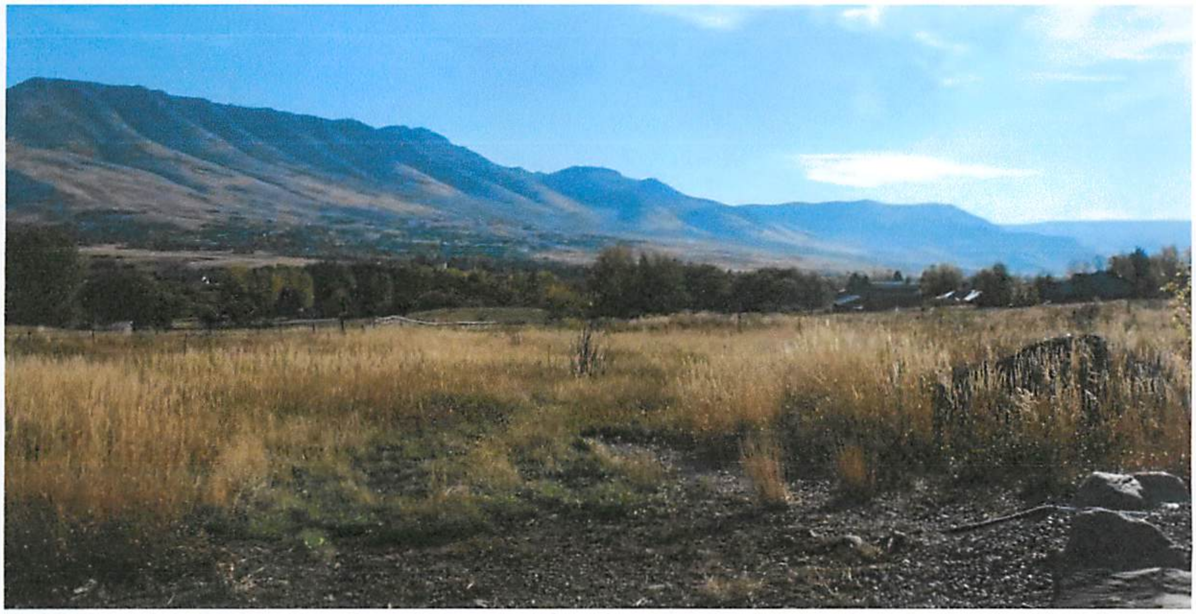
REPORT

GEOLOGIC HAZARDS RECONNAISSANCE

RESIDENTIAL LOT

3644 EAST 3300 NORTH

EDEN, WEBER COUNTY, UTAH



Prepared for

Bobby Cvitkovich
3430 Big Piney Drive
Eden, Utah. 84310

October 9, 2016

Prepared by

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October 9, 2016

Bobby Cvitkovich
3430 Big Piney Drive
Eden, Utah. 84310

SUBJECT: Geologic Hazards Reconnaissance
Residential Lot
3644 East 3300 North
Eden, Weber County, Utah

Dear Mr. Cvitkovich:

This report presents results of a reconnaissance-level engineering geology and geologic hazards review and evaluation conducted by Western GeoLogic, LLC (Western GeoLogic) for a residential lot at 3644 East 3300 North in Eden, Utah (Figure 1 – Project Location). The Project consists of a 3.66-acre parcel identified as Weber County Assessor Parcel Number 22-023-0014. The Project is on northeast-facing slopes in northwestern Ogden Valley about 0.5 miles north of Nordic Valley Ski Area, and is in the NE1/4 Section 29, Township 7 North, Range 1 East (Salt Lake Base Line and Meridian; Figure 1). Elevation of the site is about 5,120 feet. It is our understanding that no formal development plans have been made, but the intended site use is for development of one single-family residential home.

PURPOSE AND SCOPE

The purpose and scope of this investigation is to identify and interpret surficial geologic conditions at the site and identify potential risk from geologic hazards to the project. This investigation is intended to: (1) provide preliminary geologic information and assessment of geologic conditions at the site; (2) identify potential geologic hazards that may be present and qualitatively assess their risk to the intended site use; and (3) provide recommendations for additional site- and hazard-specific studies or mitigation measures, as may be needed based on our findings. No hazard-specific evaluations or subsurface exploration were conducted for this report or within the scope of our study.

