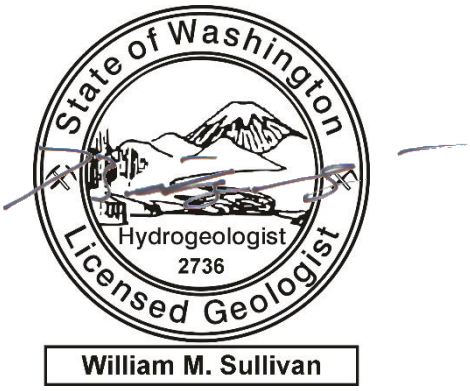
MEMORANDUM

Project No. 180274

May 20, 2020

To: Ben Alworth, Wheeler Ridge, LLC

From:



Bill Sullivan, LHG, CWRE
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Re: **Section 17 Geological Hazard Assessment**

Background and Project Understanding

Wheeler Ridge, LLC proposes to develop commercial cherry orchard on approximately 250 acres of privately-owned land in the southeastern two thirds of Section 17, Township 21 North, Range 20 East Willamette Meridian in Chelan County, Washington (Site). The Site is currently undeveloped. In addition to orchard trees, irrigation sprinklers, and cover grass, the proposed development will include fencing, gravel-surfaced roads, several small buildings associated with seasonal housing and a shop, and an irrigation storage reservoir planned for less than 10 acre-feet (ac-ft) volume. Water will be conveyed to the Site via new buried pipeline from lower elevation sources northeast of the Site. The project requires improving and rerouting portions of Wheeler Ridge Road, a primitive county road. Developing portions of the Site proposed for orchard will require removing coniferous trees and understory shrubs comprising much of the Site as well as grading to prepare land for development.

The Chelan County Code addresses geologically hazardous areas through a Geologically Hazardous Overlay District (GHOD), Chapter 11.86 of the Chelan County Code, for the purpose of consistency with the Growth Management Act to protect public health and safety and property.

Section 11.86.020 of the GHOD classifies sites as having Known or Suspected Risk to development if the site lies near areas containing landslides, steep slopes greater than 40 percent, erodible soils, debris flow hazards, and avalanches. The GHOD requires a geological hazard assessment to be

completed for development proposals for sites meeting one of these criteria. The site assessment reporting is required to verify and characterize geological hazard conditions and provide recommendations to mitigate risk to development including whether a geotechnical engineering report is required.

Based on review of existing information, Chelan County determined a geological hazard assessment is required for the proposed development because it contains one or more of the above listed criteria.

Existing Studies

Two studies documenting slope stability and earth conditions at the Site have been completed related to this project. Another study was completed addressing slope stability for a nearby similar project.

Aspect produced a memorandum for this project titled "Slope Stability Reconnaissance" dated October 30, 2017 (Aspect, 2017) to summarize and describe Site geology, landslide features, and associated risks with orchard development and road building and/or realignment at the Site. This report was completed supporting Wheeler Ridge, LLC submitting a Washington Department of Natural Resources (DNR) Forest Practices Application/Notification (FPA) to harvest timber on approximately 250 acres and conversion to commercial cherry orchard. It consisted of an office review of readily available existing information and a field inspection to identify the presence of potentially unstable landforms as defined by WAC 222-16-050 in and around the Site known as "rule-identified landforms."

Aspect produced a memorandum titled "Section 16 and 17 Upper Wheeler Road Reconnaissance and Planning-Level Geotechnical Considerations" dated August 7, 2018 (Aspect, 2018a) providing

planning-level geotechnical considerations for realignment of Upper Wheeler Road (an unimproved county road) at the Site and in adjacent Section 16. The geotechnical memorandum was revised on September 12, 2018 to reflect changes in road realignment (Aspect, 2018b).

Aspect also produced a memorandum titled "Section 10 Slope Stability Reconnaissance" (Aspect, 2019) for an FPA covering forestry practices and conversion of lands to cherry orchard about 1.5 miles northeast of the Site in Section 10, T. 21 N., R. 20 E.W.M. This report summarized geology, landslide features, and associated risks with orchard development and evaluated potential changes to the quantity of water infiltrating into the subsurface under pre-harvest/land-clearing conditions and two conditions resulting from proposed changes (first year after clearing and at full orchard maturity).

Scope of Work

This report addresses geological hazards identified in Section 11.86.020 of the GHOD and was completed in accordance with requirements for geological hazard assessments in Section 11.86.070(1). Aspect completed an office study of readily available existing information and performed a surface reconnaissance of the Site to identify and evaluate geological hazards.

During our office study, we compiled and reviewed information on the development proposal, geological maps and reports, topographic maps, soils mapping, aerial photography, and LiDAR

hillshade images. The development proposal has been modified several times with respect to areas proposed for orchard and the proposed realignment of the county road. The most recent version of these changes are shown on Figure 1.

