# GCS Geoscience

**Report Professional Geologist Site Reconnaissance and Review**
**1.02-Acre Parcel #23-051-0022**
**Sunridge Subdivision No. 2 Lot 38**
**11764 East Creek Road**
**Huntsville, Utah 84317**

For:

Nathan Walker
PO Box 183
Bear River City, Utah
84301

By:

GCS Geoscience
554 South 7700 East Street
Huntsville, Utah 84317

September 28, 2023
GCS File No: 2023.29

# GCS Geoscience

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File No: 2023.29

Nathan Walker
PO Box 183
Bear River City, Utah
84301

**Attention:** Nathan Walker

**Subject:** **Report**
**Professional Geologist Site Reconnaissance and Review**
**1.02-Acre Parcel #23-051-0022**
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**Huntsville, Utah 84317**

## INTRODUCTION

In response to your request, GCS Geoscience (GCS), has prepared this Professional Geologist site reconnaissance review report for the above referenced property. The subject parcel consists of an approximately 1.02-acre property located in the Middle Fork 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.

The property is presently undeveloped, and is part of the Sunridge Subdivision No. 2 Subdivision which is a Cluster Summer Home Subdivision type project, that includes 22 homesite lots each an acre or more in area, and open space common areas. The subject parcel and surrounding properties are zoned by Weber County as Forest Zone F-10 Zone (Forest Zone - 10) land-use zone. According to the Weber County Code of Ordinances the intent of the forest zones 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 area in the F-10 Zone is 10 acres (excluding cluster provisions), with single family residences included as a permitted use.

It is our understanding that you intend to construct an addition to an existing cabin structure on the site. We expect that the proposed construction will be supported on helical pier footings, as is the existing cabin structure. Above grade levels will consist of wood frame construction one to two levels in height. Projected site grading is anticipated to consist of minimal cutting into the existing ground to construct the residence, with very little fill projected for the site development.

Because the proposed site appears to be located in part on a hillslope area in the vicinity of mapped landslide hazards, marginal soils, and FEMA floodplain areas, Weber County will request 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 before a building permit will be issued. 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.

The objectives and scope of this study were presented to Nathan Walker (**Client**) in our (GCS) Proposal-Agreement dated September 7, 2023, and was signed September 8, 2023 by Nathan Walker.

## 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 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 38 site was within an area classified as *"landslide- undifferentiated*" hazard according the UGS landslide database (Elliott and Harty, 2010). The location did not show exposure to the other aforementioned hazard area layers, including; *Engineering Problems* (Mulvey, 1992), *Quaternary Faults* (USGS and UGS, 2006), and *FEMA Flood Zone* (FEMA, 2015).

The Weber County Geologic Map shows the site is underlain by (**Qms**) Mass movement deposits, which are geologic units that have been determined by Weber County as requiring hazard studies.

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

1. Reviews of previous mapping and literature pertaining to site geology including Coogan and King (2015), and Coogan and King (2016).

2. An analysis of vertical and stereoscopic aerial photography for the site including 1947 1:20,000 stereoscopic sequences, a 2018 0.6-meter digital NAIP orthoimagery coverage, and a 2006 12-inch digital HRO orthoimagery coverage of the site;

3. A GIS analysis using the QGIS® GIS platform to geoprocess and analyze 5.0 Meter Auto-Correlated DEM (digital elevation data) developed from 1.0-meter 2006 NAIP Orthophotography DEM (digital elevation model) data made available for the site by the Utah Geospatial Resource Center (UGRC). 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 site-specific documentation for this review we relied on geologic mapping by Coogan and King (2015), and Coogan and King (2016). The geological mapping for this review is as taken from Coogan and King (2016), and is provided on Figure 3, Geologic Mapping. Topographic, slope, and elevation data for this review was supported through the aforementioned DEM analysis which is presented on Figure 4, DEM Analysis.

## REVIEW FINDINGS

The site is located on the southern end of the Bear River Range of Utah and Idaho, which is a mountain system that is flanked on its eastern side by the Monte Cristo Range and on the west by Ogden Valley (Avery, 1994). In the vicinity of the site, the range is a plateau structure which formed by the eastward extension of the Willard Thrust sheet, which is believed to have moved onto the vicinity during the Cretaceous Sevier orogeny, approximately 140 million years ago (ma). The thrust sheet rocks consist of older Paleozoic aged rocks (500-350 ma) that have experienced significant folding and faulting, and are now covered by more gently folded to horizontal bedded Tertiary aged (65-35 ma) rocks at the surface (Coogan and King, 2015). Regional uplift during the Laramide orogeny between 70 ma and 40 ma gave rise to the area, which subsequently has been modified by Quaternary age landscape incision and erosion; and localized late-Quaternary stream deposition, residual soil weathering and development, and mass movement processes on the surface (Coogan and King, 2015; and Coogan and King, 2016).

