GCS Geoscience

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File No: 2016.11 Prop.

Mr. Dennis Heiner
Sunrise Oaks Capital Fund LLC
880 South Main Street
Bountiful, Utah 84010

Re: Report
Professional Geologist Site Reconnaissance and Review
Approximately 134 Acre, Four Parcel Property
Approximately 5710 Old Snowbasin Road, Huntsville, Utah
Weber County, Utah Parcels:
#20-035-0021 - 11.62 Acres
#20-035-0059 - 1.79 Acres
#20-040-0005 - 60.01 Acres
#20-040-0006 - 60.79 Acres

Dear Mr. Heiner,

In response to your request, GCS Geoscience (GCS), has prepared this Professional Geologist site reconnaissance review report for the above referenced property.

1.0 Introduction

The 134 Acre, Four Parcel Property consists of mountainous lands located in the vicinity of Old Snowbasin Road, in the Huntsville Area of Ogden Valley in Weber County, Utah. The Site location relative to topographic and improved features as of 1991 is shown on Figure 1, Vicinity Map. The property consist of four contiguous parcels comprising a combined unit of 134 acres, and are indexed by the county as follows:

Parcel #20-035-0021 - 11.62 Acres
Parcel #20-035-0059 - 1.79 Acres
Parcel #20-040-0005 - 60.01 Acres
Parcel #20-040-0006 - 60.79 Acres

Parcel #20-035-0021 affronts Old Snowbasin road. Parcels #20-035-0021 and #20-035-0059 are located within the Weber County FV-3 Zone (Forest Valley Zone - 3), while parcels #20-040-0005 and #20-040-0006 are within the Weber County F-5 Zone (Forest Zone - 5). 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 in the FV-3 Zone is three acres. For the F-5, Forest Zone, the intent... *is to protect and preserve*

the natural environment of those areas of the county that are characterized by mountainous, forest or naturalistic land, and to permit development compatible to the preservation of these areas. The prescribed minimum building lot in the F-5 Zone is five acres. Single family dwellings and cluster subdivisions are included as premited uses in the FV-3 and F-5 zones. A larger scale photographic plan rendering of the 134 Acre, Four Parcel Property (the Site) is presented on Figure 2, Aerial Coverage.

Current development plans are not finalized for the 134 Acre, Four Parcel Property at this time, however we expect the Site will be improved to accommodate single-family homesites, and associated roadways and pavements. Site development will require a moderate to significant amount of earthwork in the form of site cutting, filling and grading. Individual homes will likely to be constructed with a basement levels supported on conventional spread and strip footings. Above grade levels will consist of wood frame construction one to three levels in height. Projected individual homesite grading is anticipated to consist primarily of cutting into the existing ground to construct the residence, with very little fill projected for the homesites.

Because the Site appears to be located on a hillslope area in the vicinity of mapped landslide hazards (Elliott and Harty, 2010), and marginal soils areas (Mulvey, 1992), Weber County will request that a geological site reconnaissance be performed to asses whether all or parts of the Site are exposed to the hazards that are included in the Weber County Code, Chapter 27, Natural Hazards Overlay District. These hazards include, but are not limited to: Surface-Fault Rupture, 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 Hillside Development Review Procedures and Standards to evaluate and/or mitigate the hazard exposure.

2.0 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 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 relevant for site specific usage. When hazard layer data on the Geo-Gizmo are found to interact with Applicant site improvement locations, Weber County Engineers and Planners will request that the Applicant have a Professional Geologist Site Reconnaissance Review, such as presented herein, conducted for the Site.

Our preliminary review of the Geo-Gizmo layers indicated that parts of the 134 Acre, Four Parcel Property was within areas classified as "Landslide" or areas preliminarily mapped as landslide hazard based upon a UGS state-wide compilation of landslide hazard areas (Elliott and Harty, 2010), and also areas classified as "*Engineering Problems"* or soils related to engineering geologic problems (Mulvey, 1992).

Our professional site specific review included a GIS data integration effort that included reviews of previous mapping and literature pertaining to Site geology including Coogan and King (2016) and King et al. (2008); an analysis of vertical and stereoscopic aerial photography for the Site including a 1946 1:20,000 stereoscopic sequence, a 2014 1.0 meter digital NAIP coverage, and a 2012 5.0 inch digital HRO coverage of the Site; and a GIS analysis using the QGIS® GIS platform to geoprocess and analyze 2011 1.0 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 used geologic mapping by King et al. (2008) which provided the most up-to-date and best scale rendering of geological mapping for the Site location, which is presented on Figure 3, Site Geology. Topographic, slope, and elevation data for this review was supported through the aforementioned LiDAR analysis which is presented on Figure 4, LiDAR/Slope Analysis.

3.0 Review Findings and Discussion

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 (King, et al., 2008), and has been measured to be as much as 7000 feet thick in the vicinity of the Site. The existing surface of the Site and vicinity appears to have been modified by

Quaternary age erosion, and localized late-Quaternary stream, residual soil weathering and development, and mass movement processes (King, et al., 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. Surface vegetation consists of open areas of grasses, weeds and sage brush with densely clustered wooded areas of scrub oak, alder, river birch and maple trees. The topography of the Site vicinity consisted of steep sloping hillsides sloping north and south off a prominent west to east ridge feature that followed the southern boundary of the Site.

