



August 21, 2015
Project No. EH130228A

Concrete Nor'West
P.O. Box 280
Mount Vernon, Washington 98273

Attention: Mr. Dan Cox

Subject: Hydrogeologic Site Assessment
Concrete Nor'West – Grip Road Mine
Skagit County, Washington

Dear Mr. Cox:

PURPOSE

The purpose of this letter report is to provide a hydrogeologic site assessment for the proposed Concrete Nor'West Grip Road Mine (Site) in Skagit County, Washington. The Grip Road Mine is located within a portion of the north $\frac{1}{2}$ of the southeast $\frac{1}{4}$ of Section 27, Township 36 north, Range 4 east. The location of the mine and vicinity is shown on the "Vicinity Map", Figure 1.

BACKGROUND

Concrete Nor'West is currently applying for a mining special use permit from Skagit County for the development of the Site as a surface mine for aggregate resources. The Site will be dry mined using standard surface mining equipment such as front end loaders and excavators. The mined resource will be loaded into trucks and transported to market. The maximum depth of the mine is proposed to be a minimum of 10 feet above the seasonal high ground water elevation beneath the site. It is possible that water right exempt quantities of ground water may be used at the site for industrial and/or domestic (i.e. drinking water) during the operation of the mine.

The proposed mine will be accessed via an existing gated private forest road from Grip Road located approximately 0.7 miles east of the intersection of Grip Road and Prairie Road (Figure 1).

Upon initial review of Concrete Nor'West's application for a mining special use permit, Skagit County determined that the Site is located within an aquifer recharge zone and a hydrogeologic site assessment was required under Skagit County Code (SCC) 14.24.330 and 14.16.330 (8).

SITE CONDITIONS

The Site is located on a relatively flat terrace that slopes gently from a ground surface elevation slightly less than 250 feet (relative to mean-sea level [msl]) in the southeast portion of the Site to approximately 200 feet msl along the northern mine boundary (Figure 1). The terrace is approximately 50 to 75 feet above the Samish River valley floor in the eastern portion of the Site. Mean annual precipitation at the Site is approximately 45 inches per year (in/yr) based on the 30-year period of 1981-2010 in the Parameter-Elevation Relationships on Independent Slopes Model (PRISM, Daly and others, 1994). Precipitation values from PRISM are consistent with those in the Western Washington Hydrology Model (WWHM) for the Site location. Evapotranspiration for the existing forested condition at the Site was estimated at approximately 21 in/yr using WWHM.

Soils

Soils in Skagit County were mapped by the Natural Resource Conservation Service (NRCS) in the 1980s (NRCS, 1989). Site soils are mapped as predominately Skipopa silt loam, a somewhat poorly drained soil on terraces. Although the permeability of this soil is generally low, runoff is slow and the hazard of water erosion is slight due to the relatively flat slope (NRCS, 1989).

Geology

Detailed descriptions of the surficial and subsurface geology of the Site and vicinity are presented in a technical report (Open File Reports 98-5) completed by the Washington State Department of Natural Resources (DNR, 1998). Site geology was also evaluated as part of a resource evaluations conducted by Concrete Nor'West (CNW, 2003) and AESI (AESI, 2011). The surficial geology of the Site and vicinity is presented on the "*Site and Geology Map*", Figure 2; "*Geologic Cross Section A-A*", Figure 3; and "*Geologic Cross Section B-B*", Figure 4.

The geology of the Site and vicinity consists predominantly of Sumas-age recessional glacial outwash sand and gravel (**Qgos**), Everson age glaciomarine drift (silt and clay, **Qgdme**), Vashon-age glacial till (**Qgtv**), Vashon-age advance outwash (**Qgav**), and Quaternary river valley alluvium and alluvial fan deposits (**Qa(s)** and **Qaf**). The **Qgos** is the predominant geologic unit present at the ground surface at the Site (Figure 3). **Qgtv** is exposed at the ground surface on the slope faces located north and east of the proposed mine boundary, as well as to the south. **Qgdme** is exposed at the ground surface north, south and west of the proposed mine boundary.

The **Qgos** unit is comprised of glacial fluvial sediments deposited by glacial meltwater during the Sumas Stade of glaciation approximately 10,000-12,000 years before present. The **Qgos** is described by DNR (1998) as a loose, brown to gray, moderately to well-sorted sandy cobbly gravel that can consist locally of gravelly medium to coarse sand, silty sand, sandy silt and silt. Stratigraphically, the **Qgos** is typically deposited on top of the **Qgdme**, which overly the **Qgtv** and **Qgav**. Explorations completed at the Site (CNW, 2003) indicate that most, if not all, of the **Qgdme**, and **Qgtv** that typically separates the **Qgos** from the **Qgav** was removed by erosion prior to and/or during the deposition of the **Qgos** (Figures 3 and 4). Thus, the stratigraphy beneath

the Site consists of coarse grained sand and gravel of the **Qgos** lying unconformably on top of the coarse grained sand and gravel of the **Qgav** (Figures 3 and 4).