Our surface site reconnaissance was performed by Aspect geologist Bill Sullivan on October 12, 2017, and on June 15, 2018. Our reconnaissance focused on areas of Section 17 that are proposed for development and areas immediately adjacent. Areas of Section 17 that were not field reviewed include the northwestern third in the Squilchuck canyon, along the midslope of the Squilchuck canyon wall, and the steep slopes in an adjacent drainage in the northeast corner of Section 17, locally known as Mikes Canyon. No development or forestry practices are planned for these areas. No test pits or borings were completed and no subsurface data were collected as part of our study.

Site Conditions and Observations

The Site lies about 7 miles south of Wenatchee on Wheeler Ridge, between the base of Naneum Ridge to the west and Wenatchee Heights to the east. This ridge forms the topographic divide between the upper portions of the Stemilt and Squilchuck Creek basins that are both tributaries to the Columbia River. It is bounded to the south by Orr Creek, a tributary of Stemilt Creek, and to the north by Squilchuck Creek.

The orchard is proposed to be located on the broad crest and gently sloping southern flank of Wheeler Ridge in the southeastern two thirds of Section 17 shown on Figure 1 as Units 1, 2, and 3. Areas proposed for orchard extend to near the break in slope where the ridge crest meets steeper slopes. Fencing and primitive orchard roads will line the perimeter of each orchard. No land clearing or development is proposed for the steep slopes forming the southern canyon wall of the Squilchuck drainage in the northwestern third of Section 17 nor Mikes Canyon in the northeastern corner of Section 17.

Wheeler Ridge is incised by two drainages flowing west to east across the Site (Figure 1). In the southern portion of Section 17, the upper reaches of a small perennial tributary to Orr Creek run between Units 2 and 3. Further east, this tributary becomes more incised and steeper, forming a topographic barrier separating Units 1 and 3. Topographic relief in this lower reach is about 150 feet. No timber harvest or development is proposed in the steeper, lower reach of the drainage, and the existing private road traversing the northern wall of this drainage is proposed to be decommissioned.

In the northeastern portion of Section 17, a small intermittent drainage runs through Unit 1 forming a tributary to Mikes Canyon, which drains to Squilchuck Creek. Maximum relief in this drainage is about 100 feet at the eastern boundary of Unit 1. No timber harvest or development is planned for the steep areas east of Unit 1.

Vegetation across the Site is comprised primarily of ponderosa pine forest with grass and shrub groundcover. Some shrub-steppe vegetation is present in the upland regions and riparian vegetation in the bottoms of drainages.

Topography

Elevations across the Site vicinity range from 2,800 feet above sea level (asl) at Squilchuck Creek to 3,800 feet asl at Wheeler Ridge. Land surface slopes gently on Wheeler Ridge at 20 percent or

less. This includes nearly all lands within Units 1, 2, and 3 where timber will be harvested and land will be cleared for orchards. Drainages incising Wheeler Ridge are between 100 and 150 feet deep. Slope angles are discussed in the Geological Hazards section of this report. Except where existing primitive roads have been graded, no modified ground including cut and fill slopes were observed.

Development in Section 17 and Adjacent Areas

All of Section 17 is undeveloped except for several unpaved roads. These roads are unimproved and lack regular maintenance. Poorly maintained culverts at one or more small water crossings have resulted in localized erosion, deep ruts, and rerouting of water courses outside of their natural drainage channels.

The area adjacent to Section 17 is a mix of private and public ownership. Land use in the vicinity is primarily commercial forestry. Commercial agriculture (orchard), an unpaved road (Orr Creek), and a county road (Stemilt Loop) are present within 1 to 2 miles downslope to the east and south in the Stemilt basin. Rural residential development, a county road (Squilchuck), and Squilchuck State Park are present along the bottom of Squilchuck canyon, about 0.5-mile downslope to the northwest.

Geology

Regional Geology

Based on geologic mapping and reporting (DNR, 2020; Tabor et. al., 1982), geology of the region between Naneum Ridge and the Columbia River is primarily characterized by late Tertiary Grande Ronde flood basalts of the Columbia River Basalt Group overlying thick early Tertiary continental sedimentary rocks of the Chumstick and Wenatchee Formations. Late Tertiary uplift associated with the Yakima Fold Belt tilted these rocks to the southeast resulting in slope failures along contacts between the porous basalt and lower porosity underlying sedimentary rocks. The slope failures initiated debris flows filling ancient valley bottoms draining toward the Columbia River with mixtures of landslide debris referred to as basaltic diamictite. The solidified diamictite formed a cap that was more resistant to erosion than the surrounding sedimentary rocks resulting in an inversion of topography that left some of the ancient valley bottom deposits standing in relief—Wheeler Ridge, forming the divide between Stemilt and Squilchuck drainages, is one of the most prominent examples of this inverted terrane. Numerous younger landslides have occurred in the canyon walls of these two deeply incised Columbia River tributaries.

