March 12, 2025
Job No. 3361-006-25

Mr. Ryan Woolsey, Mr. Ben Ahern, and Mr. Peter Traum
Snowbasin Resort
3925 East Snowbasin Road
Huntsville, Utah 84317

Attention: Mr. Woolsey, Mr. Ahern, and Mr. Traum

RE: Geological and Geotechnical Reconnaissance
Proposed New Becker Ski Lift
Snowbasin Resort
3925 East Snowbasin Road
Huntsville, Utah

1. INTRODUCTION

In response to your request, GSH Geotechnical, Inc (GSH) has prepared this geological and geotechnical reconnaissance report for the proposed New Becker Ski Lift project, at Snowbasin Resort, Huntsville, Weber County, Utah. The location of the proposed new alignment is shown on Figure 1, Vicinity Map, and Figure 2, Site Plan, provides aerial coverage of the site and detail of the current (2025) layout of the site vicinity.

The proposed new lift consists of an approximately 5,050-foot-long high-speed quad ski lift alignment, that covers parts of Section 32, Township 5 North, Range 1 East and Section 5, Township 5 North, Range 1 East, Salt Lake base and meridian. The site is located on the east side of the Mount Ogden-DeMoisy Peak ridgeline crest of the Wasatch Mountains. The preliminary concept plans prepared by Snowbasin indicate the proposed lift project is to include upper and lower terminal structures, and 23 lift towers. The locations of the proposed alignment, terminals, and towers are shown on Figure 2. The proposed new alignment will be built generally parallel but on the west side of the existing Becker lift alignment, with the Lower Terminal located approximately 290 feet to the west of the existing Becker Lift lower terminal.

Because the proposed new alignment appears to be located in part on sloping areas in the vicinity of mapped landslide hazards, marginal soils, Quaternary faults and FEMA floodplain areas, Weber County is requesting that a geological site reconnaissance be performed to assess whether all or parts of the new alignment project are exposed to the hazards that are included in the Weber County Code, Section 108-22 Natural Hazard Areas. These hazards include, but are not limited to: Surface-Fault Ruptures, Landslide, Tectonic Subsidence, Rock Fall, Debris Flows, Liquefaction Areas, Flood, or other Hazardous Areas.

The purpose of this reconnaissance is to evaluate if the proposed new alignment is outside or within areas identified as Natural Hazards Overlay District, and if within a hazard area, to recommend appropriate additional studies that comply with the purpose and intent of the Weber County Natural Hazards Area guidelines and standards in order to be "cleared" for building permit issuance by the county, as outlined by the Weber County Development Process packet as provided by the Weber County Building Inspection Department.

The objectives and scope of this study were discussed and presented to Mr. Ben Ahern, Lift Maintenance Manager of Snowbasin Resort, in our (GSH) Professional Services Agreement dated December 30, 2024, was signed by Mr. Davey Ratchford, General Manager of Snowbasin Resort January 10, 2025.

The **Objectives** of this geological and geotechnical reconnaissance study are to:

1) Define potential geologic hazards, and geotechnical conditions;
2) Provide appropriate recommendations for geologic hazards, as well as foundations, earthwork, and geoseismic conditions.

In accomplishing the objectives, our **Scope** included the following:
Geological Reconnaissance Scope

1) Reconnaissance visit to the site for geological for geologic hazards and geotechnical conditions;
2) Engineering analysis including review available literature, mapping, and LiDAR, etc.; and
3) Summary report.

Geotechnical Observations Scope

1) Observe owner/client provided tower and terminal excavations during construction; and
2) Provide associated geotechnical observations and recommendation letters.

1.2 AUTHORIZATION

Authorization was provided by Mr. Davey Ratchford by returning a signed copy of our Professional Services Agreements No. 24-1237 dated January 10, 2025.

1.3 PROFESSIONAL STATEMENTS

Supporting data upon which our recommendations are based are presented in subsequent sections of this report. Recommendations presented herein are governed by the physical properties of the soils and rock observed at the site, projected groundwater conditions, and the layout and design data discussed in Section 2, Proposed Construction, of this report. If subsurface conditions other than those described in this report are encountered and/or if design and layout changes are implemented, GSH must be informed so that our recommendations can be reviewed and amended, if necessary.

Our professional services have been performed, our findings developed, and our recommendations prepared in accordance with generally accepted geological and engineering principles and practices in this area at this time.

2. PROPOSED CONSTRUCTION

We understand that construction for the high-speed quad lift is planned for the proposed new lift alignment. The proposed new lift is to include upper and lower terminal structures, and 23 lift towers. The new lift will span approximately 5,050 feet and will lift skiers approximately 1,270 feet in elevation.