The maximum thickness of the **Qgos** beneath the Site appears to be approximately 70 feet, (CNW, 2003; Figure 4) and pinches out near southern mine boundary. The maximum thickness of the **Qgav** deposits beneath the Site is unknown as none of the explorations by Concrete Nor'West (CNW, 2003) penetrated the **Qgav** into the pre-Vashon nonglacial deposits that presumably underlie the **Qgav**. The maximum thickness of the **Qgav** in the area is thought to be approximately 175 feet (DNR, 1998).

Hydrogeology

The ground water table beneath the Site was measured during exploration drilling completed by Concrete Nor'West in October, 2003. Ground water is present in unconsolidated sands and gravels in the lower portions of the **Qgos** and **Qgav**. The average depth to ground water was approximately 70 feet below the ground surface at elevations that range from approximately 145 to 155 feet (Figures 3 and 4). Approximate ground water elevation contours in the vicinity of the Site are presented on the "*Ground Water Contour Map*", Figure 5.

Ground Water Flow

The ground water levels information and site topography indicate that ground water beneath the Site predominantly flows from south to north, although there is likely an easterly component of ground water flow near the eastern boundary of the proposed mine. Ground water within the **Qgos/Qgav** aquifer likely discharges to the alluvial sediments located in the Samish River Valley (Figure 5). Ground water within the alluvial sediments is presumably in hydraulic conductivity with the Samish River, meaning ground water would discharge as baseflow to the river when ground water elevations are higher than water levels in the river.

There are no known springs or water supply wells located within 1,000 feet of the proposed mine boundary. An approximately 6,500 reach of the Samish River is located within 1,000 feet of the proposed mine boundary (Figures 1 and 3). Ground water beneath the Site likely discharges to the Samish River within that reach. Approximate locations of individual domestic and public water system wells located within 1-mile of the proposed mine boundary are presented on the "*Location of Water Supply Wells*", Figure 6. There are no wells located within 1,000 feet of the Site or hydraulically down gradient between the proposed mine boundary and the presumed ground water discharge location of the Samish River.

Aquifer Properties

Regional studies (USGS, 2009; USGS 2011) suggest hydraulic conductivities in alluvial and glacial outwash aquifers in the vicinity of the site are likely around 50 feet per day (ft/d) (transmissivity of 5,000 ft²/d for a 100-ft thick aquifer) but may range locally from approximately 1 to 1,000 ft/d. Specific storage in the aquifer is likely on the order of 0.15 ft/ft. The porosity of a well-graded mixture of sand and gravel like has been observed in the aquifer materials beneath the site is approximately 30% (Fetter, 1994). Our analysis of grain-size data collected by Concrete

Nor'West (CNW, 2003) indicate vertical infiltration rates in the unsaturated **Qgos/Qgav** sediments are likely in the range of 2 to 20 inches per hour.

Ground Water Quantity

The potential for adverse impacts to ground water quantity beneath the site under the proposal is very low. There are no new water supply wells currently proposed for the mining operation, although it is possible that water right exempt quantities of ground water may be used at the site for industrial and/or domestic (i.e. drinking water) in the future. Ground water recharge for the existing site conditions is estimated at approximately 24 to 28 inches per year based on output from the WWHM and regression equations in Vacarro, et. al, (1998). The proposal will create a closed depression and all stormwater generated on site will be captured within the mine boundary and infiltrated. This would likely result in a slight increase ground water recharge at the site and, consequently, a slight increase in ground water levels and ground water contributions to the Samish River.

Ground Water Quality

The potential risk to ground water quality under the proposal is very low. The proposed mine will maintain a 10 feet buffer of natural material between the base of mine and typical seasonal high ground water levels at all times. The proposal is for a surface mining operation with on-site processing limited to stock piles and dry screening. Standard surface mining equipment such as front end loaders and excavators will be used to extract the material and load it on to trucks. The proposal will create a closed topographic depression. All stormwater generated on site will be captured within the mine boundary and infiltrated. Stormwater management will be conducted in accordance with Ecology's National Pollutant Discharge Elimination System (NPDES) Sand and Gravel General Permit. Fueling and maintenance of all on-site equipment will be conducted using mobile services under an approved Spill Control Plan. No permanent fueling or maintenance facilities are proposed for the Site.

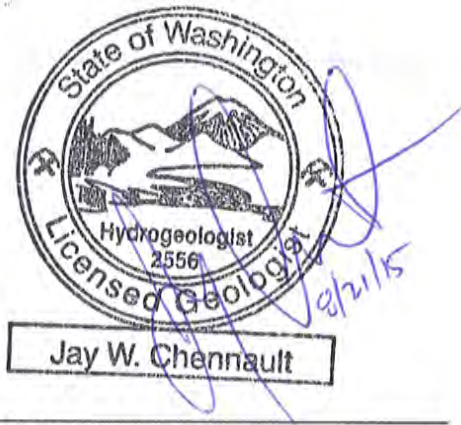
CONCLUSIONS

The purpose of this hydrogeologic assessment was to address requirements for a mining special use permit under Skagit County Code (SCC) 14.24.330 and 14.16.330 (8).