Site Geology

Based on regional geologic map data (DNR, 2020; Tabor et. al., 1982), the surficial geology across most of Section 17 and the entirety of the Site is primarily Tertiary-aged mass-wasting deposits (diamictite) overlying Tertiary continental sedimentary bedrock. Tertiary mass wasting deposits are described by Tabor et al. (1982) as primarily consisting of angular granule to boulder-size clasts of basalt including entablature boulders up to tens of feet in diameter. The deposits overlie Tertiary continental sedimentary bedrock of the Chumstick Formation described as consisting of sandstone, siltstone, and conglomerate. Regional maps show the Chumstick Formation cropping out along steep canyon walls in the northwest and northeast portions of Section 17. Younger landslides are mapped in the Squilchuck canyon along the western portion of Section 17 and within 1 mile to the northeast of Section 17. Younger landslides observed within and near the Site are discussed in the Geological Hazards and Mitigation section of this report.

No faults have been mapped or observed on the Site. A high-angle dip-slip fault of unknown offset is mapped striking northwest to southeast within a 0.5-mile southwest of Section 17.

Soils

Two soil types are mapped at the Site by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS, 2020). Stemilt silt loam, found on slopes of 0 to 25 percent occupies gentle topography along the broad crest of Wheeler Ridge. This soil occupies the majority of area proposed for orchard development and is designated by NRCS as slight to moderate erosion hazard. Stemilt silt loam, found on slopes of 25 to 45 percent occupies steeper slopes in the walls of drainages and in the bottoms of drainages. This soil occupies about 20 percent of the area proposed for orchard development and is designated by NRCS as high erosion hazard. Mitigation of erosion is discussed in the Geological Hazards and Mitigation section of this report.

Surface Water and Groundwater

Minor surface water was observed seeping from shallow soils and flowing in the bottom of the Orr Creek tributary drainage. Several small springs were observed along the northern wall of the lower portion of the drainage where old landslides were observed (see discussion on landslides below). No other surface water, springs, or seeps were observed.

Due to the remoteness of the Site, there is limited existing information on local hydrogeology. The Washington State Department of Ecology's (Ecology) well database indicates there are no wells on upper Wheeler Ridge; the nearest wells to the Site are located about 0.5-mile west in the Squilchuck Creek drainage at elevations nearly 1,000 feet lower than the Site. Drillers' logs from wells present in the greater Squilchuck/Stemilt area indicate groundwater generally occurs in three primary hydrogeologic units: unconsolidated alluvial sediments in canyon bottoms, isolated and discontinuous zones within landslide debris, and bedrock. There are insufficient data to determine local groundwater conditions, including depths and flow patterns; however, the scarcity of springs and seeps everywhere except for the drainage bottoms suggest water infiltrating the subsurface on Wheeler Ridge generally follows topography toward incised drainages.

Under existing conditions, groundwater at the Site is recharged by precipitation: rainfall and melting snow with most recharge occurring in spring months. Irrigation of the proposed orchards will increase annual groundwater recharge. Increases to groundwater recharge resulting from irrigation was previously evaluated in nearby Section 10, an analogous Wheeler Ridge site, to evaluate the relative risk presented by converting existing native land cover to irrigated orchard (Aspect, 2019). The irrigation analysis completed for the Section 10 site was determined to be relevant for the Site for this project because the sites have similar existing land cover, geology (both are mapped as old mass wasting deposits overlying sedimentary bedrock), and climatic settings.

Cherry orchard at both sites will be irrigated in a similar manner, with the exception that the higher elevation Section 17 Site will have a lower annual irrigation demand. Results of the Section 10 evaluation indicate that orchard irrigation will increase annual groundwater recharge by about 2.4 inches (or 30 percent over recharge for undeveloped conditions), that is estimated to be about 8 inches. The relative contribution to recharge from irrigation will be smaller in Section 17 than in the lower-elevation Section 10 due to greater precipitation and lower irrigation demand. Potential

impacts to slope stability from irrigation water are discussed in the Geological Hazards and Mitigation section of this report.

Geological Hazards and Mitigation

Geological hazards at the Site were evaluated based on our review of existing information, our site reconnaissance, and local agency critical area ordinance considerations, and our understanding of the proposed development. Pertinent critical areas ordinances reviewed include Chapter 11.86, Chelan County Code.

Geological hazards present at the Site vicinity include steep slopes, landslides, erodible soils, and debris flows. Figure 1 shows locations of geologic features and hazards discussed below. No project-specific geological hazards are present from snow avalanche activity. Geological hazards to the development can be mitigated by adhering to the recommendations listed below and in previous reports completed for the Site (Aspect, 2017; 2018a; 2018b) and for orchard development in Section 10 (Aspect, 2019). No offsite geological hazard impacts resulting from the development are anticipated.

