# Appendix D

**REVISED REPORT OF GEOLOGIC HAZARD EVALUATION**
**GEODESIGN INC., AN NV5 COMPANY**
**MAY 27, 2020**

GeoDesign Inc
An NV5 Company

May 27, 2020

Vaagen Brothers Lumber, Inc.
565 West 5th Avenue
Colville, WA 99114

Attention: Jeff Waterman

**Revised Report of Geologic Hazard Evaluation**
Naff Pit
Highway 20 Near Colville
Stevens County, Washington
GeoDesign Project: VaagenBros-1-01

## INTRODUCTION

GeoDesign, Inc. is pleased to submit to Vaagen Brothers Lumber, Inc. (Vaagen) this revised report providing a geologic hazard evaluation at the Naff Pit (Washington State Department of Natural Resources [DNR] permit #70-013126) located on the north side of Highway 20 west of Colville in Stevens County, Washington. Figure 1 shows the site relative to surrounding physical features.

The currently permitted mine extracts bedrock and talus along a steep working face. Vaagen intends to expand the mine northwards and is in the process of preparing a permit expansion application for DNR. There is concern that the steepness of the current slope and inherent bedrock structure could present a geologic hazard to continued mining or mine expansion. Vaagen requested that we conduct a geologic hazard review to evaluate the slope hazards at the site and develop recommendations to guide mine expansion efforts.

## SCOPE OF SERVICES

Our specific scope of services included the following:

- Reviewed publicly available geologic literature and recent light detection and ranging (LiDAR) data for the site.
- Obtained and reviewed mine permitting documents from DNR, including recent site inspection reports.
- Reviewed documents provided by Vaagen, including maps showing the current mine and property of interest for proposed expansion.

- Conducted a surface reconnaissance of the site vicinity as well as the proposed expansion area.
- Prepared this geologic hazard evaluation report summarizing our observations and recommendations.

## SITE CONDITIONS

The following summary of site conditions is based on our review of geologic maps, Vaagen documents, LiDAR topographic data, and our observations during geologic field reconnaissance on April 13, 2020.

### *SURFACE CONDITIONS*

The site is located on the north side of the Colville River Valley approximately 4.5 miles northwest of the city of Colville. The current permit area, proposed expansion area, and site topography are shown on Figure 2. The topography is derived from aerial LiDAR data collected for DNR in 2016. A photo of the current mine and expansion area is shown on Figure 3. Significant mining has not occurred at the site for several years, and the LiDAR data appear to be representative of current slope conditions.

The mine excavation and proposed expansion area are situated on a steep, west-facing slope forming the west side of a narrow ridge that projects from mountainous terrain farther north of the site. This ridge is one of several subparallel ridges in the area with troughs and suspended valleys between them. The adjacent work area west of the mine excavation and proposed expansion is located on relatively flat to gently sloped ground on the valley floor. This geomorphology reflects the underlying geology described below. Elevations at the site range from approximately 1,520 feet above mean sea level (MSL) in the west work area to approximately 1,560 MSL near the base of the highwall, then up to 2,180 MSL at the top of the ridge within the proposed expansion area.

The mine excavation is composed primarily of a single, steeply inclined highwall with relief of up to 200 vertical feet with overall gradients of approximately 75 to 100 percent, including some vertical segments (Figures 2 through 5). We understand the upper slope was excavated using a drag line, where talus was mined from the slope along with a finer-grained soil matrix. Much of this older excavation has been reclaimed by volunteer vegetation (see Figure 2). The bedrock underlying the talus was excavated in the lower portion of the mine at several locations, with a maximum vertical exposure of approximately 40 feet (see Figures 3 and 4).

Undisturbed slopes in the vicinity are covered with patches of grass and isolated stands of pine trees and brush. There are also many natural bedrock outcroppings (see Figure 5). Undisturbed slopes are steep, ranging from approximately 50 to 100 percent gradient. Due to the steepness and shallow bedrock, the slopes within the site area generally do not have established drainages. We did not observe indications of groundwater seepage out of the site slopes or in the mined excavations.

## *GEOLOGIC CONDITIONS*

DNR geologic mapping indicates the site vicinity is underlain by interbedded Ordovician to Carboniferous marine and continental metasedimentary rocks (480 to 300 million years old).[1,2] These represent folded and faulted sedimentary rocks thrust onto the North American Plate and stacked one against the other. Based on fault studies compiled by the U.S. Geological Survey, none of the faults mapped in the area is interpreted to be recently active.[3] The compressional tectonics led to the rocks being weakly metamorphosed and caused the faulted and folded strata to strike more or less north to south. The differing resistance of the strata to weathering resulted in the subparallel ridges and suspended valleys observed today. River erosion and sediment transport along the Colville River Valley has led to accumulation of much younger alluvium in the valley floor.

The rock strata exposed in the site vicinity include weakly metamorphosed conglomerate and slate. The conglomerate is exposed in the current mine excavation and in natural outcrops above the excavation (Figure 5) as well as on the expansion area. The conglomerate consists of a chert- and mudstone-pebble conglomerate with a silty sand matrix that is well lithified. Pebbles are subangular to rounded, and their long dimension is oriented parallel to bedding. Bedding planes are prominent in the mined excavation and to a lesser degree in natural outcrops. Bedding is also evident by pebble orientation observed on fresh surfaces. The conglomerate is moderately fractured along well-developed rock cleavage (discussed below and shown in Figures 3 and 4).

A recently cut dozer trail on the less-steep slope located north of the expansion area has multiple exposures of slate. The slate is gray, fissile, finely laminated, and intensely fractured and contorted (Figure 5). It is impossible to tell the structural orientation of the slate in the outcrops we observed due to the structural disturbance of the original bedding. We interpret the less-steep natural slope gradients north of the expansion area to reflect the slate's lesser resistance to weathering, resulting in more gradual topography with no natural outcrops.

### Geologic Structure

Sedimentary bedding is the primary rock discontinuity observed at the site. Based on measurements using a field compass, bedding of the strata generally strikes north 50 to 55 degrees west and dips southwest at an average of 28 degrees. This is different from DNR mapping, which shows the strata dipping approximately 55 degrees to the west.[2] It is possible DNR mapping was completed without the benefit of the mined exposure and was thus estimated from other features.

As previously mentioned, compressional tectonics imparted rock cleavage (jointing) into the strata at different orientations from bedding. Based on our measurements using a field compass, there are two main sets of rock jointing:

---

[1] Washington State Department of Natural Resources, n.d. Washington Geologic Information Portal. Retrieved May 22, 2020 from https://geologyportal.dnr.wa.gov/

[2] Mills, J. W., Duncan, G. W., Brainard, R. C., Hogge, C. E., and Laskowski, E. R., 1985. *Geologic Map of the Echo Valley and the North Part of the Colville 7½-Minute Quadrangles, Washington.* DNR Division of Geology and Earth Resources, Open-File Report 85-7, 2 plates, scale 1:24,000.

[3] U.S. Geological Survey Geologic Hazards Science Center, n.d. *U.S. Quaternary Faults.* Retrieved May 22, 2020 from https://usgs.maps.arcgis.com/apps/webappviewer/index.html?id=5a6038b3a1684561a9b0aadf88412fcf

- Joint Set no. 1: strike north 55 to 60 degrees west, dip 70 to 80 degrees northeast
- Joint Set no. 2: strike north 5 to 15 degrees west, dip 60 to 75 degrees west/southwest

Figures 3 and 4 show photographs of jointed beds in the mined excavation. Similarly oriented joints and planar trends are exhibited in outcrops. These features are visibly aligned where they can be observed together.

### *SLOPE STABILITY HAZARDS*

The presence of dipping rock strata out of the slope and cross-cut by high-angle rock fractures presents the potential for slope instability. We did not observe signs of global slope failure or significant rockslides at the site during our reconnaissance. In fact, there are rock features toward the south end of the currently permitted area that appear to be delicately balanced, forming isolated pinnacles from gradual erosion of the surrounding bedrock (Figure 5).

We did observe large, angular boulders on the south floor of the current mine that fell out of the mined bedrock excavation. These boulders are similarly sized in all three dimensions, up to approximately 10 feet in diameter, and have prominently planar faces representing rock discontinuity surfaces. The boulders appear to be defined by two sets of intersecting joints and bedding planes. This mode of failure can result in wedge failures out of exposed bedrock if rock cuts are significantly tall and steeper than the main discontinuity, which is bedding in this case.

## CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our research and site observations, mined excavation into the bedrock has the potential to create large rockfalls and rockslides if the mining creates too tall and too steep of an exposed highwall. The main discontinuity of concern is bedding dipping to the southwest at approximately 28 degrees, which is then cross-cut by more steeply dipping rock joints that can cause the bedrock to form large boulders and fail out of the exposure.

We recommend that the bedrock highwall in the current mine excavation not be advanced farther east into the hillside at the current elevation. The current mine face has experienced some significant rockfall. Continued mining would result in a taller exposure with a greater chance for large rockslides. If further mining of the currently permitted area is not planned, we recommend the operator place a protective berm or consider backfilling the floor and restoring a slope up against the bedrock highwall to protect against potential future rockfall. Backfill should consist of clean, inert soil and weathered, non-saleable rock removed from the expanded mine excavation area. Fill should be placed in horizontal lifts using bulldozers or other heavy equipment and track-compacted into place to a firm, unyielding condition. Lifts should not exceed 2 feet in thickness. Fill should be placed during dry weather or when not excessively above optimum moisture content.

