Simon Associates LLC
geologic & environmental consultants

1981 East Curtis Drive
Salt Lake City, Utah 84121
801.718.2231

February 2, 2018

Ryan Wadman
230 W. 1975 North Street
Harrisville, Utah 84414

Subject: **Geologic Reconnaissance**
Wadman Subdivision Phase 1
Part of the West 1/2 of the Southeast 1/4 of Section 1, T7N, R1W.
Approximately 6089 N. 2250 East Street, Liberty, Utah
Weber County Parcel No: 16-003-0036
SA Project No: 18-283

Dear Mr. Wadman,

This report presents the findings of a geologic reconnaissance, performed by Simon Associates (SA), for the 3± acre parcel at approximately 6089 N. 2250 East Street in Liberty, Utah. As shown on Figure 1, Location Map, the parcel is on the southwest side of 2250 East Street about 1200 feet southeast of 6225 North Street. The property is in Section 1, Township 7N, Range 1W, at geographic coordinates 41.3684°N latitude, 111.8982°W longitude. General topographic conditions are shown on Figure 2, Topographic Map. The Wadman Subdivision Phase I Plat map is presented on Figure 3.

Based on our discussions, we understand the 3-acre parcel will be subdivided from a 14-acre parcel for purposes of the construction of a single-family residential dwelling. The purpose of the geologic reconnaissance is to:

1. Evaluate general geologic conditions at the Property.

2. Qualitatively assess the susceptibility (i.e., relative risk), of the property to the following geologic hazards: landslides, debris flows, rockfalls, and surface-fault-rupture.

3. Provide recommendations for additional site-specific studies if deemed appropriate.

A geologic reconnaissance is a limited evaluation of geologic conditions of a site, based on review of designated documents and observations of geologic site conditions on the date indicated. The geologic reconnaissance did not include subsurface exploration, soil sampling, laboratory testing, surveying, or geotechnical engineering analyses.

The Weber County Assessor's Office did not indicate an address for the 14-acre parcel and designated the 14-acre parcel as Weber County Parcel No. 16-003-0036.

Scope of Work

The scope of work performed for the geologic reconnaissance included:

1. Review of available published geologic reports and maps: Readily available pertinent geologic literature of the area were reviewed (see References Cited).

2. Interpretation of stereo-paired aerial photographs and lidar Imagery: Readily available stereo-paired aerial photographs (see References Cited) and lidar imagery (OpenTopography, 2018), were evaluated for geomorphic features indicative of geologic hazards which could adversely impact the property.

   Lidar (an acronym for Light Imaging, Detection, and Ranging) is a surveying method that measures distance to a target by illuminating the target with a pulsed laser light and measuring the reflected pulses with a sensor. Lidar is commonly used to make digital 3D-representations of the surface of the earth without vegetation ("bare-earth"). A lidar image of the property is shown on Figure 4, Lidar Image.

3. Site Reconnaissance: Mr. David Simon, a Utah licensed professional geologist, visited the property on January 16, 2018, to evaluate general geologic conditions within and/or immediately adjacent to the Property. The weather was clear with temperatures about 32 degrees Fahrenheit. About 3 to 6 inches of snow covered all portions of the property, obscuring SA's view of the ground. Based on information obtained from published geologic reports/maps, stereo-paired aerial photographs, and lidar imagery, this limitation is not expected to alter the overall findings of this assessment.

4. Geologic Analyses and Report: Data obtained from the previous tasks were evaluated and this report prepared to present the findings developed during the reconnaissance.

Site Conditions

The property was vacant and undeveloped at the time of the site reconnaissance. Review of historical aerial photographs indicate the property has been vacant since at least 1963 and possibly used for periodic agricultural purposes. An aerial photograph of the property is shown on Figure 5, Aerial Photograph.

Access to the property is via a gate from the southwest side of 2250 East Street. Elevation of the Property is about 5,330 feet (above mean sea level) and the parcel slopes downward to the southeast at a gradient of about 3 percent. Based on the site reconnaissance and review of aerial photographs, the parcel appeared to be sparsely vegetated with native grasses, likely dormant during the winter months.

The parcel is bordered by:

1. Northeast: 2250 East Street, beyond which are developed and undeveloped residential properties.

2. Southeast: Developed and undeveloped residential properties.

3. Southwest and northwest: Undeveloped properties.

Photographs of the Property at the time of the site reconnaissance are presented on Figures 6 and 7, Site Photographs.

General Geology Conditions

General geology of the site is shown in Figure 8, General Geologic Map. An explanation for the geologic units and symbols in Figure 8 are presented in Figure 9, Legend for General Geologic Map. According to Coogan and King (2016), the Property is underlain by older alluvium (mostly upper Pleistocene-age) (geologic unit Qao on Figure 8). Coogan and King (2016) describe this geologic unit as follows:

Sand, silt, clay, and gravel above and likely older than the Bonneville shoreline; mapped on surfaces above Lake Bonneville-age alluvium (Qap, Qab, Qapb); deposits lack fan shape (Qaf) and are distinguished from terraces (Qat) based on upper surface sloping toward adjacent streams from sides of drainage; also shown where areas of fans and terraces are too small to show separately at map scale; composition depends on source area; at least locally up to 110 feet (34 m) thick. Older alluvium is likely older than Lake Bonneville and the same age as Qafo, so likely Bull Lake age, 95,000 to 130,000 years old.

During the site reconnaissance, scattered rock fragments up to 12-inches in length of quartzite were observed on the ground surface.

Geologic Hazards

1. Debris flow susceptibility: Review of topographic maps, aerial photographs, lidar imagery, and surface observations did not identify features indicative of debris flow deposits, e.g., flow levees, lobate deposits, convex surface morphology, mud coatings on boulders and vegetation, damage to vegetation, etc.

   Coogan and King (2016) indicate, and our field observations confirm, the Property is underlain by alluvial sediments. Due to incision (erosion) within Cold Canyon north of the Property and a minor, unnamed drainage and Cobble Creek south of the Property (see Figure 2), the land surface occupied by the Property is no longer receiving alluvial sediments. Based on these data, we deem the debris flow hazard at the Property to be low.

2. Collapsible soils: Alluvial deposits are characteristically associated with collapsible soils. Collapsible soils are unsaturated soils (generally silts and clays) that can withstand relatively high pressure (e.g., structural loads) without showing significant change in volume; however, upon wetting (e.g., precipitation, snowmelt, landscape irrigation, etc.), are susceptible to a large and sudden reduction in volume (e.g., collapse), potentially resulting in damage to structures.

   The presence of collapsible soils could add to foundation costs, depending on the depth of the collapsible soils. Only proper soil sampling and laboratory testing by a qualified geotechnical engineering firm can determine the collapse potential of soils. We recommend consultation with a geotechnical engineer, prior to design

and construction of structures on the Property, regarding the presence of collapsible soils and to obtain appropriate foundation recommendations for proposed structures. A copy of this report should be provided to the geotechnical engineer.

3. *Surface-fault-rupture*:[1] There are no know faults passing through, or projecting towards, the Property (Coogan and King 2016; UGS, 2018a). The nearest documented Holocene-age fault[2] is the Weber segment of the Wasatch fault zone, located about 5 miles to the west (UGS, 2018a).

   Review of topographic maps, aerial photographs, lidar imagery, and surface observations did not identify fault-related geomorphic features indicative of past surface faulting at or near the Property (e.g., fault scarps, vegetation lineaments, gullies, vegetation/soil contrasts, aligned springs and seeps, sag ponds, aligned or disrupted drainages, faceted spurs, grabens, and/or displaced landforms such as terraces, shorelines, geologic units, etc.). Based on these data, we judge the surface-fault-rupture hazard at the site to be low.

