single axle load. If actual traffic levels will be above those identified above, the geotechnical engineer should be consulted.

5.8.4.2 Recommended Minimum Sections

The following table presents the recommended minimum concrete pavement sections based on the referenced AASHTO procedures.

Table 7 Recommended Minimum PCC Pavement Sections

Material	APAO Traffic Loading			
	Level I	Level II	Level III	Level IV
Portland Cement Concrete, PCC[1] (inches)	5	5½	6	7
All-Weather Base[2,3] (inches)	4	4	4	4
Subgrade Soils	Prepared in conformance with Section 5.7.1 of this report			

1 Concrete strength and other properties should be in conformance with Table 6 above.
2 All-weather base (base rock) should be a minimum of 4 inches thick.
3 Thickness shown assumes dry weather construction. A granular sub-base section and/or a geotextile separation fabric may be required in wet conditions in order to support construction traffic and protect the subgrade. Refer to Section 5.3 for additional discussion.

5.8.4.3 PCC Pavement Materials

All-Weather Base: We recommend all-weather base consist of dense-graded aggregate in conformance with Section 02630.10 of the most recent ODOT SSC, with the following additional considerations. We recommend the material consist have a maximum particle size of ¾-inch and have less than 5 percent material passing the U.S. Standard No. 200 Sieve. Aggregate base should be compacted to not less than 95 percent of the material's maximum dry density as determined in general accordance with ASTM D1557 (Modified Proctor).

PCC Pavement: Portland cement concrete (PCC) pavement should be in conformance with Section 02001 of the most recent ODOT SSC and meet the properties detailed in Table 6 above.

5.9 Additional Considerations

5.9.1 Drainage

Subsurface drains should be connected to the nearest storm drain or other suitable discharge point. Paved surfaces and grading near or adjacent to the building should be sloped to drain away from the building. Surface water from paved surfaces and open spaces should be collected and routed to a suitable discharge point. Surface water should not be directed into foundation drains, retaining wall drains, or onto site slopes.

5.9.2 Expansive Potential

The near surface native soils consist mostly of moderate plasticity elastic silt soils. Based on our experience with similar soils in the vicinity of the site, these soils are not considered to be susceptible to appreciable movements from changes in moisture content. Accordingly, no special considerations are required to mitigate expansive potential of the near surface soils at the site.

6.0 RECOMMENDED ADDITIONAL SERVICES

6.1 Design Review

Geotechnical design review is of paramount importance. We recommend the geotechnical design review take place prior to releasing bid packets to contractors.

6.2 Observation of Construction

Satisfactory earthwork, foundation, floor slab, and pavement performance depends to a large degree on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during subsurface explorations, and recognition of changed conditions often requires experience. We recommend that qualified personnel visit the site with sufficient frequency to detect whether subsurface conditions change significantly from those observed to date and anticipated in this report. We recommend geotechnical engineer's representative attend a pre-construction meeting coordinated by the contractor and/or developer. The project geotechnical engineer's representative should provide observations and/or testing of at least the following earthwork elements during construction:

- Site Stripping and Grubbing
- Subgrade Preparation for Shallow Foundations, Retaining Walls, Structural Fills, Floor Slabs, and Pavements
- Compaction of Structural Fill, Retaining Wall Backfill, and Utility Trench Backfill
- Compaction of Base Rock for Floor Slabs and Pavements
- Compaction of Asphalt Concrete for Pavements

It is imperative that the owner and/or contractor request earthwork observations and testing at a frequency sufficient to allow the geotechnical engineer to provide a final letter of compliance for the earthwork activities.

7.0 LIMITATIONS

We have prepared this report for use by the owner/developer and other members of the design and construction team for the proposed development. The opinions and recommendations contained within this report are forwarded to assist in the planning and design process and are not intended to be, nor should they be construed as, a warranty of subsurface conditions.

We have made observations based on our explorations that indicate the soil conditions at only those specific locations and only to the depths penetrated. These observations do not necessarily reflect soil types, strata thickness, or water level variations that may exist between or away from our explorations. If subsurface conditions vary from those encountered in our site explorations, CGT should be alerted to the change in conditions so that we may provide additional geotechnical recommendations, if necessary. Observation by experienced geotechnical personnel should be considered an integral part of the construction process.

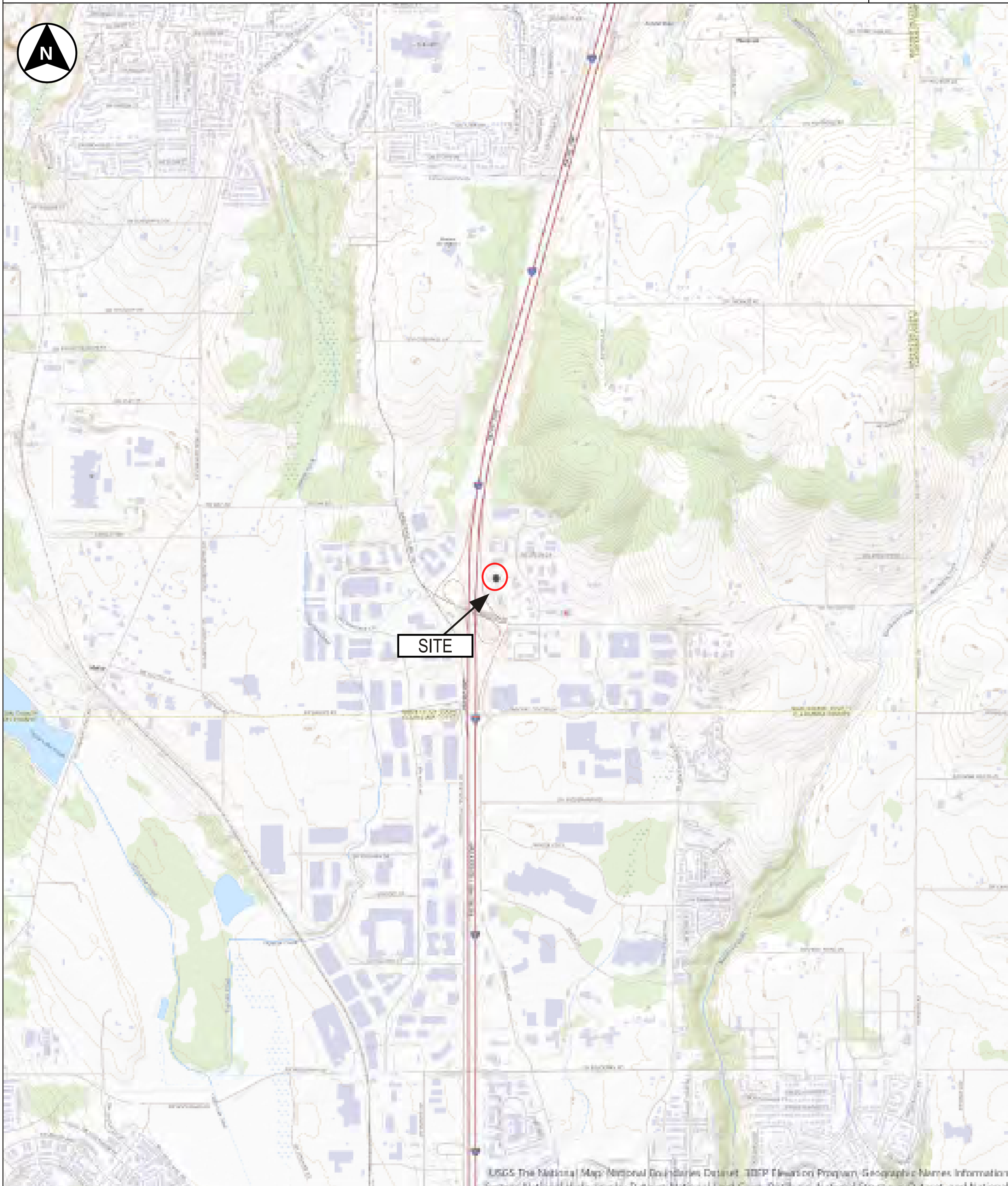
The owner/developer is responsible for ensuring that the project designers and contractors implement our recommendations. When the design has been finalized, prior to releasing bid packets to contractors, we recommend that the design drawings and specifications be reviewed by our firm to see that our recommendations have been interpreted and implemented as intended. If design changes are made, we request that we be retained to review our conclusions and recommendations and to provide a written modification or verification. Design review and construction phase testing and observation services are beyond the scope of our current assignment, but will be provided for an additional fee.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Geotechnical engineering and the geologic sciences are characterized by a degree of uncertainty. Professional judgments presented in this report are based on our understanding of the proposed construction, familiarity with similar projects in the area, and on general experience. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared; no warranty, expressed or implied, is made. This report is subject to review and should not be relied upon after a period of three years.

RON TONKIN GRAN TURISMO LAMBORGHINI DEALERSHIP - WILSONVILLE, OREGON
Project Number G2306033

FIGURE 1
Site Location



CARLSON CGT GEOTECHNICAL
503-601-8250
Drafted by: MDI

USGS Topographic base map created with The National Map, 2020, at https://viewer.nationalmap.gov/advanced-viewer/

Township 3 South, Range 1 West, Section 2, Willamette Meridian

Latitude: 45.337419° North
Longitude: 122.767954° West

1 Inch = 2,000 feet
0 2000 4000

RON TONKIN GRAN TURISMO LAMBORGHINI DEALERSHIP - WILSONVILLE, OREGON
Project Number G2306033

FIGURE 2

Site Plan

CARLSON CGT GEOTECHNICAL 503-601-8250

Drafted by: BG

LEGEND

B-1 (12') Hollow-stem auger boring. Depth to groundwater shown in ().

Orientation of site photographs shown on Figure 3

1 Inch = 60 Feet

0 60 120

NOTES: Drawing based on sheet A-101, "Site Plan", produced by Axis Design Group on 10/04/2023 and 2021 aerial imagery, provided by Wilsonville Maps, www.wilsonvillemaps.com, accessed December 2, 2023. All locations are approximate.

RON TONKIN GRAN TURISMO LAMBORGHINI DEALERSHIP - WILSONVILLE, OREGON
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FIGURE 3

Site Photographs

Photograph 1

Photograph 2

Photograph 3

Photograph 4

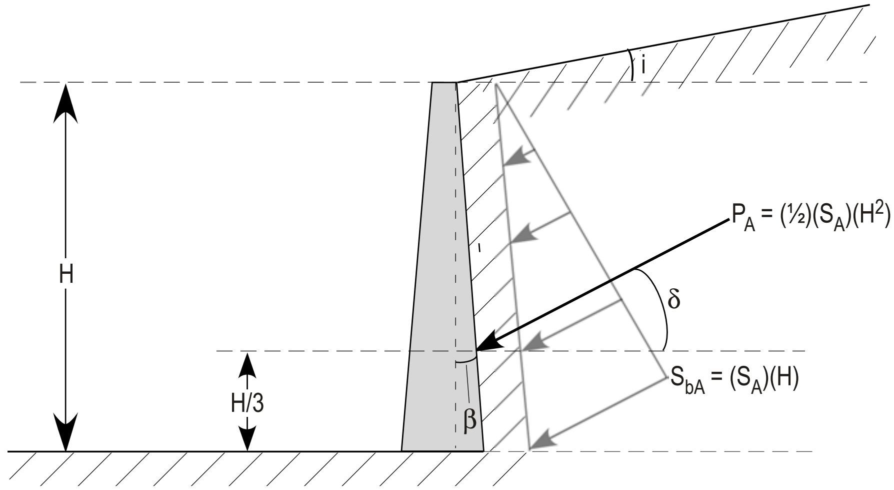
CARLSON CGT GEOTECHNICAL 503-601-8250

Drafted by: MDI

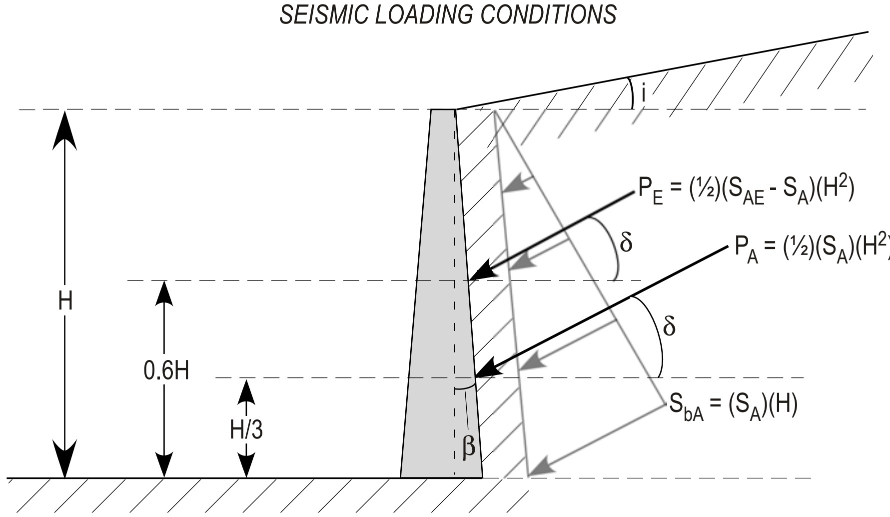
See Figure 2 for approximate photograph locations and directions. Photographs were taken at the time of our fieldwork.

