Exhibit 13

PRELIMINARY HYDROLOGY REPORT

HALL FOURPLEX

124 SE EVERETT STREET
CAMAS, WA 98607
TAX PARCEL NO. 89235000

JANUARY 25, 2021

SUBMITTED TO: CITY OF CAMAS

CASE NO.: PA20-15

REVISION LOG

MARK	DATE	DESCRIPTION
A	1/25/2021	Issued for review.

PREPARED FOR:
CORY VOM BAUR
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PREPARED BY:
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PRELIMINARY HYDROLOGY REPORT

HALL FOURPLEX

THE MATERIAL AND DATA IN THIS REPORT WERE PREPARED
UNDER THE SUPERVISION AND DIRECTION OF THE UNDERSIGNED.

JOLMA DESIGN, LLC

Engineer's Statement of Completeness and Feasibility: *This Technical Information Report includes all information required by the Camas Municipal Code Chapter 14.02—Stormwater Control for the Hall Fourplex project. The facilities, as designed, are feasible to construct and maintain and conform to City Code requirements.*

BYRON JOHN JOLMA
46182

1/25/2021

BYRON JOLMA, PE
PRINCIPAL ENGINEER

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1 VICINITY MAPS

County of Clark, Oregon Metro, Bureau of Land Management, State of Oregon GEO, State of Oregon, Esri, HERE, Garmin, INCREMENT P, NGA, USGS, US Forest Service

JOLMA DESIGN, LLC

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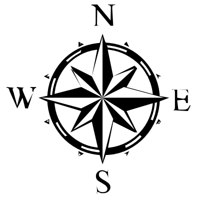
Feet

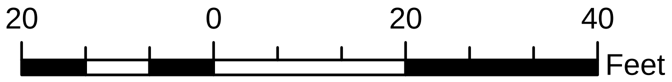
Client: Cory Vom Baur	Project No: 20131
Title: Site Location Map	Date: 1/12/2021
Project: Hall Fourplex	Figure: 1

Text

NOTE:
1. FINAL SUBBASIN AREAS AND TRENCH SIZE/
LOCATIONS TO BE DETERMINED BY OTHERS;
LOW POINTS SHOWN ARE APPROXIMATE AND
SUBJECT TO CHANGE

JOLMA DESIGN, LLC





Client: Cory Vom Baur	Project No: 20131
Title: Site Features & Post-Developed Basin Map	Date: 1/12/2020
Project: Hall Fourplex	Figure: 2

Esri, Community Maps Contributors, County of Clark, WA, Oregon Metro, State of Oregon GEO, WA State Parks GIS, BuildingFootprintUSA, Esri, HERE, Garmin, SafeGraph, INCREMENT P, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, US Census Bureau, USDA, Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

JOLMA DESIGN, LLC

N
W E
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100 0 100 200
Feet

Client: Cory VomBaur
Project No: 20231
Title: Soils & Geohazard Area Map
Date: 1/12/2021
Project: Hall Fourplex
Figure: 3

PROJECT OVERVIEW

2.1 Existing Conditions

The subject site is comprised of approximately 0.21 acres (9,062 sf) located at 124 SE Everett Street in Camas, Washington. The parcel number is 89235000, legally described as the SE ¼ of Section 11, Township 1N, Range 3E, Willamette Meridian. The property is oriented in the northwest/southeast direction, and is rectangular shaped except the southern boundary that parallels the railroad right-of-way. The west boundary abuts SE Everett Street, the north and east lines are bordered by existing residential lots, and the southern line is bounded by the railroad. SE Everett St provides access to the subject site. The property is zoned Mixed Use (MX).

An existing single-family residence and associated driveway and lawn/landscaping are situated on the property. Mature trees surround all sides of the house except toward the north. Site topography is relatively flat throughout most of the property, but drops off sharply to the railroad tracks downgradient of a discrete slope break along the southern lot boundary. There are existing water and sanitary sewer utilities serving the site; stormwater utilities are present within approximately 150 ft of the site (E 1st Ave). There are no known onsite flooding or drainage issues, and little to no runon from adjacent properties.

2.2 Proposed Development

This project proposes to remodel the existing single-family residence into a residential fourplex by constructing a 3-story addition on the north side of the existing two-story building. Appurtenant parking, drive aisle, landscaping, and stormwater improvements are proposed. The project will add 6,563 sf of new impervious surface (982 sf existing roof area + 1,020 sf new roof area + 4,561 sf parking/drive aisle area) and replace 695 sf of existing lawn/landscaping with new landscaping. Because runoff from the existing roof area will be difficult to keep segregated from new-area runoff, the existing roof is included in the stormwater design, and treated as new impervious surface. Additional details can be found in the architectural and civil site, grading, stormwater, and utility plans prepared by others.

2.3 Stormwater Management Overview

This report and associated stormwater management design applies only to those areas where land-disturbing improvements are proposed (Project Site); undisturbed areas not slated for development are excluded from the stormwater analysis.

Stormwater runoff from new roof areas will be fully managed via onsite infiltration trenches (BMP T5.10B). Less than 5,000 sf of new pollution-generating impervious surface is proposed; therefore, runoff generated by areas is exempt from treatment requirements. Infiltration testing was performed by Columbia Geotechnical, Inc. (CGI) at two onsite locations, at a depth of 4 ft below ground surface (see Attachment 1, *Geotechnical Report for Residential Addition, Four-Plex Residential Structure* dated 30 August 2020). This report was used as the basis for the Project Site stormwater design. To allow flexibility with infiltration trench locations and catchment area sizes, a prescriptive design will be used that prescribes a fixed trench width (3 ft) and depth (4 ft), with variable trench lengths determined by applying the relevant design ratio associated with the catchment area and surface type discharging to the trench.

2.4 Infiltration Testing

As referenced above, infiltration testing was performed by CGI to determine onsite coefficients of permeability at two locations using the falling head method. Table 1 provides a summary of test results and the Project Site design infiltration rate.

Table 1: Infiltration Test Results and Design Rates

Test Pit No.	Test Depth (ft below existing ground surface)	Average Calculated Coefficient of Permeability (in/hr)	Coefficient of Permeability with Factor of Safety = 2 Applied (in/hr)
TP-1	4	24.5	12.25
TP-2	4	16.4	8.2
Project Site Stormwater Design Infiltration Rate (in/hr)			**8.2**

2.5 Stormwater Minimum Requirements

The Project Site is subject to evaluation against Minimum Requirement (MR) numbers 1 through 9. Table 2 summarizes the proposed Project Site conditions; Table 3 includes information used to determine applicable stormwater minimum requirements.

Table 2: Post-Developed Project Site Conditions

Surface Type	Area (sf)	Remarks
New roof	1,020	New 3-story addition.
Existing roof	982	Included in stormwater analysis and design.
Driveway and parking	4,561	
Impervious Subtotal	**6,563 sf (0.151 ac)**	
Landscaping/Lawn	695	
Pervious Subtotal	**695 sf (0.016 ac)**	
Project Site Total	**7,258 sf (0.167 ac)**	

Table 3: Project Site Parameters Used to Determine Applicable Minimum Requirements

Description	Value	Remarks
Project Site Area	7,258 sf (0.167 ac)	Includes all areas where land-disturbing activity is proposed.
Existing Impervious Surface Area	0 sf	
Existing Impervious Surface Coverage	0%	
New Impervious Surface Area	6,563 sf (0.151 ac)	
Replaced Impervious Area	0 sf	A portion of the existing gravel driveway will be replaced; however, this area is already included as new impervious.
New + Replaced Impervious Area	6,563 sf (0.151 ac)	
Converted Pervious: Native Vegetation Converted to Lawn or Landscape	695 sf (0.016 ac)	
Converted Pervious: Native Vegetation Converted to Pasture	0 sf	
Pollution-Generating Impervious Surface (PGIS)	4,561 sf	
Non-Pollution Generating Impervious Surface (NPGIS)	2,002 sf	New + existing roof area.
Pollution-Generating Pervious Surface	0	
Total Pollution-Generating Surface Area	4,561 sf	
Total Area Subject to Land-Disturbing Activities	7,258 sf (0.167 ac))	

Exhibit 1 was used to evaluate applicable minimum requirements based on site parameters.

Exhibit 1: Minimum Requirement Flow Chart

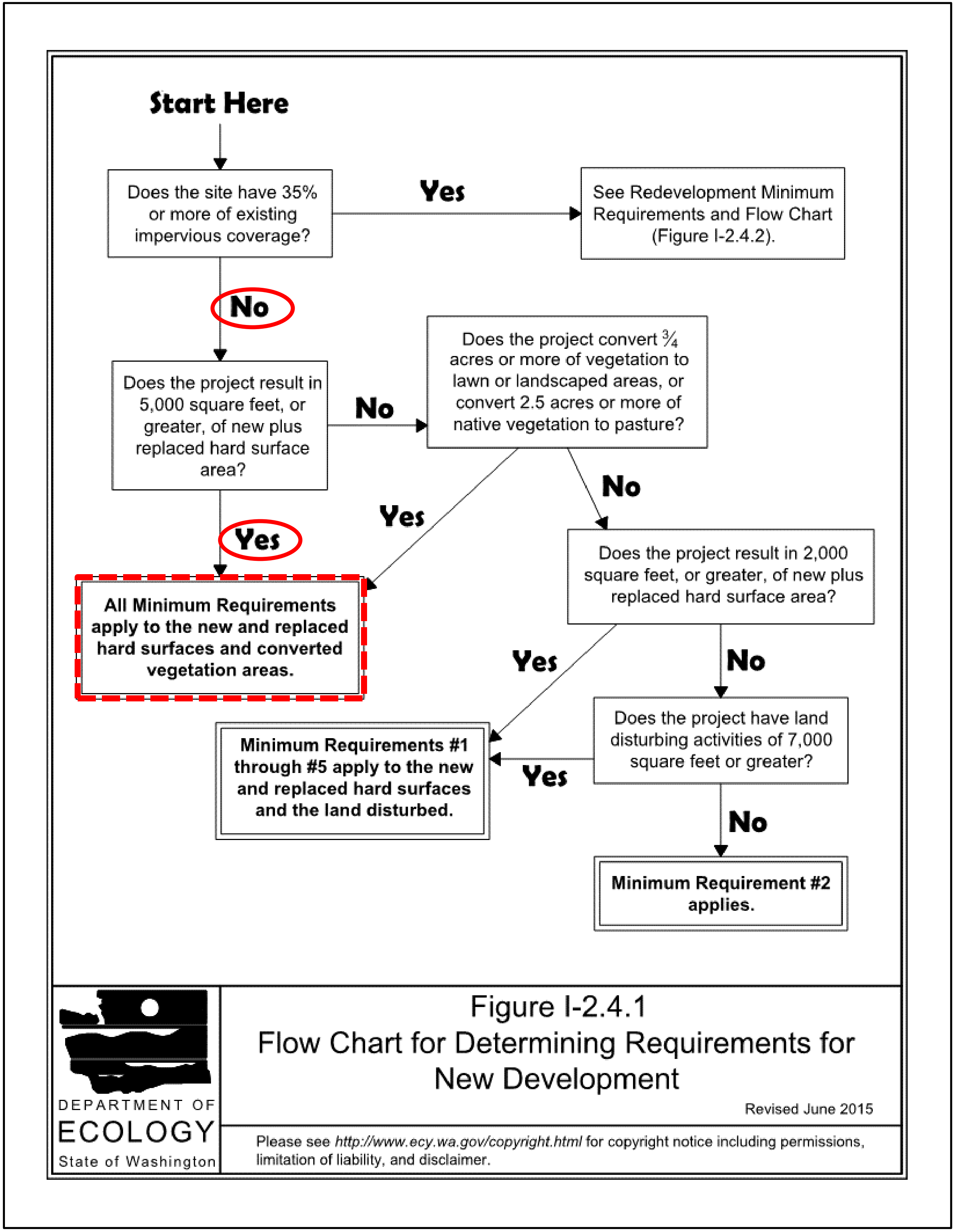

Figure I-2.4.1
Flow Chart for Determining Requirements for New Development

Revised June 2015

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3 STORMWATER MINIMUM REQUIREMENTS

Following is a discussion regarding applicable Minimum Requirements and how each will be addressed.

3.1 MR #1—Preparation of Stormwater Site Plans

The project will add more than 2,000 sf of new impervious surface; therefore, a stormwater site plan following the City guidelines for "Large and Engineered Projects" is required. This Technical Information Report (TIR) along with pertinent drawings, exhibits, and technical documents associated with this project collectively comprise the Stormwater Site Plan.

3.2 MR #2—Construction Stormwater Pollution Prevention

A Construction Stormwater Pollution Prevention Plan (SWPPP) is required and will be submitted as part of the final engineering review application.

3.3 MR #3—Source Control of Pollution

New development shall comply with the requirements of Volume IV of the Stormwater management Manual for Western Washington (SMMWW). The source control Best Management Practices (BMPs) that may apply to this project are outlined below:

- BMPs for Residential Properties
- S407—BMPs for Dust Control at Disturbed Land Areas and Unpaved Roadways and Parking Lots
- S411—BMPs for Landscaping and Lawn/Vegetation Maintenance
- S417—BMPs for Maintenance of Stormwater Drainage and Treatment Facilities

Additional BMPs may be required depending on the specific activities taking place on site.