   Coogan and King (2016) indicate a "dotted" fault immediately southwest of the Property. A dotted fault indicates the particular fault is concealed (e.g., buried) by younger deposits, which in this case implies the "dotted" fault is buried by Pleistocene-age alluvial deposits. Upon review of Coogan and King (2016), SA could not determine the basis for the concealed fault and contacted Mr. Jon King for clarification. Mr. King indicated, based on additional work in the area after publication of Coogan and King (2016), the fault immediately south of the property will be removed on subsequent versions of the geologic map of the Ogden 30' x 60' Quadrangle (Jon King, written communication, January 31, 2018; Jon King email/map to SA attached).

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[1] Surface faulting: displacement that reaches the earth's surface during slip along a fault. Commonly occurs with shallow earthquakes, those with an epicenter less than 20 km (USGS, 2016).

[2] Section 101-1-7 of the Weber County Municipal Code (Weber County, 2014), defines an active fault as "... a seismic (earthquake) fault displaying evidence of surface displacement along one or more of its traces during Holocene time (approximately 10,000 years)."

The Property is, however, in a seismically active region. Ground shaking resulting from earthquakes associated with nearby and distant faults will occur. During the life of the project, seismic activity associated with active faults in the area has the potential to generate moderate to strong ground shaking at the site.

4. *Landslide susceptibility*:[3] The Property is not located within a known or documented landslide (Harty, K.M., 1992; Giraud and Shaw, 2007; Elliott and Harty, 2010; Coogan and King, 2016).

   Review of topographic maps, aerial photographs, lidar imagery, and surface observations did not identify features indicative of landslides on the Property, e.g., hummocky and stair-step terrain, grabens, head-scarps, pressure ridges, displaced landforms, lobate deposits, convex surface morphology, etc.

5. *Rockfall*:[4] The property is not located at the base of a rock and/or talus slope (such slopes can be susceptible to rockfalls); therefore, rockfall susceptibility is considered low.

Conclusions

Based on the scope of work performed for the geologic reconnaissance we conclude:

1. The Property is suitable for the proposed subdivision and residential development described herein, from a geologic hazard perspective, provided the recommendations presented herein are considered in design and construction of the project.

2. The Property is underlain by Pleistocene-age alluvial sediments.

3. Susceptibility of the Property to be impacted by the following geologic hazards is considered low: landslides, debris flows, rock falls, and surface-fault-rupture.

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[3] Landslide: general term covering a wide variety of mass-movement landforms and processes involving the downslope transport, under gravitational influence, of soil and rock material en masse (AGI, 2011).

[4] Rockfall: the relatively free falling or precipitous movement of a newly detached segment of bedrock (usually massive, homogeneous, or jointed) of any size from a cliff or other very steep slope (AGI, 2011).

4. The Property is in a seismically active region. Ground shaking resulting from earthquakes associated with nearby and distant faults will occur. During the life of the project, seismic activity associated with active faults in the area has the potential to generate moderate to strong ground shaking at the site.

Recommendations

Based on the findings of this assessment SA recommends:

1. A soil and foundation investigation be performed by a qualified geotechnical engineering firm prior to design and construction of structures on the property, particularly structures intended for human occupancy. The Property is underlain by alluvial sediments. Alluvial deposits are characteristically associated with collapsible soils. Collapsible soils are subject to changes in volume and settlement in response to wetting and drying, often resulting in severe damage to structures. The soil and foundation study should also include evaluation of subsurface soils for the presence of collapsible soils.

2. A qualified avalanche Consultant be retained to confirm the avalanche[5] susceptibility at the property. The property is not located at the base of steep slopes in an alpine environment (steep slopes in alpine environments are susceptible to avalanche); therefore, avalanche susceptibility appears to be low. However, SA is not a qualified avalanche expert and a qualified avalanche Consultant should be retained to confirm this finding.

3. Additional structural reinforcement be considered for proposed structures owing to the proximity of the site to Holocene-age faults and associated potential for high levels of ground shaking.

4. Review and consideration of the Federal Emergency Management Agency (FEMA, 2005) document for avoiding earthquake damage, which suggests strapping water heaters to wall studs and installing flexible gas and water lines to reduce risk of fire and water damage in the event of an earthquake.

[5] Avalanche: a large mass of snow, ice, soil, or rock, or mixtures of these materials, falling, sliding, or flowing very rapidly under the force of gravity (AGI, 2011).

Closure

This report was prepared by SA, under the supervision of David B. Simon, a Professional Geologist licensed in the State of Utah. The findings and conclusions of this report were prepared in accordance with generally accepted professional geologic principles and practices in this area of Utah, at this time. If proposed construction and/or site development varies from that described herein, SA should be notified immediately so that we can evaluate the applicability of the findings and recommendations presented herein.

This report was written for the exclusive use of Ryan Wadman and only for the proposed project described herein. SA is not responsible for technical interpretations by others of the information described or documented in this report. Specific questions or interpretations concerning the findings and conclusions presented herein may require written clarification to avoid any possible misunderstandings. Please do not hesitate to contact the undersigned should you have any questions. The opportunity to be of service on this project is appreciated.

Very truly yours,

SA

LICENSED PROFESSIONAL GEOLOGIST
DAVID B. SIMON
5234321-2250
2/2/18
STATE OF UTAH

David B. Simon, P.G.
Principal Geologist

Dist: 1/Addressee (electronic)
encl:

Figure 1 Location Map
Figure 2 Topographic Map
Figure 3 Weber County Plat Map
Figure 4 Lidar Image
Figure 5 Aerial Photograph
Figure 6 Site Photographs
Figure 7 Site Photographs
Figure 8 General Geologic Map
Figure 9 Legend for General Geologic Map
01-31-18 Email from Mr. Jon King, Utah Geological Survey

References Cited

AGI, 2011, American Geological Institute, Glossary of Geology, Fifth Edition, revised, Neuendorf, K.K.E, Mehl, Jr., J.P., and, Jackson, J.A., editors: American Geological Institute, Alexandria, Virginia, 783 p.

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, 112 p., 2 plates, scale 1:100,000.
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Elliott, A.H., and Harty, K.M., 2010, Landslide maps of Utah, Ogden 30' X 60' quadrangle: Utah Geological Survey Map 246DM, 14p., 46 plates, scale 1:100,000.
http://geology.utah.gov/map-pub/maps/geologic-hazard-maps/#toggle-id-27

FEMA, 2005, Avoiding earthquake damage: Federal Emergency Management Agency publications and resources.
www.fema.gov/hazards/earthquakesnehrp/avoidingearthquake damage.shtm.