ACTIVE LATERAL PRESSURE DISTRIBUTION

STATIC LOADING CONDITIONS



SEISMIC LOADING CONDITIONS



LEGEND

S_A = Active lateral equivalent fluid pressure (lb/ft^3)*

S_{bA} = Active lateral earth pressure (static) at the bottom of wall (lb/ft^3)

S_{AE} = Active total (static + seismic) equivalent fluid pressure (lb/ft^3)*

i = Slope of backfill, relative to horizontal (degrees)**

β = Slope of back of wall, relative to vertical (degrees)**

P_A = Static active thrust force acting at H/3 from bottom of retaining wall (lb/ft)

P_E = Dynamic active thrust force acting at 0.6H from bottom of retaining wall (lb/ft)

δ = Angle from normal of back of wall (degrees). Based on friction developing between wall and backfill**

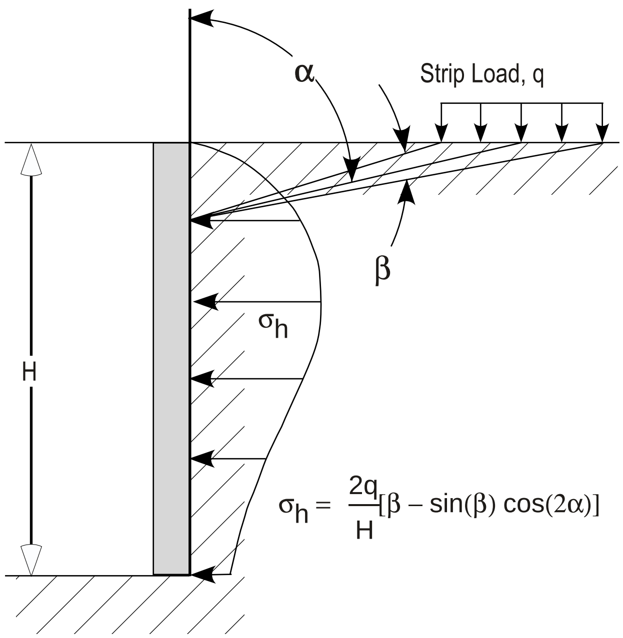
*Refer to report text for calculated values **Refer to report text for modeled/assumed values

CARLSON CGT GEOTECHNICAL 503-601-8250

Notes

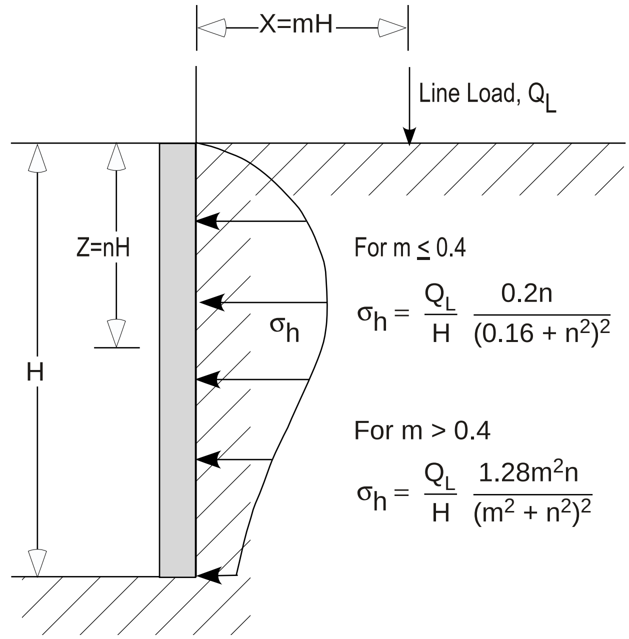
1. Uniform pressure distribution of seismic loading is based on empirical evaluations [Sherif et al, 1982 and Whitman, 1990].
2. Placement of seismic resultant force at 0.6H is based on wall behavior and model test results [Whitman, 1990].

STRIP LOAD PARALLEL TO WALL[1]



$$\sigma_h = \frac{2q}{H}[\beta - \sin(\beta)\cos(2\alpha)]$$

LINE LOAD PARALLEL TO WALL[2]



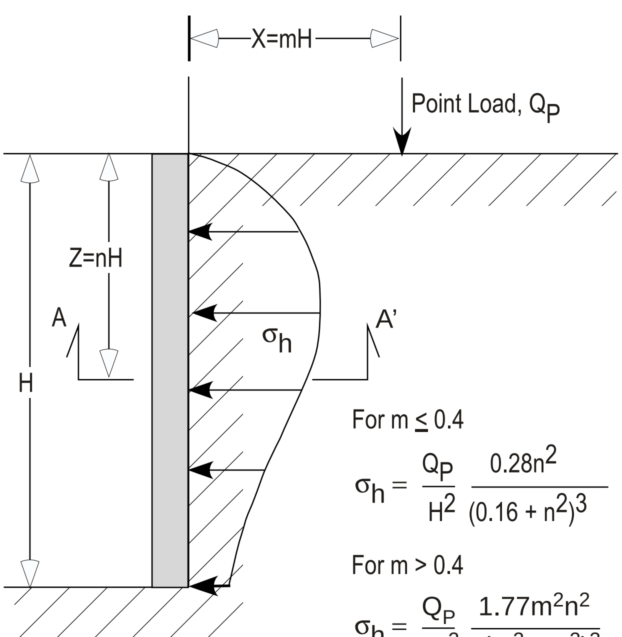
For $m \le 0.4$

$$\sigma_h = \frac{Q_L}{H}\frac{0.2n}{(0.16 + n^2)^2}$$

For $m > 0.4$

$$\sigma_h = \frac{Q_L}{H}\frac{1.28m^2 n}{(m^2 + n^2)^2}$$

VERTICAL POINT LOAD[2]



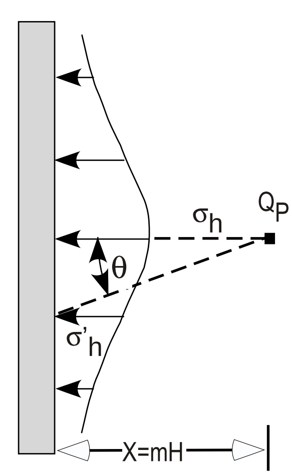
For $m \le 0.4$

$$\sigma_h = \frac{Q_P}{H^2}\frac{0.28n^2}{(0.16 + n^2)^3}$$

For $m > 0.4$

$$\sigma_h = \frac{Q_P}{H^2}\frac{1.77m^2 n^2}{(m^2 + n^2)^3}$$

Section A - A'



$$\sigma'_h = \sigma_h \cos^2(1.1\,\theta)$$

Notes: 1. Das, Principles of Geotechnical Engineering, 1990 Edition.
2. NAVFAC Design Manual 7.06.

Refer to the referenced design manuals for additional guidance. Contact CGT if there are any questions with modeling surcharge loads.

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Appendix A: Subsurface Investigation and Laboratory Testing

Ron Tonkin Gran Turismo Lamborghini Dealership
Lot South of 25195 SW Parkway Avenue
Wilsonville, Oregon

CGT Project Number G2306033

December 27, 2023

Prepared For:

Celia Tonkin
Ron Tonkin Gran Turismo
25300 SW Parkway Avenue
Wilsonville, Oregon 97070

Prepared by
Carlson Geotechnical

A.1.0 SUBSURFACE INVESTIGATION

Our field investigation consisted of five drilled borings completed on December 4, 2023. The exploration locations are shown on the Site Plan, attached to the geotechnical report as Figure 2. The exploration locations shown therein were determined based on measurements from existing site features (trees, pavements, etc.) and are approximate. Surface elevations indicated on the logs were estimated based on the topographic contours (by others) shown on the topographic survey provided by our client, and are approximate. The attached figures detail the exploration methods (Figure A1), soil classification criteria (Figure A2), and present detailed logs of the explorations (Figures A3 through A7), as discussed below.

A.1.1 Drilled Borings

CGT observed the advancement of five drilled borings (B-1 through B-5) at the site using a B58 track-mounted drill rig provided and operated by our subcontractor, PLI Systems of Hillsboro, Oregon. The borings were advanced using the hollow-stem auger drilling technique to depths ranging from approximately 6½ to 26½ feet below ground surface (bgs). Upon completion, the borings were backfilled with granular bentonite. Drilling wastes (cuttings and drilling fluids) were left onsite.

A.1.2 In-Situ Testing

A.1.2.1 <u>Standard Penetration Tests (SPTs)</u>

SPTs were conducted within the borings using a split-spoon sampler in general accordance with ASTM D1586. The SPTs were conducted at 2½- to 5-foot intervals to the termination depths of the borings. The SPT is described on the attached Exploration Key, Figure A1.

A.1.3 Material Classification & Sampling

Soil samples were obtained at selected intervals in the borings using the referenced split-spoon (SPT) sampler and thin-walled, steel (Shelby) tube samplers detailed on Figure A1. A qualified member of CGT's geological staff collected the samples and logged the soils in general accordance with the Visual-Manual Procedure (ASTM D2488). An explanation of this classification system is attached as Figure A2. The SPT samples were stored in sealable plastic bags and the Shelby tube samples were sealed with caps and tape and transported to our soils laboratory for further examination and testing. Our geotechnical staff visually examined all samples in order to refine the initial field classifications.

A.1.4 Subsurface Conditions

Subsurface conditions are summarized in Section 2.3 of the geotechnical report. Detailed logs of the explorations are presented on the attached exploration logs, Figures A3 through A7.

A.2.0 LABORATORY TESTING

Laboratory testing was performed on samples collected in the field to refine our initial field classifications and determine in-situ parameters. Laboratory testing included the following:

- Twelve moisture content determinations (ASTM D2216).
- Three percentage passing the U.S. Standard No. 200 Sieve tests (ASTM D1140).
- Three Atterberg limits (plasticity) tests (ASTM D4318).

Results of the laboratory tests are shown on the exploration logs.

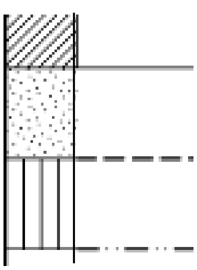
RON TONKIN GRAN TURISMO LAMBORGHINI DEALERSHIP - WILSONVILLE, OREGON Project Number G2306033	FIGURE A1 Exploration Key

PL — MC — LL	Atterberg limits (plasticity) test results (ASTM D4318): PL = Plastic Limit, LL = Liquid Limit, and MC= Moisture Content (ASTM D2216)
☐ FINES CONTENT (%)	Percentage passing the U.S. Standard No. 200 Sieve (ASTM D1140)

SAMPLING

GRAB	Grab sample
BULK	Bulk sample
SPT	**Standard Penetration Test** (SPT) consists of driving a 2-inch, outside-diameter, split-spoon sampler into the undisturbed formation with repeated blows of a 140-pound, hammer falling a vertical distance of 30 inches (ASTM D1586). The number of blows (N-value) required to drive the sampler the last 12 inches of an 18-inch sample interval is used to characterize the soil consistency or relative density. The drill rig was equipped with an cat-head or automatic hammer to conduct the SPTs. The observed N-values, hammer efficiency, and N_{60} are noted on the boring logs.
MC	**Modified California** sampling consists of 3-inch, outside-diameter, split-spoon sampler (ASTM G3550) driven similarly to the SPT sampling method described above. A sampler diameter correction factor of 0.44 is applied to calculate the equivalent SPT N_{60} value per Lacroix and Horn, 1973.
CORE	**Rock Coring** interval
SH	**Shelby Tube** is a 3-inch, inner-diameter, thin-walled, steel tube push sampler (ASTM D1587) used to collect relatively undisturbed samples of fine-grained soils.
WDCP	**Wildcat Dynamic Cone Penetrometer** (WDCP) test consists of driving 1.1-inch diameter, steel rods with a 1.4-inch diameter, cone tip into the ground using a 35-pound drop hammer with a 15-inch free-fall height. The number of blows required to drive the steel rods is recorded for each 10 centimeters (3.94 inches) of penetration. The blow count for each interval is then converted to the corresponding SPT N_{60} values.
DCP	**Dynamic Cone Penetrometer** (DCP) test consists of driving a 20-millimeter diameter, hardened steel cone on 16-millimeter diameter steel rods into the ground using a 10-kilogram drop hammer with a 460-millimeter free-fall height. The depth of penetration in millimeters is recorded for each drop of the hammer.
POCKET PEN. (tsf)	**Pocket Penetrometer** test is a hand-held instrument that provides an approximation of the unconfined compressive strength in tons per square foot (tsf) of cohesive, fine-grained soils.

CONTACTS



Observed (measured) contact between soil or rock units.

Inferred (approximate) contact between soil or rock units.

Transitional (gradational) contact between soil or rock units.

ADDITIONAL NOTATIONS

Italics	Notes drilling action or digging effort
{ Braces }	Interpretation of material origin/geologic formation (e.g. { Base Rock } or { Columbia River Basalt })

CARLSON CGT GEOTECHNICAL 503-601-8250

All measurements are approximate.

RON TONKIN GRAN TURISMO LAMBORGHINI DEALERSHIP - WILSONVILLE, OREGON
Project Number G2306033

FIGURE A2
Soil Classification

Classification of Terms and Content

NAME: Group Name and Symbol
Relative Density or Consistency
Color
Moisture Content
Plasticity
Other Constituents
Other: Grain Shape, Approximate Gradation
Organics, Cement, Structure, Odor, etc.
Geologic Name or Formation

Grain Size

		U.S. Standard Sieve
Fines		<#200 (0.075 mm)
Sand	Fine	#200 - #40 (0.425 mm)
	Medium	#40 - #10 (2 mm)
	Coarse	#10 - #4 (4.75 mm)
Gravel	Fine	#4 - 0.75 inch
	Coarse	0.75 inch - 3 inches
Cobbles		3 to 12 inches
Boulders		> 12 inches

Coarse-Grained (Granular) Soils

Relative Density

SPT N_{60}-Value	Density
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
>50	Very Dense

Minor Constituents

Percent by Volume	Descriptor	Example
0 - 5%	"Trace" as part of soil description	"trace silt"
5 - 15%	"With" as part of group name	"**POORLY GRADED SAND WITH SILT**"
15 - 49%	Modifier to group name	"**SILTY SAND**"

Fine-Grained (Cohesive) Soils

SPT N_{60}-Value	Torvane tsf Shear Strength	Pocket Pen tsf Unconfined	Consistency	Manual Penetration Test
<2	<0.13	<0.25	Very Soft	Thumb penetrates more than 1 inch
2 - 4	0.13 - 0.25	0.25 - 0.50	Soft	Thumb penetrates about 1 inch
4 - 8	0.25 - 0.50	0.50 - 1.00	Medium Stiff	Thumb penetrates about ¼ inch
8 - 15	0.50 - 1.00	1.00 - 2.00	Stiff	Thumb penetrates less than ¼ inch
15 - 30	1.00 - 2.00	2.00 - 4.00	Very Stiff	Readily indented by thumbnail
>30	>2.00	>4.00	Hard	Difficult to indent by thumbnail

Minor Constituents

Percent by Volume	Descriptor	Example
0 - 5%	"Trace" as part of soil description	"trace fine-grained sand"
5 - 15%	"Some" as part of soil description	"some fine-grained sand"
15 - 30%	"With" as part of group name	"**SILT WITH SAND**"
30 - 49%	Modifier to group name	"**SANDY SILT**"

Moisture Content

Dry: Absence of moisture, dusty, dry to the touch

Moist: Leaves moisture on hand

Wet: Visible free water, likely from below water table

	Plasticity	Dry Strength	Dilatancy	Toughness
ML	Non to Low	Non to Low	Slow to Rapid	Low, can't roll
CL	Low to Medium	Medium to High	None to Slow	Medium
MH	Medium to High	Low to Medium	None to Slow	Low to Medium
CH	Medium to High	High to Very High	None	High

Structure

Stratified: Alternating layers of material or color >6 mm thick

Laminated: Alternating layers < 6 mm thick

Fissured: Breaks along definite fracture planes

Slickensided: Striated, polished, or glossy fracture planes

Blocky: Cohesive soil that can be broken down into small angular lumps which resist further breakdown

Lenses: Has small pockets of different soils, note thickness

Homogeneous: Same color and appearance throughout

Visual-Manual Classification

Major Divisions			Group Symbols	Typical Names
Coarse Grained Soils: More than 50% retained on No. 200 sieve	Gravels: 50% or more *retained* on the No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel/sand mixtures, little or no fines
			GP	Poorly-graded gravels and gravel/sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel/sand/silt mixtures
			GC	Clayey gravels, gravel/sand/clay mixtures
	Sands: More than 50% *passing* the No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly-graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand/silt mixtures
			SC	Clayey sands, sand/clay mixtures
Fine-Grained Soils: 50% or more Passes No. 200 Sieve	Silt and Clays Low Plasticity Fines		ML	Inorganic silts, rock flour, clayey silts
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
			OL	Organic soil of low plasticity
	Silt and Clays High Plasticity Fines		MH	Inorganic silts, clayey silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic soil of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

CARLSON CGT GEOTECHNICAL
503-601-8250

References:

ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

Terzaghi, K., and Peck, R.B., 1948, Soil Mechanics in Engineering Practice, John Wiley & Sons.

