Geotechnical Report

39555 Stefenee Court
Sandy, OR

Prepared for:

Alex Shamrai/ Pro Build

24 March 2021

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PROJECT AND SITE DESCRIPTIONS

Introduction

Rapid Soil Solutions Inc (RSS) has prepared this geotechnical report, as requested, for the proposed construction of a new dwelling in Sandy, Oregon currently assigned the street address of 39555 Stefenee Court. The site is situated just off the main street in Sandy. The site is located 0.25 miles east of the intersection of Pioneer Blvd split of Highway 26. Adjacent properties include 39520 Stefenee Court to the south east. This is the last parcel on this block to be developed.

The subject site is comprised of a single tax parcel is 0.14 of an acres. In Clackamas County, and can be distinguished by the parcel # 01680540 (24E13DB02332).. The latitude and longitude of the site are 44.393457 and -122.256311.

SITE CONDITIONS

Surface Conditions

The subject parcel encompasses 0.14-acres along the relatively moderate slopes that is located just about 5.25 miles northwest of Lenhart Butte. The local morphology is dominated by the presence of Mount Hood, northwest of the subject site. The local slopes generally descend to the north-northeast, towards Sandy River. The subject parcel and immediate neighboring parcel are located in a low-density residential district zone (SFR). Density in this zone composed of not be less than 3 or more than 5.8 units per net acre. The proposed new residence is accessed via a moderately ascending Stefenee Court off the southern edge of Loundree Drive. The subject site is the last undeveloped parcel within the cul-de-sac.

RSS traversed the slopes along the vicinity of the proposed residence envelope and surrounding area looking for any indications of slope instability. At the time of the site visit, RSS found a nearly level bench along the southern boundary line of the parcel. The area is cleared from vegetation with thin patches of grass. It smoothly descends northwest towards Stefenee Court with slopes of 5-10 percent. The bench extends about 20 feet towards the slope break to its northeast. Next to the nearly level bench is the steeper region of the parcel with slopes within 30-45 percent. The slope is enveloped with tall deciduous and coniferous trees, bush with low grass and descends north-northeast, towards the property line. RSS understands that the proposed new dwelling is located within the nearly level bench and partly within the steeper slopes.

The highest elevation is located along the southeast corner of the parcel and is recorded as 1,025 feet above sea level. The lowest elevation is along the northeast corner, noted as being about 1,009 feet. The observed slopes on site were consistent with the contours on the site plan provided to RSS. See site photos below.

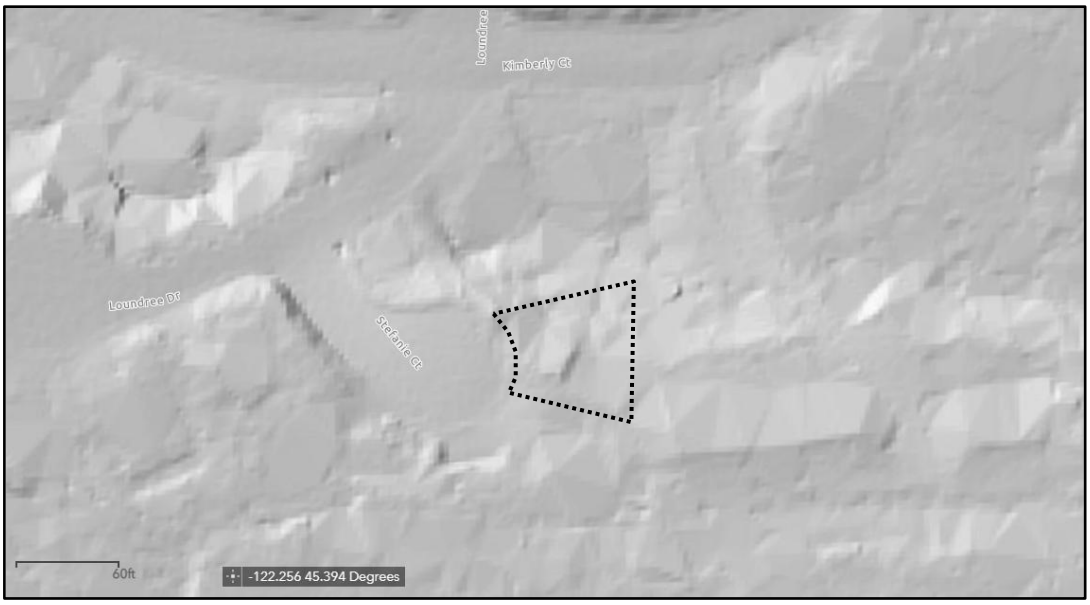
Site Photo: NW-SE-, proposed development area

Site Photo: SW-NE, proposed development area

Slopes

Lidar imagery of the subject site and surrounding slopes was referenced as part of this investigation. This imagery depicts the textures of the earth's surface, often revealing morphological indications of mass soil movement. Lidar mapping of the site shows mild to moderate undulating of slopes along the entire parcel. A slight hummocky topography is visible along its southern half. Lidar image depicts that the subject site and neighboring parcels are substantially impacted by grading.