Giraud, R.E., and Shaw, L.M., 2007, Landslide susceptibility map of Utah: Utah Geological Survey Map M.228, 11 p., 1 pl., scale 1:500,000.
http://ugspub.nr.utah.gov/publications/hazards_maps/m-228.pdf

Harty, K.M., 1992, Landslide map of the Ogden 30' X 60' quadrangle, Utah: Utah Geological Survey Open-File Report 247, 1:100,000.
http://ugspub.nr.utah.gov/publications/open_file_reports/OFR-247pl.pdf

OpenTopography (2018), on-line high-resolution topography data and tools
http://opentopography.org

UGS, 2018a, Utah Geological Survey Utah Quaternary Fault and Fold Database
http://geology.utah.gov/resources/data-databases/qfaults

UGS, 2018b, Utah Geological Survey Online Interactive Aerial Imagery Collection.
https://geodata.geology.utah.gov/imagery

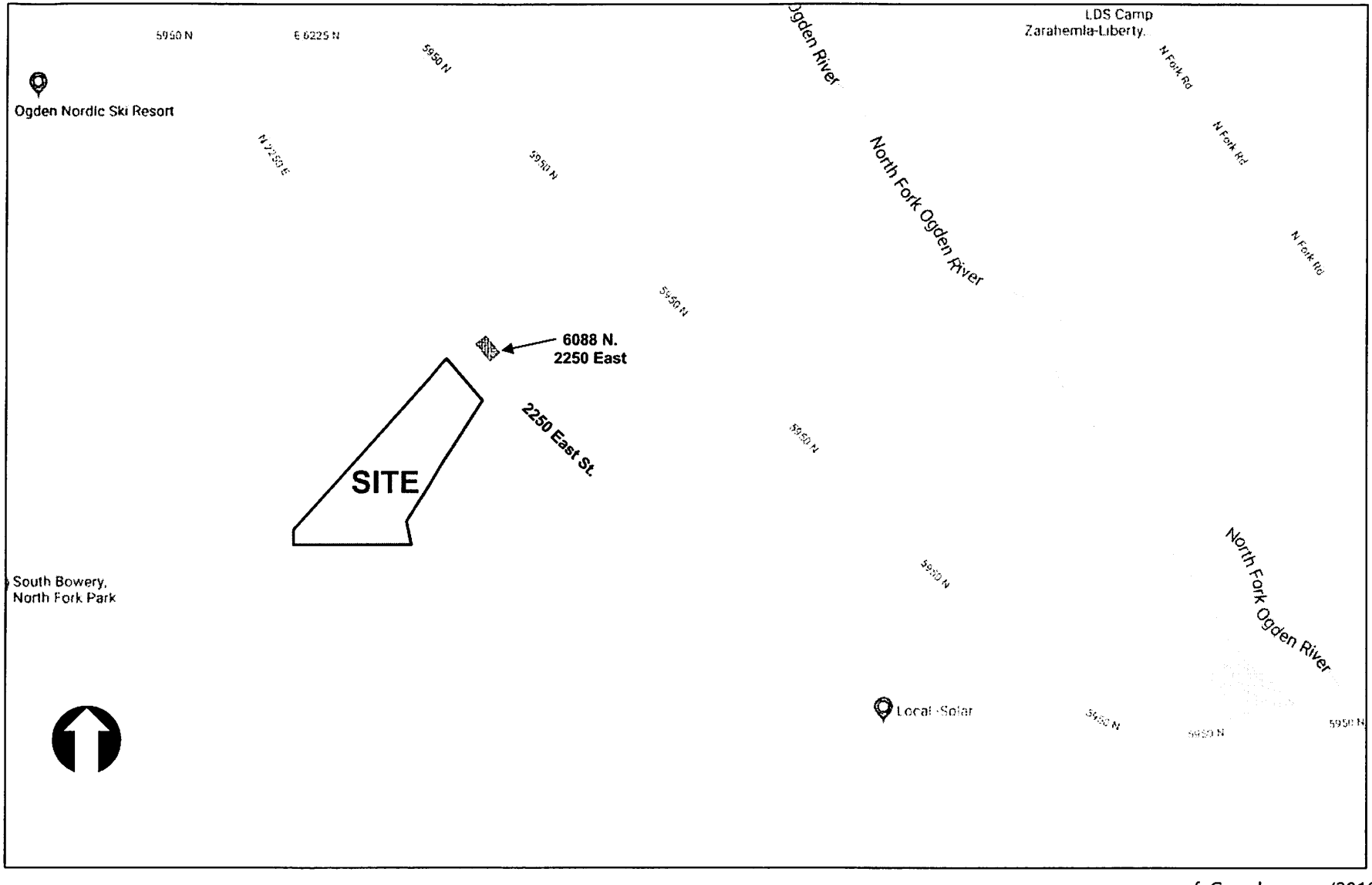
USGS (2016) U.S. Geological Survey Earthquake Glossary
http://earthquake.usgs.gov/learn/glossary/?term=surface%20faulting

Weber County Parcel Search (2018): http://www3.co.weber.ut.us/psearch

Aerial Photographs

SOURCE	DATE	FLIGHT	PHOTOGRAPHS	SCALE
UGS Aerial Imagery Collection*	06-25-63	ELK_2	44, 45	1:15,840
	1970	WF2_	002, 003	1:12,000

*https://geodata.geology.utah.gov/imagery, UGS (2018b)



ref: Google maps (2018).

Approved: 01-29-18 by: DBS

0 796 ft.

398 ft.

LOCATION MAP

SA

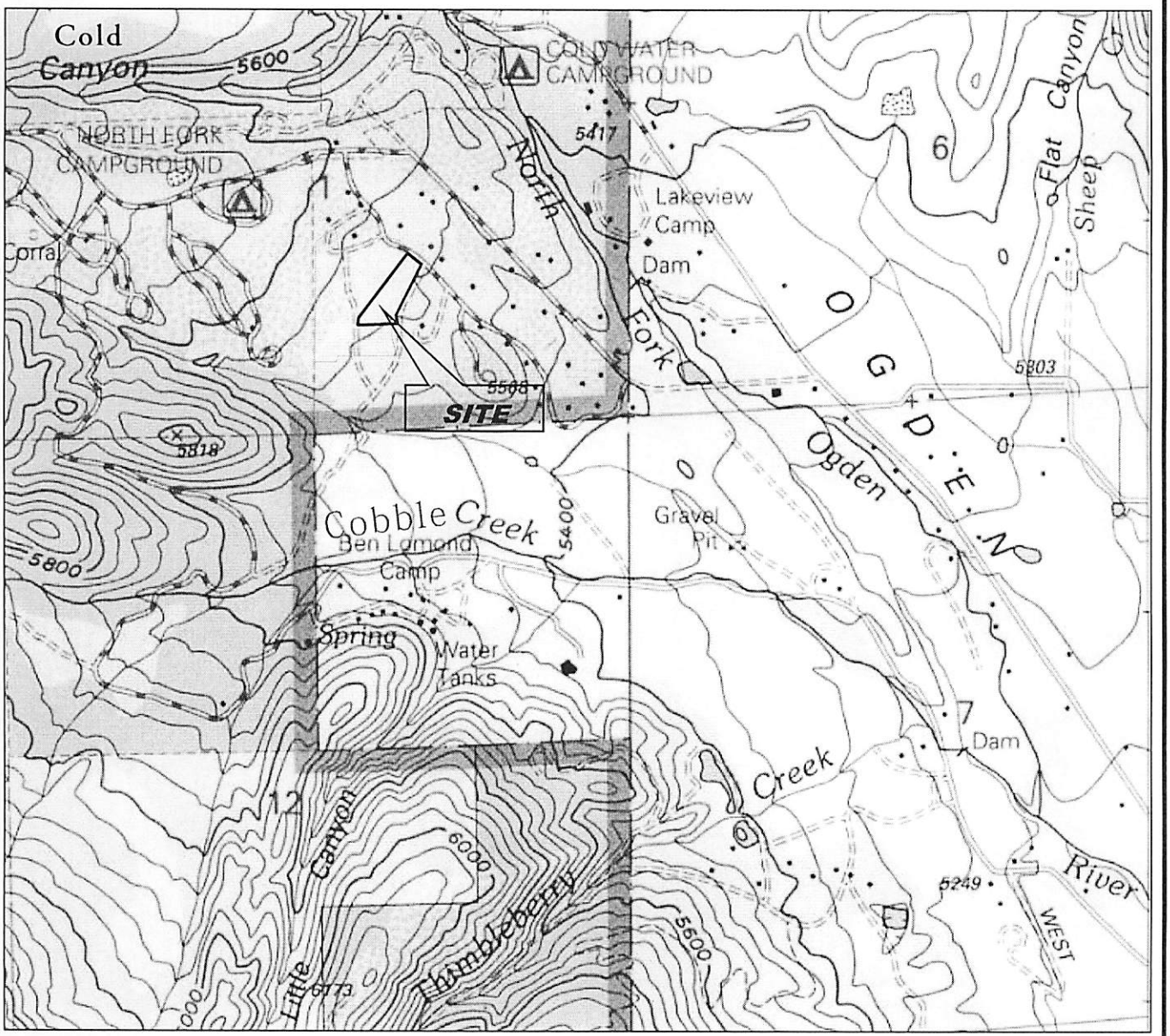
WADMAN PROPERTY

Approximately 6089 N. 2250 East Street
Liberty, Utah

Project No.
18-283

Figure No.
1

ref: portion of USGS North Ogden 7.5 minute Quadrangle (1998)



0 1,340 ft. 2,680 ft.

contour interval 40 ft.
supplemental interval 10 ft.

