Tybren Heights Development

City of Kelso, WA

Preliminary Drainage and Erosion Control Report

Fuller Designs Project No. 1920

January 26, 2020

Prepared by:

FULLER DESIGNS

645 SE Prospect Street, Chehalis, WA 98532; 520.840.3599

PRELIMINARY DRAINAGE AND EROSION CONTROL REPORT

Tybren Heights

City of Kelso, Washington
January 26, 2020

Project Information

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References

2012 Stormwater Management Manual for Western Washington as Amended in December 2014 (The 2014 SWMMWW)

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"I hereby certify that this Preliminary Drainage and Erosion Control Report for the Macomber Heights project has been prepared by me or under my supervision and meets minimum standards of Lewis County and normal standards of engineering practice. I hereby acknowledge and agree that the jurisdiction does not and will not assume liability for the sufficiency, suitability, or performance of drainage facilities designed by me."

1/30/20

Exp. 12/21/20

Table of Contents

PRELIMINARY DRAINAGE AND EROSION CONTROL REPORT

TABLE OF CONTENTS

SECTION 1 – PROPOSED PROJECT DESCRIPTION

SECTION 2 – EXISTING CONDITONS DESCRIPTION

SECTION 3 – OFFSITE ANALYSIS REPORTS

SECTION 4 – APPLICABLE MINIMUM REQUIREMENTS

SECTION 5 – PERMANENT STORMWATER CONTROL PLAN
- Site Hydrology: Total Runoff Pre and Post Developed Comparison
- Flow Control System Design and Analysis
- Water Quality System Design and Analysis

SECTION 6 – CONSTRUCTION SWPPP
- Project Specific Construction BMPs

SECTION 7 – SPECIAL REPORTS AND STUDIES
- Geotechnical Reports Prepared by Strata Design.

SECTION 8 – OPERATION AND MAINTENANCE MANUAL

SECTION 9 – DRAFT ROAD MAINTENANCE AGREEMENT

SECTION 1 – PROPOSED PROJECT DESCRIPTION

Site Address:	300 Block Tybren Heights Road Kelso, WA 98626
Parcel Number(s):	241241500; 241241400; 241241300; 241240900; 241241000; 241241600, 241241900, 241242000
Total Site Area:	40 Acres
Zoning:	Residential Single Family
Sec, Twn, Rge:	Section 1, Township 7N, Range 2W, W.M.

Proposed Improvements:
The site is located on Tybren Heights Road approximately 1 mile from its intersection with Carrol Road. This project will construct an access roadway, storm drainage, and private utility improvements up to the existing 8 lots numbered above. Also upgrades to Tybren Heights road will be performed to bring it to the proper roadway class.

Stormwater runoff from the proposed public roadways will be collected via roadside ditch where it will be conveyed around the improved road surface and dispersed back to natural drainage ways.

Later improvements to individual lots will utilize infiltration, rain gardens, or other onsite stormwater management BMPs

The lots will be served by:

Individual Well/Septic	Water and Sanitary Sewer
Cowlitz County PUD	Electricity
Centurylink & Comast	Telecommunications

The subject project properties are completely bordered by undeveloped and single-family residential parcels with similar zoning.

SECTION 2 – EXISTING CONDITONS DESCRIPTION

The site is located on Tybren Heights Road about 1 mile from its intersection with Carrol Road. Existing parcels have already been subdivided in 2001 and the surrounding area is single family residential. Existing access easements provide owners with access to property but not addressable lots. Tybren Heights is paved for the first 800’ and then changes to a 20’ wide gravel road. Near the driveway for 240 Tybren Heights, this road necks down to 14’ wide and does not meet county standards for a private roadway. The remaining roadway up to the Kelso water tower would be considered driveway or logging road standard.

The project area is mainly wooded with some steeper slopes in the north and western region. Slopes fall from the east to the west where runoff is picked up by various locations along Tybren Heights and the new private road. Runoff is transported west of the site through natural drainage paths which eventually contribute to The City of Kelso storm water system and the Columbia River.

Vegetation onsite is consistent with native or second growth alder wood forest with most trees being deciduous. A few douglas fir, hemlock, and cedar trees are located onsite. Portions of some individual lots and the new road area has been cleared to facilitate construction already.

Soils in the area include Coweeman, Hazeldell, Olympic, and Stella soil classes. These classes include predominantly Silt loam. A soil survey indicates this area is predominately hydraulic group C, is moderately drained, and has some infiltration potential.

Two mapped landslide hazard areas (LHA) are located onsite. These LHAs are described in the geotechnical reports and shown in the plans. Evaluation of these LHAs show no indication of failures or restrict proposed road development. Setbacks for residential home construction have been identified in these geotechnical reports.

The project utilities and access improvements will be built in one phase. Driveway extensions and individual sites will be constructed as they are needed. The proposed construction schedule would be to start in summer of 2020. Initial phase of construction is expected to be complete prior to the start of the following wet season.

SECTION 3 – OFFSITE ANALYSIS REPORTS

The area immediately adjacent to the proposed project properties is:

- West – Urban portions of City of Kelso, residential lots, and wooded forest
- South - Residential lots and wooded forest
- East – Tybren Heights Road, residential lots, and wooded forest
- North – Residential lots, wooded forest, and City water reservoir

Properties to the north, west, and south slope away from the project and do not contribute runoff to the project site. The lot to the east has natural drainages which contribute seasonal runoff through portions of the property. These drainages will remain and are already culverted under Tybren Heights Road.

The proposed project plans to maintain the natural drainage paths by releasing stormwater at natural locations. Storm water coming onto the project from areas to the east is expected to stay in its natural course and no impacts inside the LHA areas are proposed. Since no impacts are anticipated a further upstream analysis was deemed not necessary. This area has not been flagged as a possible stormwater problem area. Due to this combined with the large size of the project site, the residential nature of

development, and the minimal percentage of additional impervious surfaces; a downstream analysis was deemed not necessary.

SECTION 4 – APPLICABLE MINIMUM REQUIREMENTS

The minimum requirements for stormwater development and redevelopment sites are listed in Volume 1 chapter 2 of the 2014 Washington State Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW) and the Kelso Engineering Design Manual (KEDM). Not all minimum requirements of this section apply to all projects. Determination of applicable minimum requirements is based on section 2.4 of the WSDOE SWMMWW.

Based on the thresholds given in figures 2.4.1 and 2.4.2 of the SWMMWW, the proposed Tybren Heights project incorporates greater than 5000 square feet of new impervious surface and thus must address all minimum requirements. These requirements as they apply to the project are discussed in more detail below.

Minimum Requirement #1 – Preparation of Drainage Control Plans:

A Stormwater Site Plan has been prepared (see Erosion Control and Drainage Plans).

Minimum Requirement #2 – Construction Stormwater Pollution Prevention Plan

A Construction Stormwater Pollution Prevention Plan (SWPPP) has been prepared. See section 6.

Minimum Requirement #3 – Source Control of Pollution

All known, available, and reasonable source control BMPs shall be applied to the project to limit pollutants from encountering stormwater. Construction specific BMP's will be provided during construction (see Section 6 SWPPP for reference).

Minimum Requirement #4 – Preservation of Natural Drainage Systems and Outfalls

Stormwater leaving the site will be either dispersed toward natural drainages or directed toward the roadside ditches of Tybren Heights and the new private road. Ditches will be dispersed back in natural drainages and be allowed to run through an appropriate distance of natural vegetation prior to leaving the site. The same discharge points will be used in both pre and post development. Improvements onsite do not propose to impact natural drainages inside their associated buffers.

Minimum Requirement #5 – On-site Stormwater Management

This project is inside the UGA/City Limits but is on a site larger than 5 acres. Therefore, The Low Impact Performance Standard and List #2 from Section 2.5.5 in Volume I of the SWMMWW is applicable.

The proposed Best Management Practice's (BMP's) are as follows:

Lawn and Landscape Areas:

- All disturbed areas not being covered with a hard surface and all new lawn and landscape areas will contain soils meeting the Post-Construction Soil Quality and Depth (BMP T5.13) requirements.

Roof Areas:

- While no roofs are proposed during the initial phase of road construction; future roof area on individual lots shall use Full Dispersion BMP (T5.30), Downspout Dispersion (T5.10B), Rain Gardens (T5.14A), or Perforated Stubouts (T5.10C). Full Dispersion (BMP T5.30) will be used on upper lots still in a forested condition.

Other Hard Surface Areas:

- Stormwater runoff from the new private roadway and driveways will be routed to new roadside ditches where it will utilize Sheet Flow Dispersion BMP (T5.12) initially and since the lots are still in their native condition will also use Full Dispersion BMP (T5.30)

Minimum Requirement #6 – Runoff Treatment

This project proposes to create more than 5000 square feet of pollution-generating hard surface (PGHS) and is subject to this minimum requirement.

However, impervious surfaces that are "fully dispersed" in accordance with BMP T5.30 in Volume V of the SWMMWW are not considered "effective" impervious surfaces. All PGHS in the Macomber Heights project will be fully dispersed per BMP T5.30, therefore, the net "effective" pervious surface is zero square feet making this project not subject to runoff treatment. For this reason, no runoff treatment calculations were performed or provided.

All new hard roadway surfaces for Tybren Heights and the new private roadway were evaluated. When dispersed at natural discharge points, all runoff will travel through the required native vegetation path to be considered fully dispersed.

New hard surfaces used on individual lots will also use full dispersion BMPs to disperse runoff through natural vegetation prior to leaving the site.

Minimum Requirement #7 – Flow Control

Since this project utilizes full dispersion (BMP T5.30) it does not create more than 10,000 square-feet of "effective" hard surface area; therefore, Flow Control minimum requirement #7 is not applicable. For this reason, no flow control calculations were prepared or provided.

Minimum Requirement #8 – Wetlands Protection

No onsite wetlands were mapped or observed. Furthermore, the thresholds identified in Minimum Requirement #6 – Runoff Treatment, and Minimum Requirement #7 – Flow Control are used to determine the applicability of this

requirement to discharges to wetlands. Since Minimum Requirements #6 and #7 are properly mitigated, Minimum Requirement #8 is considered satisfied.

Minimum Requirement #9 – Operation and Maintenance

Maintenance of storm drainage facilities (dispersion pads, conveyance ditches, etc..) will be the responsibility of the landowner whose property the individual structure is located on, or, a Homeowner's Association (HOA) if created. A storm drainage operation and maintenance plan is included in this report. If required by the City of Kelso, a performance bond or security can be obtained prior to final approval.