2. INVESTIGATIONS

2.1 Literature and Resource Review

To evaluate the potential exposure of sites to geological hazards that impact sites or site improvements, Weber County has compiled a series of Geographic Information Systems (GIS) data mapping layers of geological hazard related information. These data may be queried on-line using the Weber County Geo-Gizmo web server application at:

https://www3.co.weber.ut.us/gis/maps/gizmo2/index.html

Using the Geo-Gizmo application, under the Engineering Layers category, is listed geological hazard related layers that may be toggled on and off to determine potential hazards exposure to sites in the county. These mapping layers include the following categories; *Quake Epicenters, FEMA Flood Zone Line, FEMA Base Flood Elevation, Wasatch Faults, Landslide Scarps, Geologic Faults, Faults, Quaternary Faults, FEMA Flood Zone, FEMA LOMR, Engineering Problems; Liquefaction Potential, Landslide, FEMA Letters of Map Change, and FEMA Flood Zones.* These layers have been compiled from the respective agencies including the Federal Emergency Management Agency (FEMA), the Utah Geological Survey (UGS), and the U.S. Geological Survey (USGS). These mapping layers consist of regional compilation hazards data but are not compiled at scales that are necessarily applicable for site specific usage and planning. When hazard layer data on the Geo-Gizmo are found to interact with Permit Applicant site improvement locations, Weber County Engineers and Planners will request that the Permit Applicant have a Professional Geologist Site Reconnaissance Review, such as presented herein, conducted for the site.

In addition to the Geo-Gizmo site screening, the Weber County Engineers and Planners rely on published UGS geological mapping (Coogan and King, 2016), that includes much of Weber County for determining if a site is located upon a potentially hazardous geological mapping unit, thus requiring a geological reconnaissance. This interactive "Weber County Geologic Map" may be viewed on-line at:

https://weber.maps.arcgis.com/apps/webappviewer/index.html?id=bd557ebafc0e4ed58471342bb03fdac5

Our preliminary review of the Geo-Gizmo indicated that the proposed new lift alignment crossed a "*shallow landslide*" hazard unit according the UGS landslide database (Elliott and Harty, 2010), however the location did not show exposure to any of the other aforementioned hazard layer areas, Including; *Quaternary Faults* (USGS and UGS, 2006), and *FEMA Flood Zone* (FEMA, 2015).

The interactive Weber County Geologic Map (web map) shows the entire proposed new lift spans ground codified (shaded red) as potential hazard by the web map. The potentially hazardous geologic units underlying the new lift alignment include: **Qg,** and **Qgmo** – glacial deposits, **Qmg** – mixed glacial and colluvial deposits, and **Qmsy** - mass movement deposits. These deposits range from Holocene and upper and middle? Pleistocene age, and have been identified by the Weber County Geologic Map as units requiring site specific investigation (Weber County Inspection, 2025)

Our site-specific review consisted of a GIS data integration effort that included:

1. Reviews of previous mapping and literature pertaining to site and regional geology including Mulvey (1992), USGS and UGS (2016), Elliott and Harty (2010), King and others (2008), and Coogan and King (2016).

2. An analysis of vertical and stereoscopic aerial photography for the site including a 1963 1:15,840 scale black and white stereoscopic sequence; a 2001 1:15,840 scale color stereoscopic sequence; a 2012 5.0-inch digital HRO orthoimagery coverage, and a 2021 0.6 meter digital NAIP orthoimagery coverage of the site.

3. A GIS analysis using the QGIS® GIS platform to geoprocess and analyze 2020 0.5-meter LiDAR digital elevation data made available for the site by the Utah Automated Geographic Reference Center (AGRC). The GIS analysis included using the QGIS® platform Geospatial Data Abstraction Library (GDAL, 2013) Contour; the GRASS® (Geographic Resources Analysis Support System, 2013) r.slope and r.shaded.relief modules.

For the best site-specific and documentation for this review we relied on 1:24,000-scale geologic mapping by King and others (2008), which provided the best scales and detail of geological mapping for the site location. The geological mapping for this review is provided on Figure 3, Geologic/LiDAR Mapping. Topographic, slope, and elevation data for this review was supported through the aforementioned LiDAR analysis is also presented on Figure 3,

Site Evaluation

The site evaluation for the proposed development included the preliminary office procedures, outlined below, followed by a general field reconnaissance:

- A review of pertinent geological literature, mapping and data. from previous studies conducted in the area (Sorensen and Crittenden, 1979; Mulvey, 1992; USGS and UGS, 2016; Elliott and Harty, 2010; King and others, 2008; and Coogan and King, 2016), and seismic hazards information that was developed from United States Geologic Survey (USGS) databases (Peterson and others, 2014).

- A photogeologic analyses of vertical digital 2012 and 2021 orthoimagery shown on Figure 2, and the analysis of historical stereoscopic imagery flown in 1963 and 2001, and indexed as follows on Table 1:

Table 1 Stereoscopic Aerial Photograph Index			
Year	**Index**	**Scale**	**Color**
1963	ELK_2-91	1:15840	B&W
1963	ELK_2-92	1:15840	B&W
2001	614190_1901-16	1:15840	Color
2001	614190_1901-17	1:15840	Color

- A GIS analyses of elevation and geoprocessed 2020 LiDAR terrain data as shown on Figure 3**.**

2.2 Field Reconnaissance

A field reconnaissance of the general site area, including an on-ground visit to the site was carried out January 30, 2025. The field reconnaissance was performed by GSH professionals; Dr. Greg Schlenker PG, Senior Geologist, Mr. Michael Huber PE, Senior Geotechnical Engineer, and Mr. Robert Gifford, PG, Project Geologist. The new lift alignment, and the proposed terminal and tower locations were observed during this reconnaissance.