- Ground water is present beneath the site at a depth of approximately 70 feet, at an elevation of approximately 145 to 155 feet (msl).
- Ground water beneath the site generally flows to the north and/or northeast and presumably discharges to Samish River, located a minimum of 200 feet from the proposed mine boundary.
- There are no water supply wells located down gradient of the proposed mine, between the mine boundary and the Samish River.
- The proposal is for a dry, surface mining operation, with limited on-site processing. The potential for a negative impact to ground water quantity and/or quality from the proposed mining activities is low.

If you should have any questions or require additional information, please do not hesitate to call.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC
Everett, Washington



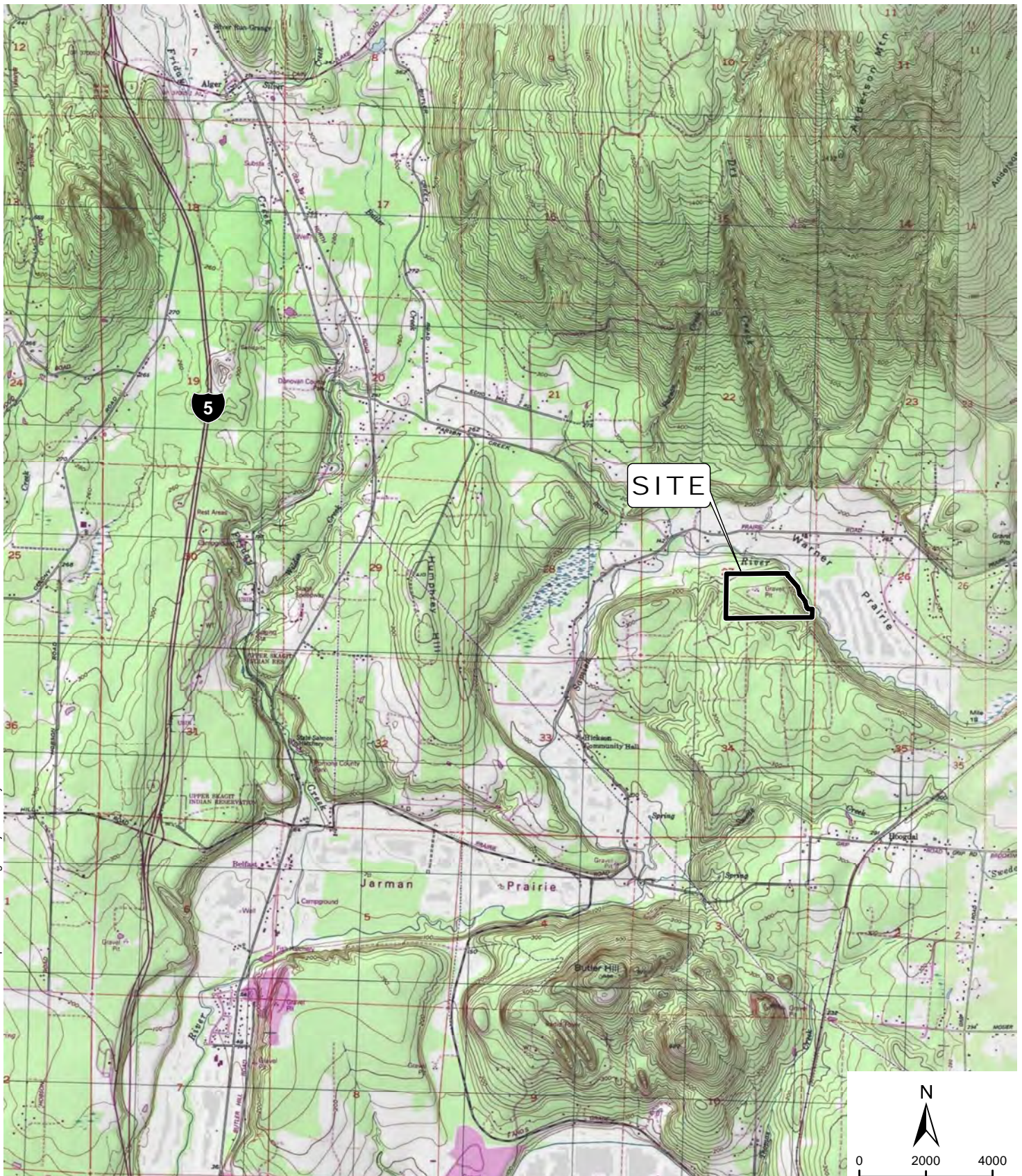
Jay W. Chennault, L.Hg., P.E.
Senior Hydrogeologist\Engineer

Charles S. Lindsay, L.G., L.E.G., L.Hg.
Senior Principal Geologist\Hydrogeologist

Attachments:	Figure 1:	Vicinity Map
	Figure 2:	Site and Geology Map
	Figure 3:	Geologic Cross Section A-A'
	Figure 4:	Geologic Cross Section B-B'
	Figure 5:	Ground Water Elevation and Flow Direction Map
	Figure 6:	Location of Water Supply Wells

