EMERIO
Design

CIVIL ENGINEERS & PLANNERS

Drainage Report
Marquis Oregon City Parking Lot Expansion
Oregon City, Oregon 97045
(TL 00301, Tax Map 3S-2E-05C)

Emerio Project Number: 086-020

City of Oregon City Permit Numbers: TBD

Date: 01/24/2018

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Table of Contents:

Project Overview and Description:

The purpose of this report is to address the stormwater management plan for the proposed development site. The site is approximately 1.84 acres in size and is located at 1680 Molalla Avenue in Oregon City, Oregon, see Appendix (A (1)). The site is bordered by Beavercreek Road to the north, Molalla Avenue to the east and commercial businesses to the south, west, and northwest. Vegetation onsite consists primarily of short grasses, shrubs and medium to large trees at the periphery of the property line. The site is occupied by the Marquis Oregon City Post-Acute Rehab Center with parking and drive areas surrounding the existing building. Proposed development at the site will consist of expansion of the existing parking lot at south and west of the existing building.

Soil Classification:

The NRCS soil survey of Clackamas County, Oregon classifies the development site soil as Bornstedt silt loam with an associated hydrologic group of C, Appendix (B (1)). The associated curve number utilized in this design is 74 for pervious surfaces with class C subsoil and 98 for impervious developed surfaces.

A geotechnical investigation conducted by GeoPacific Inc., measured an onsite infiltration rate of zero inches per hour and onsite infiltration facilities are not viable, see geotechnical report in Appendix (B (3)). Perched groundwater or seepage was not encountered during the site exploration at a maximum depth of 5.5 feet below existing ground surface. Groundwater is estimated to be approximately 15 to 25 feet below the ground surface per *United States Geological Survey, Snyder, 2018 website*.

Existing Vs. Proposed:

The proposed development site lies southwest corner of the intersection of S Beavercreek Rd and Molalla Avenue. The central portion of the site is occupied by a building and paved drive areas and parking lots surrounding the existing building. Most of the existing site is covered with impervious roof and pavements with undeveloped and forested with conifer trees at the periphery of the property line.

Existing roof drainage is routed into the parking lot with multiple downspouts located around the building and combines with parking lot drainage. All existing onsite drainage sheet flows to existing catch basins and routes to a storm main at Molalla Avenue.

Proposed development at the site will consist of expansion of the existing parking lot primarily at the southeastern corner with other additional improvements around the parking lot and associated stormwater facilities.

Methodology:

Onsite stormwater management facilities are sized to treat and flow control storm drainage from newly proposed impervious areas. Due to topographic constraints, approximately 2,067 SF of existing impervious area is proxy treated for a 1,442 SF of newly proposed impervious area, see Appendix (D (2)). The stormwater management facilities and drainage flow directions are shown in Appendix (D (2)).

Roof drainage will continue to flow through downspouts to the parking lot and sheet flows to existing catch basins onsite.

The Clackamas County Water Environmental Services BMP sizing tool and 2015 Stormwater and Grading Design Standards by Oregon City are used to size the stormwater facilities for the 10-year 24-hour design storm.

Onsite Treatment and Flow Control:

The proposed privately owned and maintained filtration Rain Gardens are designed using the BMP Sizing Tool to flow control the flow duration curve from the mitigated outflow to be equal to or lower than the flow duration curve representing pre-development condition for flows ranging from 42 percent of the 2-year peak flow to the 10-year peak flow. The pre-development surface condition is configured as forested with respective site soil group C. Onsite paved impervious area of 5,501 SF will be treated and flow controlled by 871 SF of Rain Garden onsite. A summarized result of BMP Sizing Tool report is shown below.

Rain Gardens

Rain Garden	Drainage Basin	Drainage Basin (SF)	Facility Minimum Required (SF)	Facility Provided (SF)	Orifice Size (in)
RG-A	B1	768	115	137	0.2
RG-B	B2	860	129	130	0.2
RG-C	B3	970	146	151	0.2
RG-D	B4	2,903	435	453	0.3

The proposed raingardens are properly sized to meet the minimum required size per BMP Sizing Tool, see Appendix (C (1)) for WES BMP Sizing Report. The proposed raingardens are designed per Figure C-4 of Oregon City Stormwater and Grading Design Standards.

Basin Delineation:

Offsite upstream and downstream tributary drainage basin map was determined based on OcWebMaps's 2-foot and 10-foot contour lines. The upstream and downstream contributing basins encompasses roughly 131 acres while the project site is roughly 1.84 acres. The respective drainage basins are designated as basin 200,300,400 & 401 as provided in Appendix (D (3)). Based on the GIS data available, the downstream drainage is routed to an outfall located approximately 80 feet east of the property at 1635 Beavercreek Road.

Tabulated in Appendix (C (2)) is a list of pervious and impervious surface areas determined for each delineated basin. An impervious area of 2,640 square feet per lot was used for the drainage basins. The upstream and downstream basins were created for performing downstream conveyance analysis. Reference Appendix (D (3)) for an overall basin delineation map.

Downstream Analysis:

Per Oregon City requirement, a downstream conveyance analysis was conducted to verify that the additional flow from the site development will not adversely affect the safety and or flooding potential of adjacent or downstream property owners. The 25-year 24-hour storm event with storm intensity of 4.0 inches was used to calculate downstream flow. Oregon City stormwater requirement per section 5.2.4.D "the downstream analysis shall extend to the distance where the project site contributes less than 15 percent of the cumulative tributary drainage area or 1,500 feet downstream of the approved point of discharge, whichever is greater." The downstream distance of 1,500 feet from the project site is used since it contributes larger drainage area than the 15% or less of the upstream drainage area.

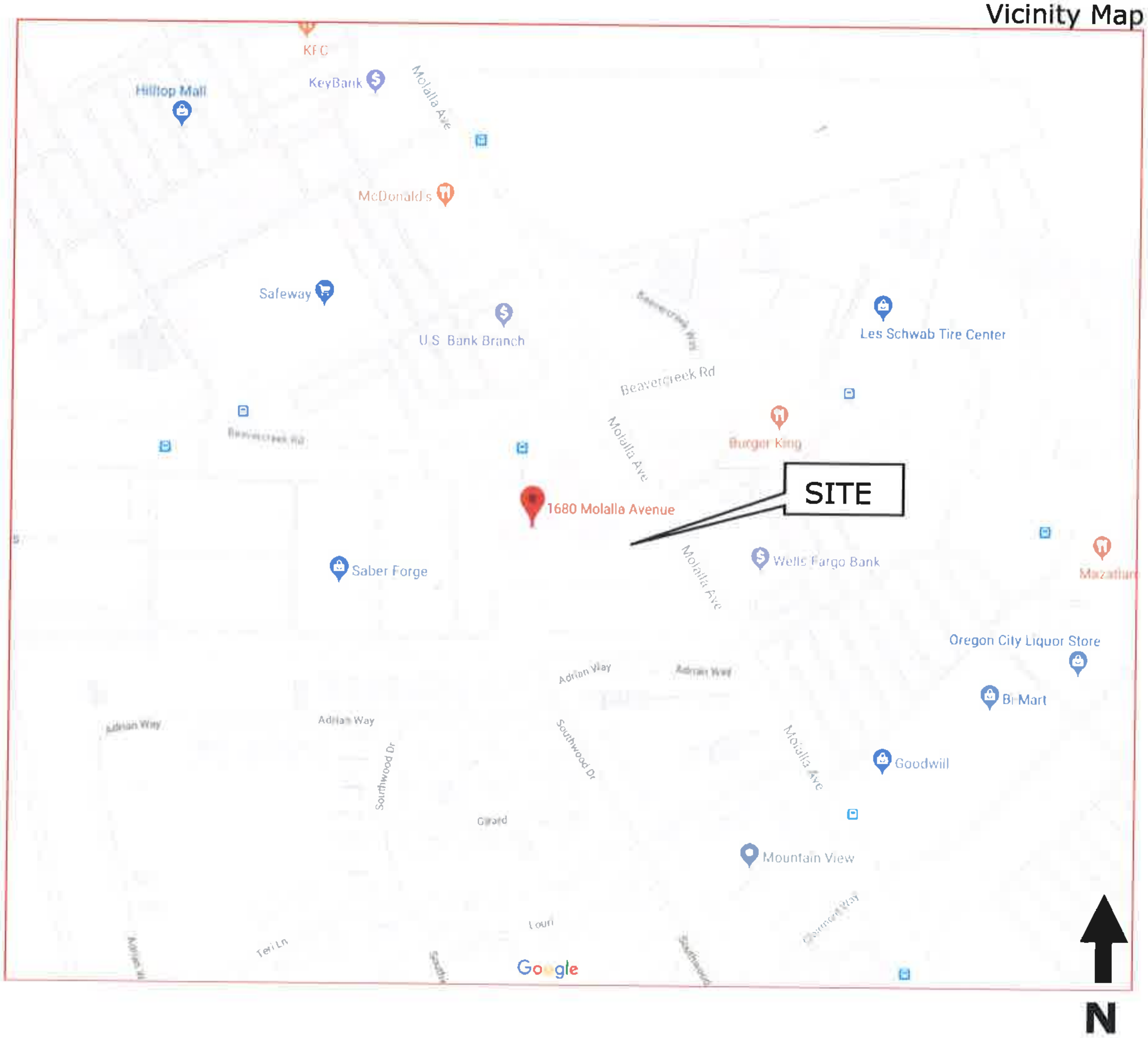
Using the design requirements of Oregon City, flow rates were calculated for each determined basin, reference the HydroCAD output in Appendix (C (3)). The existing downstream storm system is composed of 48" pipes and an assumed pipe slope of 0.49% was used, see Appendix (C (4)) for existing pipe analysis report. For conservatism, the entire onsite area is considered impervious. Downstream pipe conveyance analysis calculation indicates that all downstream existing pipes have enough capacity to convey the additional storm drainage produced from the development site. A conservative approach indicates that all the downstream pipes are operating at 32.9% capacities and the additional site drainage will not adversely affect the safety and/or flooding potential of adjacent or downstream structures.

Engineering Conclusion:

The design of the proposed site and storm management plan satisfies the water quality and flow control requirements by 2015 Oregon City Stormwater and Grading Design Standards. The existing downstream storm conveyance system has enough capacity to convey the additional drainage flow from the development.

Appendix A:

Appendix (A (1))
Vicinity Map



Appendix B:

Appendix (B (1))
Soil Classification

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Clackamas County Area, Oregon (OR610)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
8B	Bornstedt silt loam, 0 to 8 percent slopes	C	2.2	100.0%
Totals for Area of Interest			**2.2**	**100.0%**

SITE

RUNOFF CURVE NUMBERS (TR55)

Table 2-2a: Runoff curve numbers for urban areas

RUNOFF CURVE NUMBERS (TR55)					
Table 2-2a: Runoff curve numbers for urban areas [1]					
Cover description		**CN 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)		[illegible]	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		[illegible]	[illegible]	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

Use CN = 74 for Pervious Surface

Use CN = 98 for Impervious Surface

APPENDIX. B(3)

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

Geotechnical Engineering Study

Marquis Oregon City Parking Lot Expansion
1680 Molalla Avenue
Oregon City, Oregon 97045

GeoPacific Engineering, Inc. Job No. 18-4984
August 29, 2018

14835 SW 72nd Avenue
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Real-World Geotechnical Solutions
Investigation • Design • Construction Support

TABLE OF CONTENTS

Real-World Geotechnical Solutions
Investigation • Design • Construction Support

List of Appendices

List of Figures

August 28, 2018
Project No. 18-4984

Marquis Companies
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SUBJECT: GEOTECHNICAL ENGINEERING STUDY
MARQUIS OREGON CITY PARKING LOT EXPANSION
1680 MOLALLA AVENUE
OREGON CITY, OREGON 97045

PROJECT INFORMATION

This report presents the results of a geotechnical engineering study conducted by GeoPacific Engineering, Inc. (GeoPacific) for the above-referenced project. The purpose of our study was to investigate subsurface conditions at the site and provide recommendations for stormwater management and the construction of new pavement sections. This geotechnical study was performed in accordance with GeoPacific Proposal No. P-6631, dated June 13, 2018, and your subsequent authorization of our proposal and *General Conditions for Geotechnical Services.*

Site Location:	1680 Molalla Avenue Oregon City, Oregon 97045 (see Figures 1 through 3)
Civil Designer:	Emerio Design Kyung Han 6445 SW Fallbrook Place, Suite 100 Beaverton, Oregon 97008 Phone: (503) 746-8812 Email: kyung@emeriodesign.com
Jurisdictional Agency:	City of Oregon City, Oregon
Prepared By:	GeoPacific Engineering, Inc 14835 SW 72nd Avenue Portland, Oregon 97224 Tel (503) 598-8445 Fax (503) 941-9281

SITE AND PROJECT DESCRIPTION

The site is approximately 1.84 acres in size, and is located at 1680 Molalla Avenue in Oregon City, Oregon (Figure 1). The site is bordered by Beavercreek Road to the north, Molalla Avenue to the east, and commercial businesses to the south, west, and northwest. Vegetation onsite consists primarily of short grasses, shrubs, and medium to large trees. The central portion of the site is occupied by the Marquis Oregon City Post Acute Rehab Center with parking and drive areas surrounding the existing building. The southeastern portion of the site is undeveloped and forested with conifer trees. Topography at the site is relatively flat with site elevations ranging from 429 to 432 feet amsl.

Based upon communication with the client and review of preliminary project plans, GeoPacific understands that the proposed development at the site will consist of the expansion of the existing parking lot primarily onto the southeastern portion of the site, and associated stormwater facilities.

REGIONAL GEOLOGIC SETTING

Regionally, the subject site lies within the Willamette Valley/Puget Sound lowland, a broad structural depression situated between the Coast Range on the west and the Cascade Range on the east. A series of discontinuous faults subdivide the Willamette Valley into a mosaic of fault-bounded, structural blocks (Yeats et al., 1996). Uplifted structural blocks form bedrock highlands, while down-warped structural blocks form sedimentary basins. Valley-fill sediment in the adjacent basin achieves a maximum thickness of 1,500 feet and overlies Miocene Columbia River Basalt at depth (Madin, 1990; Yeats et al., 1996).

The subject site lies on a broad volcanic plateau underlain by the Boring Lava which formed during a period of Plio-Pleistocene (5 to 0.2 million years ago) volcanism and faulting (Schlicker and Finlayson, 1979). The Boring Lava consists mainly of basaltic lava flows, but locally contains tuff breccia, ash, tuff, cinders, and scoriaceous volcanic debris flows deposited on the flanks of volcanic cones. The flows are commonly light gray to nearly black, with lighter tones predominating, and are characterized by columnar jointing and flow structures. The upper surface of the Boring Lava is typically weathered to depths of 25 feet or more with the upper 5 to 15 feet consisting of red-brown, clayey silt to silty clay soil.

