GCS Geoscience

Report Professional Geologist Site Reconnaissance and Review
1.52-Acre Parcel #20-102-0033
Legends at Hawkins Creek Subdivision Lot 33
6677 East Chaparral Road
Huntsville, Weber County, Utah

For:

Ryan and Heidi Spendlove
693 North 7800 East Street
Huntsville, Utah
84317

By:

GCS Geoscience
554 South 7700 East Street
Huntsville, Utah 84317

July 25, 2022
GCS File No: 2022.30

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July 25, 2022
File No: 2022.30 Proposal

Ryan and Heidi Spendlove
693 North 7800 East Street
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Attention: Ryan and Heidi Spendlove

Subject: **Report**
Professional Geologist Site Reconnaissance and Review
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6677 East Chaparral Road
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INTRODUCTION

In response to your request, GCS Geoscience (GCS) has prepared this Professional Geologist site reconnaissance review report for the above referenced site. The subject parcel consists of an approximately 1.52-acre property located in the Huntsville Area in Weber County, Utah, as shown on attached Figure 1. Figure 2 provides aerial coverage of the site and detail of the current (2021) layout of the site vicinity. Figure 2 also shows the Lot 33 Boundary, and the prescribed Building Area on the property as delimited by the Weber County Dedication Plat (#63-058) as drawn in 2005.

The property is presently undeveloped, and is part of the Legends at Hawkins Creek Subdivision which is a cluster subdivision project, that includes forty-one residential development lots roughly one to two acres in area, and covers a total area of approximately 165 acres, with approximately 40-percent of the subdivision area dedicated to common areas. The subject parcel and surrounding properties are zoned by Weber County as Forest Zone FV-3 (Forest Valley Zone - 3) land-use zone. According to the Weber County Code of Ordinances *the purpose of the Forest Valley Zone, FV-3 is to provide area for residential development in a forest setting at a low density, as well as to protect as much as possible the naturalistic environment of the development.*

The prescribed minimum building lot area in the FV-3 Zone is 3 acres (excluding cluster type provision areas), with single family residences included as a permitted use.

It is our understanding that you intend to build a single-family residence on the Lot 33 property. We expect that the proposed construction will consist of a single-family residence structure, likely to be constructed with a basement level and supported on conventional spread and strip footings. Above grade levels will consist of wood frame construction one to three levels in height. Projected site grading is anticipated to consist primarily of cutting into the existing ground to construct the residence, with very little fill projected for the site.

Because the proposed site appears to be located in part on a hillslope area 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 site are exposed to the hazards that are included in the Weber County Code, Section 108-22 Natural Hazard Areas (Weber County Code, 2022). 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 **Professional Geologist Site Reconnaissance Review** is to evaluate if the proposed development 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 (2022).

The objectives and scope of this study were presented to Ryan and Heidi Spendlove (**Clients**) in our (GCS) Proposal-Agreement dated June 29, 2022, and was signed June 29, 2022 by Ryan Spendlove.

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:

http://www.co.weber.ut.us/gis/maps/gizmo/.

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 recently 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 Lot 33 Property was within an area classified as "*Engineering Problems*" by UGS database layers (Mulvey, 1992), and "*landslide*" hazard units were mapped nearby 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).

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 and Sorensen and Crittenden (1979), Mulvey (1992), USGS and UGS (2016), Elliott and Harty (2010), and Coogan and King (2016).

2. An analysis of vertical and stereoscopic aerial photography for the site including a 1946 1:20,000 stereoscopic sequence, 2012 5.0 inch digital HRO coverage, and 2022 0.6meter digital NAIP coverage of the site.

3. A GIS analysis using the QGIS® GIS platform to geoprocess and analyze 2016 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 documentation for this review we relied on geologic mapping by King and others (2008), which provided the best scale (1:24,000) rendering of geological mapping for the site location. Mapping by Coogan and King (2016) was also used to support this review. The geological mapping for this review is provided on Figure 3, Geologic Map. Topographic, slope, and elevation data for this review was supported through the aforementioned LiDAR analysis which is presented on Figure 4, LiDAR Analysis.