REFERENCES

- AESI, 2011, Draft Technical Memorandum, Summary of Grip Road Mine Geology and Aggregate Quantity/Quality, From Charles, S. Lindsay L.G., L.Hg, to Brad Barton – Concrete Nor'West, October 21, 2011.
- CNW, 3003, Resource Analysis for Trillium Grip Road Property, Skagit County T36N R4E, Sec 28, Concrete Nor'West Memo from Ken Coats to Walt Miles, Frank Miles, Brad Barton, and Mike Crawford, October 30, 2003.
- Daly, C., Neilson, R.P., and Philips, D.L., 1994, A Statistical-topographic Model for Mapping Climatological Precipitation over Mountainous Terrain, *Journal of Applied Meteorology*, v. 33, pp 140-158.
- DNR, 1998, Geologic Map and Interpreted Geologic History of the Bow and Alger 7.5-minute Quadrangles, Western Skagit County, Washington, prepared by Dragovich, J.D., Norman, D.K., Grisamer, C.L., Logan, R.L., and Anderson, G., Washington Department of Natural Resources, Division of Geology and Earth Resources, Open File Report 98-5, September 1998.
- Fetter, 1994, *Applied Hydrogeology*, 3rd ed., Upper Saddle River, New Jersey, Prentice-Hall, Inc., 1994.
- NRCS, 1989, Soil Survey of Skagit County Area, Washington, U.S, Department of Agriculture, Soil Conservation Service, Issued September 1989.
- USGS, 2011, Numerical Simulation of the Groundwater-Flow System in Tributary Subbasins and Vicinity, Lower Skagit River Basin, Skagit and Snohomish Counties, Washington, U.S. Geological Survey Scientific Investigations Report 2010-5184, Version 1.1, March 2011.
- USGS, 2009, Hydrogeologic Framework, Groundwater Movement, and Water Budget in Tributary Subbasins and Vicinity, Lower Skagit River Basin, Skagit and Snohomish Counties, Washington, U.S. Geological Survey Scientific Investigations Report 2009-5270.

