GSH

REPORT
GEOLOGICAL STUDY
LOTS 50R TO 54R SUMMIT AT SKI LAKE NO. 13
EAST CLAIRETINA COURT
HUNTSVILLE, UTAH

Submitted To:

Valley Enterprise Investment Company
Attention: Mr. Ray Bowden
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Submitted By:

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Job No. 2077-01N-16

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Mr. Ray Bowden
Valley Enterprise Investment Company
5393 East 3850 North
Eden, Utah 84310

RE: Report
Geological Study
Five Residential Development Lots
Lots 50R, 51R, 52R, 53R, and 54R
The Summit at Ski Lake Phase 13
Weber County, Utah
(Parts of Section 24, Township 6 North, Range 1 East, Salt Lake base and meridian)

1. INTODUCTION

In response to your request, GSH Geotechnical, Inc (GSH) has prepared this Geological Study for proposed residential construction for Lots 50R, 51R, 52R, 53R, and 54R at the Summit at Ski Lake Phase 13. The Summit at Ski Lake Phase 13 Subdivision (Parcel) is located in the vicinity of Huntsville Town, Weber County, Utah (41.2429, -111.7884). The general Ski Lake development area is located on the south side of Utah SR-39 between MP-16.6 and -17.4, and entirely within Section 24, Township 6 North, Range 1 East, Salt Lake base and meridian. The Summit at Ski Lake Phase 13 consists of five residential development lots roughly one-acre or greater in area with common space, comprising a total area of approximately 9.3 acres as shown on Figure 1, Site Vicinity Map. Previous phases of the Summit at Ski Lake development are established to the north and generally downslope of the Phase 13 parcel. The Via Cortina roadway accesses the five development lots as shown on Figure 2, Site Plan. Elevation rises approximately 110 feet from the north side of the Parcel to the south side of the Parcel. Based upon plan drawings prepared by Great Basin Engineering (2016) proposed or suggested "Building Areas" for each of the lots is shown on Figure 2. The general area of the Phase 13 Parcel and improvements includes slopes on the order of 20-pecent to 32-percent.

1.1 Weber County Natural Hazards Overlay Districts

Because the proposed residential development is located on a sloping hillside area with susceptible expansive soil and rock conditions, Weber County (Planning Commission) has recorded the five lots as Restricted (R), and requested that additional geotechnical and geological studies be conducted prior to use to evaluate conformance with development plans. At this time specific guidelines for these studies have not been specified by the County, however Weber County Code Section 104-27-2, Potential Hazards (Weber County Code, 2015), pertaining to Landslide/Tectonic Subsidence provides the following requirements:

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... any development proposed within a designated landslide hazard area, as delineated on the Sensitive Lands Overlay District maps, shall require the submittal, review and approval by the planning commission, of specific site studies, including grading plans, cut/fill, and plans produced by a qualified engineering geologist and a Utah licensed geotechnical engineer. The site specific study shall address slope stability (including natural or proposed cut slopes), evaluate slope-failure potential, effects of development and recommendations for mitigative measures. Slope stability analysis shall include potential for movement under static, development-induced and earthquake-induced conditions as well as likely groundwater conditions.

Sensitive Lands Overlay District maps addressing Landslide/Tectonic Subsidence zones for Weber County is presently not available for the site. A preliminary review of site geological mapping prepared by Utah Geological Survey (UGS) geologists (King, et al, 2008), show on Figure 3, Geologic Map has indicated that parts of the Phase 13 Parcel is within mapped Quaternary landslide deposits (Qms and Qmc). Based upon our review of the mapping, the Parcel is mapped as being mostly underlain by Tertiary age Norwood Formation (Tn) rocks, with peripheral areas that include Quaternary landslide deposits (Qms and Qmc) as mapped by King, et al., (2008).

To present the adequacy of our proposed geotechnical and geological studies for the Phase 13 development, a Work Plan for these proposed studies dated March 31, 2016 was prepared for submission to the Weber County Staff.

1.2 Work Plan

The Work Plan presented the following scope of work (work plan) for this evaluation of the Parcel in general and the five residential development lots as it pertains to the Weber County Natural Hazards Overlay District Code:

Pending any scoping meeting amendments, GSH proposes to conduct Geotechnical/Geological Study to include:

1) Work Plan and scope of work development and plan implementation and meetings with Weber County Staff;
2) A search and review of previous relevant documentation of site engineering and geologic studies and including UGS mapping (King, et al, 2008), and reports and studies prepared by our staff and others (GSH Geotechnical Inc., 2015; Applied GeoTech, 2013; KPS and Associates, Inc., 2001);
3) A field reconnaissance study including the geologic/geotechnical logging and geotechnical sampling of a five walk-in exploration trenches approximately 60 to 120 feet in length and as much as 14 feet in depth and the geotechnical logging and sampling of 5 walk-in test pits to a depth of as much as 20 feet, and two geotechnical hollow-stem auger borings to 30 to 50 feet in depth (or auger refusal), at the locations shown on Figure 2;

4) Site specific geological mapping and classification to identify critical geological units and exposure to proposed site improvements;
5) Slope analysis from LiDAR DEM geoprocessing identifying critical areas 25-percent or greater across the site and/or surficial features potentially affecting the proposed site improvements;
6) A laboratory geotechnical soils testing program of samples recovered from the test pits, trenches and borings for typical and critical geological units explored and identified in our subsurface evaluation. Laboratory testing program to include but not be limited to the moisture, density, gradation, Atterberg limits, consolidation, vane shear, and direct shear tests of representative soil samples; and
7) Preparation of summary report presenting results of our analysis and findings including:

- *A vicinity map showing the location of the property relative to site vicinity and topographic features*

- *A geologic map showing the site specific surficial geology of the property and surrounding area.*

- *Aerial photography showing the site and nearby surficial geologic features.*

- *Logs of trenches, test pits and borings.*

- *An assessment of potential geologic hazards in the vicinity of the site and the exposure of the site and proposed site improvements to hazards named in the ordinance including but not limited to: landsliding and slope stability; alluvial fan processes including debris-flow; surface fault rupture hazards, strong earthquake ground motion, and liquefaction hazards; rockfall and avalanche hazards, and flood hazards and radon exposure.*

- *Cross-sections of slopes depicting encountered geological conditions.*

- *Site development recommendations based upon our findings and professional experience.*

- *Following completion of the geologic study, a geotechnical study will be prepared for the subject property based on the findings of the geologic study and concurrent/subsequent geotechnical evaluations.*

2. INVESTIGATIONS

2.1 Literature Review

During the Work Plan development, existing previous reports and geological literature sources were reviewed. Specific to the site and immediate surrounding area, reports and mapping by

KPS and Associates, Inc., 2001; King, et al., 2008; Applied GeoTech, 2013; and GSH Geotechnical Inc., 2015, were reviewed. The KPS and Associates study involved a geotechnical evaluation and test pit excavations for a water tank constructed on the south side of the Parcel. The King, et al , 2008 document is an Open-file UGS geological mapping project of the Snow Basin and Huntsville, Utah quadrangles, which includes the location of the Phase 13 Parcel. The 2013 Applied GeoTech study was a geotechnical evaluation conducted for surrounding Phases 12 and 13 of the Ski Lake development that included four test pit explorations. The 2015 GSH Geotechnical Inc., study was a geological investigation conducted for the extension of the Via Cortina roadway on the south side of the Parcel site. The GSH Study included the geological logging of approximately 700 feet of vertical cut exposure made for the roadway extension, and four "walk-in" test pits. The locations of the test pits and cut exposure walls investigated in the previous studies are included on Figure 4, Work Plan.

2.2 Field Program

GSH conducted field operations at the site on the dates April 11 through April 18, 2016. The field program involved the excavation and geological logging of five exploration trenches and five test pits and the advancement of two drilled boreholes on Parcel locations shown on Figure 4. The excavations and borings were logged to observe and characterize site subsurface/geologic and groundwater conditions for the site and the proposed residential development improvements. Trenches and test pits were located to evaluate the conditions for each of the proposed Building Areas, and borings were placed on slope locations in order to evaluate geologic subsurface conditions relative to slope stability conditions for the Phase 13 Parcel. The locations of our trenches, test pits and borings are included on Figure 4. Trenches were from 72 to 132 feet in length and extended to depths of 4.0 to 16.0 feet, and the test pits consisted of walk-in excavations, 15.0 to 25.0 feet in length and extending to depths of 10.0 to 15.0 feet. The trenches and test pits were logged so as to illustrate the vertical and lateral characteristics and variations of soil and rock conditions underlying the proposed Building Areas across the site. The trenches and test pits were excavated using a 20-ton class excavator with a 36-inch bucket and was refused at depth in most of the excavations as indicated in our field logs. In addition to the observations in the trenches and test pits, the general surface of the site and surrounding area was reconnoitered to assess geological and slope conditions. Feature location and elevation data were recorded using a hand-held GPS receiver device.

Our field program was conducted by Senior Engineering Geologist Dr. Greg Schlenker, PG of our geotechnical staff. Mr. Amos Allard, Staff Geologist also of our geotechnical staff visited the site to assist Dr. Schlenker and to collect soil samples from the trenches test pits for laboratory geotechnical testing. Mr. Allard also supervised drilling operations for Boring 1 and 2.

The soils and geology in the trenches, test pits and borings were classified in the field based upon visual and textural examination, and interpretation of geologic site formation processes. These classifications have been supplemented by subsequent inspection and testing in our laboratory. Detailed graphical representations of the subsurface conditions encountered are presented on Figure 5 through Figure 9, Log of Trenches, and Figure 10 and Figure 11, Log of Test Pits. It should be noted that no Log for Test Pit 54 is presented as the excavation at that location was refused at a depth of 1.0 feet. The soil and rock units observed in the trenches and test pits were classified in accordance with the Unified Soil Classification System (USCS), and were further classified on the basis of geological site formation processes.

Bulk and thin wall samples of representative soil layers encountered in the test pits were obtained and placed in sealable bags and/or were recovered undisturbed using driven sample tubes. The locations of the sample recovery locations are included on our trench and test pit logs. The results of our laboratory analysis and testing of the soils recovered from the test pits will be included in our accompanying geotechnical report. Groundwater was not observed in any of the excavations or test pits during the dates of our field program.