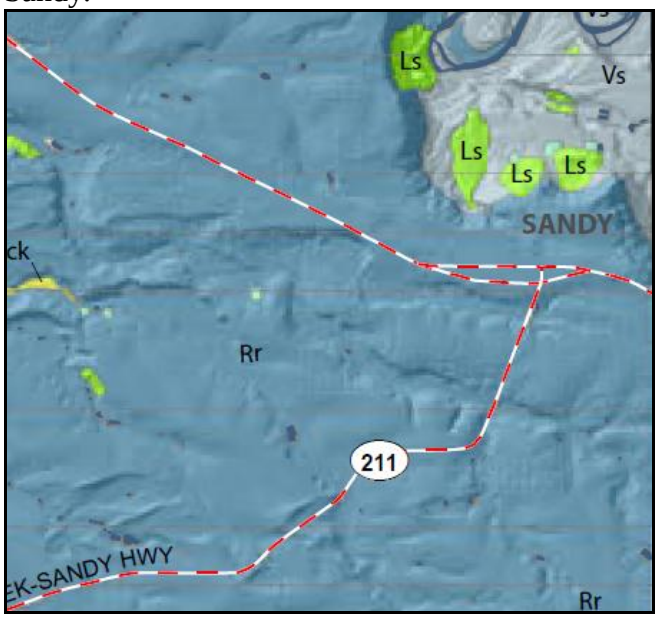
No landslide was mapped within the subject parcel. The nearest mapped landslide is located about 0.6 miles north of the parcel, along the forested Sandy River Park. The subject site is mapped having moderate (yellow) landslide hazard with high (orange) landslide hazard on its steeper region. The slopes of the site do not contain any visible indications of active land movement based on the lidar imagery. See Lidar imagery below.



An examination of the slopes within the proposed parcel did not reveal any indications of major active slope instability. No springs, seeps or free flowing water were observed within the development area. No pockets of unusual vegetation were observed. No landslide morphology was observed on site, such as fresh scarps or tension cracking. No hummocky topography, slump blocks or sag ponds were observed.

Regional Geology

Current geologic literature classifies the slopes underlaying the subject site as "Older gravel of Cascade Arc origin" (Wells et al, 2020). These gravels have also been classified by various workers as ancient river rocks (Ma et al, 2012), Pliocene-Pleistocene gravels (Schlicker & Finlayson, 1979), and the conglomerate member of the Springwater formation (Trimble, 1963). The local subgrade is comprised of unconsolidated sand and sandy to cobbly gravels. This deposit is generally found southeast of Powell Butte/Happy Valley and extends from the Sandy River to the Clackamas River. It underlays the entirety of the City of Sandy.



Geologic History

The subject site is generally situated within the forearc basin of the Cascadia subduction system between the Cascade Range (volcanic arc) and the Coastal Range (accretionary/subduction complex). The site is tucked along the eastern margin of the Portland Basin. This basin is part of a series of topographic and structural depressions that constitute the Puget-Willamette forearc trough of the Cascadia subduction system. It is a relatively low-relief valley, characterized by broad, flat, lowlands surrounded by prominent uplands controlled primarily by structural features (faulting and folding) in the underlying bedrock. Tectonic compressional stress, associated with the subduction zone and associated mountain building, both initiated basin development and produced prolonged the basin's enlargement. This basin contains a thick accumulation of material that preserves a complex

record of deposition and erosion (aggradation and incision) produced by the lakes and rivers that that flowed through the basin concurrent with its development.
The basin is floored by flows of the Columbia River Basalt Group; the lacustrine and fluvial sediments found within the basin were emplaced after the massive basalt flows. About 360 meters of sediments can be found in the Tualatin and northern Willamette Basins, about 600 meters of sediment can be found in the deepest sections of the Portland Basin. The gravels at the subject site are among the younger basin fill sediments and are part of an unnamed conglomerate where the clasts are generally derived from the nearby Cascade Range mountains. This unit interfingers with igneous deposits of the Boing Lava fields.
East of the subject site the slopes ascend into the High Cascade Range. The mountainous Cascade Range has formed over the past 40 million years. Roughly 200 million years ago, the Farallon oceanic plate began to subduct below the more buoyant continent of North America. This process scraped materials off of the oceanic plate and onto the edge of the continent resulting in the accretion of terrains and a large amount of ocean floor sediments, volcanic island chains and basalts from underwater volcanoes. Then, during the late Eocene, the earliest Cascade Range volcanoes began erupting (43-37 million years ago – Northcraft volcanoes) onto the coastal plain environment that has formed during the earlier Eocene (55-43 million years ago). Much of this volcanism emplaced mafic lavas (basalt & andesite) but some produced felsic lava and ash. Volcanic activity continued as the early Cascade volcanic arc began erupting at a fast pace (resulting in massive outpourings of lava, ash and various rock fragments). A short lull in volcanic activity occurred between 21 and 18 million years ago, which was followed by the invasion of the Columbia River Basalt Group flows from fissure volcanoes to the east (not related to the volcanic arc, but forms a useful stratigraphic marker). Modern Cascade volcanism began roughly 500,000 years ago and formed the recognizable peaks that dot the regional skyline.