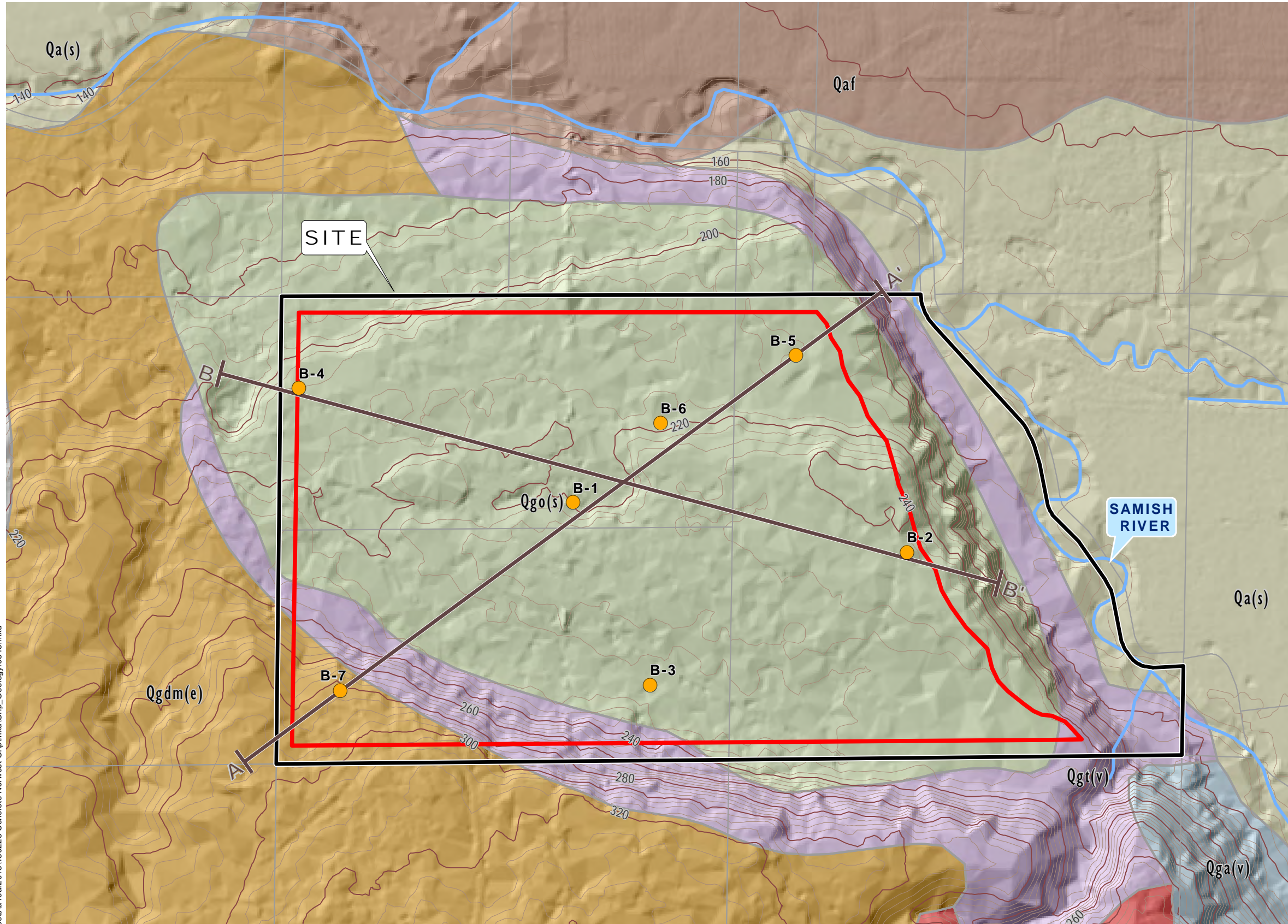


REFERENCE: USGS, SKAGIT CO



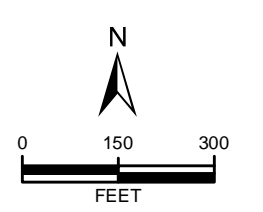
VICINITY MAP
 CONCRETE NOR'WEST - GRIP ROAD MINE
 SKAGIT COUNTY, WASHINGTON

FIGURE 1
 DATE 8/15
 PROJ. NO. KE130228A



- LEGEND**
- BORING 2003, GROUND WATER ELEVATION
 - CROSS SECTION
 - PROPOSED MINE BOUNDARY
 - PARCEL BOUNDARY
 - 20 FT CONTOUR
 - 5 FT CONTOUR
 - Qa(s) - ALLUVIUM
 - Qaf - ALLUVIUM - FAN DEPOSITS
 - Qgo(s) - FLUVIAL OUTWASH
 - Qgdm(e) - GLACIOMARINE DRIFT
 - Qgom(e) - GLACIOMARINE OUTWASH
 - Qgt(v) - TILL
 - Qga(v) - ADVANCE OUTWASH

NOTE: The LiDAR DEM grid cell size is 6'. The elevation units are in feet. The data is in WA State Plane North Coordinate System FIPS 4601, in the NAD83(HARN)/NAVD88 datum.



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REFERENCE: PSLC, WADNR OFR 98-5, SKAGIT CO., CONCRETE NOR'WEST (SEMRAU ENGINEERING)

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.



SITE AND GEOLOGY MAP
CONCRETE NOR'WEST - GRIP ROAD MINE
SKAGIT COUNTY, WASHINGTON

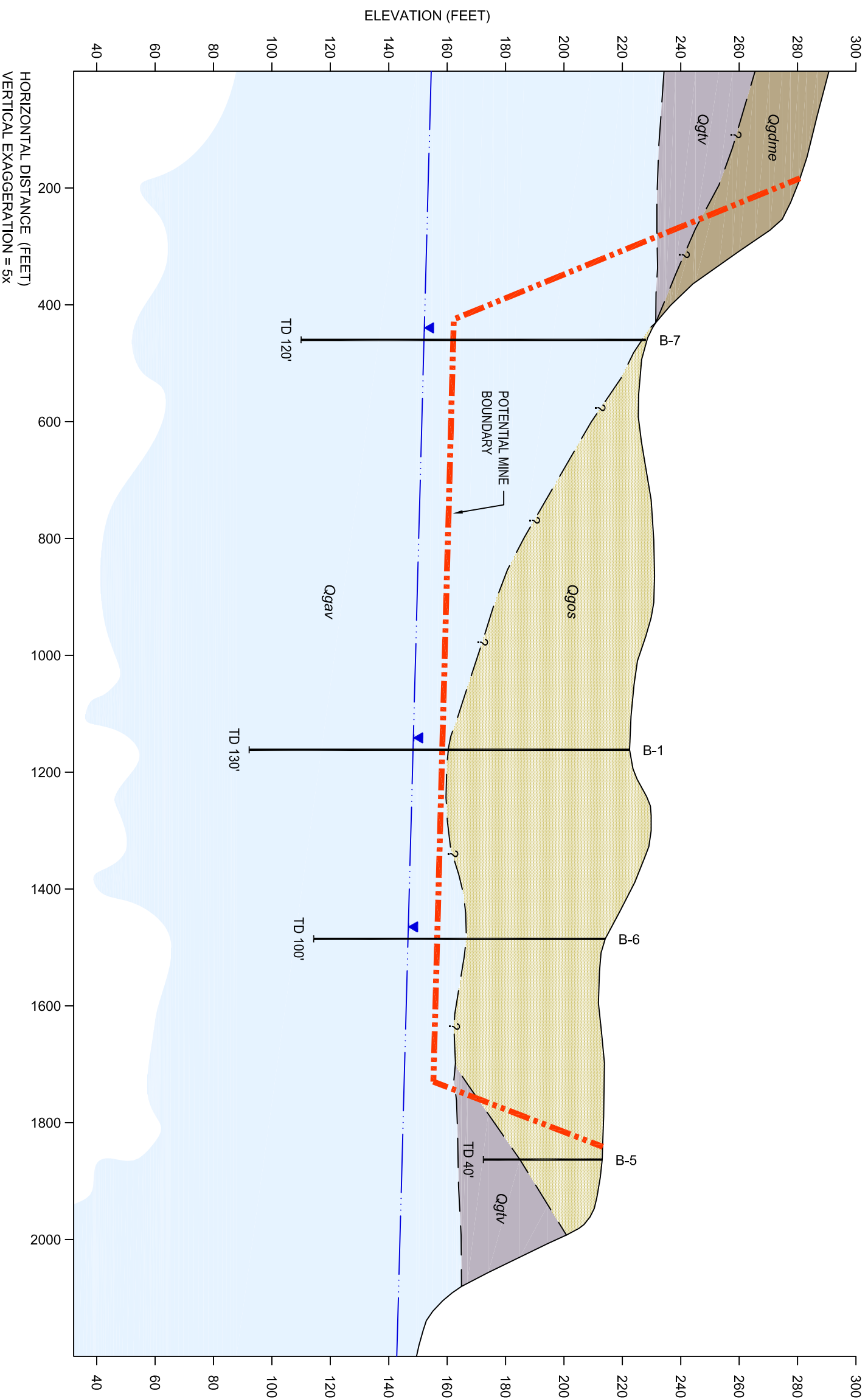
FIGURE 2
 DATE 8/15
 PROJ. NO. EH130228A