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FIGURE A3

Boring B-1

CLIENT Ron Tonkin Gran Tourismo - Celia Tonkin
PROJECT NAME Ron Tonkin Gran Turismo Lamborghini Dealership
PROJECT NUMBER G2306033
PROJECT LOCATION South of 25195 SW Parkway Ave. - Wilsonville, OR
DATE STARTED 12/4/23 **GROUND ELEVATION** 276 ft
ELEVATION DATUM From Survey Map Provided by Client
WEATHER Rain, 57F **SURFACE** Shrubs
LOGGED BY BJG **REVIEWED BY** BMW
DRILLING CONTRACTOR PLI Systems, Inc.
SEEPAGE ---
EQUIPMENT B58 Track Mounted Drill Rig
GROUNDWATER DURING DRILLING ---
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
▼ **GROUNDWATER 4 HOURS AFTER DRILLING** 12.0 ft / El. 264.0 ft

ELEVATION (ft)	GROUP SYMBOL	MATERIAL DESCRIPTION
276–275.5	OL	**ORGANIC SOIL:** Dark brown, moist, low plasticity, with some rootlets.
275.5–267	MH	**ELASTIC SILT:** : Very soft, brown to red-brown, moist, medium plasticity, with weathered rock fragments and some rounded gravel up to ¼ inch diameter. Medium stiff to stiff, some weathered rock fragments up to ¼ inch diameter, trace fine-grained sand below about 4 feet bgs.
267–249.5	SM	**SILTY SAND:** Medium dense, red/orange/yellow/brown, moist, fine- to medium-grained, medium plasticity fines, with black weathered rock fragments up to ½ inch diameter. Wet below about 12 feet bgs.

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 77.7%	DRY UNIT WT. (pcf)	MC / PL / LL / FINES CONTENT (%)
SPT 1	33	0-0-2 (2)	2		
SPT 2	33	4-8-8 (16)	16		MC 25
SPT 3	89	6-12-16 (28)	27		
SPT 4	67	4-9-12 (21)	22		PL 37, MC 46, LL 51
SPT 5	89	5-9-9 (18)	19		Fines 31, MC 45
SPT 6	89	9-15-13 (28)	31		PL 33, MC 47, LL 49
SPT 7	89	5-10-13 (23)	28		MC 44
SPT 8	100	6-10-12 (22)	27		MC 51

▲ SPT N_{60} VALUE ▲ — PL, MC, LL — ☐ FINES CONTENT (%) ☐ — 0 20 40 60 80 100

- Boring terminated at 26½ feet bgs.
- Groundwater observed at about 12 feet bgs.
- No caving observed.
- Boring backfilled with granular bentonite upon completion.

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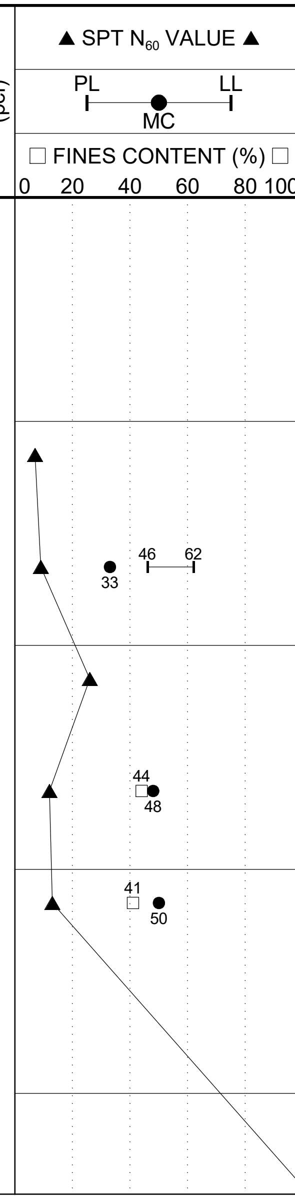
FIGURE A4

Boring B-2

CLIENT Ron Tonkin Gran Tourismo - Celia Tonkin
PROJECT NAME Ron Tonkin Gran Turismo Lamborghini Dealership
PROJECT NUMBER G2306033
PROJECT LOCATION South of 25195 SW Parkway Ave. - Wilsonville, OR
DATE STARTED 12/4/23
GROUND ELEVATION 271 ft
ELEVATION DATUM From Survey Map Provided by Client
WEATHER Rain, 58F
SURFACE Grass
LOGGED BY BJG
REVIEWED BY BMW
DRILLING CONTRACTOR PLI Systems, Inc.
SEEPAGE ---
EQUIPMENT B58 Track Mounted Drill Rig
GROUNDWATER DURING DRILLING ---
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
▼ **GROUNDWATER 2 HOURS AFTER DRILLING** 7.5 ft / El. 263.5 ft

ELEVATION (ft)	GROUP SYMBOL	MATERIAL DESCRIPTION
271–270.5	OL	**ORGANIC SOIL:** Dark brown, moist, low plasticity, with some rootlets.
270.5–261	MH	**ELASTIC SILT:** Very soft, brown, moist, medium plasticity, with some weathered rock fragments up to ¼ inch diameter, trace rootlets. Medium stiff to stiff, red-brown with gray mottling, with some weathered rock fragments up to ¼ inch diameter, some medium-grained sand below about 4 feet bgs. Wet below about 7½ feet bgs.
261–248.75	SM	**SILTY SAND:** Medium dense, red/orange/gray, wet, fine- to coarse-grained, medium plasticity fines, with some weathered rock fragments up to ½ inch diameter. Some yellow mottling below about 15 feet bgs.

SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 77.7%	DRY UNIT WT. (pcf)	PL	MC	LL	FINES CONTENT (%)
SPT 1	33	0-0-0 (0)						
SPT 2	33	2-3-4 (7)	7					
SPT 3	67	4-4-5 (9)	9		46	33	62	
SPT 4	89	4-9-16 (25)	26					
SPT 5	89	4-6-6 (12)	12			48		44
SPT 6	89	2-6-6 (12)	13			50		41
SH 7	25							
SPT 8	100	50/2"	100					



• Boring terminated at 22¼ feet bgs due to practical refusal on a boulder.
• Groundwater observed at about 7½ feet bgs.
• No caving observed.
• Boring backfilled with granular bentonite upon completion.

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FIGURE A5

Boring B-3

CLIENT Ron Tonkin Gran Tourismo - Celia Tonkin
PROJECT NAME Ron Tonkin Gran Turismo Lamborghini Dealership
PROJECT NUMBER G2306033
PROJECT LOCATION South of 25195 SW Parkway Ave. - Wilsonville, OR
DATE STARTED 12/4/23 **GROUND ELEVATION** 268 ft
ELEVATION DATUM From Survey Map Provided by Client
WEATHER Rain, 58F **SURFACE** Grass
LOGGED BY BJG **REVIEWED BY** BMW
DRILLING CONTRACTOR PLI Systems, Inc.
SEEPAGE ---
EQUIPMENT B58 Track Mounted Drill Rig
GROUNDWATER DURING DRILLING ---
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
▼ **GROUNDWATER 1 HOURS AFTER DRILLING** 4.5 ft / El. 263.5 ft

ELEVATION (ft)	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 77.7%	DRY UNIT WT. (pcf)	▲ SPT N_{60} VALUE ▲ / PL ● MC LL / ☐ FINES CONTENT (%) ☐ (0 20 40 60 80 100)
268	OL	**ORGANIC SOIL:** Dark brown, moist, low plasticity, with abundant rootlets.		0						
265	MH	**ELASTIC SILT:** Medium stiff, brown, moist, high plasticity, with trace weathered rock fragments up to ¼ inch diameter, trace rootlets.								
		Some fine-grained sand below about 3 feet bgs.			SPT 1	33	0-2-3 (5)	5		▲ 5
		Wet below about 4½ feet bgs.	▼	5						
					SPT 2	100	1-3-3 (6)	6		▲ 6; MC 34
260		Stiff below about 7½ feet bgs.			SPT 3	100	5-6-10 (16)	16		▲ 16
	SM	**SILTY SAND:** *Medium dense*, red/brown/yellow, wet, fine- to coarse-grained, low plasticity fines,		10	SH 4	42				MC 34

- Boring terminated at 12 feet bgs.
- Groundwater observed at about 4½ feet bgs.
- No caving observed.
- Boring backfilled with granular bentonite upon completion.

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FIGURE A6

Boring B-4

CLIENT Ron Tonkin Gran Tourismo - Celia Tonkin
PROJECT NAME Ron Tonkin Gran Turismo Lamborghini Dealership
PROJECT NUMBER G2306033
PROJECT LOCATION South of 25195 SW Parkway Ave. - Wilsonville, OR
DATE STARTED 12/4/23
GROUND ELEVATION 270 ft
ELEVATION DATUM From Survey Map Provided by Client
WEATHER Rain, 58F
SURFACE Grass
LOGGED BY BJG
REVIEWED BY BMW
DRILLING CONTRACTOR PLI Systems, Inc.
SEEPAGE ---
EQUIPMENT B58 Track Mounted Drill Rig
GROUNDWATER DURING DRILLING ---
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
GROUNDWATER .5 HOURS AFTER DRILLING 1.0 ft / El. 269.0 ft

ELEVATION (ft)	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 77.7%	DRY UNIT WT. (pcf)	PL / MC / LL	FINES CONTENT (%)
270	OL	**ORGANIC SOIL:** Dark brown, moist, low plasticity, with some rootlets.	▼ (1.0 ft)	0							
	MH	**ELASTIC SILT:** Medium stiff, brown with red/gray mottling, wet, medium plasticity, some fine-grained sand. Wet below about 1-foot bgs.			SPT 1	100	1-3-3 (6)	6		MC 34	
265				5	SH 2	83					
	SM	**SILTY SAND:** Medium dense, red/orange/brown, wet, fine- to coarse-grained, medium plasticity fines, with black weathered rock fragments up to ¼ inch diameter.			SPT 3	100	6-11-14 (25)	24		MC 44	

- Boring terminated at 9 feet bgs.
- Groundwater observed at about 1-foot bgs.
- No caving observed.
- Boring backfilled with granular bentonite upon completion.

Elevation scale: 265, 260, 255, 250, 245, 240

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FIGURE A7

Boring B-5

CLIENT Ron Tonkin Gran Tourismo - Celia Tonkin
PROJECT NAME Ron Tonkin Gran Turismo Lamborghini Dealership
PROJECT NUMBER G2306033
PROJECT LOCATION South of 25195 SW Parkway Ave. - Wilsonville, OR
DATE STARTED 12/4/23
GROUND ELEVATION 269 ft
ELEVATION DATUM From Survey Map Provided by Client
WEATHER Rain, 58F
SURFACE Grass
LOGGED BY BJG
REVIEWED BY BMW
DRILLING CONTRACTOR PLI Systems, Inc.
SEEPAGE ---
EQUIPMENT B58 Track Mounted Drill Rig
GROUNDWATER DURING DRILLING ---
DRILLING METHOD Hollow Stem 4¼-inch ID Auger
▼ **GROUNDWATER .5 HOURS AFTER DRILLING** 1.0 ft / El. 268.0 ft