The logs of the two borings shown on Figure 4 that were made for our concurrent geotechnical study and included in this reporting, are included on Figure 12 and Figure 13. The borings were completed using a CME 55 truck-mounted drill rig using hollow-stem auger/rotary wash equipment and methods. Soil and rock samples were recovered at 2.5-foot intervals using driven 2.42-inch inside diameter drive Dames & Moore sampler. The borings were also logged in accordance with the Unified Soil Classification System (USCS).

2.3 LiDAR - Slope Analysis

To asses slope conditions, interpret terrain, and develop site specific geologic cross sections for the site, a LiDAR - Slope Analysis was performed for the site. Elevation data consisting of 2.0 meter LiDAR digital elevation data (DEM), for the site was obtained from Utah Automated Geographic Reference Center (AGRC). These data were geo-processed using the QGIS® GIS platform, and using the r.slope, r.shaded.relief and r.contour.level GRASS® (Geographic Resources Analysis Support System) modules, slope percentages, relief renderings and elevation contours for the site area were processed.

Figure 14, LiDAR-Slope Analysis, presents the results of our slope analysis efforts. Shown on Figure 14 is the 25-percent, and greater than 30-percent slope gradients across the site. The shaded relief rendering on Figure 14 provides a visual basis for landform interpretation, and the contour elevation data shown on Figure 14 is used to develop the cross sections shown on Figures 15 and 16, Geologic Slope Cross Section. The critical gradient for slope development considerations according to the Weber County Section 108-14-3. (Weber County Code, 2015), includes slopes greater that 25-percent. The Geologic Slope Cross Sections shown on Figure 15 and 16 will be used for modeling slope stability analysis in our geotechnical reporting.

3. SITE CONDITIONS

The site conditions and site geology were interpreted through an integrated compilation of data including a review of literature and mapping from previous studies conducted in the area (Sorensen and Crittenden, 1979; Currey and Oviatt, 1985; Bryant, 1988; Coogan and King, 2001; and King et al., 2008) including a review previous evaluations discussed previously in the Literature Review Section of this report, photogeologic analyses of 2014 and 2012 imagery shown on Figure 2 and Figure 4, and historical stereoscopic imagery flown in 1946. GIS analyses of elevation and geoprocessed DEM terrain data as discussed in the previous section (LiDAR-Slope Analysis) and shown on Figure 14, field reconnaissance of the general site area, and the interpretation of the trenches, test pits and borings excavated and drilled on the site as part of our field program. Seismic hazards information was developed from United States Geologic Survey (USGS) databases (Peterson, et al., 2008).

3.1 Geologic Setting

The site is located on the eastern flank of Mount Ogden which western flank comprises the Wasatch Front. The Wasatch Front is marked by the Wasatch fault, which is 7.0 miles west of the site, and provides the basis of division between the Middle Rocky Mountain Physiographic on the east and the Basin and Range Physiographic Province on the west. The Basin and Range Physiographic Province is characterized by approximately north-south trending valleys and mountain ranges that have been formed by extensional tectonics and displacement along normal faults, and extends from the Wasatch Range on the east to the Sierra Nevada Range on the west (Hunt, 1967).

The Middle Rocky Mountain province covers parts of Utah, Colorado, Wyoming, Idaho, and Montana. The geology of the province is an assemblage of sedimentary, igneous, and metamorphic rocks that have been folded, faulted, and uplifted. Mountain building (tectonic) activity commenced about 30 million years ago (Cretaceous time) and continues to the present. The province is characterized by mountainous terrain with deep canyons and broad intervening basins, with temperate semi-arid to mesic climatic conditions (Hunt, 1967).

The surficial geology of the site vicinity is the result of the uplift and exposure of older pre-Cambrian rocks which forms the crest of Mount Ogden east of the site. This exposure was the result of movement along high-angle faults during late Tertiary and Quaternary age (Bryant, 1988).

Bounding the east foothill flank of Mount Ogden are mid Teritary units of the Norwood Formation that ramp along the base of the mountains south and west of the Ogden Valley floor. The Norwood Formation is described as "light-gray to light brown, altered tuff (claystone), tuffaceous siltstone, sandstone, and conglomerate" derived from volcanic ash deposition (King, et al., 2008), and has been measured to be as much as 7000 feet thick in the vicinity of the site. The claystone, siltstone and sandstone occurrences of the formation in the Ski Lake area are primarily a result of lacustrine (lake processes) redeposition of the volcanic ash. The site location is largely underlain by Norwood Formation lacustrine rock units which beds appear to slope gently down to the northeast across the site (King et. al, 2008). Our previous 2015 observations of the Logged Roadway Geology Cut shown on Figure 4, revealed bedded exposures of lacustrine rock sequences generally consisting of moderate to thick bed units, (one to two feet in thickness) typically fining upward (sandstone-siltstone-claystone), colored light shades of buff, tan red and green and gray, and ranged from *weak* to *strong* in field test competency (GSH Geotechnical Inc., 2015). The existing surface of the site and vicinity appears to have been modified by Quaternary age erosion, and localized late-Quaternary stream, lacustrine (Currey and Oviatt, 1985), residual soil weathering and development, and mass movement processes (King, et al., 2008).

3.2 Surface Conditions

As shown on Figure 2 and Figure 4, the site consists of an area of approximately 9.3 acres in size that is currently vacant and undeveloped. At the time of our 2016 field program, general grading for the Via Cortina roadway Clairtina Court had taken place. Surface vegetation consists of open areas of grasses, weeds and sage brush with clustered wooded areas of scrub oak, alder, box elder and maple tree cover. The topography of the site consists of a north facing hillslope with slopes on the property generally facing downward toward the north and northwest toward Ogden Valley.

Topographically the site is located on base foothills on the northeast side of Mount Ogden, and overlooks Ogden Valley and the South Fork of the Ogden River floodplain, which is inundated by Pineview Reservoir waters, to the north of the site. The site, as shown on Figure 2 and Figure 4 is bordered on the south, and east by vacant undeveloped lands, and on the north and west and by residential estate property land uses.

3.3 Subsurface Conditions

The natural rock and soils observed in the trenches and test pits and illustrated on our logs, Figures 5 to Figure 9, Logs of Trenches, and Figure 10 and Figure 11, Logs of Test Pits, generally consisted, from bottom to top of:

Bedrock sequences consisting of: 1) weathered Claystone CS light olive in color, slightly to moderately weathered, very thinly bedded, moderately fractured, weak consistency; 2) weathered Siltstone ST light olive, slightly to moderately weathered, thinly to moderately and massively bedded, moderately fractured, hard consistency; and 3) weathered Sandstone SS light brown to brown, slightly to moderately weathered, thinly to moderately and massively bedded, moderately fractured, weak consistency. The bedrock observed in the trenches and test pits at the site are believed to be localized lacustrine sediments, derived from Norwood Formation tuff deposits.

Soil sequences overlying the bedrock consist of weathered residual soils derived from underlying Norwood Formation rocks, or transported colluvial and/or landslide derived soils from the weathered residual soils. The weathered residual soils consisted of weathered siltstone (ST-ML) consisting of clayey silt, generally light yellowish brown, very stiff, slightly moist, with massive structure. The transported soils included silty clay and clays (CL), yellow-red, reddish brown and brown, stiff, slightly moist, massively bedded

Surficial pedogenic soil sequences, consisting soil A horizons of (ML) clayey silt, moist, medium stiff, dark brown, major herb roots from 6.0 to12.0 inches in thickness that were observed on the surfaces of the trench and test pit exposures. Below the surface in Trenches 50, 51 and 52, thick soil B-horizon vertisol sequences that extended as much as 6.0 to 10.0 feet in depth were observed. The vertisol soils consisted of silty clays (CL), dark brown to reddish brown, stiff, slightly moist, with vertical cracks extending the thickness of the vertisol units.

Landslide movement was observed in Trench 50 and Trench 51, and evidence of movement within the same feature was observed during our previous 2015 study in test pits GSH-2, GSH-3 and GSH-4 and on the Logged Roadway Geology Cut (GSH, 2015). This landslide feature is mapped on Figure 14, as Qms-2015. The landslide deformation and movement was observed beginning at the Logged Roadway Geology Cut on the Via Cortina roadway with movement detected in the trenches and test pits downslope from the cut in a northward direction, extending beyond the north property boundary, and joining a larger mapped landslide feature (King et al., 2008) north of the property boundary. The axial north-south length of the feature to the north property boundary is approximately 325 feet, and the east-west width is approximately 245 feet. The observed thickness of the landslide feature was from 10.0 feet in Trench 50, and possibly as thick as 15.0 feet in Test Pits GSH-2 and GSH-3 from our 2015 study (GSH 2015). The soils observed in Trench 51, appear to apical landslide flank soils on the western margin of the slide feature. The slide plane surface feature observed in the trenches displayed nominal deformation along the plane surface, with some oxidation accumulations (Fe Oxides) observed along the base of the movement in the trenches.

Groundwater was not observed in any of the trenches or test pits during our field program.

3.4 Site Engineering Geology

Our interpretation of the site Engineering Geology is presented on Figure 14 of this report. The engineering geology shown is largely based on previous mapping prepared by King, et al., (2008), with amendments to the mapping drawn on the basis of the findings of this and previous studies (GSH 2015). A summary of the mapping units identified on the site vicinity are listed below in relative age sequence (youngest-top to oldest bottom):

Qms-2015; Landslide and slump deposits (exposed during previous study).
Qmc; Landslide and slump, and colluvial deposits.
Qms; Landslide and slump deposits.
Tn; Norwood Formation.

4. DISCUSSIONS AND RECOMMENDATIONS

4.1 Summary of Findings

4.1.1 Subsurface Observations: The geology exposed by trenches and test pits were generally found to consists of surficial, upper 1.0 to 1.5 feet of soil A horizons, with B horizon vertisol sequences that extended in depth (thickness) as much as 10.0 feet, and consisting of to stiff silty clays derived from weathered rock and colluvial sources. At depth weathered rock sequences consisting of claystone, siltstone, and sandstone were observed extending to the depths penetrated by our test pits and trenches.