2.3 Slope Analysis

Elevation data consisting of 0.5-meter 2020 LiDAR imagery 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, renderings and elevation contours were calculated for the site area.

Figure 3, presents the results of our slope analysis efforts. Shown on Figure 3 are the slope percentage gradients across the site. The calculated average slope gradient for the ground underlying the proposed lift is 35.3 percent. The threshold gradient for slope development restrictions according to the Weber County Section 108-14-3. (Weber County Code, 2025), includes slopes greater than 25-percent.

Topographic contour elevation lines were also calculated from the elevation data, and are illustrated on Figure 3 with 2-foot intervals, and 10-foot index contour intervals.

3 SITE CONDITIONS

3.1 Surface

As shown on Figures 1 and 2, the new lift area includes an established ski-area with cleared ski and foot trails and unpaved access/service roads. Elevation on the new alignment ranges between 6,532 feet on the north Lower Terminal area, to 7,800 feet on the south Upper Terminal area. Slope gradients range from near-level to substantially steeper than the 30-percent. Overall, the new lift alignment span slopes gently to moderately-steeply down to the north. Surface vegetation consists of open areas of grasses, with weeds and underbrush, with areas of woody vegetation including clusters of aspen, scrub oak, maple, and fir trees. The ephemeral headwaters of Wheeler Creek emerge to the southwest of the new alignment and flows generally to the north nearly parallel to the new lift alignment.

3.2 Geologic Setting

The site is located to the east the eastern crest of Mount Ogden, which western flank comprises the Wasatch Front. 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 Tertiary units of the Wasatch Formation and the Norwood Formation that ramp along the transition of the mountains to the foothills on the east. The Wasatch Front is marked by the Wasatch fault, which is 3.9 miles west of the site, and provides the basis of division between the Middle Rocky Mountain province on the east and the Basin and Range province on the west.

The Basin and Range 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 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 (Oligocene epoch) 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 Becker Lift area is located upon older Precambrian and Paleozoic rocks that were thrusted from west to east roughly 80 million of years ago (Cretaceous Period), as part of what is called the Ogden Roof Thrust (Coogan and King, 2016). The thrusted rocks were locally covered approximately 20 to 30 million years ago by Tertiary volcanic deposits locally known as the Norwood Formation. Since the deposition of the Norwood Formation, orogenic mountain building processes have been occurring, resulting in the erosion and deposition of Quaternary age soils on the surface vicinity during the past 1.6 million years. More recently, between 30,000 BP to 12,000 BP, glacial ice accumulated upon the higher elevation peaks along the Wasatch Range, and subjected the terrain to glacial erosion and deposition, leaving eroded cirque valleys and depositional moraine features (Madsen and Currey, 1979). Since the regression of the ancient ice, stream erosion and incision of the mountain slopes has modified the glacial terrain features in the vicinity of the new alignment site.

3.3 Geologic Mapping

Figure 3, Geologic Mapping, shows the location of the site relative to integrated GIS overlays digitized from the geological mapping prepared by King and others (2008), and

Coogan and King (2016). A summary of the geological mapping units of the new alignment site and site vicinity is provided in relative age order as follows:

Qh - Human disturbance (Historical) - Obscures original deposits by cover or removal; mostly fill along railroad and highway grades, and some large gravel pits that predate 1986 aerial photographs.

Qmt - Talus (Holocene and Pleistocene) - Angular debris at the base of and on steep slopes...

Qmdf - Debris- and mud-flow deposits (Holocene and upper and middle? Pleistocene) – Very poorly sorted, clay- to boulder-sized material in unstratified deposits characterized by rubbly surface and debris-flow levees with channels, lobes, and mounding...

Qafy - Younger alluvial-fan deposits (Holocene and uppermost Pleistocene) - Mostly sand, silt, and gravel that is poorly bedded and poorly sorted; includes debris flows, particularly in drainages and at drainage mouths...

Qafo - Qafoe - Alluvial fan deposits (older), middle and lower Pleistocene. Mostly poorly bedded and poorly sorted sand, silt, and gravel; fan remnants higher than Lake Bonneville deposits...

Qmsh - Qmsy – **Qms** – Landslide deposits (Holocene and Pleistocene) - Poorly sorted clay- to boulder-sized material; includes slides and slumps, and locally includes flow deposits; generally characterized by hummocky topography, (**Qmsh**) historic movement, (**Qmsy**) post- Lake Bonneville in age, and mostly pre-historic, (**Qms**) where age uncertain (though likely Holocene and/or upper Pleistocene)…

Qmg - Mass-movement and glacial deposits, undivided (Holocene and Pleistocene) – Unsorted and unstratified clay, silt, sand, and gravel; mapped where glacial deposits lack typical moraine morphology…

Qg – **Qga -** Glacial till and outwash, age not known (Holocene and upper and middle Pleistocene) -is undivided glacial deposits (till and outwash) of various ages; till is non-stratified, poorly sorted clay, silt, sand, and gravel, to boulder size… outwash (**Qga**) is stratified and variably sorted, but better sorted and bedded than till due to alluvial reworking...