The deposits found at the subject stie have been classified as 'Older gravel of Cascade Arc origin' (Wells et al, 2020), Springwater Formation (Trible, 1963), and an unnamed fan gravel younger than the Springwater Formation (Evarts and O'Connor, 2008). The unit is generally described as weathered fluvial gravel of Cascade Range provenance interbedded with lithic-rich sand (unconsolidated sand and sandy to cobbly gravel) with local poorly sorted, matrix supported deposit with angular clasts up to 1 meter in diameter (diamicton). Morphologically these deposits comprise the distal edge of a broad, west-northwest-sloping, moderately dissected piedmont. The deposits appear to be fan aggradation associated with the ancestral Sandy River; the deposits were likely emplaced in conjunction with alpine glaciation and associated outwash-gravel production in the Cascade Range. The sands and gravels of the unit are punctuated by lahars.

Site Geology

Madin et al (2020) describes the conglomerate at the subject site as comprised of well-rounded to subrounded pebbles and cobbles of volcanic rock, chiefly andesite, derived from Cascade Range slopes east of the site.

Undivided, the unit underlaying the subject site is part of the ancient river rocks of Ma et al (2012) comprises the youngest bedrock in the Portland area, and it typically comprised of cemented and compacted sediments deposited by the ancestral Tualatin, Willamette,

Clackamas, Sandy and Columbia Rivers. They include layers of sandstone, mudstone, siltstone, and conglomerate or cemented gravel. In the Tualatin Valley, there are almost 1,000 feet of siltstone, mudstone and sandstone mostly derived from older sedimentary rocks of the Coast Range. These rocks may have been laid down as long ago as 15 million years after the cessation of the Columbia River Basalt lava flows, as a recently as 2.5 million years when the Boring volcanic field became active.

The site is further classified as Pliocene-Pleistocene aged Gravels by some and as part of the Springwater Formation by others. The Springwater Formation as described by Madin (2004 - Open-File Report O-04-02), is comprised of fluvial conglomerate, volcaniclastic sandstone, siltstone, and debris flows derived from the Cascade Range. The conglomerate generally consists of well-rounded pebbles, cobbles and boulders of basalt, andesite and dacite but can also include metamorphic and plutonic rocks. The sand and silt component of the conglomerate mix contains varying amounts of feldspathic and volcanic lithic and vitric sediment. It is not uncommon to observe massive and profoundly weathered sections of this unit. The weathered conglomerate presents as a vari-colored mass of red, brown, gray-green and orange. In the portion of this unit comprised of debris flows, the mix of clasts includes angular to rounded basalts, andesites and dacite lavas with a matrix of clay, ash, and sand. Scoria and pumice can also be found in this portion of the unit. The sandstone fraction of the Springwater formation includes fine to coarse sand while the siltstone and mudstone fractions include quartzo-feldspathic silt, ash and clay.

Field Exploration and subsurface conditions

RSS performed field explorations in three (3) locations within the proposed disturbance area. Refusal was encountered on HA#1 at a depth of 1.5 feet. Soils on HA#2 were damp, reddish brown with pockets of yellow and trace of organics, fine grained with trace of gravels, medium stiff, silty-CLAY that stayed relatively the same throughout the depth of 4 feet. Soils on HA#3 were damp, medium brown, fine grained with trace of gravels, medium stiff, silty-CLAY, also to a depth of 4 feet. Both samples of HA#2 and HA#3 changed from medium stiff to stiff at about 2.5 feet depth. RSS used a ½" carbon fiber probe to check the bearing pressure of the soils along the development area. RSS found the soils along the nearly level bench hard and non-yielding. The soils along the steeper slope region yields to about 1.5 feet.

Mapped soils

Cazadero silty Clay loam with 7 to 12 % slopes.