4.1.2 Expansive soils. Vertical cracking associated with vertisol development was observed to extend from 6.0 to 10.0 feet below the surface in Trenches 50, 51 and 52, and Test Pit GSH-4. The vertical cracking demonstrated by these soils is a result of naturally high expansive clay content within these soils (Graham and Southard, 1982). The presence or absence of the vertisol soils should be evaluated where structural loads are to be placed during future development.

4.1.3 Sloping Surfaces. The surface of site slopes developed from our LiDAR analysis range from level to over 55-percent as shown on Figure 14, LiDAR-Slope Analysis. For the Phase 13 Parcel area the slope gradient averaged approximately 30.0-percent. As previously discussed in the LiDAR-Slope Analysis section of this report, the critical gradient for slope development considerations according to the Weber County Code is 25-percent.

4.1.4 Site Engineering Geology And Mapping. The engineering geology mapping of the site presented on Figure 4 and Figure 5 reveals two issues pertinent to site development planning. These issues include: (1) **Landslide and slump deposits (Qms-2016)** - the presence of Landslide and slump deposits Qms-2106 deposits on the northeast side of the Lot 43 property; (2) **Norwood "Tuff" Formation (Tn)** - the presence of Norwood Tuff Formation **Tn** underlying much of the area comprising the development lots and Phase 13 parcel. These issues are addressed in order importance below:

1. **Landslide and slump deposits:** Presence of mass-movement landslide and slump deposits (**Qms-2015**) is based upon developed field observations including; deformation of soils and rock beds observed in Trench 50, Trench 51, and Test Pits GSH-2, GSH-3 and GSH-4, and location of the topographic features evident on the LiDAR imagery on Figure 14 indicating the planform area of movement observed in the trenches and test pits.

   Based on our observations, the area of movement, Qms-2016 shown on Figures 4 and 14 consists of a relatively shallow, approximately 10.0 to 15.0 feet in thickness, block of soil that appears to have moved or "creeped" downslope in response to inherent weak and expansive soil characteristics, and the moderately steep slope conditions in this area. Based upon our observations of evident topographic surface expression of this feature, we believe that this movement is presently active.

2. **Norwood Tuff Formation (Tn):** The Norwood Formation has a notoriety of poor stability performance and geotechnically challenging soils throughout Northern Utah (Mulvey, 1992). Furthermore, we have observed an apparent genetic relationship with the occurrence of the Norwood Formation (and Norwood "Tuff") and surficial vertisol soils, which are subject seasonal shrink-swell processes (Graham and Southard, 1982). Based upon our past experience with areas underlain by Norwood Formation rock and soil, we believe that appropriate geological/geotechnical studies should be conducted before structural improvements are made in those areas.

4.1.5 Geoseismic Setting: Utah municipalities have adopted the International Building Code (IBC) 2012. The IBC 2012 code determines the seismic hazard for a site based upon 2008 mapping of bedrock accelerations prepared by the United States Geologic Survey (USGS) and the soil site class (Peterson, et al., 2008). The USGS values are presented on maps incorporated into the IBC code and are also available based on latitude and longitude coordinates (grid points).

Based on probabilistic estimates (Peterson, et al., 2008) queried for the site , the expected peak horizontal ground acceleration on rock from a large earthquake with a ten-percent probability of exceedance in 50 years is as high as 0.16*g,* and for a two-percent probability of exceedance in 50 years is as high as 0.33*g* for the site. Ground accelerations greater than these are possible but will have a lower probability of occurrence.

4.1.6 Active Earthqauke Faults: Based upon our review of available literature, no active faults are known to pass through or immediately adjacent to the site. The nearest active (Holocene) fault is the Weber Segment of the Wasatch fault, located 7.0 miles west of the site (Black et al., 2004). The Wasatch Fault Zone is considered capable of generating earthquakes as large as magnitude 7.3 (Arabasz, et al., 1992).

4.1.7 Liquefaction Potential Hazards: In conjunction with the ground shaking potential of large magnitude seismic events as discussed previously, certain soil units may also possess a potential for liquefaction during a large magnitude event. Liquefaction is a phenomenon whereby loose, saturated, granular soil units lose a significant portion of their shear strength due to excess pore water pressure buildup resulting from dynamic loading, such as that caused by an earthquake. Among other effects, liquefaction can result in densification of such deposits causing settlements of overlying layers after an earthquake as excess pore water pressures are dissipated. Horizontally continuous liquefied layers may also have a potential to spread laterally where sufficient slope or free-face conditions exist. The primary factors affecting liquefaction potential of a soil deposit are: (1) magnitude and duration of seismic ground motions; (2) soil type and consistency; and (3) occurrence and depth to groundwater.

Liquefaction commonly occurs in saturated non-cohesive soils such as alluvium, thus no areas of the Phase 13 site appears to be susceptible to liquefaction processes.

4.1.8 Alluvial Fan Deposits: Alluvial fan deposits indicative of processes including flash flooding and debris flow hazard do not occur on the site: The nearest active alluvial fan deposits to the site, mapped as Qafy by king, et al., (2008), are located on a small fan surface (<4.0 acres in area) approximately 2,000 feet southwest of the site, and do not appear to represent a potential impact the site.

4.1.9 Flooding Hazards: No significant water ways pass in the vicinity of the site and flood insurance rate mapping by Federal Emergency Management Agency for the site vicinity has not been prepared at this time.

4.1.10 Rockfall and Avalanche Hazards: The site is over two miles from steep slope areas where such hazards may originate.

4.1.10 Radon Exposure:

Radon is a naturally occurring radioactive gas that has no smell, taste, or color, and comes from the natural decay of uranium that is found in nearly all rock and soil. Radon and has been found occur in the Ogden Valley area, and can be a hazard in buildings because the gas collects in enclosed spaces. Indoor testing following construction to detect and determine radon hazard exposure should be conducted to determine if radon reduction measures are necessary for new construction. The radon-hazard potential for the site location is mapped as "Moderate" by the UGS (Solomon, 1996).

4.2 Conclusions

Based upon our geological studies herein, we believe that the Lots 50R, 51R, 52R, 53R, and 54R of the Summit at Ski Lake Phase 13 are suitable for development, provided that soils identified in our borings, trenches and test pits as subject to past landslide movement as discussed in Section 3.3 of this report, are avoided or mitigated. Although plans are at this time not finalized, we understand that deep foundation systems and soil improvement techniques are being considered as a methodology reduce exposure to the landslide soil movement observed on the site.

The site has been shown to be underlain by Norwood Formation deposits, and expansive vertisol soils were observed in Trench 50, 51 and 52, and Test Pit GSH-2 of the excavations made for this study. Areas where these soils are present should be evaluated prior to the placement of structural loads. Further study of the expansive potential of the near surface soils will be included as part of our concurrent geotechnical study.

Due to the potential for radon to penetrate lower levels of the proposed structures, indoor radon testing must be completed at the time of construction.

Test pits and trenches were excavated in the vicinity of the proposed home or garage structure areas. The backfill soils for these explorations is likely unsuitable for bearing structures. The trench/test pit backfill soils within the structure locations must be removed and replaced with compacted structural fill meeting the requirements of the lot specific geotechnical study. Due to the potential for unsuitable soils at the site, observation of the home excavation during construction is required.

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CLOSURE

If you have any questions or would like to discuss the results of this study further, please feel free to contact us at (801) 393 2012.

Respectfully submitted,

GSH Geotechnical, Inc.

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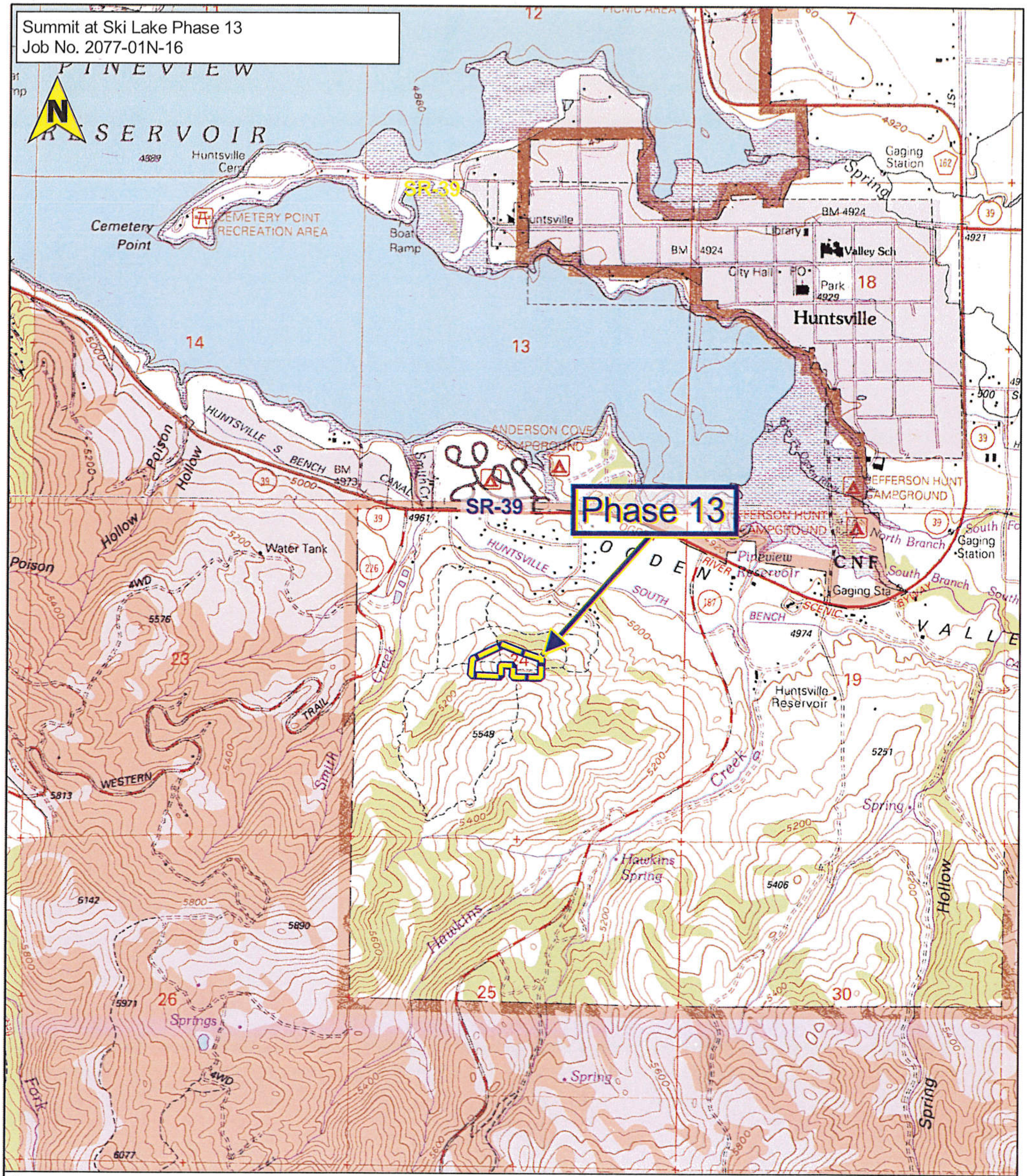
Summit at Ski Lake Phase 13
Job No. 2077-01N-16



Base:
1998 7.5 Minute USGS Toporgraphic Maps Titled
Snowbasin, Utah, and Huntsville, Utah.