SECTION 5 – PERMANENT STORMWATER CONTROL PLAN

This project will utilize Full Dispersion BMP T5.30 and Post-Construction Soil Quality and Depth in accordance with BMP T5.13 from Chapter 5 of the SWMMWW. This allows "effective" impacted runoff area to be zero. No pre-post basin evaluation, treatment calcs or flow control calcs have been provided.

SECTION 6 – CONSTRUCTION SWPPP

This project is required to prepare a construction Storm Water Pollution Prevention Plan in accordance with Minimum Requirement #2 and must be prepared in accordance with Volume II chapter 3 of the SWMMWW.

This drainage and erosion control report is intended to supplement the construction SWPPP by utilizing other sections in this report to cover required narrative elements. Also, the construction and erosion control plans supplied for the project are to act as the required drawing component of the construction SWPPP.

Intended BMPs which should be used during construction include but are not limited to:

- BMP C101: Preserving Natural Vegetation
- BMP C102: Buffer Zones
- BMP C103: High Visibility Fence
- BMP C105: Stabilized Construction Entrance / Exit
- BMP C120: Temporary and Permanent Seeding
- BMP C123: Plastic Covering
- BMP C125: Topsoiling / Composting
- BMP C140: Dust Control
- BMP C153: Material Delivery, Storage and Containment
- BMP C160: Certified Erosion and Sediment Control Lead
- BMP C162: Scheduling
- BMP C233: Silt Fence

CONSTRUCTION STORMWATER POLLUTION PREVENTION PLAN (SWPPP)

FOR

TYBREN HEIGHTS DEVELOPMENT

300 Block Tybren Heights Road

Kelso, WA 98626

Prepared by:

FULLER DESIGNS

645 SE Prospect Street
Chehalis, WA 98532
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General Requirements

Clearing and grading activities for this project shall be permitted only to the approved site development plan. These clearing and grading areas were established to preserve sensitive areas, buffers, native growth protection easements, and tree retention areas. These areas are delineated on the site plans and shall be marked on the development site.

The SWPPP shall be implemented beginning with initial land disturbance and until final stabilization. Sediment and Erosion control BMPs shall be consistent with the BMPs contained in chapters 3 and 4 of Volume II of the SWMMWW.

Seasonal Work Limitations - From October 15 through April 1, clearing, grading, and other soil disturbing activities shall only be permitted if shown to the satisfaction of the local permitting authority that silt-laden runoff will be prevented from leaving the site through a combination of the following:

1. Site conditions including existing vegetative coverage, slope, soil type and proximity to receiving waters.
2. Limitations on activities and the extent of disturbed areas.
3. Proposed erosion and sediment control measures.

Project Requirements - Construction SWPPP Elements

In most cases, all the following elements shall apply and be implemented throughout construction. Self-contained sites (discharges only to groundwater) must comply with all elements except for Element 3: Control Flow Rates.

Element 1: Preserve Vegetation/Mark Clearing Limits

- Before beginning land disturbing activities, including clearing and grading, clearly mark all clearing limits, sensitive areas and their buffers, and trees that are to be preserved within the construction area.
- Retain the duff layer, native topsoil, and natural vegetation in an undisturbed state to the maximum degree practicable.

Element 2: Establish Construction Access

- Limit construction vehicle access and exit to one route, if possible.
- Stabilize access points with a pad of quarry spalls, crushed rock, or other equivalent BMPs, to minimize tracking of sediment onto public roads.
- Locate wheel wash or tire baths on site, if the stabilized construction entrance is not effective in preventing tracking sediment onto roads.
- If sediment is tracked off site, clean the affected roadway thoroughly at the end of each day, or more frequently as necessary (for example, during wet weather). Remove sediment from roads by shoveling, sweeping, or pick up and transport the sediment to a controlled sediment disposal area.
- Conduct street washing only after sediment is removed in accordance with the above bullet.

- Control street wash wastewater by pumping back on-site, or otherwise prevent it from discharging into systems tributary to waters of the State.

Element 3: Control Flow Rates

- Protect properties and waterways downstream of development sites from erosion and the associated discharge of turbid waters due to increases in the velocity and peak volumetric flow rate of stormwater runoff from the project site.
- Where necessary to comply with the bullet above, construct stormwater retention or detention facilities as one of the first steps in grading. Assure that detention facilities function properly before constructing site improvements (e.g. impervious surfaces).
- If permanent infiltration ponds are used for flow control during construction, protect these facilities from siltation during the construction phase.

Element 4: Install Sediment Controls

- Design, install, and maintain effective erosion controls and sediment controls to minimize the discharge of pollutants.
- Construct sediment control BMPs (sediment ponds, traps, filters, etc.) as one of the first steps in grading. These BMPs shall be functional before other land disturbing activities take place.
- Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.
- Direct stormwater runoff from disturbed areas through a sediment pond or other appropriate sediment removal BMP, before the runoff leaves a construction site or before discharge to an infiltration facility. Runoff from fully stabilized areas may be discharged without a sediment removal BMP but must meet the flow control performance standard in Element #3, bullet #1.
- Locate BMPs intended to trap sediment on-site in a manner to avoid interference with the movement of juvenile salmonids attempting to enter off-channel areas or drainages.
- Where feasible, design outlet structures that withdraw impounded stormwater from the surface to avoid discharging sediment that is still suspended lower in the water column.

Element 5: Stabilize Soils

- Stabilize exposed and unworked soils by application of effective BMPs that prevent erosion. Applicable BMPs include but are not limited to: temporary and permanent seeding, sodding, mulching, plastic covering, erosion control fabrics and matting, soil application of polyacrylamide (PAM), the early application of gravel base early on areas to be paved, and dust control.
- Control stormwater volume and velocity within the site to minimize soil erosion.
- Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize erosion at outlets and to minimize downstream channel and stream bank erosion.
- Soils must not remain exposed and unworked for more than the time periods set forth below to prevent erosion:
    - During the dry season (April 2 – October 14): 7 days

    - During the wet season (October 15 - April 1): 2 days
    - Note that projects performing work under a NPDES Construction Stormwater General Permit issued by Ecology will have more restrictive time periods.
- Stabilize soils at the end of the shift before a holiday or weekend if needed based on the weather forecast.
- Stabilize soil stockpiles from erosion, protected with sediment trapping measures, and where possible, be located away from storm drain inlets, waterways and drainage channels.
- Minimize the amount of soil exposed during construction activity.
- Minimize the disturbance of steep slopes.
- Minimize soil compaction and, unless infeasible, preserve topsoil.

Element 6: Protect Slopes

- Design and construct cut-and-fill slopes in a manner to minimize erosion. Applicable practices include, but are not limited to, reducing continuous length of slope with terracing and diversions, reducing slope steepness, and roughening slope surfaces (for example, track walking).
- Divert off-site stormwater (run-on) or ground water away from slopes and disturbed areas with interceptor dikes, pipes and/or swales. Off-site stormwater should be managed separately from stormwater generated on the site.
- At the top of slopes, collect drainage in pipe slope drains or protected channels to prevent erosion.
- Place excavated material on the uphill side of trenches, consistent with safety and space considerations.
- Place check dams at regular intervals within constructed channels that are cut down a slope.

Element 7: Protect Drain Inlets

- Protect all storm drain inlets made operable during construction so that stormwater runoff shall not enter the conveyance system without first being filtered or treated to remove sediment.
- Clean or remove and replace inlet protection devices when sediment has filled one-third of the available storage (unless a different standard is specified by the product manufacturer).

Element 8: Stabilize Channels and Outlets

- Design, construct, and stabilize all on-site conveyance channels.
- Provide stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes and downstream reaches at the outlets of all conveyance systems.

Element 9: Control Pollutants

- Design, install, implement and maintain effective pollution prevention measures to minimize the discharge of pollutants.

- Handle and dispose of all pollutants, including waste materials and demolition debris that occur on-site in a manner that does not cause contamination of stormwater.
- Provide cover, containment, and protection from vandalism for all chemicals, liquid products, petroleum products, and other materials that have the potential to pose a threat to human health or the environment. On-site fueling tanks must include secondary containment. Secondary containment means placing tanks or containers within an impervious structure capable of containing 110% of the volume contained in the largest take within the containment structure. Double-walled tanks do not require additional secondary containment.
- Conduct maintenance, fueling, and repair of heavy equipment and vehicles using spill prevention and control measures. Clean contaminated surfaces immediately following any spill incident.
- Discharge wheel wash or tire bath wastewater to a separate on-site treatment system that prevents discharge to surface water, such as closed-loop recirculation or upland application, or to the sanitary sewer, with local sewer district approval.
- Apply fertilizers and pesticides in a manner and at application rates that will not result in loss of chemical to stormwater runoff. Follow manufacturers' label requirements for application rates and procedures.
- Use BMPs to prevent contamination of stormwater runoff by pH modifying sources. The sources for this contamination include, but are not limited to: bulk cement, cement kiln dust, fly ash, new concrete washing and curing waters, waste streams generated from concrete grinding and sawing, exposed aggregate processes, dewatering concrete vaults, concrete pumping and mixer washout waters.
- Adjust the pH of stormwater if necessary to prevent violations of water quality standards.
- Assure that washout of concrete trucks is performed off-site or in designated concrete washout areas only. Do not wash out concrete trucks onto the ground, or into storm drains, open ditches, streets, or streams. Do not dump excess concrete on-site, except in designated concrete washout areas. Concrete spillage or concrete discharge to surface waters of the State is prohibited.
- Obtain written approval from Ecology before using chemical treatment other than CO2 or dry ice to adjust pH.

Element 10: Control De-Watering

- Discharge foundation, vault, and trench de-watering water, which has similar characteristics to stormwater runoff at the site, into a controlled conveyance system before discharge to a sediment trap or sediment pond.
- Discharge clean, non-turbid de-watering water, such as well-point ground water, to systems tributary to, or directly into surface waters of the State, as specified in Element #8, provided the de-watering flow does not cause erosion or flooding of receiving waters. Do not route clean dewatering water through stormwater sediment ponds. Note that "surface waters of the State" may exist on a construction site as well as off site; for example, a creek running through a site.
- Handle highly turbid or otherwise contaminated dewatering water separately from stormwater.
- Other treatment or disposal options may include:
    1. Infiltration.

2. Transport off-site in a vehicle, such as a vacuum flush truck, for legal disposal in a manner that does not pollute state waters.
3. Ecology-approved on-site chemical treatment or other suitable treatment technologies.
4. Sanitary or combined sewer discharge with local sewer district approval, if there is no other option.
5. Use of a sedimentation bag that discharges to a ditch or swale for small volumes of localized dewatering.

Element 11: Maintain BMPs

- Maintain and repair all temporary and permanent erosion and sediment control BMPs as needed to assure continued performance of their intended function in accordance with BMP specifications.
- Remove all temporary erosion and sediment control BMPs within 30 days after achieving final site stabilization or after the temporary BMPs are no longer needed.