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

> The **Qac** deposits consist of alluvium and colluvium that are Holocene to Pleistocene in age, deposited 0 to 15,000 years before present (ybp). These deposits are unsorted to variably sorted gravel, sand, silt, and clay in variable proportions; includes stream and fan alluvium, colluvium, and, locally, mass-movement deposits...
>
> **The Qmc deposits are l**andslide and slump, and colluvial deposits, undivided Holocene and Pleistocene in age (0 to 30,000 ybp), consisting of poorly sorted to unsorted clay- to boulder-sized material. These mapped units include smaller landslide slopes and slopes comprised of slopewash and soil-creep deposits.
>
> The **Qms**, and **Qmso** deposits include landslide and colluvial deposits associated with failed or moving slopes, Holocene and Pleistocene in age (0 to 30,000 ybp), consisting of poorly sorted to unsorted clay- to boulder-sized material. These units include slides, slumps, and locally flows and floods. **Qmso** deposits are older, likely Pleistocene in age (>30,000).
>
> The **Qms(Tn)**, **Qms?(Tn)** and **Qmso?(Tn)** deposits include landslide and colluvial deposits associated with failed or moving slopes, Holocene and Pleistocene in age (0 to 30,000 ybp), consisting of failed Norwood Formation block material. These units include slides, slumps, and locally flows and floods. **Qmso?(Tn)** deposits are older, likely Pleistocene in age (>30,000).
>
> The **Qmc, Qms, Qmso, Qms(Tn)**, **Qms?(Tn)** and **Qmso?(Tn)** classified areas shown on Figure 3 should be collectively considered Mass Movement deposits subject to landslide and/or slope-creep process hazards.
>
> The Norwood Formation, **Tn,** is a lower Oligocene and upper Eocene (20 to 30 million years ago) ash deposit that originated from regional volcanic activity. The

Norwood Formation typically consists of light-gray to light-brown altered tuff (claystone), altered tuffaceous siltstone and sandstone, and conglomerate...

4.0 Natural and Geologic Hazards

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

1. **Landsliding:** Landsliding; including mass movement mechanisms including slope creep (Varnes, 1978); would include geological units mapped as **Qmc, Qms, Qmso, Qms(Tn)**, **Qms?(Tn)** and **Qmso?(Tn)** as shown on Figure 3. These areas (units) have experienced movement within the past 30,000 years should be considered unstable or potentially unstable for future land use considerations.

2. **Alluvial fan debris flow processes** including flash flooding and debris flow hazard: The nearest alluvial fan debris flow process deposits to the Site, are mapped as **Qafy,** and occur approximately 1600 feet northeast of the Site, and are not shown on Figure 3. These deposits and the location of these potential processes do not appear to be a potential impact to the Site.

3. **Seismic Hazards - Surface fault rupture hazards, strong earthquake ground motion, 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 6.1 miles west of the Site, thus fault rupture hazards are not considered present on the Site (Black et al., 2004). The Ogden Valley southwestern margin faults (UT2375) are located much closer to the Site, approximately 3100 feet to the northwest, 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, et al., 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. The Wasatch fault zone is considered active and capable of generating earthquakes as large as magnitude 7.3 (Arabasz et al., 1992). 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.

   The a ten-percent probability of exceedance in 50 years event has a return period of 475 years, and the 0.16*g* acceleration for this event corresponds "strong" perceived shaking with "light" potential damage based on instrument

intensity correlations (Wald et al., 1999).

The two-percent probability of exceedance in 50 years event has a return period of 2475 years, and the 0.33*g* acceleration for this event corresponds "very strong" perceived shaking with "moderate" potential damage based on instrument intensity correlations (Wald et al., 1999).

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

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, et al., 1994). This phenomena is known to occur in susceptible alluvial sediments in conjunction with shallow groundwater conditions. These conditions may be present in the **Qac** deposits mapped on the northeast side of the Site, however the location and extent of these **Qac** deposits on the Site are not likely to be affected by site development improvements.

5. **Rockfall and Avalanche Hazards:** The Site is over a mile from steep slope areas where such hazards may originate.

6. **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 for this area at this time (FEMA, 2016). Local sheet flow, slope wash, and seasonally perched soil water typical of sloping areas should be anticipated for the Site, and Site improvements.

7. **Sloping Surfaces:** The surface of the Site vicinity slopes developed from our LiDAR analysis were found to range from level to well over 100-percent as shown on Figure 4, LiDAR/Slope Analysis. Slope gradient statistics for the for the four property parcels are tabulated below:

134 Acre, Four Parcel Property Sloping Surfaces Table

Parcel #	Area (Acres)	Average Slope Gradient (%)	Area Greater than 25% (Acres)
20-035-0021	11.62	18.0 %	2.3
20-035-0059	1.79	23.2%	0.9
20-040-0005	60.01	34.1%	43.5
20-040-0006	60.79	32.3%	41.5
Site Total	134	31.76%	88.2

The threshold gradient for slope development restrictions according to the Weber County **Section 108-14-3**. (Weber County Code, 2016), includes slopes greater that 25-percent.