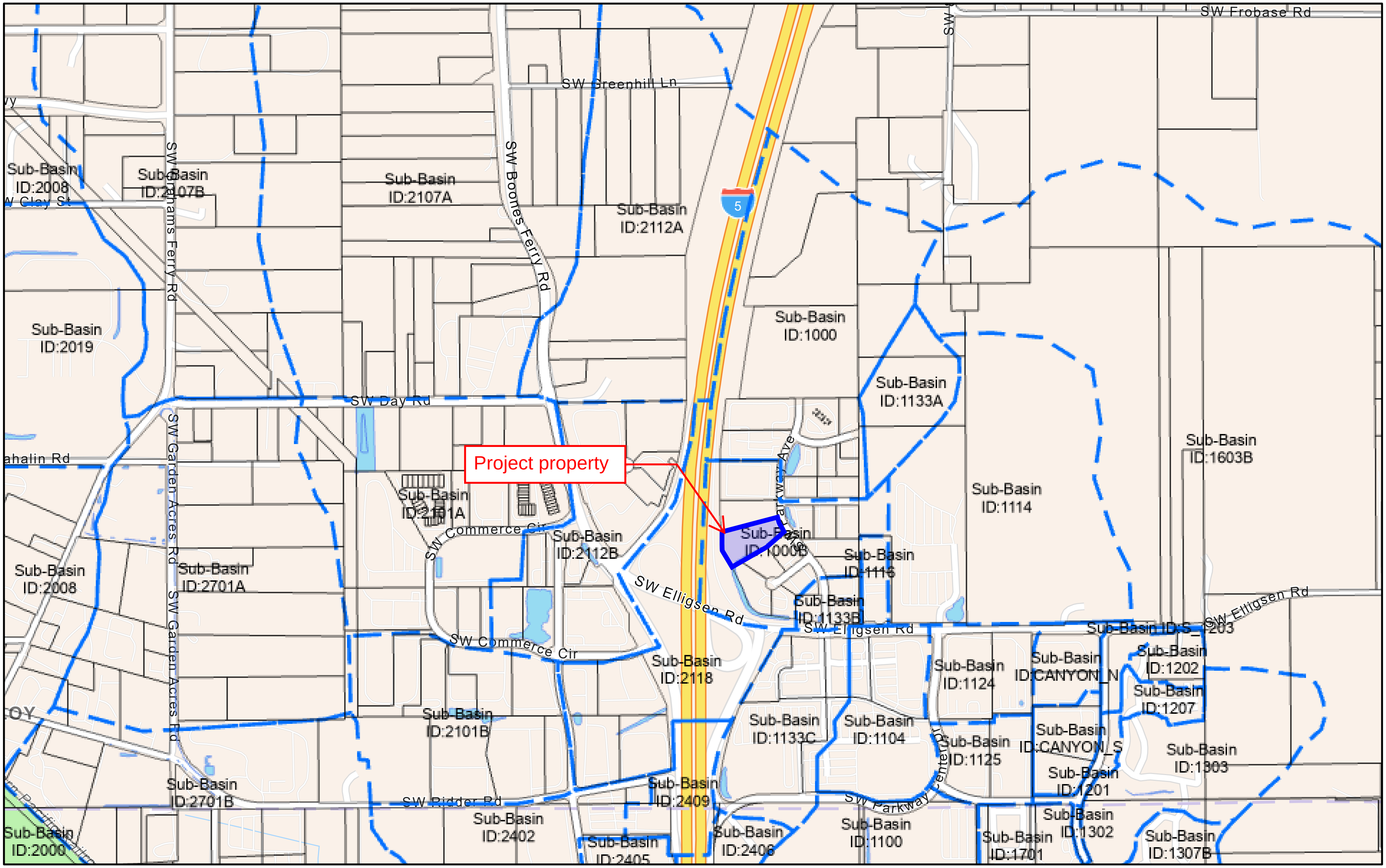
ELEVATION (ft)	GRAPHIC LOG	GROUP SYMBOL	MATERIAL DESCRIPTION	GROUNDWATER	DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N_{SPT} VALUE)	N_{60} VALUE ETR_{Hammer} = 77.7%	DRY UNIT WT. (pcf)	▲ SPT N_{60} VALUE ▲ / PL, MC, LL / ☐ FINES CONTENT (%) ☐ (0 20 40 60 80 100)
		OL	**ORGANIC SOIL:** Dark brown, moist, low plasticity, with some rootlets.	▼	0						
265		MH	**ELASTIC SILT:** Soft, brown with red/gray mottling, moist, medium plasticity, some fine-grained sand. Wet below about 1-foot bgs.			SPT 1	56	1-1-2 (3)	3		▲ 3; ● 29
			Very stiff below about 5 feet bgs.		5	SPT 2	56	9-10-12 (22)	21		▲ 21; ● 30

• Boring terminated at 6½ feet bgs.
• Groundwater observed at about 1-foot bgs.
• No caving observed.
• Boring backfilled with granular bentonite upon completion.

Elevation scale: 265, 260, 255, 250, 245, 240

APPENDIX F – Downstream Analysis Support

Stormwater Sub-Basins



June 11, 2024

RLIS Taxlots

Stormwater Basins OMS

Stormwater Subbasins OMS

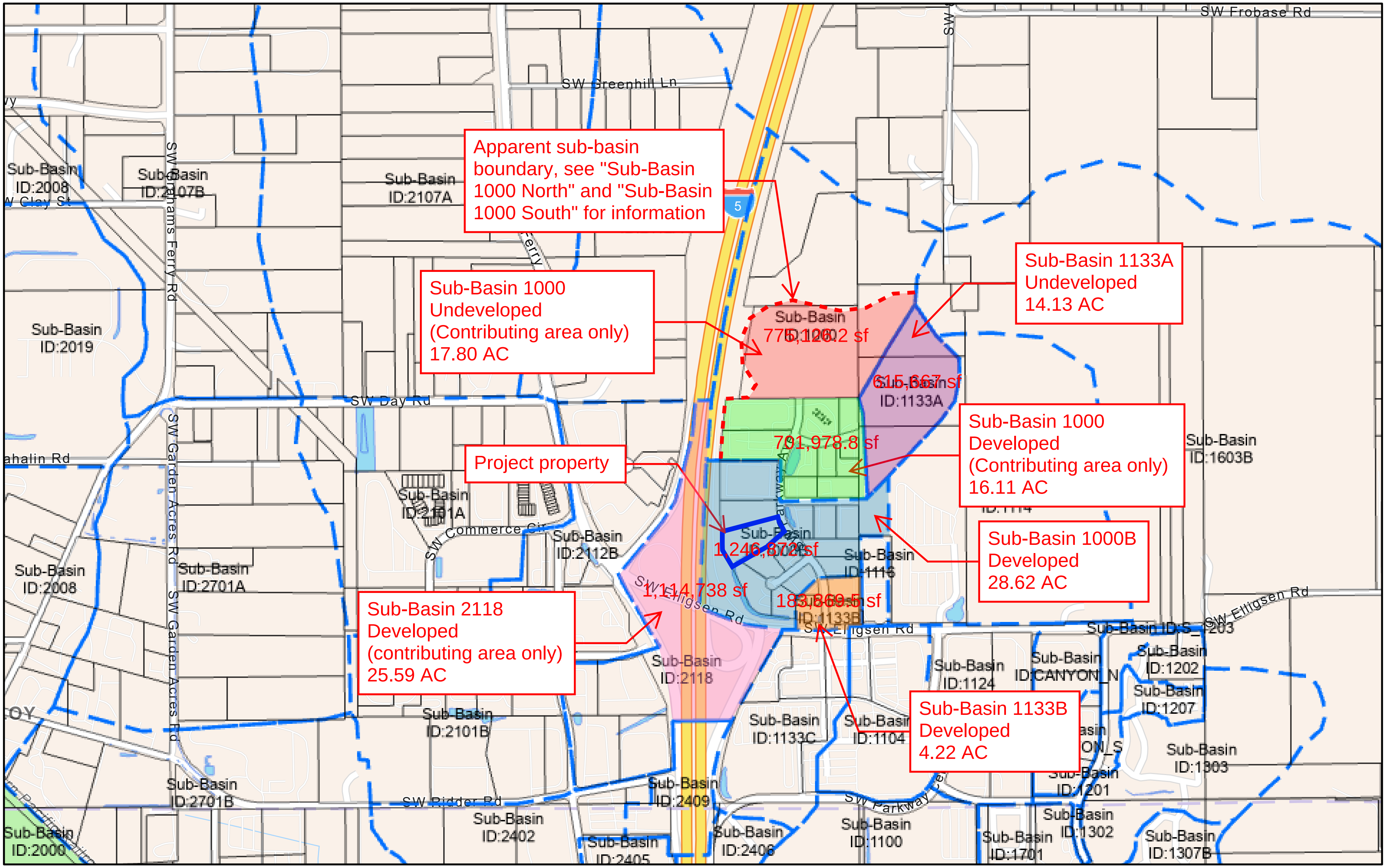
1:18,056

0 0.1 0.2 0.4 mi

0 0.17 0.35 0.7 km

Esri Community Maps Contributors, Oregon Metro, Oregon State Parks, State of Oregon GEO, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies,

Stormwater Sub-Basins



June 11, 2024

RLIS Taxlots

Stormwater Basins OMS

Stormwater Subbasins OMS

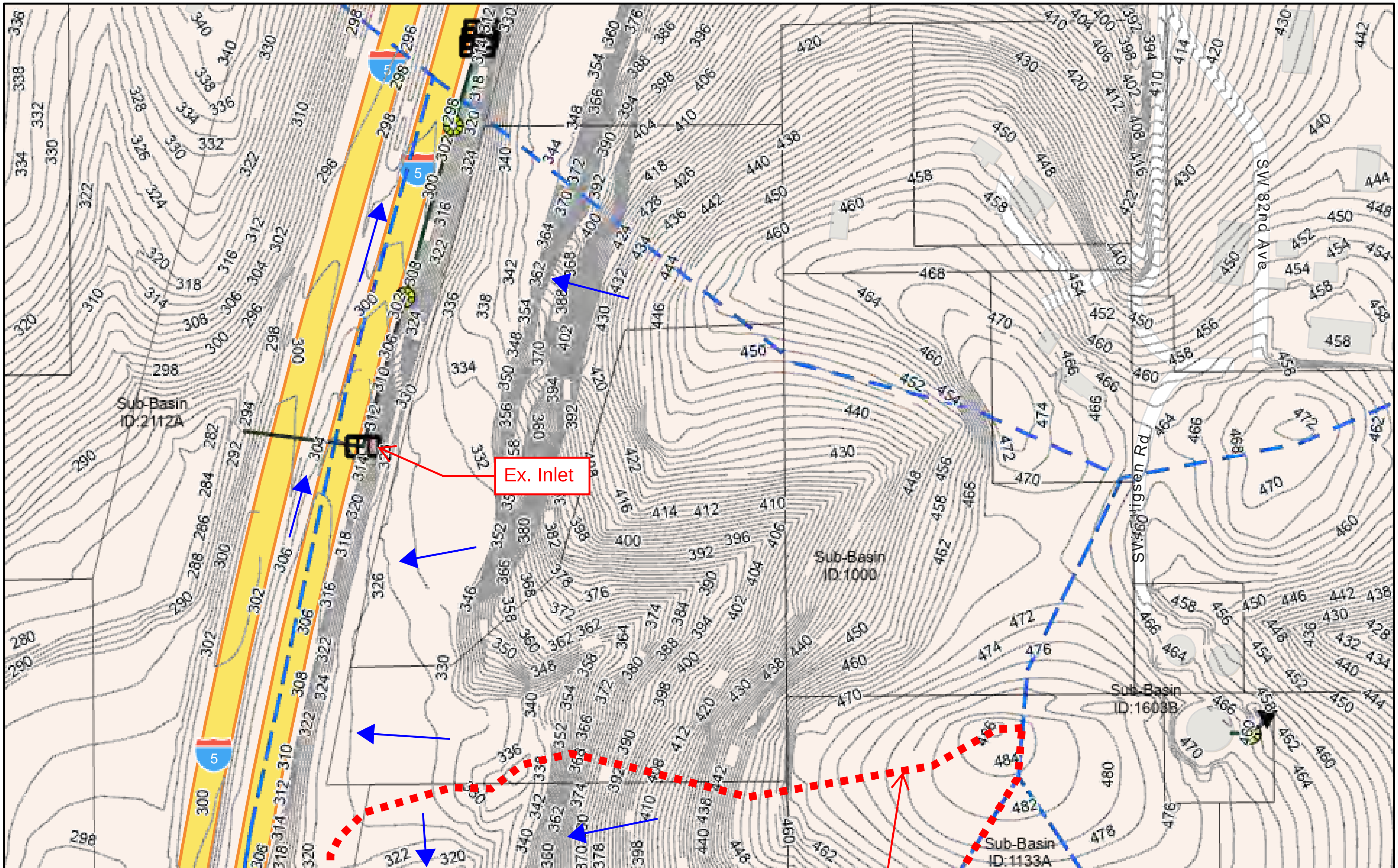
1:18,056

0 0.1 0.2 0.4 mi

0 0.17 0.35 0.7 km

Esri Community Maps Contributors, Oregon Metro, Oregon State Parks, State of Oregon GEO, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies,

Sub-Basin 1000 North



June 12, 2024

RLIS Taxlots

Stormwater Inlets OMS

Catchbasin

Stormwater Manholes OMS

Stormwater Outlets OMS

Stormwater Mainline OMS

Public, Active

Stormwater Subbasins OMS

2FT Contours

Apparent boundary for Sub-Basin 1000 (see "Sub-Basin 1000 South" for continuation)

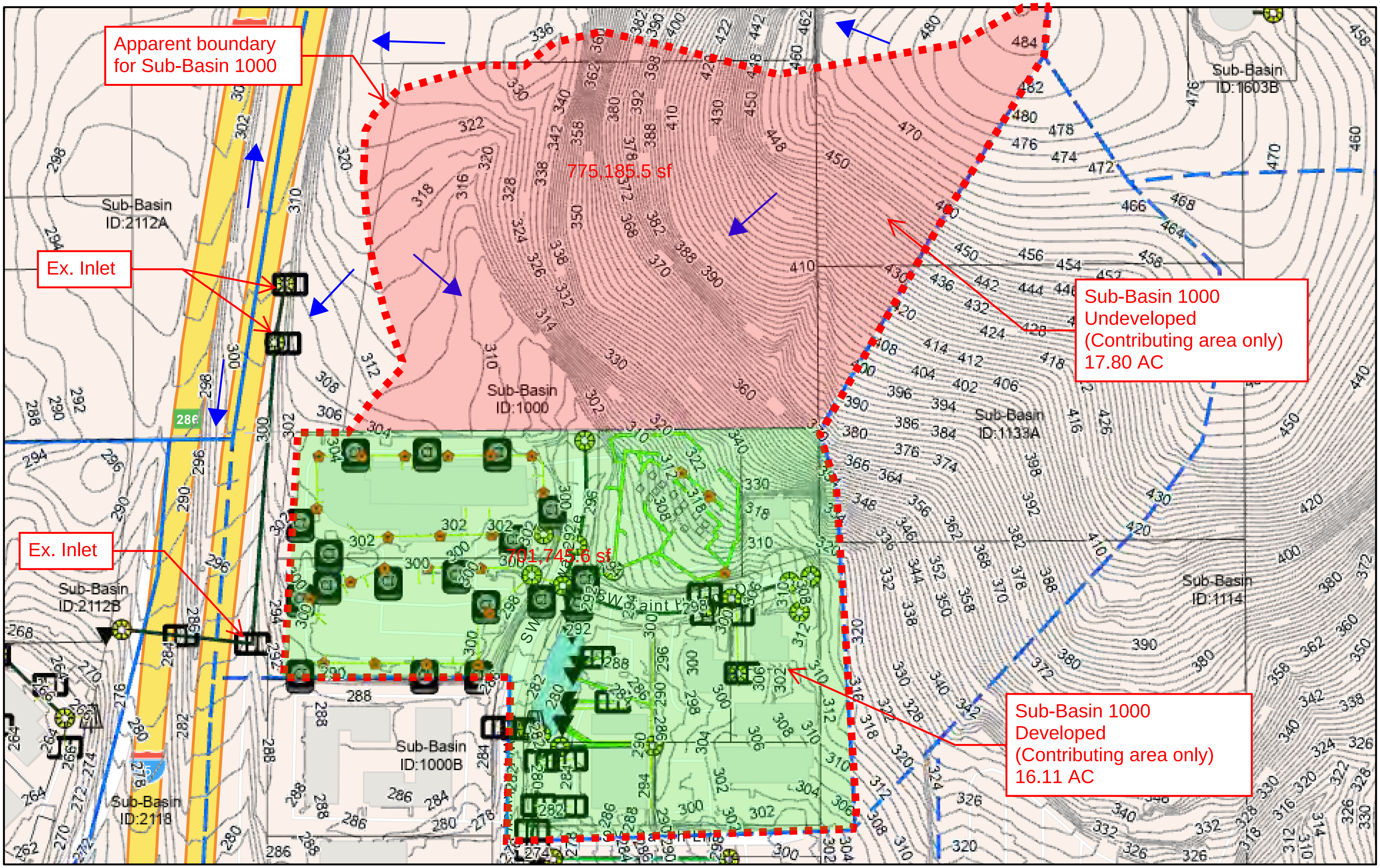
1:4,514

0 0.03 0.06 0.11 mi

0 0.04 0.09 0.17 km

Esri Community Maps Contributors, Oregon Metro, Oregon State Parks, State of Oregon GEO, © OpenStreetMap, Microsoft, Esri, TomTom, Garmin,