Element 12: Manage the Project

- Phase development projects to the maximum degree practicable and consider seasonal work limitations.
- Inspection and monitoring – Inspect, maintain and repair all BMPs as needed to assure continued performance of their intended function. Projects regulated under the Construction Stormwater General Permit must conduct site inspections and monitoring in accordance with Special Condition S4 of the Construction Stormwater General Permit.
- Maintaining an updated construction SWPPP – Maintain, update, and implement the SWPPP.
- Projects that disturb one or more acres must have site inspections conducted by a Certified Erosion and Sediment Control Lead (CESCL). Project sites disturbing less than one acre may have a CESCL or a person without CESCL certification conduct inspections. By the initiation of construction, the SWPPP must identify the CESCL or inspector, who must be present onsite or on-call at all times.
- The CESCL or inspector (project sites less than one acre) must have the skills to assess the:
    - Site conditions and construction activities that could impact the quality of stormwater.
    - Effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.
- The CESCL or inspector must examine stormwater visually for the presence of suspended sediment, turbidity, discoloration, and oil sheen. They must evaluate the effectiveness of BMPs and determine if it is necessary to install, maintain, or repair BMPs to improve the quality of stormwater discharges.
- Based on the results of the inspection, construction site operators must correct the problems identified by:
    - Reviewing the SWPPP for compliance with the 13 construction SWPPP elements and making appropriate revisions within seven (7) calendar days of the inspection.
- Immediately beginning the process of fully implementing and maintaining appropriate source control and/or treatment BMPs as soon as possible, addressing the problems not

later than within 10 days of the inspection. If installation of necessary treatment BMPs is not feasible within 10 days, the construction site operator may request an extension within the initial 10day response period.

- Documenting BMP implementation and maintenance in the site log book (sites larger than 1 acre).
- The CESCL or inspector must inspect all areas disturbed by construction activities, all BMPs, and all stormwater discharge points at least once every calendar week and within 24 hours of any discharge from the site. (For purposes of this condition, individual discharge events that last more than one day do not require daily inspections. For example, if a stormwater pond discharges continuously over the course of a week, only one inspection is required that week.) The CESCL or inspector may reduce the inspection frequency for temporary stabilized, inactive sites to once every calendar month.

Element 13: Protect Low Impact Development BMPs

- Protect all Bioretention and Rain Garden BMPs from sedimentation through installation and maintenance of erosion and sediment control BMPs on portions of the site that drain into the Bioretention and/or Rain Garden BMPs. Restore the BMPs to their fully functioning condition if they accumulate sediment during construction. Restoring the BMP must include removal of sediment and any sediment-laden Bioretention/rain garden soils, and replacing the removed soils with soils meeting the design specification.
- Prevent compacting Bioretention and rain garden BMPs by excluding construction equipment and foot traffic. Protect completed lawn and landscaped areas from compaction due to construction equipment.
- Control erosion and avoid introducing sediment from surrounding land uses onto permeable pavements. Do not allow muddy construction equipment on the base material or pavement. Do not allow sediment-laden runoff onto permeable pavements or base materials.
- Pavement fouled with sediments or no longer passing an initial infiltration test must be cleaned using procedures in accordance with this manual or the manufacturer's procedures.
- Keep all heavy equipment off existing soils under LID facilities that have been excavated to final grade to retain the infiltration rate of the soils.

SECTION 7 – SPECIAL REPORTS AND STUDIES

Three separate Geotechnical studies were performed on the project by Strata Design. These studies evaluated 2 individual properties (lots 12 and 13) and the new roadway areas. These reports are included below.

February 28, 2019

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SUBJECT: **Preliminary Geotechnical Assessment Report**
Proposed Private Road and Tybren Heights Road
Kelso, Washington

INTRODUCTION

Strata Design LLC (STRATA) has prepared this Report for the proposed residential development along Unnamed Proposed Private Road , located west of Tybren Heights Road in Kelso, Washington (see Site Plan, Figure 1). The purpose of this report is to evaluate the existing gravel roads providing access to the proposed residential development and to provide recommendations for road improvements. This report has been prepared in accordance with Cowlitz County Code (CCC 19.15.150) which defines the site as within a critical area.

Project Description

Development plans includes extending a new private road, west from the existing Tybren Heights Road. The portion of Proposed Private Road evaluated for this study included that portion which is north of Lots 12 and 13. The portion of Tybren Heights Road evaluated for this study is shown on the attached Site Plan and is identified by the labels “Start Tybren Heights Road Evaluation” and “End Tybren Heights Road Evaluation”. A future extension of the Proposed Private Road thy Lane to the west of Lot 12 may be proposed at a later date, but that portion of Proposed Private Road was not included in this study. Tybren Heights Road is an existing road. A Access Drive has been recently constructed in Private Road proposed ROW.

Mapped Landslides

According to the Cowlitz County GIS mapping (NetMaps[1]), two portions of Tybren Heights Road are within an area mapped as active deep seated landslides (see Mapped Landslides, Figure 2).

SITE RECONNAISSANCE

On February 21, 2019, STRATA performed a site reconnaissance and excavated four test pits within the existing roads at the locations shown on the attached Site Plan, Figure 1. No evidence of recent slope instability was observed within the portions of Tybren Heights Road evaluated for this study. No subsidence, cracking, or indications of stress were observed. The road appeared intact and undisturbed.

[1] http://www.cowlitzinfo.net/netmaps25/index.html?App=EPIC&

The test pits were excavated within the existing roads using hand tool. The test pits were excavated through the road's rock section to the underlying soil subgrade, except test pit TP-4 which was terminated within the rock section. The rock sections observed in test pits TP-1 through TP-3 generally consisted of medium dense, angular gravel with well graded cobbles up to 10 inches in diameter. Test pit TP-4 encountered 4 inches of dense, 2"-0 angular gravel, overlying dense, angular gravel with cobbles up to 6 inches in diameter.

Dynamic Cone Penetrometer (DCP) tests were performed within the soil subgrade exposed in test pits TP-1, TP-2 and TP-3. DCP tests were performed to assess the suitability of the native soils for support of the gravel road. Tests were performed in general accordance with ASTM D6951/D6951M-09, Standard Test Method for Use of the Dynamic Cone Penetrometer in Shallow Pavement Applications. The average penetration per blow was used to determine the correlated California Bearing Ratio (CRB).

Rock Thickness and DCP Field Test Results

Test Pit	Test Location	Rock Thickness (Inches)	DCP Material Tested	DCP Depth Interval (feet)	Average Penetration Per Blow (mm)	Correlated CBR
TP-1	See Figure 1	13	Native Silt	1.1 – 3.0	9	12
TP-2	See Figure 1	7.5	Native Silt	0.6 – 2.7	12	8
TP-3	See Figure 1	8.3	Native Silt	0.7 – 2.7	10	10
TP-4	See Figure 1	> 15.5	NA	NA	NA	NA

Conclusions / Recommendations

The portions of the Access Drive and Tybren Heights Road evaluated for this study appeared stable. No indications of recent slope instability were observed. The recently constructed Access Lane is not expected to adversely affect slope stability of the site or nearby properties.

Tybren Heights Road consisted of more than 15.5 inches of dense gravels and cobbles and is considered suitable for support of anticipated traffic, including occasional use by large trucks such as emergency vehicles.

The Access Drive consisted of angular gravel and cobbles up to 10 inches in diameter and the rock section ranged in thickness from 7.5 inches to 13 inches. Underlying the rock section, competent, native soils were observed. These soils are anticipated to provide adequate stability and bearing capacity for the road. The rock material used to construct the Access Lane has an excessive amount of large cobble and does not provide a suitable driving surface. Except for a very small portion of the Access Lane near the intersection with Tybren Heights Road, no level course / driving surface rock was observed. We recommend a leveling course consisting of a minimum of 2 inches of 1.5"-0 crushed rock be applied over

the existing road. Where the existing rock section has a thickness of less than 10 inches, the leveling course thickness should be increased to provide a total rock section thickness of 12 inches. Aggregate base should be placed in one lift and compacted to not less than 95% of the modified Proctor maximum dry density (ASTM D1557).

General Subgrade Preparation

Portions of the Proposed Private Road will require widening. Within these areas, surficial organic soils should be removed to expose competent non-organic native soils. Soft soil encountered below the organic layer should be removed and replaced with stabilization material or otherwise mitigated through consultation with the qualified professional. Stabilization may be achieved by additional excavation to firm, stable subgrade, and replacement with compacted structural fill or stabilization rock (e.g. 4-inch-minus crushed rock). Separation geotextiles and geogrid reinforcement of subgrade soils can also be utilized to stabilize soft or yielding areas.

Private Road Section

Portions of Proposed Private Road will require widening. Within these areas, the new road should be constructed with a minimum of 9 inches of 2”-0 crushed aggregate base course and 3 inches of 1.5”-0 crushed aggregate surface course. The crushed rock should have no more than 5 percent of the material passing the U.S. Standard No. 200 Sieve, and be compacted to not less than 95% of the modified Proctor maximum dry density (ASTM D1557). If needed for stabilization, the first lift may consist of 4”-0 crushed aggregate. In our opinion, the recommended new road section is suitable for support of emergency vehicles with a gross vehicular weight of 75,000 pounds, with point loads up to 12,500 pounds.

Drainage

Site drainage grades should be developed and maintained to promote surface runoff. This should include the use of ditches and culverts. Test pit TP-3 observed 3 inches of water within the rock section pooled above the silt soil subgrade. Ditches should be constructed to minimize ponding within the roadway.

Limitations

Our work has been conducted in general conformance with CCC 19.15.150 and the standard of care in the field of geotechnical engineering practice in the Pacific Northwest for projects of this nature and magnitude. No warranty, expressed or implied, exists on the information presented in this report. By utilizing the design recommendations within this report, the addressee acknowledges and accepts the risks and limitations of residential hillside lot development.

If the above proposal is amended or additional development plans arise beyond the above described assumptions, additional geotechnical assessment or analysis may be necessary in order to quantify the potential impact of slopes, landslide or other geologic hazards.

Statement of Qualification

Mr. Randall Goode, currently Licensed Washington Professional Engineer, conducted the site inspection,

reviewed the applicable geologic publications and related records, and was the primary author of this report. Mr. Goode is a geotechnical professional with 25 years of related experience and has prepared and managed numerous geotechnical site assessments throughout Cowlitz County, and meets the requirements of professional qualifications, including those identified under CCC 19.15.050.