Seismic Design Criteria

The seismic design criteria for this project found herein is based on the ASCE 7-16, on the USGS Earthquake Hazards Program. A summary of seismic design criterion below using Latitude: 45.393457, Longitude: -122.256311. Null = see section 11.4.8

	Short Period	**1 Second**
Maximum Credible Earthquake Spectral Acceleration	Ss = 0.709g	S1 = 0.316
Adjusted Spectral Acceleration	Sms = 0.874	Sm1 = null
Design Spectral Response Acceleration Perimeters	Sds = 0.583	Sd1= null

Foundation Design
Based on the field exploration and our experience with this soil formation it is our opinion that the foundation should consist of foundations into the silty CLAY which was found at 0.5ft below grade. ***Please allow at least 48hours notice to call for foundation excavation inspection.***

The new footings should be designed for a maximum allowable bearing pressure of 2,500 pounds per square foot (psf) as per scribed in 2018 IBC code book under section 1804.2 Table 2 Allowable Foundation and Lateral Pressures. Lateral pressures may be resisted by friction between the bases of the footings and the underlying ground surface.

Engineering values summary

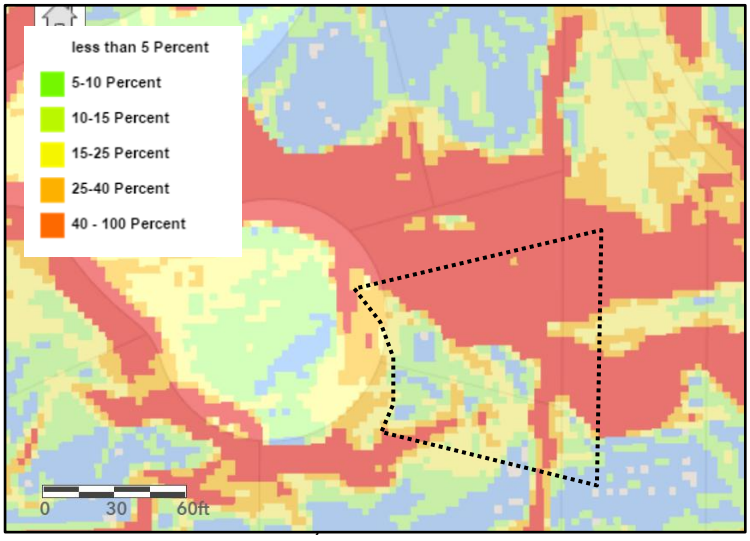
Bearing capacity	2,500psf
Friction angle	35
Active pressure	40pcf
Passive pressure	300pcf

GeoHazard Review
The Oregon HazVu: Statewide Geohazard Viewer and Metro Map were reviewed on 24 March 2021 to investigated mapped geological hazards.

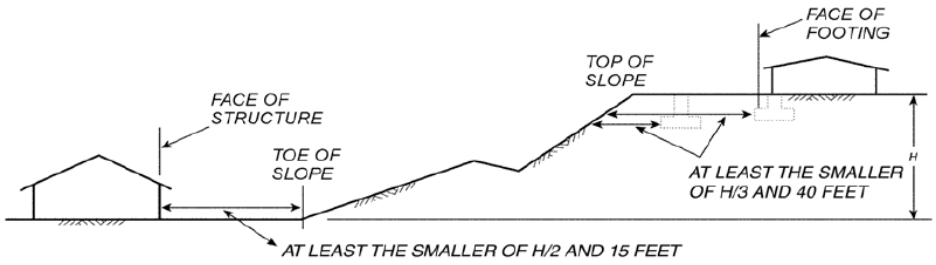
This review indicates that the subject site is outside the 100-year floodplain, as mapped by FEMA. The expected earthquake-shaking hazard is classified as 'very strong' with a 'moderate' earthquake liquefaction hazard.

The local morphology suggests that the steep slopes in the southern end of the subject stie are moderately susceptibility to landslides. No landslides are mapped on or adjacent to the subject site. No distinct landslide morphology was observed in the lidar imagery of the subject site. The mapped landslide hazard at the subject site ranges from 'low' to 'high', with the low-slope majority of the parcel containing a low susceptibility and the steeply sloping areas containing moderate to high susceptibilities.

On 01 February 2021, no observations were made that would indicate that normal construction activities could produce an erosion hazard that could threaten the stability of the site. Observed slopes on site appeared to be generally consistent with those mapped by 5-ft DEM of Portland.



Setback Recommendations
The house foundation as it steps down the slope shall meet the below slope setback figure below. When RSS is on site for the foundation inspection we will check the setbacks.



For SI: 1 foot = 304.8 mm.

FIGURE 1808.7.1
FOUNDATION CLEARANCES FROM SLOPES

Settlement
Based on our knowledge of the project scope, and for footings designed as described in the preceding paragraphs, maximum settlement should not exceed 1 inch. Differential settlement should be on the order of 50 to 75% of the maximum settlement over 50 feet. Our settlement estimate assumes that no disturbance to the foundation soils would be permitted during excavation and construction, and that footings are prepared as described in the preceding paragraphs.