Topographically the site is located on gently southeast dipping slopes near the headwaters of Middle Fork of the Ogden River with the eastern (Right Fork) passing approximately 500 feet west of the site. From the site vicinity, the Middle Fork of the Ogden River system drains to the south and west, terminating at Pineview Reservoir approximately 9.5 miles downstream of the site. The topography of the site and vicinity consists of gently sloping plateau surfaces surrounded by steeply incised drainages. The site located on a plateau side-slope, west facing, and sloping downward to the Right Fork drainageway. The elevation of the site is between 6804 feet on the west side of the property, and 6850 feet on the east side of the property. Slope mapping on Figure 4, illustrates the slope conditions and topographic relief on the site, and shows that property is situated primarily on a gentle to moderate slope, that drops downward to the west toward the Right Fork drainageway which drains to the south into the Middle Fork River.

### Geological Mapping

Figure 3, Geologic Mapping, shows the location of the site relative to prepared GIS overlays including geological mapping prepared by Coogan and King (2016). A summary of the geological mapping units of the site vicinity is provided as follows, and is ordered relative youngest to oldest in age:

> **Qac -** Alluvial and colluvial deposits, Holocene and Pleistocene. Unsorted to variably sorted gravel, sand, silt, and clay in variable proportions; typically mapped along smaller drainages that lack flat bottoms; includes stream and fan alluvium...
>
> **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;...

**Qmc -** Mass-movement and colluvial deposits, undivided (Holocene and Pleistocene) - Mapped where landslides, slumps, and flows are difficult to distinguish from colluvium (slopewash and soil creep)...

**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...

**Qao -** Older alluvium (mostly upper Pleistocene) – Sand, silt, clay, and gravel above and likely older than the Bonneville shoreline; mapped on surfaces above Lake Bonneville-age alluvium…

**Qaoe? -** Older eroded alluvium (middle and lower Pleistocene) – Eroded alluvium located above Bonneville shoreline…mostly sand, silt, and gravel in stream and alluvial fan deposits...

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

**Cgcu -** Geertsen Canyon Quartzite (Middle and Lower Cambrian and possibly Neoproterozoic) - Upper part in west – Mostly buff quartzite with pebble conglomerate beds increasing downward; colors vary from tan and light to medium gray, with pinkish, orangish, reddish, and purplish hues interbedded micaceous argillite and quartzite common…

The geological unit mapped as underlying the subject site, and the proposed construction location is classified as Holocene and Pleistocene Landslide deposits (**Qms**).

## Site Engineering Geology

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

1. **Landsliding:** Mass-movement Landslide deposits (Holocene and Pleistocene) mapped as **Qms** on Figure 3, are shown as covering the entirety of the site and proposed building area. Based on our aerial photography and DEM terrain analyses, our field observations, and landslide age classification criteria developed by McCalpin, (1984), we assess that he landslide unit underlying the subject property, is relatively old and presently inactive. On the basis of time dependent morphological indices, including the smoothing of surface features, surface drainage development, vegetation coverage as outlined by McCalpin, (1984), we estimate the **Qms** unit underlying the subject property to be at least

10,000 years, or more since the unit was active, and we assess the this unit is presently not an active hazard.

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 **Qmdf** (Coogan and King, 2016) and occur approximately 900 feet southwest as shown on Figure 3. These deposits and the location of these potential processes are down-gradient of the site and 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 14.2 miles west of the site, thus fault rupture hazards are not considered present on the site (Black and others, 2004). The East Cache fault zone, southern section (UT2352c) faults are located closer to the site, trending approximately 6.5 miles to the northwest, however the most recent movement along this fault is estimated to be pre-Holocene (<130,000 ybp), and presently is not considered an active risk to the site (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 region as well as the site. 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 0.15*g,* and for a two-percent probability of exceedance in 50 years is as high as 0.32*g* for the site.