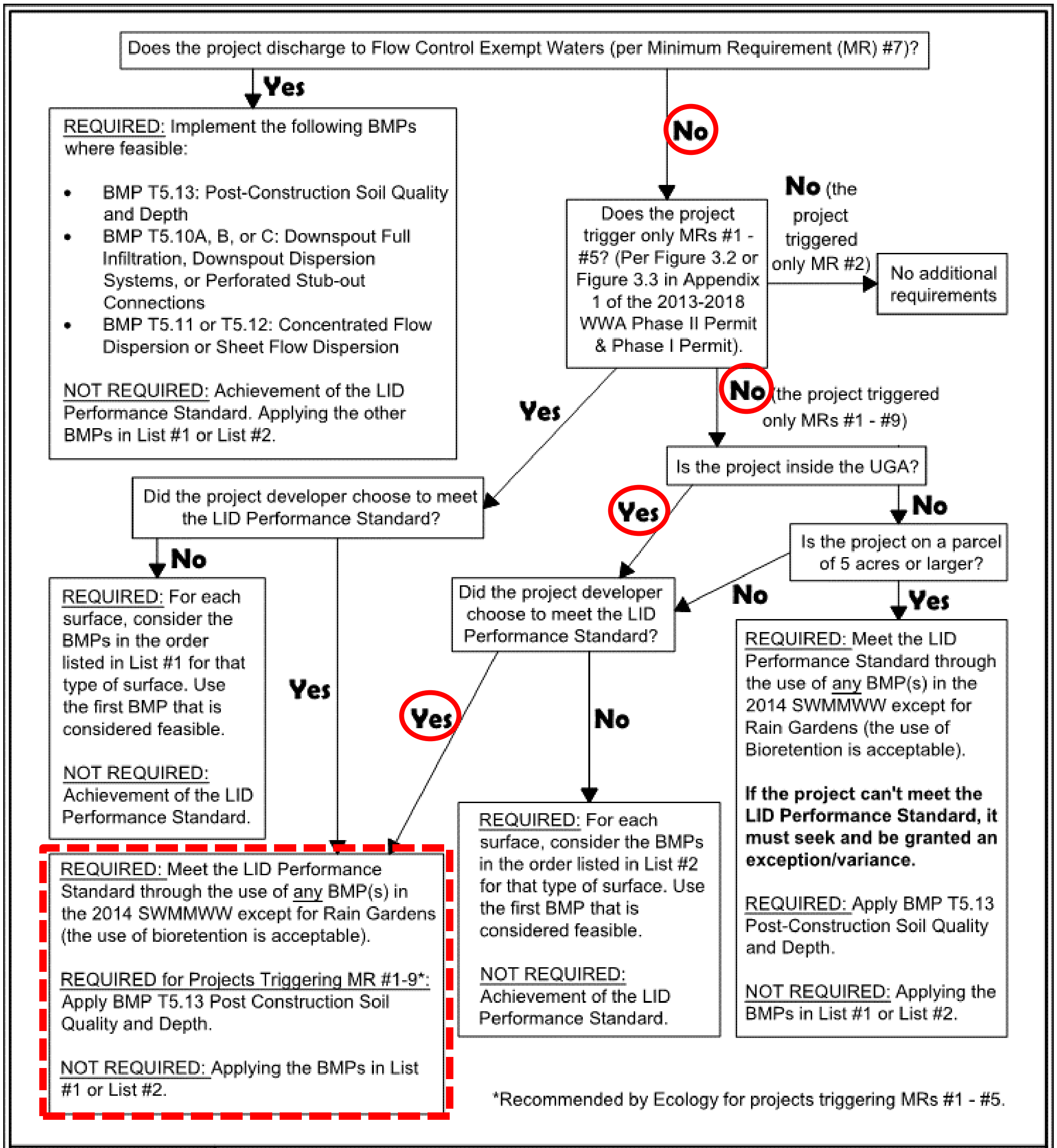
3.4 MR #4—Preservation of Natural Drainage System and Outfalls

Project Site stormwater will be managed using infiltration trenches. Runoff generated during most storm events will be infiltrated on site. Runoff from the Project Site generated during larger storm events will discharge to SE Everett Street. There are no discrete outfalls or discharge points, as the site is relatively flat; however, predeveloped drainage patterns will be maintained to the extent practicable. Non-infiltrated post-developed Project Site runoff will discharge to SE Everett Street, and will not cause adverse impacts to downstream receiving waters or downgradient properties.

3.5 MR #5—Onsite Stormwater Management BMPs

Because the project will add more than 2,000 sf of new impervious surface, it is subject to MR #5, which requires the use of onsite stormwater management BMPs. The proposed onsite BMPs include Downspout Full Infiltration Systems (BMP T5.10A) and Post-Construction Soil Quality & Depth (BMP T5.13). The developer is electing to meet the LID Performance Standard and BMP T5.13 (see Exhibit 2).

Exhibit 2: Flow Chart for Determining LID #5 Requirements



Does the project discharge to Flow Control Exempt Waters (per Minimum Requirement (MR) #7)?

REQUIRED: Implement the following BMPs where feasible:

- BMP T5.13: Post-Construction Soil Quality and Depth
- BMP T5.10A, B, or C: Downspout Full Infiltration, Downspout Dispersion Systems, or Perforated Stub-out Connections
- BMP T5.11 or T5.12: Concentrated Flow Dispersion or Sheet Flow Dispersion

NOT REQUIRED: Achievement of the LID Performance Standard. Applying the other BMPs in List #1 or List #2.

Does the project trigger only MRs #1 - #5? (Per Figure 3.2 or Figure 3.3 in Appendix 1 of the 2013-2018 WWA Phase II Permit & Phase I Permit).

No additional requirements

Is the project inside the UGA?

Is the project on a parcel of 5 acres or larger?

Did the project developer choose to meet the LID Performance Standard?

Did the project developer choose to meet the LID Performance Standard?

REQUIRED: For each surface, consider the BMPs in the order listed in List #1 for that type of surface. Use the first BMP that is considered feasible.

NOT REQUIRED: Achievement of the LID Performance Standard.

REQUIRED: Meet the LID Performance Standard through the use of any BMP(s) in the 2014 SWMMWW except for Rain Gardens (the use of bioretention is acceptable).

REQUIRED for Projects Triggering MR #1-9*: Apply BMP T5.13 Post Construction Soil Quality and Depth.

NOT REQUIRED: Applying the BMPs in List #1 or List #2.

REQUIRED: For each surface, consider the BMPs in the order listed in List #2 for that type of surface. Use the first BMP that is considered feasible.

NOT REQUIRED: Achievement of the LID Performance Standard.

REQUIRED: Meet the LID Performance Standard through the use of any BMP(s) in the 2014 SWMMWW except for Rain Gardens (the use of Bioretention is acceptable).

If the project can't meet the LID Performance Standard, it must seek and be granted an exception/variance.

REQUIRED: Apply BMP T5.13 Post-Construction Soil Quality and Depth.

NOT REQUIRED: Applying the BMPs in List #1 or List #2.

*Recommended by Ecology for projects triggering MRs #1 - #5.

DEPARTMENT OF
ECOLOGY
State of Washington

Figure I-2.5.1
Flow Chart for Determining LID MR #5 Requirements

Revised June 2015

3.6 MR #6—Runoff Treatment

The project will add less than 5,000 sf of new pollution-generating hard surface area within a threshold discharge area and therefore is not subject to MR #6.

3.7 MR #7—Flow Control

The project is not subject to the flow control requirements because it does not meet the thresholds triggering MR #7. Following are the threshold against which a project is assessed to determine whether MR #7 is applicable, and the project values associated with each threshold.

3.7.1 Threshold 1: Effective Impervious Surface Area

Projects in which the total of effective impervious surfaces is 10,000 square feet or more in a threshold discharge area are not subject to the flow control requirements. Effective impervious surfaces are those connected via sheet flow or discrete conveyance to a drainage system. Residential roofs are considered ineffective if infiltrated in accordance with BMP T5.10A (Downspout Full Infiltration); roof runoff will be fully infiltrated on this project. The total Project Site effective impervious surface area is 5,256 sf and therefore does not meet this threshold.

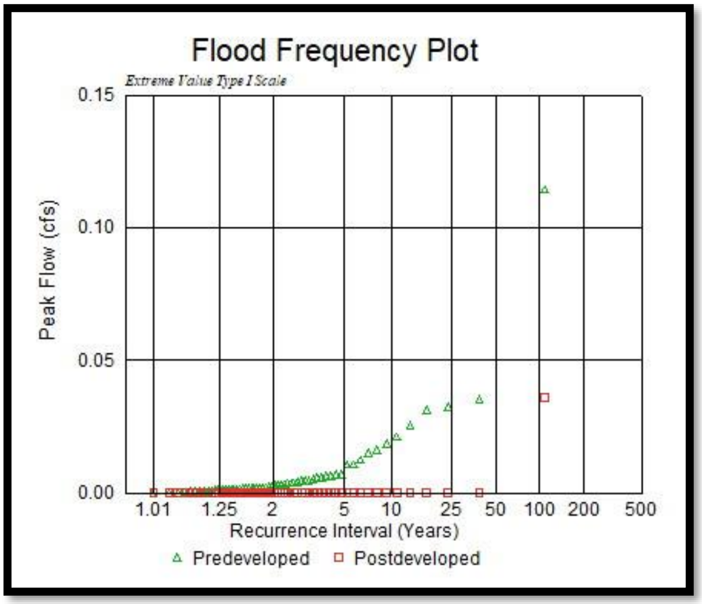
3.7.2 Threshold 2: Pervious Surface Area

Projects that convert ¾ acres or more of vegetation to lawn or landscape, or convert 2.5 acres or more of native vegetation to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site are subject to the flow control requirements. The project proposes to convert 695 sf (0.016 ac) of vegetation to lawn/landscaping and therefore does not meet Threshold 2.

3.7.3 Threshold 3: 100-YR Flow Frequency

Projects that through a combination of effective hard surfaces and converted vegetation areas cause a 0.10 cubic feet per second increase in the 100-year flow frequency from a threshold discharge area as estimated using the Western Washington Hydrology Model or other approved model and one-hour time steps (or a 0.15 cfs increase using 15-minute time steps) must meet MR #7. As illustrated in Exhibit 3 extracted from the Project Site hydrologic model, the 100-yr flow frequency decreases from the pre- to postdeveloped scenario.

Exhibit 3: 100-yr Flow Frequency Plot



3.8 MR #8—Wetlands Protection

The project does not propose any discharge of stormwater directly or indirectly into a wetland; therefore, MR #8 does not apply.

3.9 MR #9—Operation and Maintenance

All stormwater systems will be privately owned, operated, and maintained. Final Operation and Maintenance guidelines will be submitted as part of the final engineering application.

4 MGSFLOOD METHODOLOGY

The Washington State Department of Ecology (DOE) requires flow control BMPs be designed using a calibrated continuous simulation hydrologic model based on the Environmental Protection Agency's HSPF (Hydrologic Simulation Program-Fortran) program. DOE has approved three continuous runoff models: Western Washington Hydrology Model (WWHM); KCRTS (King County Runoff Time Series); and MGSFlood, a program used by the Washington State Department of Transportation. JD elected to use MGSFlood because of its faster processing time, particularly with complex hydrologic models. The purpose of this section is to provide an overview of the methodology used to develop the Project Site MGSFlood hydrologic model.

4.1 General Information

The site is at 124 SE Everett Street in Battle Ground, Washington. MGSFlood uses a scaling factor to account for the subject site's location relative to the rain gage used to generate precipitation data. For this project, the Portland airport precipitation station was used, equating to a 25-yr, 24-hr precipitation scale factor of 1.370 for the Clark Co.—Troutdale climate region. The HSPF runoff parameters specific to Clark County were used. The Project Site is within one threshold discharge area (TDA-1) with one assumed point of compliance (POC-1).

4.2 Scenarios

4.2.1 Predeveloped

The predeveloped Project Site scenario was modeled as a single 0.0459-acre flat, forested subbasin (PD-1) with Soil Group (SG) 4 soils. The Clark County GIS and USDA Web Soil Survey both map the Project Site soils as Fill land (Fn). Based on CGI's report and the moderate permeability of the underlying soils, JD elected to designate the soils as SG 2, which in our professional opinion more accurately reflects onsite conditions.

4.2.2 Postdeveloped

The postdeveloped scenario is comprised of three subbasins representing non-pollution generating impervious surface (NPGIS), pollution-generation impervious surface (PGIS), and non-pollution-generating pervious surface (NPGPS) areas. NPGIS areas include the new and existing roof; PGIS areas are comprised of the parking and drive aisle surfaces; and lawn/landscaping areas form the NPGPS subbasin. To allow for design flexibility with respect to finished grading and stormwater facility locations, a trench length design ratio was determined by dividing the trench length by the surface area draining to it. Table 4 below outlines the trench dimensions for each subbasin and the associated design ratio. IT-01 is sized to manage roof runoff generated during the full precipitation time series.

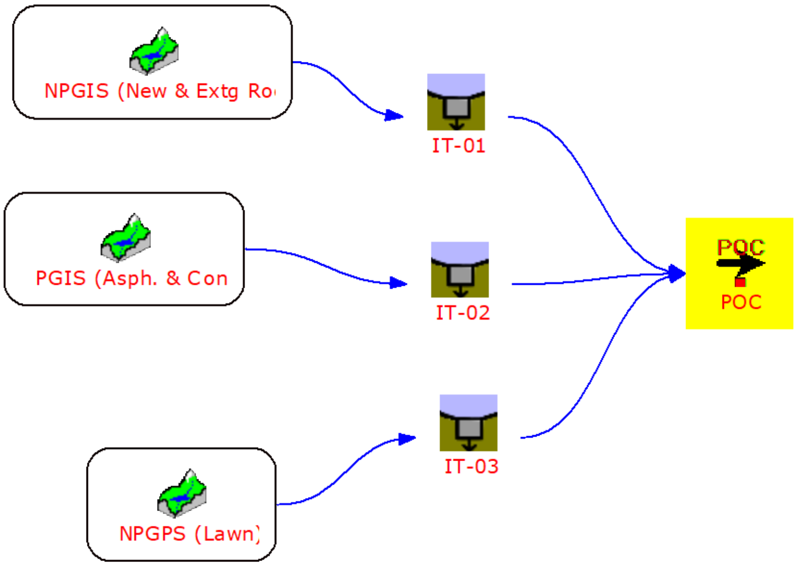
Table 4: MGSFlood Infiltration Trench Design Calculations

Infiltration Trench Identifier	Subbasin Surface Description	Subbasin Surface Classification	Subbasin Area (sf)	Trench Length (Fixed Width = 3 ft; Fixed Depth = 4 ft)	Trench Length Design Ratio (Length/Area)
IT-01	New & existing roof	NPGIS	2,002	18 ft	0.008991[1]
IT-02	Parking & drive aisle	PGIS	4,561	20	0.004385
IT-03	Lawn	NPGPS	695	1	0.001439

[1] To determine the required trench length, multiply the subbasin area draining to the trench by the design ratio. Weighted ratios may be used if multiple surface classifications are draining to a single trench.