FIELD EXPLORATION AND SUBSURFACE CONDITIONS

Our site-specific explorations for this report was conducted on July 27, 2018 and consisted of 3 hand auger borings extending to a maximum depth of 5.5 feet below ground surface (bgs), and 2 portable dynamic cone penetration tests (PDCPs). Hand augers HA-1 and HA-3 were performed to observe soil and groundwater conditions. Infiltration testing was conducted within hand auger HA-2 at 4.6 feet below the ground surface. The approximate locations of the explorations are shown on the attached site plans (Figures 2 and 3). It should be noted that the exploration locations were located in the field by pacing or taping distances from apparent property corners and other site features shown on the plans provided. As such, the locations of the explorations should be considered approximate. During the exploration, GeoPacific observed and recorded pertinent soil information such as color, stratigraphy, strength, and soil moisture content. Soils were classified in general accordance with the Unified Soil Classification System (USCS). At the completion of the explorations, the hand augers were backfilled loosely with onsite soils. Exploration logs corresponding to hand augers HA-1 through HA-3, PDCP-1, and PDCP-2 are attached to the appendix of this report. Soil and groundwater conditions encountered in our explorations are summarized below.

Soil Descriptions

Undocumented Fill: Underlying the ground surface at the location of hand auger HA-2, we observed undocumented fill material consisting of medium stiff, brown, moderately organic, damp, SILT (ML-OL). The fill material contained subrounded to angular gravel and fine to medium roots. The undocumented fill was surfaced with grass and developed approximately 6 inches of topsoil on the ground surface. The undocumented fill extended to an approximate depth of 18 inches below the ground surface at the location of hand auger HA-2.

Topsoil Horizon: Underlying the ground surface at the location of hand augers HA-1 and HA-3, we observed a topsoil horizon consisting of medium stiff, dark brown, moderately organic, damp, SILT (ML-OL). The topsoil layer contained fine to medium roots. The topsoil horizon extended to an approximate depth of 10 inches below the ground surface in hand auger borings HA-1 and HA-3.

Residual Soil: Underlying the topsoil in hand augers HA-1 and HA-3, and the undocumented fill in hand auger HA-2, we observed residual soil consisting of stiff to very stiff, damp to moist, low plasticity, reddish brown, Lean CLAY (CL). The residual soil gradually graded to weathered rock at an approximate depth of 4-5 feet in our hand auger explorations. Based upon our observations of the soil type and review of geologic mapping, residual soil encountered in our explorations was derived from weathering of the underlying Boring Lava Formation.

Boring Lava – Beneath the residual soil, we encountered weathered rock belonging to the Boring Lava Formation in all explorations. The upper foot of the weathered rock was generally extremely soft to very soft (R0-R1). We experienced practical refusal on very soft (R1) basalt at a depth of 4.6 feet in hand auger HA-1, 5.5 feet in hand auger HA-2, and 4.2 feet in hand auger HA-3.

Table 1 - Rock Hardness Classification Chart

ODOT Rock Hardness Rating	Field Criteria	Unconfined Compressive Strength	Typical Equipment Needed For Excavation
Extremely Soft (R0)	Indented by thumbnail	<100 psi	Small excavator
Very Soft (R1)	Scratched by thumbnail, crumbled by rock hammer	100-1,000 psi	Small excavator
Soft (R2)	Not scratched by thumbnail, indented by rock hammer	1,000-4,000 psi	Medium excavator (slow digging with small excavator)
Medium Hard (R3)	Scratched or fractured by rock hammer	4,000-8,000 psi	Medium to large excavator (slow to very slow digging), typically requires chipping with hydraulic hammer or mass excavation)
Hard (R4)	Scratched or fractured w/ difficulty	8,000-16,000 psi	Slow chipping with hydraulic hammer and/or blasting
Very Hard (R5)	Not scratched or fractured after many blows, hammer rebounds	>16,000 psi	Blasting

Groundwater and Soil Moisture

On July 27, 2018, observed soil moisture conditions within our test pit explorations were generally damp, grading moist at approximately 2-3 feet below the ground surface. Perched groundwater or seepage was not encountered during our site exploration. According to the *Estimated Depth to Groundwater in the Portland, Oregon Area, (United States Geological Survey, Snyder, 2018 website)*, groundwater may be present at an approximate depth of 15 to 25 feet below the ground surface. It is anticipated that groundwater conditions will vary depending on the season, local subsurface conditions, changes in site utilization, and other factors.

Infiltration Testing

Soil infiltration testing was performed using the open-hole method in hand auger HA-2. The approximate locations of the subsurface explorations are indicated on Figures 2 and 3. The test location was pre-saturated prior to testing. During testing the water level was measured to the nearest 0.01 foot (1/8 inch) from a fixed point, and the change in water level was recorded at regular intervals until three successive measurements showing a consistent infiltration rate were achieved.

Table 2 summarizes the results of our infiltration testing. Soils at the test location were observed and sampled in order to characterize the subsurface profile. Tested native soils classified as Lean CLAY (CL). The result of the infiltration testing indicates an infiltration rate that was not measurable in the field (0.0 inches per hour) from 0 to 5.5 feet below the ground surface. The measured rate for this test reflects both vertical and horizontal flow pathways. The infiltration results presented in Table 2 do not incorporate factors of safety.

Table 2 - Summary of Infiltration Test Results

Test Location	Depth (feet)	Soil Type	Infiltration Rate (inches/hr)	Hydraulic Head Range (inches)
HA-2	4.6	CL	0.0	12

Portable Dynamic Cone Penetrometer Testing

On July 27, 2018, GeoPacific Engineering conducted in place strength testing of native soils in two locations, indicated on Figure 2. A portable dynamic cone penetrometer was used to collect data for design of the pavement sections. Table 3 summarizes the results of our PDCP testing. PDCP testing data is attached to this report.

Table 3 - PDCP Field Test Results and Representative CBR Values

Field Test Designation	Material Tested	Depth Interval of Test (inches)	Average Penetration Per Blow (mm)	Correlated CBR Value
PDCP-1	Native SILT	5-45	7	34
PDCP-2	Native SILT	17-47	7	34

CONCLUSIONS AND RECOMMENDATIONS

Our site investigation indicated that the proposed construction is geotechnically feasible, provided that the recommendations of this report are incorporated into the design and construction phases of the project.

In our opinion, the primary geotechnical concern associated with construction at the site is the presence of residual soil and weathered rock. The residual soil exhibits negligible hydraulic conductivity. Based on results of our soil infiltration testing, soils at the subject site exhibited infiltration rates that were not measurable in the field. In our explorations, weathered rock was encountered between 3.8 to 4.2 feet below the ground surface. Generally, at least 5 feet of separation is recommended between infiltration facilities and rock. Based on the subsurface conditions encountered, subsurface infiltration of stormwater is not recommended for this site.

The second geotechnical concern associated with construction at the site is the potential for bedrock at shallow depths across the site. The Boring Lava Formation, which underlies the site, is known for rounded residual boulders, which could hamper excavations, such as for stormwater management facilities and utility trenching. The potential for encountering boulders should be anticipated. The following report sections provide recommendations for site development and construction in accordance with the current applicable codes and local standards of practice.

Site Preparation Recommendations

Areas of proposed construction should be cleared of vegetation, stockpiled soils, and any organic and inorganic debris. Inorganic debris and organic materials from clearing should be removed from the site. Organic-rich soils and root zones should then be stripped from construction areas of the site or where engineered fill is to be placed. Based upon our observations, the residual soil appears to be adequate for reuse as engineered fill provided the soil is adequately aerated to within 2 percent of optimum moisture during site grading.

The depth of stripping of organic soils and topsoil is estimated to be approximately 6 inches across the undeveloped portion of the site. However, depth of organic soil layers may increase in areas not explored. The southeast portion of the site, where the majority of new parking lot expansion is proposed, is densely forested, and deep stripping will likely be required in that area to remove organic material and topsoil. The final depth of soil removal will be determined on the basis of a site inspection after the stripping/excavation has been performed. Stripped topsoil should be removed from the site. Any remaining topsoil should be stockpiled only in designated areas and stripping operations should be observed and documented by the geotechnical engineer or his representative. Deeper stripping to remove large tree roots or other organics may be necessary in portions of the site. It is possible that portions of the soil containing medium to large roots, but not much other organic content, may be remediated by ripping/tilling, root-picking, and recompacting. Prior to placement of engineered fill, subgrade soils should be aerated and recompacted. If unstable soil is encountered in low-lying, high seasonal groundwater areas, crushed aggregate or cement amended stabilization may be necessary.

If encountered, undocumented fills and any subsurface structures (dry wells, basements, driveway and landscaping fill, old utility lines, septic leach fields, etc.) should be completely removed and the excavations backfilled with engineered fill.

Engineered Fill

We anticipate that onsite soils, consisting of SILT and Lean CLAY will largely be suitable for use as engineered fill. All grading for the proposed construction should be performed as engineered grading in accordance with the applicable building code at the time of construction with the exceptions and additions noted herein. Areas proposed for fill placement should be prepared as described in the site preparation section. Surface soils should then be scarified and recompacted prior to placement of structural fill. Proper test frequency and earthwork documentation usually requires daily observation and testing during stripping, rough grading, and placement of engineered fill. Imported fill material must be approved by the geotechnical engineer prior to being imported to the site. Oversize material greater than 12 inches in diameter should not be used in engineered fill.

Engineered fill should be compacted in horizontal lifts not exceeding 8 inches using standard compaction equipment. We recommend that engineered fill be compacted to at least 95 percent of the maximum dry density determined by ASTM D698 (Standard Proctor) or equivalent. Field density testing should conform to ASTM D2922 and D3017, or D1556. All engineered fill should be observed and tested by the project geotechnical engineer or his representative. Typically, one density test is performed for at least every 2 vertical feet of fill placed or every 500 yd^3, whichever requires more testing. Because testing is performed on an on-call basis, we recommend that the earthwork contractor be held contractually responsible for test scheduling and frequency. Site earthwork will be impacted by soil moisture and shallow groundwater conditions.

Excavating Conditions and Utility Trench Backfill

We anticipate that on-site soils can be excavated using conventional heavy equipment. Maintenance of safe working conditions, including temporary excavation stability, is the responsibility of the contractor. Actual slope inclinations at the time of construction should be determined based on safety requirements and actual soil and groundwater conditions. All temporary cuts in excess of 4 feet in height should be sloped in accordance with U.S. Occupational Safety and Health Administration (OSHA) regulations (29 CFR Part 1926), or be shored. The existing native soils classify as Type B Soil and temporary excavation side slope inclinations as steep as 1H:1V may be assumed for planning purposes. This cut slope inclination is applicable to excavations above the water table only.

Shallow, perched groundwater may be encountered during the wet weather season and should be anticipated in excavations and utility trenches. Vibrations created by traffic and construction equipment may cause some caving and raveling of excavation walls. In such an event, lateral support for the excavation walls should be provided by the contractor to prevent loss of ground support and possible distress to existing or previously constructed structural improvements.
PVC pipe should be installed in accordance with the procedures specified in ASTM D2321 and Oregon City standards. We recommend that structural trench backfill be compacted to at least 95 percent of the maximum dry density obtained by the Standard Proctor (ASTM D698) or equivalent. Initial backfill lift thicknesses for a ¾"-0 crushed aggregate base may need to be as great as 4 feet to reduce the risk of flattening underlying flexible pipe. Subsequent lift thickness should not exceed 1 foot. If imported granular fill material is used, then the lifts for large vibrating plate-compaction equipment (e.g. hoe compactor attachments) may be up to 2 feet, provided that proper compaction is being achieved and each lift is tested. Use of large vibrating compaction equipment should be carefully monitored near existing structures and improvements due to the potential for vibration-induced damage.

Adequate density testing should be performed during construction to verify that the recommended relative compaction is achieved. Typically, at least one density test is taken for every 4 vertical feet of backfill on each 200-lineal-foot section of trench.

Erosion Control Considerations

During our field exploration program, we did not observe soil conditions that would be considered highly susceptible to erosion. In our opinion, the primary concern regarding erosion potential will occur during construction in areas that have been stripped of vegetation. Erosion at the site during construction can be minimized by implementing the project erosion control plan, which should include judicious use of straw wattles, fiber rolls, and silt fences. If used, these erosion control devices should remain in place throughout site preparation and construction.

Erosion and sedimentation of exposed soils can also be minimized by quickly re-vegetating exposed areas of soil, and by staging construction such that large areas of the project site are not denuded and exposed at the same time. Areas of exposed soil requiring immediate and/or temporary protection against exposure should be covered with either mulch or erosion control netting/blankets. Areas of exposed soil requiring permanent stabilization should be seeded with an approved grass seed mixture, or hydroseeded with an approved seed-mulch-fertilizer mixture.

Wet Weather Earthwork

Soils underlying the site are likely to be moisture sensitive and may be difficult to handle or traverse with construction equipment during periods of wet weather. Earthwork is typically most economical when performed under dry weather conditions. Earthwork performed during the wet-weather season will probably require expensive measures such as cement treatment or imported granular material to compact areas where fill may be proposed to the recommended engineering specifications. If earthwork is to be performed or fill is to be placed in wet weather or under wet conditions when soil moisture content is difficult to control, the following recommendations should be incorporated into the contract specifications.

- Earthwork should be performed in small areas to minimize exposure to wet weather. Excavation or the removal of unsuitable soils should be followed promptly by the placement and compaction of clean engineered fill. The size and type of construction equipment used may have to be limited to prevent soil disturbance. Under some circumstances, it may be necessary to excavate soils with a backhoe to minimize subgrade disturbance caused by equipment traffic;
- The ground surface within the construction area should be graded to promote run-off of surface water and to prevent the ponding of water;
- Material used as engineered fill should consist of clean, granular soil containing less than 5 percent passing the No. 200 sieve. The fines should be non-plastic. Alternatively, cement treatment of on-site soils may be performed to facilitate wet weather placement;
- The ground surface within the construction area should be sealed by a smooth drum vibratory roller, or equivalent, and under no circumstances should be left uncompacted and exposed to moisture. Soils which become too wet for compaction should be removed and replaced with clean granular materials;
- Excavation and placement of fill should be observed by the geotechnical engineer to verify that all unsuitable materials are removed and suitable compaction and site drainage is achieved; and
- Geotextile silt fences, straw wattles, and fiber rolls should be strategically located to control erosion.

If cement or lime treatment is used to facilitate wet weather construction, GeoPacific should be contacted to provide additional recommendations and field monitoring.

Flexible Pavement Design – Private Parking and Drive Areas – 20 Year Design Life

We understand that development at the site will include construction of private parking and drive areas inside the project. Based on the results of PDCP testing, the subgrade exhibits an average CBR value of 31 in dry weather conditions. For the new private pavement sections we conservatively assume that the subgrade will exhibit a resilient modulus of at least 9,000, which correlates to a CBR value of 6. We assumed an anticipated 18-kip ESAL count of approximately 75,000 over 20 years, accounting for projected population growth. Our design considers 550 trips per day with 3 percent heavy trucks. If higher amounts of truck traffic are expected for the site, GeoPacific should be consulted to provided revised pavement design recommendations. Table 4 presents our flexible pavement design input parameters. Table 5 presents our recommended minimum dry-weather pavement section for the proposed roadway, supporting 20 years of vehicle traffic per Oregon City standards. Pavement design calculations are attached to this report.