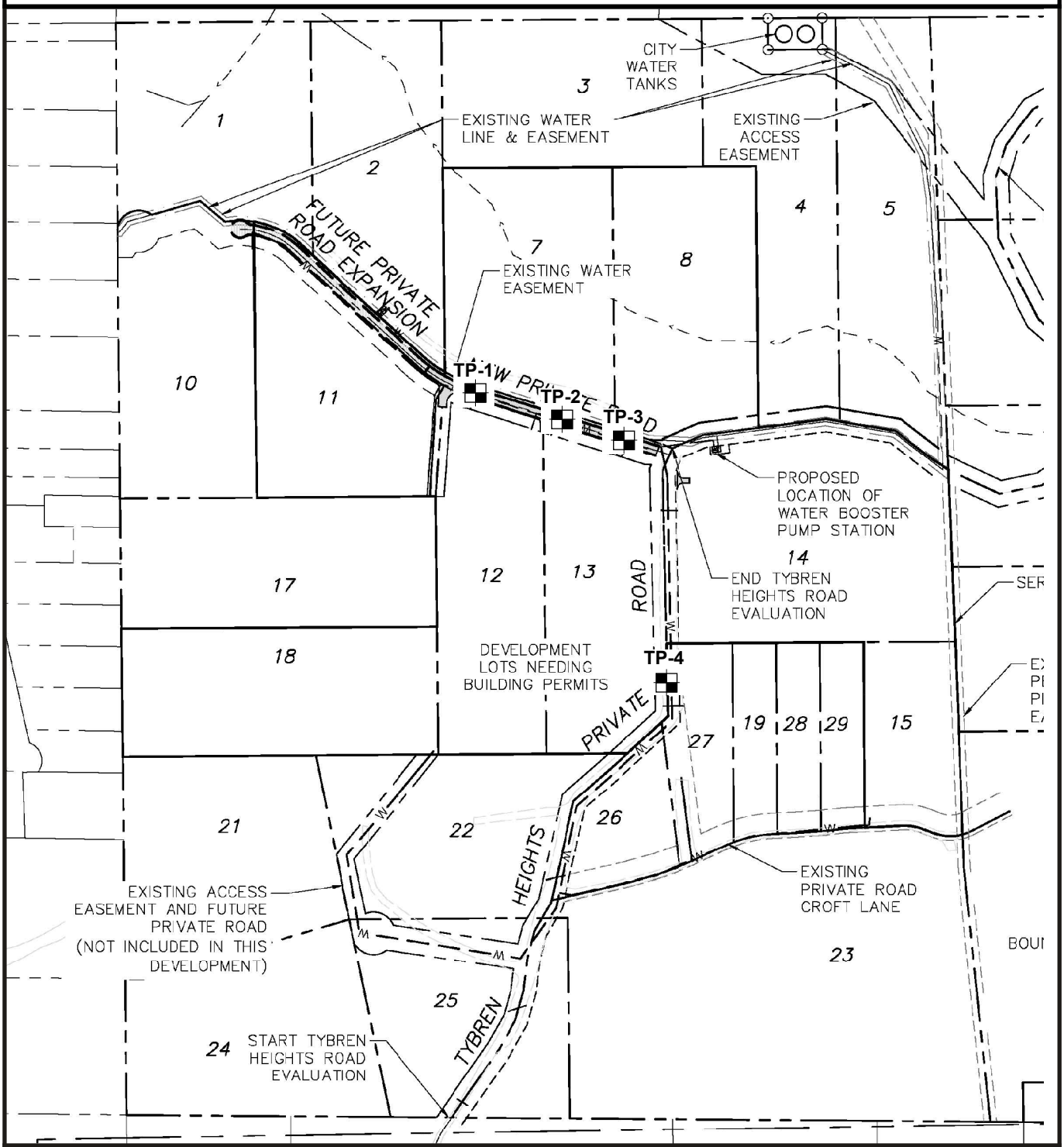
Sincerely,
STRATA DESIGN, LLC

Randy Goode. P.E.

Attachments:

Figure 1:	Site Plan
Figure 2:	Mapped Landslides

SITE PLAN



Legend

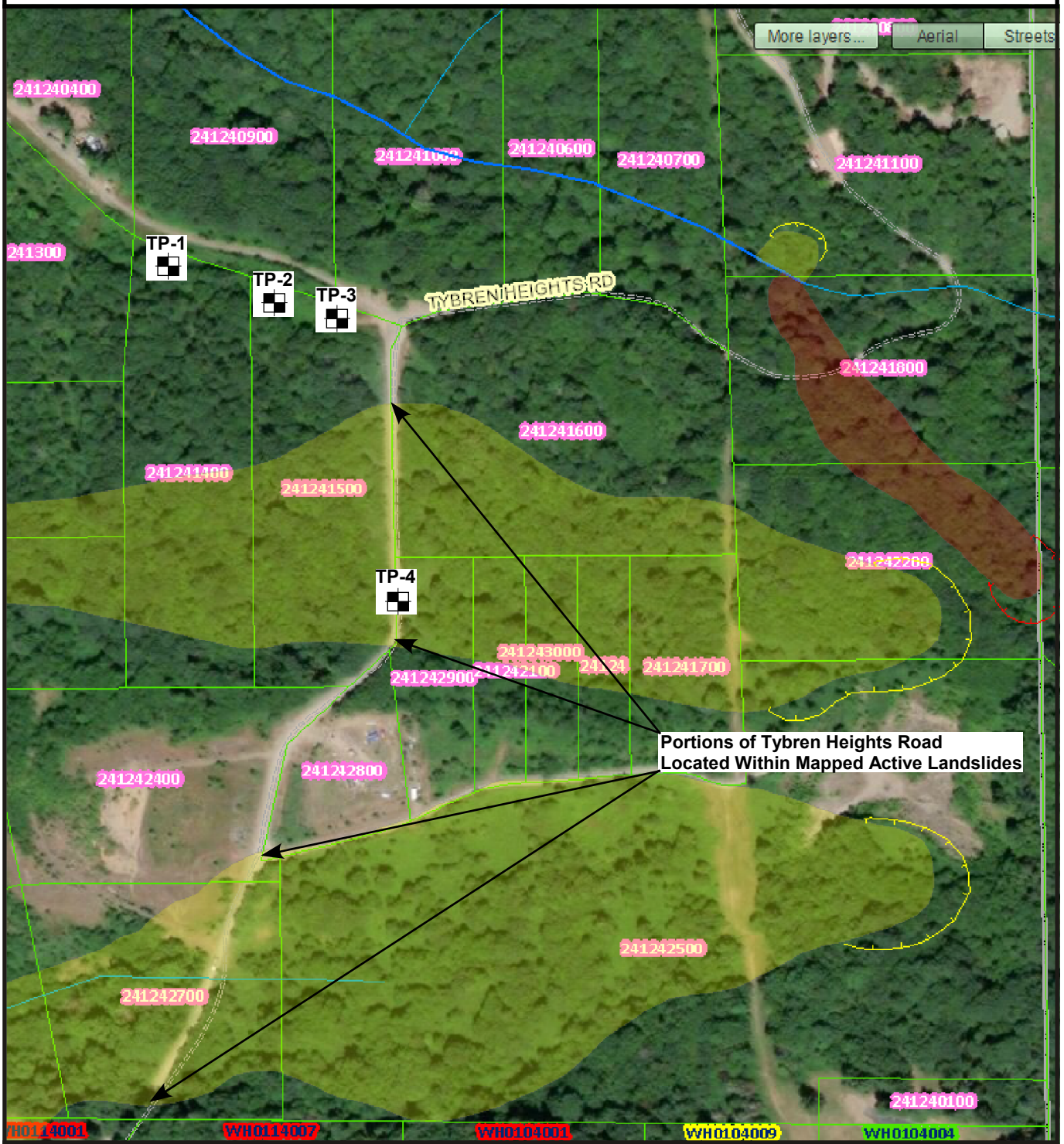
TP-4 Test Pit

NORTH
NO SCALE

Project: Dorothy Lane and Tybren Heights Road
Kelso, Washington

FIGURE 1

MAPPED LANDSLIDES



Legend

TP-4 Test Pit

Base map provided by Cowlitz County Netmaps

NORTH
NO SCALE

Project: Dorothy Lane and Tybren Heights Road
Kelso, Washington

FIGURE 2

September 10, 2018

Randy Bjur
Email: randy.bjur@gmail.com
Cell: 360 901-4781

SUBJECT: *GEOTECHNICAL ASSESSMENT*
PROPOSED SINGLE FAMILY HOME, SHOP AND DRAINFIELD
LOT 12, TYBREN HEIGHTS ROAD, KELSO, WA

Introduction

Per your request, Strata Design LLC (STRATA) has prepared this Report of Geotechnical Assessment with respect to proposed residential dwelling unit and shop building. The purpose of this report is to address the potential of landslide hazards relative to the steep slopes which are present at the site. The property is located within incorporated Kelso, Washington, as shown in the site vicinity map (Figure 1, attached).

The southern portion of the parcel is mapped within what is mapped as "active, deep seated landslide", as depicted in Figure 2. City of Kelso development code stipulates that a geotechnical assessment be completed as part of the building development application. In preparation of this report, STRATA conducted a field reconnaissance and studied relevant geologic maps, roadside cut slope features, and observed backhoe excavated test holes this past August (2018).

In preparation of this report, STRATA conducted field reconnaissance, and observed soil exploration test holes. In addition, we reviewed available geologic maps, well log(s) and other published references and available information, and we provide site development recommendations.

Project Description

The proposed location for the building site on the property is shown in FIGURE 2. We understand the proposed development is to construct an accessory structure (pole building) nearest to the road easement, and construct a single family dwelling to the south of the pole building. Water service would be from the local water district.

Local Geology

According to DNR landslide inventory publication (Wegmann[1]), which provided a geologic hazard study of the Cowlitz County Urban Corridor, the study site is located within the margins of a mapped deep-seated landslide. The publication cites the landslide character as a subtle topographic depression, possibly originating along the contact between Troutdale formation (fluvial deposits) and the overlying Basaltic andesite. The study also cites the concentrated water discharge from the upgradient commercial quarry operation as a possible trigger to the slide. The quarry is located about ½ mile east.

From the online Natural Resources Conservation Service (NRCS) soil survey[2], the surface deposition at this property is designated as "Coweeman silt loam in the upland, north portion of the site, and Olympic silt loam across the remainder of the site. The area soil cover is not generally considered to be in the category of "severe" or "very severe" for erosion hazard.