Appendix A contains detailed MGSFlood hydrologic model output including design parameters and analysis results. Exhibit 4 illustrates the postdeveloped schematic elements used in the model.

Exhibit 4: Postdeveloped MGSFlood Schematic

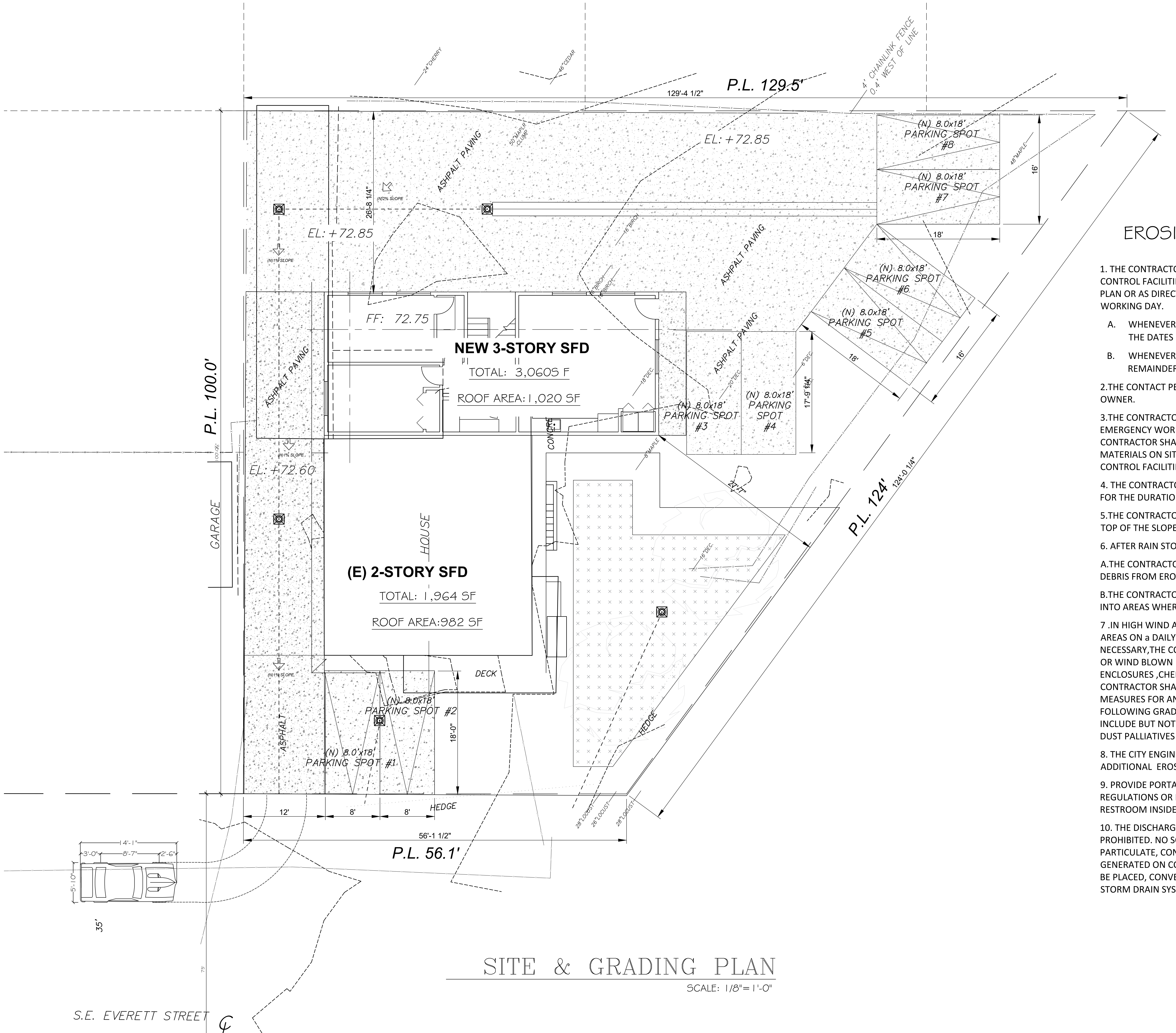


Appendix A

DRAWING

SITE & GRADING PLAN

PROJECT NAME: ALTERATION LEVEL3-NEW 3-STORY SFD E
PROJECT ADDRESS: 124 SE EVERETT ST, CAMAS, WA 98607

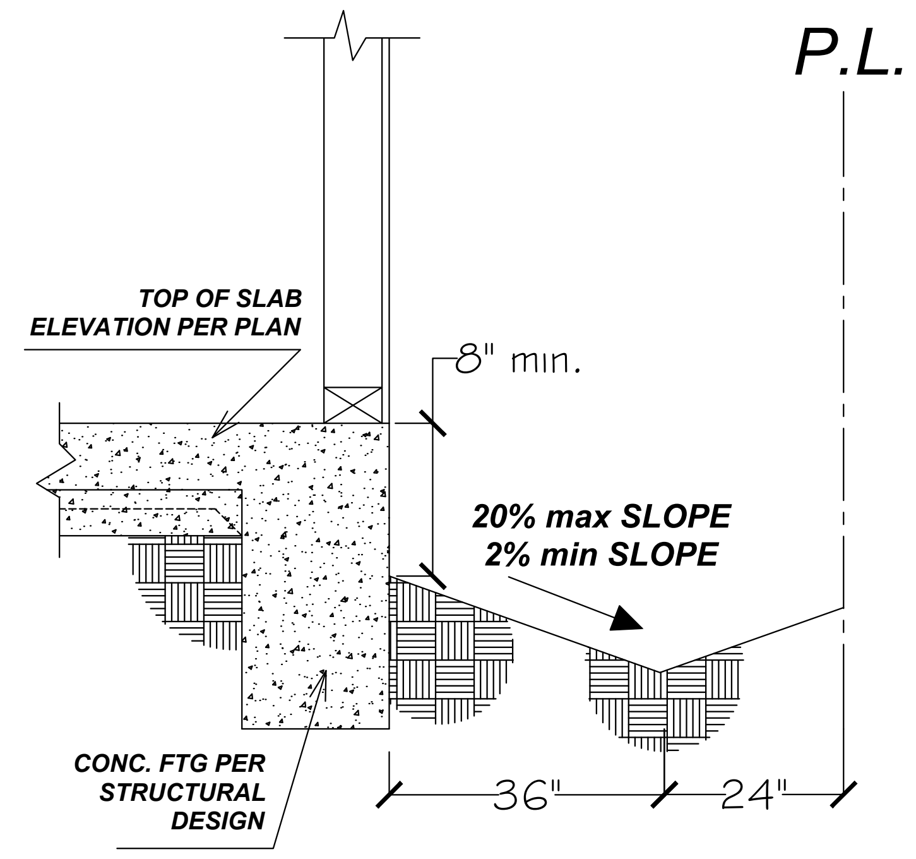


SITE & GRADING PLAN

SCALE: 1/8"= 1'-0"

DRAINAGE NOTES

1. REPLACE EXISTING DRAINAGE TOWARD RETAINING WALL.
2. PROVIDE NEW MIN. SLOPE 2%.



EROSION CONTROL NOTES

1. THE CONTRACTOR SHALL BE RESPONSIBLE TO INSTALL ALL EROSION CONTROL FACILITIES AS SHOWN ON THE APPROVED EROSION CONTROL PLAN OR AS DIRECTED BY THE CITY ENGINEER AT THE END OF EACH WORKING DAY.

A. WHENEVER THE 5-DAY RAIN PROBABILITY EXCEEDS 40% BETWEEN THE DATES OF OCTOBER 15 AND APRIL (RAIN SEASON).

B. WHENEVER THE DAILY RAIN PROBABILITY EXCEEDS 50% THE REMAINDER OF THE YEAR AND APRIL 15 (RAINY SEASON).

2.THE CONTACT PERSON RESPONSIBLE FOR EROSION CONTROL IS THE OWNER.

3.THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AN EMERGENCY WORK CREW AT ALL TIMES DURING THE RAINY SEASON THE CONTRACTOR SHALL STOCKPILE THE NECESSARY EROSION CONTROL MATERIALS ON SITE TO FACILITATE RAPID INSTALLATION OF EROSION CONTROL FACILITIES.

4. THE CONTRACTOR SHALL CONSTRICT DESILTING FACILITIES AS NECESSARY FOR THE DURATION OF THE PROJECT.

5.THE CONTRACTOR SHALL TAKE MEASURE TO PREVENT RUNOFF OVER THE TOP OF THE SLOPES.

6. AFTER RAIN STORM:

A.THE CONTRACTOR SHALL REMOVE ALL SILT,STANDING WATER ,AND DEBRIS FROM EROSION CONTROL FACILITIES.

B.THE CONTRACTOR SHALL BE RESPONSIBLE TO PREVENT PUBLIC ACCESS INTO AREAS WHERE STANDING WATER POSES A POTENTIAL HAZARD.

7 .IN HIGH WIND AREAS THE CONTRACTOR SHALL WATER SPRAY GRADED AREAS ON a DAILY BASIS TO CONTROL DUST OR WINDY PERIODS,WHEN NECESSARY,THE CONTRACTOR SHALL TAKE MEASURES TO CONTROL DUST OR WIND BLOWN DEBRIS BY INSTALLING DEBRIS FENCES,ADDITIONAL TRASH ENCLOSURES ,CHEMICAL LAND TREATMENT ,GEOMATS ,ETC.THE CONTRACTOR SHALL IMPLEMENT LONG TERM WIND EROSION CONTROL MEASURES FOR ANY AREA THAT IS NOT IMPROVED IN A MANNER FOLLOWING GRADING LONG TERM WIND EROSION CONTROL MEASURES INCLUDE BUT NOT LIMITED TO:PERIMETER WALLS ,WIND BARRIERS ,SOIL DUST PALLIATIVES ,SOIL MATS , HYDROSEEDING AND IRRIGATION SYSTEM .

8. THE CITY ENGINEER RESERVES THE RIGHT TO REQUIRE ALTERNATIVE OR ADDITIONAL EROSION CONTROL FACILITIES AS HE DEEMS NECESSARY.

9. PROVIDE PORTABLE TOILET AND HAND WASH STATION PER OSHA REGULATIONS OR PROVIDE ACCESS FOR CONSTRUCTION WORKERS TO RESTROOM INSIDE THE HOUSE.

10. THE DISCHARGE OF POLLUTANTS TO ANY STORM DRAINAGE IS PROHIBITED. NO SOLID WASTE, PETROLEUM BYPRODUCTS, SOIL PARTICULATE, CONSTRUCTION WASTE MATERIALS, OR WASTEWATER GENERATED ON CONSTRUCTION SITE OR CONSTRUCTION ACTIVITIES SHELL BE PLACED, CONVEYED OR DISCHARGED INTO THE STREET, GUTTER OR STORM DRAIN SYSTEM.

GRADING NOTES

1.EXCAVATION BELOW EXISTING FINISH GRADE ARE FOR FOOTING FOR THE CONSTRUCTION OF A BUILDING ONLY AND WILL BE AUTHORIZED BY A BUILDING PERMIT.

2.ANY CUT OR FILL SHALL NOT EXCEED 50 CUBIC YARDS OF MATERIAL NOR EXCEED ONE FOOT IN DEPTH OR HEIGHT.

3. IF MORE THAN 50 CUBIC YARDS OF CUT AND FILL IS BEING MOVED ON THE PROJECT SITE A GRADING PERMIT SHALL BE REQUIRED FROM THE PUBLIC WORKS DEPARTMENT.

4. IF CUT/FILL IS LESS THAN 50 CUBIC YARDS: EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES SHALL BE IMPLEMENTED AND MAINTAINED TO MINIMIZE AND/OR PREVENT THE TRANSPORT OF SOIL FROM THE CONSTRUCTION SITE. APPROPRIATE BMPS FOR CONSTRUCTION RELATED MATERIALS, WASTES, SPILLS, OR RESIDUES SHALL BE IMPLEMENTED TO ELIMINATE OR REDUCE TRANSPORT FROM THE SITE TO THE STREETS, DRAINAGE FACILITIES, OR ADJOINING PROPERTIES BY WIND OR RUNOFF.

5. LOTS SHALL BE GRADED TO DRAIN SURFACE WATER AWAY FROM THE FOUNDATION WALLS. THE GRADE SHOULD FALL A MIN. OF 6" WITHIN THE FIRST 10 FT (5%). WHERE LOT LINES, WALLS, SLOPES OR OTHER PHYSICAL BARRIER PROHIBIT 6" OF FALL WITHIN 10 FT, DRAINS OR SWALES SHALL BE CONSTRUCTED TO ENSURE DRAINAGE AWAY FROM THE STRUCTURE (CRC R401.3).

6. IMPERVIOUS SURFACES WITHIN 10 FT OF THE BUILDING FOUNDATION SHALL BE SLOPED A MIN. OF 2% AWAY FROM THE BUILDING (CRC R401.3 EXCEPTION).