For the proposed expansion area located north of the current mine, we recommend developing a mining plan that minimizes the height of vertical exposures in the hillside. An initial cut at the toe of the slope for 10 to 20 feet may be required to define the initial expansion. However, the main phase of mine development should generally follow a top-down mining plan using benched cuts with a final net slope gradient of 2H:1V. Maximum bench height should generally not

exceed 30 feet. This net slope would be less steep than the bedding plane orientations measured on rock exposures in the expansion area and should prevent massive rockslides from occurring. Rockfall out of the vertical part of each bench is still possible. The operator should periodically monitor benches for development of isolated rock masses that might slip out of the vertical portion of the benches.

**LIMITATIONS**

We prepared this report for use by Vaagen and other members of the design and construction team for the proposed Naff Pit expansion project. The data and report can be used for estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other nearby sites.

Our interpretations of the geologic conditions are based on the exposures of soil and rock within the mine vicinity. They do not necessarily reflect soil and rock strata or water level variations that may exist in the subsurface. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The scope does not include services related to construction safety precautions, and our recommendations are not intended to direct the methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty, express or implied, should be understood.

♦ ♦ ♦

We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

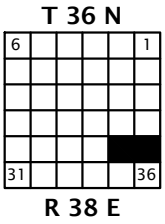
Erick J. Staley, L.E.G.
Principal Engineering Geologist

EJS:sn:kt
Attachments
One copy submitted (via email only)
Document ID: VaagenBros-1-01-052720-minlr-rev.docx


State of Washington
Engineering Geologist
2344
Licensed Geologist
Erick J. Staley

Signed 05/27/2020

# FIGURES




**SITE COORDINATES:**

LATITUDE: **48° 35' 20.8 " N**

LONGITUDE: **117° 58' 33.3" W**

**EASTERN WASHINGTON**


## DIRECTIONS TO SITE

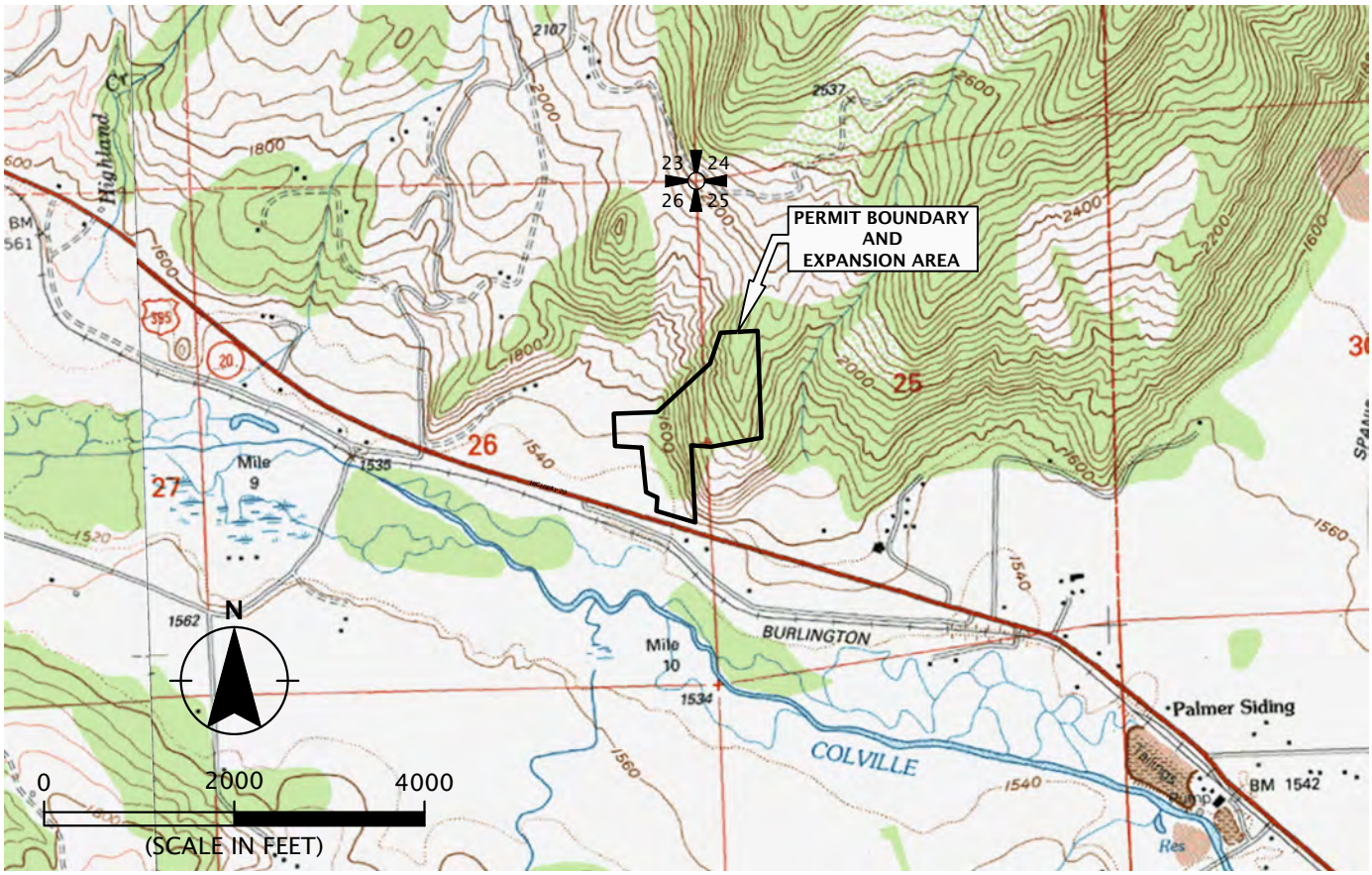
NAFF PIT IS LOCATED APPROXIMATELY 4.25 MILES NORTHWEST OF COLVILLE, WA. FROM COLVILLE, DRIVE NORTHBOUND ON STATE HIGHWAY 20. NAFF PIT SITE ACCESS IS LOCATED ON THE RIGHT (NORTH) SIDE OF HIGHWAY 20 APPROXIMATELY 4.25 MILES FROM COLVILLE.

## LEGAL DESCRIPTION

THE PERMIT BOUNDARY IS LOCATED IN PORTIONS OF THE FOLLOWING QUARTER-QUARTER SECTIONS:

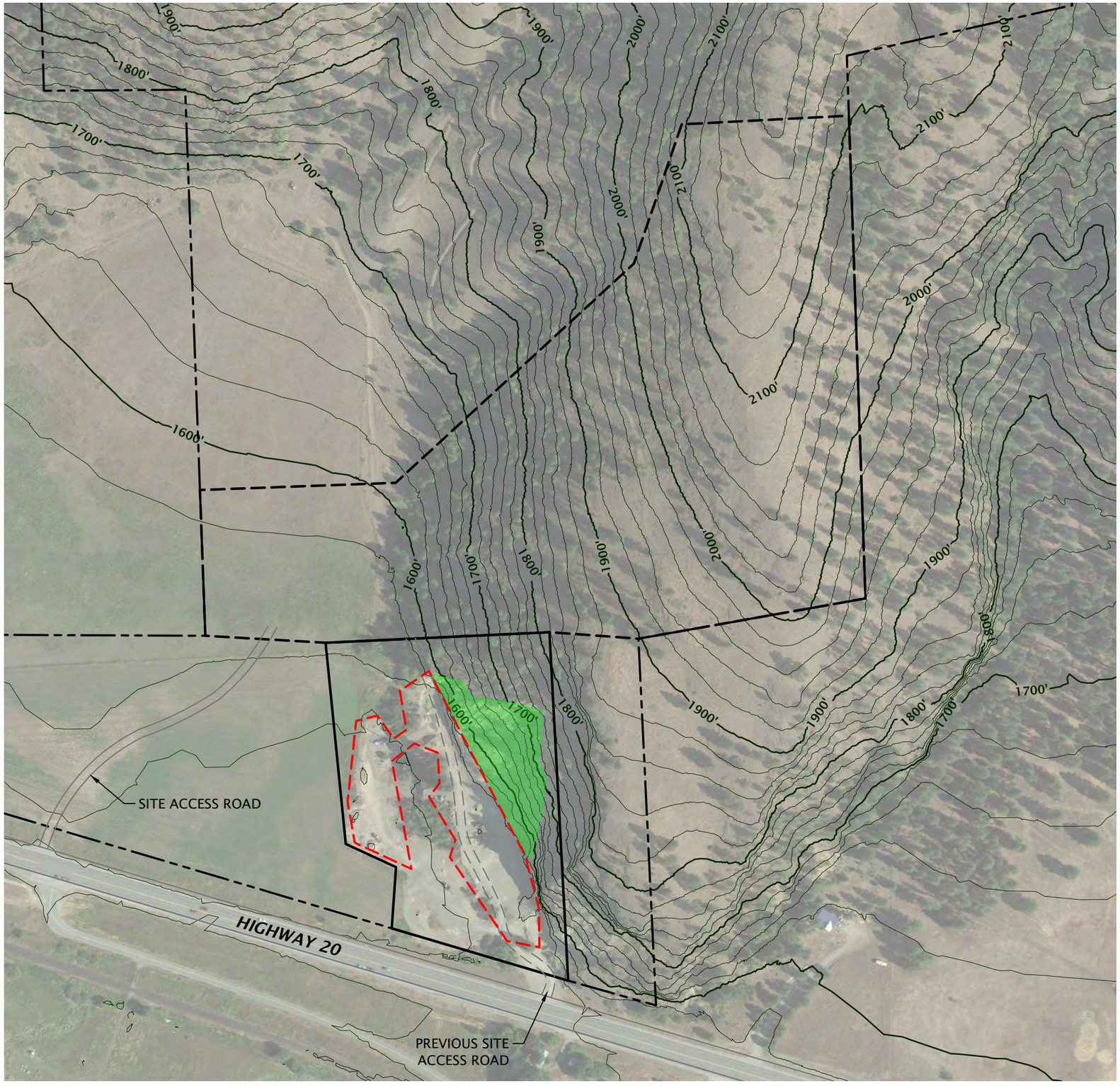
- SE QUARTER OF THE NE QUARTER OF SECTION 26
- NE QUARTER OF THE SE QUARTER OF SECTION 26
- SW QUARTER OF THE NW QUARTER OF SECTION 25