[1] Wegmann, K.W., 2003, "Digital Landslide Inventory for the Cowlitz County Urban Corridor Kelso to Woodland", Washington Division of Geology and Earth Resources, Report of Investigations 34, Version 1.0.
[2] http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Area Landslides

The site lies in the Western Cascades geologic province near the northern margin of the Portland Basin, which forms the southern portion of the Puget Lowlands. Following mild folding, faulting and erosion, the bedrock units in the Western Cascade Range volcanic arc formed a low-relief terrain within which the Portland Basin began to develop. Basaltic lavas of the Miocene-age Columbia River Basalt Group and fluvial deposits of the ancestral Columbia River were deposited on the older Paleogene bedrock within the subsiding or 'pull-apart' Portland basin. Erosion during the geologically recent (late Pleistocene-age, +/- 14,000 ya) Missoula Catastrophic Floods, caused by periodic failure of the ice dam that impounded water in glacial Lake Missoula, is interpreted to have created a flow-through channel or terrace that is present below an elevation of about 300 feet. In the area around the town of Kalama, Washington, this flood-terrace feature is approximately ½ to ¾ miles wide and extends to the south for a distance of approximately four (4) miles. The stripped flood terraces can be identified by the wide, level and gently sloping ground surfaces with the occasional basalt bedrock ridges or buttes protruding above the flood plain surface. Basaltic and andesitic rock outcrops and flat-topped depositional surfaces with thin deposits of micaceous and pumiceous sands along their bases, indicate stripping by the rising and peak floodwaters and sedimentation by slack and receding floodwaters.

Characteristic throughout the Columbia River corridor region of Cowlitz County, larger ancient landslides occurred hundreds or even thousands of years ago as the result of geologic equilibrium actions during repeated cycles of heavy, sustained rainfall events and seismic activity.

SITE ASSESSMENT

The undersigned professional completed a reconnaissance of the study site to observe all potential geologic or landslide hazards that may be associated with the proposed site improvements. Work consisted of traversing the site and the nearby vicinity of about 200 feet or more each direction from the proposed grading areas. In addition, we evaluated the surrounding terrain utilizing our map of 2-foot elevation contours created from LiDAR point cloud data obtained by the DNR in 2016 (see Figure 2, attached).

The immediate building site is within nearly level grades that were previously stripped of surficial organic soils, exposing relatively hard ground at the surface of the house pad. No seeps or springs were observed near the homesite. Based on the surface expressions or patterns, we see no visual evidence of past fill placed in proximity to the proposed development zones. The proposed foundation for the home and pole barn would be placed on existing site grades which drain from north to south on grade of 12 to 15 percent.

We did not characterize patterns of irregular and/or hummocky ground or structural evidence of landslide activity within the proposed development zone. As shown in Figure 2, the development zone is defined as the topography to the north of the distinct drainage draw that flows east to west across the lot. Based on our reconnaissance, the gradual (12% to 25%) slope terrain to the north of the draw and surrounding the building sites, exhibit relatively stiff consistencies, with no exposed contacts between units that would appear to act as slip planes or seepage pathways.

Based on our observations of the soil test pits excavated between the proposed location of the home and shop, we observed no significant soil slumping or sloughing and we observed no bedding plane contacts that can often lead to slide planes. Soils explored are observed to be light gray silts and clays with increasing stiffness at about 5 feet depth. The test pits indicate that slope soils are consistent with the

NRCS soil classifications. The fine-textured soils along the hill slope are capped by loose, organic-rich topsoil.

The geomorphology of the southern portion of the property indicates slope movements at some time in the indeterminate past. That portion of the site is designated in Figure 2 (attached) as a no-development zone. The morphology within the southern portion of the tax lot resembles a transition stage between 'dormant-young' and 'dormant-mature'.

Conclusions / Recommendations

For the proposed location of work, it is our belief, based on the surrounding slope setting and conditions observed, that the proposed development is feasible in the context of maintaining a stable slope setting. As is generally the case for hillside sites, constraints exist to the development in the form of the surrounding slope grades. For the described project scope and location, development along with adhering to building codes and best management practices is unlikely to trigger future landslides at the site and surrounding area.

Our summary of key findings and considerations applicable to development of the site are the following:

- Within the scope of this reconnaissance, no former fill areas, of scale of concern, are identified to exist throughout the property.
- Seasonally perched groundwater conditions appear to exist in many portions of the site. Installation of drainage measures surrounding the structure foundation zones should be considered.
- Grades should be developed and maintained to drain perimeter surface and roof runoff away from foundation subgrade soils and prevent ponding.
- Cut slopes should be revegetated to prevent erosion hazards. Surrounding grades should be shaped to allow continuance of drainage away from proposed structures.

In accordance with current building codes, we recommend the foundation plans include subdrain lines, generally placed within 6-inches of the bottom of the footing, and no further than 18" horizontal distance from the outer face. All foundation drain lines should be 'tight-lined' to a suitable, non-erosive discharge area a minimum of 10-feet distance from the structure. We recommend that footings be embedded through all soils containing or organic/root zones.

In general, stormwater runoff resulting from the site grading development should prevent areas of local surface ponding from occurring, unless engineered. We advise that gravel (quarry spall, etc.) pads be placed at the outlet locations of pipe(s), and that drain outlets be placed down the slope of the river bank.

Limitations

Our work has been conducted in general conformance with the standard of care in the field of geotechnical engineering practice in the Pacific Northwest for projects of this nature and magnitude. No warranty, expressed or implied, exists on the information presented in this report. By utilizing the design recommendations within this report, the addressee acknowledges and accepts the risks and limitations of residential hillside lot development.

If the above proposal is amended or additional development plans arise beyond the above described assumptions, additional geotechnical assessment or analysis may be necessary in order to quantify the potential impact of slopes, landslide or other geologic hazards.

Statement of Qualification

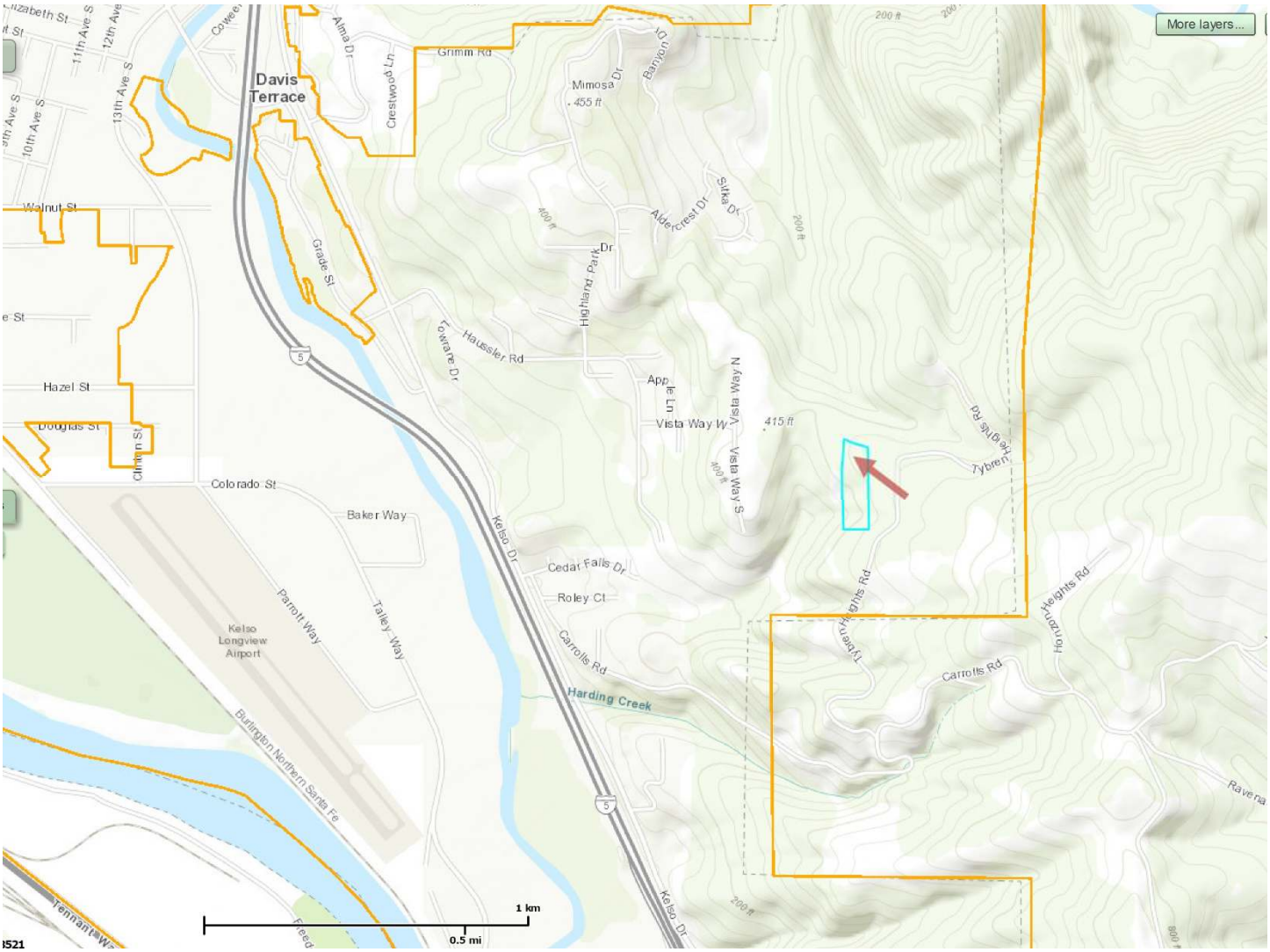
Mr. Randall Goode, currently Licensed Washington Professional Engineer, conducted the site inspection, reviewed the applicable geologic publications and related records, and was the primary author of this report. Mr. Goode is a geotechnical professional with 25 years of related experience and has prepared and managed numerous geotechnical site assessments throughout Cowlitz County, and meets the requirements of professional qualifications, including those identified under CCC 19.15.050.