Qgy – **Qgmy -** Younger glacial till and outwash (Holocene and upper Pleistocene) - Mostly Pinedale-age (~15,000 to 30,000 years old, upper Pleistocene) deposits mapped as undivided (**Qgy**), distinct moraines (**Qgmy**)... till is non-stratified, poorly sorted clay, silt, sand, and gravel, to boulder-size materials...

Qgp – Pinedale glacial till and outwash (upper Pleistocene) – Pinedale-age (~12,000 to 30,000 years old)... till is non-stratified, poorly sorted clay, silt, sand, and gravel, to boulder size...

Qgo - Qgmo - Older glacial till and outwash (upper and middle? Pleistocene) – Poorly to moderately sorted clay, silt, sand, gravel to boulder size material...

QTaf/Tn – QTaf - High-level alluvial-fan deposits (lower Pleistocene and/or Pliocene) – Gravel, sand, silt, and clay above other stream-terrace and alluvial-fan deposits / over Tertiary **Tn** Norwood Formation...

Tw – Wasatch Formation (Eocene and upper Paleocene) – Typically red to brownish-red sandstone, siltstone, mudstone, and conglomerate with minor gray limestone and marlstone locally; conglomerate clasts mainly rounded Neoproterozic and Paleozoic sedimentary rocks, typically Neoproterozoic and Cambrian quartzite…

Cm – Maxfield Limestone (Middle Cambrian) – From top down includes dolomite, limestone, argillaceous to silty limestone and calcareous siltstone and argillite, and basal limestone with argillaceous interval…

Not show on mapping, but underlying the site at depth:

Tn - Norwood Formation (lower Oligocene and upper Eocene) - Typically light-gray to light brown, altered tuff (claystone), tuffaceous siltstone, sandstone, and conglomerate; locally colored light shades of red and green…locally includes landslides and slumps that are too small to show at map scale…

Summarily the geology of the site vicinity is the result of site formation processes beginning with structural thrust faulting during the Cretaceous time, normal faulting and mountainous uplift which commenced during Oligocene time, and late-Pleistocene glacial erosion deposition, which has sculpted the present terrain of the new alignment area.

4 DISCUSSIONS AND RECOMMENDATIONS

4.1 Summary of Findings

The engineering geology findings presented in this section pertain to the natural and geological hazards named in the Weber County Code, Section 108-22 Natural Hazard Areas. These hazards include, but are not limited to: Surface-Fault Ruptures, Landslide, Tectonic Subsidence, Rock Fall, Debris Flows, Liquefaction Areas, Flood, or other Hazardous Areas

4.1.1 Landsliding: The mapped units potentially prone to landslide movement consist of Holocene age (**Qmsy**), and upper and middle Pleistocene age (**Qms**) landslide deposits as mapped King and others (2008), that are located underneath or nearby the proposed new lift alignment. The Holocene age (**Qmsy**) landslide deposits underlying the new lift alignment are located near the south end of the alignment, in the vicinity of Towers T-18 through T-21, with Tower T-19 located within a mapped **Qmsy** unit.

The **Qmsy** landslide feature at the Tower T-19 location appears to be a rotational slump (Varnes, 1978), and based on slope morphology the past movement appears to have been in a northwestward direction, with an average slope gradient of 27.2 percent. Based on topography and landslide morphology observed during our reconnaissance of the alignment we believe that the Tower T-19 location is within the head scarp of the landslide unit, and expect the disturbed or moved soils in this location to be relatively thin, insomuch that a typical tower foundation will penetrate the disturbed or moved soils and be founded upon stable undisturbed soils. For this reason, we recommend that T-19 tower foundation excavation be inspected and approved by a Geotechnical Engineer before the foundation concrete is placed.

4.1.2 Sloping Surfaces: The site vicinity slopes developed from our LiDAR Analysis range from level to well over 30-percent as shown on Figure 4. Slope percentage values for the average slope gradient for the ground underlying the proposed lift is 35.3 percent.

4.1.3 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 and others, 2014). 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 and others, 2014) queried for the length of the new alignment, the expected peak horizontal ground acceleration on rock from a large earthquake with a ten-percent probability of exceedance in 50 years is 0.18*g,* and for a two-percent probability of exceedance in 50 years is 0.45*g* for the length of the new alignment.

The a ten-percent probability of exceedance in 50 years event has a return period of 475 years, and the 0.18*g* acceleration for this event corresponds "strong" perceived shaking with "light" potential damage based on instrument intensity correlations. The two-percent probability of exceedance in 50 years event has a return period of 2475 years, and the 0.45*g* acceleration for this event corresponds "severe " perceived shaking with "moderate" potential damage based on instrument intensity correlations (Wald and others, 1999).

Maximum Considered Earthquake (MCE) design spectra for the site is to be included in our forthcoming Geotechnical Report.

4.1.4 Active Earthquake Faults: Based upon our review of available literature, no active Holocene age faults are known to pass through or immediately adjacent to the site. The nearest active (Holocene) fault is the Wasatch fault zone, Weber section (UT2351e), located 3.9 miles west of the new alignment (Black and others, 2004). The Wasatch Fault Zone is considered capable of generating earthquakes as large as magnitude 7.3 (Arabasz and others 1992).