Drainage
The Contractor should be made responsible for temporary drainage of surface water and groundwater as necessary to prevent standing water and/or erosion at the working surface.

Water should not be allowed to "pond" or collect anywhere on the site. The ground surface around the structure should be sloped to create a minimum gradient of 2% away from the building foundations for a distance of at least 5 feet. Surface water should be directed away from all buildings into drainage swales or into a storm drainage system. "Trapped" planting areas should not be created next to any buildings without providing means for drainage.

Limitations
This report has been prepared for the exclusive use of the addressee, and their architects and engineers for aiding in the design and construction of the proposed development. It is the addressee's responsibility to provide this report to the appropriate design professionals, building officials, and contractors to ensure correct implementation of the recommendations. The opinions, comments and conclusions presented in this report were based upon information derived from our literature review, field investigation, and laboratory testing.

Conditions between, or beyond, our exploratory borings may vary from those encountered. Unanticipated soil conditions and seasonal soil moisture variations are commonly encountered and cannot be fully determined by merely taking soil samples or soil borings. Such variations may result in changes to our recommendations and may require that additional expenditures be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

If there is more than 2years time between the submission of this report and the start of work at the site; if conditions have changed due to natural causes or construction operations at, or adjacent to, the site; or, if the basic project scheme is significantly modified from that assumed, it is recommended this report be reviewed to determine the applicability of the conclusions and recommendations.

The work has been conducted in general conformance with the standard of care in the field of geotechnical engineering currently in practice in the Pacific Northwest for projects of this nature and magnitude. No warranty, express 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 development at the site, as outlined within the report.

References

Google Maps: https://www.google.com/maps/
Google Earth 2020
USDA Natural Resource Conservation Service, Web Soil Survey:
https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm
Oregon Water Resources Department, Well Report Query:
https://apps.wrd.state.or.us/apps/gw/well_log/
Clacakamas County GIS
USGS Topo View: https://ngmdb.usgs.gov/topoview/
DOGAMI Oregon State Wide Geohazard Viewer (HazVu):
https://gis.dogami.oregon.gov/maps/hazvu/
DOGAMI Lidar Viewer: https://gis.dogami.oregon.gov/maps/lidarviewer/
DOGMAI Statewide Landslide Information Layer for Oregon:
https://gis.dogami.oregon.gov/maps/slido/
Wells, R.E., Niem, A.R., Priest, G.R., Ma, L., Niewendorp, C.A., and Madin, I.P., 2008, Preliminary digital geologic compilation map of part of western Oregon [map plate of West portion of OGDC project]: Oregon Department of Geology and Mineral Industries, Open-File Report O-08-13, scale 1:100,000.
Thayer, T.P., 1939, Geology of the Salem Hills and North Santiam River basin: Oregon Department of Geology and Mineral Industries, Bulletin 15, scale 1:125,000.