Based on our review of available information and field reconnaissance, and our understanding of the proposed development at the Site, additional study including geotechnical evaluation is not expected to be required to address geological hazards, provided that recommendations in this report and in previous reports related to the project (Aspect 2017; 2018a; 2018b) are adopted.

We understand the proposed reservoir is currently planned to be located somewhere within Unit 1 and that a final location has not been determined. We recommend geotechnical consultation to support final siting of the proposed reservoir. Aspect should review final proposed siting for the reservoir to be consistent with geological hazards identified in this report and other reports completed for the project. Additionally, geotechnical evaluation for the reservoir will be required if it is jurisdictional under Ecology's Dam Safety Office based on storage volume and dam height.

Steep Slopes

The Chelan County Code identifies slopes greater than 40 percent as presenting risk of erosion or landslide. Slopes on or near the Site greater than 40 percent are located along the walls of Squilchuck and Mikes Canyons in the northern portion of Section 17 and in the northern sidewall of the Orr Creek tributary separating Units 1 and 3. With one exception, no slopes exceeding 40 percent are present within the area proposed for development (Units 1, 2, and 3). The exception is in the western portion of Unit 1 where the existing primitive road makes a switchback as it traverses the tributary to Mikes Canyon. The slope angle of a small area in the northern sidewall and southern sidewall of this drainage ranges between 40 and 50 percent. Although this steep slope lies within Unit 1, we understand no development is proposed for the slope and we recommend avoiding clearing or altering the slope. Figure 2 shows areas having slopes of 40 percent or more; the angle most slope failures were observed to have occurred on (Aspect, 2017).

Mitigation for Steep Slopes

Clearing of native landcover on slopes of 35 percent or greater should be minimized. Where timber must be harvested to support adequate sunlight adjacent to orchard margins, we recommend maintaining native grass, shrubs, and soil to minimize runoff, erosion, and infiltration into the subsurface. Areas of disturbed groundcover should be replanted immediately after clearing.

The development should avoid plans that could exacerbate erosion and slope instability, including diverting runoff onto slopes and directing surface water in a way that could undercut slopes. Runoff should not be directed onto slopes where landslides have previously occurred and slopes displaying rule-identified landforms potentially indicating unstable slopes as discussed below. Local ordinances reference the International Building Code (IBC) to establish setbacks for buildings proposed near undeformed slopes (i.e., no landslides).

Where development is proposed closer to steep slopes than described by the IBC or near slopes having delineated landslides, a site-specific geotechnical evaluation will be required. Such evaluations may result in recommendations for reduced setbacks in areas of relatively low hazard, or potentially increased setbacks if elevated hazards are identified in specific areas. We recommend completing geotechnical consultation during siting for the proposed reservoir.

Observations of soils and existing slopes on the Site indicate permanent slopes in unconsolidated soils should be excavated to 30 percent or flatter, assuming the proposed cut slope is not fully saturated and/or perched groundwater is not present. Slopes for cuts and fills related to the roadway realignment are addressed in the geotechnical report (Aspect, 2018a).

Landslides

The DNR defines landslides as the downhill movement of rock, soil, or debris. More broadly, the U.S. Geological Survey (USGS) defines landslides as a type of mass wasting; a process that includes any downhill movement of soil and rock under the influence of gravity.

The Site and vicinity display evidence of past landslides and landforms having potential instability. Past slope instability is from natural processes. Past failures were observed on slopes of 35 to 40 percent and greater within the geologic unit mapped as mass-wasting deposits. Figure 1 shows locations where there is evidence of past instability or potentially unstable landforms. These are discussed in the descriptions below that have been modified from Aspect (2017).

We observed rule-identified landforms potentially indicating unstable slopes including convergent headwalls and hollows having slopes greater than 35 degrees (70 percent), inner gorges, and other areas where evidence cumulatively suggest the presence of unstable slopes. We did not observe rule-identified landforms including deep-seated landslides having toe slopes greater than 33 degrees, groundwater recharge areas for deep-seated glacial landslides, or outer edges of meander bends.

Areas where evidence of past slope instability was observed include:

- **Northeastern corner of Section 17.** Steep slopes exceeding 30 degrees (55 percent) are present adjacent to the eastern boundary of Unit 1. A convergent headwall measuring about 1,000 feet across and one or two hollows and inner gorges are present in the upper reaches of Mikes Canyon along the eastern boundary of Unit 1. Within Unit 1, there is evidence of a small landslide measuring about 50 feet across located on the northern sidewall of the tributary drainage to Mikes Canyon.
- **Northwestern third of Section 17.** Several adjoining landslides are present on steep slopes exceeding 30 degrees (55 percent) adjacent to the western boundaries of Units 1 and 2.