Table 4 – Flexible Pavement Section Design Input Parameters for New Private Pavement Sections

Input Parameter	Design Value
18-kip ESAL Initial Performance Period (20 Years)	75,000
Initial Serviceability	4.2
Terminal Serviceability	2.5
Reliability Level	85 Percent
Overall Standard Deviation	0.5
Roadbed Soil Resilient Modulus (PSI)	9,000
Structural Number	**2.06**

Table 5 - Recommended Minimum Dry-Weather Pavement Section for New Private Pavement Sections

Material Layer	Private Pavement (inches)	Structural Coefficient	Compaction Standard
Asphaltic Concrete (AC)	3	.42	91%/ 92% of Rice Density AASHTO T-209
Crushed Aggregate Base ¾"-0 (leveling course)	2	.10	95% of Modified Proctor AASHTO T-180
Crushed Aggregate Base 1½"-0	8	.10	95% of Modified Proctor AASHTO T-180
Subgrade	12	9,000 PSI	95% of Standard Proctor AASHTO T-99 or equivalent
Total Calculated Structural Number		**2.26**	

The subgrade should be ripped or tilled to a depth of 12 inches, moisture conditioned, root-picked, and compacted in-place prior to the placement of crushed aggregate base for pavement. Any pockets of organic debris or loose fill encountered during ripping or tilling should be removed and replaced with engineered fill (see *Site Preparation Recommendations* section). In order to verify subgrade strength, we recommend proof-rolling directly on subgrade with a loaded dump truck during dry weather and on top of base course in wet weather. Soft areas that pump, rut, or weave should be stabilized prior to paving.

If pavement areas are to be constructed during wet weather, the subgrade and construction plan should be reviewed by the project geotechnical engineer at the time of construction so that condition specific recommendations can be provided. The moisture sensitive subgrade soils make the site a difficult wet weather construction project. General recommendations for wet weather pavement sections are provided below.

During placement of pavement section materials, density testing should be performed to verify compliance with project specifications. Generally, one subgrade, one base course, and one asphalt compaction test is performed for every 100 to 200 linear feet of paving.

Wet Weather Construction Pavement Section

This section presents our recommendations for wet weather pavement section and construction for new pavement sections at the project. These wet weather pavement section recommendations are intended for use in situations where it is not feasible to compact the subgrade soils to Oregon Cities requirements, due to wet subgrade soil conditions, and/or construction during wet weather.

Based on our site review, we recommend a wet weather section with a minimum subgrade deepening of 6 to 12 inches to accommodate a working subbase of additional 1½"-0 crushed rock. Geotextile fabric, Mirafi 500x or equivalent, should be placed on subgrade soils prior to placement of base rock.

In some instances it may be preferable to use a subbase material in combination with overexcavation and increasing the thickness of the rock section. GeoPacific should be consulted for additional recommendations regarding use of additional subbase in wet weather pavement sections if it is desired to pursue this alternative. Cement treatment of the subgrade may also be considered instead of overexcavation. For planning purposes, we anticipate that treatment of the onsite soils would involve mixing cement powder to approximately 6 percent cement content and a mixing depth on the order of 12 to 18 inches.

With implementation of the above recommendations, it is our opinion that the resulting pavement section will provide equivalent or greater structural strength than the dry weather pavement section currently planned. However, it should be noted that construction in wet weather is risky and the performance of pavement subgrades depend on a number of factors including the weather conditions, the contractor's methods, and the amount of traffic the road is subjected to. There is a potential that soft spots may develop even with implementation of the wet weather provisions recommended in this letter. If soft spots in the subgrade are identified during roadway excavation, or develop prior to paving, the soft spots should be overexcavated and backfilled with additional crushed rock.

During subgrade excavation, care should be taken to avoid disturbing the subgrade soils. Removals should be performed using an excavator with a smooth-bladed bucket. Truck traffic should be limited until an adequate working surface has been established. We suggest that the crushed rock be spread using bulldozer equipment rather than dump trucks, to reduce the amount of traffic and potential disturbance of subgrade soils.

Care should be taken to avoid overcompaction of the base course materials, which could create pumping, unstable subgrade soil conditions. Heavy and/or vibratory compaction efforts should be applied with caution. Following placement and compaction of the crushed rock to project specifications (95 percent of Modified Proctor), a finish proof-roll should be performed before paving.

The above recommendations are subject to field verification. GeoPacific should be on-site during construction to verify subgrade strength and to take density tests on the engineered fill, base rock and asphaltic pavement materials.

Stormwater Management

We understand that it is desired to incorporate subsurface infiltration of stormwater into the design of stormwater management facilities. However, during our geotechnical investigation of the site, we observed infiltration rates that were negligible (0.0 inches per hour), and encountered weathered rock at relatively shallow depths across the site. In our explorations, weathered rock was encountered between 3.8 to 4.2 feet below the ground surface. Generally, at least 5 feet of separation is recommended between infiltration facilities and rock.

Based on the subsurface conditions encountered, subsurface infiltration of stormwater is not recommended for this site. Our opinion is based on low measured infiltration rates and the fact that the native soil layer overlying weathered rock is generally less than 5 feet thick.

Stormwater management systems should be constructed as specified by the designer and/or in accordance with jurisdictional design manuals. Stormwater exceeding storage capacities will need to be directed to a suitable surface discharge location, away from structures. Stormwater management systems may need to include overflow outlets, surface water control measures and/or be connected to the street storm drain system, if available. In no case should uncontrolled stormwater be allowed to flow over slopes.

Subsurface stormwater disposal systems have the potential to affect groundwater quality since they provide a more direct pathway to groundwater aquifers. Consequently, disposal systems should be constructed and maintained in accordance with Oregon Department of Environmental Quality (DEQ) requirements for groundwater protection. Systems receiving runoff from pavement areas should include water quality elements; such as oil traps, filters, or similar measures.

UNCERTAINTIES AND LIMITATIONS

Infiltration test methods and procedures attempt to simulate the as-built conditions of a planned subsurface disposal system. However, due to natural variations in soil properties, actual infiltration rates may vary from the measured and/or recommended design rates. Storm events in excess of the design event are possible, and systems should be constructed such that potential overflow is discharged in a controlled manner away from structures.

We have prepared this report for the owner and their consultants for use of this project only. This report should be provided in its entirety to prospective contractors for bidding and estimating purposes; however, the conclusions and interpretations presented in this report should not be construed as a warranty of the subsurface conditions. Experience has shown that soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations that may not be detected by a geotechnical study. If, during future site operations, subsurface conditions are encountered which vary appreciably from those described herein, GeoPacific should be notified for review of the recommendations of this report, and revision of such if necessary.

Sufficient geotechnical monitoring, testing and consultation should be provided during construction to confirm that the conditions encountered are consistent with those indicated by explorations. The checklist attached to this report outlines recommended geotechnical observations and testing for the project. Recommendations for design changes will be provided should conditions revealed during construction differ from those anticipated, and to verify that the geotechnical aspects of construction comply with the contract plans and specifications.

Within the limitations of scope, schedule and budget, GeoPacific attempted to execute these services in accordance with generally accepted professional principles and practices in the fields of geotechnical engineering and engineering geology at the time the report was prepared. No warranty, expressed or implied, is made. The scope of our work did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous or toxic substances in the soil, surface water, or groundwater at this site.

We appreciate this opportunity to be of service.

Sincerely,

GEOPACIFIC ENGINEERING, IN

REGISTERED PROFESSIONAL ENGINEER 90013PE OREGON MAY 22, 2015 BENJAMIN G. ANDERSON

Expires: 12/31/19

Thomas Torkelson, E.I.T
Engineering Staff

Benjamin G. Anderson, P.E.
Senior Engineer

REFERENCES

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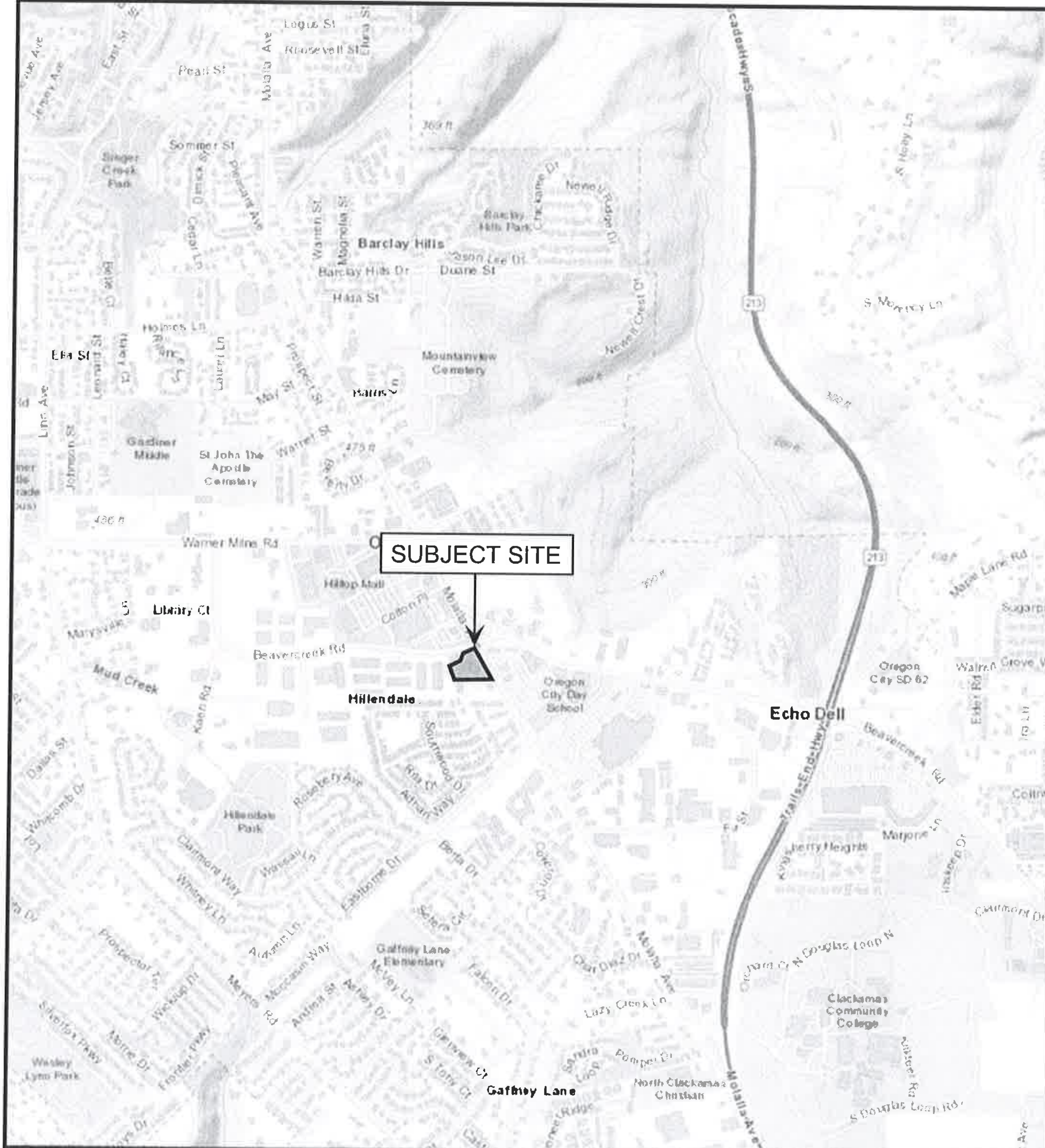
FIGURES

GeoPacific Engineering, Inc.

14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

SITE VICINITY MAP



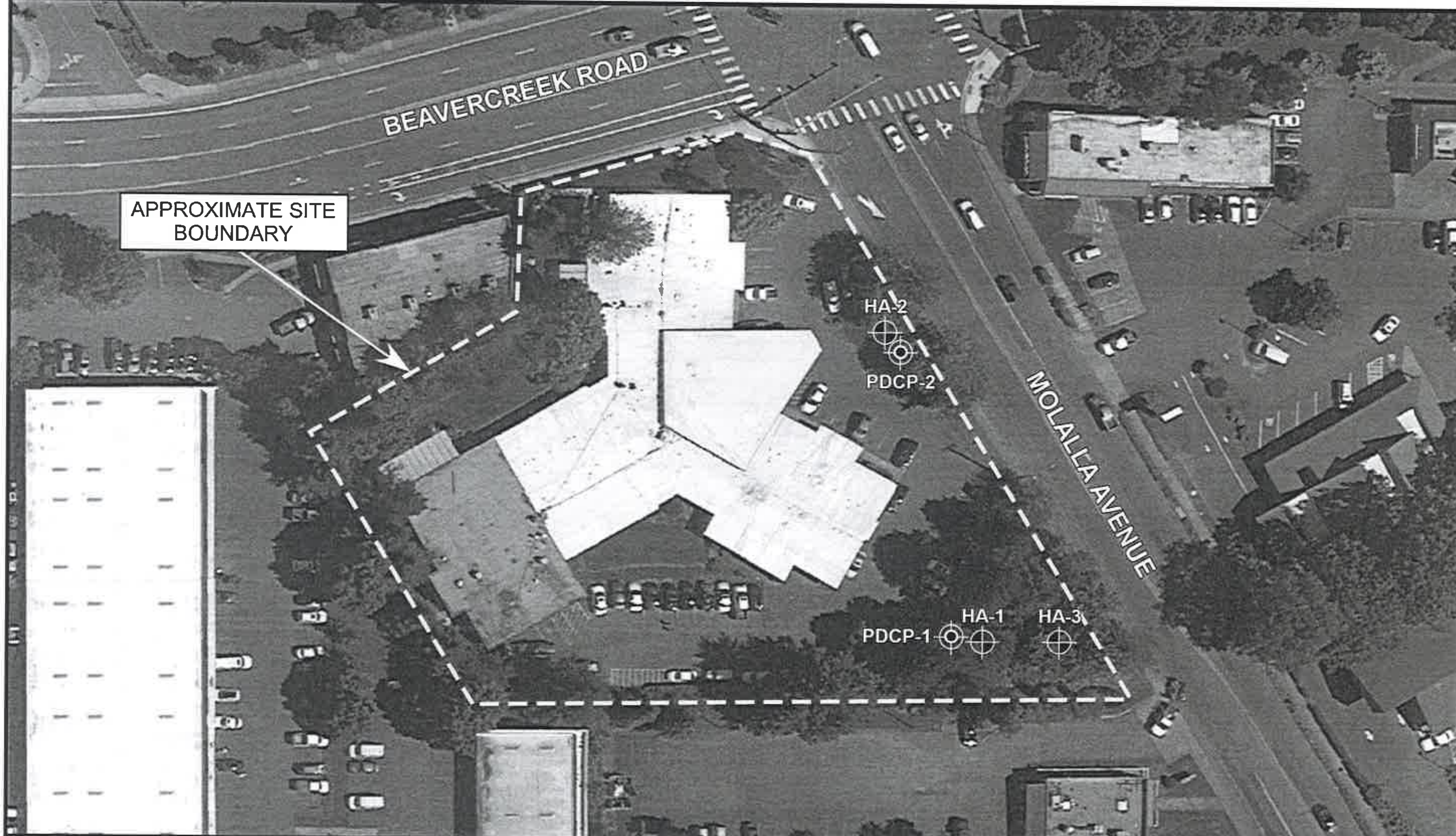
Base map: DOGAMI HAZVU Maps 2018 Date: 8/09/2018 Drawn by: TJT	1:24,000 0 0.13 0.25 0.5 mi 0 0.23 0.45 0.9 km
North	

Project: Marquis Oregon City Parking Lot Oregon City, Oregon 97045	Project No. 18-4984	FIGURE 1

GeoPacific Engineering, Inc.