APPENDIX

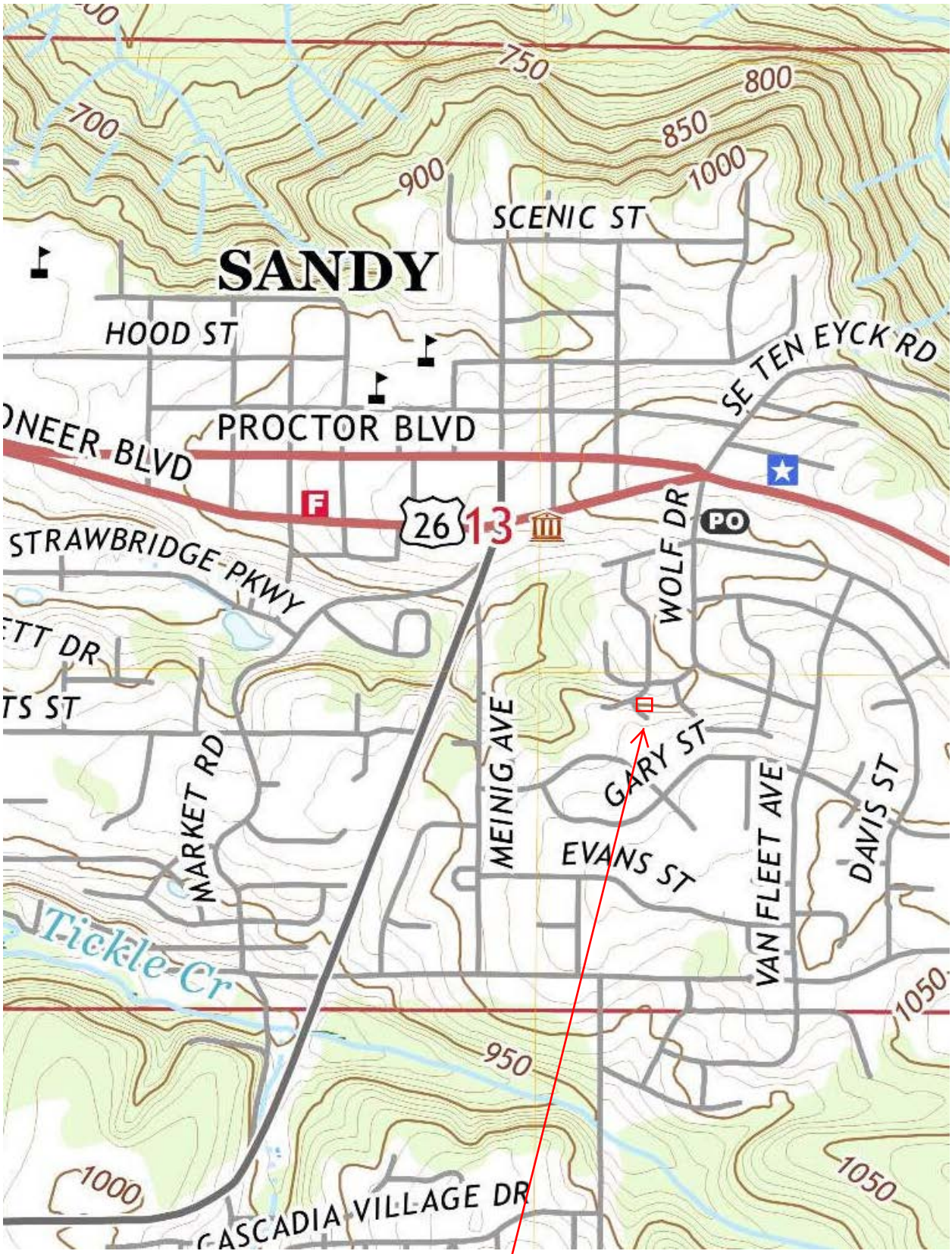
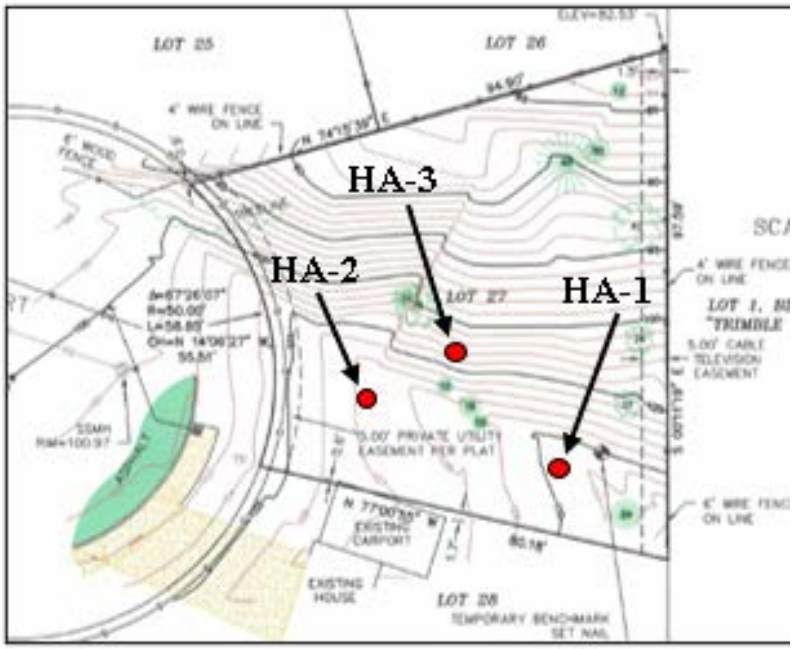