8. **Norwood Formation (Tn):** The Norwood Formation extensively underlies the entirety of the Site, either appearing on the surface or projected to underlie the Quaternary age soils covering the surface. 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.

9. **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 mapping has been prepared for most of Ogden Valley by the Utah Geological Survey (Solomon, 1996), however that mapping does not extend far enough to the south to include the Site. The radon-hazard potential is mapped as "Moderate" for the area directly north of the site (1200 feet) included in studies by the UGS (Solomon, 1996). For new structures radon-resistant construction techniques as provided by the EPA (EPA 2016) should be considered.

5.0 Site Reconnaissance

The Site was reconnoitered on August 29, 2016. Surface vegetation was observed to consist of open areas of grasses, weeds and sage brush with densely clustered wooded areas of scrub oak, alder, river birch and maple trees. The topography of the Site vicinity consisted of steep sloping hillsides sloping north and south off a prominent

west to east ridge feature that followed the southern boundary of the Site. The Site surface was observed to consist of a range of slopes, but generally facing north, north west and north east. Exposed soils on the surface were observed to be clayey, and displayed expansion and cracking in many places. Exposed rock consisted of buff, slightly weathered, tabular siltstone, that was exposed in areas where slopes appeared to naturally oversteepened.

With the exception of a smaller A-frame cabin structure on the west side of the Site, the Site was generally unimproved. Estate homesite developments were observed on properties to the north of the Site, and open pasture lands were observed to the south of the site.

6.0 Mass Movement Hazards and Steep Slope Limitations

Figure 5, Mass Movement Hazards and Steep Slope Limitations presents the compilation of mass movement hazards areas and steep slope limitation areas (>25% slope) over the 134 Acre, Four Parcel Property. The Mass Movement Hazard Areas include the geological unit areas classified as **Qmc, Qms, Qmso, Qms(Tn)**, **Qms?(Tn)** and **Qmso?(Tn)** on Figure 3. The Steep Slope Limitation areas includes those areas calculated from the LiDAR analysis shown to be steeper than 25 percent of Figure 4. As shown on Figure 5, significant areas within the four parcels are exposed to mass movement processes and/or steep slope limitations.

7.0 Conclusions and Recommendations

The conclusions and recommendations provided as follows should be considered preliminary for planning use in site development and analysis and design.

For the landslide-mass movement hazards, the Weber County Natural Hazards Overlay **Section 104-27-2** - Potential hazards section, provides the following guidance for landslide (mass movement) hazard reduction:

> *...Where avoidance is not feasible, various engineering techniques are available to stabilize slopes, including de-watering (draining), retaining structures, piles, bridging, weighting or buttressing slopes with compacted earth fills and drainage diversion. Since every landslide and unstable slope has differing characteristics, any development proposed within a designated landslide hazard area...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.*

These guidelines should be considered a basis for landslide hazards reductions where proposed improvements will be exposed to landslide (mass movement) hazard areas as shown on Figure 5.

With respect to steep slope limitations, the excavation, grading and filling guidelines provided in **Section 108-14-8** of the Weber County Code should be followed for Site development planning and impelmentation.

For preliminary Site development guidance and planning, we recommend the following treatments be applied for site development based upon the areal classifications provided on Figure 5:

1. **Mass Movement Hazard only areas, Steep Slope Limitation only areas and Unclassified Site areas on Figure 5:** These areas should undergo the requirements of **Section 108-14 - Hillside Development Review Proceedures and Standards,** with specific attention to excavation, grading and filling guidelines provided in **Section 108-14-8.** These standards should also be supported by site specific geotechnical engineering studies including slope stability analysis as outlined by **Weber County Natural Hazards Overlay Districts - Section 104-27-2.**
2. **Combined Mass Movement and Steep Slope Limitation areas on Figure 5:** For areas that are shown on Figure 5 to be exposed to both Mass Movement Hazards and Steep Slope Limitations, we recommend that these areas be avoided with respect to structural and/or grading improvements or disturbances.

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

7.0 Limitations

Our services were limited to the scope of work discussed in the introduction section of this report. The results provided by this study include but are limited to geological hazards included as "potential hazards" in Chapter 27 of the Weber County Code. The reporting provided here is not based upon any subsurface observations, 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

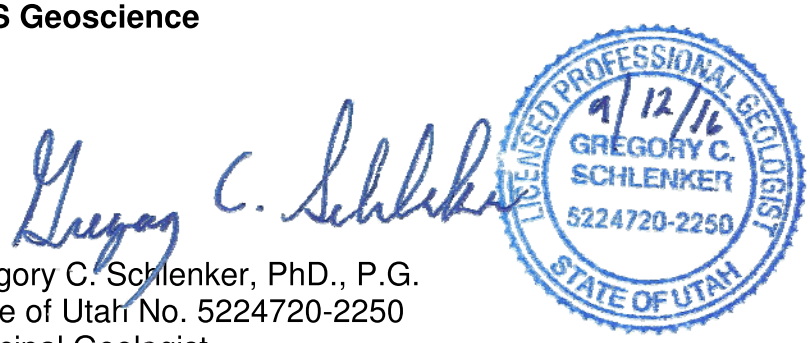
prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, express or implied, is made.