7. WE, THE DESIGNER,ENGINEER, CONTRACTOR AND PROPERTY OWNER(S) OF A PROJECT HEREIN THE ATTACHED SET OF DRAWINGS, UNDERSTAND THAT SAID INFORMATION WILL BE A BASIS FOR SUBSEQUENT CITY ACTION ON THE PROJECT PROPOSED AND DESCRIBED HEREON.

PROJECT INFORMATION

PROJECT:	NEW HOUSE ADDITION AND GRADING
PROJECT LOCATION:	124 SE EVERETT ST, CAMAS WA
PIN #:	89-235-000
COUNTY:	CLARK COUNTY
LEGAL DESCRIPTION:	
OWNER:	VOM BAUR CORY J & VOM BAUR KENDALE E
DESIGNER & CIVIL ENGINEER:	EUI S KIM, PE ekim1234@gmail.com

E KIM ENG.& DESIGN
CIVIL & STRUCTURE DESIGN

37325 8th Ave S
FEDERAL WAY, WA 98003
PHONE: (818) 321-4243

REVISIONS

PROJECT TITLE :
MULTI FAMILY RESIDNECE
Mr. Cory Vom Baur

124 SE EVERETT ST
CAMAS, WA 98607

SCALE : AS INDICATED
DATE : OCTOBER 25, 2020
JOB NO : 230-20

Eui S Kim
53437

SHEET NO.
C-01

Appendix B

STORMWATER CALCULATIONS

B1—MGSFLOOD HYDROLOGIC MODELING REPORT

MGS FLOOD
PROJECT REPORT

Program Version: MGSFlood 4.52
Program License Number: 202010005
Project Simulation Performed on: 01/21/2021 4:14 PM
Report Generation Date: 01/25/2021 9:58 AM

Input File Name:	20131_HallFourPlex_HydrologicModel_ProjectSite.fld
Project Name:	Hall Fourplex
Analysis Title:	Hydrologic Model
Comments:	

PRECIPITATION INPUT

Computational Time Step (Minutes): 15

Precipitation Station Data Selected
Climatic Region Number: 41

Full Period of Record Available used for Routing
Precipitation Station : 610012 Troutdale 10/01/1948-10/01/2008
Evaporation Station : 610000 Clark Co. N. Willamette
Precipitation Scale Factor : 1.370
Evaporation Scale Factor : 0.750

HSPF Parameter Region Number: 2
HSPF Parameter Region Name : Clark County

********** Default HSPF Parameters Used (Not Modified by User) ***************

********************** WATERSHED DEFINITION ***********************

Predevelopment/Post Development Tributary Area Summary

	Predeveloped	Post Developed
Total Subbasin Area (acres)	0.167	0.167
Area of Links that Include Precip/Evap (acres)	0.000	0.000
Total (acres)	0.167	0.167

---------------------SCENARIO: PREDEVELOPED

Number of Subbasins: 1

---------- Subbasin : PD-01 ----------

	-------Area (Acres) --------
Clark Co. SG2, Forest	0.167
Subbasin Total	0.167

```
--------------------SCENARIO: POSTDEVELOPED
Number of Subbasins:   3


  ---------- Subbasin : PGIS (Asph. & Conc.) ----------
                          -------Area (Acres) --------
Impervious Flat   0.105
----------------------------------------------
Subbasin Total             0.105


  ---------- Subbasin : NPGPS (Lawn) ----------
                          -------Area (Acres) --------
Clark Co. SG2, Lawn,      0.016
----------------------------------------------
Subbasin Total             0.016


  ---------- Subbasin : NPGIS (New & Extg Roof) ----------
                          -------Area (Acres) --------
Impervious Flat   0.046
----------------------------------------------
Subbasin Total             0.046



************************* LINK DATA *******************************

--------------------SCENARIO: PREDEVELOPED
Number of Links:   0


************************* LINK DATA *******************************

--------------------SCENARIO: POSTDEVELOPED
Number of Links:   4


----------------------------------------
Link Name: IT-02
Link Type:   Infiltration Trench
Downstream Link Name: POC

Trench Type                     : Trench at Toe of Embankment
Trench Length (ft)              :     20.00
Trench Width   (ft)             :     3.00
Trench Depth   (ft)             :     4.00
Trench Bottom Elev (ft)         :     0.00
Trench Rockfill Porosity (%)    :     40.00

Constant Infiltration Option Used
Infiltration Rate (in/hr):   8.20


----------------------------------------
```

Link Name: IT-03
Link Type: Infiltration Trench
Downstream Link Name: POC

Trench Type : Trench at Toe of Embankment
Trench Length (ft) : 1.00
Trench Width (ft) : 3.00
Trench Depth (ft) : 4.00
Trench Bottom Elev (ft) : 0.00
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 8.20

--

Link Name: POC
Link Type: Copy
Downstream Link: None

--

Link Name: IT-01
Link Type: Infiltration Trench
Downstream Link Name: POC

Trench Type : Trench at Toe of Embankment
Trench Length (ft) : 18.00
Trench Width (ft) : 3.00
Trench Depth (ft) : 4.00
Trench Bottom Elev (ft) : 0.00
Trench Rockfill Porosity (%) : 40.00

Constant Infiltration Option Used
Infiltration Rate (in/hr): 8.20

************************FLOOD FREQUENCY AND DURATION STATISTICS**********************

---------------------SCENARIO: PREDEVELOPED
Number of Subbasins: 1
Number of Links: 0

---------------------SCENARIO: POSTDEVELOPED
Number of Subbasins: 3
Number of Links: 4

************ Subbasin: PGIS (Asph. & Conc.) ************

Flood Frequency Data(cfs)
(Recurrence Interval Computed Using Gringorten Plotting Position)

Tr (yrs)	Flood Peak (cfs)
2-Year	5.922E-02
5-Year	7.449E-02

```
    10-Year      9.192E-02
    25-Year      0.118
    50-Year      0.160
    100-Year     0.187
    200-Year     **
    500-Year     **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

************ Subbasin: NPGPS (Lawn) ************

```
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)         Flood Peak (cfs)
========================================
    2-Year       2.982E-03
    5-Year       4.667E-03
    10-Year      5.753E-03
    25-Year      6.631E-03
    50-Year      1.074E-02
    100-Year     1.629E-02
    200-Year     **
    500-Year     **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

************ Subbasin: NPGIS (New & Extg Roof) ************

```
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)         Flood Peak (cfs)
========================================
    2-Year       2.602E-02
    5-Year       3.273E-02
    10-Year      4.038E-02
    25-Year      5.200E-02
    50-Year      7.037E-02
    100-Year     8.202E-02
    200-Year     **
    500-Year     **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

```
********** Link: IT-02 **********      Link Inflow Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)         Flood Peak (cfs)
========================================
    2-Year       5.922E-02
    5-Year       7.449E-02
    10-Year      9.192E-02
    25-Year      0.118
    50-Year      0.160
    100-Year     0.187
    200-Year     **
```

```
    500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



********** Link: IT-02 **********      Link Outflow 1 Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)           Flood Peak (cfs)
=======================================
    2-Year         1.665E-05
    5-Year         1.615E-02
    10-Year        3.941E-02
    25-Year        6.410E-02
    50-Year        8.101E-02
    100-Year       0.105
    200-Year       **
    500-Year       **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



********** Link: IT-03 **********      Link Inflow Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)           Flood Peak (cfs)
=======================================
    2-Year         2.982E-03
    5-Year         4.667E-03
    10-Year        5.753E-03
    25-Year        6.631E-03
    50-Year        1.074E-02
    100-Year       1.629E-02
    200-Year       **
    500-Year       **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals



********** Link: IT-03 **********      Link Outflow 1 Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)           Flood Peak (cfs)
=======================================
    2-Year         1.510E-05
    5-Year         2.083E-03
    10-Year        3.644E-03
    25-Year        4.542E-03
    50-Year        8.649E-03
    100-Year       1.420E-02
    200-Year       **
    500-Year       **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

```
********** Link: POC                                                    **********      Link Inflow
Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          Flood Peak (cfs)
=======================================
   2-Year        3.505E-05
   5-Year        1.616E-02
   10-Year       4.409E-02
   25-Year       6.412E-02
   50-Year       8.463E-02
   100-Year      0.119
   200-Year      **
   500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

```
********** Link: IT-01 **********      Link Inflow Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          Flood Peak (cfs)
=======================================
   2-Year        2.602E-02
   5-Year        3.273E-02
   10-Year       4.038E-02
   25-Year       5.200E-02
   50-Year       7.037E-02
   100-Year      8.202E-02
   200-Year      **
   500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

```
********** Link: IT-01 **********      Link Outflow 1 Frequency Stats
 Flood Frequency Data(cfs)
 (Recurrence Interval Computed Using Gringorten Plotting Position)
Tr (yrs)          Flood Peak (cfs)
=======================================
   2-Year        4.828E-06
   5-Year        7.906E-06
   10-Year       9.461E-06
   25-Year       1.302E-05
   50-Year       1.734E-05
   100-Year      1.968E-05
   200-Year      **
   500-Year      **
** Record too Short to Compute Peak Discharge for These Recurrence Intervals
```

**************Groundwater Recharge Summary** *************

Recharge is computed as input to Perlnd Groundwater Plus Infiltration in Structures

Total Predeveloped Recharge During Simulation

```
Model Element                                Recharge Amount (ac-ft)
-------------------------------------------------------------------------------------------
Subbasin: PD-01                   15.711
________________________________________________
Total:                                      15.711

               Total Post Developed Recharge During Simulation
Model Element                                Recharge Amount (ac-ft)
-------------------------------------------------------------------------------------------
Subbasin: PGIS (Asph. & Conc.)          0.000
Subbasin: NPGPS (Lawn)                  1.625
Subbasin: NPGIS (New & Extg Ro          0.000
Link:      IT-02                  22.117
Link:      IT-03                  0.652
Link:      POC                    0.000
Link:      IT-01                  9.740
________________________________________________
Total:                                               34.135

Total Predevelopment Recharge is Less than Post Developed
Average Recharge Per Year, (Number of Years= 60)
Predeveloped:     0.262 ac-ft/year,    Post Developed:     0.569 ac-ft/year

 ***********Water Quality Facility Data *************

---------------------SCENARIO: PREDEVELOPED

Number of Links:   0


----------------------SCENARIO: POSTDEVELOPED

Number of Links:   4


********** Link: IT-02 **********

 Infiltration/Filtration Statistics--------------------
 Inflow Volume (ac-ft):   22.17
 Inflow Volume Including PPT-Evap (ac-ft):   22.17
 Total Runoff Infiltrated (ac-ft):   22.12,   99.76%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Primary Outflow To Downstream System (ac-ft):   0.03
 Secondary Outflow To Downstream System (ac-ft):   0.00
 Percent Treated (Infiltrated+Filtered)/Total Volume: 99.76%

********** Link: IT-03 **********

 Infiltration/Filtration Statistics--------------------
 Inflow Volume (ac-ft):   0.65
 Inflow Volume Including PPT-Evap (ac-ft):   0.65
 Total Runoff Infiltrated (ac-ft):   0.65,   100.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Primary Outflow To Downstream System (ac-ft):   0.01
 Secondary Outflow To Downstream System (ac-ft):   0.00
 Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%
```

```
********** Link: POC                                                                  **********

 Infiltration/Filtration Statistics--------------------
 Inflow Volume (ac-ft):   0.03
 Inflow Volume Including PPT-Evap (ac-ft):   0.03
 Total Runoff Infiltrated (ac-ft):   0.00,   0.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Primary Outflow To Downstream System (ac-ft):   0.03
 Secondary Outflow To Downstream System (ac-ft):   0.00
 Percent Treated (Infiltrated+Filtered)/Total Volume: 0.00%

********** Link: IT-01 **********

 Infiltration/Filtration Statistics--------------------
 Inflow Volume (ac-ft):   9.74
 Inflow Volume Including PPT-Evap (ac-ft):   9.74
 Total Runoff Infiltrated (ac-ft):   9.74,   100.00%
 Total Runoff Filtered (ac-ft):   0.00,   0.00%
 Primary Outflow To Downstream System (ac-ft):   0.00
 Secondary Outflow To Downstream System (ac-ft):   0.00
 Percent Treated (Infiltrated+Filtered)/Total Volume: 100.00%


 ***********Compliance Point Results *************

Scenario Predeveloped Compliance Subbasin: PD-01

Scenario Postdeveloped Compliance Link: POC

      *** Point of Compliance Flow Frequency Data ***
      Recurrence Interval Computed Using Gringorten Plotting Position

        Predevelopment Runoff                 Postdevelopment Runoff
Tr (Years)        Discharge (cfs)             Tr (Years)       Discharge (cfs)
-------------------------------------------------------------------------------------------------------------------
   2-Year                 2.995E-03               2-Year                  0.000
   5-Year                 9.094E-03               5-Year             1.616E-02
   10-Year                2.002E-02               10-Year            4.409E-02
   25-Year                3.269E-02               25-Year            6.412E-02
   50-Year                5.553E-02               50-Year            8.463E-02
   100-Year                   0.109               100-Year                0.119
   200-Year                      **                       200-Year                 **
   500-Year                      **                       500-Year                 **
 ** Record too Short to Compute Peak Discharge for These Recurrence Intervals


**** LID Duration Performance ****
Excursion at Predeveloped 8%Q2 (Must be Less Than 0%):                 -100.0%       PASS
Maximum Excursion from 8%Q2 to 50%Q2 (Must be Less Than 0%):            -98.8%       PASS

-------------------------------------------------------------------------------------------
MEETS ALL LID DURATION DESIGN CRITERIA:          PASS
-------------------------------------------------------------------------------------------
```

Attachment 1

COLUMBIA GEOTECHNICAL, INC.
GEOTECHNICAL REPORT

Columbia Geotechnical, Inc., PO Box 87367, Vancouver, WA 98687 ··· 360-944-7397 / 360-513-2691