Approved: 01-31-18 by: DBS

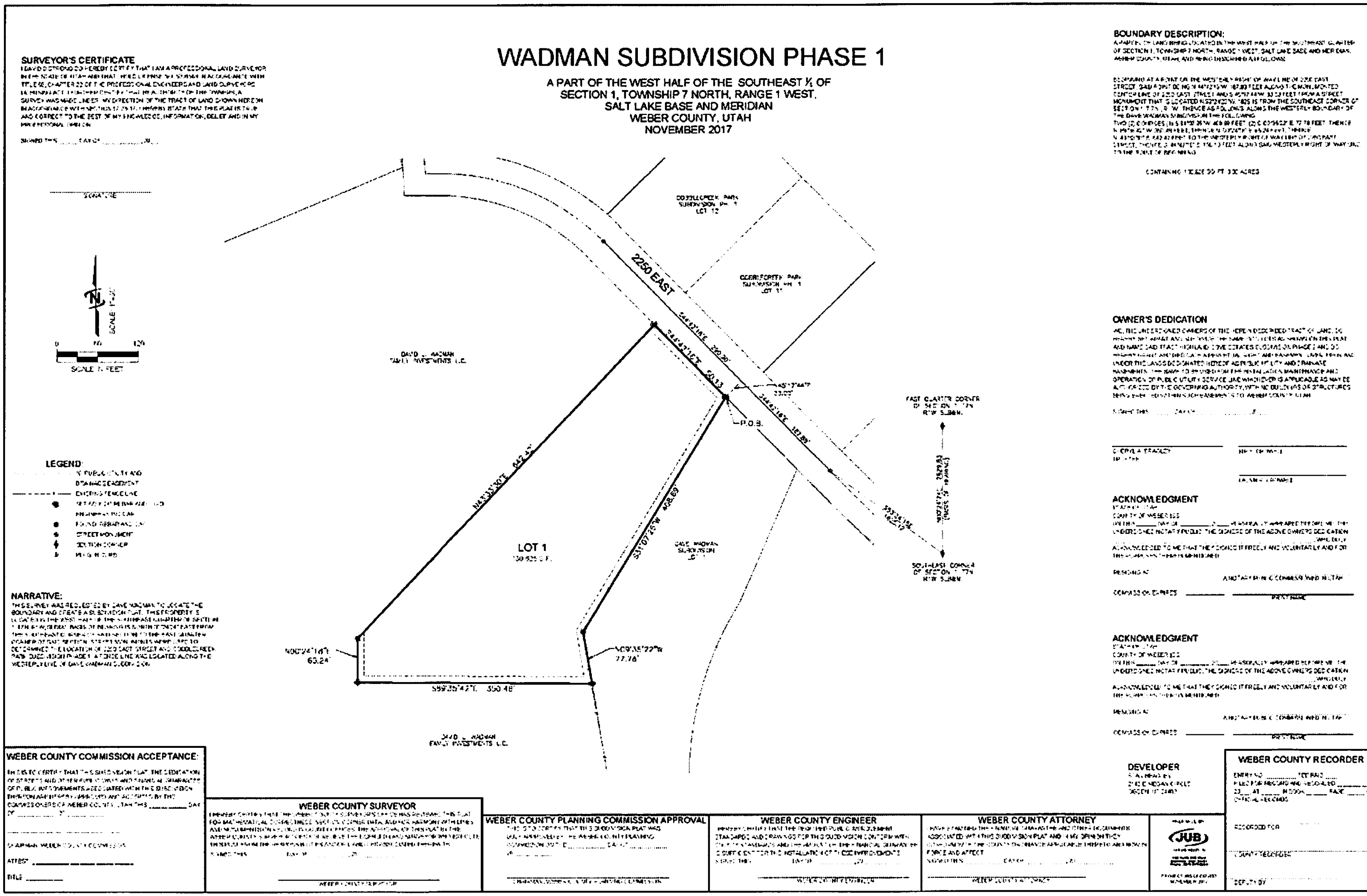
TOPOGRAPHIC MAP

SA

WADMAN PROPERTY
Approximately 6089 N. 2250 East Street
Liberty, Utah

Project No.
18-283

Figure
2



PLAT MAP

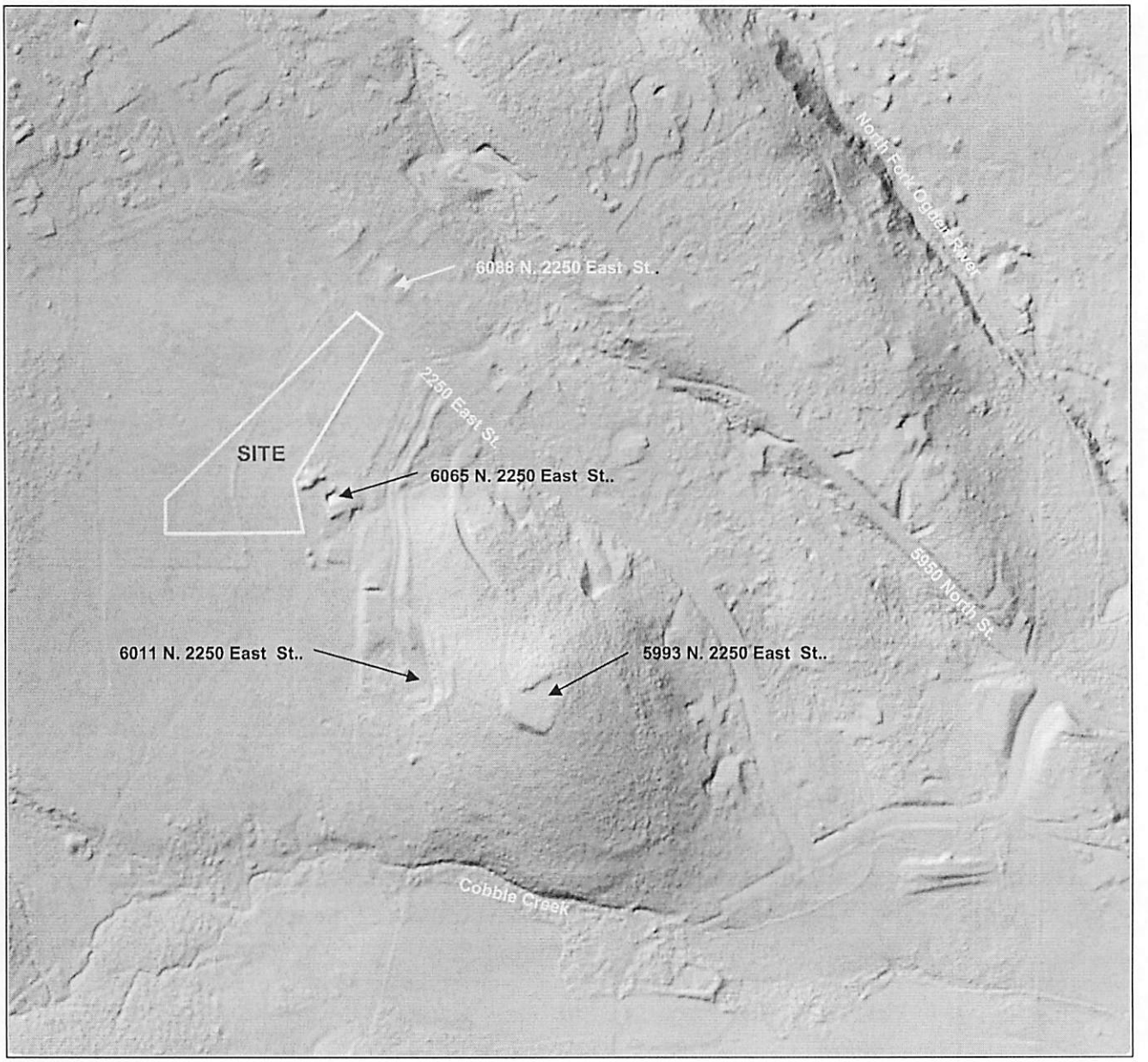
WADMAN PROPERTY

Approximately 6089 N. 2250 East Street
Liberty, Utah

Project No. 18-283

Figure No. 3

Approved: 01-29-18 by: DBS



site boundaries approximate.

Altitude: 45°
Azimuth: 270°

0 389 778± ft.