0 1000 2000 3000 4000 ft

1:24,000

FIGURE 1
VICINITY MAP

GSH

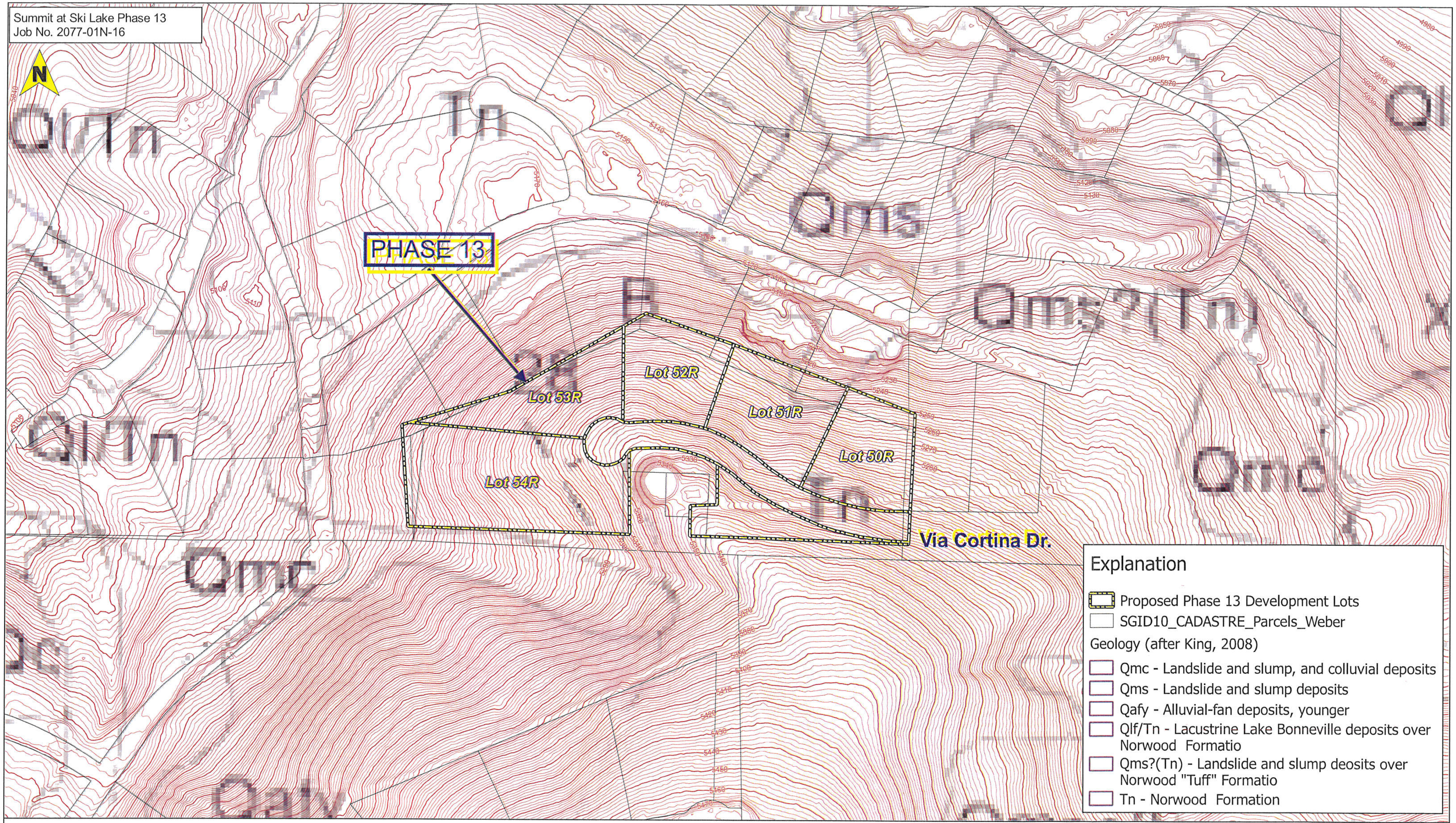
Base: 2012 6-inch Color HRO Orthoimagery,
from Utah AGRC; http://gis.utah.gov/
Elevation: 2006 2.0m Geoprocessed LiDARfrom Utah AGRC;
http://gis.utah.gov/

0 100 200 300 400 ft

1:960

FIGURE 2
SITE PLAN

GSH



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0 100 200 300 400 ft

1:2,400

FIGURE 3
GEOLOGIC MAP

GSH

Base: 2012 6-inch Color HRO Orthoimagery, from Utah AGRC; http://gis.utah.gov/
Elevation: 2006 2.0m Geoprocessed LiDARfrom Utah AGRC; http://gis.utah.gov/