14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

SITE AERIAL AND EXPLORATION LOCATIONS



Legend: Base Map Obtained From Google Earth 2018

HA-1 Hand Auger Boring Designation and Approximate Location

PDCP-1 PDCP Testing Designation and Approximate Location

APPROXIMATE SCALE (FEET) 40 0 40 80

Drawn by: TJT
Date: 8/09/2018

North

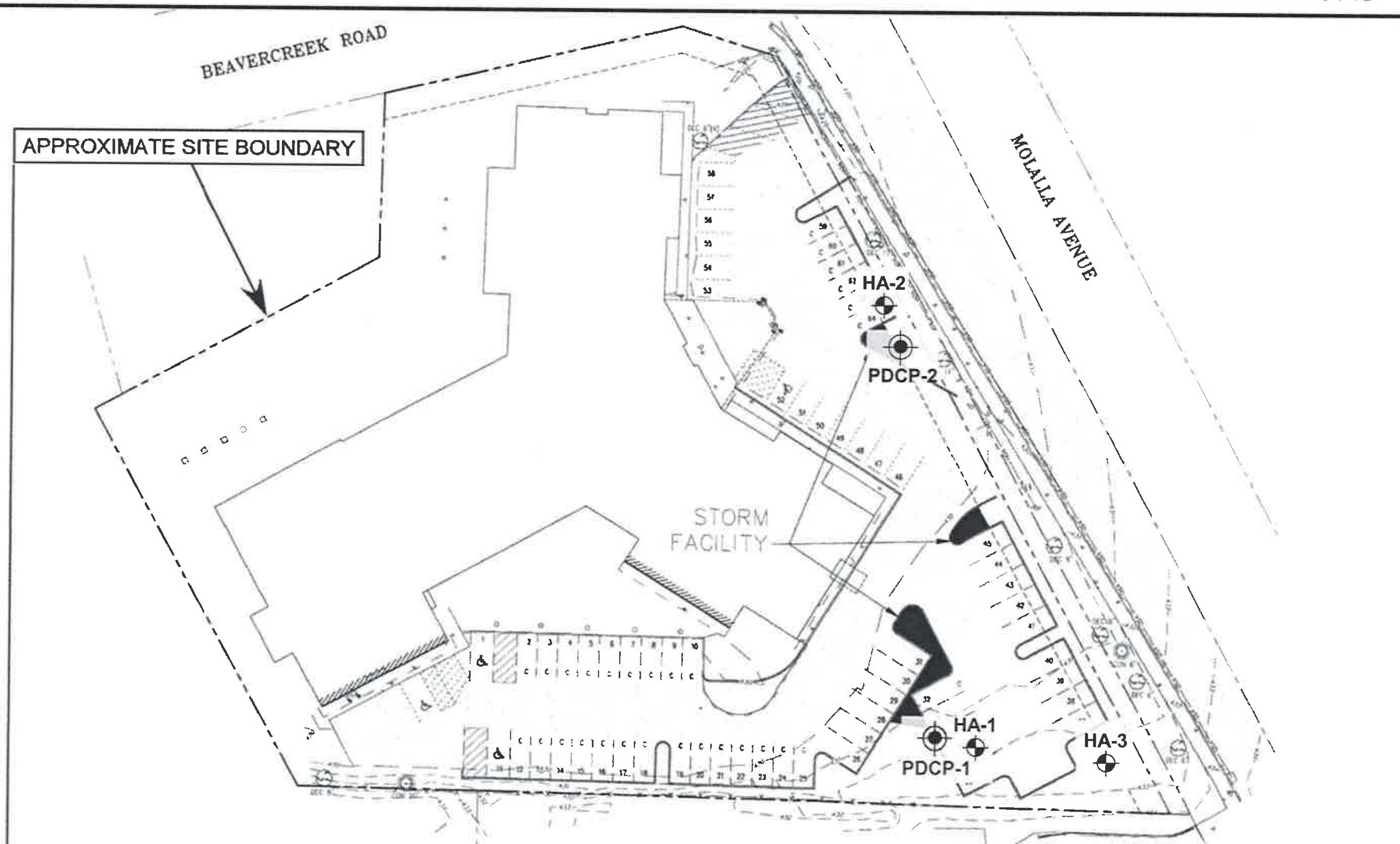
Project: Marquis Oregon City Parking Lot
1680 Molalla Avenue
Oregon City, Oregon 97045

Project No. 18-4984

FIGURE 2

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

SITE PLAN AND EXPLORATION LOCATIONS



Legend: Base Map Provided By Emerio Designs

HA-1 Hand Auger Boring Designation and Approximate Location

PDCP-1 PDCP Designation and Approximate Location

APPROXIMATE SCALE (FEET)
30 0 30 60

North

Drawn by: TJT
Date: 8/09/2018

Project: Marquis Oregon City Parking Lot
1680 Molalla Avenue
Oregon City, Oregon 97045

Project No. 18-4984

FIGURE 3

EXPLORATION LOGS

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

HAND AUGER LOG

Project: Marquis Oregon City Parking Lot, 1680 Molalla Avenue, Oregon City, Oregon	Project No. 18-4984	Hand Auger No. **HA-1**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
						SILT (ML), brown, medium stiff, moderately organic, trace fine and medium roots damp, surfaced with pine needles and leaves. (Topsoil).
1						Lean CLAY (CL), reddish brown, stiff to very stiff, with trace fragments of weathered rock, trace black and orange staining, damp. (Residual Soil).
						1 inch thick layer of gray ash 1.5 feet bgs.
2						Grades to moist and with more pronounced angular basalt at 2.2 feet bgs.
3						
4						Highly weathered BASALT, light to dark gray, extremely soft (R0), reddish-brown matrix of silty clay, black staining, moist. (Boring Lava)
5						Hand auger terminated at 4.6 feet bgs due to refusal on weathered rock. No seepage or groundwater encountered No caving observed
6						
7						
8						

LEGEND

100 to 1,000 g — Bag Sample
5 Gal. Bucket — Bucket Sample
Shelby Tube Sample
Seepage
Water Bearing Zone
Water Level at Abandonment

Date Excavated: 07/27/2018
Logged By: TJT
Surface Elevation:

GeoPacific Engineering, Inc.
14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

HAND AUGER LOG

Project: Marquis Oregon City Parking Lot
1680 Molalla Avenue
Oregon City, Oregon

Project No. 18-4984

Hand Auger No. **HA-2**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
						SILT (ML), brown, medium stiff, moderately organic, contains subrounded to angular gravel, with trace fine and medium roots, damp, 6 inches of topsoil developed on the surface, surfaced with grass. (Undocumented Fill).
1						
2						Lean CLAY (CL), reddish brown, stiff to very stiff, with trace fragments of weathered rock, trace black and orange staining, damp. (Residual Soil). Grades to with more pronounced angular basalt at 2.0 feet bgs.
3						Grades to moist at 3.5 feet bgs.
4						
5						Highly weathered BASALT, light to dark gray, extremely soft (R0), reddish-brown matrix of silty clay, black staining, moist. (Boring Lava). Infiltration testing conducted at 4.6 feet bgs. Measured rate = 0.0 inches/hour
6						Hand auger terminated at 5,5 feet bgs due to refusal on weathered rock. Infiltration testing conducted at 4.6 feet below the ground surface. Measured Rate = 0.0 inches per hour. No seepage or groundwater encountered No caving observed
7						
8						

LEGEND

100 to 1,000 g — Bag Sample
5 Gal. Bucket — Bucket Sample
Shelby Tube Sample
Seepage
Water Bearing Zone
Water Level at Abandonment

Date Excavated: 07/27/2018

Logged By: TJT

Surface Elevation:

14835 SW 72nd Avenue
Portland, Oregon 97224
Tel: (503) 598-8445 Fax: (503) 941-9281

HAND AUGER LOG

Project: Marquis Oregon City Parking Lot 1680 Molalla Avenue Oregon City, Oregon	Project No. 18-4984	Hand Auger No. **HA-3**

Depth (ft)	Pocket Penetrometer (tons/ft²)	Sample Type	In-Situ Dry Density (lb/ft³)	Moisture Content (%)	Water Bearing Zone	Material Description
						SILT (ML), brown, medium stiff, moderately organic, trace fine and medium roots damp, surfaced with pine needles and leaves. (Topsoil).
1						Lean CLAY (CL), reddish brown, stiff to very stiff, with trace fragments of weathered rock, trace black and orange staining, damp. (Residual Soil).
						1 inch thick layer of gray ash 1.5 feet bgs.
2						Grades to with more pronounced angular basalt at 2.0 feet bgs.
3						Grades to moist at 3.0 feet bgs.
4						Highly weathered BASALT, light to dark gray, extremely soft (R0), reddish-brown matrix of silty clay, black staining, moist. (Boring Lava).
						Hand auger terminated at 4.2 feet bgs due to refusal on residual soil. No seepage or groundwater encountered No caving observed
5						
6						
7						
8						

LEGEND

100 to 1,000 g — Bag Sample
5 Gal. Bucket — Bucket Sample
Shelby Tube Sample
Seepage
Water Bearing Zone
Water Level at Abandonment

Date Excavated: 07/27/2018

Logged By: TJT

Surface Elevation:

PDCP TESTING DATA

GeoPacific Engineering, Inc.
Real-World Geotechnical Solutions
Investigiation, Design, Construction Support

14835 SW 72nd Avenue
Portland, Oregon 97224

Tel (503) 598-8445
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Portable Dynamic Cone Penetrometer (PDCP) / California Bearing Ratio (CBR) Correlation

Project: Marquis Parking Lot **Date: 07.27.2018** **Existing A/C Thickness: none** **Test:** PDCP-1
Project No. 18-4984 **Engineer: TJT** **Existing Base Aggregate Thickness: none**
Location: South of Existing Parking Lot **Subgrade: Native Lean CLAY** **Notes:** Location on Figure 2

Length of shaft	Height (from ref) at start	Depth below ground at start	Length of shaft	Height (from ref) at start	Depth below ground at start
mm	mm	mm	in	in	in
1320	1320	110	52.0	48.0	4.3

Blows	Height(from ref) in	Height(from ref) mm	Depth (below ground) mm	Depth (inches below ground)	Depth (feet below ground)	mm/blow	CBR
1	4.92	125	125	4.92	0.41	15.00	14.1
5	6.10	155	155	6.10	0.51	6.00	39.3
5	6.89	175	175	6.89	0.57	4.00	61.8
5	8.07	205	205	8.07	0.67	6.00	39.3
5	8.86	225	225	8.86	0.74	4.00	61.8
10	10.83	275	275	10.83	0.90	5.00	48.1
10	12.80	325	325	12.80	1.07	5.00	48.1
10	16.34	415	415	16.34	1.36	9.00	24.9
10	20.87	530	530	20.87	1.74	11.50	18.9
10	24.80	630	630	24.80	2.07	10.00	22.2
10	28.15	715	715	28.15	2.35	8.50	26.6
10	30.71	780	780	30.71	2.56	6.50	35.9
10	32.48	825	825	32.48	2.71	4.50	54.2
10	34.65	880	880	34.65	2.89	5.50	43.3
10	37.01	940	940	37.01	3.08	6.00	39.3
10	39.76	1010	1010	39.76	3.31	7.00	33.0
10	41.93	1065	1065	41.93	3.49	5.50	43.3
10	44.49	1130	1130	44.49	3.71	6.50	35.9
					Average	6.97	38.3

Measurements are after each blow. Mm/blow is difference between previous and current blow

Portable Dynamic Cone Penetrometer (PDCP) / California Bearing Ratio (CBR) Correlation

Project: Marquis Parking Lot **Date: 07.27.2018** **Existing A/C Thickness: none** **Test:** PDCP-2
Project No. 18-4984 **Engineer: TJT** **Existing Base Aggregate Thickness: none**
Location: East of Existing Parking Lot **Subgrade: Native Lean CLAY** **Notes:** Location on Figure 2

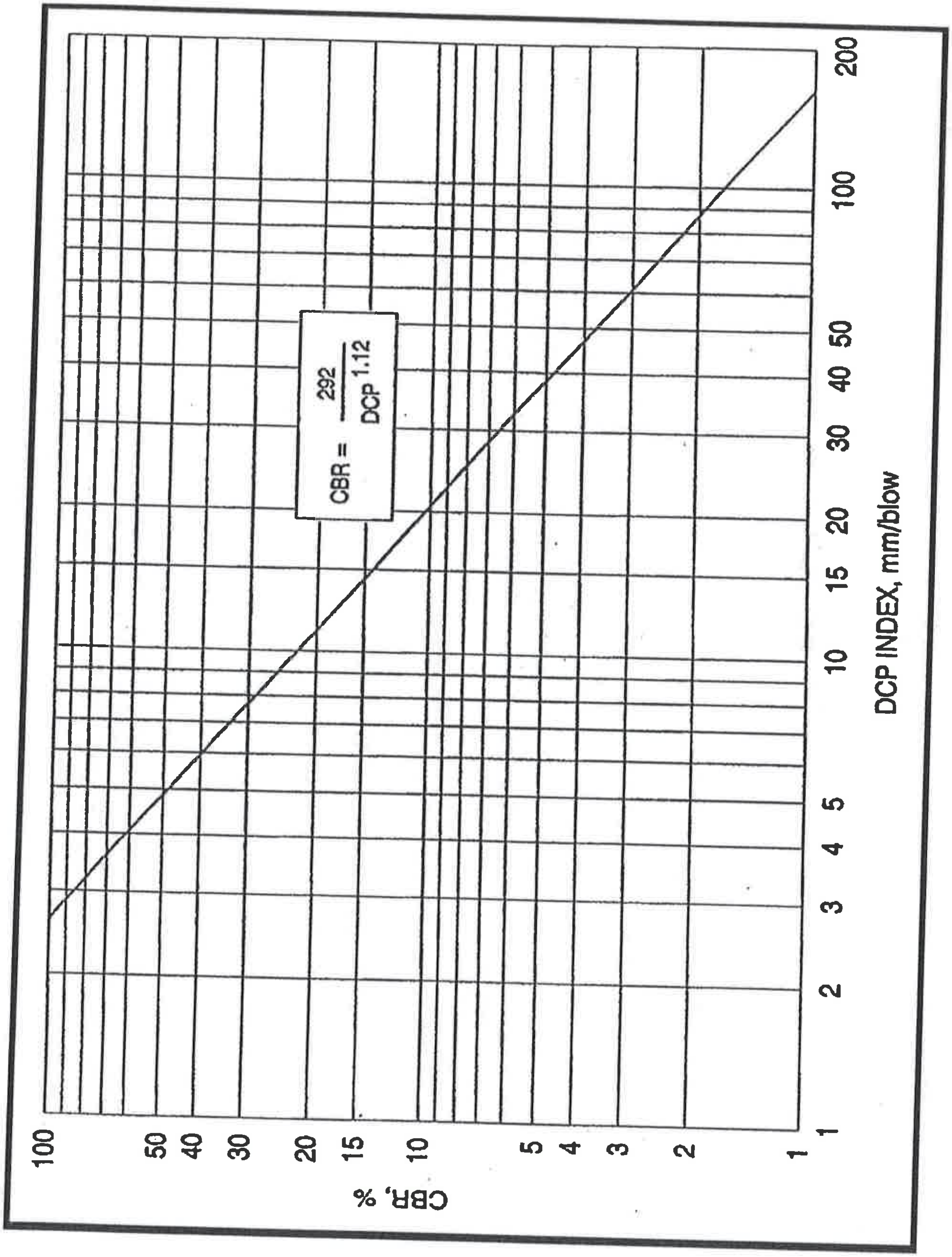
Length of shaft	Height (from ref) at start	Depth below ground at start	Length of shaft	Height (from ref) at start	Depth below ground at start
mm	mm	mm	in	in	in
1320	1320	375	52.0	48.0	14.8