Respectfully Submitted,
STRATA DESIGN, LLC

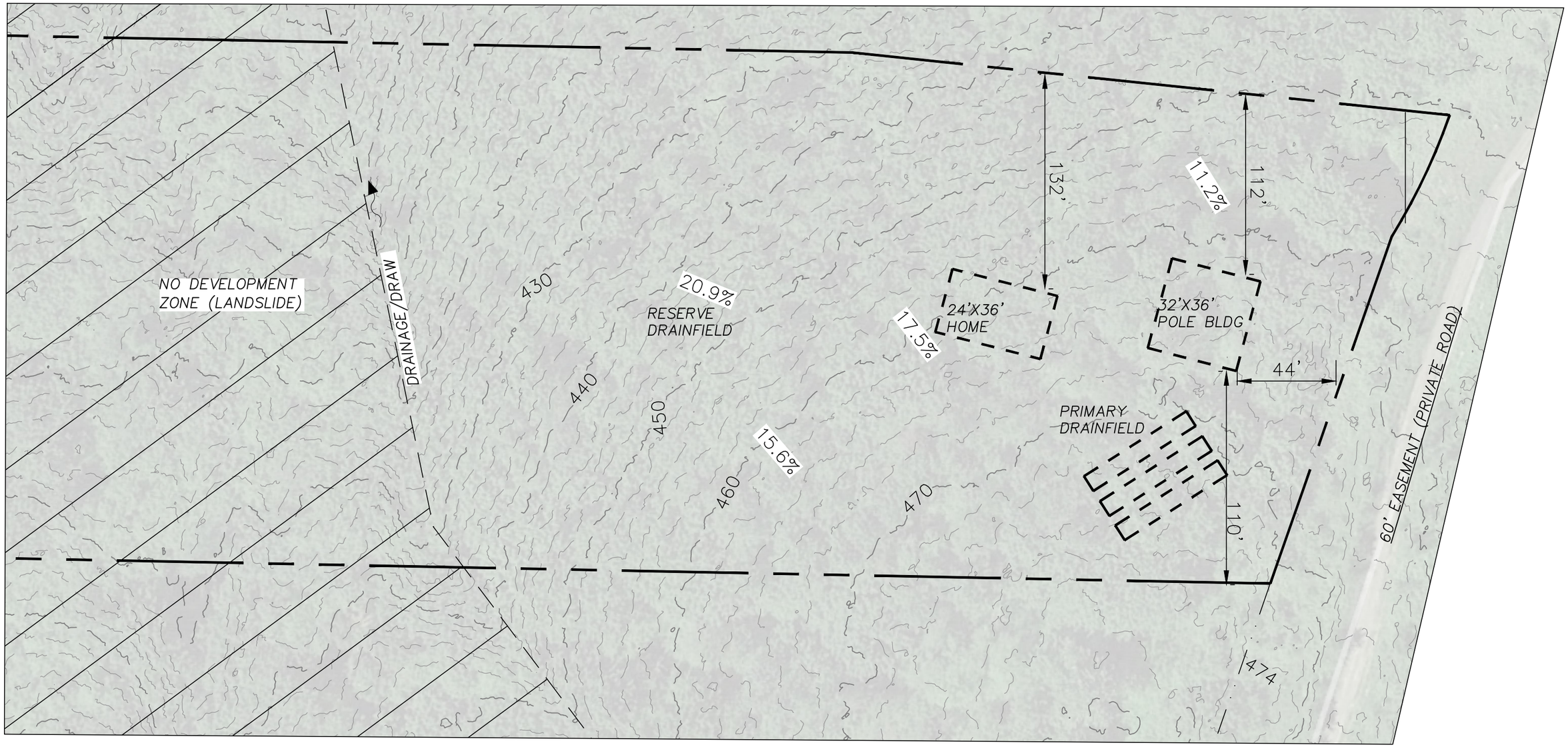
Randy Goode. P.E.

ATTACHMENTS:

APPENDIX A:
Figure 1: DNR Map (GIS Landslides)
Figure 2: Site Plan
Figure 3: Landslide Inventory Map



STRATADESIGN 519 SW Park Ave, #410 • Portland OR 97205 503 • 819 • 4423 STRATA-DESIGN.COM	VICINITY MAP LOT 12, TYBREN HEIGHTS RD KELSO, WA	FIGURE 1



NOTES:
2–FT CONTOUR INTERVALS (USACE, 2016 LIDAR)
SCALE: 1" = 50'

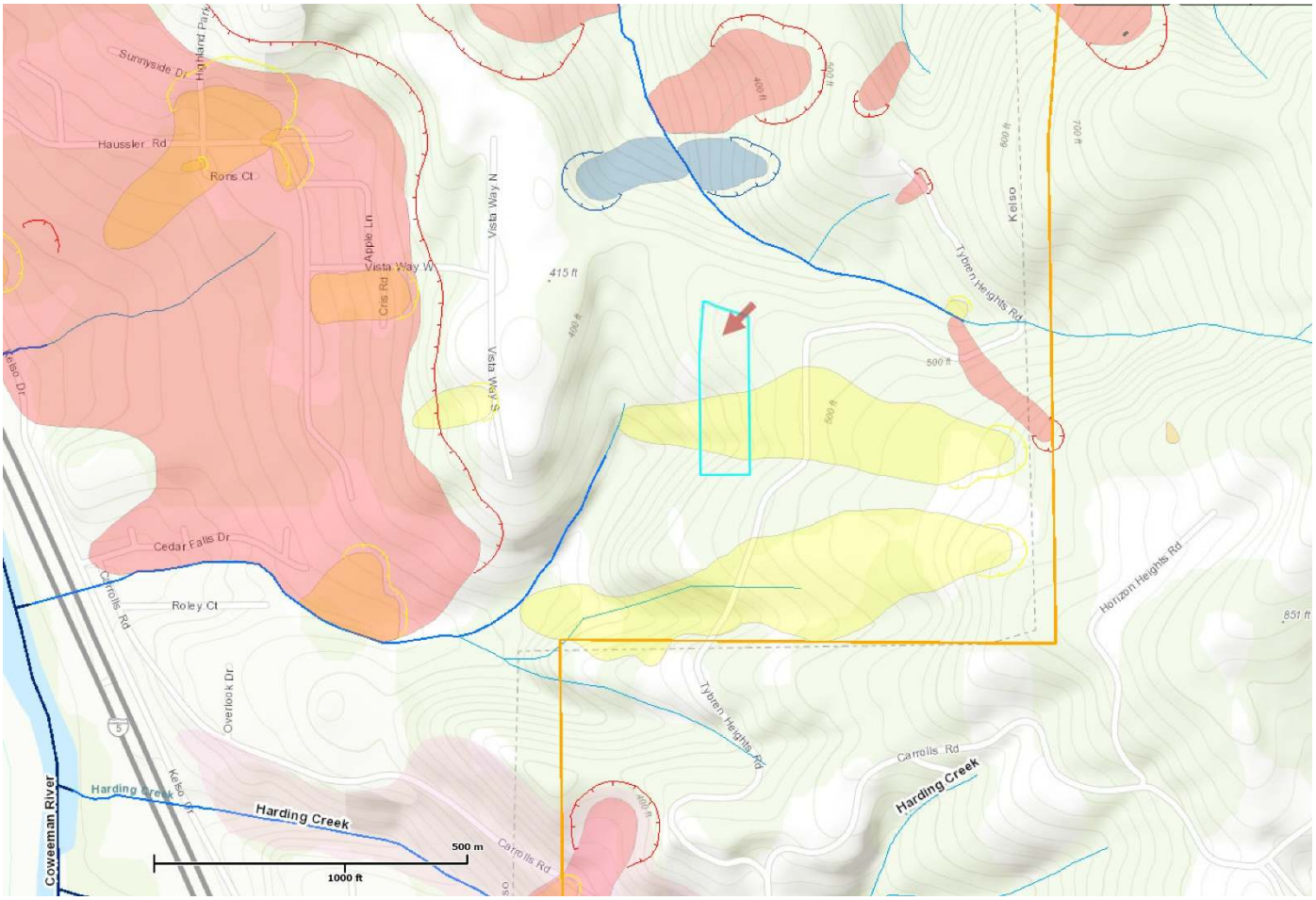
0 50 100 Feet

STRATA DESIGN
519 SW Park Ave, #410 • Portland OR 97205
503 • 819 • 4423 STRATADESIGN.COM

PLOT PLAN FOR LOT 12

TYBREN HEIGHTS RD.
KELSO, WA

PROJECT:	2018–
DRAWN:	RSG
CHECKED:	RSG
DATE:	2018
REVISIONS:	



LANDSLIDE DATA SOURCE: WEGMANN, K.W., 2006, "DIGITAL LANDSLIDE INVENTORY FOR THE COWLITZ COUNTY URBAN CORRIDOR KELSO TO WOODLAND", WASHINGTON DIVISION OF GEOLOGY AND EARTH RESOURCES, REPORT OF INVESTIGATIONS 35.

Legend

- Sag Ponds
- Inactive Landslide Area (not field surveyed)
- Deep Seated Landslide Area
- Active Landslide Area
- Potentially Unstable Slope Area
- Approximate location of a Spring

STRATADESIGN 519 SW Park Ave, #410 • Portland OR 97205 503 • 819 • 4423 STRATA-DESIGN.COM	LANDSLIDE INVENTORY MAP LOT 12, TYBREN HEIGHTS RD KELSO, WA	FIGURE 3

December 12, 2019

Randy Bjur
Email: randy.bjur@gmail.com
Cell: 360 901-4781

SUBJECT: *GEOTECHNICAL ASSESSMENT*
PROPOSED SINGLE FAMILY HOME, SHOP AND DRAINFIELD
LOT 13, TYBREN HEIGHTS ROAD, KELSO, WA

Introduction

Per your request, Strata Design LLC (STRATA) has prepared this Report of Geotechnical Assessment with respect to proposed residential dwelling unit and shop building. The purpose of this report is to address the potential of landslide hazards relative to the steep slopes which are present at the site. The property is located within incorporated Kelso, Washington, as shown in the site vicinity map (Figure 1, attached).

The southern portion of the parcel is mapped within what is mapped as "active, deep seated landslide", as depicted in Figure 1, based on the WA-DNR landslide inventory publication (Wegmann[1]). Therefore, per City of Kelso development codes, a geotechnical report is required to be completed as part of the building and site development application. In preparation of this report, STRATA conducted a field reconnaissance and studied relevant geologic maps, roadside cut slope features, and observed backhoe excavated test holes.

In preparation of this report, STRATA conducted field reconnaissance, and observed soil exploration test holes. In addition, we reviewed available geologic maps, well log(s) and other published references and available information, and we provide site development recommendations.

Project Description

The proposed location for the building site on the property is shown in FIGURE 2. We understand the proposed development is to construct an accessory structure (pole building) nearest to the road easement, and construct a single family dwelling to the south of the pole building. Water service would be from the local water district. In September 2018, STRATA completed a geotechnical report for the adjoining vacant lot to the west (Lot 12)[2].

Local Geology

According to the Wegmann publication, which provided a geologic hazard study of the Cowlitz County Urban Corridor, the study site is located within the margins of a mapped deep-seated landslide. The landslide is cited in the publication as a subtle topographic depression, possibly originating along the contact between Troutdale formation (fluvial deposits) and the overlying Basaltic andesite. The study also cites a source of concentrated water discharge from an upgradient commercial rock quarry as a possible contributor to the slide. The quarry is located about ½ mile east.