The a ten-percent probability of exceedance in 50 years event has a return period of 475 years, and the 0.15*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 0.33*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 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 in detail for the eastern Weber County area, as has occurred in other parts of northern Utah (Anderson, and others, 1994). This phenomenon is known to occur in susceptible alluvial sediments in conjunction with shallow groundwater conditions, however these conditions do not appear to be present on the site.

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

5. **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 (*not printed*) 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 surface of the site vicinity slopes developed from our DEM analysis were found to range from level to over 30-percent as shown on Figure 4, DEM Analysis. From our GIS-DEM analysis, the average slope gradients for the 1.02-acre property area are calculated to be 17.2 percent, and 16.8 percent for the proposed construction location. The threshold gradient for slope development considerations and hillside review according to the Weber County Section 108-14-3 includes slopes greater that 25-percent (Weber County Code, 2023).

## Site Reconnaissance

The site was reconnoitered on September 23, 2023. The site is accessed from the south by the unpaved gravel graded Creek Road roadway. Surface vegetation on the site was observed to consist of open areas of grasses, weeds and sage brush, but predominantly wooded with maple, oak and aspen trees, with an understory cover of Oregon grape brush. The topography of the site and vicinity was observed to consist of a gently down to the west sloping surface. A gravel driveway has been established connecting with Creek Road to an RV pad area, with the building area directly east of the pad, located as shown as Proposed Construction on Figure 2. The exposed soils on the surface were observed to be sandy silts and sands, with trace gravel, and few cobbles and boulders. At the time of our reconnaissance the existing structure

consisted of an unfinished approximately 200-square-foot wood-frame structure supported upon a helical pier system. It is our understanding you will be extending the existing structure on the south side of the existing structure, and the new construction will be located as shown as Proposed Construction on Figure 2. We also understand that you will be using a helical pier system to support the new construction. During the reconnaissance no geologically hazardous conditions were observed on the site.

## CONCLUSIONS

Based upon the findings of this review we believe that the 1.02-acre parcel, Lot 38 in Sunridge Highlands No. 8, and specifically the proposed residence location as shown on Figure 2, is not adversely exposed to the geological hazards specified in Chapter 22 of the Weber County Code.

Because groundwater and subsurface soils conditions for the development lots is presently undefined, we suggest, but not require, that a licensed Geotechnical Engineer conduct a site-specific geotechnical engineering soils and groundwater evaluation for homesite design and construction. Because you will be using a helical pier system for the new construction, and no excavations are planned for the construction, we suggest that you retain an installation report from the helical pier installation contractor for engineering review.

## 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 September 7, 2023. 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 (2023). The reporting provided here is not a geotechnical engineering study based upon subsurface observations, engineering, soils sampling and analysis, 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 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.

## REFERENCES


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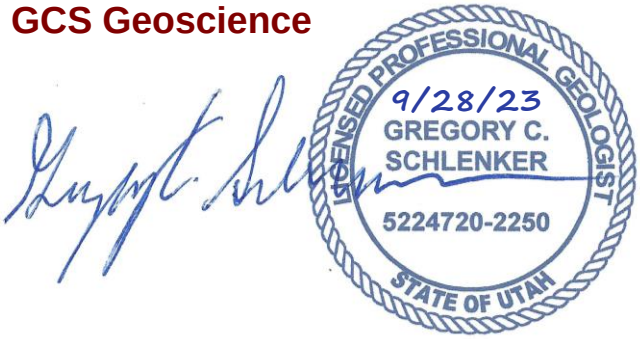
## CLOSING

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




Gregory C. Schlenker, PhD., P.G.
State of Utah No. 5224720-2250
Principal Geologist