Blows	Height(from ref) in	Height(from ref) mm	Depth (below ground) mm	Depth (inches below ground)	Depth (feet below ground)	mm/blow	CBR
5	17.13	435	435	17.13	1.43	12.00	18.1
5	18.50	470	470	18.50	1.54	7.00	33.0
5	19.88	505	505	19.88	1.66	7.00	33.0
5	21.26	540	540	21.26	1.77	7.00	33.0
5	22.24	565	565	22.24	1.85	5.00	48.1
10	24.80	630	630	24.80	2.07	6.50	35.9
10	27.36	695	695	27.36	2.28	6.50	35.9
10	30.31	770	770	30.31	2.53	7.50	30.6
10	32.68	830	830	32.68	2.72	6.00	39.3
10	34.65	880	880	34.65	2.89	5.00	48.1
10	36.42	925	925	36.42	3.03	4.50	54.2
10	38.78	985	985	38.78	3.23	6.00	39.3
10	41.93	1065	1065	41.93	3.49	8.00	28.4
5	43.90	1115	1115	43.90	3.66	10.00	22.2
5	46.06	1170	1170	46.06	3.84	11.00	19.9
3	47.44	1205	1205	47.44	3.95	11.67	18.6
					Average	6.95	33.6

Measurements are after each blow. Mm/blow is difference between previous and current blow

DCP Index mm/blow	CBR %	DCP Index mm/blow	CBR %
<3	100	51	3.6
3	80	52	3.5
4	60	53-54	3.4
5	50	55	3.3
6	40	56-57	3.2
7	35	58	3.1
8	30	59-60	3.0
9	25	61-62	2.9
10-11	20	63-64	2.8
12	18	65-66	2.7
13	16	67-68	2.6
14	15	69-71	2.5
15	14	72-74	2.4
16	13	75-77	2.3
17	12	78-80	2.2
18-19	11	81-83	2.1
20-21	10	84-87	2.0
22-23	9	88-91	1.9
24-26	8	92-96	1.8
27-29	7	97-101	1.7
30-34	6	102-107	1.6
35-38	5	108-114	1.5
39	4.8	115-121	1.4
40	4.7	122-130	1.3
41	4.6	131-140	1.2
42	4.4	141-152	1.1
43	4.3	153-166	1.0
44	4.2	166-183	0.9
45	4.1	184-205	0.8
46	4.0	206-233	0.7
47	3.9	234-271	0.6
48	3.8	272-324	0.5
49-50	3.7	>324	<0.5

Figure 4: Tabulated Correlation of CBR versus DCP Index


CBR = 292 / DCP 1.12
CBR, %
100
50
40
30
20
15
10
5
4
3
2
1
DCP INDEX, mm/blow
1
2
3
4
5
10
15
20
30
40
50
100
200

Appendix C:

APPENDIX: C(1)

WES BMP Sizing Software Version 1.6.0.2, May 2018

WES BMP Sizing Report

Project Information

Project Name	Marquis - Parking Lot Expansion
Project Type	Addition
Location	1680 Molalla Ave, Oregon City, OR 97045
Stormwater Management Area	4679
Project Applicant	Scott Miller
Jurisdiction	OutofDistrict

Drainage Management Area

Name	Area (sq-ft)	Pre-Project Cover	Post-Project Cover	DMA Soil Type	BMP
B1	768	Forested	ConventionalConcrete	C	RG-A
B2	860	Forested	ConventionalConcrete	C	RG-2
B3	970	Forested	ConventionalConcrete	C	RG-3
B4	2,903	Forested	ConventionalConcrete	C	RG-4

LID Facility Sizing Details

LID ID	Design Criteria	BMP Type	Facility Soil Type	Minimum Area (sq-ft)	Planned Areas (sq-ft)	Orifice Diameter (in)
RG-A	FlowControlAndTreatment	Rain Garden - Filtration	Lined	115.2	137.0	0.2
RG-2	FlowControlAndTreatment	Rain Garden - Filtration	Lined	129.0	130.0	0.2
RG-3	FlowControlAndTreatment	Rain Garden - Filtration	Lined	145.5	151.0	0.2
RG-4	FlowControlAndTreatment	Rain Garden - Filtration	Lined	435.5	453.0	0.3

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.

Basin Area Tabulated Data
Marquis, Parking Lot Expansion

Appendix: C(2)

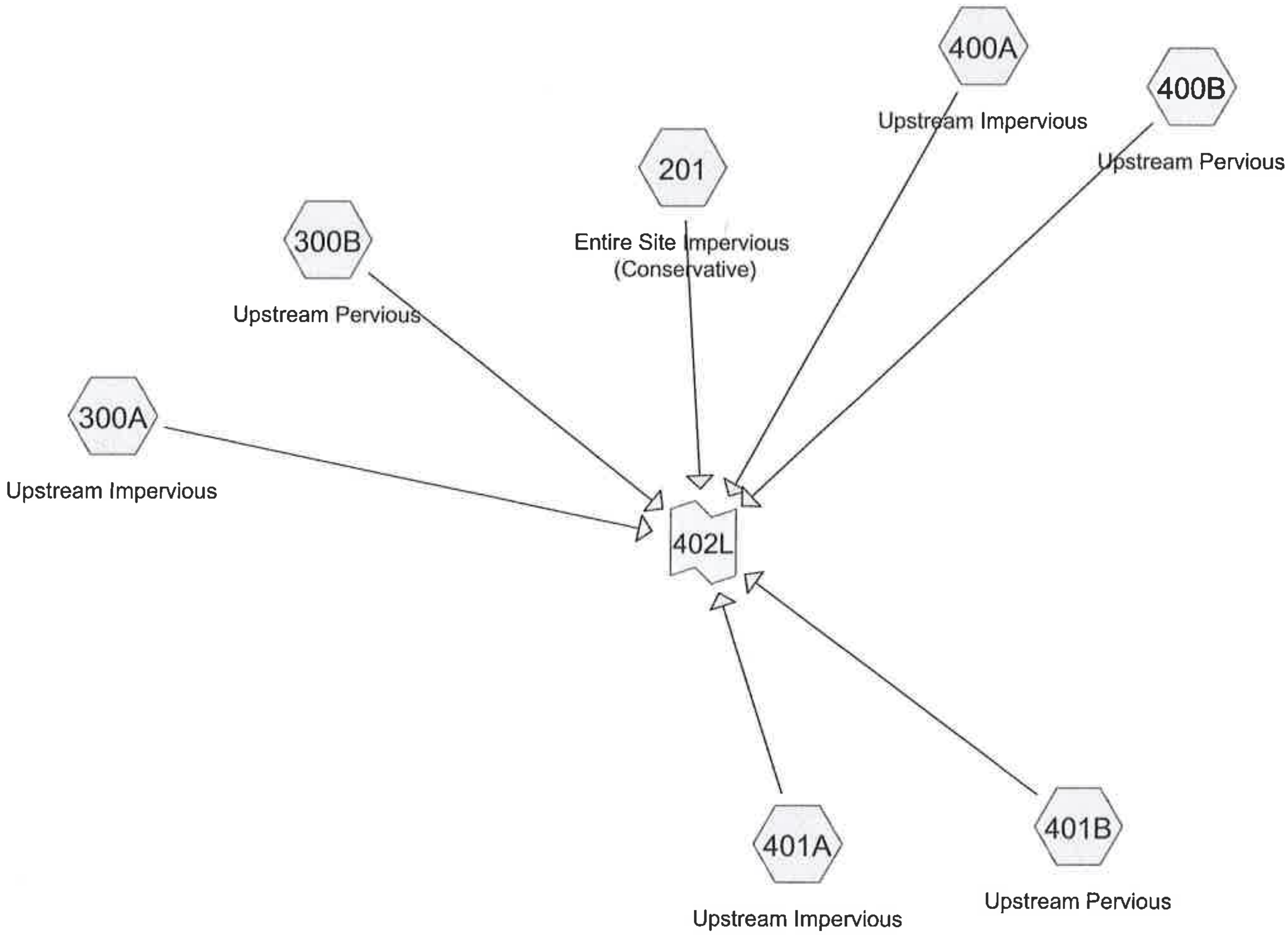
Basin #	Name	Total Area SF	Total Area Acres	Qty of Lots	Lot Impervious SF	ROW/Tract Imp SF	Total Impervious SF	Total Pervious (Calc'd) SF
201	Onsite Post-Developed	80,150	1.84	1	2,640	77,510	80,150	0
300	Upstream Basin	4,247,536	97.51	150	396,000	347,520	743,520	3,504,016
400	Downstream Basin	797,148	18.30	73	192,720	107,350	300,070	497,078
401	Downstream Basin	668,646	15.35	13	34,320	184,400	218,720	449,926

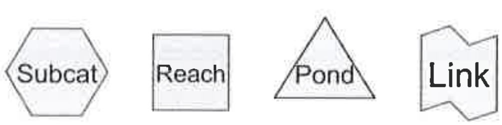
APPENDIX: C(2)

APPENDIX: C(3)

Downstream Conveyance Analysis

25-Year Flow Rates





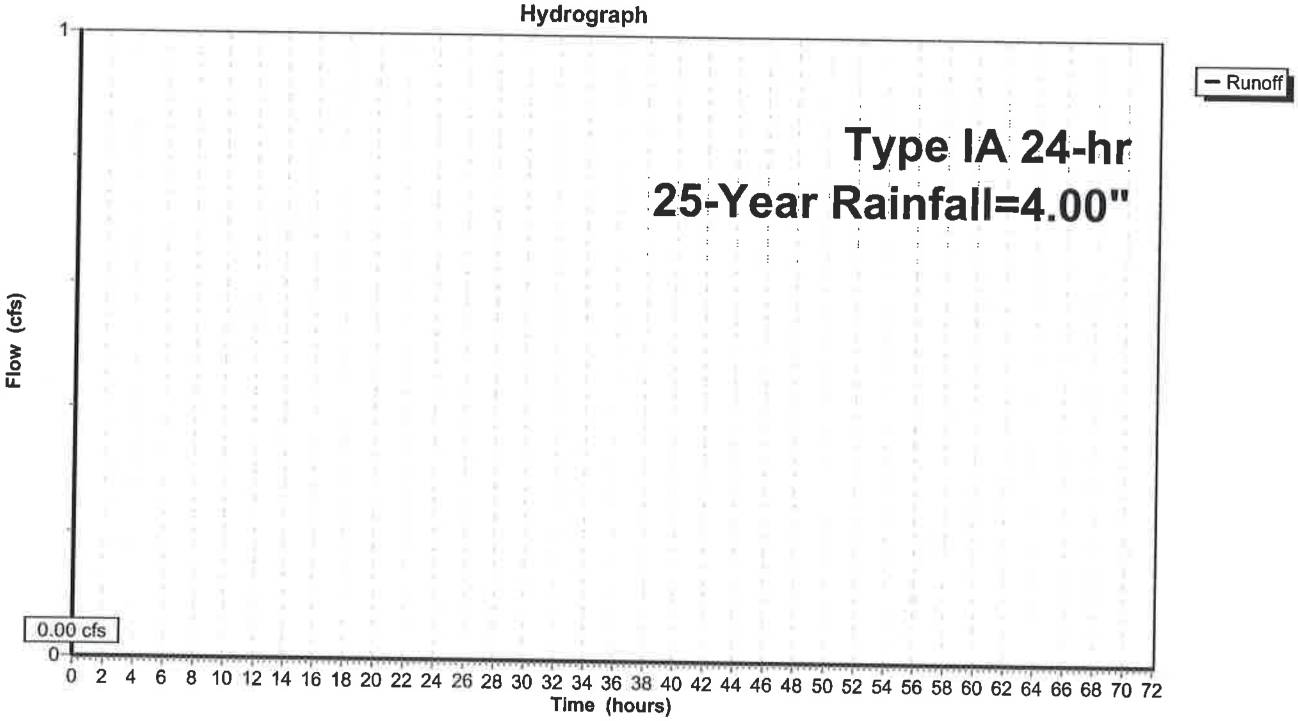
Routing Diagram for 082-020-Marquis Oregon
Prepared by Emerio Design, Printed 1/23/2019

Summary for Subcatchment 201: Entire Site Impervious (Conservative)

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.00"

Subcatchment 201: Entire Site Impervious (Conservative)



Summary for Subcatchment 300A: Upstream Impervious

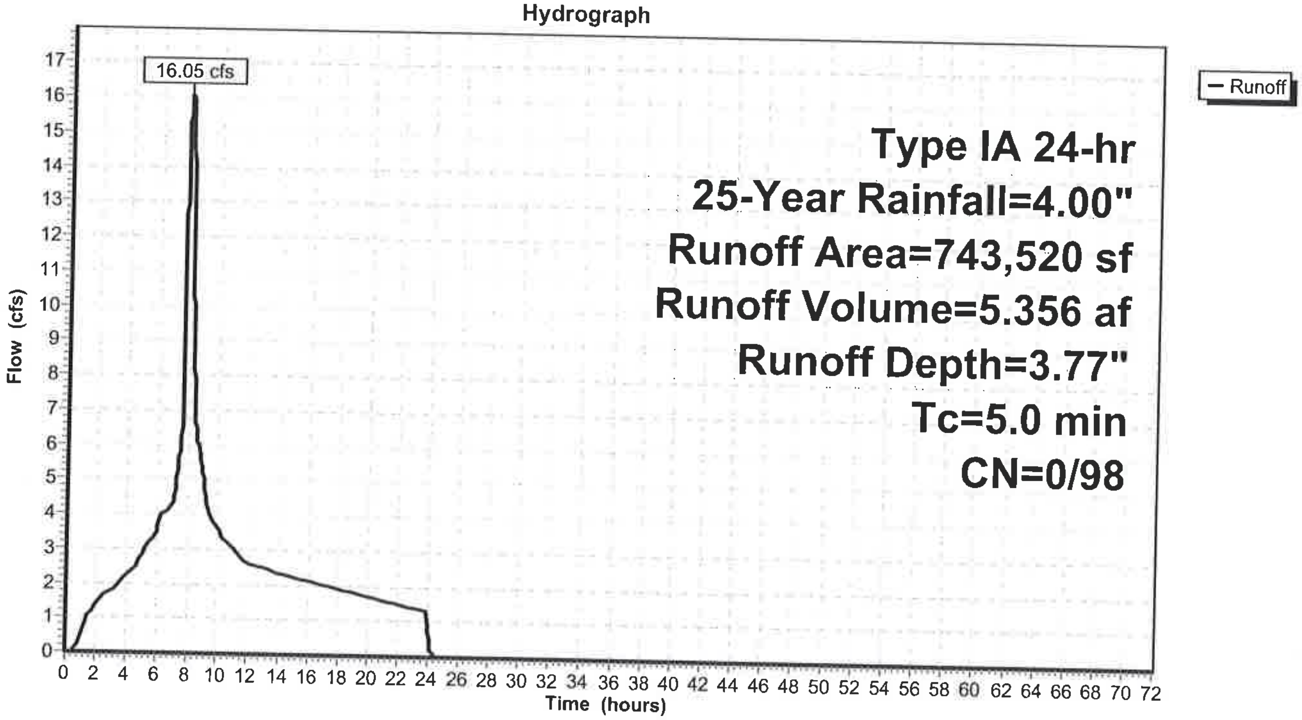
Runoff = 16.05 cfs @ 7.88 hrs, Volume= 5.356 af, Depth= 3.77"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.00"