4.1.5 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 potential hazards have not been mapped in detail for the Snowbasin area, as has occurred in other parts of northern Utah (Anderson and others, 1994). Liquefaction commonly occurs in saturated non-cohesive soils such as alluvium, which is not found on the proposed new alignment, consequently the conditions susceptible to liquefaction do not appear to be present at the site.

4.1.6 Tectonic Subsidence is surface tilting subsidence that occurs along the boundaries of normal faults in response to surface-faulting earthquakes (Keaton, 1986). Because the Site is not located in near proximity to active earthquake faults, tectonic subsidence hazards are not considered a risk to the site.

4.1.7 Alluvial Fan - Debris Flow Hazards: Alluvial fan debris flow processes including flash flooding and debris flow hazard: The nearest potential debris flow process deposits to the site are mapped as **Qmdf** – Debris- and mud-flow deposits, and occur near the new alignment, between the proposed Towers T-14 and T15 locations as shown on Figure 3**.** Based upon our reconnaissance and review, these **Qmdf** – Debris- and mud-flow deposits and associated processes, as located on Figure 3, do not appear to a potential hazard to the new alignment.

4.1.8 Flooding Hazards: No significant waterways pass in the vicinity of the new alignment and flood insurance rate mapping by Federal Emergency Management Agency for the site vicinity has not been prepared for this area at this time (FEMA, 2015). Local sheet flow, slope wash, and seasonally perched soil water typical of sloping areas should be anticipated for the site, and site improvements.

4.1.9 Rockfall and Avalanche Hazards: No talus deposits **(Qmt) w**ere observed in the vicinity of the Upper Terminal area where steep rock slopes are nearest to the proposed new alignment, thus we consider exposure to rockfall hazards to be minimal for the Upper Terminal area.

The Snowbasin Snow-Safety staff have indicated from their experience that the Upper Terminal area is not subject avalanche runout (Perla and Martinelli, 1976), and furthermore we understand the new alignment area will be subject Snow-Safety control during winter operations.

5. CONCLUSIONS

This report provides our assessment of potential geologic hazards in the vicinity of the new alignment and the exposure of the new alignment to the hazards that are included in the Weber County Code, Section 108-22 Natural Hazard Areas. These hazards include, but are not limited to: Surface-Fault Ruptures, Landslide, Tectonic Subsidence, Rock Fall, Debris Flows, Liquefaction Areas, Flood, or other Hazardous Areas.

Based upon the findings of this review we believe that the proposed new alignment is not adversely exposed to the geological hazards specified in the Section 108-22 Natural Hazard Areas of the Weber County Code (2025).

Tower and terminal foundations may be constructed over suitable natural soils and/or bedrock. The most significant geotechnical aspects of the site are the potential to encounter non-engineered fills, particularly where unimproved access roads have been graded or where previous lift tower and terminals were located and the mass movement deposit mapped within the vicinity of Tower T-19.

Prior to proceeding with construction, demolition and removal of any existing lift towers and terminals (if in conflict with the new alignment), debris, surface vegetation, root systems, topsoil, non-engineered fill (if encountered), and any deleterious materials from beneath an area extending out at least 3 feet from the perimeter of the proposed foundation footprints is required. All existing utility locations should be reviewed to assess their impact on the proposed construction and abandoned and/or relocated as appropriate.

A qualified representative from GSH must observe each foundation excavation to verify that all unsuitable soils have been removed and that suitable soils and or bedrock has been encountered prior to placing structural fill or constructing foundations. Specific recommendations for each excavation observation will be communicated during the site visit and formally within a letter documenting the observations and recommendations.

From a geological standpoint it is our opinion that the new alignment project be permitted to move forward with the appropriate Geotechnical Engineering support for the terminal and tower location foundation design, and siting.

6. CLOSURE

If you have any questions or would like to discuss these items further, please feel free to contact us at (801) 685-9190.

Respectfully submitted,
GSH Geotechnical, Inc (GSH)

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Encl.	Figure 1,	Vicinity Map
	Figure 2,	Aerial Coverage
	Figure 3,	Geologic/LiDAR Mapping