0 100 200 300 400 ft

1:960

FIGURE 4
WORK PLAN

GSH

Summit at Ski Lake Phase 13
Job No. 2077-01N-16

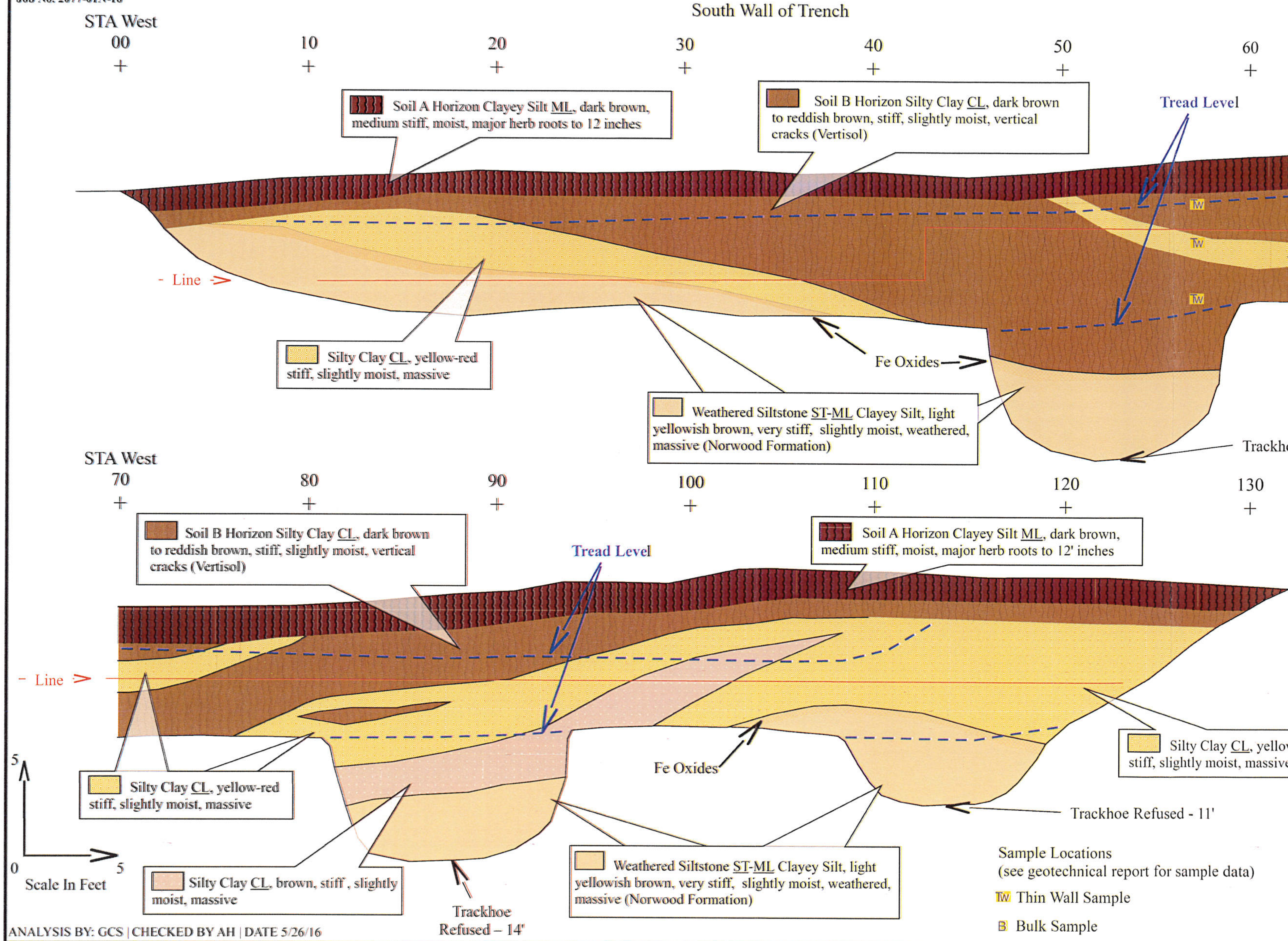


FIGURE 5
LOG OF TRENCH 50
STA 00 TO 132 WEST

GSH

ANALYSIS BY: GCS | CHECKED BY AH | DATE 5/26/16

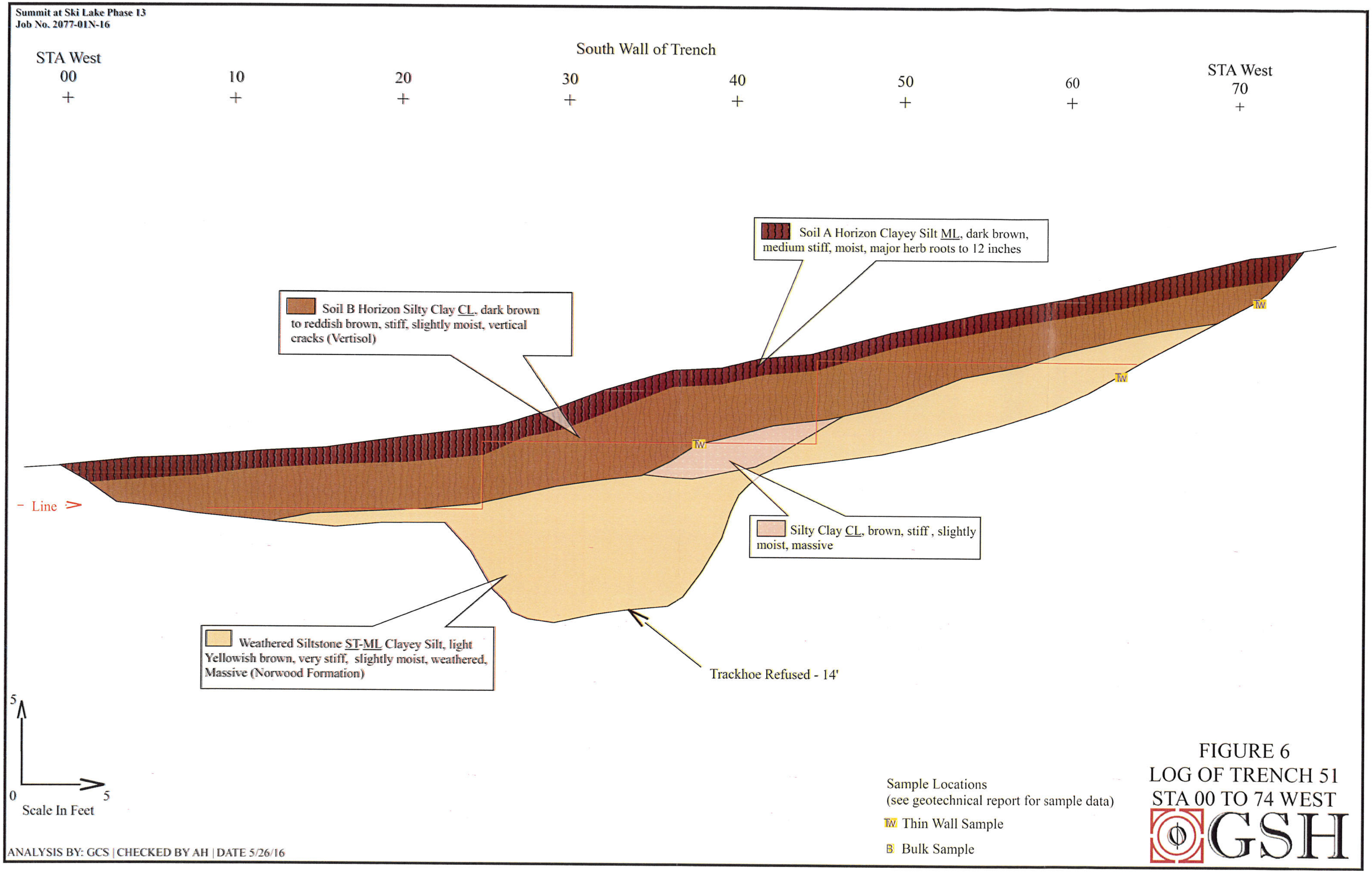
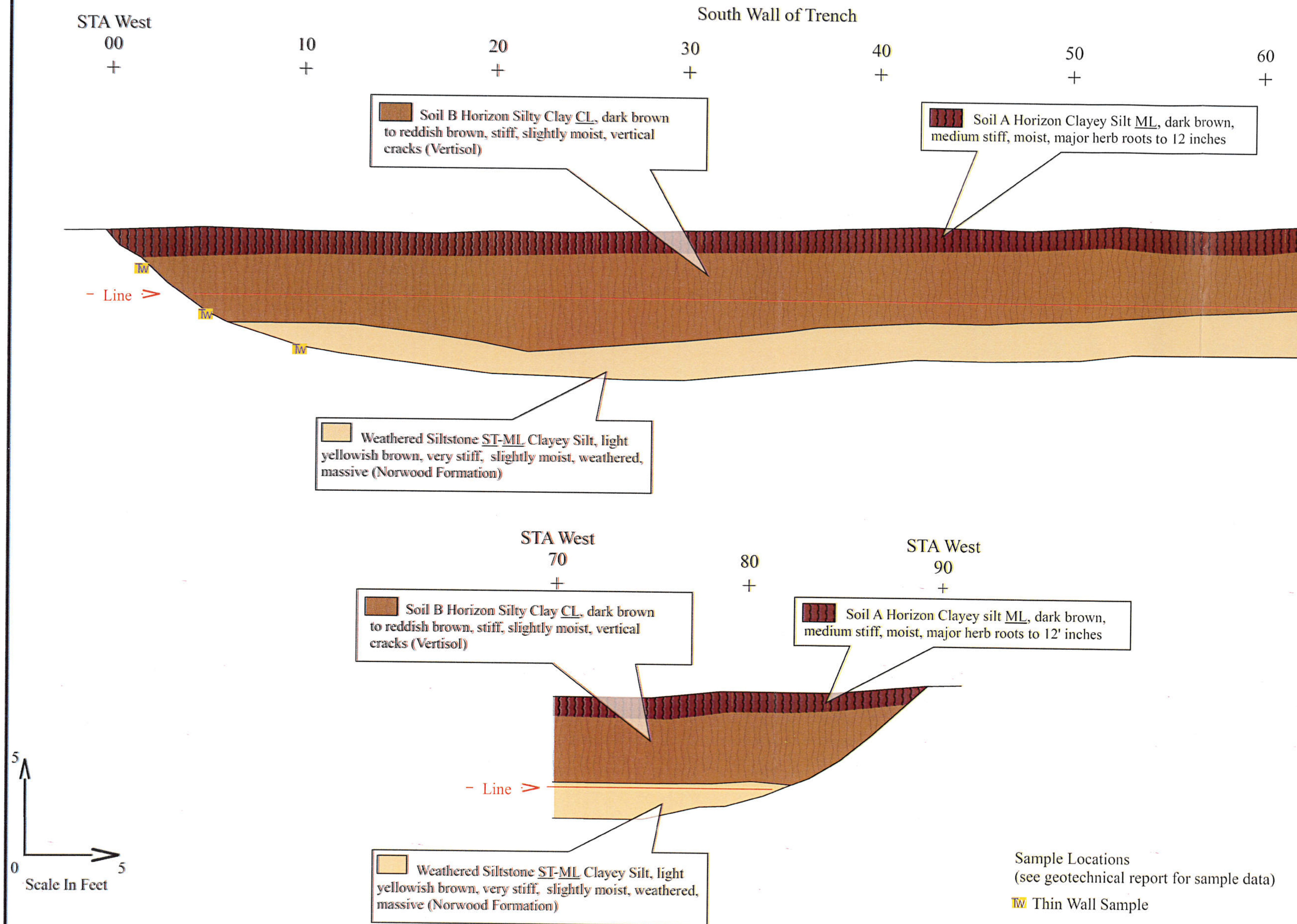