REVIEW FINDINGS

The site is located on the eastern flank 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 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, and has been measured to be as much as 7000 feet thick in the vicinity of the site (King and others 2008). 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 and others 2008).

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. As shown on Figure 2 the site consists of an area of approximately 1.52 acres in size that is currently vacant and undeveloped. The topography of the site vicinity consists of a north-south trending foothill ridge crest with about 300 feet of total vertical relief, with elevations on the property ranging between 5274 feet and 5332 feet (msl). The site, as shown on Figure 2, (2021 imagery) is bordered by developed and vacant undeveloped residential lots, and at the time of our July 12, 2022 site visit a few near-by properties in the subdivision were built or currently under construction.

Site Geology

Figure 3, Site Geology shows the location of the site relative to GIS overlays including geological mapping layers prepared by King and others (2008). A paraphrased summary of the geological mapping of the site vicinity is provided as follows:

> **Qac -** Alluvium and colluvium (Holocene and Pleistocene) - Includes stream and fan alluvium, colluvium, and locally mass-movement deposits...
>
> **Qc -** Colluvium (Holocene and Pleistocene) - Includes materials moved by slopewash and soil creep...
>
> **Qafy -** Alluvial-fan deposits (Holocene) – Mostly sand, silt, and gravel that is poorly bedded and poorly sorted...variably consolidated, and includes debris flows...
>
> **Qmc** - Landslide and slump, and colluvial deposits, undivided (Holocene and Pleistocene)... (slopewash and soil creep)...
>
> **Qmsy -** Younger landslide and slump deposits (Holocene) - Poorly sorted clay- to boulder-sized material...

Qms - Landslide and slump deposits (Holocene and Pleistocene) - Poorly sorted clay- to boulder-sized material...

Qmso - Older landslide and slump deposits (Pleistocene) - Poorly sorted clay- to boulder-sized material - **Qmso(Tn)** - where overlying Norwood Formation rocks

Ql/Tn - Lacustrine deposits (Pleistocene) - over Norwood Formation rocks...

Tn- Norwood Formation (lower Oligocene and upper Eocene) - Typically light-gray to light brown, altered tuff (claystone), tuffaceous siltstone, sandstone, and conglomerate...

The Lot 33 property is shown on Figure 3 to be located upon Norwood Formation (**Tn**) bedrock deposits. The Norwood Formation (**Tn**) bedrock has a notoriety of poor stability performance (particularly with steep slopes), and geotechnically challenging soils throughout the area, and such is the reason the site is considered exposed to "*Engineering Problems*" on the UGS database (Mulvey, 1992).

Geologic/Natural Hazards

In addition to the review and location query we searched for nearby or proximal classifications or conditions that could possibly present hazardous conditions to the site. A summary of this search is provided as follows:

1. **Landsliding:** The nearest active (Holocene age) landslide units are mapped as **Qmsy** deposits by King and others (2008), and are located approximately 350 feet to the northwest of the site as shown on Figure 3, and should not potentially impact the proposed use of the site.

2. **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 **Qafy** by King and others (2008), and occur approximately 400 feet east of the site. These deposits and processes do not appear to be a potential impact to the site.

3. **Geoseismic: Surface fault rupture hazards, Strong earthquake ground motion, Tectonic subsidence and Liquefaction:**

   Surface fault rupture hazards: The nearest active (Holocene) earthquake fault to the site is the Weber segment of the Wasatch fault zone (UT2351E) which is located 6.8 miles west of the site, thus fault rupture hazards are not considered present on the site (Black and others, 2004). The Ogden Valley southwestern margin faults (UT2375) are located much closer to the site, approximately 1.2 miles to the west, however the most recent movement along this fault is estimated to be pre-Holocene (>15,000 ybp), and presently is not considered an active risk (Black and others, 1999).