**NOTE:** USGS TOPOGRAPHIC QUADRANGLE MAPS REPRODUCED USING MAPTECH TERRAIN NAVIGATOR PRO®.




| | | |
|---|---|---|
| GEODESIGN INC AN NV5 COMPANY | VAAGEN BROTHERS LUMBER, INC. | **VICINITY MAP** NAFF PIT (DNR #70-013126) |
| | VAAGENBROS-1-01 MAY 2020 | STEVENS COUNTY, WA SECTIONS 25 & 26, TOWNSHIP 36N, RANGE 38E W.M. — **FIGURE 1** |

Printed By: mmiller | Print Date: 5/27/2020 4:22:37 PM
File Name: J:\S-Z\VaagenBros\VaagenBros-1\VaagenBros-1-01\Figures\CAD\VaagenBros-1-01-VM02.dwg | Layout: FIGURE 1




**LEGEND:**

- EXISTING NAFF PIT PERMIT BOUNDARY (8.1 ACRES)
- PERMIT EXPANSION BOUNDARY (25 ACRES)
- PROPERTY BOUNDARY
- 2000' EXISTING TOPOGRAPHY (20-FOOT INTERVALS; 100-FOOT INDEX CONTOURS)
- EXISTING DISTURBANCE BOUNDARY
- RECLAIMED AREA

N

0 250 500

(SCALE IN FEET)

**NOTES:**

1. EXISTING TOPOGRAPHY (2016) OBTAINED FROM DNR LIDAR PORTAL.
2. EXISTING DISTURBANCE AND RECLAIMED AREAS OBTAINED FROM DNR AERIAL PHOTOGRAPHY REPORT DATED JULY 10, 2019.
3. AERIAL PHOTOGRAPH (AUGUST 20, 2016) OBTAINED FROM GOOGLE EARTH PRO.

**SITE MAP**
NAFF PIT (DNR #70-013126)

STEVENS COUNTY, WA
SECTIONS 25 & 26, TOWNSHIP 36N, RANGE 38E W.M.

**FIGURE 2**

VAAGEN BROTHERS LUMBER, INC.

VAAGENBROS-1-01
MAY 2020

GeoDesign AN NV5 COMPANY

Printed By: mmiller | Print Date: 5/27/2020 4:22:45 PM
File Name: J:\S-Z\VaagenBros\VaagenBros-1\VaagenBros-1-01\Figures\CAD\VaagenBros-1-01-SP01.dwg | Layout: FIGURE 2

NAFF PIT (RIGHT) AND THE PROPOSED EXPANSION AREA (LEFT OF MINE DISTURBANCE) VIEWED FROM HIGHWAY 20. A RECENT DOZER TRAIL IS LOCATED FURTHER LEFT OF THE EXPANSION AREA. PANORAMIC PHOTOGRAPH TAKEN FACING EAST/NORTHEAST.

SOUTH END OF MINED EXCAVATION INTO BEDROCK (CONGLOMERATE) AT NAFF PIT. BEDDING APPEARS NEAR HORIZONTAL IN THIS VIEW BECAUSE THE PERSPECTIVE FACES UP-DIP TO THE NORTHEAST. STEEPLY DIPPING ROCK JOINTS CROSS-CUT THE CONGLOMERATE BEDS.

MINED EXCAVATION INTO CONGLOMERATE AT NAFF PIT. BEDDING DIPS DOWN AND TO THE RIGHT (SOUTHWEST). ROCKFALL HAS ACCUMULATED AT THE FOOT OF THE HIGHWALL. PHOTOGRAPH TAKEN FACING EAST.

ROCKFALL BOULDER APPROXIMATELY 8 FEET IN DIAMETER. THE MINED SLOPE IN THE BACKGROUND IS MOSTLY FORMED FROM REMOVAL OF TALUS. PHOTOGRAPH TAKEN FACING NORTHEAST.

VIEW PARALLEL TO THE MINED EXCAVATION, INCLUDING THE TALUS SLOPE UNDERLAIN BY A BEDROCK CUT IN THE FOREGROUND, AND THE BEDROCK EXCAVATION WITH ROCKFALL IN THE BACKGROUND. PHOTOGRAPH TAKEN FACING SOUTH/SOUTHEAST. NOTE THE NATURAL OUTCROP ABOVE BOTH SLOPES ORIENTED PARALLEL TO THE BEDDING EXPOSED IN THE BEDROCK EXCAVATION. ROCK PINNACLE ALSO VISIBLE AT THE RIGHT END OF THE NATURAL OUTCROP.

SLATE EXPOSED ALONG DOZER TRAIL NORTH OF THE EXPANSION AREA. YELLOW ARROW POINTS AT THE CONTORTED BEDDING IN THE SLATE. PHOTOGRAPH TAKEN FACING EAST.



| GeoDesign Inc an NV5 company | VAAGENBROS-1-01 | **SITE PHOTOGRAPHS** | |
|---|---|---|---|
| | MAY 2020 | NAFF PIT<br>STEVENS COUNTY, WA | **FIGURE 5** |

# Appendix E

**GEOLOGIC HAZARD EVALUATION**
**FULCRUM GEORESOURCES LLC**
**AUGUST 12, 2024**

**RECEIVED**
**November 8, 2024**
**Washington Geological Survey**

FULCRUM
GEO RESOURCES LLC
17600 Pacific Highway, Unit 357
Marylhurst, Oregon 97036
503.250.2247

August 12, 2024

Vaagen Brothers Lumber, Inc.
565 West 5th Avenue
Colville, WA 99114

Attention: Kurtis Vaagen

RECEIVED
November 8, 2024
Washington Geological Survey

**Geologic Hazard Evaluation**
Drive Inn/Naff Pit
U.S. Route 395 Near Colville
Stevens County, Washington
Project: 012.01.01

## INTRODUCTION

Fulcrum GeoResources LLC (Fulcrum) provides this report summarizing a geologic hazard evaluation for the Drive Inn/Naff Pit mine (Washington State Department of Natural Resources [DNR] surface mine reclamation permit [SMRP] #70-013126) located on the north side of U.S. Route 395 west of Colville in Stevens County, Washington. Figure 1 shows the site relative to surrounding physical features. The property owner is Vaagen Brothers Lumber, Inc. (Vaagen), and the permittee for the SMRP is currently N.E.W. Gravel, LLC. Vaagen was the prior permittee, who then transferred the SMRP to N.E.W. Gravel in March 2023. C.V. Resources, LLC (CVR) has operated the site as a commercial mine since approximately 2021.

DNR recently noted that mining was not being conducted in compliance with the geotechnical recommendations and mine plan associated with the site's SMRP. DNR required Vaagen to arrange for a supplemental geotechnical evaluation of the current site conditions by a geotechnical professional to evaluate potential slope instability and provide recommendations to mitigate hazards and for future mining. Vaagen requested Fulcrum to conduct a geologic hazard evaluation, which is summarized in this technical report. Fulcrum conducted a surface reconnaissance of the site on April 4, 2024 to observe the mined conditions. Current site topography is shown on Figure 2, which was collected by Mid-Mountain Surveyors, Inc. out of Republic, Washington on June 19, 2024 using an unmanned aerial vehicle (UAV) with ground survey control.

## BACKGROUND

Prior to Vaagen acquiring the property, a small mine existed on the site operated by Mike Naff. The prior mine extracted bedrock and talus along a steep working face on the west side of a steep-sided ridge. This resulted in local slope instability including raveling of loose talus from above the mine excavation and large block failures of jointed, dipping bedrock falling to the mine floor. The prior mine roughly corresponds to the green-shaded "reclaimed area" and backfilled floor to the southwest shown in Figure 2.