FIGURE 6
LOG OF TRENCH 51
STA 00 TO 74 WEST

GSH

Summit at Ski Lake Phase 13
Job No. 2077-01N-16



ANALYSIS BY: GCS | CHECKED BY AH | DATE 5/26/16

FIGURE 7
LOG OF TRENCH 52
STA 00 TO 90 WEST

GSH

Summit at Ski Lake Phase 13
Job No. 2077-01N-16

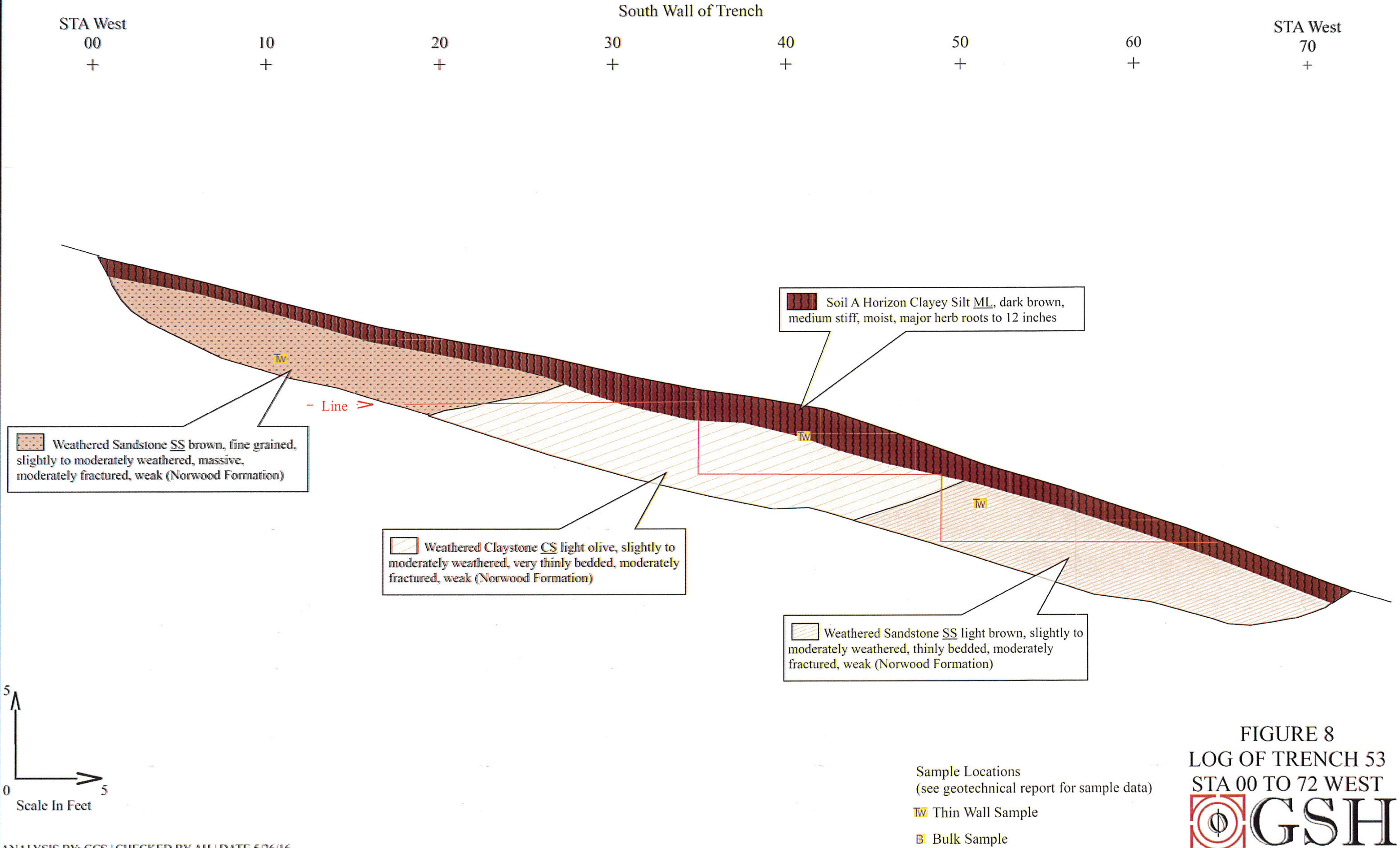
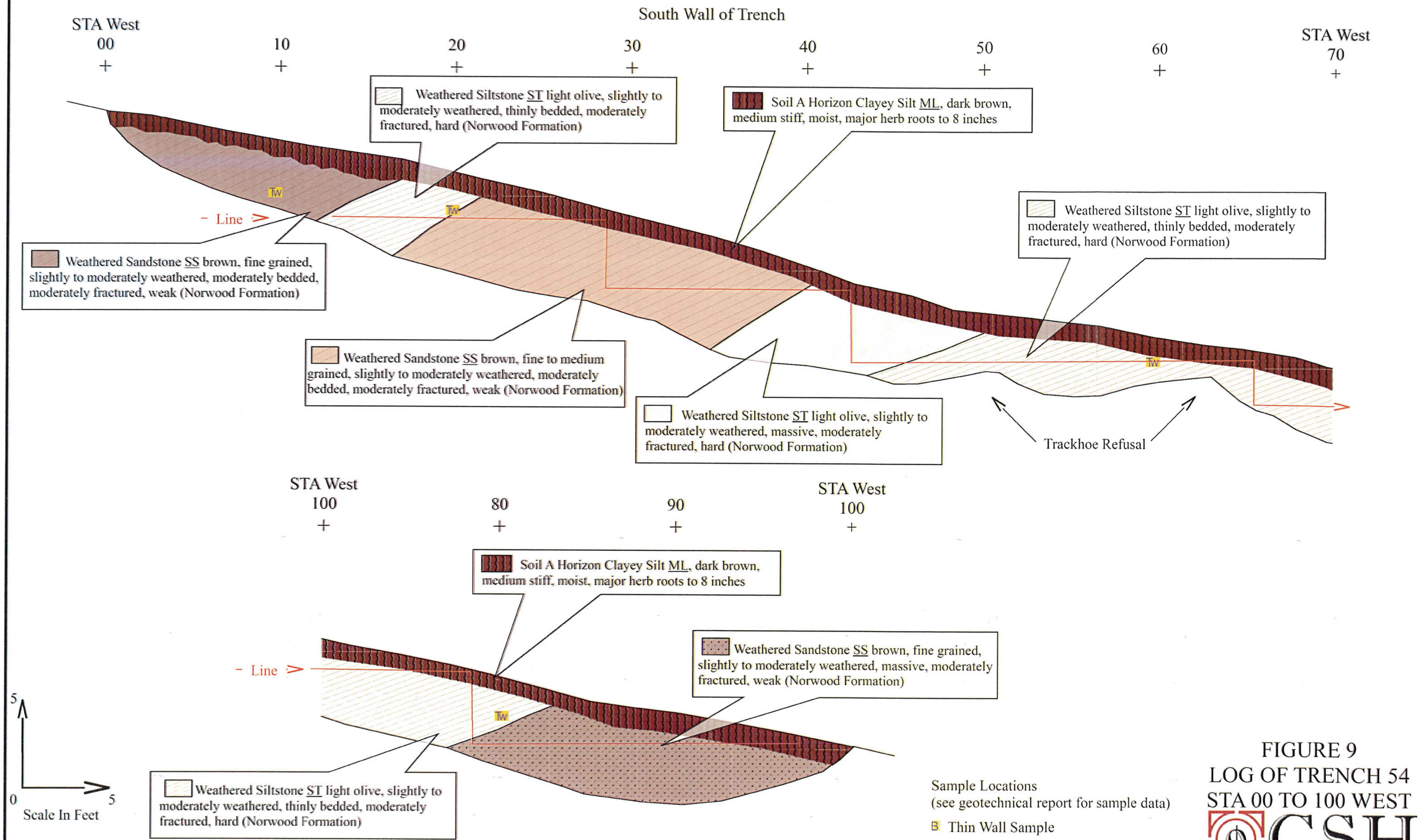


FIGURE 8
LOG OF TRENCH 53
STA 00 TO 72 WEST

GSH

ANALYSIS BY: GCS | CHECKED BY AH | DATE 5/26/16

Summit at Ski Lake Phase 13
Job No. 2077-01N-16



Sample Locations
(see geotechnical report for sample data)