Figure 1 – site location

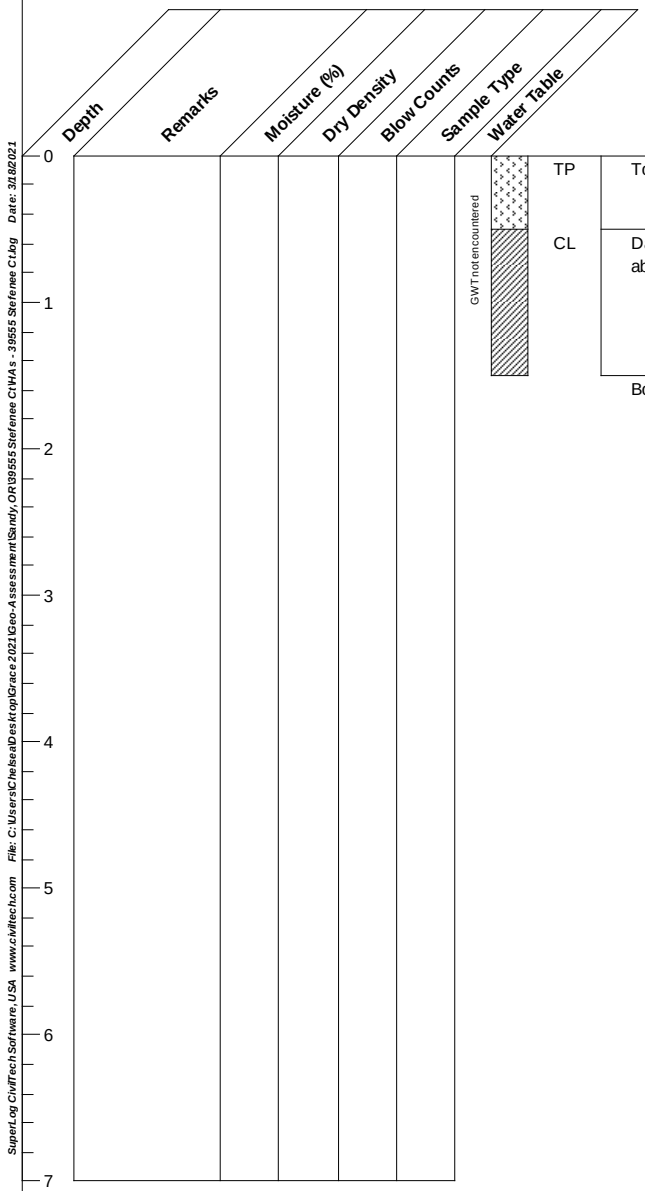
Clackamas County GIS map of Parcel

Preliminary Site Plan

Figure 2 – site plan with testing locations



HA-1



Surface Elevation:
Boring Date: 01 February 2021
Boring Location: Amboy, W A
Drilling Method: Hand Auger

TP	Top soil with roots
CL	Damp, medium brown, fine grained w/ trace gravels and abundant roots, medium stiff, silty CLAY

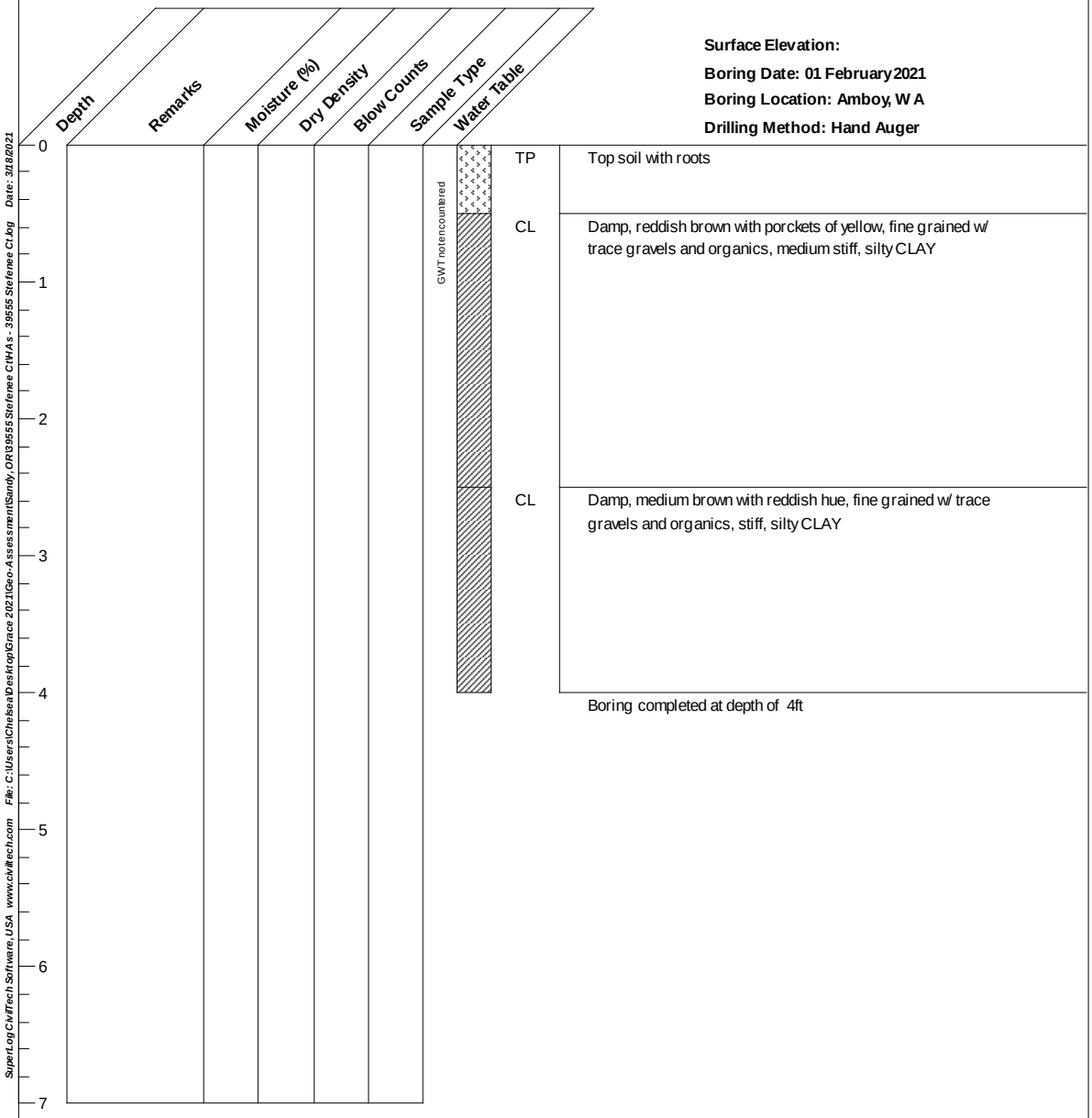
Boring completed at depth of 1.5ft, refusal