Closure

We appreciate the opportunity to work with you on this project and look forward to assisting 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,

GCS Geoscience



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Principal Geologist

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Encl. Figure 1, Site Vicinity Map
Figure 2, Aerial Coverage
Figure 3, Site Geology
Figure 4, LiDAR/Slope Analysis
Figure 5, Mass Movement Hazards and Steep Slope Limitations

References

Anderson, L.R., Keaton, J.R., and Bay, J.A., 1994, Liquefaction potential map for the northern Wasatch Front, Utah, complete technical report: Utah Geological Survey Contract Report 94-6, 150 p., 6 plates, scale 1:48,000.

Arabasz, W.J., Pechmann, J.C., and Brown, E.D., 1992, Observational seismology and the evaluation of earthquake hazards and risk in the Wasatch Front area, Utah, in Gori, P.L., and Hays, W.W., (eds.), Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah: U.S. Geological Survey Professional Paper 1500-D, 36 p.

Black, B.D., DuRoss, C.B., Hylland, M.D., McDonald, G.N., and Hecker, S., compilers, 2004, Fault number 2351e, Wasatch fault zone, Weber section, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults.

Black, B.D., Hylland, M.D., and Hecker, S., compilers, 1999, Fault number 2375, Ogden Valley southwestern margin faults, in Quaternary fault and fold database of the United States: U.S. Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults.

Bryant, B.B., 1988, Geology of the Farmington Canyon Complex, Wasatch Mountains, Utah: USGS Professional Paper 1476, 54 p., 1 scale 1:50,000

Coogan, J.C., and King, J.K., 2016, Interim geologic map of the Ogden 30' x 60' quadrangle, Box Elder, Cache, Davis, Morgan, Rich, and Summit Counties, Utah, and Uinta County, Wyoming: Utah Geological Survey Open File Report 653DM, for use at 1:62,500 scale, 3 plates, 147 p.

Elliott, A.H., and Harty, K.M., 2010, Landslide Maps of Utah, Utah Geological Survey Map 246DM, 14 p., 46 plates, 1:100,000 scale, DVD.

EPA 2016, Radon-Resistant Construction Basics and Techniques: Environmental Protection Agency website, https://www.epa.gov/radon/radon-resistant-construction-basics-and-techniques accessed 07/20/2016

FEMA, 2016, Flood Insurance Rate Map, Weber County, Utah, Panel 49057C0018F and 49057C0019F, Scale 1 inch equals 1000 feet.

GDAL-SOFTWARE-SUITE, 2013, Geospatial data abstraction library. http://www.gdal.org/

GRASS-PROJECT, 2013. Geographic resource analysis support system. http://grass.osgeo.org/.

Graham, R.C., and Southard, A.R., 1982, Genesis of a Vertisol and an Associated Mollisol in Northern Utah: Soil Science Society of America Journal, Vol. 47 no. 3, pp. 552-559.

King, J.K., Yonkee, W.A., and Coogan, J.C., 2008, Interim geologic map of the Snow Basin and part of the Huntsville quadrangle, Davis, Morgan, and Weber Counties, Utah: Utah Geological Survey Open-File Report 536, scale 1:24,000.