Strong earthquake ground motion: Strong ground motion originating from the Wasatch fault or other near-by seismic sources is capable of impacting the site, as well as the surrounding region. The Wasatch fault zone is considered active and capable of generating earthquakes as large as magnitude 7.3 (Arabasz and others, 1992). Based on probabilistic estimates (Petersen and others, 2014) 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 0.17*g,* and for a two-percent probability of exceedance in 50 years is as high as 0.37*g* for the site.

The a ten-percent probability of exceedance in 50 years event has a return period of 475 years, and the 0.17*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 0.37*g* acceleration for this event corresponds "very strong" perceived shaking with "moderate" potential damage based on instrument intensity correlations (Wald and others, 1999).

Future ground accelerations greater than these are possible but will have a lower probability of occurrence.

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.

Liquefaction potential hazards: In conjunction with strong earthquake ground motion 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 studied or mapped for the Ogden Valley 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 property, consequently the conditions susceptible to liquefaction do not appear to be present at the site.

4. **Rockfall and avalanche hazards**: The site is over a mile from steep slope areas where such hazards may originate.

5. **Flooding:** 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 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.

6. **Sloping surfaces:** The site vicinity slopes developed from our LiDAR analysis range from level to well over 50-percent as shown on Figure 4, LiDAR Analysis. As shown on Figure 4, the Lot 33 site surface slopes moderately to steeply to the northwest. The average slope for the property area is calculated to be 25.6 percent, and the average slope of 21.1 percent is calculated for the Buildable Area on the site.

   The threshold gradient for slope development considerations and hillside review according to the Weber County Section 108-14-3 includes slopes greater than 25-percent (Weber County Code, 2022).

7. **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 is mapped as "Moderate" for the site included in studies by the UGS (Solomon, 1996). For new structures radon-resistant construction techniques as provided by the EPA (2016) should be considered.

Site Reconnaissance

The subdivision site was reconnoitered on July 12, 2022. The access roadways for the subdivision, Sweetwater Road and Chaparral Road, were paved and in place, as were electrical, sewer and water connections. The site is a mostly rectangular property with planform dimensions of approximately 330 feet east to west, and 196 feet north to south. From the property frontage on the west side of the Chaparral roadway, the site surface slopes moderately to steeply up the west. Vegetative cover at the site consisted of an undergrowth of tall grass, weeds, with flowering mule ear, and shrubs consisting of sage brush and Oregon grape. Isolated hawthorn, maple, and juniper trees were also dispersed across the site area. The surficial soils on the site were observed to consist of gravelly clays with tabular sub-angular cobble and boulder sized particles. Development lots adjacent to the Lot 33 property were undeveloped at the time of our site reconnaissance.

During the reconnaissance no conditions of imminent geologic hazards were observed at the site.

CONCLUSIONS

Based upon the findings of this review we believe that Lot 33 Legends at Hawkins Creek Subdivision is not adversely exposed to the geological hazards specified in the Section 108-22 Natural Hazard Areas of the Weber County Code (2022). With this finding we point out that the property is located upon Norwood Formation (**Tn**) bedrock, a unit that has a notoriety of poor stability performance and geotechnically challenging soils throughout the region.

Because groundwater and subsurface soils conditions for the site are presently unevaluated; because of the steep slopes on the property; and because the site is primarily upon Norwood Formation (**Tn**) bedrock and related soils; for building within the prescribed Building Area we <u>suggest</u> (but not require) that site specific geotechnical engineering soils and groundwater study by a licensed Geotechnical Engineer be conducted for homesite design and construction; but minimally we <u>recommend</u> (require) that a licensed Geotechnical Engineer observe the foundation excavation prior to the setting of the footings of proposed structures during commencement of construction, to confirm the suitability of the foundation soils for the proposed residence construction.