ref: OpenTopography (2018)

Approved: 01-31-18 by: DBS

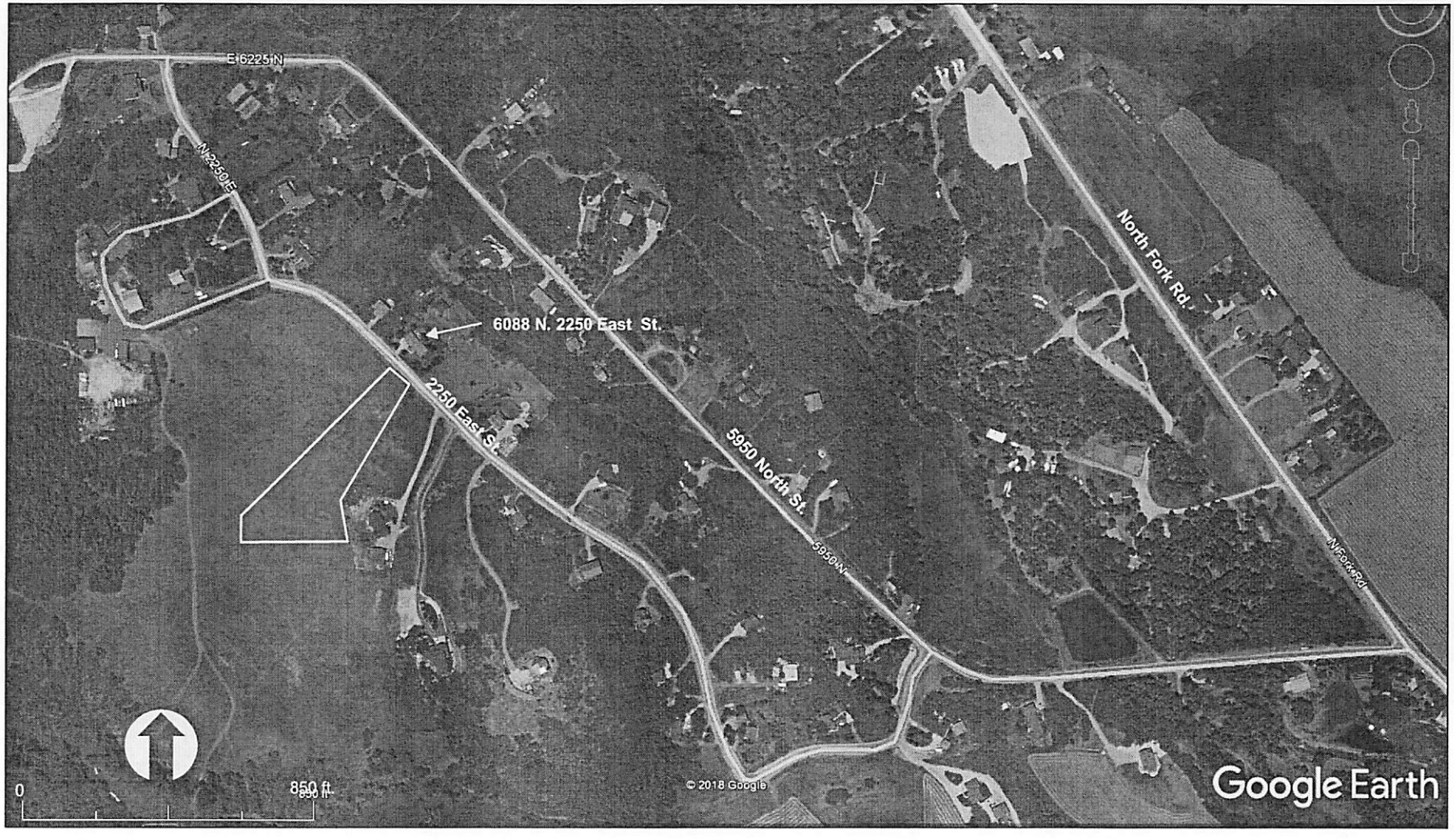
LIDAR IMAGE

SA

WADMAN PROPERTY
Approximately 6089 N. 2250 East Street
Liberty, Utah

Project No. 18-283

Figure 4



Site boundaries approximate.

ref: Google maps (2018).

Approved: 01-29-18 by: DBS

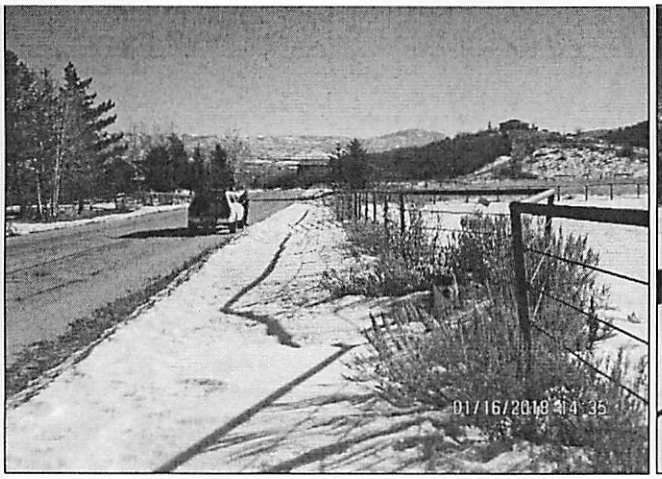
AERIAL PHOTOGRAPH

SA

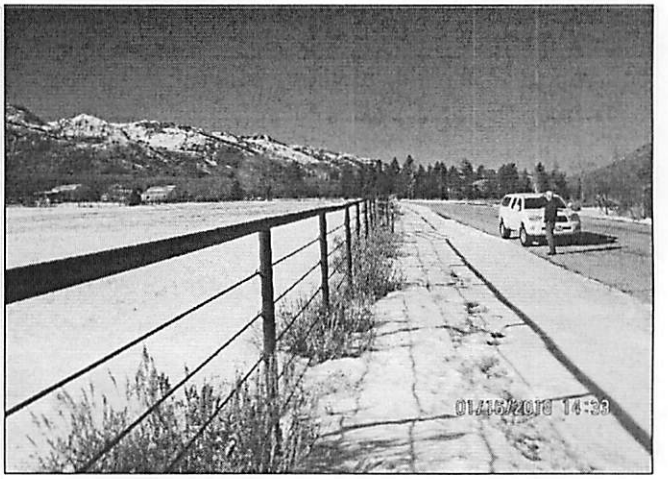
WADMAN PROPERTY
Approximately 6089 N. 2250 East Street
Liberty, Utah