	Area (sf)	CN	Description
*	743,520	98	
	743,520	98	100.00% Impervious Area

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

Subcatchment 300A: Upstream Impervious



Summary for Subcatchment 300B: Upstream Pervious

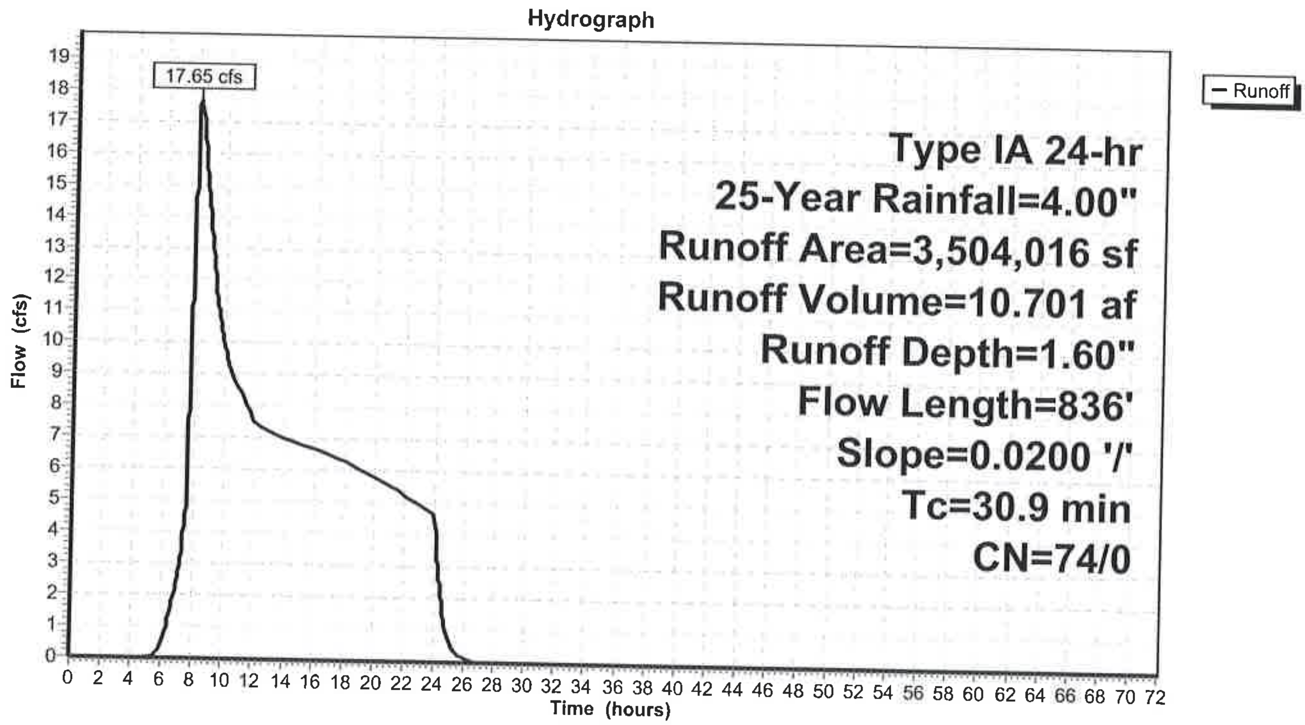
Runoff = 17.65 cfs @ 8.10 hrs, Volume= 10.701 af, Depth= 1.60"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.00"

	Area (sf)	CN	Description
*	3,504,016	74	
	3,504,016	74	100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	300	0.0200	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
4.2	536	0.0200	2.12		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
30.9	836	Total			

Subcatchment 300B: Upstream Pervious



Summary for Subcatchment 400A: Upstream Impervious

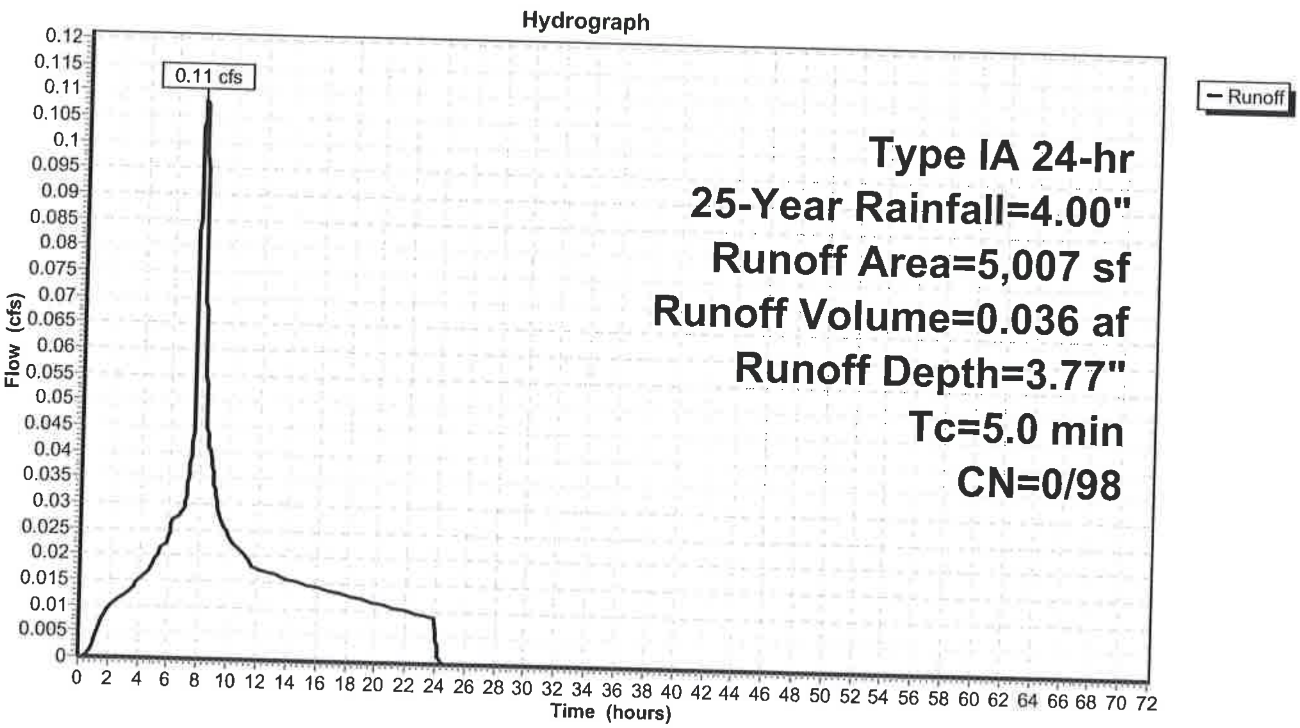
Runoff = 0.11 cfs @ 7.88 hrs, Volume= 0.036 af, Depth= 3.77"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.00"

	Area (sf)	CN	Description
*	5,007	98	
	5,007	98	100.00% Impervious Area

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

Subcatchment 400A: Upstream Impervious



Summary for Subcatchment 400B: Upstream Pervious

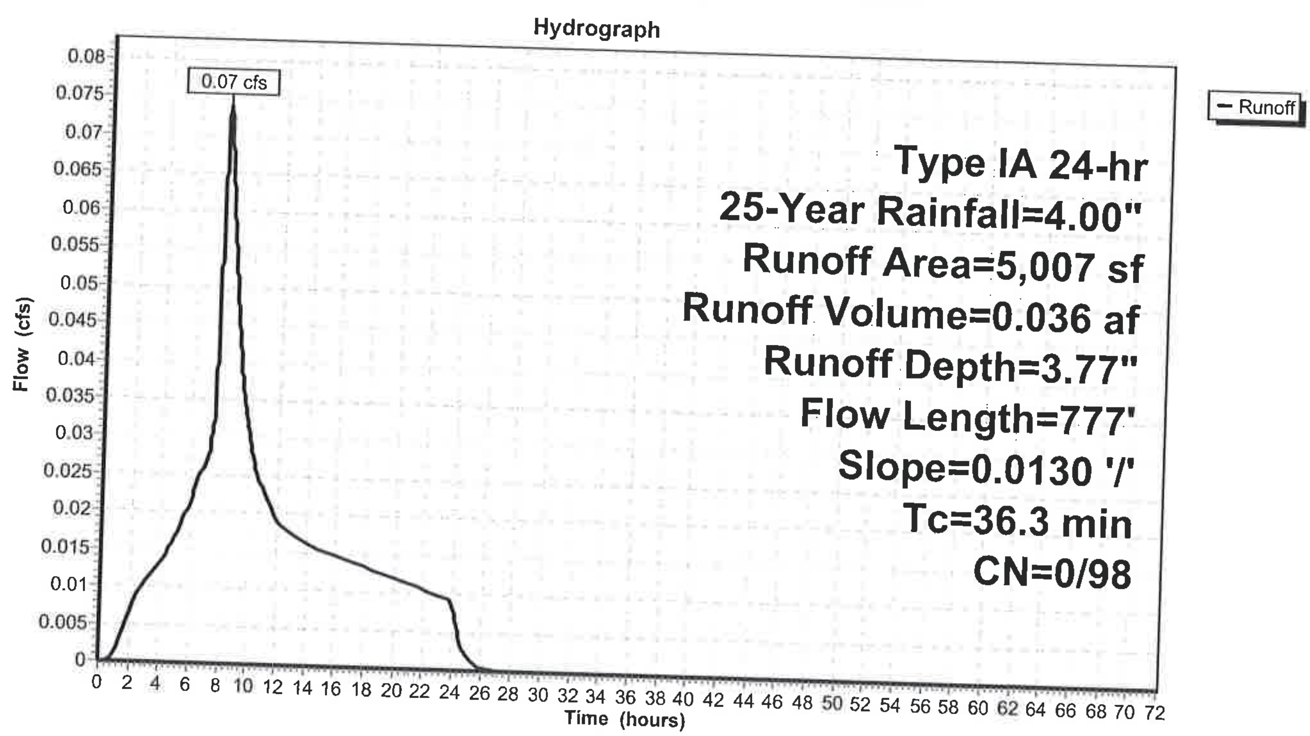
Runoff = 0.07 cfs @ 8.01 hrs, Volume= 0.036 af, Depth= 3.77"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.00"

	Area (sf)	CN	Description
*	5,007	98	
	5,007	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.7	300	0.0130	0.16		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
4.6	477	0.0130	1.71		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
36.3	777	Total			

Subcatchment 400B: Upstream Pervious



Summary for Subcatchment 401A: Upstream Impervious

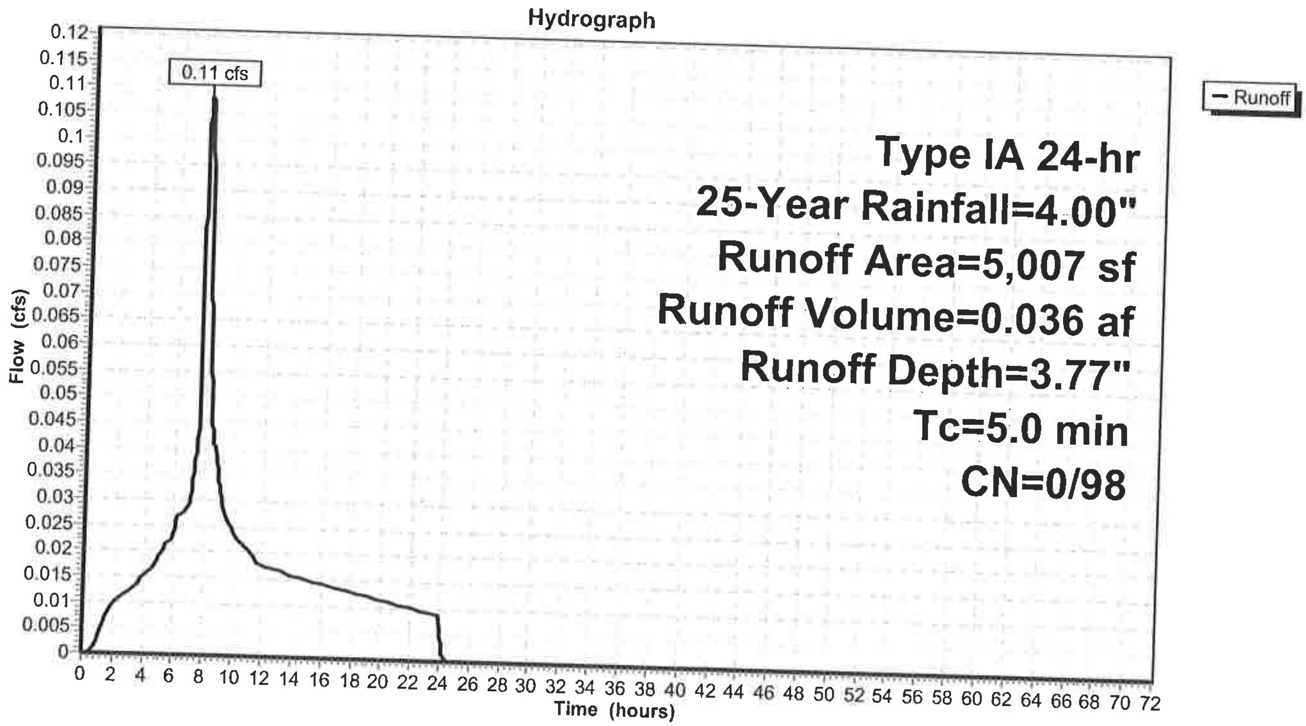
Runoff = 0.11 cfs @ 7.88 hrs, Volume= 0.036 af, Depth= 3.77"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.00"