Although not addressed by the Weber County ordinances, we <u>recommend</u> that radon exposure be evaluated to determine if radon reduction measures are necessary for the new construction. It is our understanding that new construction in Ogden Valley area often includes radon remedial measures as part of final design.

LIMITATIONS

Our services were limited to the scope of work discussed in the introduction section of this report, and the Conditions specified in our (GCS) Proposal-Agreement dated June 29, 2022. The results provided by this study are limited to geological hazards included as "potential hazards" in Section 108-22 Natural Hazard Areas of the Weber County Code (2022). The reporting provided here is <u>not a geotechnical engineering study</u> based upon subsurface observations, engineering, and calculations, and should in no way preclude the results of a geotechnical engineering soils and groundwater studies for foundations, earthwork, and geoseismic design prepared by a professional engineer licensed in the State of Utah.

Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. The recommendations contained in this report are based on our site observations, available data, probabilities, and our understanding of the facilities investigated. This report was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, express or implied, is made.

This report may be used only by the client (addressee) and only for the purposes stated within a reasonable time from its issuance. The regulatory requirements and the "state of practice" can and do change from time to time, and the conclusions presented herein may not remain current. Based on the intended use of the report, or future changes to design, GCS Geoscience may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else, unless specifically agreed to in advance by GCS Geoscience in writing will release GCS Geoscience from any liability resulting from the use of this report by any unauthorized party.

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We appreciate the opportunity to work with you on this project and look forward to assisting with you in the future. If you have any questions or need additional information on this or other reporting, please contact the undersigned at (801) 745-0262 or (801) 458-0207.

Respectfully submitted,

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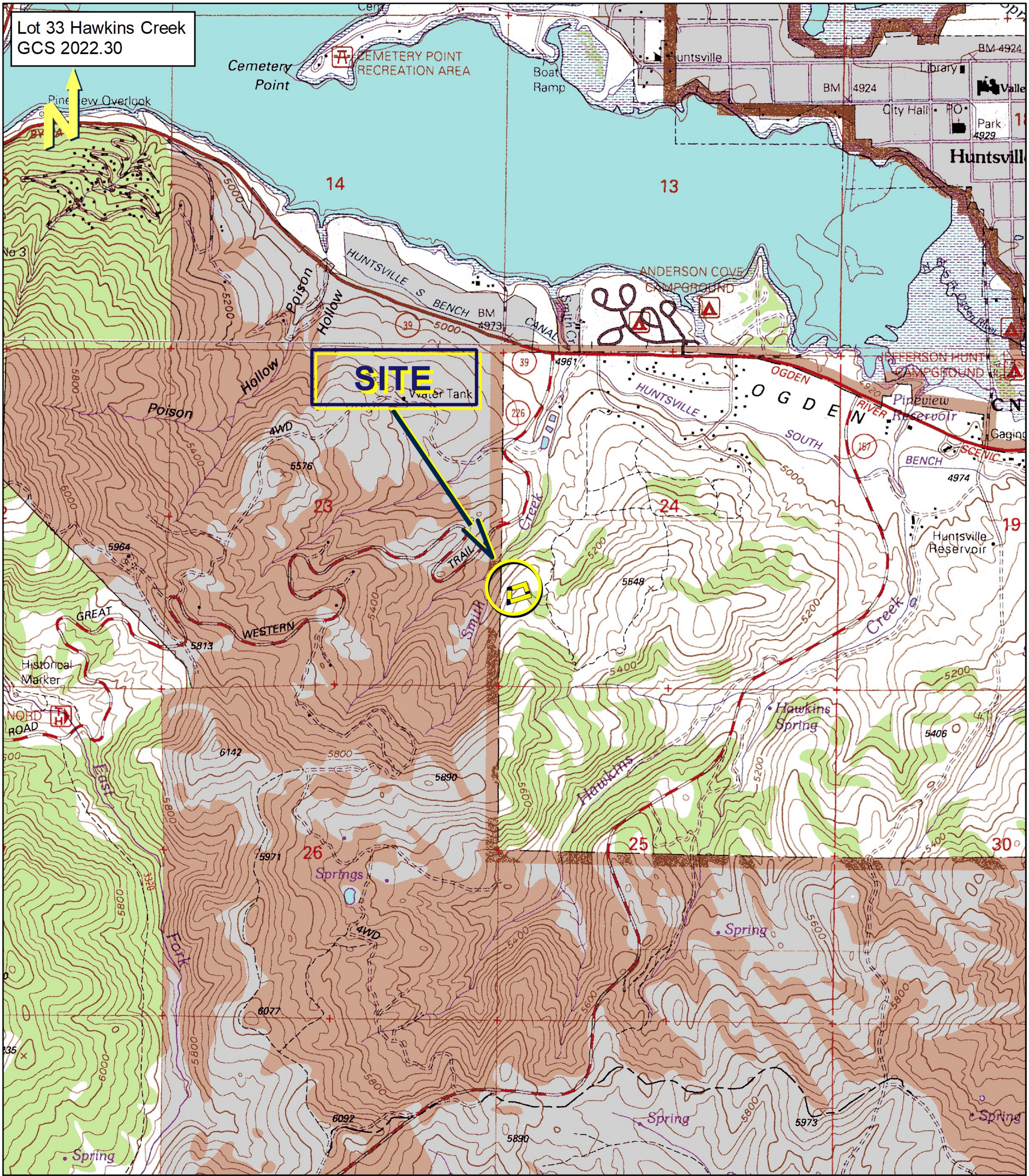
Encl. Figure 1, Site Vicinity Map
Figure 2, Aerial Coverage
Figure 3, Geologic Mapping
Figure 4, LiDAR Analysis