These slopes drop about 800 feet vertically from Wheeler Ridge to the bottom of the Squilchuck canyon. Several hollows up to between about 100 and 500 feet across are present in the upper portion of the canyon wall along the northwestern boundaries of Units 1 and 2. The upslope extent of these hollows terminates at or slightly within the boundaries of the Units 1 and 2.

- **Orr Creek Tributary.** Within Unit 2 in the upper reaches of the Orr Creek tributary, benched slopes suggesting slow moving creep processes were observed along the northern sidewalls of the drainage on slopes of about 20 degrees (35 percent). On the southern sidewall between Units 2 and 3, a small rotational landslide measured about 50 feet across. Further down the drainage in the region between Units 2 and 3, multiple adjoining slope failures were observed in the northern and southern sidewalls having slopes of 30 degrees (55 percent) or more. These adjoining landslides lie adjacent to the southern and northern boundaries of Units 1 and 2, respectively. At least two deep-seated rotational slides measuring about 200 feet across were observed with toes extending to the bottom of the drainage. Additionally, we observed surficial indications that past landslide activity or slow moving ground creep extends several hundred feet west from the headscarps of the adjoining landslides into Unit 1 (Figure 1). These indications consist of tilted or pistol-butted evergreen trees and areas of depressed or hummocky terrain.

The primary mechanism for past slope failure in the Site vicinity is oversteepening of sidewalls resulting from drainage incision occurring over thousands of years or more. No active or recent slope failures were observed. The age of past instability is inferred to be on the order of a hundred years or more based on the roundedness of scarp surfaces and the presence of well-developed soils and vegetation (trees) on the landslide deposits.

Risks of Unstable Slopes and Mitigation

While no recent slope failures were identified, the mechanism driving past slope failures is ongoing and we expect periodic failure will continue irrespective of proposed development activities described in this report. Future slope failures could include reactivation of old landslides and initiation of new ones, especially during periods of prolonged and exceptionally wet weather or seismic activity. These subsequent landslides are expected to be no larger than the largest past slope failures and their impacts are not expected to extend to developed areas below the Site, nor are they expected to significantly impact the proposed orchard development. Wheeler Ridge, LLC can expect that some slope failure will occur within portions of Units 1, 2, or 3 where indications of past slope instability are identified and should plan for periodic maintenance where these areas cannot be avoided.

Risks of slope instability specific to the realignment of Wheler Ridge Road adjacent to the tops of identified landslide areas and mitigation were previously addressed in Aspect (2018a and 2018b):

> *We believe there is an inherently low to moderate likelihood that a realigned road positioned closer to the observed landslide features than the current road could result in vertical and horizontal roadway movement over the design life of the road (assumed about 20 to 30 years). We envision landslide or ground creep-induced movement could manifest as tension cracks and depressed/sagging areas in the roadway that can be repaired/re-leveled with ongoing maintenance by Wheeler Ridge, LLC after it occurs. A more extreme, but less likely consequence is large-scale roadway movement on the order of several feet or*

more such that it might be most economical to abandon the road and realign it further away from landslide activity.

Changes to Site hydrology can increase slope instability. Road construction has the potential to change natural drainage patterns by diverting water in roadside ditches away from natural drainage courses and concentrating flows on steep slopes, resulting in erosion and soil saturation. Additionally, broken or leaking irrigation pipes could increase slope instability by saturating soils.

Earth grading, including loading the tops of slopes with fill and oversteepening the toes of steep slopes (e.g., during road construction), could also increase slope instability.

Irrigation is not expected to significantly or detrimentally change Site hydrology, increase groundwater levels, or contribute to slope instability. Based on evaluation of a similar development proposed for nearby Section 10 (Aspect, 2019), irrigation is expected to increase annual groundwater recharge by up to 30 percent over undeveloped conditions. This increase lies within the range of local-precipitation variability and is not considered to be significant for slope stability because irrigation water will only be applied over a 4-month period during the dry season. While irrigation will increase annual groundwater recharge, irrigation will occur off-cycle from natural recharge due to normal winter precipitation and spring snow melt. Off-cycle recharge is not expected to result in overall higher groundwater levels at the Site than those resulting from natural winter and spring precipitation.