Project No.
18-283

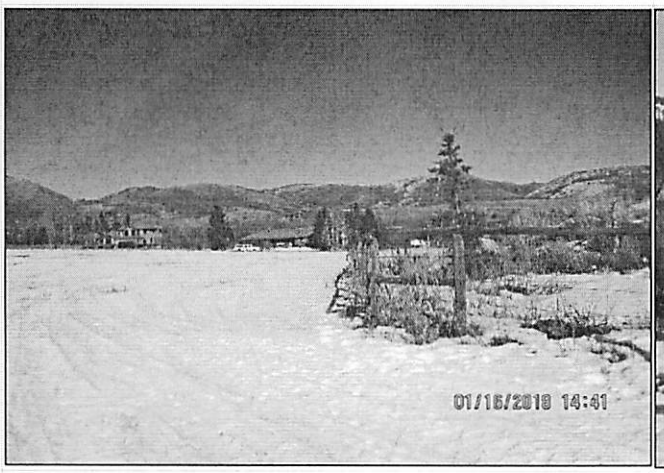
Figure No.
5



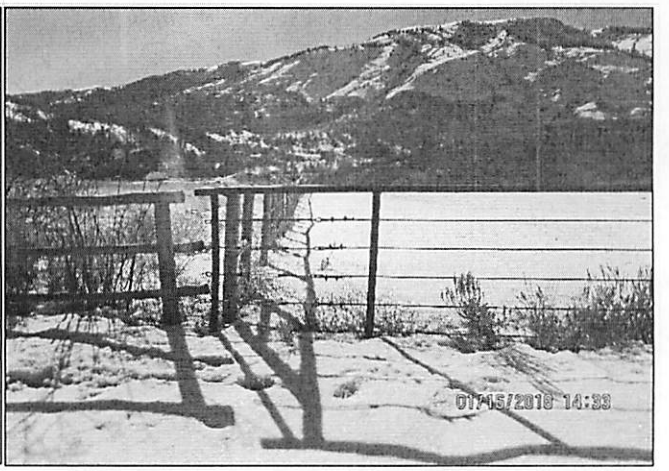
1. Northeast property line, view to southeast.



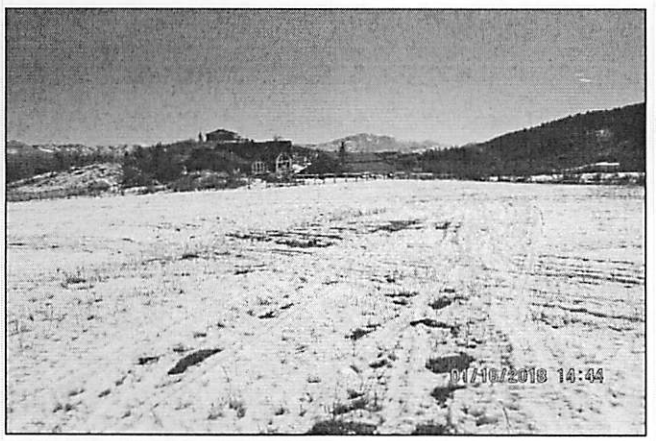
2. Northeast property line, view to northwest.



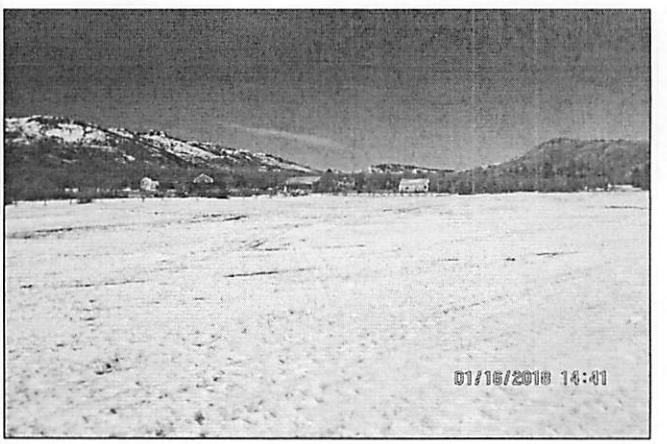
3. Southeast property line, view to northeast.



4. Southeast property line, view to southwest .



5. South property line, view to east.



6. South property line, view to west.

SITE PHOTOGRAPHS

SA

WADMAN PROPERTY
Approximately 6089 N. 2250 East Street
Liberty, Utah

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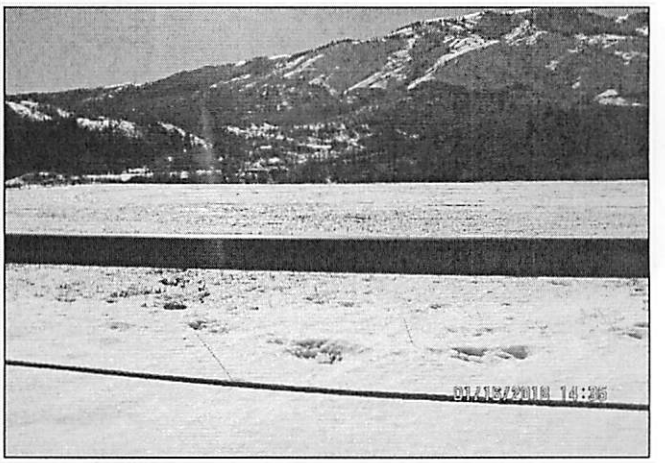
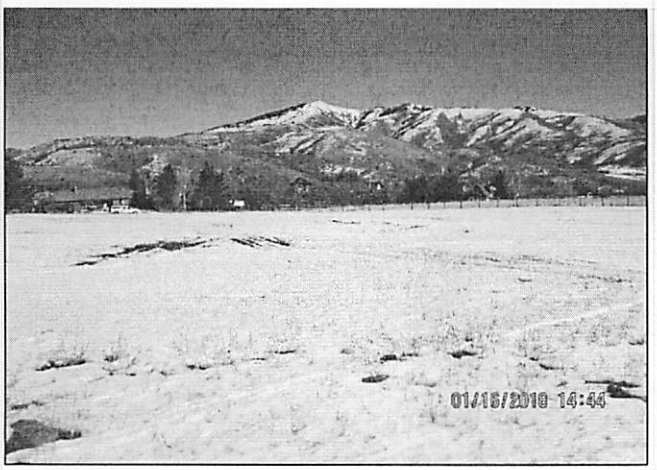
18-283

Figure
6

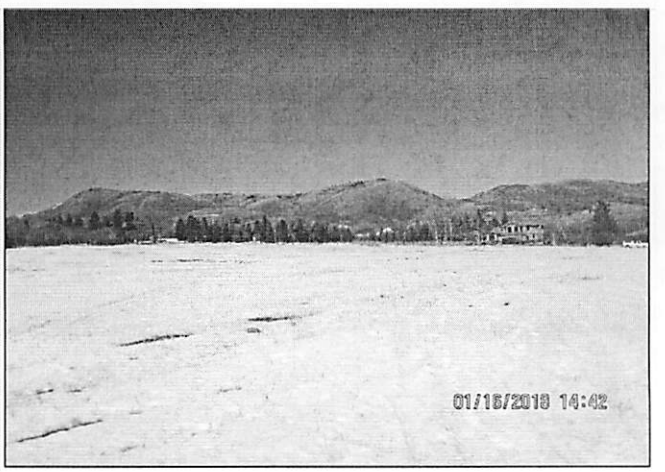
7. Northwest property line, view to northeast.