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

0 2000 4000 ft

1:24,000

FIGURE 1
VICINITY MAP

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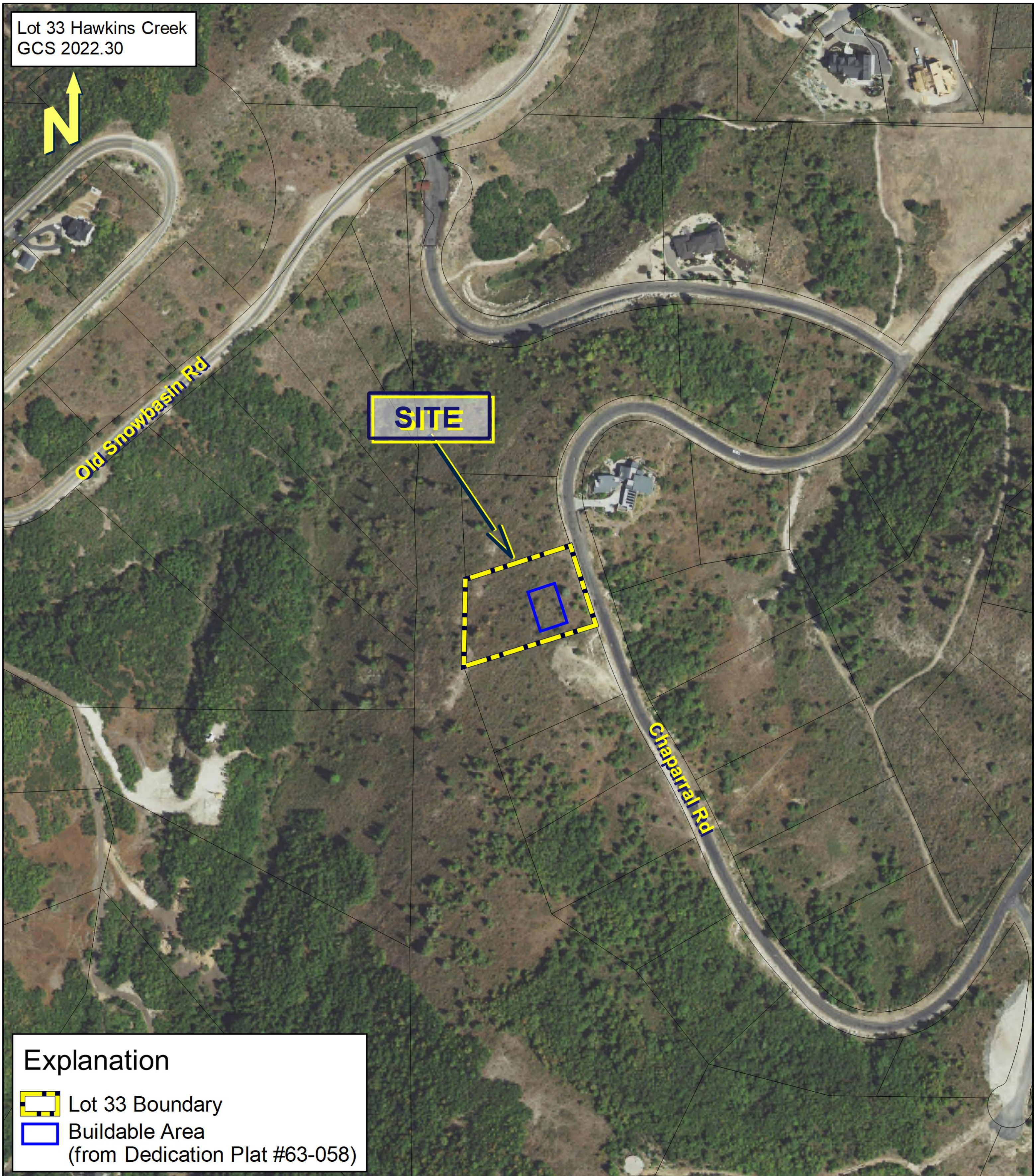