The following are recommended to minimize slope instability:

- Limit timber harvest, land clearing, and orchard development to the proposed areas shown on Figure 1. Forest and orchard activities outside of this area could increase risk of slope instability, especially in areas having slopes greater than 35 percent.
- Irrigation mainlines should be located as far away from steep slopes as practicable. Irrigation laterals and sub-mains should be inspected daily during irrigation season to ensure they are not leaking or ruptured, especially where they run near steep slopes. Irrigation lines should be equipped with pressure gauges and means to sound an alarm or otherwise alert operators when a sudden pressure drop is detected outside of a scheduled irrigation event.
- When constructing roads, use appropriate best management practices (BMPs) for drainage design to minimize saturation of soils on steep slopes and erosion. Designs should consider constructing roadside ditches on the uphill side and providing multiple, properly sized culverts to maintain natural drainage courses avoiding concentrating flows on steep slopes. Culverts should be maintained to avoid clogging/overtopping. Culverts within the Orr Creek tributary should be properly sized and water courses returned to their natural channels to minimize erosion and soil saturation.
- Avoid large fills and steep cuts near steep slopes. Large soil stockpiles should not be placed adjacent to the tops of steep slopes. Avoid filling depressions near the tops of steep slopes. In some cases, these are the uppermost expressions of hollows resulting from previous slope movement. Filling these depressions could reinitiate slope movement.

Erosion Hazard

About 20 percent of the area proposed for orchard development contains soils classified as having a high erosion hazard. Erosion hazard increases on steep slopes, in areas stripped of vegetation, and where changes to hydrology concentrate flows. The greatest potential for erosion will be during the first 1 to 2 years following timber harvest and ground clearing, and prior to orchard groundcover becoming fully established. Erosion can be mitigated by avoiding development and minimizing disturbances on steep slopes, replanting groundcover immediately following ground clearing and minimizing changes to Site hydrology. Erosion mitigation during earthwork activities can be appropriately addressed by implementing Best Management Practices outlined in Ecology's *Eastern Washington Stormwater Management Manual*.

Debris Flows

Debris flows are common in the greater Squilchuck/Stemilt area, typically from rapid snow melt or high intensity rainstorms. Although no evidence of recent (within about 100 years) debris flows were observed, potential for debris flows exists in all drainages throughout the Site. The Mikes Canyon drainage presents the greatest potential for debris flows.

Mitigation for debris flows includes avoiding development in potential floodways, minimizing erosion, and proper sizing of hydraulic structures at stream crossings.

References

Aspect Consulting, LLC (Aspect), 2017, Slope Stability Reconnaissance, prepared for Wheeler Ridge, LLC, October 30, 2017.

Aspect Consulting, LLC (Aspect), 2018a, Section 16 and 17 Upper Wheeler Road Reconnaissance and Planning-Level Geotechnical Considerations, prepared for Wheeler Ridge, LLC, August 7, 2018.

Aspect Consulting, LLC (Aspect), 2018b, Section 16 and 17 Upper Wheeler Road Reconnaissance and Planning-Level Geotechnical Considerations—Revised, prepared for Wheeler Ridge, LLC, revised September 12, 2018.

Aspect Consulting, LLC (Aspect), 2019, Section 10 Slope Stability Reconnaissance, prepared for Kyle Mathison Orchards, December 31, 2019.

International Building Code, 2006, International Code Council, March 1, 2006, 679 pp.

Tabor, R. W., Waitt, R. B., Frizzell, V.A., Jr., Swanson, D. A., Byerly, G. R., and Bentley, R. D., 1982, Geologic Map of the Wenatchee 1:100,000 Quadrangle, Central Washington, United States Department of the Interior Geological Survey, Miscellaneous Investigations Series Map 1-13311.

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), 2020, Web Soil Survey, online at https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm.

Washington Department of Natural Resources (DNR), 2020, Division of Geology and Earth Resources, Washington Interactive Geologic Map, online at http://www.dnr.wa.gov/geologyportal, accessed May 2020.

Limitations

Work for this project was performed for Wheeler Ridge, LLC, and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting, LLC (Aspect). The information above is for preliminary, planning-level design and should not be used for final design or construction.

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Wheeler Ridge, LLC. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations.

Risks are inherent with any site involving slopes and no recommendations, geologic analysis, or engineering design can assure slope stability. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the client.

It is the Wheeler Ridge, LLC's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this planning level memorandum should be revised and/or expanded upon.

The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor's site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

All reports prepared by Aspect for the Wheeler Ridge, LLC's apply only to the services described in the Agreement(s) with the Wheeler Ridge, LLC's. Any use or reuse by any party other than the Wheeler Ridge, LLC's is at the sole risk of that party, and without liability to Aspect. Aspect's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Attachment 1 titled "Report Limitations and Guidelines for Use" for additional information governing the use of this report

Attachments: Figure 1 – Site Map and Geological Hazards
Figure 2 – Slopes Greater Than 40 Percent
Attachment 1 – Report Limitations and Guidelines for Use