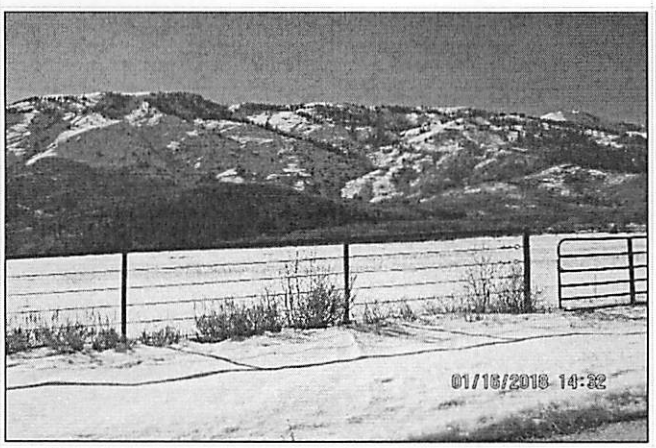
8. Northwest property line, view to southwest.



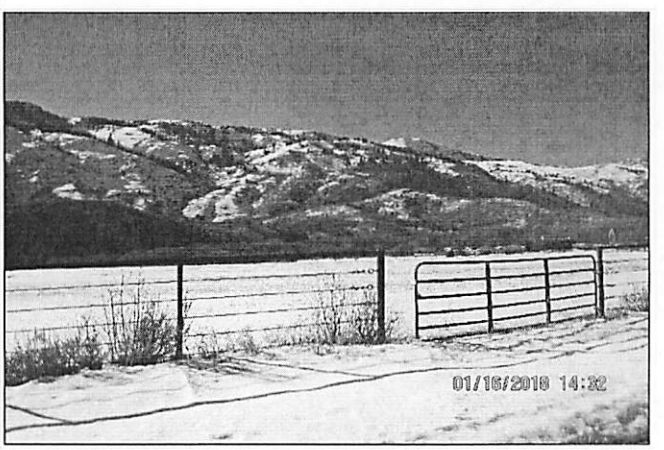
9. Overview of parcel, view to north.



10. Overview of parcel, view to northwest



11. Overview of parcel, view to south/southeast.



12. Overview of parcel, view to south/southeast .

SITE PHOTOGRAPHS

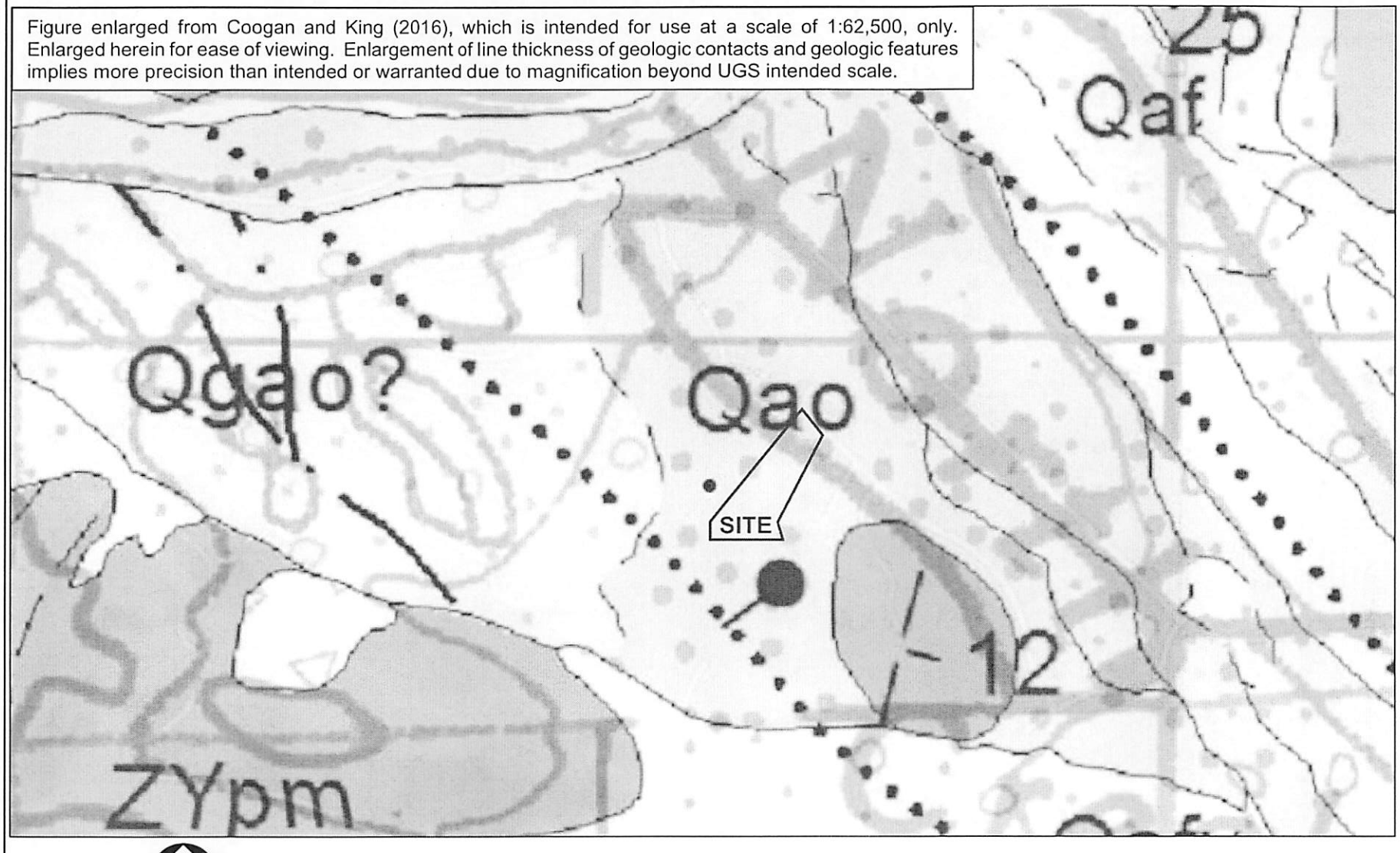
SA

WADMAN PROPERTY
Approximately 6089 N. 2250 East Street
Liberty, Utah

Project No.
18-283

Figure
7

Figure enlarged from Coogan and King (2016), which is intended for use at a scale of 1:62,500, only. Enlarged herein for ease of viewing. Enlargement of line thickness of geologic contacts and geologic features implies more precision than intended or warranted due to magnification beyond UGS intended scale.



Approved: 01-29-18 by: DBS

0 640 1,280 ft.

contour interval 50 meters

see Figure 9 for explanation

GENERAL GEOLOGIC MAP

SA

WADMAN PROPERTY
Approximately 6089 N. 2250 East Street
Liberty, Utah

Project No.
18-283

Figure No.
8

LEGEND FOR GEOLOGIC MAP
(see Figure 8)

Qaf, Qaf?: Alluvial-fan deposits, undivided (Holocene and Pleistocene) – Mostly sand, silt, and gravel that is poorly bedded and poorly sorted and is near late Pleistocene Lake Bonneville and is geographically in the Ogden River drainages; variably consolidated; includes debris flows, particularly in drainages and at drainage mouths (fan heads).