	Area (sf)	CN	Description
*	5,007	98	
	5,007	98	100.00% Impervious Area

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

Subcatchment 401A: Upstream Impervious



Summary for Subcatchment 401B: Upstream Pervious

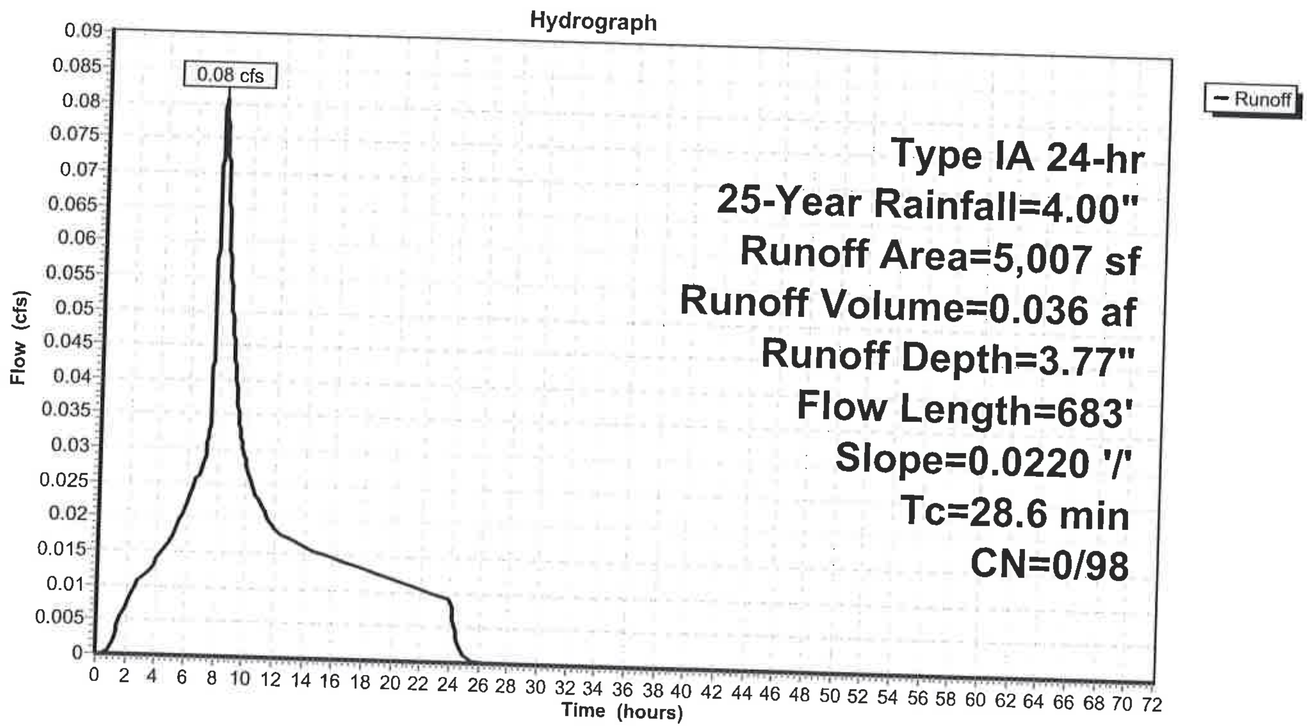
Runoff = 0.08 cfs @ 8.01 hrs, Volume= 0.036 af, Depth= 3.77"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-Year Rainfall=4.00"

	Area (sf)	CN	Description
*	5,007	98	
	5,007	98	100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	300	0.0220	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
2.9	383	0.0220	2.22		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
28.6	683	Total			

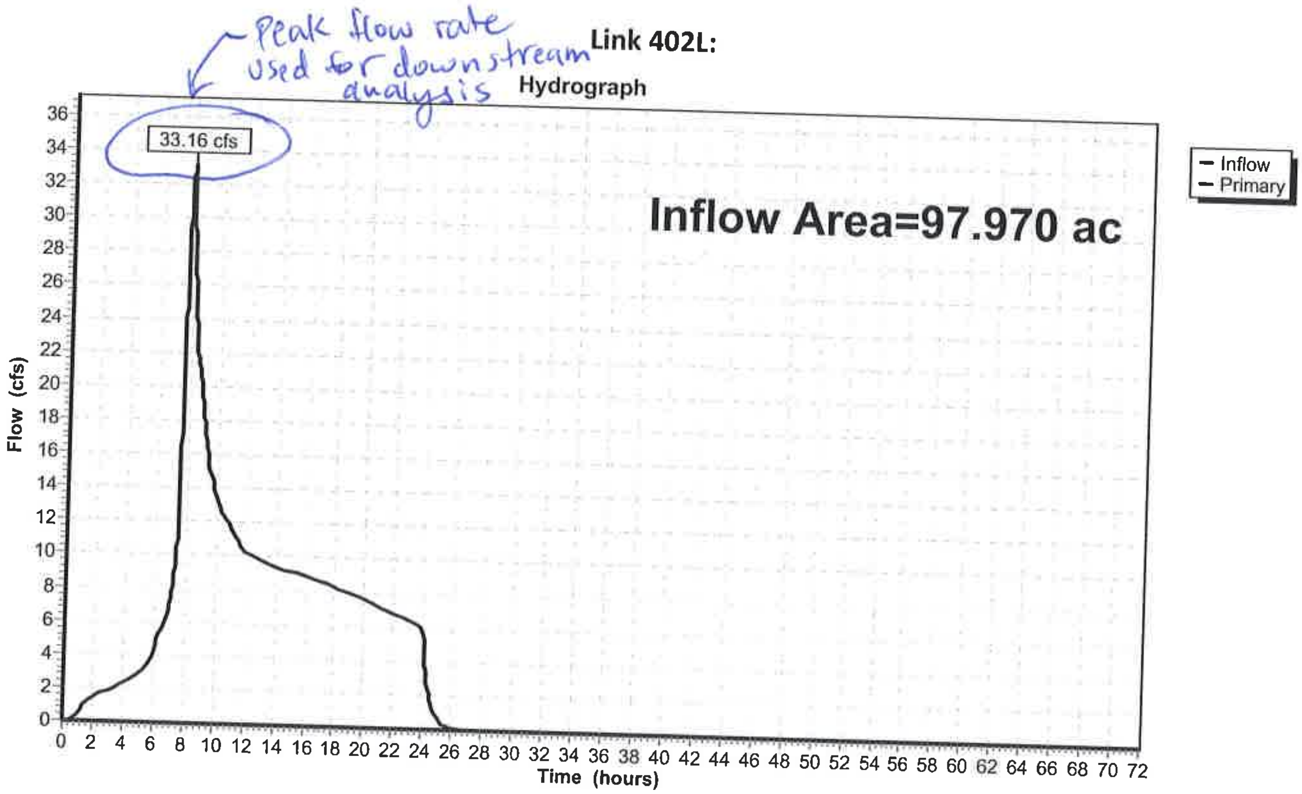
Subcatchment 401B: Upstream Pervious



Summary for Link 402L:

Inflow Area = 97.970 ac, 17.89% Impervious, Inflow Depth = 1.98" for 25-Year event
Inflow = 33.16 cfs @ 8.00 hrs, Volume= 16.201 af
Primary = 33.16 cfs @ 8.00 hrs, Volume= 16.201 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs



APPENDIX: C(4)

Appendix: C(4)

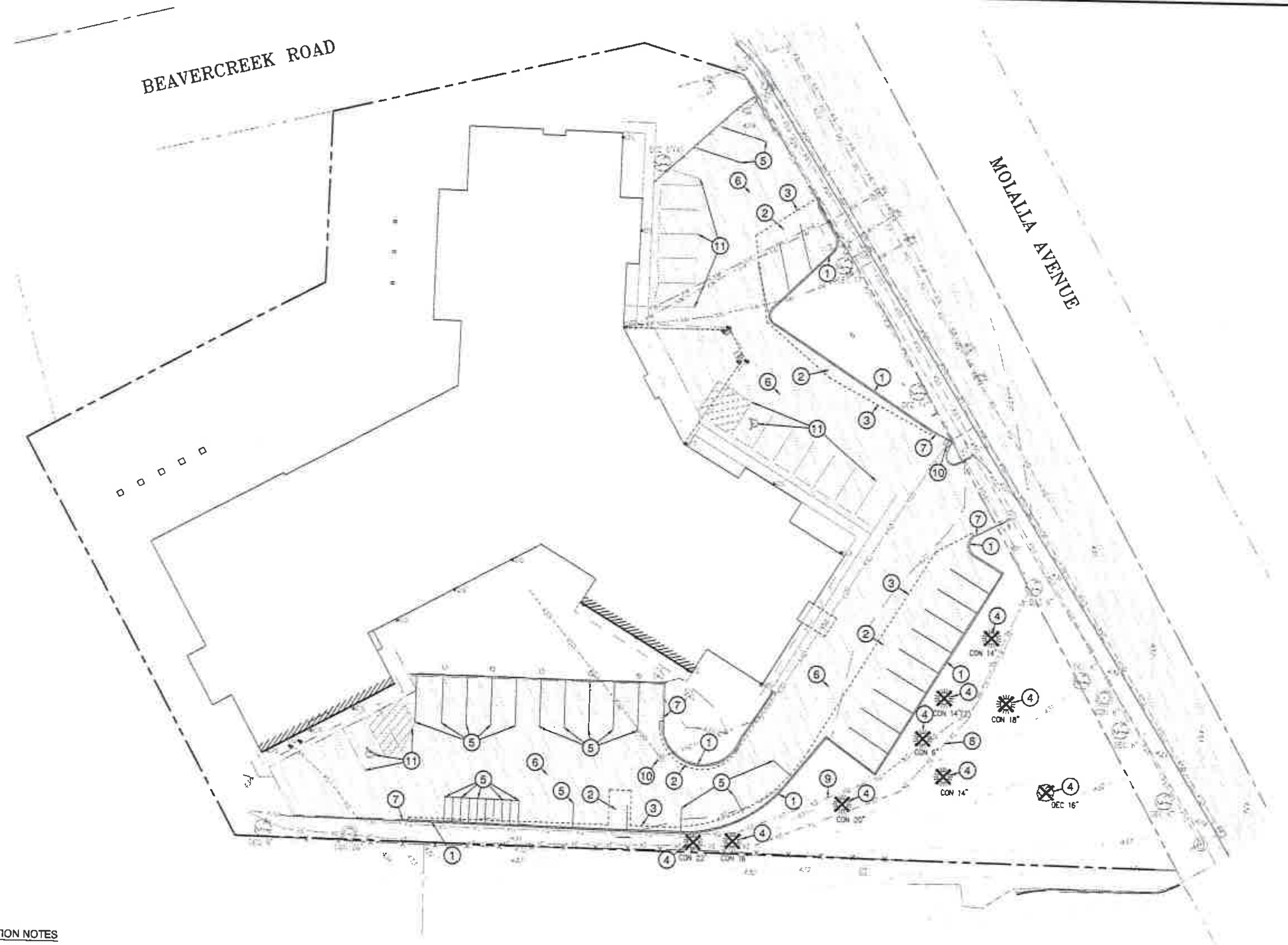
Project: Marquis Oregon City Parking Lot Expansion
Project: 25-yr event Downstream Conveyance Analysis
Date: 1/24/2019
Calc'd By: Evans

Design Section	Segment	Q (Calc'd) "Q"	Pipe Dia. (inch) "D"	Pipe Dia. (ft) "D"	Manning's number "n"	Slope "S" %	Slope "S"	Area Full (Calc'd) "Af"	Wetted Perimeter (Calc'd) "WPf"	Hydraulic Radius (Calc'd) "Rf"	Velocity Full (Calc'd) "Vf"	Flow Rate Full (Calc'd) "Qf"	% Pipe Capacity Used (Calc'd) "Q/Qf"	Velocity @ Q/Qf (Calc'd) "V"
			Downstream Conveyance Analysis											
S Beavercreek Rd	SDMH34615-SDMH37235	33.16	48	4.00	0.013	0.49	0.0049	12.566	12.566	1.000	8.031	#####	32.9%	2.64
S Beavercreek Rd	SDMH37235-SDMH34602	33.16	48	4.00	0.013	0.49	0.0049	12.566	12.566	1.000	8.031	#####	32.9%	2.64
S Beavercreek Rd	SDMH34602-SDMH34611	33.16	48	4.00	0.013	0.49	0.0049	12.566	12.566	1.000	8.023	#####	32.9%	2.64
S Beavercreek Rd	SDMH34611-SDMH30023	33.16	48	4.00	0.013	0.49	0.0049	12.566	12.566	1.000	8.031	#####	32.9%	2.64
S Beavercreek Rd	SDMH30023-SDMH34994	33.16	48	4.00	0.013	0.49	0.0049	12.566	12.566	1.000	8.031	#####	32.9%	2.64
To Outfall	SDMH34994-OUTFALL	33.16	48	4.00	0.013	0.49	0.0049	12.566	12.566	1.000	8.031	#####	32.9%	2.64

Note: For conservatism,total combined flow rate of 33.16 CFS was used with a pipe slope less than 0.5%.