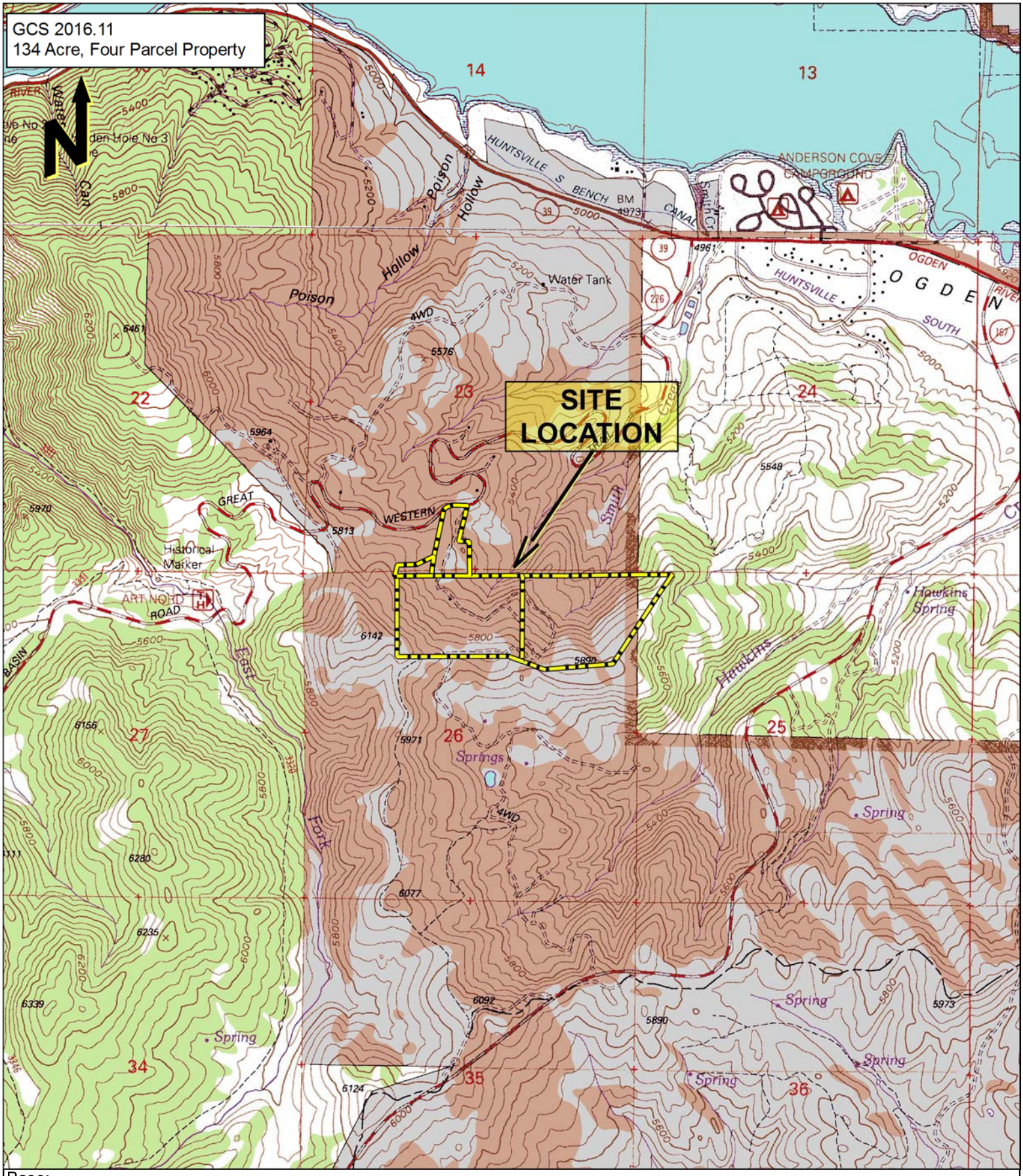
Mulvey, W.E., 1992, Soil and rock causing engineering geologic problems in Utah: Utah Geological Survey Special Study 80, 23 p., scale 1:500,000.

Petersen, M.D., Frankel, A.D., Harmsen, S.C., Mueller, S.C., Haller, K.M., Wheeler, R.L., Wesson, R.L., Zeng, Y., Boyd, O.S., Perkins, D.M., Luco, N., Field, E.H., Wills, C.J., and Rukstales, K.S. (2008). "Documentation for the 2008 Update of the United States National Seismic Hazard Maps", USGS Open-File Report 2008-1128, 128p.

Varnes, D.J., 1978, Slope movement types and processes, in Schuster, R.L., and Krizek, R.J., eds., Landslides—Analysis and control: National Research Council, Washington, D.C., Transportation Research Board, Special Report 176, p. 11–33

Wald, D.J., Quitoriano, V., Heaton, T.H., and Kanamori, H., 1999, Relationship between Peak Ground Acceleration, Peak Ground Velocity, and Modified Mercalli Intensity in California: Earthquake Spectra, v. 15, no. 3, p. 557-564

Weber County Code (2016), retrieved from: https://www.municode.com/library/ut/weber_county/codes/code_of_ordinances?nodeId=PTIILAUSCO_TIT108ST_CH14HIDEREPRST_S108-14-3AP.