August 30, 2020

CG20-1408

Cory Vom Baur
124 SE Everett St
Camas, WA 98607

GEOTECHNICAL REPORT FOR RESIDENTIAL ADDITION
FOUR-PLEX RESIDENTIAL STRUCTURE
124 SE EVERETT STREET
CAMAS, WASHINGTON

I. GENERAL INFORMATION AND LITERATURE RESEARCH

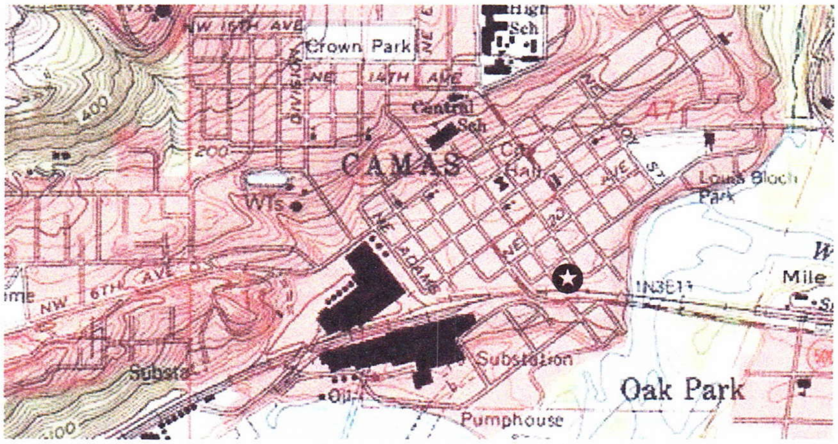
This report presents the results of our site visit and literature review of the above-referenced property (124 SE Everett Street in Camas) where an existing single-family lot will be modified for the addition of three additional units to supplement the existing house and form the new four-plex. The 0.21-acre lot was originally developed in 1920 when the existing house and attached garage were built, according to the Clark County Property Information Center website. We understand the existing 1000-sf house will remain, but the 300-sf attached garage and shed structure along the northwest property line will be demolished and removed for the access driveway for the planned new parking spaces in the east corner of the lot and the new addition. The planned three-level addition to the existing house will be situated north of and attached to the existing house, as shown in the site plan, attached as Figure 1. Most of the trapzoid-shaped property is relatively level, though there are steep slopes on the order of 20 to 50 percent grade along and downhill of the south property line that borders the adjacent railroad grade roughly 15 feet lower than the majority of the lot. The ground elevations vary from roughly 72 feet at the house and planned addition to 68 feet along the south property line; the adjacent railroad grade is at roughly elevation 56 feet. The vegetation on the lot includes several trees and invasive blackberry on the slope.

We performed the field investigation on 8/26/20, at which time we logged the soil conditions exposed in three different test pits, tested the infiltration rates using the standard, single-ring falling-head test method, and took representative soil samples from the depth of the infiltration test. Our literature review included review of published geologic, groundwater, and hazard maps as well as our previous geotechnical reports from the area. Our work was performed as per our proposal prepared on 8/11/20.

Project Scope

For this four-plex project, we anticipate minimal grading for the driveway extension and new parking spaces. Once the topsoil is stripped and removed from the site, and a compacted gravel base placed in all new driveway and parking areas, those portions of the lot may be used for material storage and access during the construction of the addition. The foundation of the addition will require the overexcavation of the existing basement backfill unless it can be determined that the backfill is everywhere at least as dense as the native soil. Another reason that the existing basement wall adjacent to the addition may need to be overexcavated is to reinforce that wall or construct new, deepened footings for the addition that do not place additional lateral loads on the 100-year-old basement wall. Cut soil from under the organic topsoil will likely be difficult to use as engineered fill due to the high percentage of cobbles and boulders. The standard utilities will require trenching, as usual, that may be enlarged in areas where the large boulders are encountered and removed.

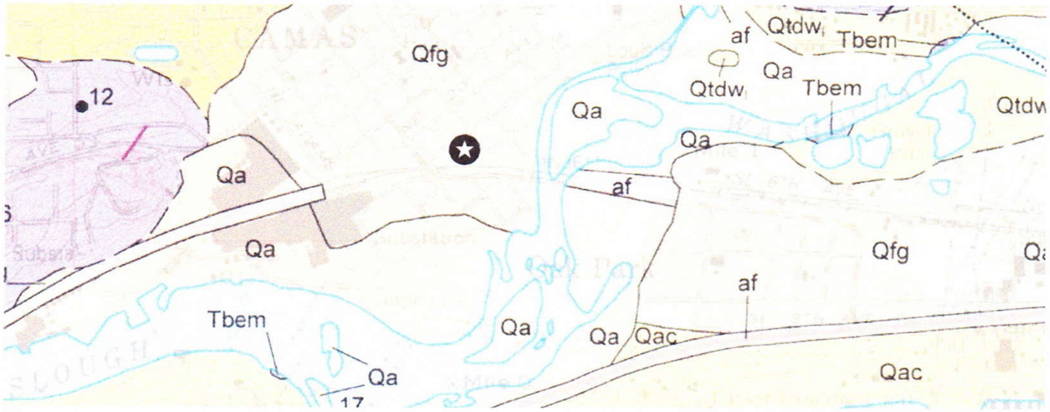
Site Description

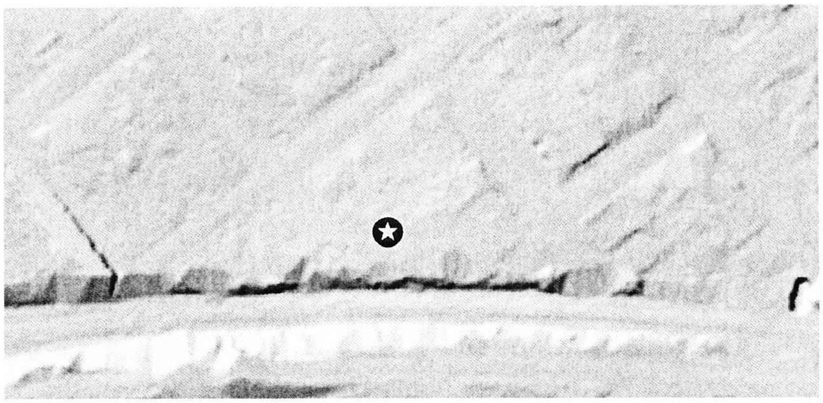


The 0.21-acre residential lot is located in the old residential area south of the downtown blocks, shown at the star symbol to the right. Most of the site is nearly level, though the south end has a steep cut-slope down roughly 12 to 15 feet to the railroad grade that was cut more than 100 years ago. The local soils are slightly cemented gravelly soils of the roughly 12,000-year-old glacial outburst floods and appear to have experienced only minor surface erosion and shallow slumping despite the poor vegetation and what appears to be little to no significant slope maintenance other than periodic clearing at the bottom of the slopes. We understand the existing house and adjacent garage were built in 1920 and we do not know of any significant additions or modifications to the original structure. We are also not aware of any existing foundation issues with the existing house. We understand the existing unfinished half-basement will be maintained, which may require additional retaining wall work or deepened spread footings to mitigate any new lateral loads from the new three-level addition. The elevations on the property vary from roughly 68 to 72 ft above MSL. Most of the steep slope down to the railroad grade is south of the property line. We expect much of the existing vegetation in the project area will be removed and replaced with perimeter plantings following the construction of the addition.

Geologic History, Soil Conditions, and Goundwater,

The geology of the surface soil in the area is illustrated in the 2008 USGS geologic map of the Camas quadrangle (SIM-3017 by Evarts and O-Connor, below), which indicates the site (at star) is underlain by over 100 feet of coarse-grained gravelly sediments (Qfg) deposited 15,000 to 20,000 years ago during the numerous glacial-outburst floods, now commonly referred to as the Bretz floods. The cataclysmic floods flowed through the Columbia River Gorge and fanned out west of the Cascade Range, depositing thick sediments where the water velocities slowed in the Portland-Vancouver basin.





The topography of the area, consisting of the somewhat erosion-resistant, slightly cemented, gravelly soil that was deposited across the entire downtown Camas area and was excavated over 100 years ago to provide the level railroad grade is visible in the lidar topographic image of the area, illustrated at left.

Based on USGS web-based data in the publication *Estimated Depth to Ground Water in the Portland, Oregon Area* (or.water.usgs.gov/projs_dir/puz/), the depth to groundwater on this block is roughly 25 feet below ground surface. The adjacent Washougal River is at roughly 18 ft elevation, which is roughly 50 feet lower than the site elevation. This soil type is usually moderately permeable and generally has little to no runoff.

Slope Stability

There are deep-seated landslides, both prehistoric and historic, within a mile of the site, as well as rockfall and debris flow landslides, all in areas where past river or flood erosion has undermined and/or eroded lower slopes and contributed to the instability. We are not aware of any landslides associated with the steep cut-slope adjacent to the south end of this lot. There is very little risk of slope instability where the planned structure addition is planned so long as the grading and drainage recommendations are followed and documented with the recommended geotechnical oversight specified in this report. Although there is room for some parking at the east corner of the property, the eastern 10 to 15 feet of planned parking may need to be modified, depending on the slope conditions revealed during the site clearing. Although the southern corner of the existing house and the southern corner of the planned new addition are in areas identified as steep slope (>15%) and potential landslide hazard on the Clark County GIS mapping, there are no mapped severe erosion hazard areas. Based on our review of the property and existing house, it is our opinion that the existing house and the planned addition are not located on potentially hazardous slopes and this project will not dramatically change the overall stability of the area, particularly if the invasive vegetation is replaced with native, deep-rooted plantings. We do not anticipate any decrease in slope stability from the subject development so long as our grading, drainage, and retaining wall recommendations are followed.

Seismic Considerations

We have evaluated the seismic hazards at this site with regard to the degree of complexity of the proposed project. We did not do site specific testing, but referred to published literature and guidelines. Based on our evaluation, there is very little to no liquefaction susceptibility due to the deep groundwater and gravelly soil conditions. The closest known shallow fault to the site is the Frontal Fault Zone, which includes the Lacamas Lake Fault a half-mile northeast of the site, with a low probability of activity and estimated magnitude 6.6. We recommend a Structural Engineer review the plans and specifications for compliance with local seismic design. We do not anticipate unusual earthquake risks (unusual lateral loads or liquefaction) at the house location. Based on our interpretation of site geology, the soil conditions at this site are most similar to IBC Site Class D soil (stiff soil profile).

Wind, earthquakes, and unbalanced earth loads will subject the proposed walls to lateral forces. These forces can generally be resisted by a combination of sliding resistance of the footing on the underlying soil and passive earth pressure against the buried portions of the structure.
The native soil is classified as IBC Site Class D and the following site parameters apply:

Seismic Design Parameter	**Recommended Value**
Location (Lat., Long.), °	45.5847, -122.3999
Short Period Acceleration Value, S_s	0.815 g
1.0 second Period Accel. Value, S_1	0.352 g
F_a site soil coefficient for D_2	1.20
Acceleration site value, S_{DS} ($2/3 \cdot F_a \cdot S_s$)	0.652 g
Horiz. seismic acceleration factor, k_h (S_{DS} / 2.5)	0.261 g
PGA MCE of site modified peak ground acceleration	0.367 g
Site modified PGA (MCE_G PGA$\cdot$1.2)	0.440 g

(SEAOC/OSHPD Seismic Design Maps Tools)

II. SITE INVESTIGATION

On 8/26/20, we visited the subject property and explored the near-surface soil up to nine feet deep with three test pit explorations. The planned project, topography, and the location of our test pit explorations is illustrated in the attached Figure 1.

Specific geologic conditions

Based on our explorations, the upper six to nine inches is considered nonstructural topsoil that transitions to what appears to be undisturbed native soil across most of the site, though there may be landscape fill or other shallow materials to be overexcavated in the area of the artificial pond. The native soil is a silty GRAVEL with some sand that could also be described as a gravelly loam soil with boulders on the order of one foot to four feet in diameter. The sandy silt matrix component of the soil is gray brown near the ground surface, but transitions to orange-brown color below about two feet depth. The soil is fairly dry near the surface and is damp from about two feet deep to nine feet deep. Everywhere, the soil is medium dense where undisturbed. The gravel-size fraction of the soil is visually roughly 50 to 75 percent, with boulders occupying roughly 20 percent and the sandy silt matrix about 10 to 20 percent. The vertical side slopes of the test pits were stable while left open for several hours with little spalling, but the large boulders may provide a challenge for the utility trenching. The actual soil conditions for all new footings can be best evaluated during the foundation excavation, at which time we will also be able to direct any minor overexcavations if necessary.

We expect the native soils are moderately well drained based on the soil type, natural moisture, and lack of surface erosion from the existing solid surfaces.

Suitability of the site

Based on our field observations, the existing site is suitable for the planned building addition. We anticipate only minor grading to consist of stripping the organic topsoil and any uncontrolled fill encountered during the initial site grading and foundation excavation and minor grading for the driveway extension and parking areas. The medium dense subgrade soil appears adequate for standard concrete spread footing foundations and the moderate infiltration rates of the soils should not present any challenges for the stormwater design.

Infiltration-Rate Testing

Overall, the undisturbed native soil is moderately well-drained. Based on published groundwater data for this site, the static water level is expected to be at least 25 feet deep. We did not encounter any indications of shallow perched groundwater in the upper nine feet explored with test pit explorations.

Since the soil was dry to damp and appeared favorable for infiltration at four feet depth, we set the two pipes in the sandy silt matrix where we could get a good seal, testing two locations to check local variability. It took several attempts to get a good seal due to the large cobbles and boulders just under the surface everywhere. Both tests were in the silty gravel soil at four feet depth where the infiltration system would most likely be built. Shallower than four feet, we expect similar rates; deeper than six feet, the costs would be higher due to increased excavation, but the rates would also definitely be higher due to the coarser grained material at six feet and deeper.