Appendix D:

APPENDIX: D(1)



N

SCALE: 1" = 10'
11"X17" @ 1" = 20'

LEGEND

- BOUNDARY LINE
- ADJACENT/ADJOINING LOT LINE
- CENTER LINE ROW
- EASEMENT
- EXISTING 1' CONTOUR LINE
- EXISTING 5' CONTOUR LINE
- EXISTING TREE
- EXISTING CATCH BASIN
- EXISTING STORM SEWER MANHOLE
- EXISTING SANITARY SEWER MANHOLE
- EXISTING FIRE HYDRANT
- EXISTING WATER VAULT
- EXISTING WATER VALVE
- EXISTING IRRIGATION VALVE
- EXISTING UTILITY POLE
- EXISTING STREET LIGHT
- EXISTING GAS METER
- EXISTING BOLLARD
- EXISTING SIGN
- EXISTING DOWN SPOUT
- EXISTING HANDICAP PARKING
- EXISTING OVERHEAD LINE
- EXISTING SANITARY SEWER LINE
- EXISTING STORM SEWER LINE
- EXISTING WATER LINE
- EXISTING GAS LINE
- EXISTING FENCELINE

DEMOLITION NOTES

1. EXISTING CURB TO BE REMOVED
2. EXISTING AC TO BE REMOVED
3. SAWCUT LINE
4. EXISTING TREE TO BE REMOVED
5. EXISTING STRIPING TO BE REMOVED
6. EXISTING AC PAVEMENT TO REMAIN AND BE PROTECTED DURING DEMOLITION
7. EXISTING CURB TO REMAIN AND BE PROTECTED DURING DEMOLITION
8. EXISTING ELECTRIC LINE TO REMAIN BE PROTECTED DURING DEMOLITION
9. EXISTING GAS LINE TO REMAIN AND BE PROTECTED DURING DEMOLITION
10. EXISTING STORM CATCH BASIN TO REMAIN AND BE PROTECTED DURING DEMOLITION
11. EXISTING STRIPING TO REMAIN AND BE PROTECTED DURING DEMOLITION

1680 MOLALLA AVENUE

TAX MAP T3S R2E 05C
TAX LOT 00301
CITY OF OREGON CITY, OREGON

EXISTING CONDITIONS AND DEMOLITION PLAN

REVISIONS		
NO.	DATE	DESCRIPTION

EMERIO Design
6445 SW FALLBROOK PLACE, SUITE 100
BEAVERTON, OREGON 97008
TEL: (503) 746-8812
FAX: (503) 639-9592
www.emeriodesign.com

SHEET 2 OF 5

FILE P: \086-020 Marquis Oregon City Parking Lot Expansion\dwg\plan\086-020_02.dwg, Layout: 2 EXISTING CONDITINOS AND DEMOLITION PLAN, Plot Date: 9/18/2018 7:18 AM, by: Kyung Him

APPENDIX; D(2)

LEGEND

- BOUNDARY LINE
- ADJACENT/ADJOINING LOT LINE
- CENTER LINE ROW
- EXISTING STORM DRAIN LINE
- DIRECTION OF SURFACE DRAINAGE
- DRAINAGE BASINS

1680 MOLALLA AVENUE
TAX MAP T3S R2E 05C
TAX LOT 00301
CITY OF OREGON CITY, OREGON

STORMWATER MANAGMENT PLAN

REVISIONS

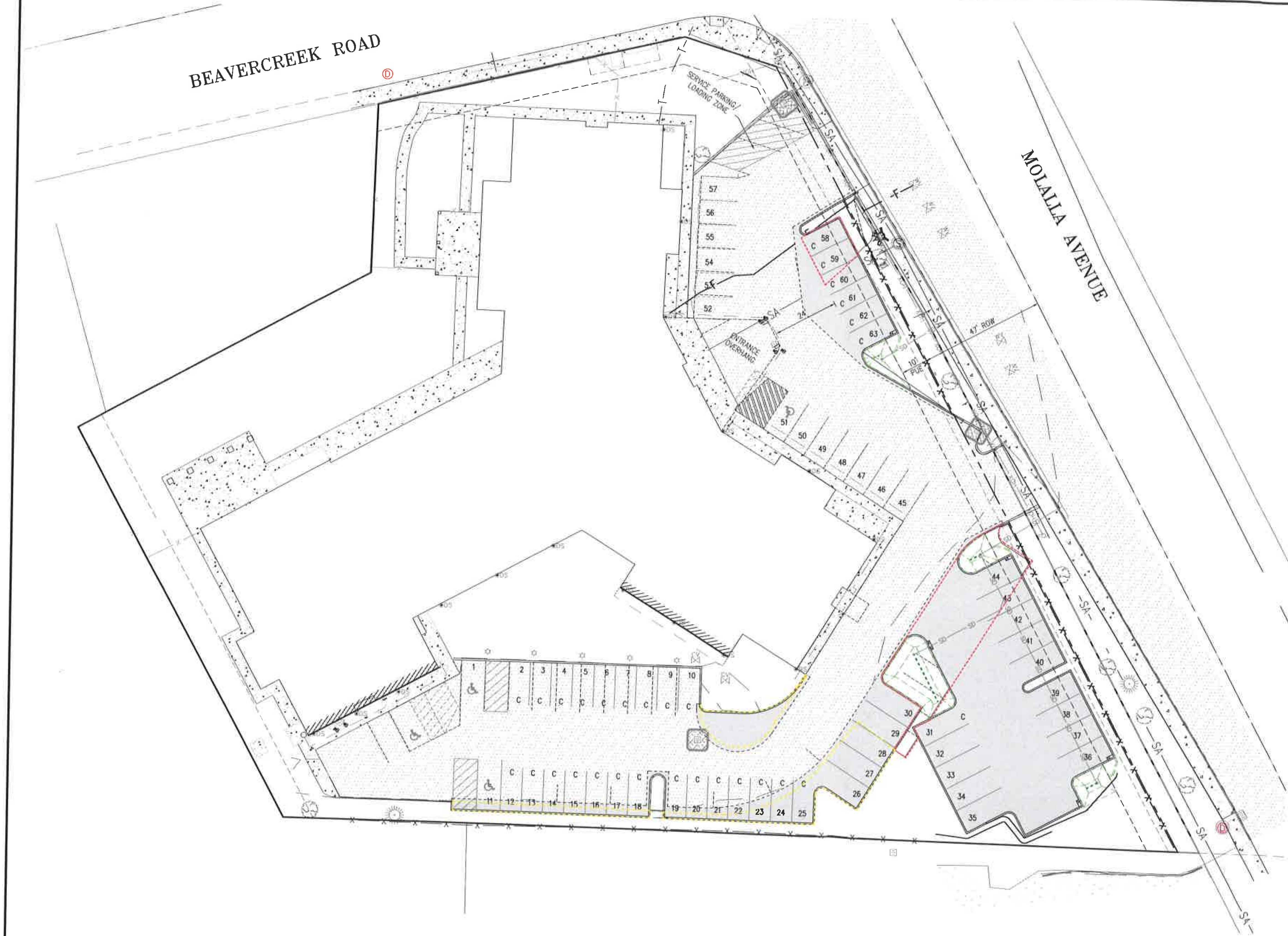
NO.	DATE	DESCRIPTION

EMERIO Design

TEL: (503) 746-8812
FAX: (503) 639-9592
www.emeriodesign.com

SHEET 3 OF 5

FILE: P:\086-020 Marquis Oregon City Parking Lot Expansion\docs\civil\Storm\CAD\086-020_03prgrd, Layout: PROPOSED DRAINAGE BASIN, Plot Date: 1/24/2019 9:08 AM, by: Tenzin Pallyon



N

SCALE: 1" = 20'
11"X17" @ 1" = 40'

LEGEND

— - — - —	BOUNDARY LINE
— — — —	ADJACENT/ADJOINING LOT LINE
— - - —	CENTER LINE ROW
—— XSD ——	EXISTING STORM DRAIN LINE
←	DIRECTION OF SURFACE DRAINAGE
— x — x —	PROPOSED SEDIMENT FENCE
(red dashed box)	PROXY TREATED AREA
(yellow dashed box)	UNTREATED NEW AREA

SURFACE AREAS:

PROXY TREATED AREA:	2,067 S.F.
UNTREATED NEW AREAS:	1,442 S.F.

1680 MOLALLA AVENUE

TAX MAP T3S R2E 05C
TAX LOT 00301
CITY OF OREGON CITY, OREGON

PROXY TREATMENT AREA

REVISIONS

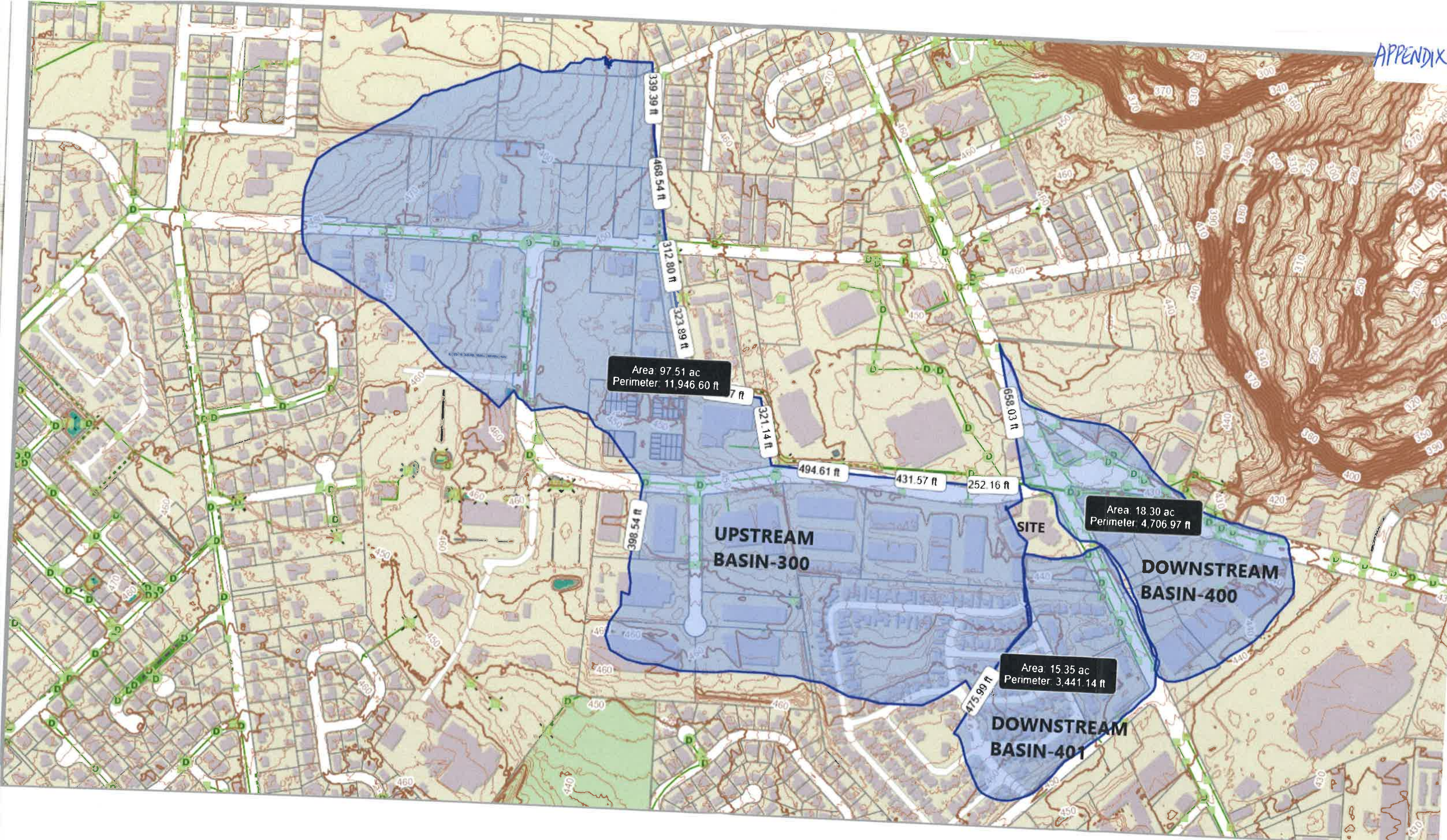
NO.	DATE	DESCRIPTION

EMERIO Design
TEL: (503) 746-8812
FAX: (503) 639-9592
www.emeriodesign.com

SHEET 3 OF 5

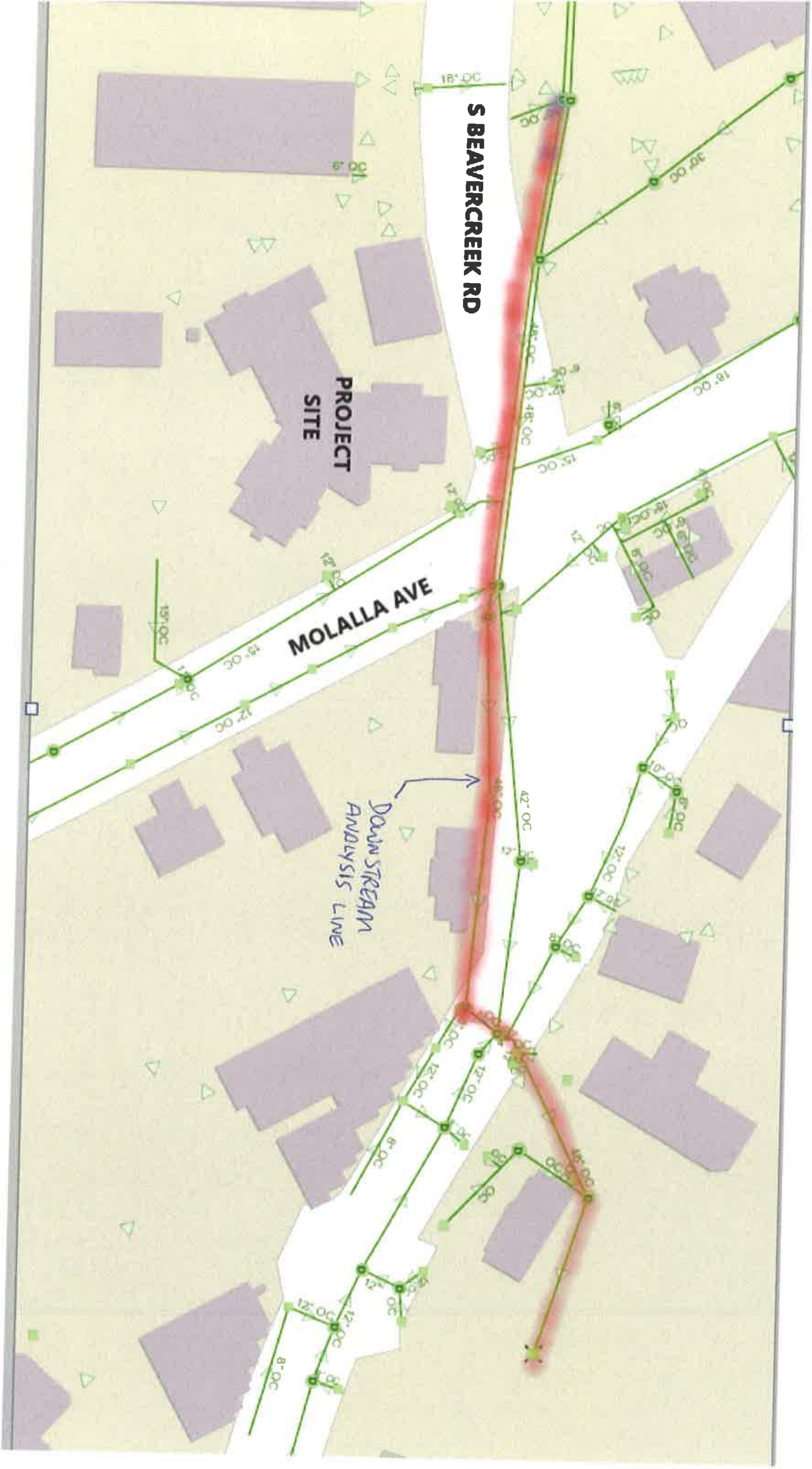
FILE: P:\086-020 Marquis Oregon City Parking Lot Expansion\docs\civ\Storm\CAD\086-020_03pgrd, Layout: PROXY TREATMENT, Plot Date: 1/24/2019 9:08 AM, by: Tenzin Palyon

APPENDIX: D(



Area: 97.51 ac
Perimeter: 11,946.60 ft
UPSTREAM BASIN-300
SITE
Area: 18.30 ac
Perimeter: 4,706.97 ft
DOWNSTREAM BASIN-400
Area: 15.35 ac
Perimeter: 3,441.14 ft
DOWNSTREAM BASIN-401
339.39 ft
468.54 ft
312.80 ft
323.89 ft
321.14 ft
494.61 ft
431.57 ft
252.16 ft
658.03 ft
398.54 ft
475.99 ft

APPENDIX: D(4)


S BEAVERCREEK RD
PROJECT SITE
MOLALLA AVE
DOWNSTREAM ANALYSIS LINE