associated
earth sciences
incorporated

A SOUTHWEST

NORTHEAST A'

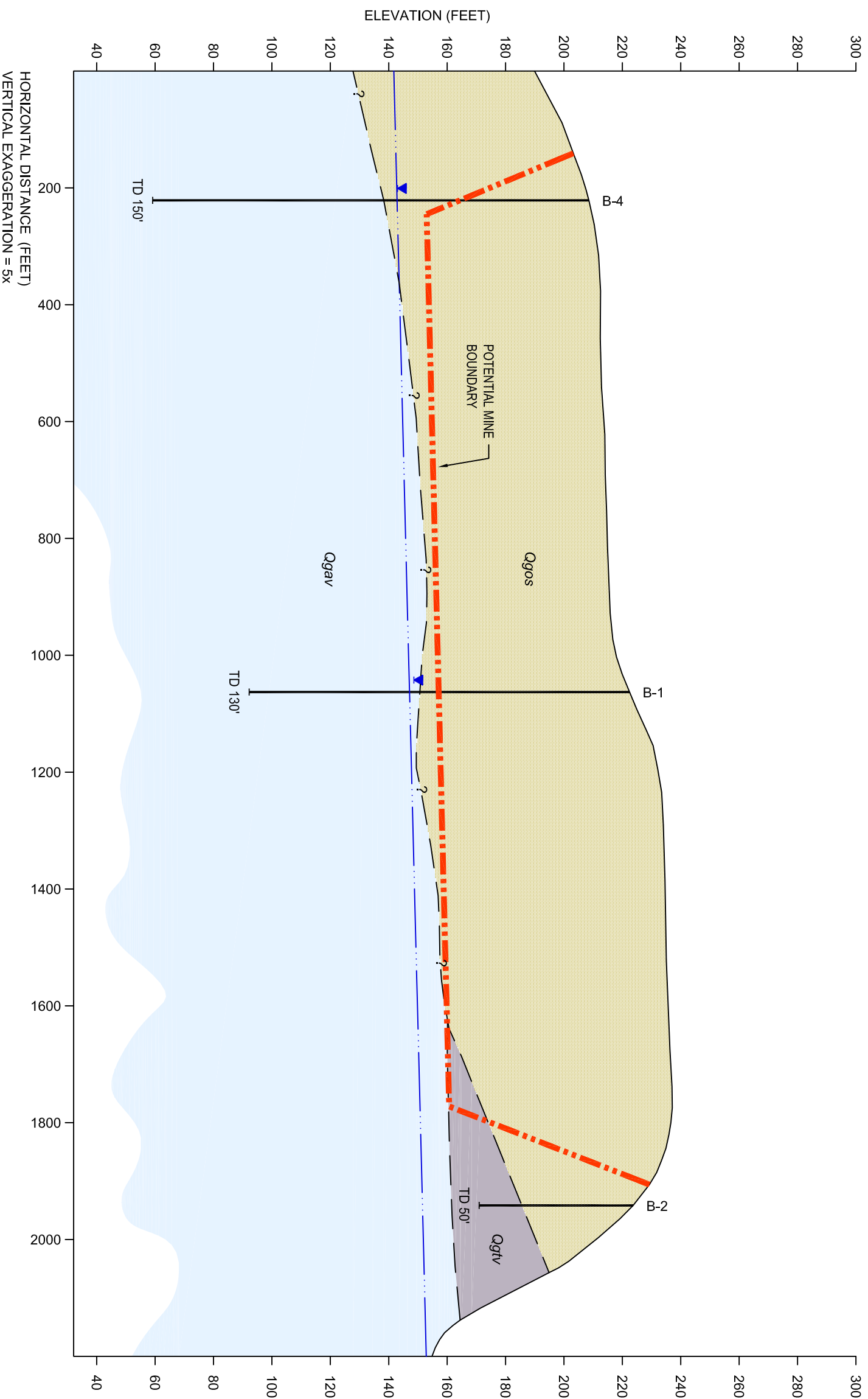


- LEGEND:**
- SUMAS GLACIAL OUTWASH
 - EVERERSON GLACIOMARINE DRIFT
 - VASHON LODGEMENT TILL
 - VASHON ADVANCE OUTWASH
 - EXPLORATION
 - WATER LEVEL - AT TIME OF EXPLORATION
 - TOTAL DEPTH OF EXPLORATION
 - GEOLOGIC CONTACT -
 - '?' INDICATES APPROXIMATE