After acquiring the property, Vaagen planned to expand the mine to the north and hired GeoDesign, Inc. (GeoDesign) to evaluate geologic conditions and provide recommendations for future mining, including addressing slope instability observed in the older, smaller mine. GeoDesign concluded that mined excavations into the west side of the ridge have the potential to create large rockfalls and rockslides if mining creates too tall and too steep of an exposed highwall. The main factor influencing stability is the orientation of the bedrock dipping to the southwest, which is then cross-cut by steeply inclined rock joints that can cause the bedrock to form large boulders or slabs that fail out of excavations.

GeoDesign prepared a geotechnical report[1] with recommendations including the following:

- The bedrock highwall in the prior mine excavation should not be advanced farther east into the hillside. Instead, GeoDesign recommended placing a protective berm or backfilling the floor and restoring a slope up against the bedrock highwall to protect against potential future rockfall.
- For the planned expansion north of the prior mine, GeoDesign recommended that expanded mining should generally follow a top-down mining plan using benched cuts with a final net slope gradient of 2 horizontal to 1 vertical (2H:1V). Maximum bench height should not exceed 30 feet. This net slope would be less steep than the bedding plane orientations measured on rock exposures in the expansion area and should prevent massive rockslides from occurring.
- Rockfall from the bench walls would still be possible. The operator should periodically monitor benches for development of isolated rock masses that might slip out of the vertical portion of the benches.

CVR backfilled much of the prior bedrock mine excavation with non-resource rock material, as shown in the aerial image and by the topographic contours below the green-shaded "reclaimed area" on Figure 2. However, expanded mining north of the prior mine has not followed the top-down mine plan and benching parameters recommended by GeoDesign. The following summarizes Fulcrum's observations of current site conditions and associated geologic hazards.

[1] GeoDesign, Inc., 2020. *Revised Report of Geologic Hazard Evaluation; Naff Pit; Highway 20 Near Colville; Stevens County, Washington*, dated May 27, 2020. GeoDesign Project: VaagenBros-1-01

## SITE CONDITIONS

The 2020 GeoDesign report presents a thorough discussion of the geologic conditions and surface conditions observed prior to more recent, expanded mining of the site. The following briefly discusses geologic conditions then provides more detail for the current site conditions.

### *GEOLOGIC CONDITIONS*

DNR geologic mapping indicates the site vicinity is underlain by interbedded metasedimentary rocks that were folded and faulted as they were thrust onto the North American Plate and then eroded into the mountains and intervening valleys of the region[2,3]. The rock strata exposed in the site vicinity include weakly metamorphosed conglomerate and slate. The conglomerate consists of a chert- and mudstone-pebble conglomerate with a silty sand matrix that is well lithified. Bedding planes are prominent in mined excavations and to a lesser degree in natural outcrops. The conglomerate is moderately fractured along well-developed rock cleavage.

Bulldozed access roads north of the expanded mine excavation expose slate that is gray, fissile, finely laminated, and intensely fractured and contorted. It is impossible to tell the structural orientation of the slate in individual outcrops due to structural disturbance of the original bedding. The less-steep natural slope gradients north of the expanded extraction area likely reflect the slate's lesser resistance to weathering, resulting in more gradual topography.

#### Geologic Structure

Sedimentary bedding is the primary rock discontinuity observed at the site. Based on measurements using a field compass in 2020, GeoDesign estimated the bedding of the strata generally strikes northwest and dips southwest at an average of 28 degrees. Compressional tectonics imparted rock cleavage (jointing) into the strata at different orientations from bedding, mostly striking north to northwest at inclinations ranging from 60 to 75 degrees west or 70 to 80 degrees northeast. Where these high-angle rock joints are prominent and intersect bedding, they can result in distinct rock masses that present a risk of block failure or large rockfalls out of steeply excavated mined slopes. In the prior mine excavation, angular boulders up to 10 feet in diameter were observed on the floor, having slipped out of the excavated highwall.

### *CURRENT MINE CONDITIONS*

The expanded mine conditions are presented on Figures 2 and 3 using the June 2024 UAV aerial imagery and topographic survey. A multi-use property access road extends north and east of the mine and was widened and graded with additional switchbacks to ascend the north slope. Two internal haul roads extend south from the switchbacks to access benches cut into the west hillside at elevations of about 1,770 and 1,830 feet above mean sea level (msl). An additional haul road is located at 1,690 feet msl.

---

[2] Washington State Department of Natural Resources, n.d. Washington Geologic Information Portal. Retrieved from https://www.dnr.wa.gov/geologyportal.

[3] Mills, J. W., Duncan, G. W., Brainard, R. C., Hogge, C. E., and Laskowski, E. R., 1985. *Geologic Map of the Echo Valley and the North Part of the Colville 7½-Minute Quadrangles, Washington*. DNR Division of Geology and Earth Resources, Open-File Report 85-7, 2 plates, scale 1:24,000.

As part of ongoing efforts to perfect the SMRP, N.E.W. Gravel plans to submit an expansion application to capture all areas of mining disturbance including operations on relatively flat-lying ground west of the ridge and the internal haul roads devoted to mining activity. The proposed final topography for the updated expansion plan is presented on Figure 4 and in the cross sections on Figure 5. The cross sections on Figure 5 also present the June 2024 UAV topography and lidar elevation data collected by DNR in 2016 prior to expanded mining of the site that started approximately in 2021.

There are three principal areas where resource extraction resulted in tall, very steep rock cuts, labeled Cut 1, Cut 2, and Cut 3 on Figure 2. Cuts 1 and 3 are located along cross section A-A'. Cut 2 is located along cross section B-B'. By comparing the June 2024 UAV survey to the 2016 lidar data, estimated maximum vertical cuts are as follows:

- Cut 1 – 120 vertical feet (elevation 1,640 to 1,760 feet msl)
- Cut 2 – 50 vertical feet (elevation 1,830 to 1,880 feet msl)
- Cut 3 – 70 vertical feet (elevation 1,850 to 1,920 feet msl)

**Exposed Bedrock**

The bedrock exposed in the current mine mostly consists of metamorphosed conglomerate with lesser sandstone beds that display prominent dip to the southwest in agreement with previous studies. The dip angle is generally about 28 degrees but may be locally steeper due to undulations. Refer to Figures A-1 and A-2 in the Attachment. Thin-bedded sandstone and slate exhibiting contorted folding are exposed in the lower part of Cut 1, as shown on Figure A-1. Slate is exposed north of the mine excavation along dozed haul roads and switchbacks. Based on the current mined bedrock exposures, it is our opinion the slate may be stratigraphically below the conglomerate and sandstone beds, suggesting the thin-bedded sandstone and slate in Cut 1 are stratigraphically connected to the slate north of the mine excavation. However, we also observed thin sandstones interbedded with conglomerates exposed in Cut 2, indicating the transition from coarse-grained to fine-grained strata may also occur laterally along strike.

**Observed Slope Instability**

Two of the principal resource extraction areas – Cut 1 and Cut 2 – show signs of past and current slope instability. Each cut is discussed below.

***Cut 1 Slope Stability Concerns***

Cut 1 consists of a very tall "box-cut" into the lower hillside, exposing thick conglomerate beds underlain by finer-grained, thin sandstone and slate beds in the east wall of the cut. Refer to Figures A-1 and A-2 in the Attachment. Undulations in the bedding have also resulted in locally steeper dip planes that appear to have caused smaller, localized failure of prior benches. One remnant block from a previous bench, located in the southeastern corner of Cut 1, remains at the top of the cut wall. Refer to Figure A-2. Adjacent areas to the north expose a smoothed, dipping plane that appears to underlie this suspended block, suggesting there were other blocks located along the previous bench that already slid.

The finer-grained strata – particularly the slate – located at the base of the east wall in Cut 1 is of significant concern. Slate is a much weaker rock than the overlying conglomerate and sandstone, as exhibited along the dozed roadways north of the mine. If Cut 1 were expanded northward or southward from the current box cut into a longer bench, it could lead to a global failure of the ridge, where the overlying conglomerate and sandstone could slide over the exposed slate. Based on the proposed final contours on Figure 4 and cross section A-A' on Figure 5, Cut 1 has been excavated below a final floor projecting at 2H:1V from the east edge of the proposed extraction limits. As such, some of the current Cut 1 may require backfill to achieve the proposed final topography presented on Figures 4 and 5.

***Cut 2 Slope Stability Concerns***

Cut 2 consists of a bench more than 350 feet in length that experienced a bench wall failure over about 200 feet of its length. Refer to Figures A-3 and A-4 in the Attachment. The bench wall is tilted 80 degrees with the top oversteepened westward above the former bench floor. At the time of Fulcrum's reconnaissance and in the June 2024 UAV imagery, there was accumulated rock debris piled across most of the bench width and against the lower part of the bench wall. The inclined wall appears to be a consequence of high-angle rock joints that formed a detachment, allowing dipping rock strata to topple out of the excavated wall. Based on the 2016 topography and current elevations in adjacent areas, the maximum bench height was about 50 feet and bench width about 50 feet prior to failure.