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

0 1000 2000 3000 ft

1:24,000

FIGURE 1
SITE VICINITY MAP

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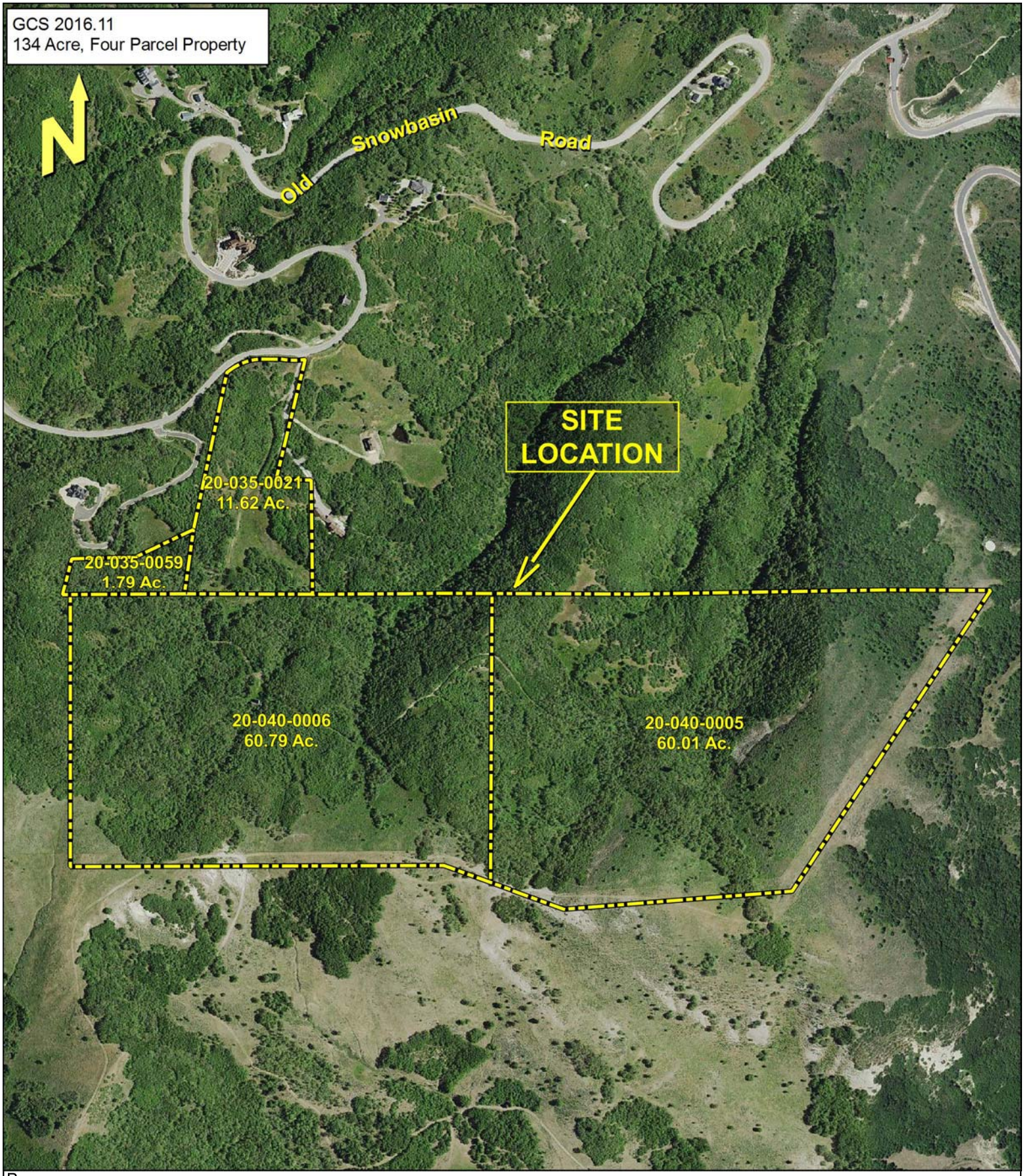

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from Utah AGRC; http://gis.utah.gov/
Boundaries from Utah AGRC SGID -
http://gis.utah.gov/data/sgid-cadastre/parcels/

0 300 600 900 ft

1:7,200

FIGURE 2
AERIAL COVERAGE

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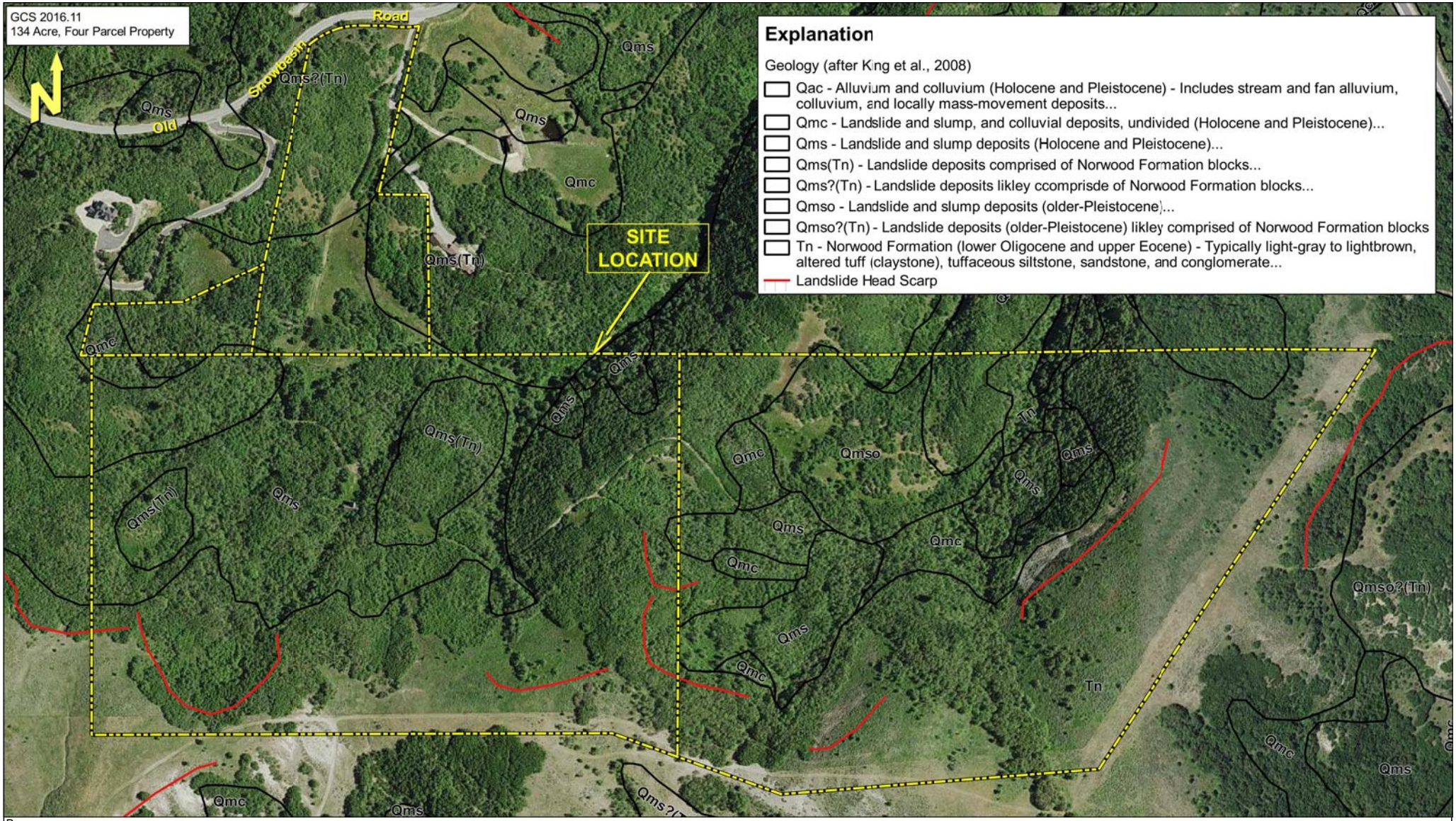