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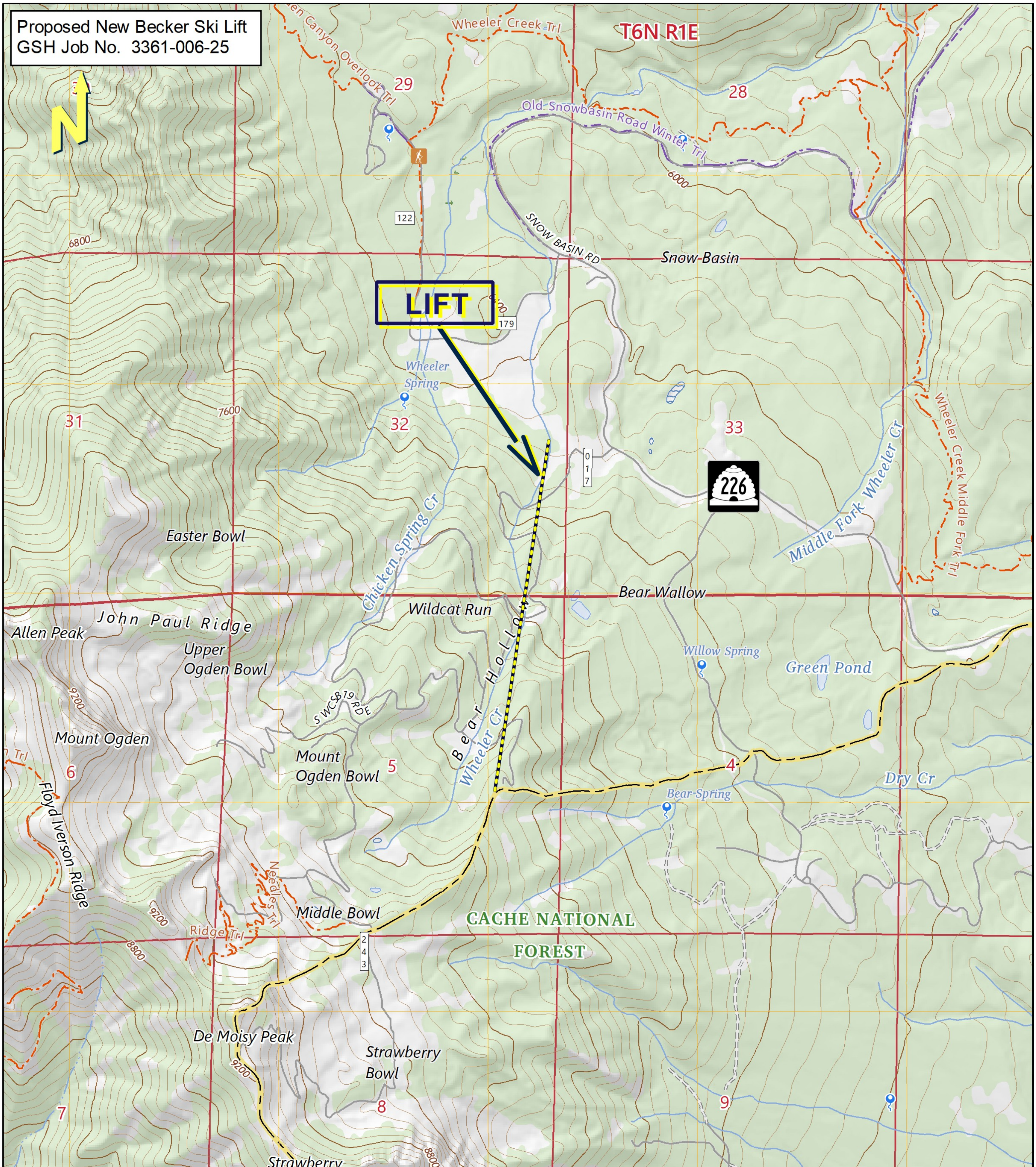
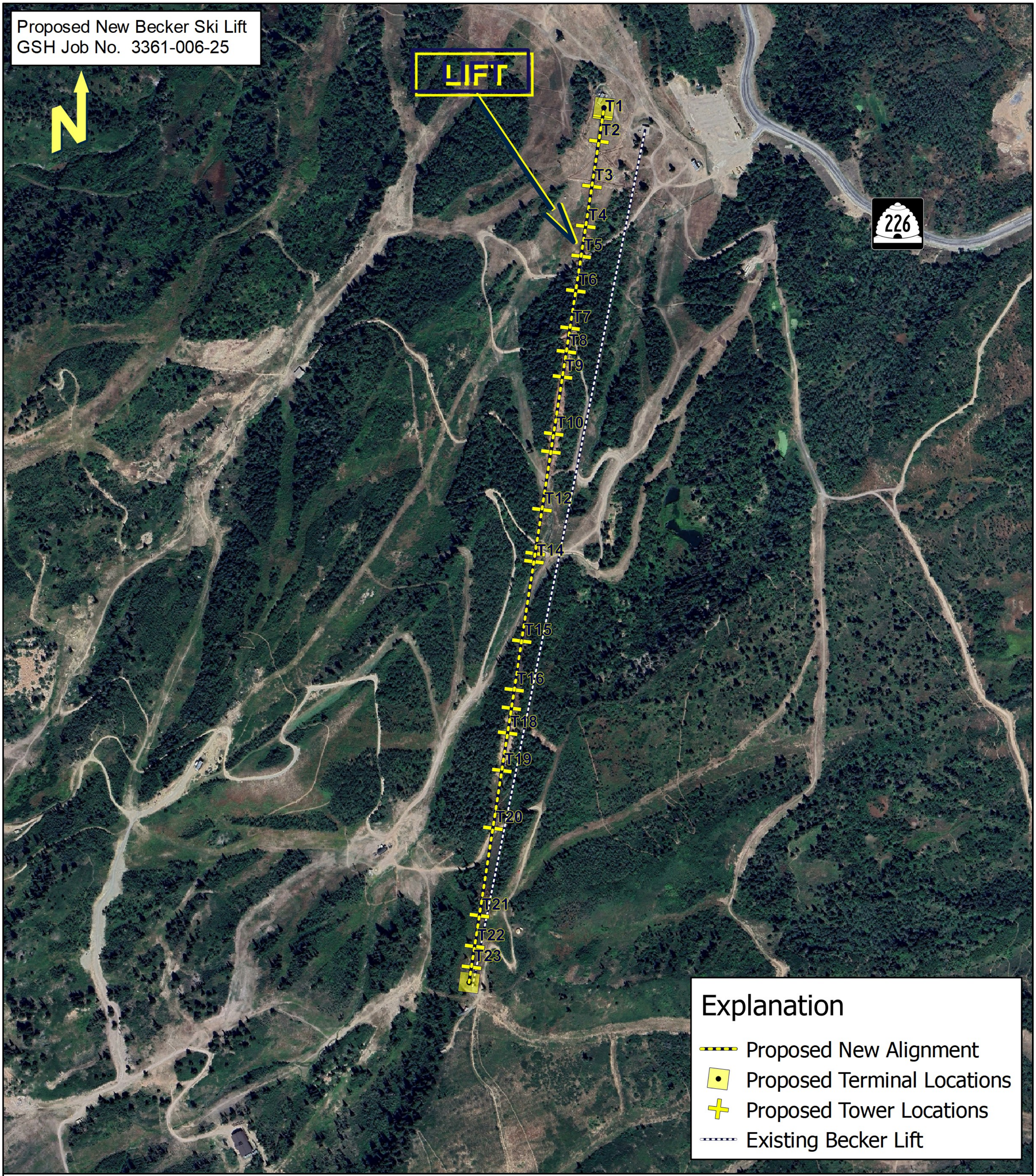