Qao, 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 (Qap, Qab, Qapb); deposits lack fan shape (Qaf) and are distinguished from terraces (Qat) based on upper surface sloping toward adjacent streams from sides of drainage; also shown where areas of fans and terraces are too small to show separately at map scale; composition depends on source area; at least locally up to 110 feet (34 m) thick. Older alluvium is likely older than Lake Bonneville and the same age as Qafo, so likely Bull Lake age, 95,000 to 130,000 years old.

Qgao, Qgao? Older glacial till and outwash (upper and middle? Pleistocene) – Mapped down-drainage from and locally laterally above Pinedale deposits as undivided (Qgo), till in distinct vegetated moraines (Qgmo), and outwash (Qgao).

ZYpm: "Mudstone" member (Neoproterozoic and possibly Mesoproterozoic) – Gray- and green-weathering, black, non-foliated argillite and sandy argillite, and slate.

Normal fault, concealed.

12 Bedding, strike & dip, inclined, approximate, photo-interpreted.

ref: portion of Coogan, and King, 2016.

Approved: 01-31-18 by: DBS

LEGEND FOR GENERAL GEOLOGIC MAP

SA

WADMAN PROPERTY
Approximately 6089 N. 2250 East Street
Liberty, Utah

Project No. 18-283

Figure 9

Gmail by Google

David Simon <david@utahgeologist.com>

map

2 messages

David Simon <david@utahgeologist.com> Wed, Jan 31, 2018 at 2:53 PM
To: Jon King <jonking@utah.gov>

Regards,
David

David B. Simon, P.G.
Simon Associates, LLC
Principal Geologist

1981 East Curtis Drive
Salt Lake City, Utah 84121
801.718.2231
david@utahgeologist.com

18-283 GeoMap(1).pdf
271K

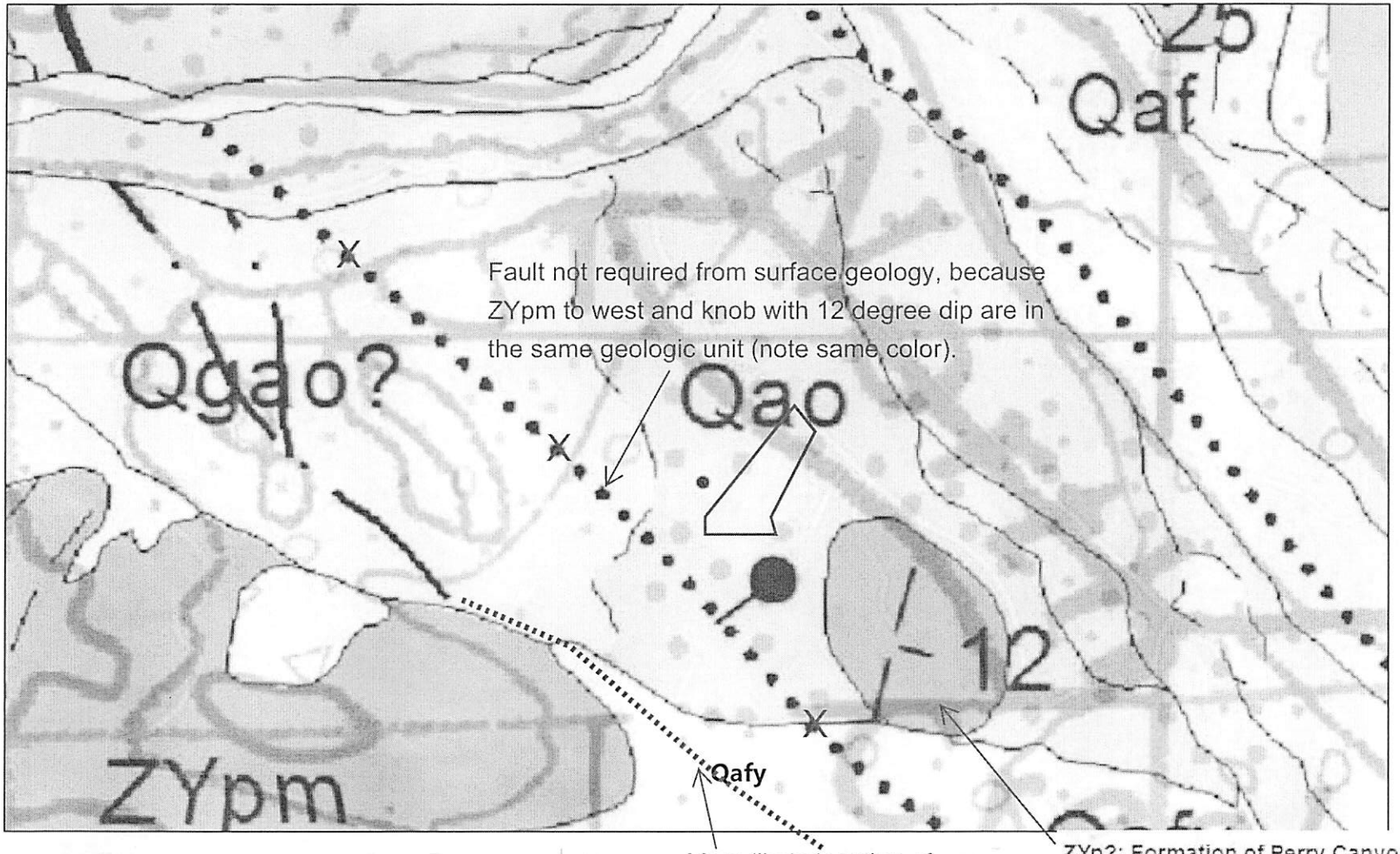
Jon King <jonking@utah.gov> Wed, Jan 31, 2018 at 3:43 PM
To: David Simon <david@utahgeologist.com>

David Simon,
Thanks for pointing out the inconsistency on the Interim Ogden 30x60-minute geologic map.
During the rush to release the map I did not re-evaluate the position of the concealed fault (dotted) south of Cold Canyon; another user had pointed out to me that I had mis-mapped the knob with the 12-degree dip on it. This was corrected on the interim map (note the green colored blobs).
Because the rocks on this knob and the area of ZYpm (labeled) to the west are part of the same geologic unit (formation of Perry Canyon), a fault is not required between the ZYpm area and the knob (ZYp?). Based on my fault mapping to the north of Cold Canyon and the lineaments in unit Qgao? (likely Bull Lake-age glacial outwash, pre-Lake Bonneville, Pleistocene), I think a concealed fault (a fault with no scarp on the surface) is present to the west of the black concealed fault (dotted) with the bar and ball. I would map this fault next to the outcrop of ZYpm.
I have attached an edited version of your map pdf with changes and notes in red (X on the fault to be removed; dotted fault to the west).
Thanks again. Map users comments always improve the maps.
Jon K. King
Mapping Geologist
Utah Geological Survey
[Quoted text hidden]

18-283 GeoMap(1) edit.pdf
722K

Qafy: Qafy

Mostly poorly bedded and poorly sorted, mostly unconsolidated sand, silt, and gravel; impinge on present-day floodplains, divert active streams, and overlie low terraces



Qgao?: Qgao?

Likely Bull Lake glaciation age

Stratified, variably sorted and bedded clay, silt, sand, gravel to boulder size

Qao: Qao

Variably sorted sand, silt, clay, and gravel above and likely older than Bonneville shoreline

More likely location of concealed fault

ZYp?: Formation of Perry Canyon, undivided, queried

Argillite to meta-graywacke upper unit, middle meta-diamictite, and basal slate, argillite, and meta-sandstone; locally phyllitic