The two single-ring falling head infiltration tests (encased falling head), used a 15-inch long, 6-inch diameter, ¼-inch thick steel pipe for each test. The pipe was carefully pressed and/or tapped roughly 6 inches into the undisturbed soil at the depths selected to create a seal and prevent water from seeping up around the pipe. The pipes were continuously filled with water using a garden hose with valves to control the flow and soaked for two hours. Following the second hour of the saturation period, we started measuring the water drop from the refilled pipe several times for an hour to begin the testing until we were able to verify that the rates were not decreasing with time. The selected rates were the final rates measured.

The rates expressed below include the calculated average coefficients of permeability (k) for the final three tests at each location and average measured rates of fall in each pipe. The infiltration rate as expressed as the saturated vertical coefficient of permeability is determined from the equation: **$k = (L/t) \ln (h_1/h_2)$**, where: k = coefficient of permeability (in/hr), L = length of flow through soil (6 in), t = time interval (hr), h_1 = initial head in filled pipe (15 in), and h_2 = final head to bottom of pipe at time of measurement (in). The coefficient of permeability is the approximate rate at which water can be expected to infiltrate vertically under long-term saturated flow conditions.

Coefficient of Permeability and Falling Head Results

Test Pit No.	Test Depth (ft)	Test Method	Soil Description	Weight % passing 200 sieve (dry)	Average calculated coefficient of permeability, k (in/hr)	Measured falling head infiltration rate of upper six inches of pipe (in/hr)
TP-1	4.0	Single-ring falling head	Silty GRAVEL (w/o cobbles, etc)	14	24.5	48
TP-1 (5 ft from other test)	4.0	Single-ring falling head	Silty GRAVEL (w/o cobbles, etc)	18	16.4	32

Based on our field test results, we expect moderate infiltration rates everywhere on the site. The variability of tested rates can be attributed to the local silt content in the layered sediments and the actual infiltration system generally spans areas larger than any thin silty layers, providing an average infiltration typical of the average of tested values. The infiltration rates provided can be used for preliminary design of facilities located anywhere on the property so long as the soil conditions are verified and/or the actual rates verified during construction.

The design infiltration rate is obtained by choosing an appropriate factor of safety, generally chosen with consideration of other surface water sources, time of year the test was performed, and the variability of fine grained soil conditions, with a usual maximum adjusted allowed design rate of 250 inches/hour. We provided both the coefficient of permeability, which may better simulate the downward infiltration under long-term saturated conditions, and the tested infiltration rate. We recommend the standard correction factor of 2.

III. RECOMMENDATIONS

General

The property appears to have had only minor past surficial grading associated with the existing structures and surface landscaping. Around the house, the soil adjacent to the house can be expected to be disturbed at least in the upper two feet and where there is a basement retaining wall, the soil has obviously been disturbed down to the full depth of the existing wall footing. Based on our test pit explorations, the quality of the native, undisturbed soil below the topsoil is uniform and appropriate for the planned new residential subdivision project. We anticipate standard concrete spread footings for the addition and a standard residential pavement section for the driveway and parking areas.

The depths for footing excavations are anticipated to be between 6 and 18 inches to get below the organic topsoil but we anticipate minimum finished footing depths of 18 inches below finished grade for frost protection; the actual depths should be determined by review of the soil conditions encountered following the stripping and during the foundation excavation, which should be approved by the engineering geologist or geotechnical engineer prior to placing any gravel subbase or setting rebar and forming the footings in case any minor modifications are recommended. Immediately adjacent to the existing house where there is a basement wall, additional mitigation is expected to offset the additional lateral loads on the basement wall, either by reinforcing the existing basement wall to accommodate the anticipated surcharge and/or by deepening the footings to eliminate the lateral influence on the existing basement wall. We recommend the roof runoff be collected in a durable outlet pipe (such as ADS N-12) and routed to the planned infiltration system. Often, driveway runoff is best accommodated by linear rain gardens next to the new paved areas.

We located our test pits outside any planned new building footprints so that we would not disturb the soil there and in the area of likely infiltration under the planned new parking areas. We left the large boulders excavated from the test pits at the surface so they could be more easily removed during the foundation excavation; to reduce future settlement of pavement in these areas, the entire depth of the test pits should be overexcavated and recompacted. Areas where buried features are discovered should be overexcavated and replaced with engineered fill. Engineered fill is, by definition, drained, benched, and mechanically compacted to a nonyielding density with final compaction verified (generally a minimum of 95 to 98 percent of the material's maximum dry density obtained from the standard Proctor, depending on the planned loading).

Construction monitoring is known to be key to determining that construction is completed according to planned drawings and specifications. During construction, we expect to observe the soil subgrade prior to and during any replacement engineered fill, as well as following the foundation excavations and subgrade preparation. Subsurface conditions that differ from those encountered in this limited exploration phase should be expected and evaluated for modifications to the geotechnical recommendations. We recommend a return site visit(s) by an engineer/geologist from Columbia Geotechnical is coordinated with the earthwork contractor and owner.

Clearing and Stripping

We recommend the upper 6 to 12 inches (or more if necessary) of organic topsoil be stripped. The stripped organic soil should likely be removed from the site since there are no good areas to fill.

Engineered Fill

All filling under future structures, posts, patios, roads, or driveways, should be considered engineered fill. All engineered fill should be compacted in horizontal lifts not exceeding eight inches uncompacted (roughly 6 inches compacted) using standard compaction equipment (vibratory smooth roller, jumping jack, or heavy diesel plate compactor). The inorganic native soil on this site can be used as engineered fill if necessary during dry weather so long as the natural moisture content is not more than roughly three percent higher than the material's Optimum Moisture Content, as determined by the Modified Proctor laboratory test or by field examination and proof-roll testing. Uniform thickness and continuous fill lifts will provide more structurally sound fill overall that exhibits less differential settlement than if fill is placed in uneven or discontinuous lifts. The finished ground surface (foundation backfill) should be graded so that surface water drains away from structures and is prevented from ponding, taking future settlement under consideration and thickened slightly next to the foundation.

Engineered fill should be compacted to at least 95 percent of the maximum dry density determined by the modified Proctor or an equivalent nonyielding density; engineered fill can be evaluated and tested by proof-rolling and site observations or by nuclear density testing using a certified technician. Documentation and testing of earthwork generally requires daily observation and testing/proof-rolling or soil probing every two vertical feet of fill. We can provide on-site observation and proof-roll testing, as needed. Alternatively, Proctor testing and nuclear density gauge testing could be coordinated with a materials testing subcontractor and reviewed by an engineer from our office. With the exception of compacting clean gravel, it is usually wise to postpone all earthwork during wet weather days since even a small rainstorm can saturate the silty portion of the native soil and prevent adequate compaction. The ground surface during grading should promote surface runoff and prevent any temporary unplanned ponding of water. Erosion control measures such as straw bales and geotextile erosion-control fences should be used to prevent silt from washing off the site.

Foundations

We estimate the footings for the new structure be at least 18 inches below adjacent grade for frost protection, though the soil bearing capacity is likely adequate at 12 inches below the existing grade. The actual depth will be determined by the depth of the topsoil and stiffness of the subgrade soil during the foundation excavation review. Where buried organics or other uncontrolled fill are encountered in footing areas, they will need to be completely removed and locally filled with granular fill (or on-site soil only if it is within a few percent of optimum moisture during the driest summer months), and compacted to "engineered fill" specifications and testing requirements. We estimate a design bearing capacity of roughly 2000 psf at 12 inches depth. For use in design, we estimate a coefficient of friction of 0.35 along the interface between the base of the footing and the subgrade. The planned new addition is over 20 feet from the slope break, which provides an adequate slope setback. If the foundation excavation work is done during the fall, winter, or spring season(s) and rainfall ponds at all, we recommend the footing excavations are made with a slight grade to allow rainfall to drain off the foundation area during the construction period. To preserve the stiffness of the freshly cut foundation soil in the fall, winter, or spring, we recommend three to six inches of ¾"-0 crushed rock gravel be mechanically compacted onto all structural areas immediately after the subgrade is approved (left open less than a day); if a crushed rock gravel subbase is property placed and compacted, the coefficient of friction between the subgrade and footing can be increased to 0.40 and the bearing capacity can be increased to 2500 psf.

We recommend standard perimeter foundation drains are placed adjacent to all footings at the deepest elevation that is excavated and drained by gravity in solid outlet pipes separate from the roof drains to an approved outlet to better control shallow water that may pond in the crawlspace; the perforated foundation drainage pipes and all solid outlet pipes should have positive drainage (minimum 3 percent) all the way to the outlet. See *Drainage* section below for foundation drain specifications. If the ground surface next to the structure is finished with a slab-on-grade, the slope can be reduced so long as surface water adequately drains away from the structure.

Retaining Walls

Although no retaining walls are planned, we have provided soil parameters that are appropriate for the site for additional structural design on the existing basement wall or deepened foundation wall to accommodate any new lateral loads of the new spread footings along the NE wall of the existing house. Residential foundation retaining walls should be designed to resist lateral forces calculated using an equivalent fluid pressure of 35 pcf for active pressure (wall allowed to rotate at the top) and 55 pcf for at-rest pressure (basement wall). The recommended fluid weight assumes that the wall backfill is level, fully drained by a foundation drainage system (shown in Figure 2), and consists of the specified imported gravel that has been compacted to the equivalent of 95 percent of the maximum dry density determined by the standard Proctor test. Passive pressures of 250 pcf (unrestrained wall) and 105 (restrained wall) are recommended for design, assuming a relatively level ground surface.

Friction between the footings and subgrade soil may be used to resist lateral sliding. A friction factor of 0.35 should be used when the bottom of the footing excavation is the medium-grained native soil and 0.40 if there is at least three inches of compacted crushed rock gravel under the footing. Passive pressures may also be used to resist sliding if the ground in front of the footing is level for at least 10 feet. Only 2/3 of the ultimate passive pressure should be used if friction and passive resistance are combined to resist lateral forces.

Design for dynamic lateral loads due to earthquakes should include an additional lateral soil load. Based on the Mononobe-Okabe equation and peak horizontal accelerations appropriate for the site location, seismic loading should be designed with an additional rectangular-shaped seismic load of magnitude 7H, where H is the total height of the wall.

All walls must include a drainage system consisting of at least a 4-inch diameter perforated pipe surrounded on all sides by at least 12 inches of 1½"-¼" drain rock that is completely wrapped in a nonwoven, permeable geotextile such as Mirafi 140N or equivalent. Backfill should include similar drainage gravel all the way to the top of the wall at least one foot thick, as shown in Figure 2.

Drainage

We recommend a perimeter foundation subdrain to drain seasonally perched groundwater and shallow surface runoff during the wet weather months. The subdrains should consist of a minimum of a 4-inch perforated pipe enveloped in at least 4 ft^3/ft of washed drain rock (1½"-¾") and completely wrapped in a free-draining geotextile such as Mirafi 140N geotextile or equivalent and covered with roughly 3 inches of compacted gravel for sun protection (Figure 2). Any retaining walls or landscape walls should also be drained. The solid outlet pipes for all subdrains should have at minimum 3% downhill grade; foundation and retaining wall drains should be able to drain from the outlet pipe onto native landscaping so long as the slope stability is not compromised. Roof runoff should be collected in a durable solid pipe (such as ADS N-12) and should always be plumbed independent of all foundation drains to the approved outlet.

IV. CLOSING

Based on our review, this report is appropriate for the planned project development. We suggest that the owner/contractor incorporate the recommendations in this report into their agreement with the earthwork contractor. The factual data (test pit logs and infiltration rates) can be shared with contractors during the bidding process so long as no warranty of subsurface conditions is implied. Based on their experience, the contractors should determine the best method for the specific earthwork components. CGI is not responsible for any part of jobsite safety before, during, or after construction of the project.

All earthwork should be performed to both City of Camas standards and the applicable provisions in the International Building Code (2018 IBC) including Appendix J and should be in general conformance with the recommendations in this report. Site conditions are often different than expected from initial explorations and some revisions to the design and construction will likely be required. A geotechnical engineer and/or engineering geologist from Columbia Geotechnical should remain involved throughout the final design and the construction of the earthwork, foundation, and drainage systems. A final report summarizing earthwork activities should be obtained from the geotechnical consultant as soon as possible after conclusion of the geotechnical activities and before site development is considered complete.

Optimum results of any infiltration facility require careful management of erosion during all adjacent construction. Prevention of the movement of fines into infiltration facilities particularly during but also after the construction phase is critical to the long-term performance of the infiltration facility.

Please feel free to contact us for any questions you may have regarding this report or to schedule additional work. To facilitate subsequent field visits and inspections, please keep our office informed of your construction schedule and allow a minimum of one week advance notice for approximate times of return visits.

Sincerely,

Columbia Geotechnical, Inc.

State of Washington Licensed Geologist
Engineering Geologist
732
Ruth A. Wilmoth

RUTH ANN WILMOTH
State of Washington
42848
Registered Professional Engineer
expires 12/30/20

By Ruth Wilmoth
Ruth A. Wilmoth, C.E.G., P.E.
Engineering Geologist/Geotechnical Engineer

REFERENCES

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

US Geological Survey, 7.5 Minute Topographic Map Series, Camas quadrangle, 1990.

Clark County Property Information Center, https://gis.clark.wa.gov/gishome/property/index.cfm

Washington Lidar Portal, https://lidarportal.dnr.wa.gov/

Geologic Map of the Camas Quadrangle, USGS SIM-3015, Evarts & O'Connor, 2008.

Liquefaction Susceptibility Map of Clark County, WA, Parmer et al, 2004.