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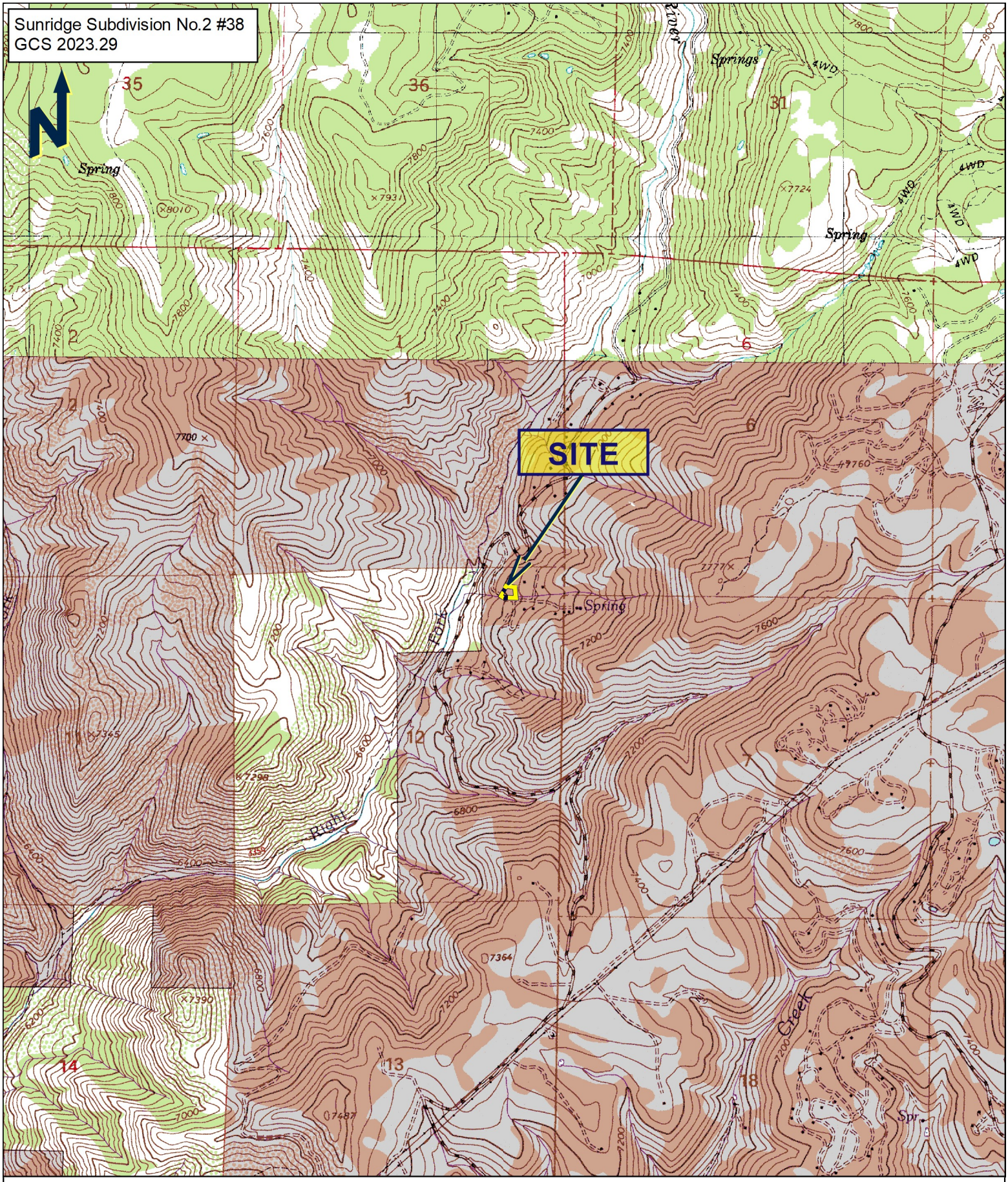
Encl. Figure 1, Vicinity Map
Figure 2, Aerial Coverage
Figure 3, Geologic Mapping
Figure 4, DEM Analysis




Base:
USGS 7.5 Minute topographic maps titled "Sharp Mountain, Utah 1991" and "Browns Hole, UT 1998" from Utah UGRC; http://gis.utah.gov/

0 2000 4000 ft

1:24,000

**FIGURE 1**
**VICINITY MAP**

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Base:
2021 0.6m NAIP Color Orthoimagery,
from Utah UGRC; http://gis.utah.gov/