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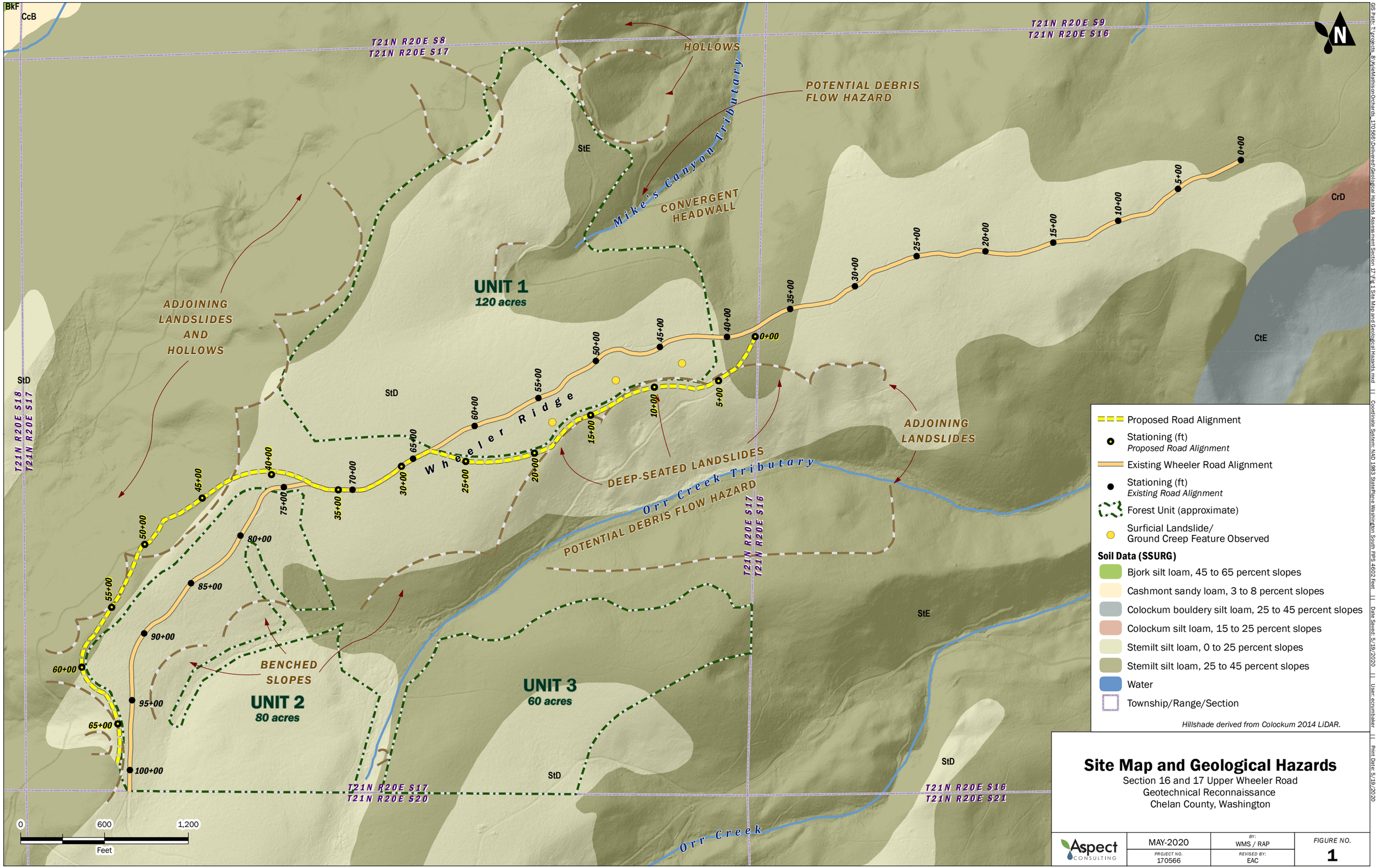
FIGURES