INFORMATION ABOUT AND LIMITATIONS OF YOUR GEOTECHNICAL REPORT

The professional services provided are tailored to the needs of each client as we understand them, with the goal to contribute to the understanding and mitigation of the geotechnical aspects of the project and to maintain a long-term professional relationship based on communication, trust, and respect. The basis of our report includes site conditions revealed from the explorations, existing literature realized during our review, and the synthesis of the data during our analysis and report preparation. Our work is performed in accordance with generally accepted engineering principles and practices in this area at the time the report is prepared, but also limited by the scope approved by the owner. Geotechnical engineering (including geology and groundwater) is based extensively on judgment of limited data and opinion, and as a result, it is less exact than other design disciplines. Our work involves making a realistic estimate of the expected ground conditions before, during, and after construction. We make no warranty of present or future conditions, either expressed or implied and we are not responsible for any deviation from the intent of the report.

The report was written for the current owner(s), his/her contractor and designer, and for the development indicated as we understand it. However, the report may not be adequate for all needs of the project's contractors or design professionals. We recommend the entire geotechnical report is provided to others so that portions of the report are not taken out of context. We would be pleased to provide additional input during the design process, to explain the relevant geotechnical, geological, and hydrogeological findings, to review plans and specifications relative to these issues prior to construction, and to provide on-site observation and testing during construction. Since the observational method forms the basis of geotechnical services, liability and other problems can result when another firm is retained to provide construction or remediation observation. In addition, sharing the best available information between the owners, designers, and contractors helps prevent many costly construction problems. If there is a change in ownership or scope of construction than what is described in the report, if site conditions change, or if there is a lapse of time greater than three years between the date of the report and the start of construction, the report should be reviewed and updated or replaced with a revised geotechnical report.

The report was prepared within the limitations of the scope and budget approved. The judgment and recommendations pertain to the material tested/inspected only and are not intended to be nor should they be construed to represent a warranty of the subsurface conditions, but are forwarded to assist in the design and planning process. Actual soil and water conditions are documented at locations, depths, and times noted; the exploration logs illustrate our opinion of the subsurface conditions revealed by observation and sampling. Sample intervals may miss changes in geology or groundwater and the soil descriptions and interfaces between layers are interpretive and often gradual. Geotechnical sampling also generally produces large areas between explorations that may vary, though we use judgment to make assumptions regarding the overall subsurface soil and groundwater conditions. Unanticipated conditions are commonly encountered in construction and cannot be fully determined from soil explorations. If a more refined analysis is desired to confirm or refine some of our assumptions, we recommend additional explorations, soil sampling, and soil testing. If any conditions are discovered by the owner or contractor before or during construction that differ from those described in the report, we ask to be contacted for review of implications to our recommendations, with revised recommendations provided if necessary. Actual subsurface conditions may be determined only during the earthwork/foundation phase of construction, at which time geotechnical recommendations can also be refined, if necessary. When conditions are more favorable than initially assumed, we can provide design or construction changes that save money.

Steep or unstable slopes carry additional inherent risk that belongs to the owners; property owners are responsible for taking the risks associated with future development on their property. Based on his/her experience, the contractors should determine the best method for specific earthwork components; the safety of the site is the responsibility of the contractor.

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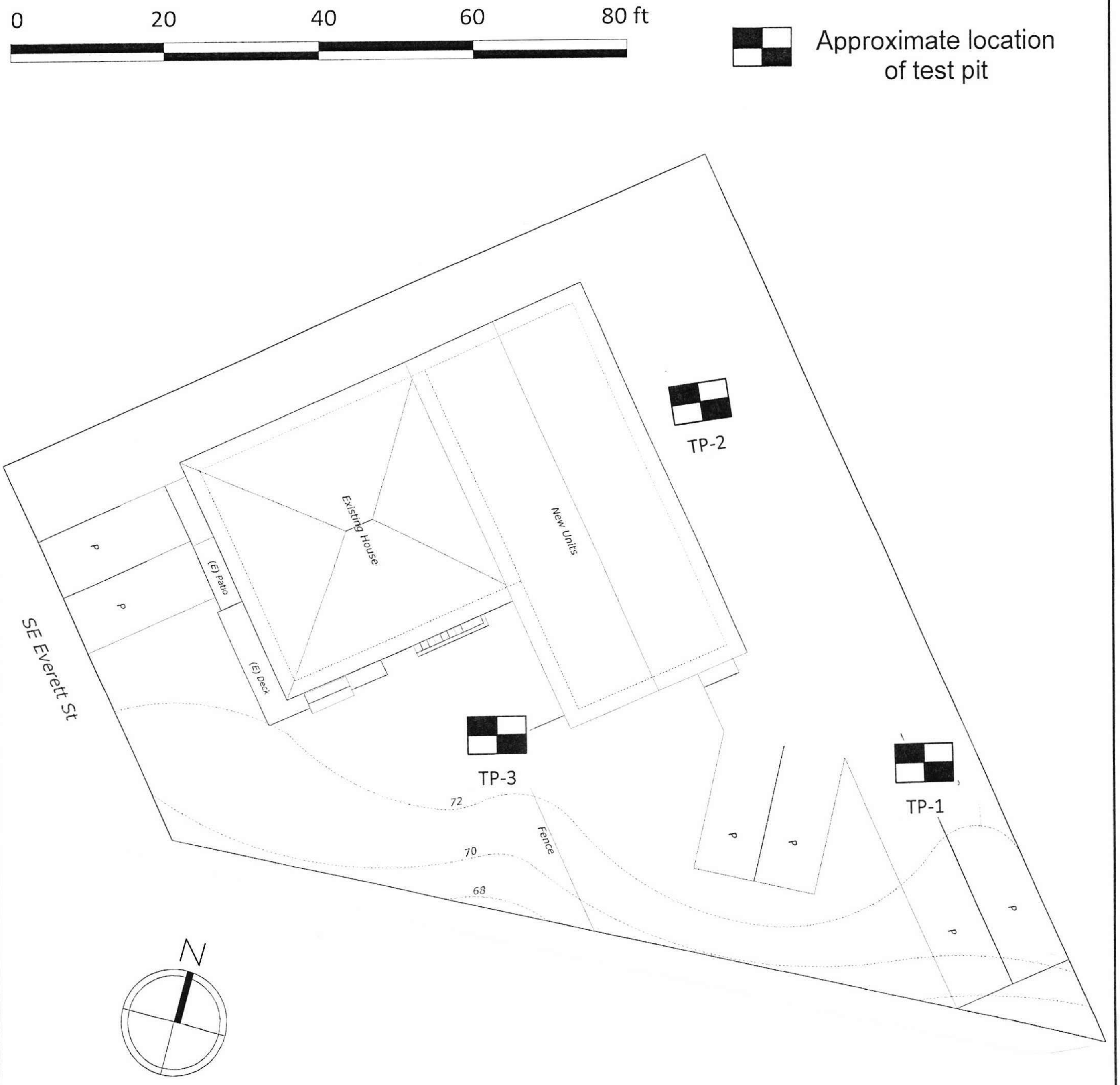
TITLE Site Plan		PAGE Figure 1
JOB NAME Cory Vom Baur Four-plex		JOB NO. CG20-1408
SITE LOCATION 124 SE Everett St, Camas	APPROX. SURFACE ELEVATION 72 ft	DATE 8/26/20
DRAWN BY Wilmoth	CLIENT	SHEET 1

Reference: Site plan provided by Cory Vom Baur. Details not field verified.

SCALE: 1"=20'

LEGEND:

▚ Approximate location of test pit



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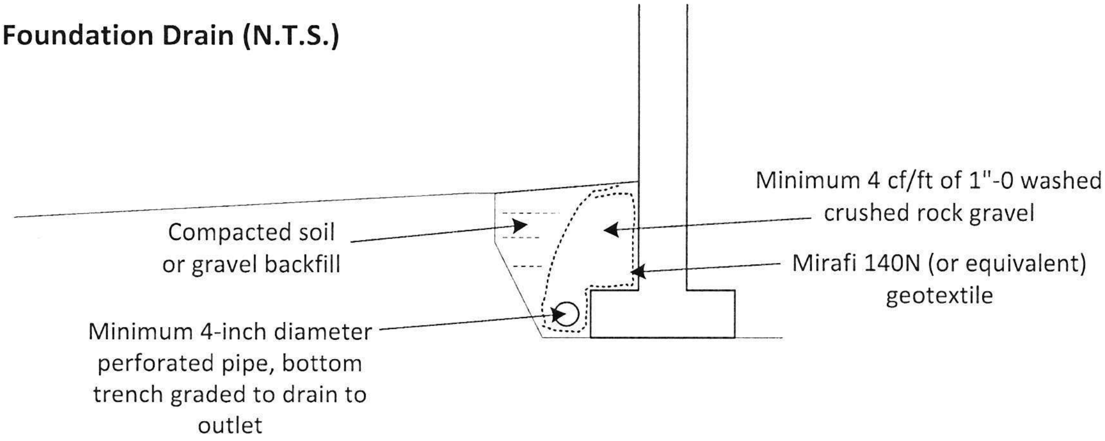
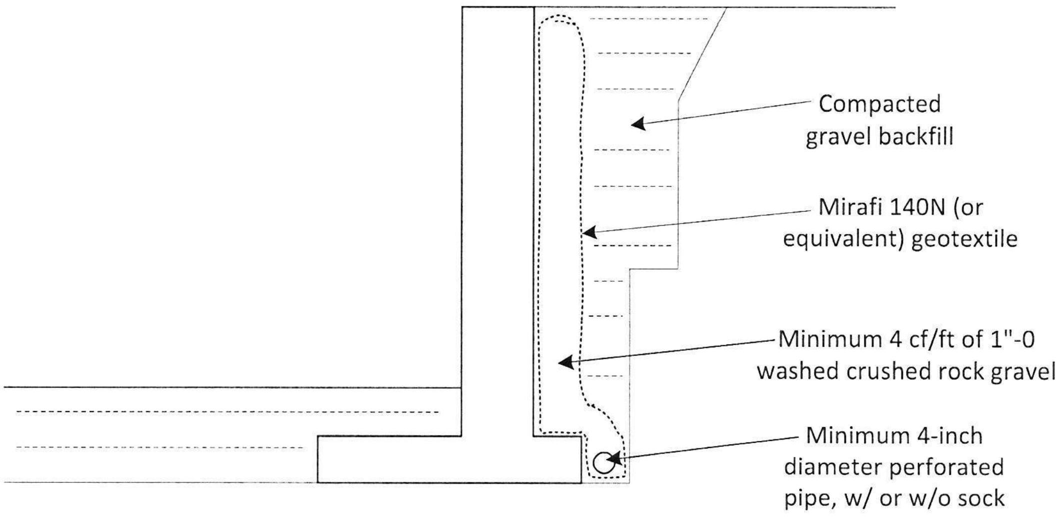
TITLE Typical Subdrain		PAGE Figure 2
JOB NAME Cory Vom Baur Four-plex		JOB NO. CG20-1408
SITE LOCATION 124 SE Everett St, Camas	APPROX. SURFACE ELEVATION ~72 ft	DATE 8/26/20
DRAWN BY Wilmoth	CLIENT	SHEET 1

These typical sections are provided to illustrate the full height of the drainage material and to provide the recommended material specifications.

Foundation Drain (N.T.S.)



Typical Retaining Wall Drain (N.T.S.)



Appendix A

Field Exploration

Our scope of work for this evaluation included three test pit explorations on 8/26/20, using a trackhoe supplied by the owner and directed by Columbia Geotechnical. The exploration locations are shown on Figure 1 and the exploration logs are attached on pages A-1 through A-3. The logs indicate the depths at which soil characteristics change with horizontal dashed lines, although the change may be gradual.

Soil conditions were evaluated, described, and classified in the field in accordance with the classification format based on the Unified Soil Classification System, summarized below:

Soil Classification System:
Name: GRAVEL/SAND/SILT/CLAY (primary)
gravelly/sandy/silty/clayey (secondary; 30 to 50 percent)
with gravel/sand/silt/clay (15 to 30 percent)
USCS: G (gravel), S (sand), M (silt), C (clay), O (organic)
fine grained: L (low plasticity), H (high plasticity)
coarse grained with little to no fines: W (well-graded), P (poorly-graded)coarse with fines: M (silty), C (clayey)
Plasticity: Nonplastic (can not be rolled, falls apart dry), low plasticity (barely roll 1/8-inch, easily crushed dry), medium plasticity (easily roll 1/8-inch, difficult to crush dry), high plasticity (1/8-inch easily re-rolled, impossible to crush dry by hand)
Consistency: very soft (penetrated by fist), soft (penetrated by thumb), medium stiff (penetrated by thumb with effort), stiff (indented by thumb), very stiff (indented by thumb nail), hard (indented with thumb nail with effort), very hard (impossible to indent)
Moisture: dry (dusty), damp (has moisture), moist (darkened), wet (visible water)

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TITLE **Test Pit Log for TP-1**			PAGE **A-1**
JOB NAME Cory Vom Baur Four-plex			JOB NO. CG20-1408
APPROXIMATE TEST PIT LOCATION East corner of site parking area	APPROX. SURFACE ELEVATION 72 ft		DATE 8/26/20
LOGGED BY Wilmoth	FILENAME		SHEET 1 of 3

Depth (ft)	Pocket Penetrometer	Sample Type	Moisture Content (%)	USCS	AASHTO	Material Description
						Wood chips, roots, organic soil, dark brown (Topsoil)
1			dry	GW		Silty GRAVEL with some sand (GW), gray brown transitions to orange brown below about 2 ft depth, low to no plasticity, dry to damp, medium dense, gravel-size pieces occupy roughly half the exposure, boulders larger than two feet common roughly every foot of depth (Coarse-grained flood deposit; Qfg)
2						
3			damp			Infiltration testing at two locations in wide test pit set at 4 ft depth
4						Bottom of excavation at 4 ft depth. No groundwater encountered.
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

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TITLE
Test Pit Log for TP-2

PAGE **A-2**

JOB NAME: Cory Vom Baur Four-plex
JOB NO.: CG20-1408
APPROXIMATE TEST PIT LOCATION: North of north end of addition
APPROX. SURFACE ELEVATION: 72 ft
DATE: 8/26/20
LOGGED BY: Wilmoth
FILENAME:
SHEET: 2 of 3

Depth (ft)	Pocket Penetrometer	Sample Type	Moisture Content (%)	USCS	AASHTO	Material Description
						Wood chips, roots, organic soil, dark brown (Topsoil)
1 2 3			damp	GW		Silty GRAVEL with some sand (GW), gray brown transitions to orange brown below about 1.5 ft depth, low to no plasticity, dry to damp, medium dense, gravel-size pieces occupy roughly 75% of the exposure, boulders larger than two feet common roughly every foot of depth (Coarse-grained flood deposit; Qfg)
4 5 6 7 8 9 10 11 12 13 14						Bottom of excavation at 4 ft depth. No groundwater encountered.