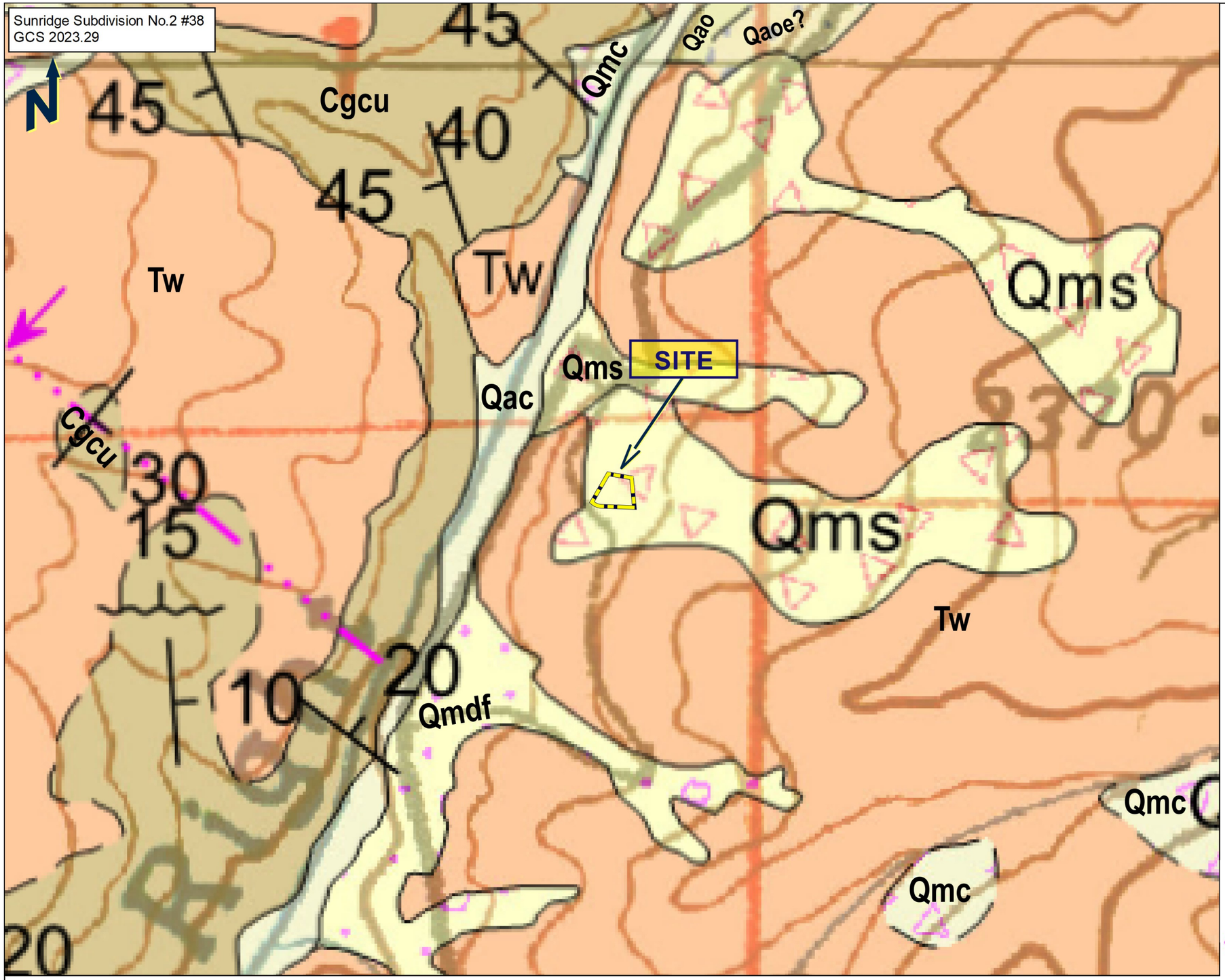
0 200 400 ft

1:2,400

**FIGURE 2**
**AERIAL COVERAGE**

**GCS Geoscience**

Sunridge Subdivision No.2 #38
GCS 2023.29




Base:
Coogan and King, 2016

0 600 1200 ft

1:7,200

## Explanation

(from Coogan and King, 2016)

**Qac -** Alluvial and colluvial deposits, Holocene and Pleistocene. Unsorted to variably sorted gravel, sand, silt, and clay in variable proportions; typically mapped along smaller drainages that lack flat bottoms; includes stream and fan alluvium...

**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;...

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**Qaoe? -** Older eroded alluvium (middle and lower Pleistocene) – Eroded alluvium located above Bonneville shoreline…mostly sand, silt, and gravel in stream and alluvial fan deposits...