Sub-Basin 1000 South



June 12, 2024

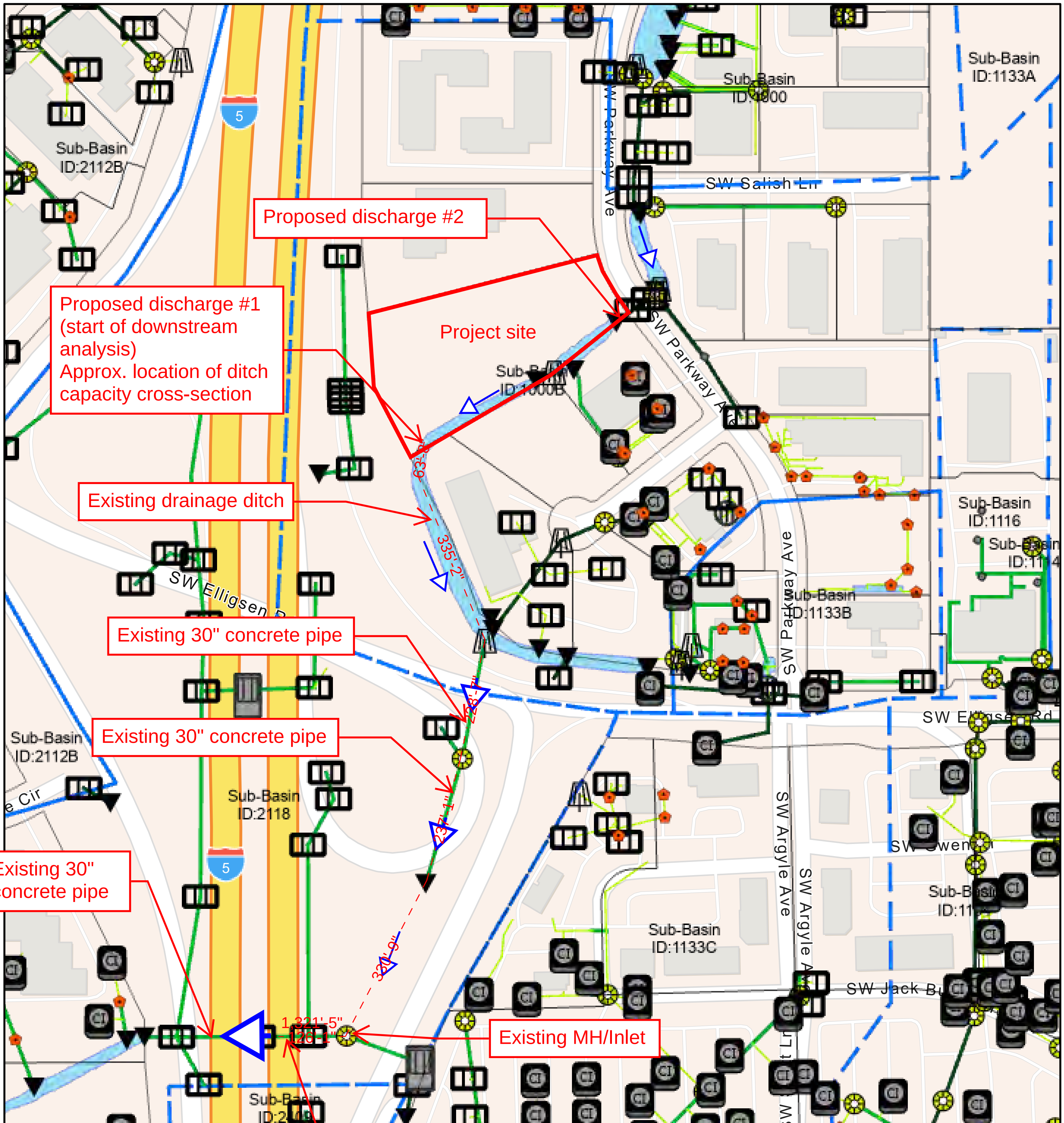
1:4,514

0 0.03 0.06 0.11 mi

0 0.04 0.09 0.17 km

- RLIS Taxlots
- Stormwater Cleanouts OMS
- Stormwater Inlets OMS
- Catchbasin
- Curb Inlet
- Other Design
- Stormwater Manholes OMS
- Stormwater Outlets OMS
- Stormwater Laterals OMS
- Stormwater Mainline OMS
- Public, Active
- Private, Active
- Stormwater Basins OMS
- Stormwater Subbasins OMS
- 2FT Contours

Storm System Map



June 13, 2024

1:4,514

0 0.03 0.06 0.11 mi

0 0.04 0.09 0.17 km

- RLIS Taxlots
- Stormwater Cleanouts OMS
- Stormwater Inlets OMS
  - Area Drain
  - Catchbasin
  - Curb Inlet
- Ditch Inlet
- Other Design
- Stormwater Manholes OMS
- Stormwater Outlets OMS
- Stormwater Culverts OMS
- Stormwater Laterals OMS
- Stormwater Mainline OMS
  - Public, Active
  - Private, Active
- Stormwater Basins OMS
- Stormwater Subbasins OMS

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Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	13.44	2	474	188,679	------	------	------	Sub-Basin 1000 Developed
2	SBUH Runoff	23.88	2	474	335,195	------	------	------	Sub-Basin 1000B
3	SBUH Runoff	3.521	2	474	49,424	------	------	------	Sub-Basin 1133B
4	SBUH Runoff	21.35	2	474	299,707	------	------	------	Sub-Basin 2118
5	SBUH Runoff	8.874	2	480	161,156	------	------	------	Sub-Basin 1000 & 1133A Undevelope
6	Combine	45.84	2	476	685,029	1, 2, 5	------	------	Combined Ditch
7	Combine	70.66	2	476	1,034,160	1, 2, 3, 4, 5,	------	------	Combined ODOT Pipe

Hydrograph Report

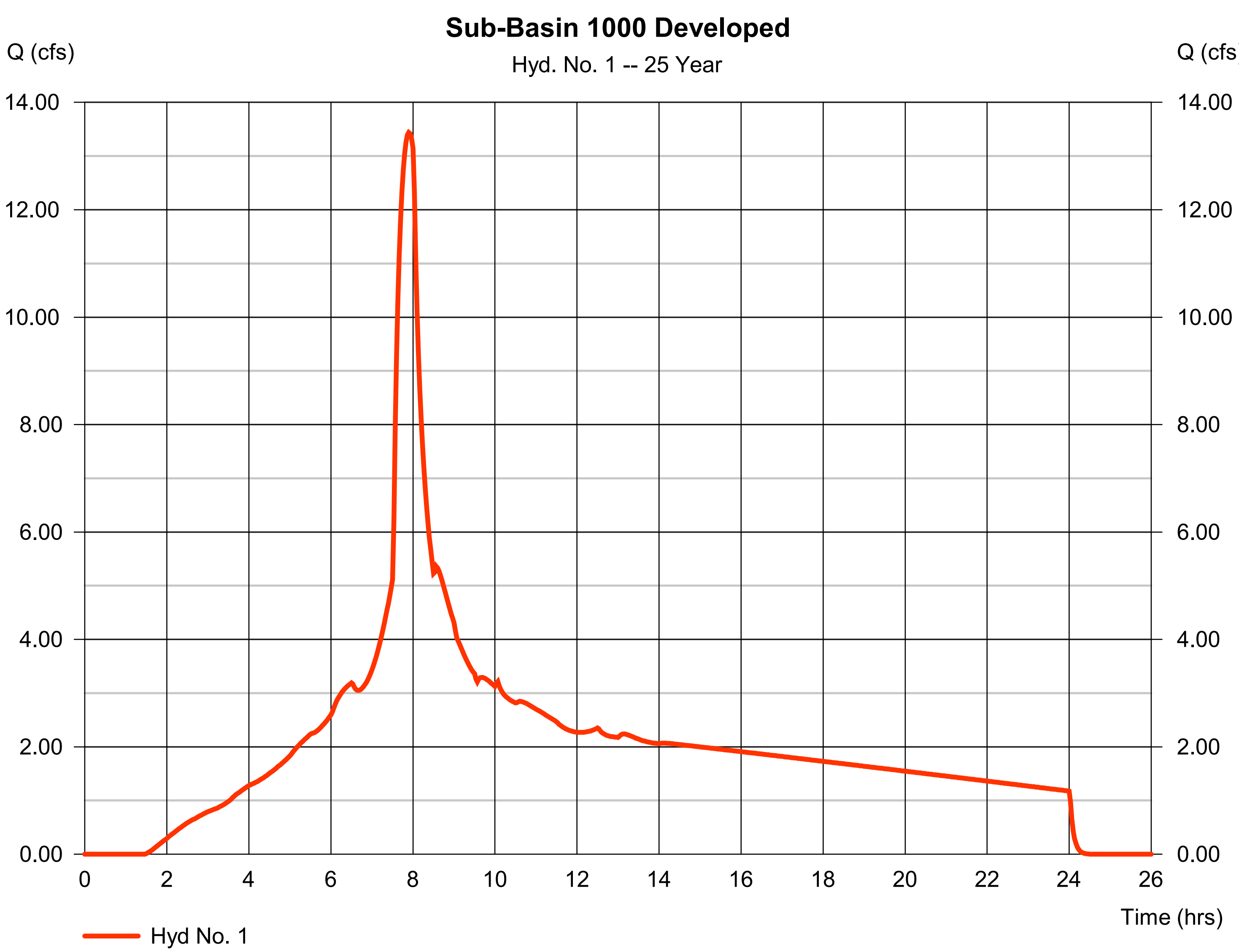
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Friday, 06 / 14 / 2024

Hyd. No. 1

Sub-Basin 1000 Developed

Hydrograph type	= SBUH Runoff	Peak discharge	= 13.44 cfs
Storm frequency	= 25 yrs	Time to peak	= 7.90 hrs
Time interval	= 2 min	Hyd. volume	= 188,679 cuft
Drainage area	= 16.110 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(13.690 x 98) + (2.420 x 74)] / 16.110



Hydrograph Report

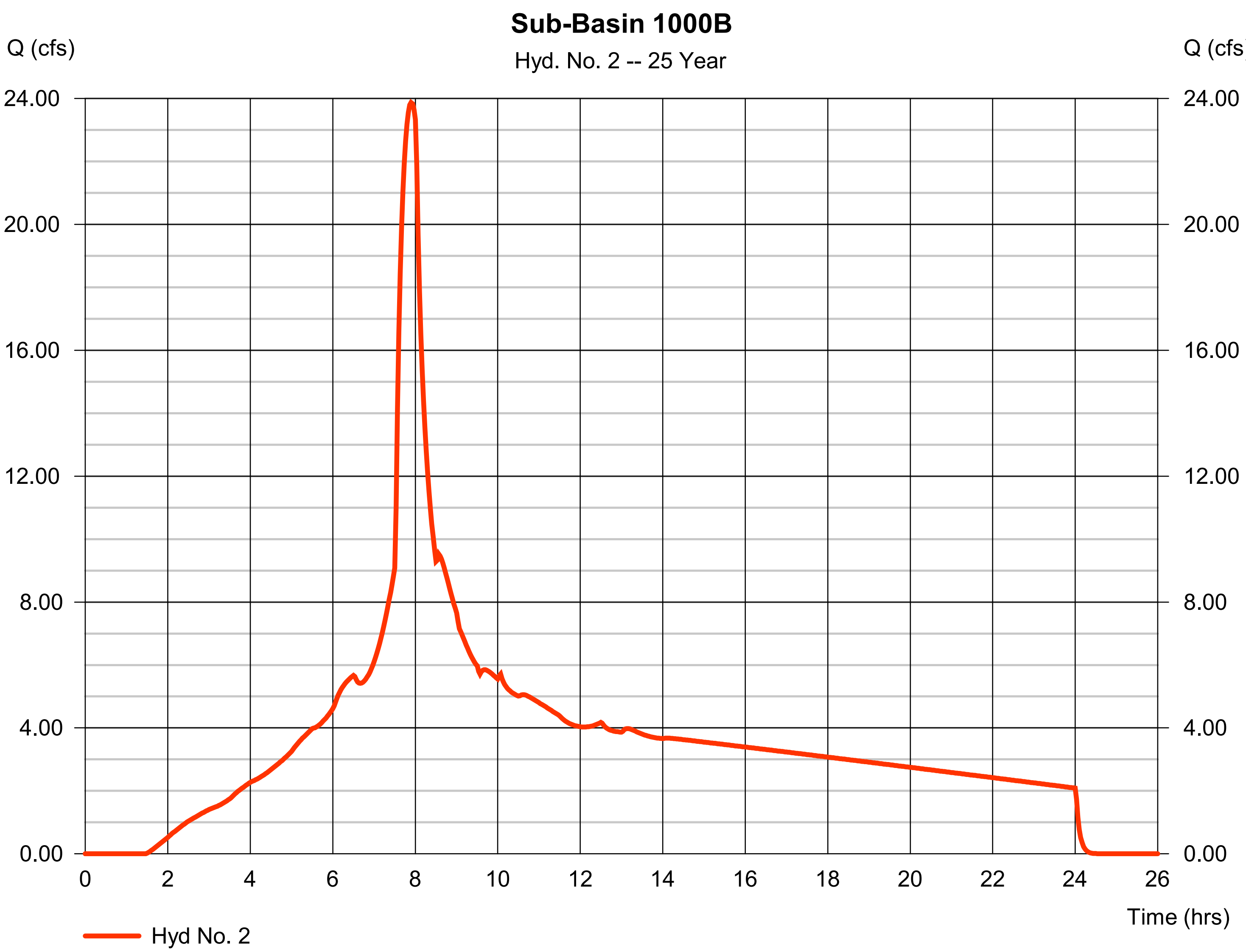
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Friday, 06 / 14 / 2024