LOG OF BORING

Rapid Soil Solutions	**39555 Stefenee Ct.**	**Plate 1**

HA-2

Surface Elevation:
Boring Date: 01 February 2021
Boring Location: Amboy, W A
Drilling Method: Hand Auger



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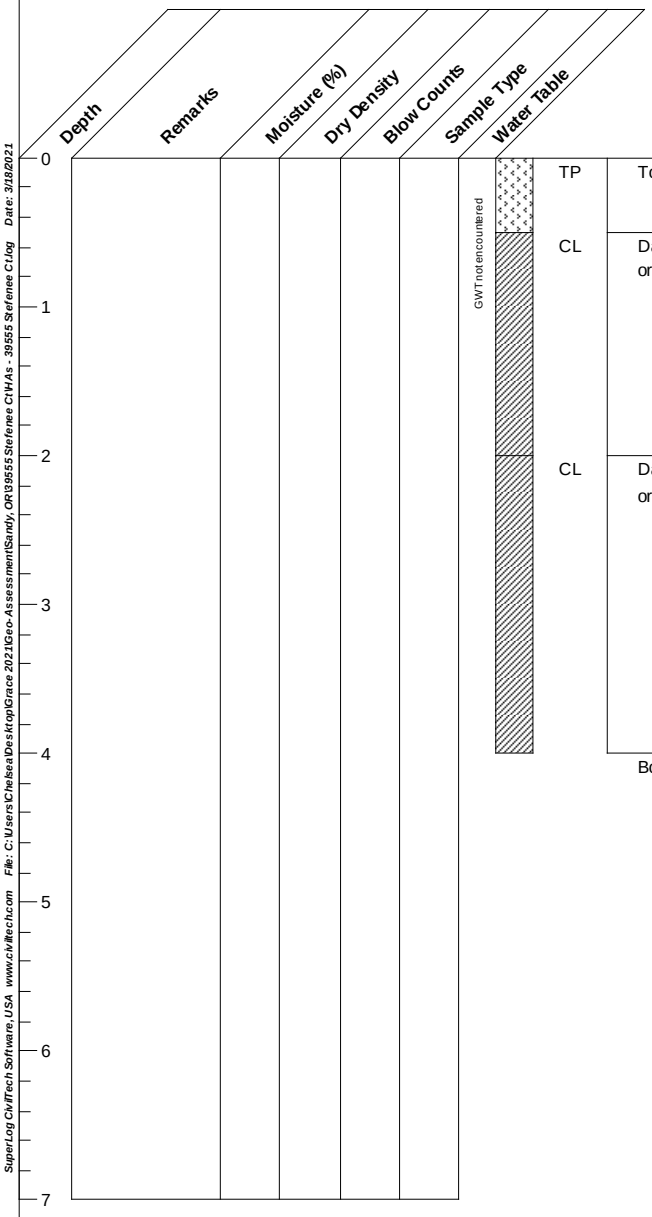
LOG OF BORING

Rapid Soil Solutions	**39555 Stefenee Ct.**	**Plate 2**

HA-3



Surface Elevation:
Boring Date: 01 February 2021
Boring Location: Amboy, W A
Drilling Method: Hand Auger

0	TP	Top soil with roots
0 – 2	CL	Damp, medium brown, fine grained w/ trace gravels and organics, medium stiff, silty CLAY
2 – 4	CL	Damp, medium brown, fine grained w/ trace gravels and organics, stiff, silty CLAY

Boring completed at depth of 4ft

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Users\Chelsea\Desktop\Grace 2021\Geo-Assessment\Sandy, OR\39555 Stefenee Ct\HAs - 39555 Stefenee Ct.log Date: 3/18/2021

LOG OF BORING

Rapid Soil Solutions	**39555 Stefenee Ct.**	**Plate 3**