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

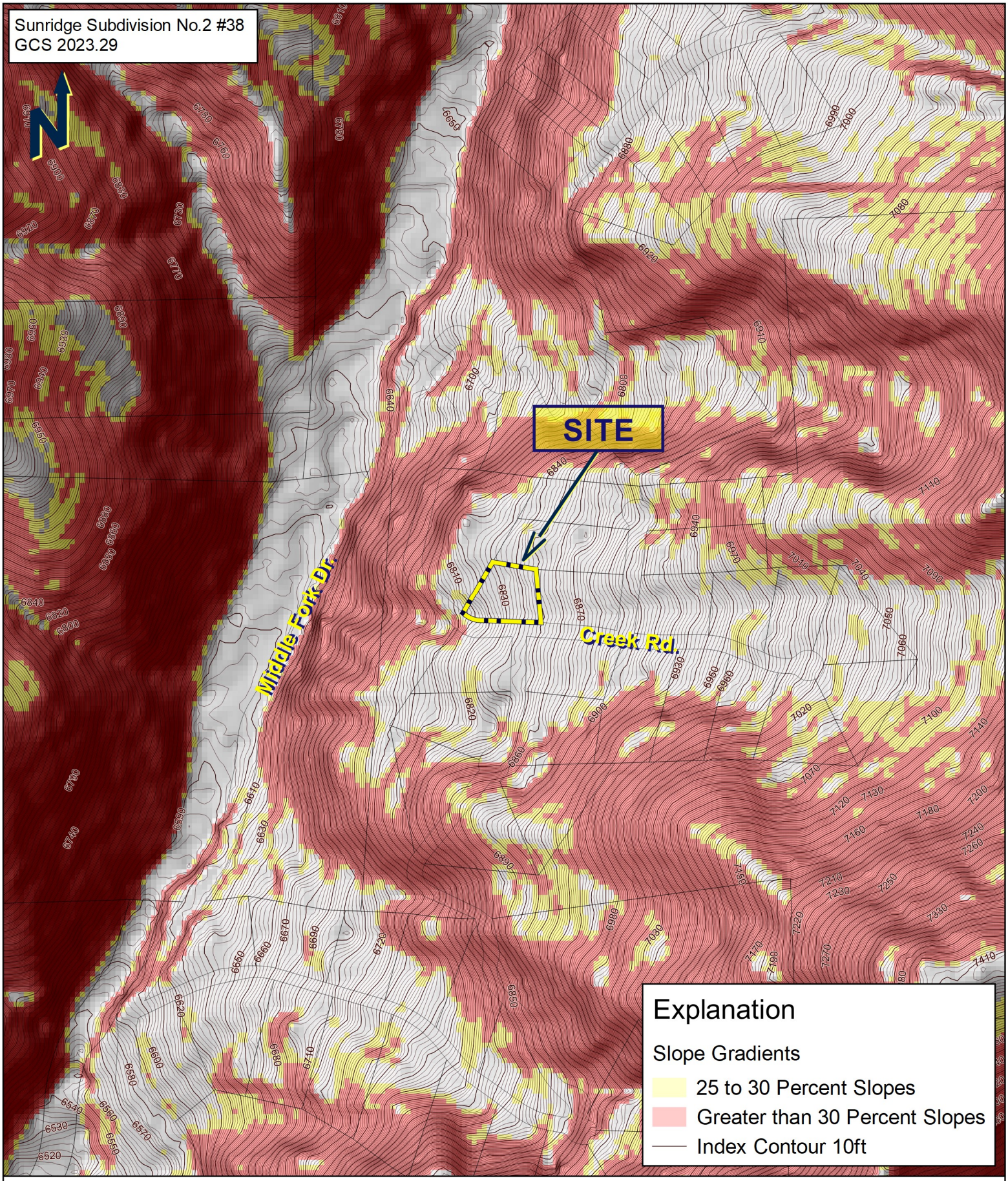
**Cgcu -** Geertsen Canyon Quartzite (Middle and Lower Cambrian and possibly Neoproterozoic) - Upper part in west – Mostly buff quartzite with pebble conglomerate beds increasing downward; colors vary from tan and light to medium gray, with pinkish, orangish, reddish, and purplish hues interbedded micaceous argillite and quartzite common…

**Strike and Dip -** strike and dip of beds

**Syncline -** upright, concealed

**FIGURE 3**
**GEOLOGIC MAPPING**

**GCS Geoscience**




Base:
2006 5 Meter Auto-Correlated DEM from 1m GSD Orthophotography from Utah AGRC; http://gis.utah.gov/

0 400 800 ft

1:4,800

**FIGURE 4**
**DEM ANALYSIS**

**GCS Geoscience**