Hyd. No. 2

Sub-Basin 1000B

Hydrograph type	= SBUH Runoff	Peak discharge	= 23.88 cfs
Storm frequency	= 25 yrs	Time to peak	= 7.90 hrs
Time interval	= 2 min	Hyd. volume	= 335,195 cuft
Drainage area	= 28.620 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(24.330 x 98) + (4.290 x 74)] / 28.620



Hydrograph Report

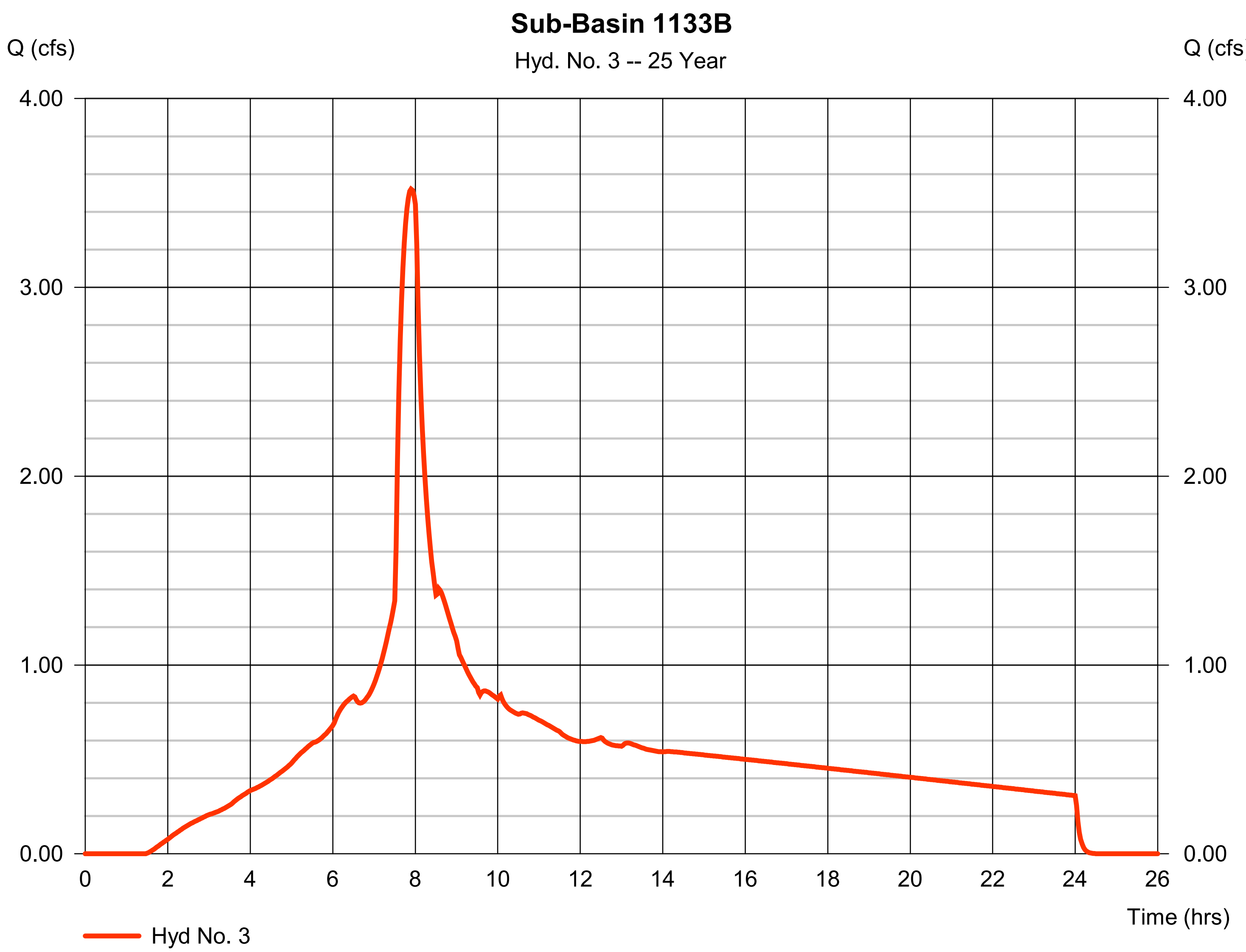
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Friday, 06 / 14 / 2024

Hyd. No. 3

Sub-Basin 1133B

Hydrograph type	= SBUH Runoff	Peak discharge	= 3.521 cfs
Storm frequency	= 25 yrs	Time to peak	= 7.90 hrs
Time interval	= 2 min	Hyd. volume	= 49,424 cuft
Drainage area	= 4.220 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(3.590 x 98) + (0.630 x 74)] / 4.220



Hydrograph Report

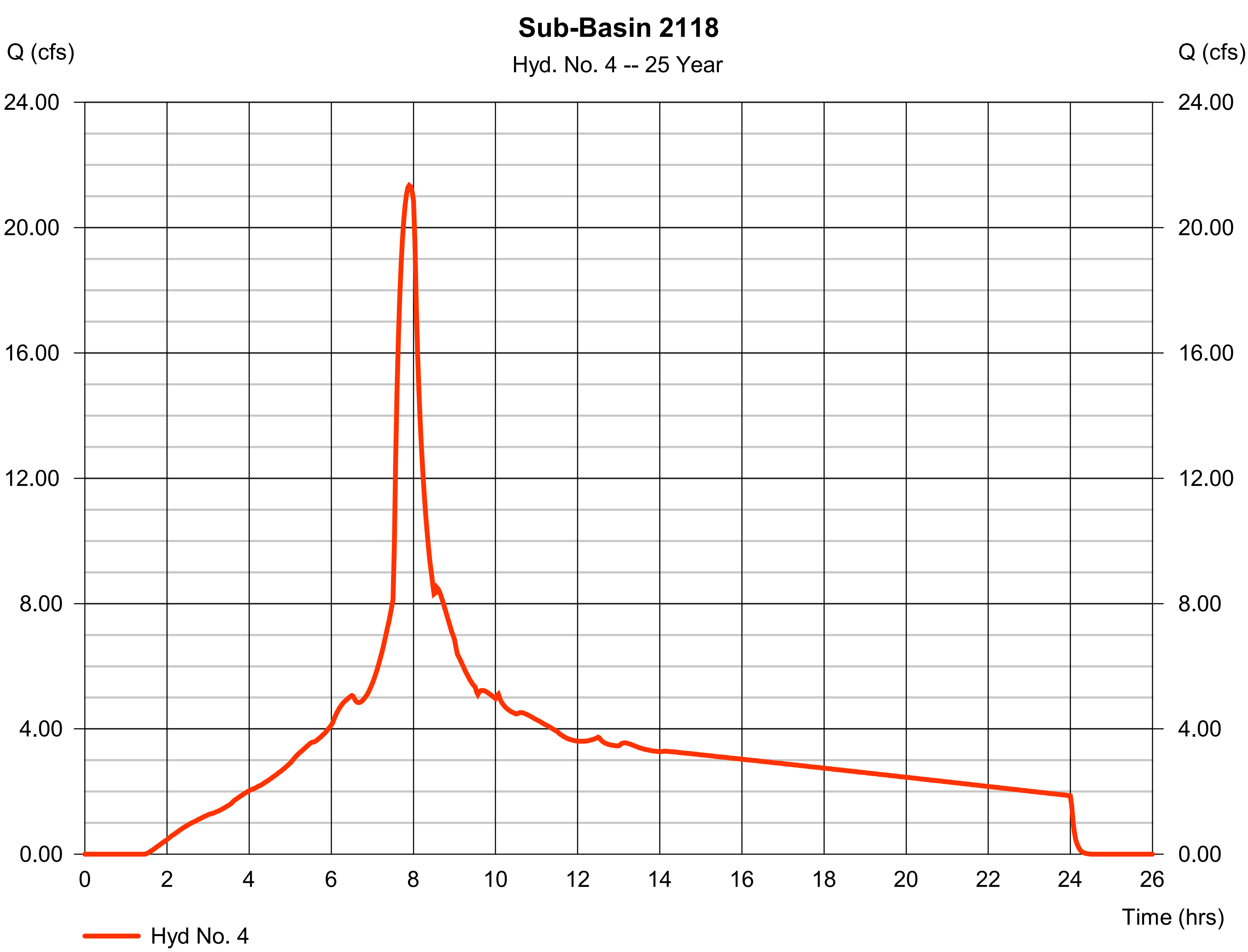
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 | Friday, 06 / 14 / 2024

Hyd. No. 4

Sub-Basin 2118

Hydrograph type	= SBUH Runoff	Peak discharge	= 21.35 cfs
Storm frequency	= 25 yrs	Time to peak	= 7.90 hrs
Time interval	= 2 min	Hyd. volume	= 299,707 cuft
Drainage area	= 25.590 ac	Curve number	= 94*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(21.750 x 98) + (3.840 x 74)] / 25.590



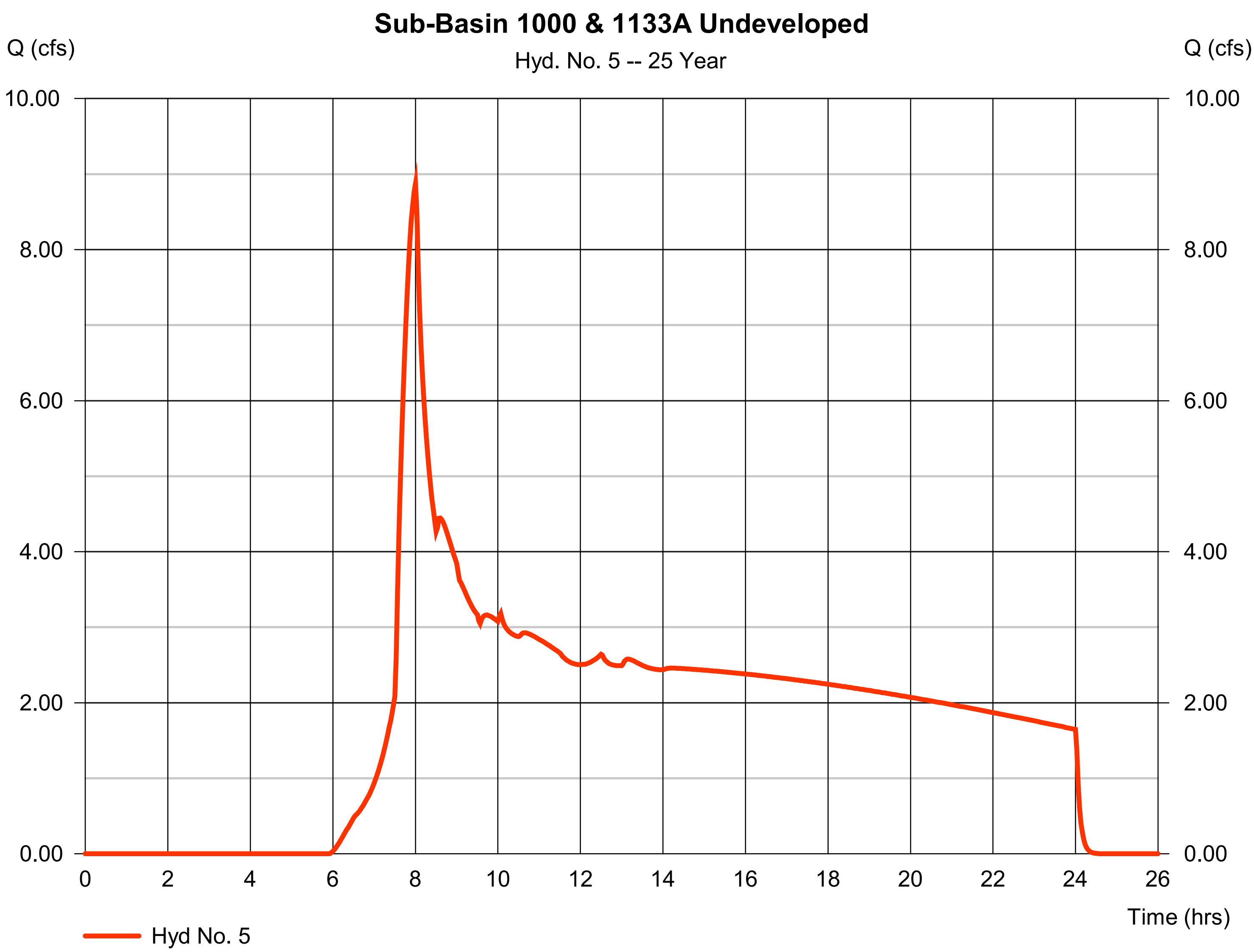
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 Friday, 06 / 14 / 2024

Hyd. No. 5

Sub-Basin 1000 & 1133A Undeveloped

Hydrograph type	= SBUH Runoff	Peak discharge	= 8.874 cfs
Storm frequency	= 25 yrs	Time to peak	= 8.00 hrs
Time interval	= 2 min	Hyd. volume	= 161,156 cuft
Drainage area	= 31.930 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