GEOLOGIC CROSS-SECTION A - A'
CONCRETE NORTHWEST - GRIP ROAD MINE
SKAGIT COUNTY, WASHINGTON

B NORTHWEST

SOUTHEAST B'

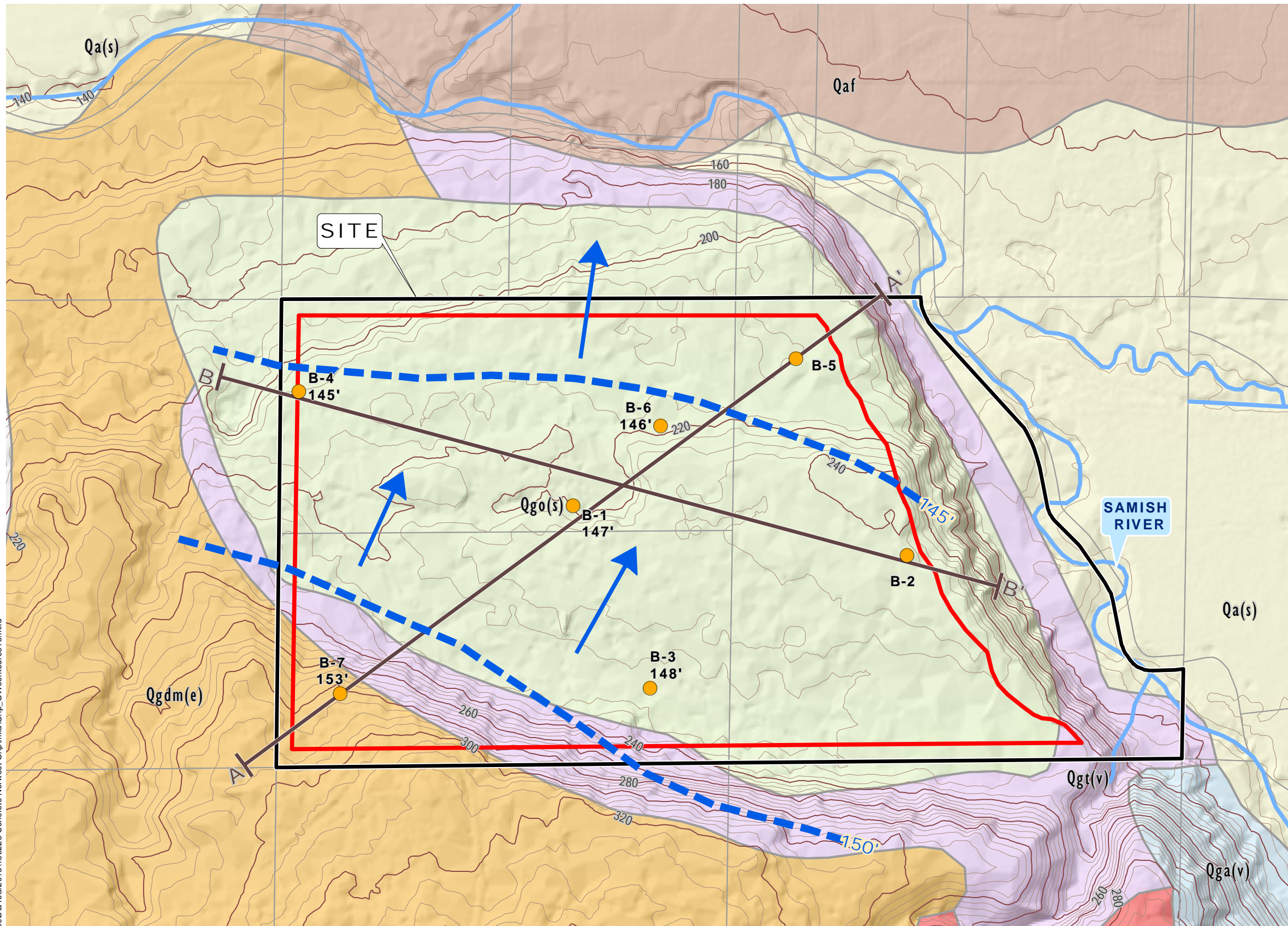


- LEGEND:**
- SUMAS GLACIAL OUTWASH
 - EVERSON GLACIOMARINE DRIFT
 - VASHON LODGEMENT TILL
 - VASHON ADVANCE OUTWASH
 - EXPLORATION
 - WATER LEVEL - AT TIME OF EXPLORATION
 - TOTAL DEPTH OF EXPLORATION
 - GEOLOGIC CONTACT - ?
 - ? INDICATES APPROXIMATE



GEOLOGIC CROSS-SECTION B - B'
 CONCRETE NORTHWEST - GRIP ROAD MINE
 SKAGIT COUNTY, WASHINGTON

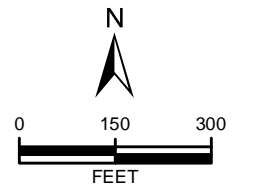
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LEGEND