From the online Natural Resources Conservation Service (NRCS) soil survey, the surface deposition at this property is designated as Coweeman silt loam in the upland (proposed development) portion of the site, and Olympic silt loam across the southern portion of the site. The area soil cover is listed as soil erosion category of severe.

---

[1] Wegmann, K.W., 2003, "Digital Landslide Inventory for the Cowlitz County Urban Corridor Kelso to Woodland", Washington Division of Geology and Earth Resources, Report of Investigations 34, Version 1.0.

[2] Geotechnical Assessment report for Lot 12, Tybren Heights Road, Kelso, WA, by Strata Design, LLC, dated September 18, 2018

Area Landslides

The site lies in the Western Cascades geologic province near the northern margin of the Portland Basin, which forms the southern portion of the Puget Lowlands. Following mild folding, faulting and erosion, the bedrock units in the Western Cascade Range volcanic arc formed a low-relief terrain within which the Portland Basin began to develop. Basaltic lavas of the Miocene-age Columbia River Basalt Group and fluvial deposits of the ancestral Columbia River were deposited on the older Paleogene bedrock within the subsiding or 'pull-apart' Portland basin. Erosion during the geologically recent (late Pleistocene-age, +/- 14,000 ya) Missoula Catastrophic Floods, caused by periodic failure of the ice dam that impounded water in glacial Lake Missoula, is interpreted to have created a flow-through channel or terrace that is present below an elevation of about 300 feet. In the area around the town of Kalama, Washington, this flood-terrace feature is approximately ½ to ¾ miles wide and extends to the south for a distance of approximately four (4) miles. The stripped flood terraces can be identified by the wide, level and gently sloping ground surfaces with the occasional basalt bedrock ridges or buttes protruding above the flood plain surface. Basaltic and andesitic rock outcrops and flat-topped depositional surfaces with thin deposits of micaceous and pumiceous sands along their bases, indicate stripping by the rising and peak floodwaters and sedimentation by slack and receding floodwaters.

Characteristic throughout the Columbia River corridor region of Cowlitz County, larger ancient landslides occurred hundreds or even thousands of years ago as the result of geologic equilibrium actions during repeated cycles of heavy, sustained rainfall events and seismic activity.

SITE ASSESSMENT

The undersigned professional completed a reconnaissance of the study site to observe all potential geologic or landslide hazards that may be associated with the proposed site improvements. Work consisted of traversing the site and the nearby vicinity of about 200 feet or more each direction from the proposed grading areas. In addition, we evaluated the surrounding terrain utilizing our map of 2-foot elevation contours created from LiDAR point cloud data obtained by the DNR in 2016 (see Figure 2, attached).

The proposed home site, shop site and drainfield areas of the site are within the more upland portion of the site, within native topography with grades draining north to south at between 10 and 15 percent. The site was stripped in late 2018, exposing a medium stiff silt (native) subgrade for the surface. No seeps or springs were observed within this portion of the site. Based on the surface expressions or patterns, we see no visual evidence of significant degrees of fill placement within a 50 foot surrounding proximity of the proposed development locations. The proposed foundation for the home and pole barn would be placed on existing site grades which drain from north to south on grade of 5 to 15 percent.

We did not observe patterns of irregular and/or hummocky ground or structural evidence of landslide activity within the proposed development zone, or near 50 feet buffer. As shown in Figure 2, the development zone is defined as the topography to the north of the distinct drainage draw that flows east to west/southwest across the lot. Based on our reconnaissance, the subsurface soils exhibit relatively stiff consistency (suitable for structure placement). Within soil test pits, we did not observe soil unit contacts between units that would appear to act as slip planes or seepage pathways.

Based on our observations of the soil test pits excavated, soils explored are observed to be light gray silts and clays with increasing stiffness at about 5 feet depth.

Based on the ground morphology of the southern portion of the property, we recommend this portion of the site be designated as a no-development area, and maintained in their naturally occurring states as riparian and woodland. As noted in the Wegman landslide study, the morphology within the southern portion of the tax lot resembles a transition stage between 'dormant-young' and 'dormant-mature'.

Conclusions / Recommendations

Given that the proposed development impacts are limited to the upland, low relief portions of the property (Figure 2), we believe, the proposed development can be carried forth per these recommendations in a manner of maintaining overall slope stability and minimizing soil erosion loss. Outside of the limited area of grading and structure development shown in Figure 2, we advise the protecting the native topographic conditions of the site. To promote stormwater dispersion across the slope areas, exposed bare soil areas should be re-seeded with native grass mixes, and/or riparian (woodland) seed mixes.

For the described project scope and location, development along with adhering to building codes and best management practices is unlikely to trigger future landslides at the site and surrounding area.

Our summary of key findings and considerations applicable to development of the site are the following:

- Within the scope of this reconnaissance, no former fill areas, of scale of concern, are identified to exist throughout the property.
- Seasonally perched groundwater conditions appear to exist in many portions of the site. Installation of drainage measures surrounding the structure foundation zones should be considered.
- Grades should be developed and maintained to drain perimeter surface and roof runoff away from foundation subgrade soils and prevent ponding.
- Cut slopes should be revegetated to prevent erosion hazards. Surrounding grades should be shaped to allow continuance of drainage away from proposed structures.

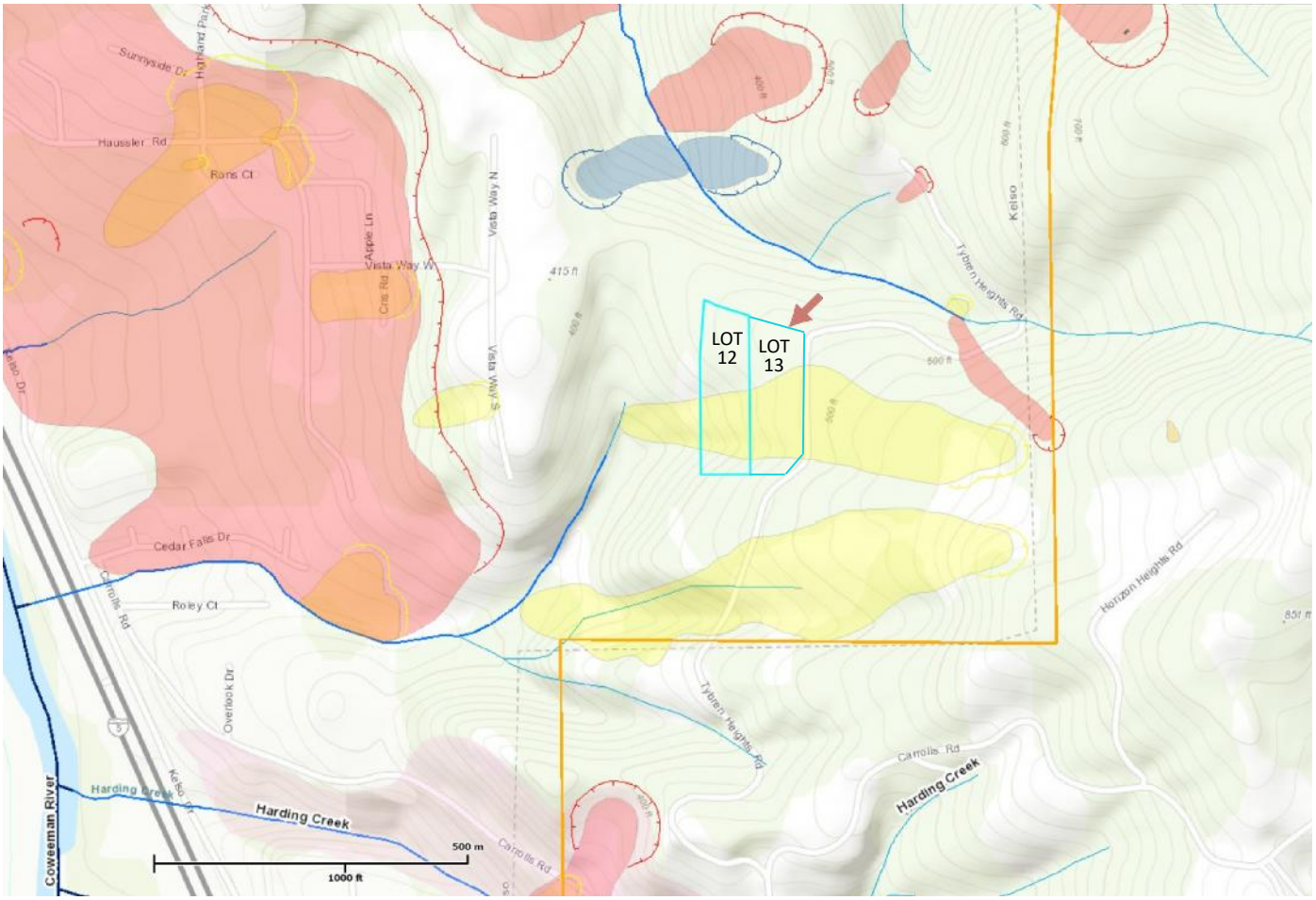
In accordance with current building codes, we recommend the foundation plans include subdrain lines, generally placed within 6-inches of the bottom of the footing, and no further than 18" horizontal distance from the outer face. All foundation drain lines should be 'tight-lined' to a suitable, non-erosive discharge area a minimum of 10-feet distance from the structure. We recommend that footings be embedded through all soils containing or organic/root zones.

In general, stormwater runoff resulting from the site grading development should prevent areas of local surface ponding from occurring, unless engineered. We advise that gravel (quarry spall, etc.) pads be placed at the outlet locations of pipe(s).

Limitations

We have provided current design recommendations based on prior site explorations that indicate the soil conditions at only those specific locations and only to the depths explored. These observations do not account for potential variations in soil types, thickness, or water level that may exist between or away from the explorations. If subsurface conditions vary from those encountered in our site exploration, STRATA should be alerted to the change in conditions so that we may provide additional recommendations, if necessary. Observation by experienced geotechnical personnel should be considered an integral part of the construction process. The owner is responsible for insuring that the project designers and contractors implement our recommendations. This study consisted of visual examinations and a review of readily available geologic resources judged pertinent to the evaluation. Accordingly, the limitations of this study must be recognized.

Sincerely,
STRATA DESIGN, LLC



LANDSLIDE DATA SOURCE: WEGMANN, K.W., 2006, "DIGITAL LANDSLIDE INVENTORY FOR THE COWLITZ COUNTY URBAN CORRIDOR KELSO TO WOODLAND", WASHINGTON DIVISION OF GEOLOGY AND EARTH RESOURCES, REPORT OF INVESTIGATIONS 35.