Base:
USGS 7.5 Minute topographic maps titled "Snowbasin, Utah" and "Ogden, Utah" from https://topobuilder.nationalmap.gov 2025

0 2000 4000 ft
1:24,000

FIGURE 1
VICINITY MAP

GSH



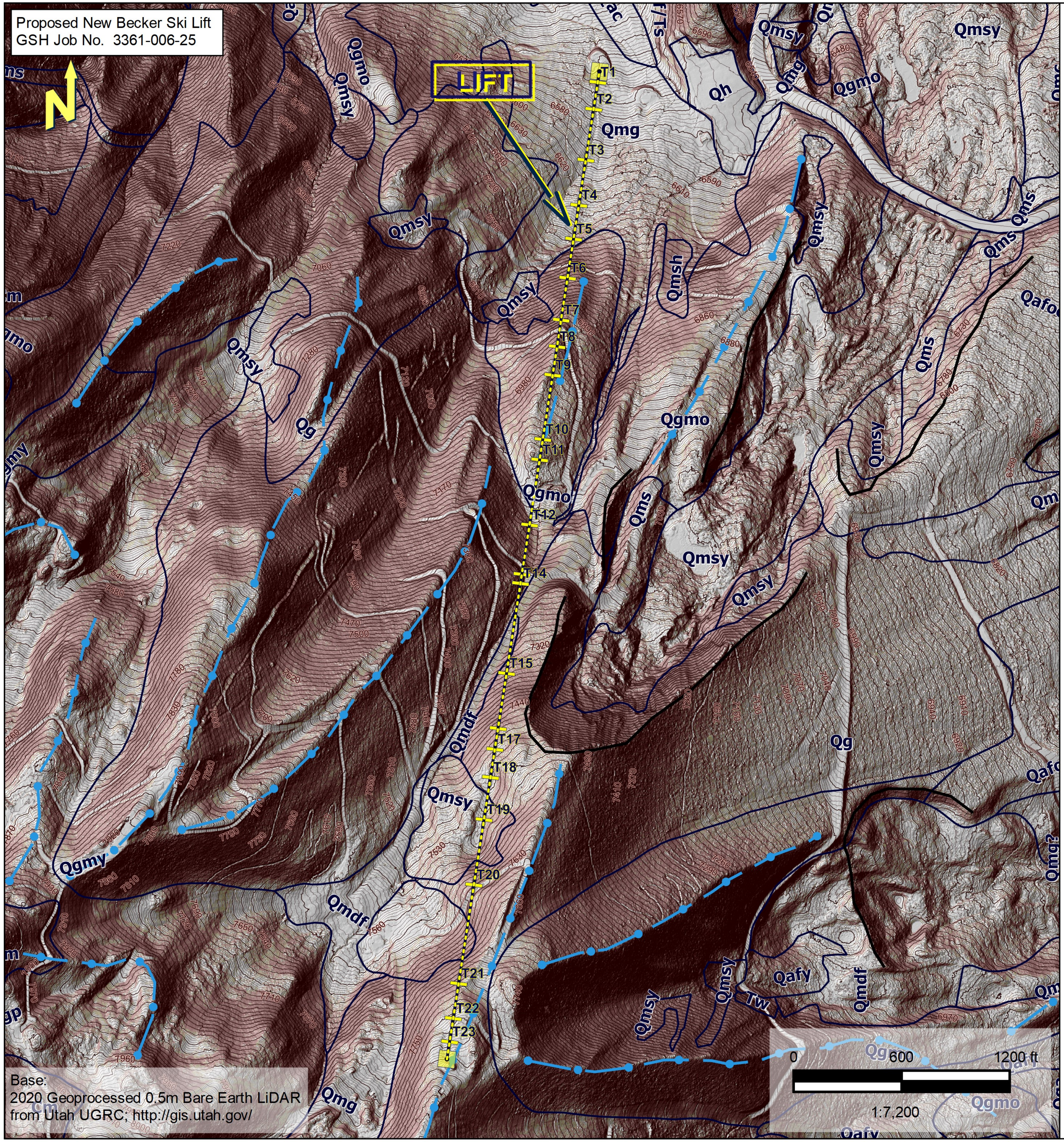
Base:
2024 ~0.5ft Color Google Earth®
Orthoimagery,
from; https://earth.google.com/web/