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TITLE
Test Pit Log for TP-3

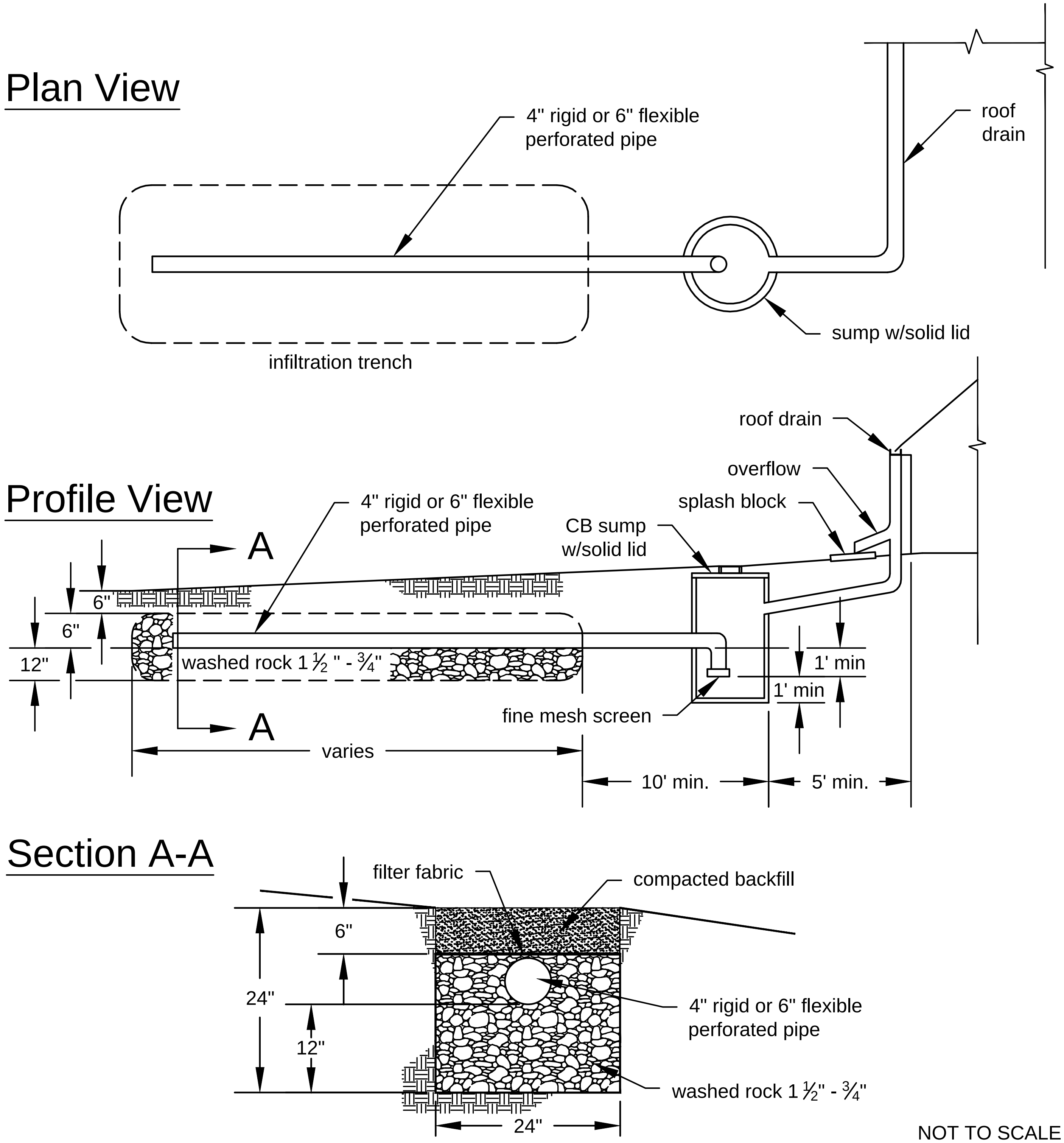
PAGE **A-3**

JOB NAME: Cory Vom Baur Four-plex
JOB NO.: CG20-1408
APPROXIMATE TEST PIT LOCATION: South of south end of addition
APPROX. SURFACE ELEVATION: 72 ft
DATE: 8/26/20
LOGGED BY: Wilmoth
FILENAME:
SHEET: 3 of 3

Depth (ft)	Pocket Penetrometer	Sample Type	Moisture Content (%)	USCS	AASHTO	Material Description
						Wood chips, roots, organic soil, dark brown (Topsoil)
1						Gravelly soil fill, some rounded rock mixed with other soil (Landscape fill)
2			damp			Silty GRAVEL with some sand (GW), gray brown transitions to orange brown below about 2 ft depth, low to no plasticity, dry to damp, medium dense, gravel-size pieces occupy roughly half the exposure, boulders larger than two feet common roughly every foot of depth
3						
4						
5						
6						Transitions to coarser sand in matrix, boulders
7						Transitions to pea gravel in matrix, boulders
8						(Coarse-grained flood deposit; Qfg)
9						Bottom of excavation at 9 ft depth to confirm no groundwater at least 5 ft below infiltration testing. No groundwater encountered.
10						
11						
12						
13						
14						

Attachment 2

TYPICAL INFILTRATION FACILITY DETAILS



NOT TO SCALE

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Figure III-3.1.2
Typical Downspout Infiltration Trench

Revised November 2015

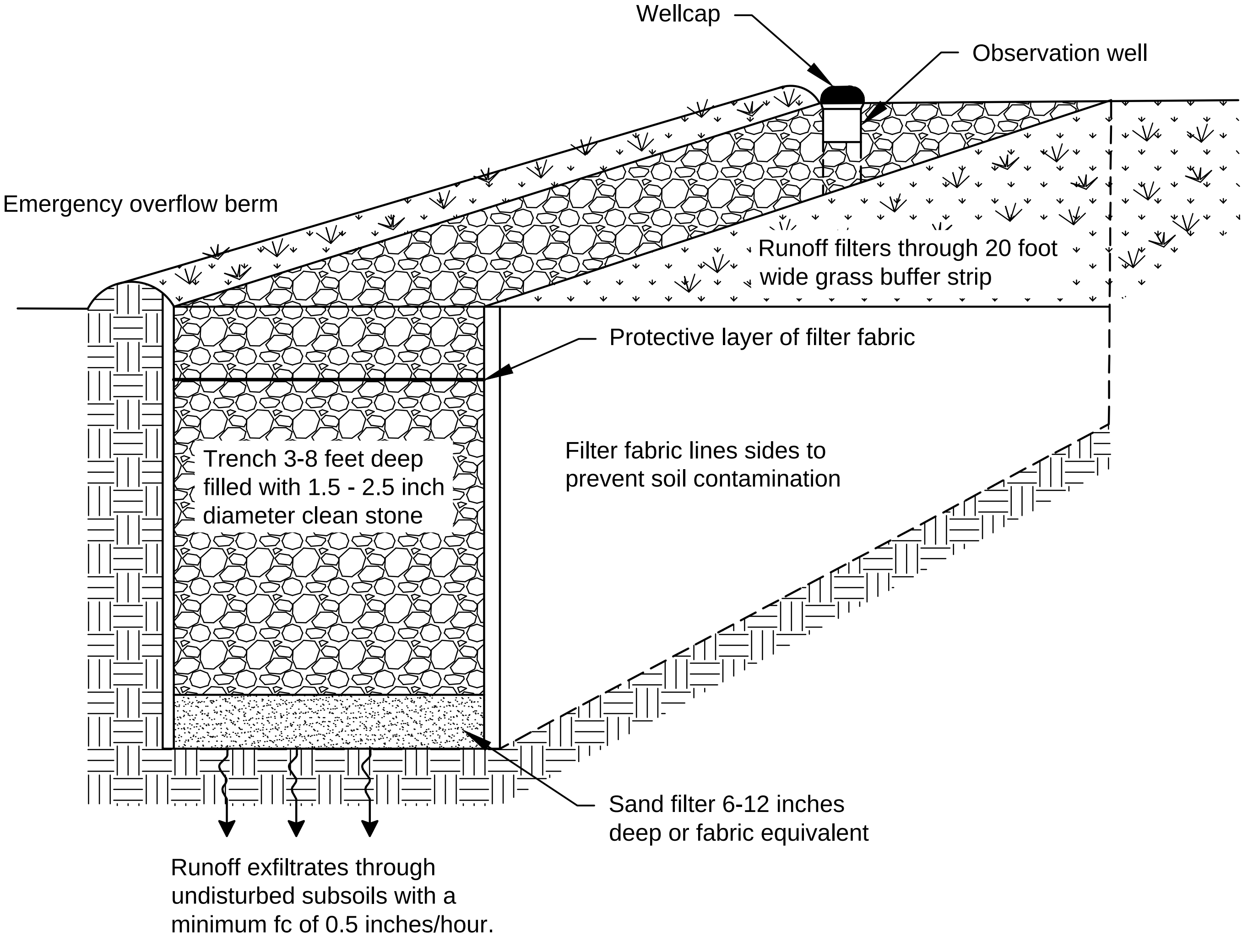

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Figure III-3.3.4
Schematic of an Infiltration Trench

Revised December 2015

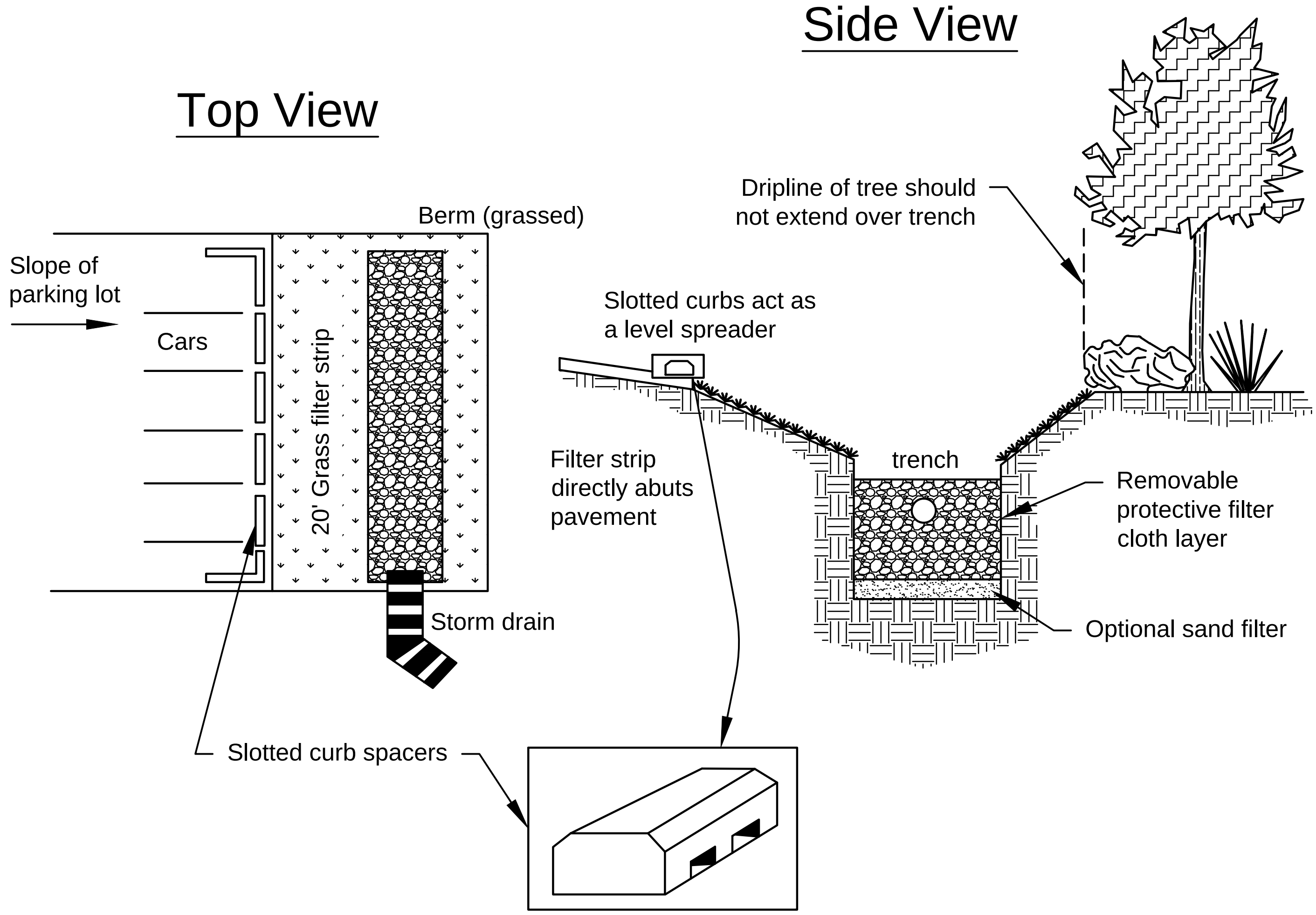

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Figure III-3.3.5
Parking Lot Perimeter Trench Design

Revised December 2015