Legend

- Sag Ponds
- Inactive Landslide Area (not field surveyed)
- Deep Seated Landslide Area
- Active Landslide Area
- Potentially Unstable Slope Area
- Approximate location of a Spring

STRATADESIGN	LANDSLIDE INVENTORY MAP LOT 13, TYBREN HEIGHTS RD KELSO, WA	FIGURE 1

TOPOGRAPHY SOURCE: 2-FT CONTOUR INTERVALS (WA-DNR, 2016 LIDAR SURVEY)

STRATADESIGN
519 SW Park Ave, #410 - Portland OR 97205
503-819-4423
STRATA-DESIGN.COM

DEVELOPMENT PLOT PLAN – LOT 13

TYBREN HEIGHTS RD.
KELSO, WA

PROJECT:	C18-224
DRAWN:	RSG
CHECKED:	RSG
DATE:	12/9/19
REVISIONS:	

SHEET: 1 OF 1

SECTION 8 – OPERATION AND MAINTENANCE MANUAL

The Following pages contain maintenance needs for most of the components that are part of your drainage system, as well as components that you may not have. Let us know if there are any components that are missing from these pages. Ignore the requirements that do not apply to your system. You should plan to complete a checklist for all system components on the following schedule

1. Monthly from November through April
2. Once in late summer (preferably September).
3. After any major storm (use 1" of precipitation in 24 hours) for any items marked "S".

Using photocopies of these pages, check off the items you looked for after each inspection. Add comments on issues found and actions taken. Keep these records in your files. These files will be needed to write your annual report if required. Some items may not need to be looked at every time an inspection is done. Use the suggest frequency at the left of each item as a guideline for your inspection.

You may call the jurisdiction for technical assistance. Please do not hesitate to call, especially if you are unsure whether a situation you have discovered may be a developing issue.

ATTACHMENT 'A': MAINTENANCE PROGRAM

COVER SHEET

Inspection Period: _____

Number of Sheets Attached: _____

Date Inspected: _____

Inspector's Signature: _____

ATTACHMENT "A": MAINTENANCE PROGRAM

Maintenance Checklist for **Conveyance Systems** (Pipes, Ditches and Swales)

Frequency	Drainage System Feature	□□□Req'd	Problem	Conditions To Check For	Conditions That Should Exist
M.S.	Pipes	□	Sediment & debris	Accumulated sediment that exceeds 20% of the diameter of the pipe.	Pipe cleaned of all sediment and debris.
M		□	Vegetation	Vegetation that reduces free movement of water through pipes.	All vegetation removed so water flows freely.
A		□	Damaged (rusted, bent or crushed)	Protective coating is damaged, rust is causing more than 50% deterioration to any part of pipe.	Pipe repaired or replaced.
M		□		Any dent that significantly impedes flow (i.e., decreases the cross section area of pipe by more then 20%).	Pipe repaired or replaced.
M				Pipe has major cracks or tears allowing groundwater leakage.	Pipe repaired or replaced.
M.S.	Swales	□	Trash & debris	Dumping of yard wastes such as grass clippings and branches into swale. Unsightly accumulation of non-degradable materials such as glass, plastic, metal, foam and coated paper.	Remove trash and debris and dispose as prescribed by County Waste Management Section.
M		□	Sediment buildup	Accumulated sediment that exceeds 20% of the design depth.	Swale cleaned of all sediment and debris so that it matches design.
M		□	Vegetation not growing or over-grown	Grass cover is sparse and weedy or areas are overgrown with woody vegetation.	Aerate soils and reseed and mulch bare areas. Maintain grass height at a minimum of 6" for best stormwater treatment. Remove woody growth, recontour and reseed as necessary.
M		□	Conversion by home-owner to incompatible use	Swale has been filled in or blocked by shed, woodpile, shrubbery, etc.	If possible, speak with homeowner and request that swale area be restored. Contact County to report problem if not rectified voluntarily.
A		□	Swale does not drain	Water stands in swale or flow velocity is very slow. Stagnation occurs.	A survey may be needed to check grades. Grades need to be in 1% range if possible. If grade is less than 1%, underdrains may need to be installed.

If you are unsure whether a problem exists, please contact the Jurisdiction and ask for technical assistance.
Comments:

Key: A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms

ATTACHMENT "A"

Maintenance Checklist for Ponds

Frequency	Drainage System Feature	Req'd	Problem	Conditions to Check For	Conditions That Should Exist
M,S	General	√	Trash & debris buildup in pond.	Clumping of yard wastes such as grass clippings and branches into basin. Unsightly accumulation of nondegradable materials such as glass, plastic, metal, foam and coated paper..	Removed trash and debris and dispose as prescribed by City Waste Management Section
M,S		√	Trash rack plugged or missing	Bar screen over outlet more than 25% covered by debris or missing.	Replace screen. Remove trash and debris and dispose as prescribed by City Waste Management Section.
M		√	Poisonous vegetation	Any poisonous vegetation which may constitute a hazard to the public. Examples of poisonous vegetation include: tansy ragwort, poison oak, stinging nettles, and devilsclub.	Remove poisonous vegetation. Do not spray chemicals on vegetation without obtaining guidance from the Cooperative Extension Service and approval from the City.
M,S		√	Fire hazard or pollution	Presence of chemicals such as natural gas, oil and gasoline, obnoxious color, odor or sludge noted.	Find sources of pollution and eliminate them. Water is free from noticeable color, odor or contamination.
M		√	Vegetation not growing or is overgrown	For grassy ponds, grass cover is sparse and weedy or is overgrown. For wetland ponds, plants are sparse or invasive species are present.	For grassy ponds, selectively thatch, aerate, and reseed ponds. Grass cutting unnecessary unless dictated by aesthetics. For wetland ponds, handplan nursery-grown wetland plants in bare areas. Contact the Cooperative Extension Service for direction on invasive species such as purple loosestate and reed canary grass. Pond bottoms should have uniform dense coverage of desired plant species.
M		√	Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. Contact the Thurston County Health Department for guidance.
M		√	Insects	When insects such as wasps and hornets interfere with maintenance activities, or when mosquitoes become a nuisance.	Insects destroyed or removed from site. Contact Cooperative Extension Service for guidance.
A		√	Tree growth	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, or equipment movements). If trees are not interfering with access, leave trees along.	Trees do not hinder maintenance activities. Selectively cultivate trees such as alders for firewood.
M	Side slopes of pond	√	Erosion on berms or at entrance/exit.	Check around inlets and outlets for signs of erosion. Check berms for signs of sliding or settling. Action is needed where eroded damage over 2 inches deep and where there is potential for continued erosion.	Find causes of erosion and eliminate them. Then slopes should be stabilized by using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction.
M	Storage area	√	Sediment buildup in pond	Accumulated sediment that exceeds 10% of the designed pond depth. Buried or partially buried outlet structure probably indicates significant sediment deposits.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
A	Pond dikes	√	Settlements	Any part of dike, which has settled 4 inches, lower than the design elevation.	Dike should be build back to the design elevation.

A	Emergency overflow/ spillway	√	Rock missing	Only one layer of rock exists above native soil in area 5 square feet or larger, or any exposure of native soil.	Replace rocks to design standards.
One Time	Emergency overflow/ spillway	√	Overflow missing	Side of pond has no area with large rocks to handle emergency overflows.	Contact City for guidance.

If you are unsure whether a problem exists, please contact the Jurisdiction and ask for technical assistance.
Comments:

Key: A = Annual (March or April preferred)
M = Monthly (see schedule)
S = After major storms

SECTION 9 – DRAFT ROAD MAINTENANCE AGREEMENT

The following pages represent a draft road maintenance agreement. Please comment to amend as needed. Intent is to finalize this draft agreement during the review process. The final agreement can be recorded with the county auditor just prior to construction acceptance.

Parcel Number(s): 241241500; 241241400; 241241300; 241240900; 241241000; 241241600, 241241900, 241242000
Project Name: Tybren Heights Upgrade/Dorothy Lane Improvements
Address: 0 Tybren Heights Road, Kelso, WA 98626

THIS AGREEMENT, made this _____ day of _____, 20__, by and between Randall Bjur, hereinafter referred to as the "Owners(s)" of the following property and City of Kelso hereinafter referred to as the "City".

WITNESSETH, that

WHEREAS, Owner has submitted for approval by City a permit application and Site Plan for the construction and installation of stormwater management facilities pursuant to City Code; and

WHEREAS, the City Code requires, as a condition of permit approval, a maintenance agreement between the City and the Owner ensuring the Owner constructs and maintains the stormwater facilities identified in the Site Plan.

THEREFORE, the Owner of certain real property, with full authority to execute deeds, mortgages, other covenants, do hereby covenant with the City and agree as follows:

1. Owner shall construct and install stormwater management facilities as depicted and shown on the Record Drawings for the above referenced parcel number(s)

2. Owner shall continuously maintain the stormwater management facilities as shown on the Site Plan in good working order and as specified in the maintenance schedule.

3. Owner hereby grants City, its authorized agents and employees, to enter onto the Property to inspect the stormwater facilities pursuant to the City Code.

4. In the event Owner fails to maintain the stormwater management facilities as shown on the Site Plan in good working order acceptable to the City, the City may enter the Property and take whatever steps deemed necessary and appropriate to maintain (including repair or replace) said stormwater facilities. It is expressly understood and agreed that the City is under no obligation to maintain or repair or replace said facilities, and in no event shall this Agreement be construed to impose such an obligation on the City.

5. In the event that the City performs work of any nature pursuant to section 4 of this agreement or expends any funds in performance of such work for labor, equipment, supplies or materials, Owner shall reimburse City for all reasonable costs incurred. Owner, its executors, administrators, assigns, heirs, and any other successors in interest, shall reimburse City for all costs within thirty (30) days of Owner's receipt of written demand by the City for reasonable costs incurred, including but not limited to attorney fees, collection costs, and interest at the statutory rate.

6. It is the intent of this Agreement to ensure the continuous and proper maintenance of stormwater management facilities by the Owner, its heirs, successors and assigns; provided, however, that this Agreement shall not be deemed to create or affect any additional liability of any party for damage alleged to result from or caused by stormwater management.

7. Owner, its executors, administrators, assigns, and any other successors in interest, shall indemnify and hold the City, its agents and employees harmless from any and all damages, accidents, casualties, occurrences, or claims which might arise or be asserted against City, its agents or employees, from the construction, presence, existence, or maintenance, of the stormwater management facilities by Owner.

8. This Agreement shall be recorded among the land records of Cowlitz County, Washington, and shall constitute a covenant running with the land, and shall be binding upon Owner, its administrators, executors, assigns, heirs, and any other successor in interest.