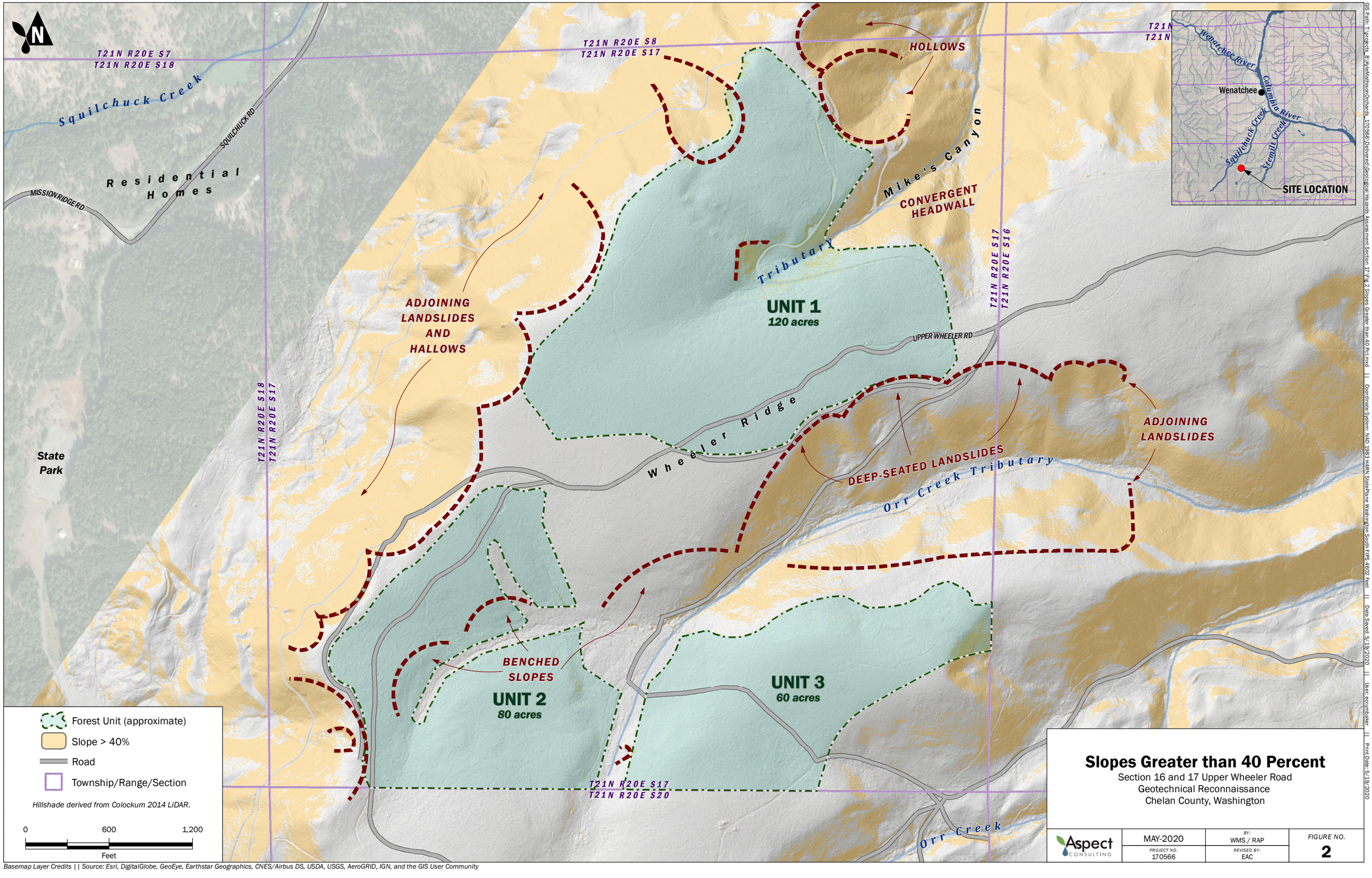


Site Map and Geological Hazards

Section 16 and 17 Upper Wheeler Road
Geotechnical Reconnaissance
Chelan County, Washington

Aspect Consulting	MAY-2020	BY: WMS / RAP	FIGURE NO. 1
	PROJECT NO. 170566	REVISED BY: EAC	

GIS Path: T:\projects_8\WyleMathisonOrchards_170566\Delivered\Geological Hazards Assessment Section 17\Fig 1 Site Map and Geological Hazards.mxd || Coordinate System: NAD 1983 StatePlane Washington South FIPS 4602 Feet || Date Saved: 5/19/2020 || User: ecrumbaker || Print Date: 5/19/2020



Basemap Layer Credits | | Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Slopes Greater than 40 Percent

Section 16 and 17 Upper Wheeler Road
Geotechnical Reconnaissance
Chelan County, Washington

Aspect Consulting	MAY-2020	BY: WMS / RAP	FIGURE NO. 2
	PROJECT NO. 170566	REVISED BY: EAC	

GIS Path: T:\projects_8\WyleMathisonOrchards_170566\Delivered\Geological Hazards Assessment Section 17\Fig 2 Slopes Greater than 40 Pct.mxd | | Coordinate System: NAD 1983 HARN StatePlane Washington South FIPS 4602 Feet | | Date Saved: 5/19/2020 | | User: ecrumbaker | | Print Date: 5/19/2020

ATTACHMENT 1

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND GUIDELINES FOR USE

This Report and Project-Specific Factors

Aspect Consulting, LLC (Aspect) considered a number of unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you
- Not prepared for the specific purpose identified in the Agreement
- Not prepared for the specific real property assessed
- Completed before important changes occurred concerning the subject property, project or governmental regulatory actions

Geoscience Interpretations

The geoscience practices (geotechnical engineering, geology, and environmental science) require interpretation of spatial information that can make them less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Use Guidelines" apply to your project or site, you should contact Aspect.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared.

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods, earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Discipline-Specific Reports Are Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions please contact the Aspect Project Manager for this project.