Base:
2021 6.0m NAIP Orthoimagery
from Utah UGRC; http://gis.utah.gov/

0 300 600 ft

1:3,600

FIGURE 2
AERIAL COVERAGE

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Base:
2021 6.0m NAIP Orthoimagery
from Utah UGRC; http://gis.utah.gov/

0 300 600 ft

1:3,600

Explanation

Geolopgy after King and others 2008

- Qac - Alluvium and colluvium (Holocene and Pleistocene) - Includes stream and fan alluvium, colluvium, and locally mass-movement deposits...
- Qc - Mass movement colluvial deposits (Holocene and Pleistocene) Unsorted clay- to boulder-sized material...
- Qafy – Younger alluvial-fan deposits (Holocene and Pleistocene) – Mostly sand, silt, and gravel that is poorly bedded and poorly...variably consolidated; includes debris flows...
- Qmc - Landslide and slump, and colluvial deposits, undivided (Holocene and Pleistocene)... (slopewash and soil creep)...
- Qmsy - Younger landslide and slump deposits (Holocene) - Poorly sorted clay- to boulder-sized material...
- Qms - Landslide and slump deposits (Holocene and Pleistocene) - Poorly sorted clay- to boulder-sized material...
- Qmso - Older landslide and slump deposits (Pleistocene) - Poorly sorted clay- to boulder-sized material - Qmso(Tn) where overlying Norwood Formation rocks
- Qlf/Tn - Ql/Tn - Lake Bonniville lacustrine fine grained deposits (Pleistocene) - over Norwood Formation rocks...
- Tn - Norwood Formation (lower Oligocene and upper Eocene) - Typically light-gray to light brown, altered tuff (claystone), tuffaceous siltstone, sandstone, and conglomerate...
- Lake Bonneville Shoreline