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FIGURE 3
SITE GEOLOGY

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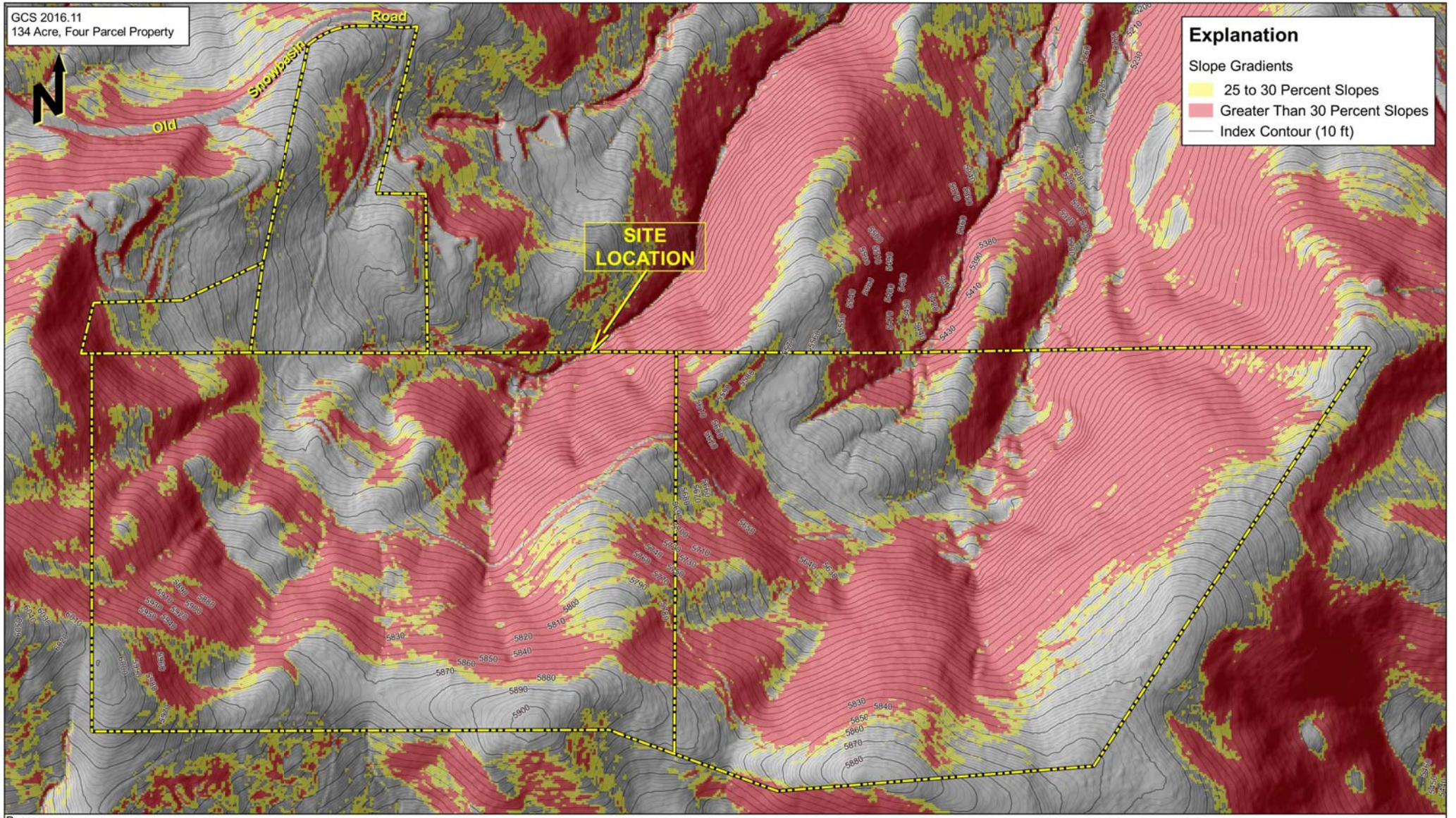