The current wall orientation is still tilted to the west and oversteepened, suggesting additional failure is possible. Accumulated debris at the base of the topple is currently buttressing the base of the wall. Additional failures of the top of the wall could cause the adjacent bench to be overfilled with debris, leading to loose rock material falling past the bench and farther downhill to lower portions of the site.

***Other Slope Stability Concerns***

The June 2024 UAV imagery indicated the presence of bedrock cracks forming in the mid-slope of the northeast part of Cut 1. These cracks are mapped on Figures 2 and 3 and located along cross section C-C'. The cracks are not accessible on foot. Indication of possible cracking was noted in one area during Fulcrum's April 2024 reconnaissance, as shown on Figure A-5 in the Attachment. The separation and orientation of these cracks indicate an incipient rock topple failure is forming in the highwall similar to the rock topple in Cut 2, though involving a taller exposure. This presents a significant hazard to mine staff working below the wall. The wall height in this area makes recognition of slope stability hazards difficult in the field without the benefit of overhead/UAV assistance.

Cut 3 does not currently appear to show signs of slope instability even though the vertical relief at 70 feet is greater than that in Cut 2 at 50 feet. Refer to Figure A-5. This may be due to the prevalence of conglomerate exposed in Cut 3 versus the interbedded conglomerate and sandstone in Cut 2. However, the highwall gradient is less steep in Cut 3 than in Cuts 1 and 2 and involves at least two relict benches, suggesting the use of less-steep bench heights helped prevent significant slope instability.

## CONCLUSIONS AND RECOMMENDATIONS

As previously described, expanded mining north of the prior mine has not followed the top-down mine plan and benching parameters recommended by GeoDesign. Several areas of bedrock block failure were observed at the current mine site, which are a result of intersecting bedding and rock jointing leading to bedrock blocks slipping or toppling out of excessively tall highwalls. This was the failure mechanism of concern discussed in the 2020 GeoDesign report. The rock failures observed at the site present significant risks to mining staff and to stability of the mined excavations.

### *HAZARD MITIGATIONS*

We recommend several mitigations to address the current slope instability areas at the site, which are graphically presented on Figure 3. We do not recommend any further mining of the lower slope or mid-slope of the ridge. Operations and staff should observe an exclusion zone below Cuts 1 and 2 where further work or access is prohibited, corresponding to the red-shaded area on Figure 3. The exclusion zone could be subject to rock failures from the adjacent highwall or from rockfall debris from retrogression of the bench wall at Cut 2. To assist in establishing the exclusion zone, we recommend the operator place blocks, berms, or similar barriers at mid-slope haul roads or other points of access, including from the current Cut 1 floor east of the rock crusher visible in Figures 2 and 3.

The bench around Cut 2 served as an effective primary catchment for rock debris that fell from the bench wall and could continue to serve this role as long as there is capacity for debris to accumulate on the bench. The operator should regularly observe this bench to make sure it does not become overfull and could spill material further downslope. If material needs to be cleared for this purpose, we recommend only the outer part of the bench (i.e., the west side) be cleared of debris. Leaving debris in place on the east side serves a benefit to buttress the oversteepened highwall. We recommend the bench only be accessed when needed to clear debris to maintain the catchment.

We expect that future block and topple failures in the mined mid-slope benches and cuts will occur, and the operator should make regular observations for developing highwall cracks or similar signs of incipient failure. This will likely require the assistance of a UAV system to capture images from overhead, such as the cracks mapped on Figures 2 and 3 that were not observable on foot, and to prevent staff from needing to be present in the exclusion zone.

### *FUTURE MINING*

We recommend that future mining follow the top-down strategy recommended by GeoDesign, where future mining would start at the top of the ridge and develop benches gradually down the slope to form a net 2H:1V gradient. As previously recommended, benches should not be more than 30 feet in vertical height. We recommend benching should observe a 2H:1V gradient for both interim and final slopes.

The area upslope of the Cut 2 oversteepened bench and internal haul roads, shaded yellow on Figure 3, should not be mined until the ridge top is first mined to its final, benched grade. The geology in this area may not be as competent as the overlying rock strata and the strata to the south, presenting a greater risk of slope instability.

Similarly, the exclusion zone shown on Figure 3 should continue to be observed until mining upslope of the exclusion zone has achieved its final, benched grade. The operator should consult with a licensed geotechnical professional prior to mine staff working or operating equipment in the exclusion zone.

Rockfall from the bench walls may still be possible even with bench heights limited to 30 vertical feet. The operator should periodically monitor benches for development of cracks, separations, or other signs of rock failure that might slip out of the vertical portion of the benches.

If it is determined that any portion of the currently mined slopes lie below the proposed final contours shown on Figures 4 and 5, those excavations should be backfilled to blend into adjacent areas to achieve the final 2H:1V grades. Backfilling operations should be planned to avoid requiring mine staff to be present below potentially unstable slopes.

**LIMITATIONS**

We prepared this report for use by Vaagen Brothers Lumber, Inc. and other members of the design and operation teams for the Naff Pit mine project. This report and our conclusions and interpretations should not be construed as warranty of the site or subsurface conditions and are not applicable to other nearby sites.

Our interpretations of the geologic conditions are based on the exposures of soil and rock within the quarry area and data provided by others. They do not necessarily reflect soil and rock strata or water level variations that may exist in the subsurface. If subsurface conditions differing from those described are noted, re-evaluation will be necessary.

The scope does not include services related to operational safety precautions, and our recommendations are not intended to direct the operator's methods, techniques, sequences, or procedures, except as specifically described in this report for consideration by the operator.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time this report was prepared. No warranty, express or implied, should be understood.

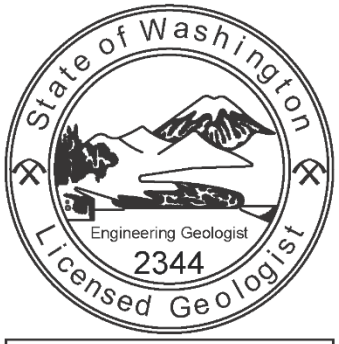
——— ♦♦ ———

We appreciate the opportunity to work with you on this project. If you have questions concerning the information provided, please call.

Sincerely,

Fulcrum GeoResources LLC

Erick J. Staley, L.E.G.
Principal Engineering Geologist

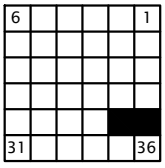



Erick J. Staley

Signed 08/12/2024

cc: Jeff Waterman, 1 DUB Civil, LLC

Document ID: 012.01.01_2024-08-12-geo rpt_v2.docx




**SITE COORDINATES:**

LATITUDE: **48° 35' 20.8" N**

LONGITUDE: **117° 58' 33.3" W**

**EASTERN WASHINGTON**


## DIRECTIONS TO SITE

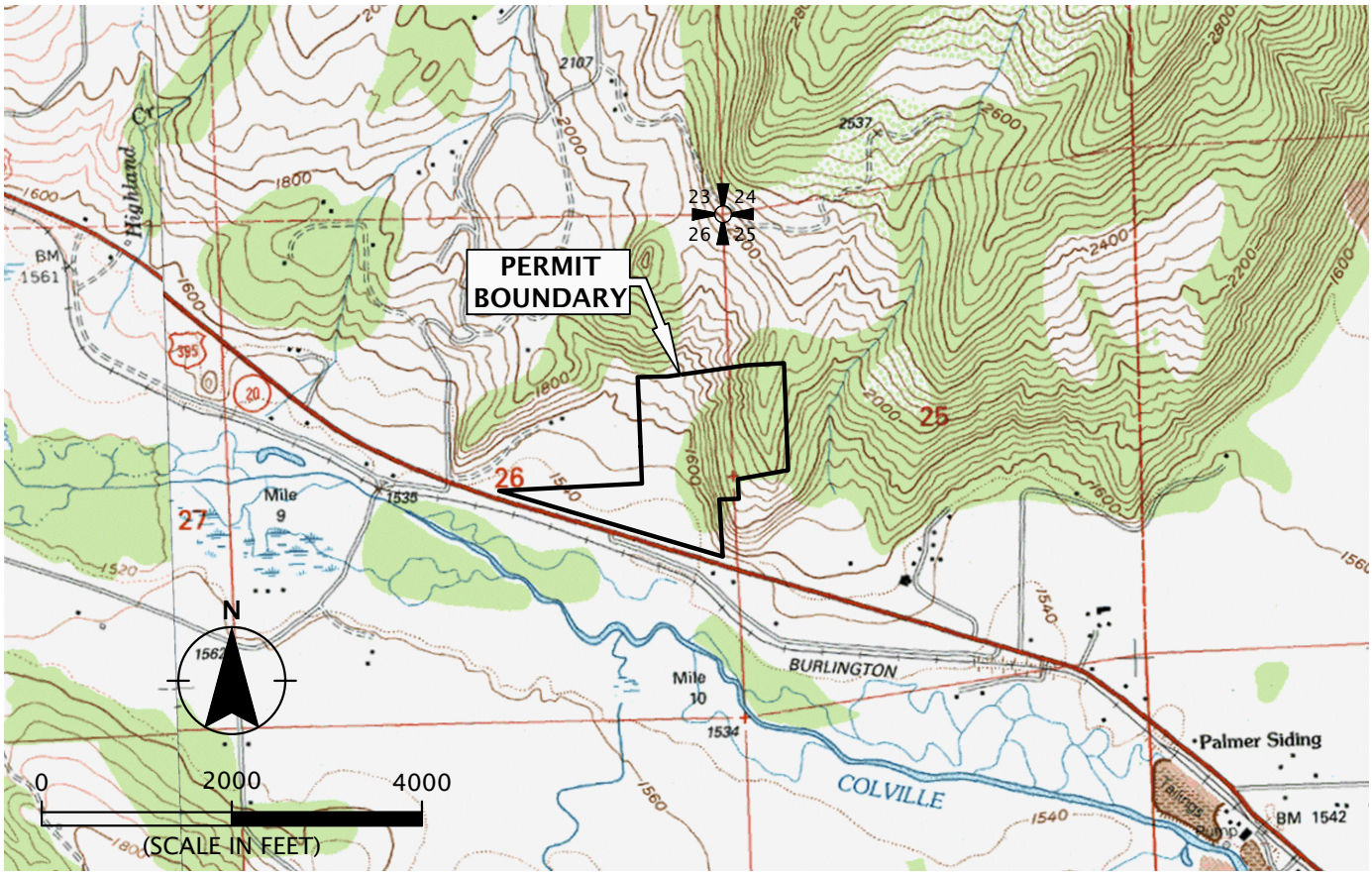
NAFF PIT IS LOCATED APPROXIMATELY 4.25 MILES NORTHWEST OF COLVILLE, WA. FROM COLVILLE, DRIVE NORTHBOUND ON STATE HIGHWAY 20. NAFF PIT SITE ACCESS IS LOCATED ON THE RIGHT (NORTH) SIDE OF HIGHWAY 20 APPROXIMATELY 4.25 MILES FROM COLVILLE.