FIGURE 3
GEOLOGIC MAPPING

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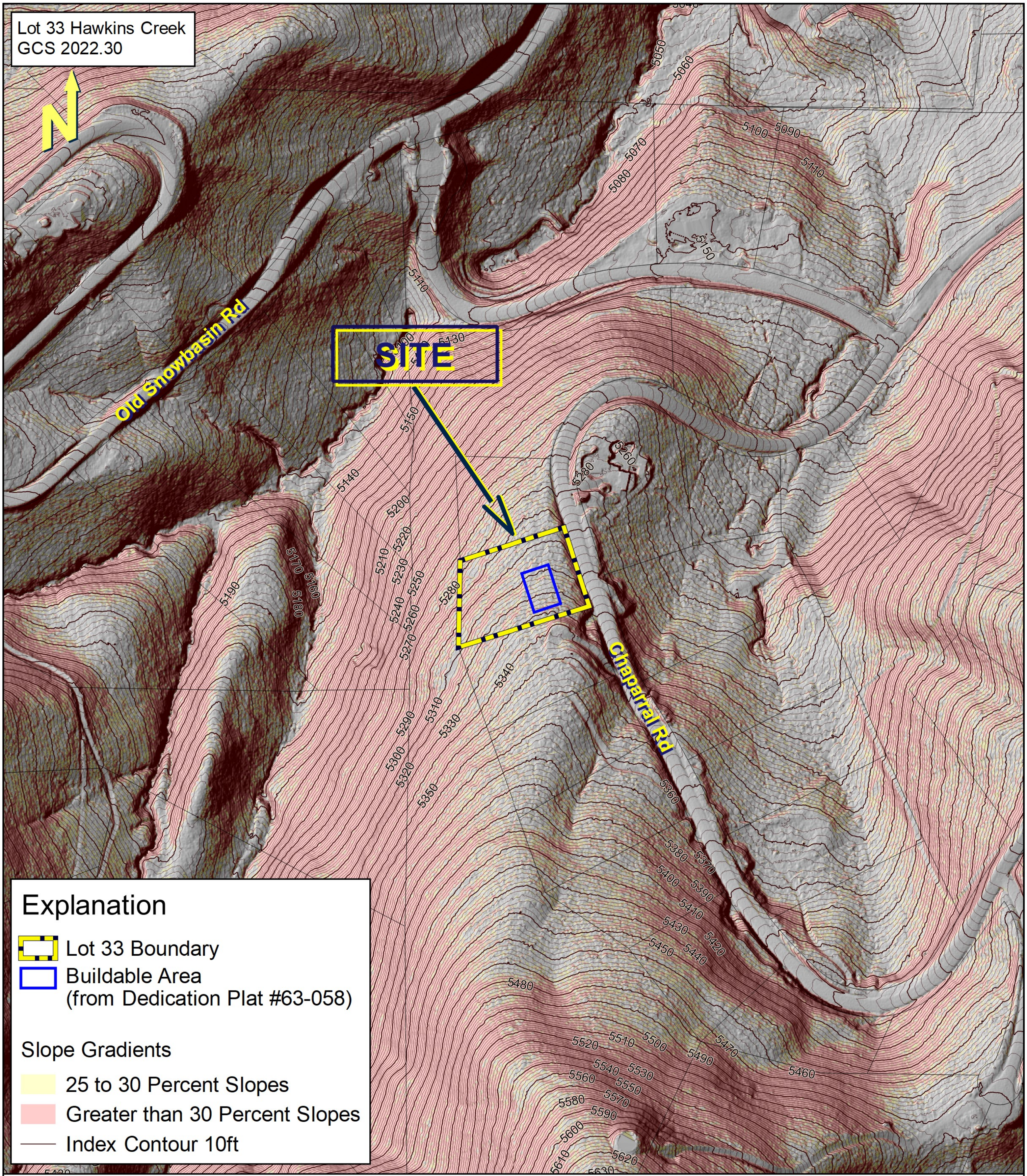

Base:
2016 0.5 m LiDAR Imagery
from Utah AGRC; http://gis.utah.gov/

0 300 600 ft

1:3,600

FIGURE 4
LiDAR ANALYSIS

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