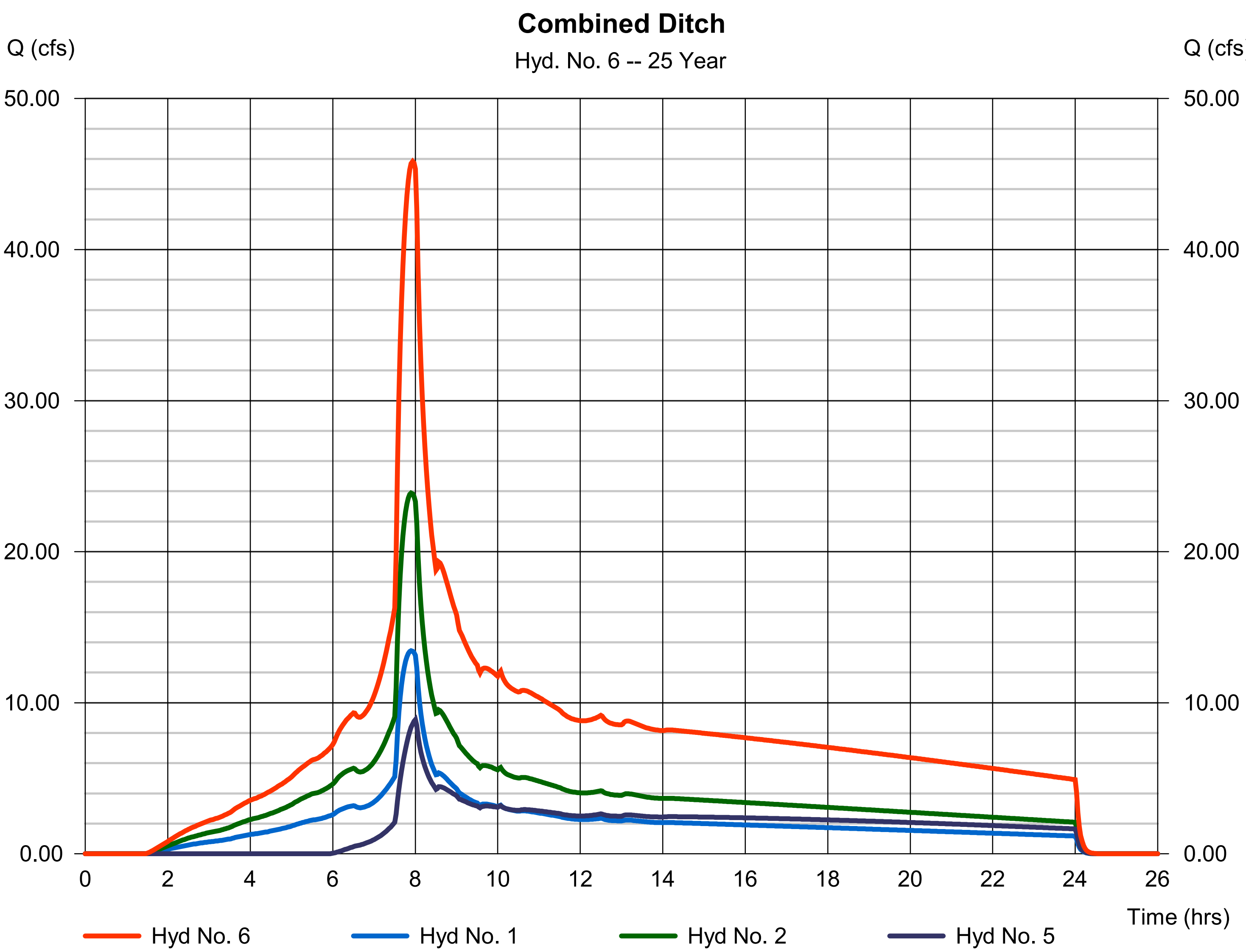
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 | Friday, 06 / 14 / 2024

Hyd. No. 6

Combined Ditch

Hydrograph type	= Combine	Peak discharge	= 45.84 cfs
Storm frequency	= 25 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 685,029 cuft
Inflow hyds.	= 1, 2, 5	Contrib. drain. area	= 76.660 ac



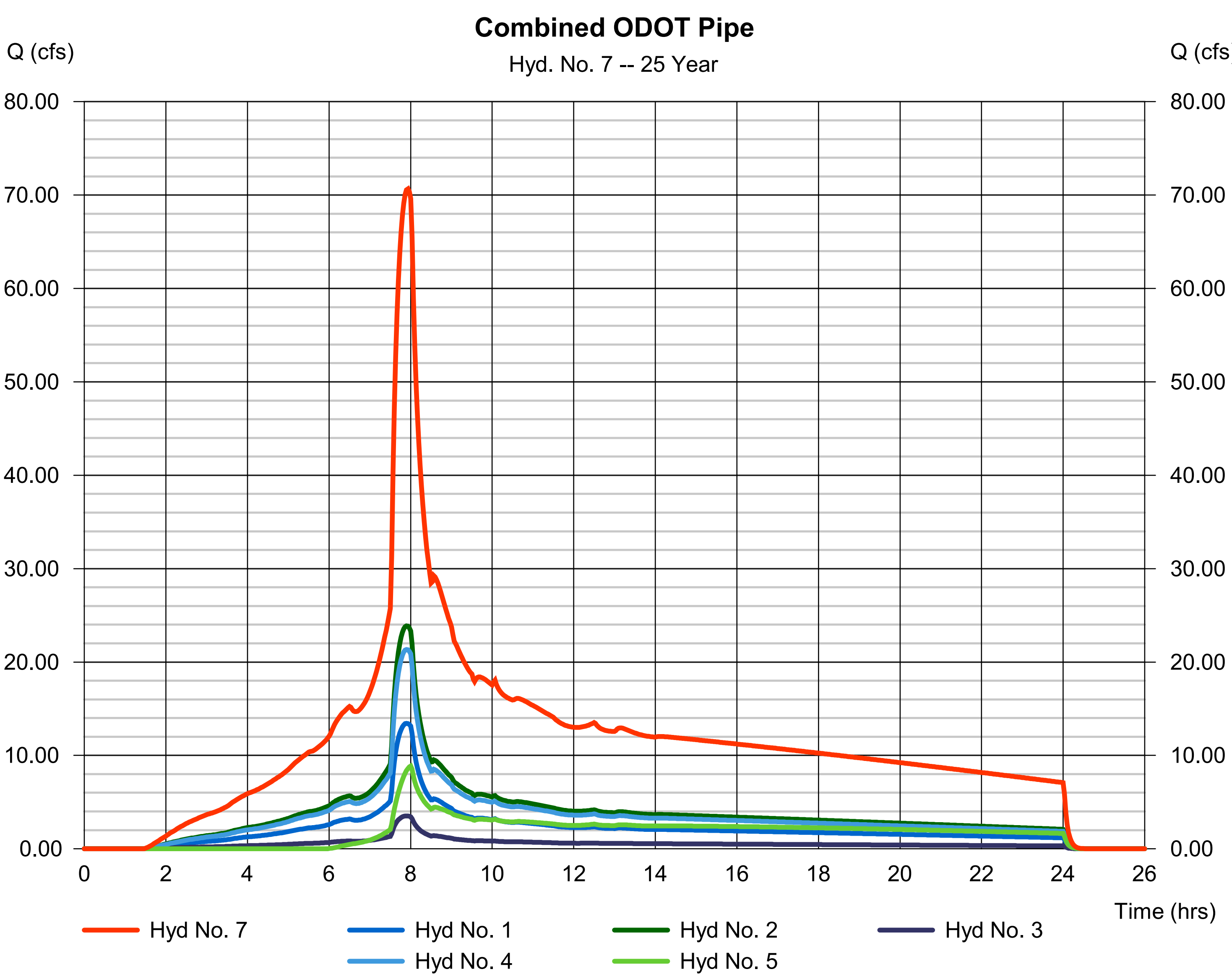
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2024 — Friday, 06 / 14 / 2024

Hyd. No. 7

Combined ODOT Pipe

Hydrograph type	= Combine	Peak discharge	= 70.66 cfs
Storm frequency	= 25 yrs	Time to peak	= 7.93 hrs
Time interval	= 2 min	Hyd. volume	= 1,034,160 cuft
Inflow hyds.	= 1, 2, 3, 4, 5	Contrib. drain. area	= 106.470 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Axis Design Group)\ADG-122 (Wilsonville Lamborghini)\ADG122-DOCS\Reports\Stormwater\Hydraflow\Wilsonville.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.83	2.40	1.20	2.90	3.40	3.90	0.00	4.40
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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

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

1 Average runoff condition, and $I_a = 0.2S$.
2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

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

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

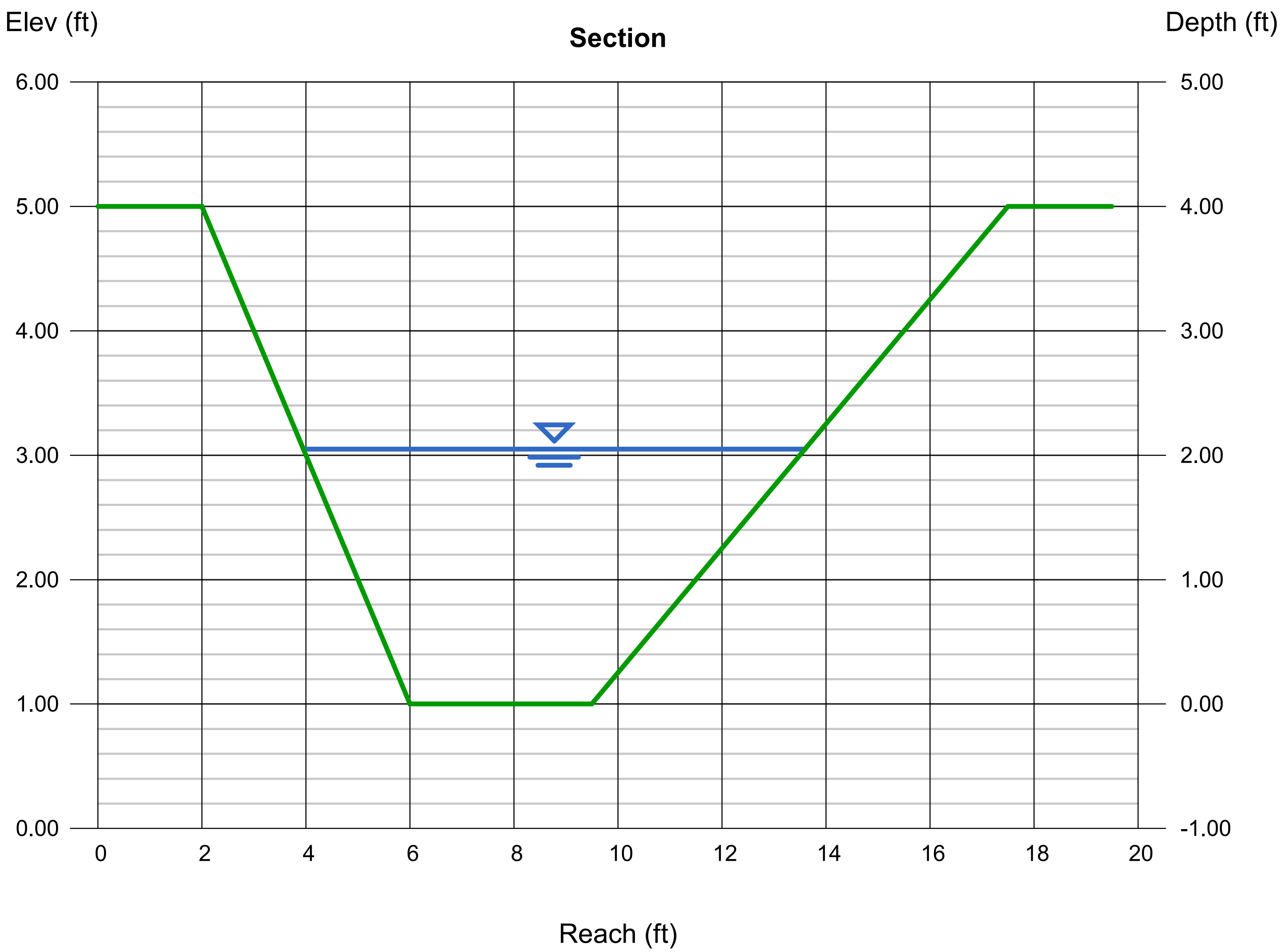
1 Average runoff condition, and I_a = 0.2S.
2 *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.
3 *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.
4 Actual curve number is less than 30; use CN = 30 for runoff computations.
5 CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.
6 *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Channel Report

Conveyance Ditch (SW Property Corner)

Trapezoidal	
Bottom Width (ft)	= 3.50
Side Slopes (z:1)	= 1.00, 2.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 1.00
Slope (%)	= 1.00
N-Value	= 0.050
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 45.84

Highlighted	
Depth (ft)	= 2.05
Q (cfs)	= 45.84
Area (sqft)	= 13.48
Velocity (ft/s)	= 3.40
Wetted Perim (ft)	= 10.98
Crit Depth, Yc (ft)	= 1.42
Top Width (ft)	= 9.65
EGL (ft)	= 2.23



Wilsonville Tonkin Lamborghini

Pipe Conveyance Calculations - Downstream Analysis

Prepared by Harper Houf Peterson Righellis Inc.