## LEGAL DESCRIPTION

THE PERMIT BOUNDARY IS LOCATED IN PORTIONS OF THE FOLLOWING QUARTER-QUARTER SECTIONS:

- SE QUARTER OF THE NE QUARTER OF SECTION 26
- NE QUARTER OF THE SE QUARTER OF SECTION 26
- NW QUARTER OF THE SE QUARTER OF SECTION 26
- SW QUARTER OF THE NW QUARTER OF SECTION 25

**NOTE:** USGS TOPOGRAPHIC QUADRANGLE MAPS REPRODUCED USING MAPTECH TERRAIN NAVIGATOR PRO®.




| | | | |
|---|---|---|---|
| FULCRUM GEO RESOURCES | VAAGEN BROTHERS LUMBER, INC. | **VICINITY MAP** NAFF PIT - GEOLOGIC HAZARD EVALUATION | |
| | PROJECT 012.01.01 AUGUST 2024 | STEVENS COUNTY, WA SECTIONS 25 & 26, TOWNSHIP 36N, RANGE 38E W.M. | **FIGURE 1** |

**LEGEND:**

- PERMIT BOUNDARY (62.8 ACRES)
- PROPERTY BOUNDARY
- 30-FOOT SETBACK (6.2 ACRES)
- 2000' EXISTING TOPOGRAPHY (20-FOOT INTERVALS; 100-FOOT INDEX CONTOURS)
- PROPOSED LIMITS OF EXTRACTION (26.9 ACRES)
- RECLAIMED AREA - SEE NOTE 2 (1.1 ACRES)
- DRAINAGE PATTERNS
- OVERSTEEPENED BENCH
- CRACKS IN HIGHWALL
- A A' CROSS SECTION


**NOTES:**

1. EXISTING TOPOGRAPHY AND AERIAL PHOTOGRAPH BOTH DATED JUNE 19, 2024, OBTAINED FROM MID-MOUNTAIN SURVEYORS.
2. RECLAIMED AREA OBTAINED FROM WADNR AERIAL PHOTOGRAPHY REPORT DATED JULY 10, 2019.

**AERIAL SITE MAP**
NAFF PIT - GEOLOGIC HAZARD EVALUATION
STEVENS COUNTY, WA
SECTIONS 25 & 26, TOWNSHIP 36N, RANGE 38E W.M.

**FIGURE 2**

VAAGEN BROTHERS LUMBER, INC.

PROJECT 012.01.01
AUGUST 2024

FULCRUM GEO RESOURCES LLC

Printed By: MikeMiller | Print Date: 11/8/2024 1:14:09 PM
File Name: C:\Users\MikeMiller\Box\Mining\4259-Fulcrum Geo Resources\Naff Pit\Naff Pit\CAD\012.01.01-GEO SP01.dwg | Layout: FIGURE 2

**LEGEND:**

- PERMIT BOUNDARY (62.8 ACRES)
- PROPERTY BOUNDARY
- 30-FOOT SETBACK (6.2 ACRES)
- 2000' EXISTING TOPOGRAPHY (20-FOOT INTERVALS; 100-FOOT INDEX CONTOURS)
- PROPOSED LIMITS OF EXTRACTION (26.9 ACRES)
- RECLAIMED AREA - SEE NOTE 2 (1.1 ACRES)
- DRAINAGE PATTERNS
- OVERSTEEPENED BENCH
- CRACKS IN HIGHWALL
- NO EXTRACTION UNTIL ALL MATERIAL UPSLOPE MINED OUT
- PRIMARY ROCKFALL CATCHMENT
- EXCLUSION ZONE - HIGHWALL FAILURE RISK AREA
- ROAD BARRIER
- A A' CROSS SECTION


**NOTES:**

1. EXISTING TOPOGRAPHY AND AERIAL PHOTOGRAPH BOTH DATED JUNE 19, 2024, OBTAINED FROM MID-MOUNTAIN SURVEYORS.
2. RECLAIMED AREA OBTAINED FROM WADNR AERIAL PHOTOGRAPHY REPORT DATED JULY 10, 2019.

# AERIAL SITE MAP WITH GEOTECHNICAL RECOMMENDATIONS

NAFF PIT - GEOLOGIC HAZARD EVALUATION

STEVENS COUNTY, WA
SECTIONS 25 & 26, TOWNSHIP 36N, RANGE 38E W.M.

**FIGURE 3**

VAAGEN BROTHERS LUMBER, INC.