- BORING 2003, GROUND WATER ELEVATION AT TIME OF EXPLORATION
- ➔ GROUND WATER FLOW DIRECTION
- - - INFERRED GROUND WATER CONTOUR
- CROSS SECTION
- ▭ PROPOSED MINE BOUNDARY
- ▭ PARCEL BOUNDARY
- ~ 20 FT CONTOUR
- ~ 5 FT CONTOUR
- Qa(s) - ALLUVIUM
- Qaf - ALLUVIUM - FAN DEPOSITS
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REFERENCE: PSLC, WADNR OFR 98-5, SKAGIT CO., CONCRETE NOR'WEST (SEMRAU ENGINEERING)

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GROUND WATER CONTOUR MAP
CONCRETE NOR'WEST - GRIP ROAD MINE
SKAGIT COUNTY, WASHINGTON

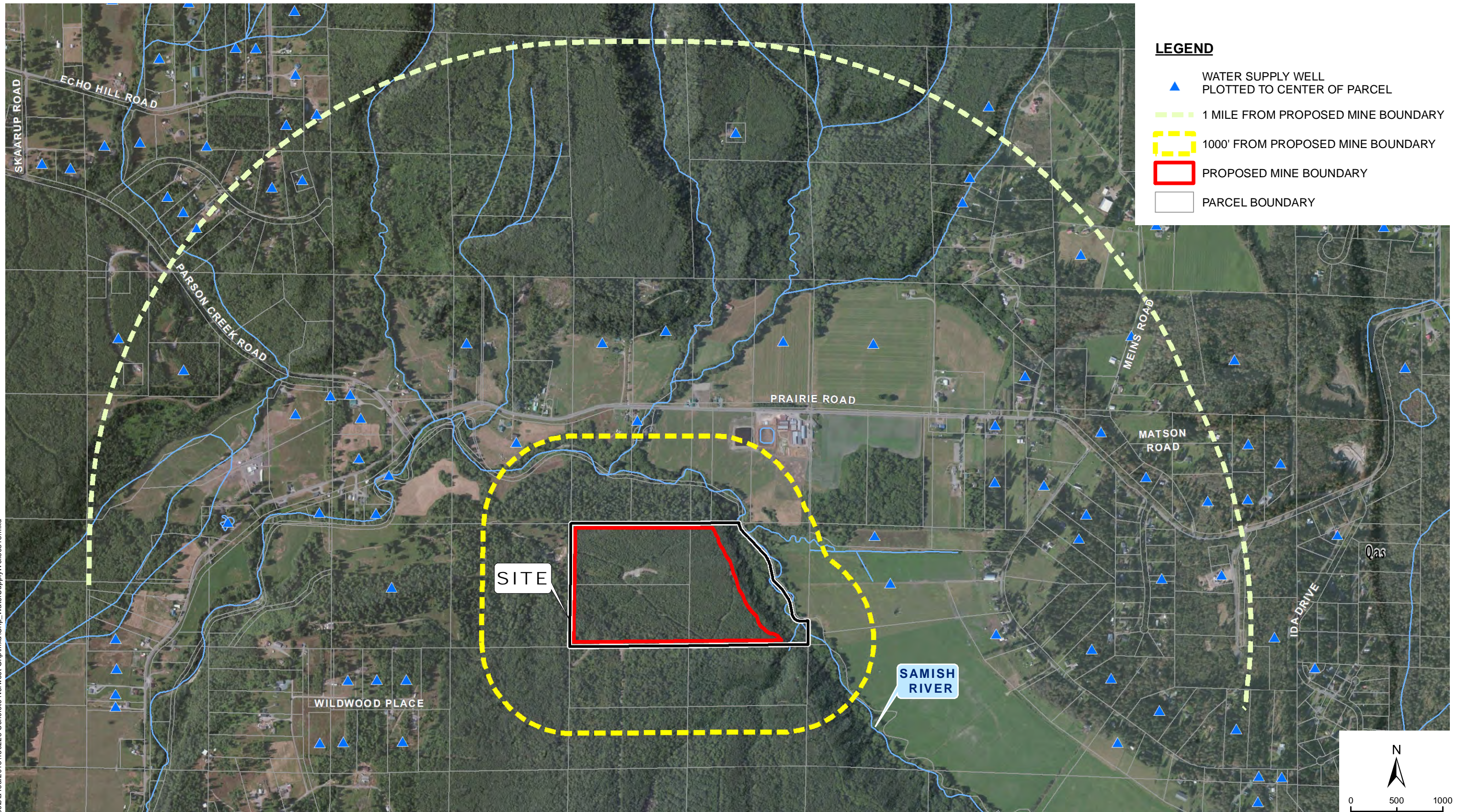


FIGURE 5

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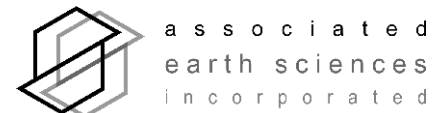
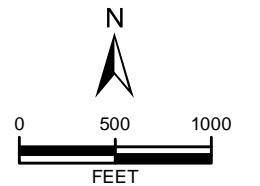
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REFERENCE: BING 2011, SKAGIT CO., CONCRETE NOR'WEST (SEMRAU ENGINEERING)

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LOCATION OF WATER SUPPLY WELLS
 CONCRETE NOR'WEST - GRIP ROAD MINE
 SKAGIT COUNTY, WASHINGTON

FIGURE 6

DATE 8/15

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