0 800 1600 ft

1:9,600

FIGURE 2
SITE PLAN

GSH



Geologic Classification

(modified from King and others, 2008; and Coogan and King, 2016)

Qh - Human disturbance (Historical) - Obscures original deposits by cover or removal; mostly fill along railroad and highway grades, and some large gravel pits that predate 1986 aerial photographs. **Qmt** - Talus (Holocene and Pleistocene) - Angular debris at the base of and on steep slopes...

Qmdf - Debris- and mud-flow deposits (Holocene and upper and middle? Pleistocene) – Very poorly sorted, clay- to boulder-sized material in unstratified deposits characterized by rubbly surface and debris-flow levees with channels, lobes, and mounding...

Qafy - Younger alluvial-fan deposits (Holocene and uppermost Pleistocene) - Mostly sand, silt, and gravel that is poorly bedded and poorly sorted; includes debris flows, particularly in drainages and at drainage mouths...

Qafo - Qafoe - Alluvial fan deposits (older), middle and lower Pleistocene. Mostly poorly bedded and poorly sorted sand, silt, and gravel; fan remnants higher than Lake Bonneville deposits...

Qmsh - Qmsy – Qms – Landslide deposits (Holocene and Pleistocene) - Poorly sorted clay- to boulder-sized material; includes slides and slumps, and locally includes flow deposits; generally characterized by hummocky topography, (Qmsh) historic movement, (Qmsy) post- Lake Bonneville in age, and mostly pre-historic, (Qms) where age uncertain (though likely Holocene and/or upper Pleistocene)...

Qmg - Mass-movement and glacial deposits, undivided (Holocene and Pleistocene) – Unsorted and unstratified clay, silt, sand, and gravel; mapped where glacial deposits lack typical moraine morphology...

Qg – Qga - Glacial till and outwash, age not known (Holocene and upper and middle Pleistocene) -is undivided glacial deposits (till and outwash) of various ages; till is non-stratified, poorly sorted clay, silt, sand, and gravel, to boulder size... outwash (Qga) is stratified and variably sorted, but better sorted and bedded than till due to alluvial reworking...

Qgy – Qgmy Younger glacial till and outwash (Holocene and upper Pleistocene) - Mostly Pinedale-age (~15,000 to 30,000 years old, upper Pleistocene) deposits mapped as undivided (Qgy), distinct moraines (Qgmy)... till is non-stratified, poorly sorted clay, silt, sand, and gravel, to boulder-size materials...

Qgp – Pinedale glacial till and outwash (upper Pleistocene) – Pinedale-age (~12,000 to 30,000 years old)... till is non-stratified, poorly sorted clay, silt, sand, and gravel, to boulder size...

Qgo - Qgmo - Older glacial till and outwash (upper and middle? Pleistocene) – Poorly to moderately sorted clay, silt, sand, gravel to boulder size material...

QTaf/Tn – QTaf - High-level alluvial-fan deposits (lower Pleistocene and/or Pliocene) – Gravel, sand, silt, and clay above other stream-terrace and alluvial-fan deposits / over Tertiary Tn Norwood Formation...

Tw – Wasatch Formation (Eocene and upper Paleocene) – Typically red to brownish-red sandstone, siltstone, mudstone, and conglomerate with minor gray limestone and marlstone locally; conglomerate clasts mainly rounded Neoproterozic and Paleozoic sedimentary rocks, typically Neoproterozoic and Cambrian quartzite...

Cm – Maxfield Limestone (Middle Cambrian) – From top down includes dolomite, limestone, argillaceous to silty limestone and calcareous siltstone and argillite, and basal limestone with argillaceous interval...

Not show on mapping, but underlying the site at depth:
Tn - Norwood Formation (lower Oligocene and upper Eocene) - Typically light-gray to light brown, altered tuff (claystone), tuffaceous siltstone, sandstone, and conglomerate; locally colored light shades of red and green...locally includes landslides and slumps that are too small to show at map scale...

Landslide Scarps

Moraine Crest

Slope Gradients

25 to 30 Percent Slopes

Greater than 30 Percent Slopes

Index Contour 10ft

FIGURE 3
GEOLOGIC/LiDAR MAPPING

GSH