PROJECT 012.01.01
AUGUST 2024

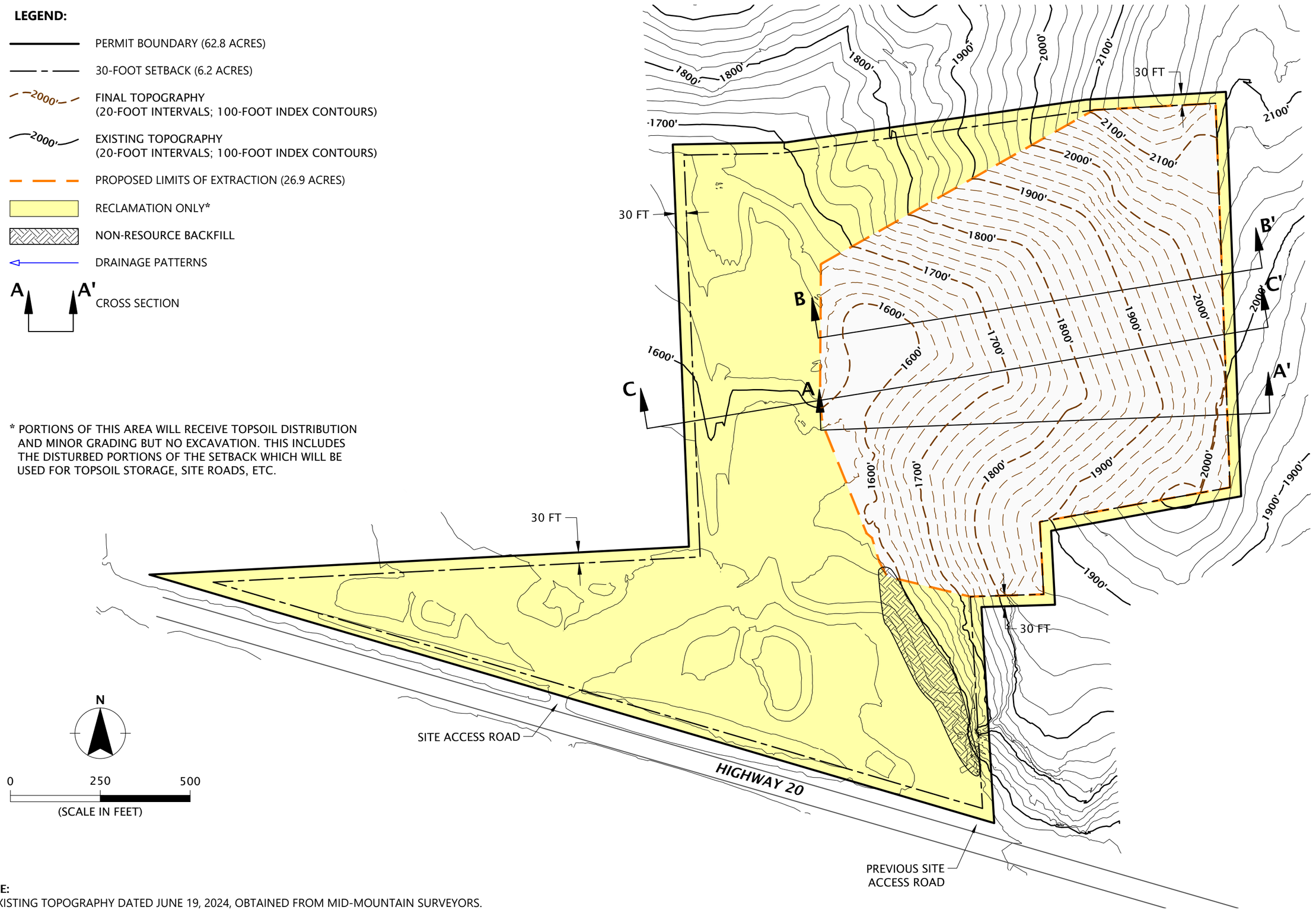
FULCRUM GEO RESOURCES LLC

Printed By: MikeMiller | Print Date: 11/8/2024 1:14:12 PM
File Name: C:\Users\MikeMiller\Box\Mining\4259-Fulcrum Geo Resources\Naff Pit\Naff Pit\CAD\012.01.01-GEO SP01.dwg | Layout: FIGURE 3

**LEGEND:**

- PERMIT BOUNDARY (62.8 ACRES)
- 30-FOOT SETBACK (6.2 ACRES)
- 2000' FINAL TOPOGRAPHY (20-FOOT INTERVALS; 100-FOOT INDEX CONTOURS)
- 2000' EXISTING TOPOGRAPHY (20-FOOT INTERVALS; 100-FOOT INDEX CONTOURS)
- PROPOSED LIMITS OF EXTRACTION (26.9 ACRES)
- RECLAMATION ONLY*
- NON-RESOURCE BACKFILL
- DRAINAGE PATTERNS
- A A' CROSS SECTION

* PORTIONS OF THIS AREA WILL RECEIVE TOPSOIL DISTRIBUTION AND MINOR GRADING BUT NO EXCAVATION. THIS INCLUDES THE DISTURBED PORTIONS OF THE SETBACK WHICH WILL BE USED FOR TOPSOIL STORAGE, SITE ROADS, ETC.




**NOTE:**

1. EXISTING TOPOGRAPHY DATED JUNE 19, 2024, OBTAINED FROM MID-MOUNTAIN SURVEYORS.

**FINAL TOPOGRAPHY MAP**
NAFF PIT - GEOLOGIC HAZARD EVALUATION
STEVENS COUNTY, WA
SECTIONS 25 & 26, TOWNSHIP 36N, RANGE 38E W.M.

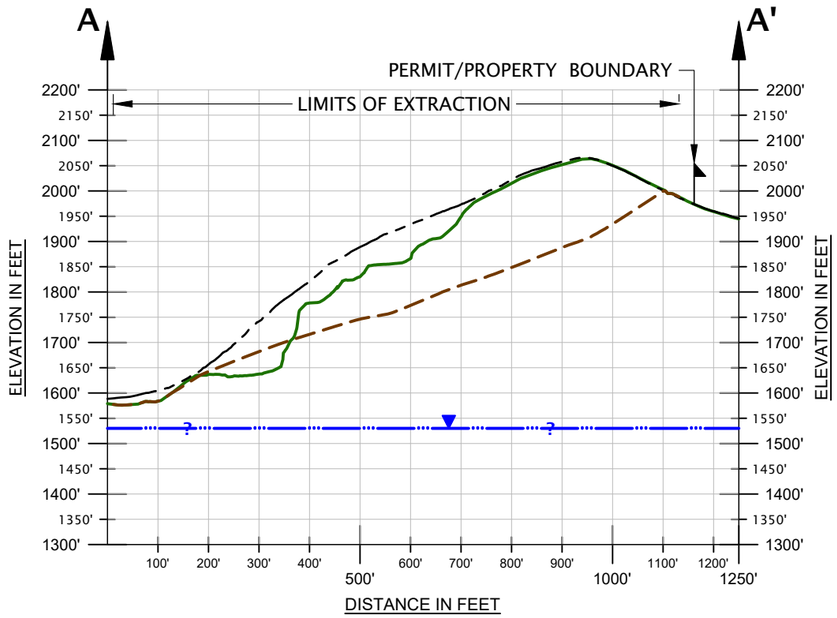
**FIGURE 4**

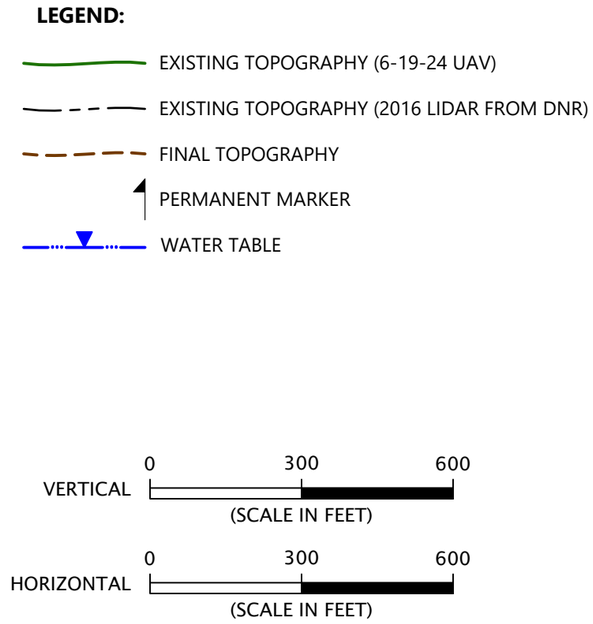
VAAGEN BROTHERS LUMBER, INC.

PROJECT 012.01.01
AUGUST 2024

FULCRUM GEO RESOURCES LLC

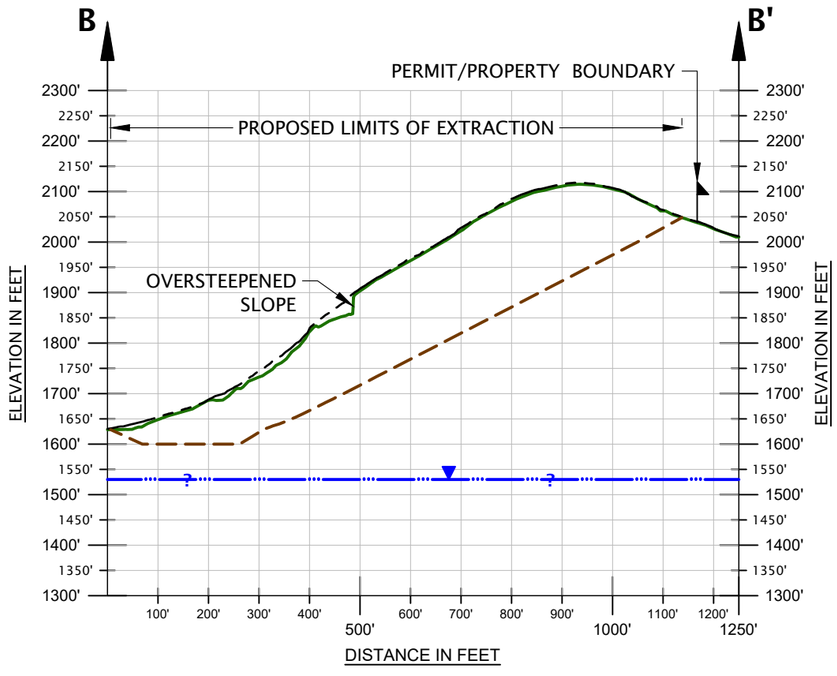
Printed By: MikeMiller | Print Date: 11/8/2024 1:14:16 PM
File Name: C:\Users\MikeMiller\Box\Mining\4259-Fulcrum Geo Resources\Naff Pit\Naff Pit\CAD\012.01.01-GEO SP01.dwg | Layout: FIGURE 4