B Thin Wall Sample

TW Bulk Sample

FIGURE 9
LOG OF TRENCH 54
STA 00 TO 100 WEST

GSH

ANALYSIS BY: GCS | CHECKED BY AH | DATE 5/26/16

Summit at Ski Lake Phase 13
Job No. 2077-01N-16

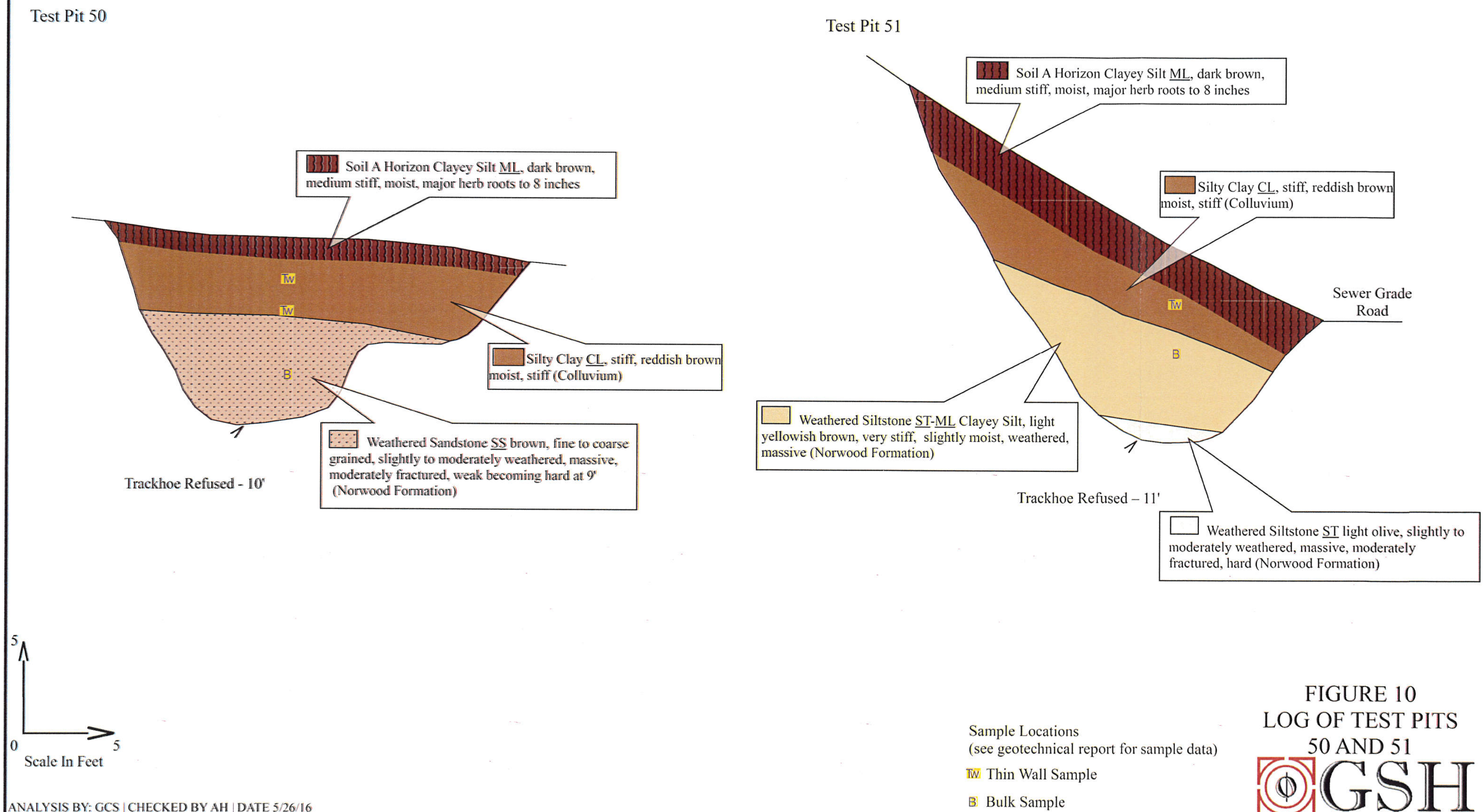


FIGURE 10
LOG OF TEST PITS 50 AND 51

GSH

ANALYSIS BY: GCS | CHECKED BY AH | DATE 5/26/16

Summit at Ski Lake Phase 13
Job No. 2077-01N-16

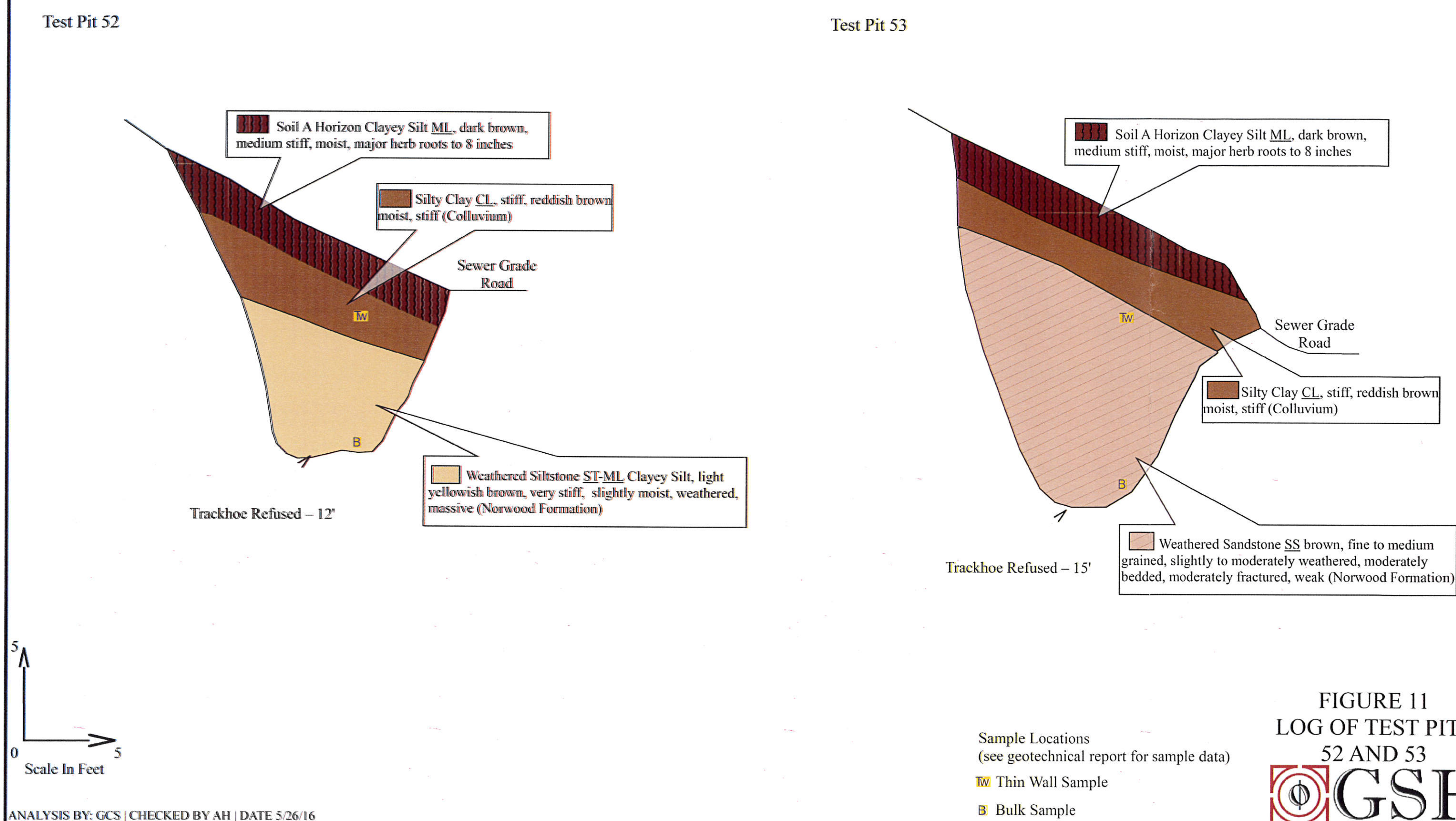


FIGURE 11
LOG OF TEST PITS
52 AND 53

GSH

ANALYSIS BY: GCS | CHECKED BY AH | DATE 5/26/16

BORING LOG

Page: 1 of 1

BORING: B-1

CLIENT: Valley Enterprise Investment Company | PROJECT NUMBER: 2077-01N-16

PROJECT: Summit at Ski Lake No. 13 | DATE STARTED: 4/14/16 | DATE FINISHED: 4/14/16

LOCATION: East Clairetina Court, Huntsville, Utah | GSH FIELD REP.: AA

DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: Not Encountered (4/14/16) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL brown									
	SM/ BR	WEATHERED/FRACTURED SANDSTONE BEDROCK/SILY SAND reddish-brown									dry very dense
			5	50+	X						
				50+	X	15	102	34			
		End of Exploration at 9.0' No groundwater encountered at time of drilling Installed 1.25" diameter slotted PVC pipe to 7.5'	10								
			15								
			20								
			25								

See Subsurface Conditions section in the report for additional information.

GSH

BORING LOG

BORING: B-2

CLIENT: Valley Enterprise Investment Company | PROJECT NUMBER: 2077-01N-16

PROJECT: Summit at Ski Lake No. 13 | DATE STARTED: 4/14/16 | DATE FINISHED: 4/14/16

LOCATION: East Clairetina Court, Huntsville, Utah | GSH FIELD REP.: AA

DRILLING METHOD/EQUIPMENT: 3-3/4" ID Hollow-Stem Auger | HAMMER: Automatic | WEIGHT: 140 lbs | DROP: 30"

GROUNDWATER DEPTH: Not Encountered (4/14/16) | ELEVATION: ---

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
		Ground Surface	0								
	CL FILL	SILTY CLAY, FILL with trace fine to coarse sand; light brown									
	CL	SILTY CLAY with trace fine sand; gray with oxidation									slightly moist hard
				95+							
	SM	SILTY FINE SAND/FINE SANDY SILT highly weathered siltstone/sandstone; light brown	5	82		19	105				slightly moist very dense
	ML	SILT with trace fine sand; gray with oxidation									slightly moist hard
				80+		35	72		46	13	
	SM/BR	SILTY FINE SAND/WEATHER SANDSTONE BEDROCK reddish-brown									dry very dense
			10	98+							
				86+		17		19			
			15	50+							
				50+							
			20	82+		27	93	16			
				50+							
			25								

See Subsurface Conditions section in the report for additional information.

GSH

BORING LOG

Page: 2 of 2

BORING: B-2

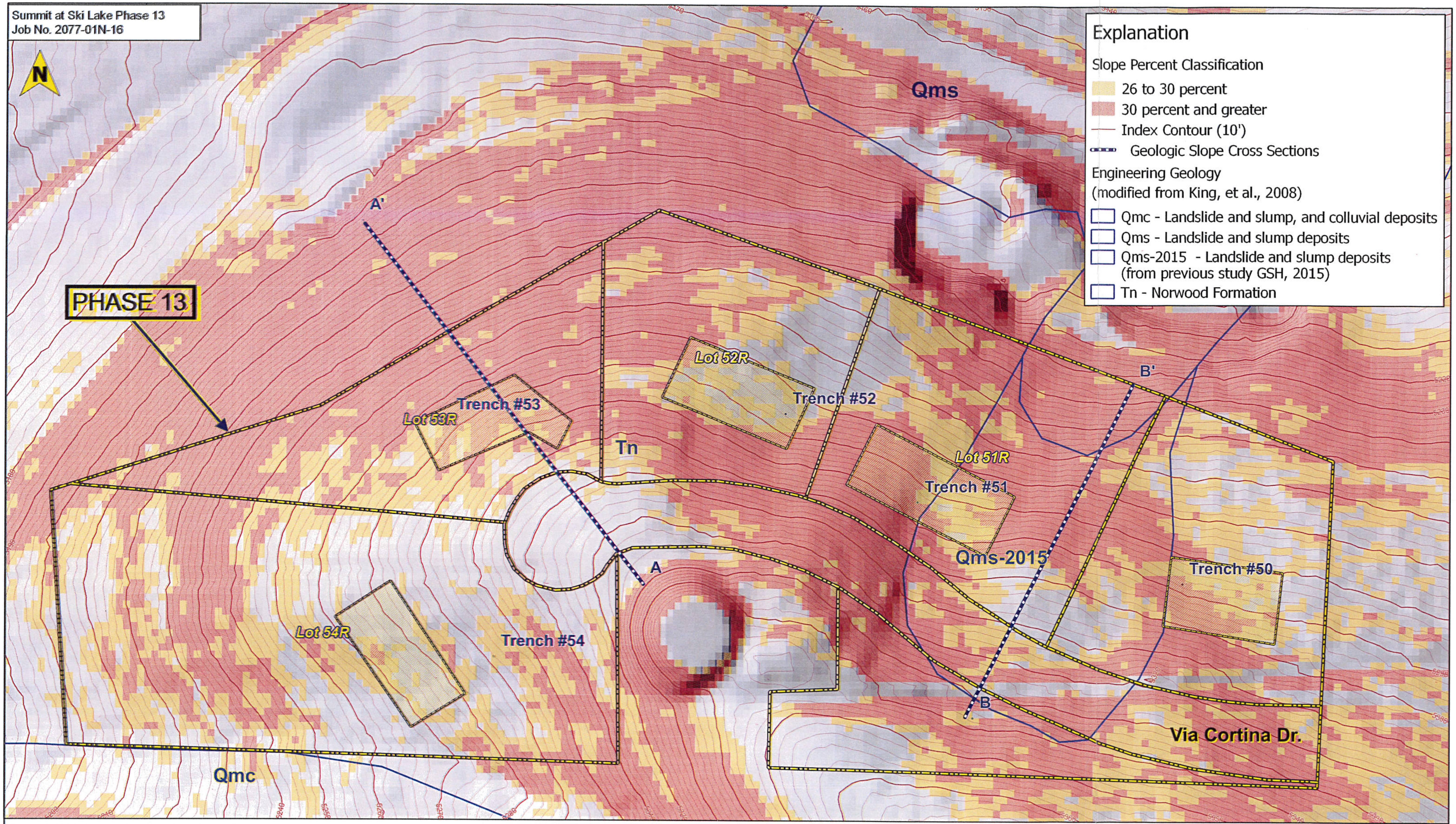
CLIENT: Valley Enterprise Investment Company — PROJECT NUMBER: 2077-01N-16

PROJECT: Summit at Ski Lake No. 13 — DATE STARTED: 4/14/16 — DATE FINISHED: 4/14/16

WATER LEVEL	USCS	DESCRIPTION	DEPTH (FT.)	BLOW COUNT	SAMPLE SYMBOL	MOISTURE (%)	DRY DENSITY (PCF)	% PASSSING 200	LIQUID LIMIT (%)	PLASTICITY INDEX	REMARKS
			25	100+							slightly moist
				50+							
		End of Exploration at 29.0' No groundwater encountered at time of drilling Installed 1.25" diameter slotted PVC pipe to 27.5'	30								
			35								
			40								
			45								
			50								

See Subsurface Conditions section in the report for additional information.