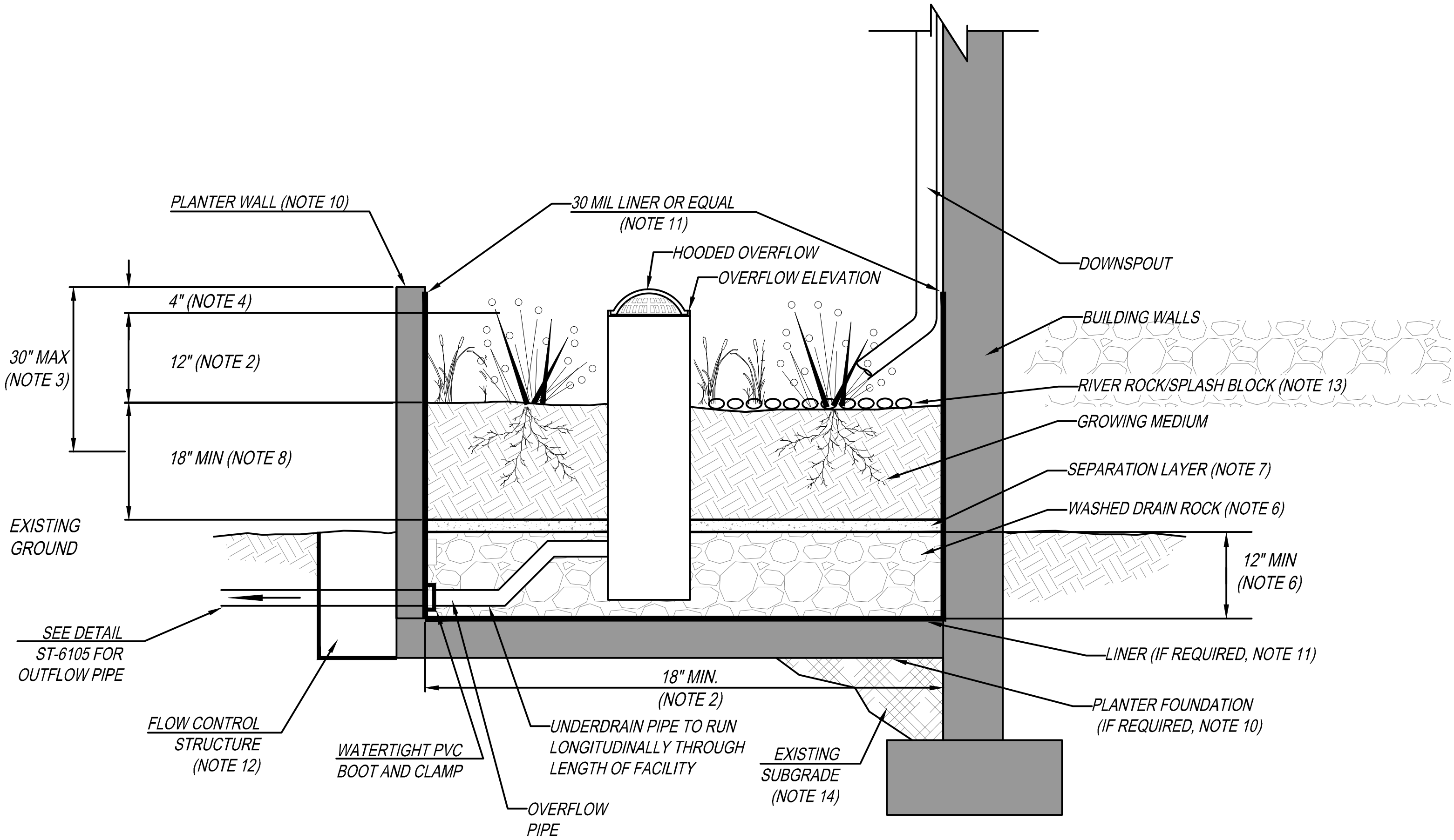
Job No. ADG-122
June 2024

Pipe Segment	Upstream Basin	Pipe Size (in)	Area (sf)	Per. (ft)	N (--)	Q25 (1) (cfs)	Slope (%)	$Q_{CAPACITY}$ (cfs)	Velocity Full (fps)	Capacity Met?
Pipe Conveyance										
1	ODOT Pipe under Hwy 5	30	4.91	7.85	0.013	70.66	1.00%	41.03	8.36	NO

(1) Q25 peak flow information provided from Hydraflow Hydrographs program

APPENDIX G – Operation & Maintenance - Storm Facilities

This Detail Drawing may not be altered or changed in any manner except by the City Engineer. It is the responsibility of the user to acquire the most current version.



GENERAL NOTES:

1. **PROVIDE PROTECTION** FROM ALL VEHICLE TRAFFIC, EQUIPMENT STAGING, AND FOOT TRAFFIC IN PROPOSED INFILTRATION AREAS PRIOR TO, DURING AND AFTER CONSTRUCTION. WRAP UNDER-DRAIN IN FILTER FABRIC TO REDUCE TRANSPORT OF FINES.
2. **DIMENSIONS:**
   -WIDTH: 18" MINIMUM
   -DEPTH OF PLANTER (FROM TOP OF GROWING MEDIUM TO OVERFLOW ELEVATION): 12"
   -SLOPE OF PLANTER: 0.5% OR LESS
3. **HEIGHT/SETBACK**
   -PLANTERS SHALL BE LESS THAN 30" IN HEIGHT ABOVE SURROUNDING AREA
   -PLANTERS SHALL BE MINIMUM OF 5 FEET FROM PROPERTY LINE
4. **OVERFLOW:**
   -INLET ELEVATION SHALL ALLOW FOR 4" OF FREEBOARD, MINIMUM
   -PROTECT FROM DEBRIS AND SEDIMENT WITH STRAINER OR GRATE
5. **PIPING:**
   -PERFORATED UNDER-DRAIN PIPING: SHALL RUN LONGITUDINALLY THROUGH LENGTH OF FACILITY, SHALL BE ABS SCH. 40, CAST IRON, OR PVC SCH.40, 6" MINIMUM DIAMETER. PIPING SHALL HAVE 1% GRADE AND FOLLOW THE UNIFORM PLUMBING CODE. PVC NOT ALLOWED ABOVE GROUND. WRAP UNDER-DRAIN IN FILTER FABRIC TO REDUCE TRANSPORT OF FINES.
   -OVERFLOW PIPING: SHALL BE ABS SCH.40, CAST IRON, OR PVC SCH.40 AND SHALL NOT BE PERFORATED. MINIMUM DIAMETER IS 6". PIPING SHALL HAVE 1% GRADE AND FOLLOW THE UNIFORM PLUMBING CODE. PVC NOT ALLOWED ABOVE GROUND.
6. **DRAIN ROCK:**
   -SIZE FOR FLOW-THROUGH PLANTER: 1 1/2" - 3/4" WASHED
   -DEPTH: 12" MINIMUM
7. **SEPARATION** BETWEEN DRAIN ROCK AND GROWING MEDIUM: SHALL BE A 3" LAYER OF 3/4" - 1/4" OPEN GRADED AGGREGATE.
8. **GROWING MEDIUM:**
   -DEPTH: 18" MINIMUM
   -SEE APPENDIX A FOR SPECIFICATION OR USE SAND/LOAM/COMPOST 3-WAY MIX.
   -FACILITY SURFACE AREA MAY BE REDUCED BY 25% WHEN GROWING MEDIA DEPTH IS INCREASED TO 30" OR MORE.
9. **VEGETATION:** FOLLOW LANDSCAPE PLANS OR REFER TO PLANTING REQUIREMENTS IN APPENDIX A.
10. **PLANTER FOUNDATION AND WALLS:**
    -MATERIALS SHALL BE 4" REINFORCED CONCRETE, STONE, BRICK, OR OTHER DURABLE MATERIAL.
    -CONCRETE, BRICK, OR STONE WALLS SHALL BE INCLUDED ON FOUNDATION PLANS.
    -INSTALL INVERTED CURB AS NEEDED BETWEEN PLANTER AND ROAD SUBGRADE.
    -SUBMIT RETAINING WALL DESIGN IN ACCORDANCE WITH APPLICABLE STRUCTURAL CODES FOR REVIEW AND APPROVAL.
11. **WATERPROOF LINER (IF REQUIRED):**
    -LINER SHALL BE 30 MIL PVC OR EQUIVALENT, FOR FLOW THROUGH FACILITIES.
    -A WATERPROOF LINER IS NOT REQUIRED IF THE FOUNDATION OR WALL MATERIAL IS WATERPROOF REINFORCED CONCRETE OR APPROVED EQUAL.
12. **FLOW CONTROL** STRUCTURE. SEE DETAIL ST-6105.
13. **INSTALL RIVER ROCK** SPLASH PAD OVER A NON WOVEN GEO TEXTILE FABRIC TO TRANSITION FROM INLETS TO GROWING MEDIUM. SIZE OF ROCK SHALL BE 1" - 3", 4 SQUARE FEET, 6" DEEP.
14. **SEASONAL HIGH GROUNDWATER SEPARATION:**
    --SEPARATION DISTANCE AS REQUIRED BY THE CITY.

Stormwater Planter - Filtration			CITY OF WILSONVILLE
DRAWING NUMBER: ST-6005	DRAWN BY: SR	SCALE: N.T.S.	
FILE NAME: ST-6005.DWG	APPROVED BY: NK	DATE: 4/16/18	PUBLIC WORKS STANDARDS

Stormwater Planters
Operations & Maintenance Plan

What to Look For	What to Do
Structural Components, including inlets and outlets/overflows, shall freely convey stormwater.	
Clogged inlets or outlets	-Remove sediment and debris from catch basins, trench drains and curb inlets and pipes to maintain at least 50% conveyance capacity at all times.
Cracked Drain Pipes	-Repair/seal cracks. Replace when repair is insufficient.
Check Dams	-Maintain 4 to 10 inch deep rock check dams at design intervals.
Vegetation	
Dead or strained vegetation	-Replant per original planting plan, or substitute from Appendix A. -Irrigate as needed. Mulch banks annually. DO NOT apply fertilizers, herbicides, or pesticides.
Tall Grass and Vegetation	-Cut back grass and prune overgrowth 1-2 times per year. Remove cuttings
Weeds	-Manually remove weeds. Remove all plant debris.
Growing/Filter Medium, including soil and gravels, shall sustain healthy plant cover and infiltrate within 72 hours.	
Gullies	-Fill, lightly compact, and plant vegetation to disperse flow.
Erosion	-Replace splash blocks or inlet gravel/rock.
Slope Slippage	-Stabilize 3:1 slopes/banks with plantings from Appendix A
Ponding	-Rake, till, or amend to restore infiltration rate.

Annual Maintenance Schedule:

Summer. Make any structural repairs. Improve filter medium as needed. Clear drain. Irrigate as needed.
Fall. Replant exposed soil and replace dead plants. Remove sediment and plant debris.
Winter. Monitor infiltration/flow-through rates. Clear inlets and outlets/overflows to maintain conveyance.
Spring. Remove sediment and plant debris. Replant exposed soil and replace dead plants. Mulch.
All seasons. Weed as necessary.
Maintenance Records: Record date, description, and contractor (if applicable) for all structural repairs, landscape maintenance, and facility cleanout activities. Keep work orders and invoices on file and make available upon request of the inspector.
Access: Maintain ingress/egress to design standards.
Infiltration/Flow Control: All facilities shall drain within 72 hours. Record time/date, weather, and site conditions when ponding occurs.
Pollution Prevention: All sites shall implement best management practices to prevent hazardous or solid wastes or excessive oil and sediment from contaminating stormwater. Contact ___________ for immediate assistance responding to spills. Record time/date, weather, and site conditions if site activities contaminate stormwater.
Vectors (Mosquitoes & Rodents): Stormwater facilities shall not harbor mosquito larvae or rats that pose a threat to public health or that undermine the facility structure. Monitor standing water for small wiggling sticks perpendicular to the water's surface. Note holes/burrows in and around facilities. Call Clackamas County Vector Control for immediate assistance to eradicate vectors. Record time/date, weather, and site conditions when vector activity observed.

This Detail Drawing may not be altered or changed in any manner except by the City Engineer. It is the responsibility of the user to acquire the most current version.

STORMWATER FACILITIES OPERATIONS AND MAINTENANCE CHECKLIST

Problem	Frequency	Trigger	Preferred Condition
Sediment Accumulation in Treatment Area	Monthly from November through April Annually Required	Sediment depth exceeds 3 inches	Sediment removed from vegetated treatment area: level side to side and drains freely toward outlet; no standing water within 24 hours of any major storm (1" in 24 hours)
Erosion Scouring	Monthly from November through April Annually Required	Monthly from November through April Annually Required	Repair ruts or bare areas by filling with topsoil during dry season; regreade and replant large bare areas.
Standing Water	Monthly from November through April and after any major storm (1 inch in 24 hours)	Standing water in the planter between storms that does not drain freely	Remove sediment or trash blockages; improve end to end grade so there is no standing water 24 hours after any major storm (1 inch in 24 hours)
Flow not Distributed Evenly	Monthly from November through April Annually Required	Flows unevenly distributed through planter width due to uneven or clogged flow spreader	Level the spreader and clean so that flows spread evenly over entire planter width
Settlement/ Misalignment	Annually Required	Failure of planters has created safety, function, or design problem	Planter replaced or repaired to design standards
Constant Baseflow	Monthly from November through April Annually Required	Small, continual flow of water through the planter even after weeks without rain; planter bottom has an eroded, muddy channel	Add a low-flow pea gravel drain the length of the planter or bypass the baseflow around the planter
Vegetation	Monthly from November through April Annually Required	Vegetation blocking more than 10% of the inlet pipe opening	No vegetation blocking the inlet pipe opening
Poor Vegetation Coverage	Monthly Annually Required	Grass or other vegetation is sparse, or bare in more than 10% of the planter area	Determine cause of poor growth and correct the condition; replant with plants (per Appendix A) as needed to meet facility standards
Invasive Vegetation	Monthly Annually Required	No invasive vegetation is planted or permitted to remain	no invasive vegetation present; remove excessive weeds. Control if complete eradication is not feasible
Rodents	Monthly Annually Required	Evidence of rodents or rodent damage	No rodents; functioning facility
Insects	Annually Required	Insects such as wasps and hornets that interfere with maintenance activities	Harmful Insects removed
Trash and Debris	Monthly and after any major storm (1 inch in 24 hours) Annually Required	Visual evidence of trash, debris or dumping	Trash and Debris removed from facility
Contamination and Pollution	Monthly from November through April Annually Required	Any evidence of oil, gasoline, contamination or other pollutants	No contaminants or pollutants present; coordinate removal/cleanup with local water quality response agency
Obstructed Inlet/Outlet	Monthly and after any major storm event (1 inch in 24 hours) Annually Required	Inlet/outlet areas clogged with sediment, vegetation or debris	Clear inlet and outlet; obstructions removed
Excessive Shading	Monthly from November through April Annually Required	Vegetation growth is poor because unlight does not reach planter	Trim over-hanging limbs and/or remove brushy vegetation as needed
Vegetation	Monthly from November through April Annually Required	Specified or approved grass grows so tall that if competes with shrubs and/or becomes a fire danger	String trim non-wetland grasses to 4 inch to 6 inch and remove clippings; protect woody vegetation

Stormwater Facilities Operations & Maintenance Checklist			CITY OF WILSONVILLE PUBLIC WORKS STANDARDS
DRAWING NUMBER: ST-6115	DRAWN BY: SR	SCALE: N.T.S.	
FILE NAME: ST-6115.DWG	APPROVED BY: NK	DATE: 10/3/14	