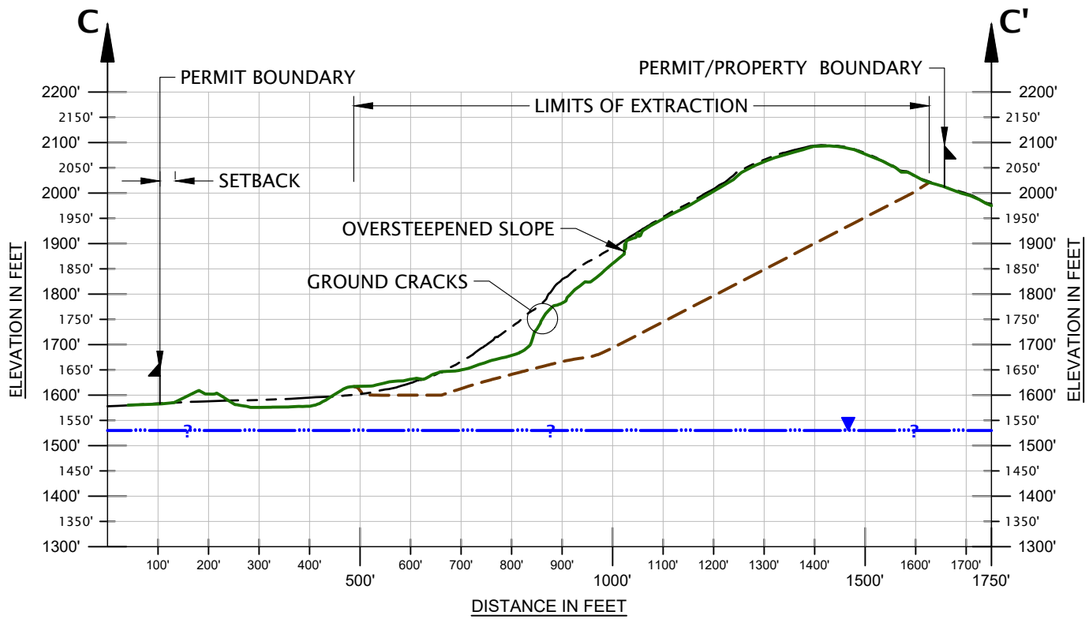









**CROSS SECTIONS**
NAFF PIT - GEOLOGIC HAZARD EVALUATION
STEVENS COUNTY, WA
SECTIONS 25 & 26, TOWNSHIP 36N, RANGE 38E W.M.

**FIGURE 5**

VAAGEN BROTHERS LUMBER, INC.

PROJECT 012.01.01
AUGUST 2024

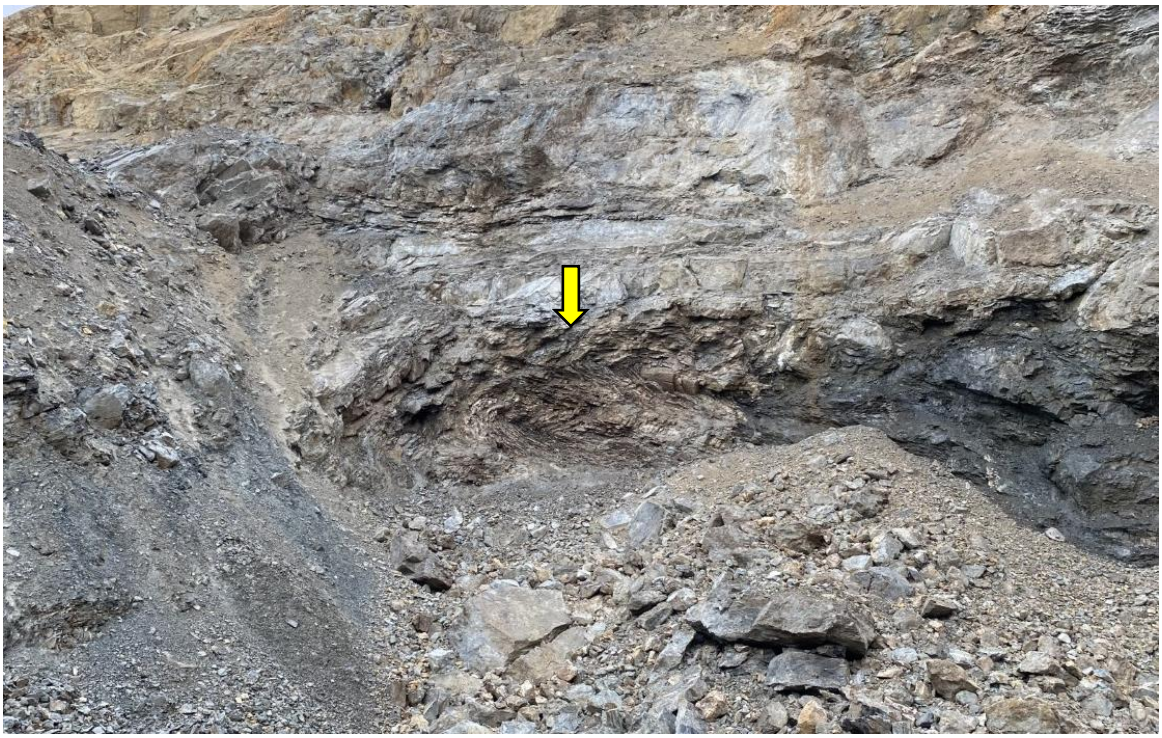
FULCRUM GEO RESOURCES LLC

Printed By: MikeMiller | Print Date: 11/8/2024 1:14:27 PM
File Name: C:\Users\MikeMiller\Box\Mining\4259-Fulcrum Geo Resources\Naff Pit\Naff Pit\CAD\012.01.01-GEO CS03.dwg | Layout: FIGURE 5

# Attachment

## SITE PHOTOS FROM APRIL 4, 2024 RECONNAISSANCE

VIEW EAST INTO THE "BOX CUT" OF CUT 1. NOTE THE DARKER, FINE-GRAINED STRATA (THIN SANDSTONE BEDS AND SLATE) AT THE BOTTOM OF THE CUT.



CONTORTED BEDDING (YELLOW ARROW) IN SLATE TOWARD THE BOTTOM OF THE EAST WALL IN CUT 1. VIEW IS TO THE NORTHEAST.

| | | | |
|---|---|---|---|
| FULCRUM GEO RESOURCES | VAAGEN BROTHERS LUMBER, INC. | **SITE PHOTOGRAPHS** | |
| | PROJECT 012.01.01 AUGUST 2024 | DRIVE INN/NAFF PIT STEVENS COUNTY, WA | **FIGURE A-1** |

PROMINENT, SOUTHWEST-DIPPING BEDDING IN CONGLOMERATE EXPOSED IN THE SOUTH WALL OF CUT 1. VIEW IS TO THE SOUTH.

SUSPENDED BLOCK OF CONGLOMERATE (GRAY) IN CUT 1. NOTE THE ORANGE-STAINED, ANGLED BEDDING PLANE IN THE FOREGROUND LEFT OF THE BLOCK, WHICH LIKELY UNDERLIES THE BLOCK. VIEW IS TO THE SOUTHEAST.

| | | | |
|---|---|---|---|
| FULCRUM GEO RESOURCES PLLC | VAAGEN BROTHERS LUMBER, INC. | **SITE PHOTOGRAPHS** | |
| | PROJECT 012.01.01 AUGUST 2024 | DRIVE INN/NAFF PIT STEVENS COUNTY, WA | **FIGURE A-2** |

OVERSTEEPENED BENCH WALL AND ROCK DEBRIS IN CUT 2. OTHER BENCHES AND THE TALL SOUTH WALL OF CUT 1 ARE VISIBLE AT RIGHT. VIEW IS TO THE SOUTH.

OVERSTEEPENED WALL AND ACCUMULATED ROCK DEBRIS ON THE BENCH AT CUT 2. VIEW IS TO THE SOUTH.

| | | | |
|---|---|---|---|
| FULCRUM GEO RESOURCES PLLC | VAAGEN BROTHERS LUMBER, INC. | **SITE PHOTOGRAPHS** | |
| | PROJECT 012.01.01 AUGUST 2024 | DRIVE INN/NAFF PIT STEVENS COUNTY, WA | **FIGURE A-3** |

OVERSTEEPENED WALL AT CUT 2. NOTE THE FLAT, TABULAR PARTINGS IN THE BEDROCK FROM HIGH-ANGLE ROCK JOINTS. VIEW IS TO THE SOUTHEAST.

VIEW LOOKING NORTH AT THE TOPPLED ROCK DEBRIS AND OVERSTEEPENED WALL AT CUT 2. THE DETACHED BEDROCK ALONG BEDDING LEFT A PROMINENT PLANAR SURFACE. START OF CUT 3 VISIBLE AT RIGHT.

| | | | |
|---|---|---|---|
| FULCRUM GEO RESOURCES PLLC | VAAGEN BROTHERS LUMBER, INC. | **SITE PHOTOGRAPHS** | |
| | PROJECT 012.01.01 AUGUST 2024 | DRIVE INN/NAFF PIT STEVENS COUNTY, WA | **FIGURE A-4** |

BEDROCK CRACK (YELLOW ARROW) OBSERVED IN THE MIDDLE OF THE HIGHWALL IN CUT 1. THIS CORRESPONDS TO THE CRACK MAPPED FURTHEST NORTH ON FIGURES 2 AND 3. VIEW IS TO THE NORTHWEST.

VIEW NORTHWEST OF THE HIGHWALL AT CUT 3. THE HIGHWALL GRADIENT IS LESS STEEP THAN THE OTHER TWO CUTS – THOUGH STILL STEEPER THAN 2H:1V – AND APPEARS TO INCLUDE AT LEAST TWO RELICT BENCHES.

| | | | |
|---|---|---|---|
| FULCRUM GEO RESOURCES PLLC | VAAGEN BROTHERS LUMBER, INC. | **SITE PHOTOGRAPHS** | |
| | PROJECT 012.01.01 AUGUST 2024 | DRIVE INN/NAFF PIT STEVENS COUNTY, WA | **FIGURE A-5** |