FIGURE 13
(continued)

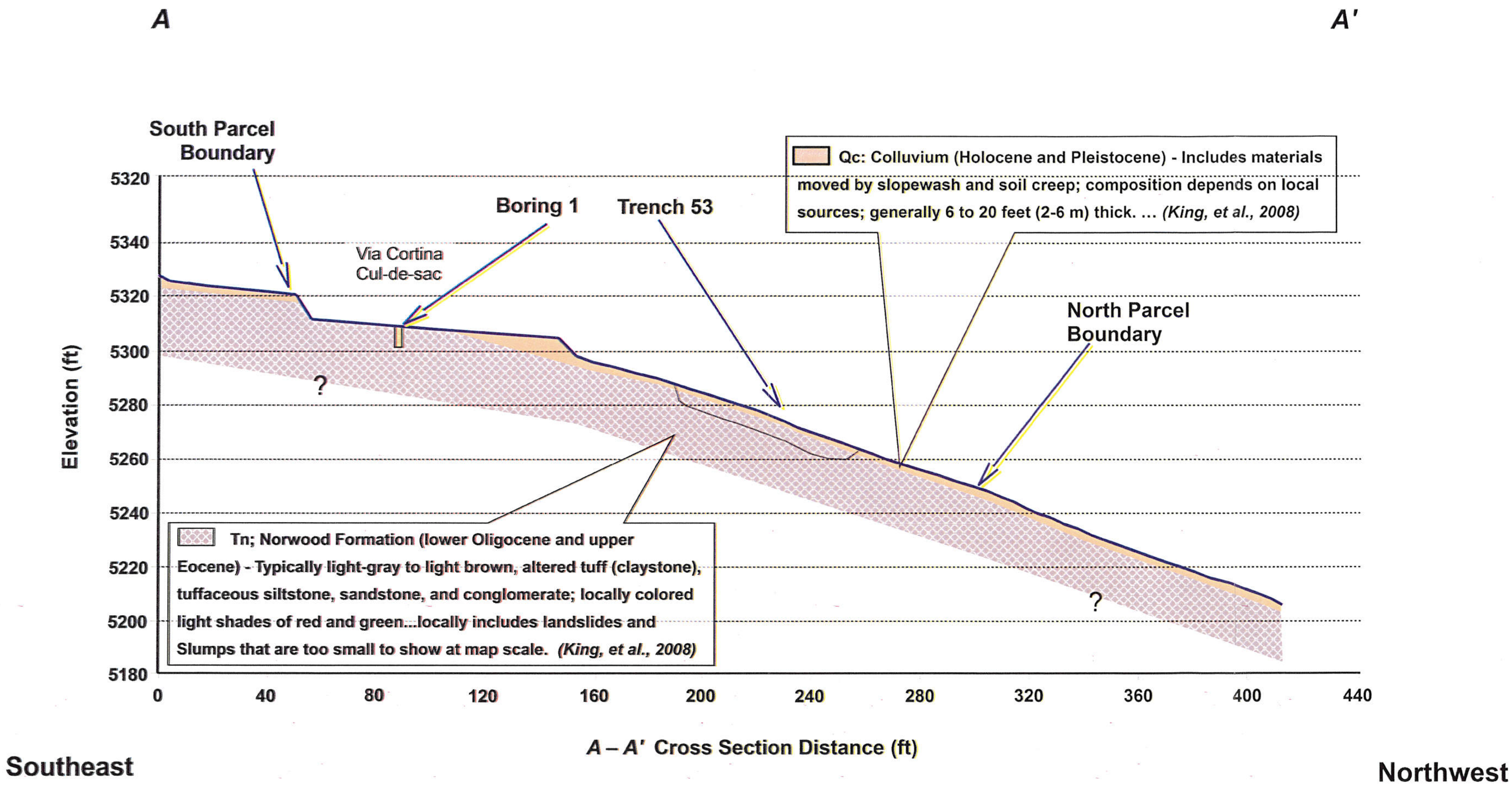


Base: 2012 6-inch Color HRO Orthoimagery,
from Utah AGRC; http://gis.utah.gov/
Elevation: 2006 2.0m Geoprocessed LiDARfrom Utah AGRC;
http://gis.utah.gov/

FIGURE 14
LiDAR-SLOPE ANALYSIS

GSH

Summit at Ski Lake Phase 13
Job No. 2077-01N-16



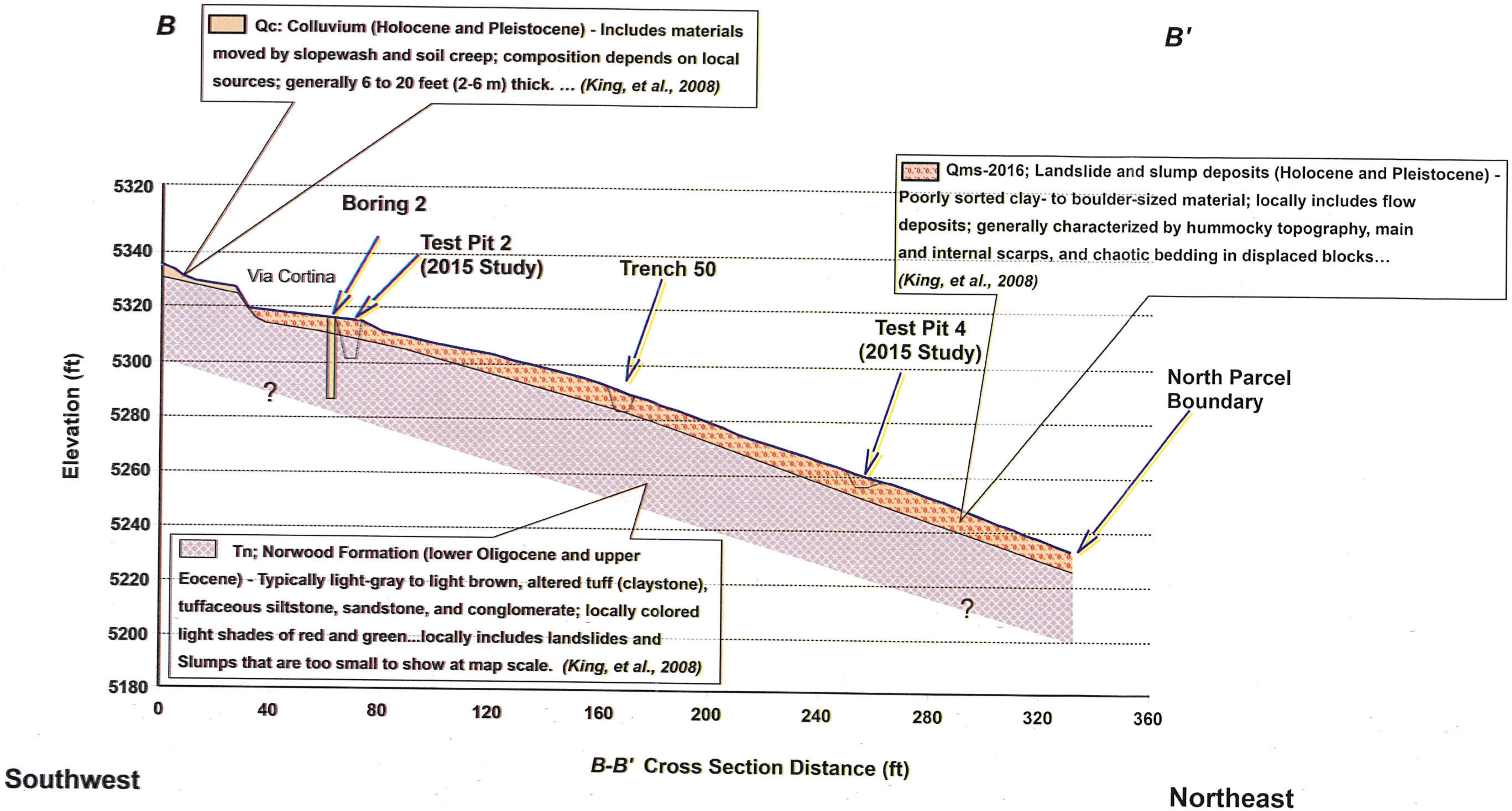
*Elevation data for the cross section were developed from 2.0 meter 2006 LiDAR digital elevation data. Elevations for the Via Cortina cut slopes were recorded using a hand-held GPS receiver device during our field program.

FIGURE 15
GEOLOGIC SLOPE
CROSS SECTION A-A'
GSH

ANALYSIS BY: GCS | CHECKED BY AH | DATE 05/24/16

* From Section Line Shown On Figure 4 and 14

Summit at Ski Lake Phase 13
Job No. 2077-01N-16



*Elevation data for the cross section were developed from 2.0 meter 2006 LiDAR digital elevation data. Elevations for the Via Cortina cut slopes were recorded using a hand-held GPS receiver device during our field program.

FIGURE 16
GEOLOGIC SLOPE CROSS SECTION *B-B'*

GSH

ANALYSIS BY: GCS | CHECKED BY AH | DATE 05/24/16

* From Section Line Shown On Figure 4 and 14