Base:
2011 1.0m LiDAR Imagery
from Utah AGRC; http://gis.utah.gov/

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1:3,600

FIGURE 4
LiDAR/SLOPE ANALYSIS
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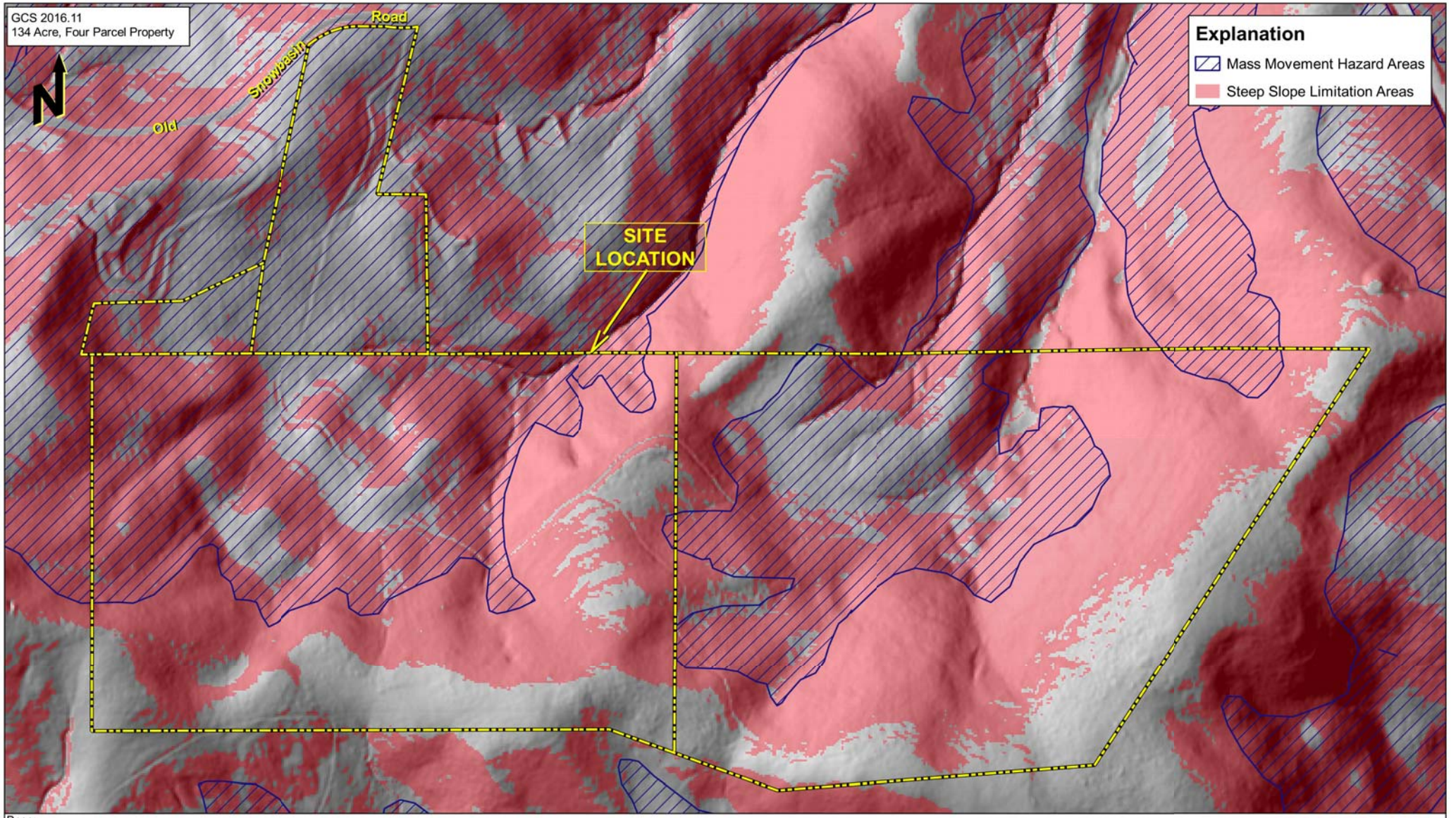

FIGURE 5
MASS MOVEMENT HAZARDS
AND STEEP SLOPE LIMITATIONS

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