The following services were performed in accordance with the above stated purpose and scope:

- A site reconnaissance conducted by an experienced certified engineering geologist to assess the site setting and look for adverse geologic conditions;
- Review of readily-available geologic maps, reports, and air photos; and
- Evaluation of available data and preparation of this report, which presents the results of our study.

The engineering geology section of this report has been prepared in accordance with Bowman and Lund (2016) and current generally accepted professional engineering geologic principles and practice in Utah, and meets specifications provided in Chapter 27 of the Weber County Land Use Code within the above stated scope. However, we do not include discussion of radon hazard potential, as recommended in Bowman and Lund (2016), because radon gas poses an environmental health hazard and indoor levels are heavily influenced by several post-construction, non-geologic factors. The hazard from radon should be evaluated by long-term testing following construction.

HYDROLOGY

The U.S. Geological Survey (USGS) topographic map of the Huntsville Quadrangle shows the site is about 0.9 miles east-northeast of the mouth of Dry Canyon near the northwest margin of Ogden Valley (Figure 1). Union Creek is shown on Figure 1 flowing northeastward into the valley to where it merges with an unlined canal (Holmes-Ferrin Ditch, Figure 1) slightly south of the Project. The canal crosses the western part of the property and was flowing at the time of our reconnaissance. Liberty Spring Creek is about 0.2 miles to the northeast of the site, and flows to the southeast to its confluence with North Fork Ogden River about 0.9 miles east of the Project (Figure 1).

The site is near the northwestern margin of Ogden Valley, which is dominated in the valley bottom by unconsolidated lacustrine and alluvial basin-fill deposits. Slopes in the site area are mainly in sandy lacustrine sediments former Lake Bonneville overlain by a thin veneer of alluvium at the surface. No site-specific groundwater information is available for the Project, but six water wells are on adjoining properties in the site area (Figure 1; Utah Division of Water Rights Well Log Database, http://www.waterrights.utah.gov/wellInfo/wellInfo.asp). These wells, which were drilled between 1977 and 2015 to depths of from 200 to 300 feet, show static groundwater depths of from 15 to 59 feet below the ground surface (bgs). Mean static groundwater depth from these wells is 39.2 feet bgs, with a median depth of 41.5 feet bgs. Based on the above, we anticipate groundwater at the Project to be about 40 feet deep. Regional flow is likely to the northeast based on topography. However, groundwater depth may vary seasonally from snowmelt runoff and annually from climatic fluctuations, as would be expected for an alpine environment, and perched conditions may also be present in the subsurface that could cause locally shallower levels. Local features such as drains and pumps can also influence groundwater depth and flow direction.

Avery (1994) indicates groundwater in Ogden Valley occurs under perched, confined, and unconfined conditions in the valley fill to depths of 750 feet or more. A well-stratified lacustrine silt layer forms a leaky confining bed in the upper part of the valley-fill aquifer. The aquifer below the confining beds is the principal aquifer, which is in primarily fluvial and alluvial-fan deposits. The principal aquifer is recharged from precipitation, seepage from surface water, and subsurface inflow from bedrock into valley fill along the valley margins (Avery, 1994). The confined aquifer is typically overlain by a shallow, unconfined aquifer recharged from surface flow and upward leakage. Groundwater flow is generally from the valley margins into the valley fill, and then toward the head of Ogden Canyon (Avery, 1994).

GEOLOGY

Surficial Geology

The site is located in northwestern Ogden Valley, a sediment-filled intermontane valley within the Wasatch Range. The Wasatch Range is a major north-south trending mountain range marking the eastern boundary of the Basin and Range physiographic province (Stokes; 1977, 1986). Surficial geology of the site is mapped by Coogan and King (2016; Figure 2) as alluvium overlying Lake Bonneville sand deposits (Qafy/Qlsb).

Coogan and King (2016) describe surficial geologic units in the site area on Figure 2 as follows:

> *Qal, Qal1, Qal2, Qal2? – Stream alluvium and flood-plain deposits (Holocene and uppermost Pleistocene).* Sand, silt, clay, and gravel in channels, flood plains, and terraces typically less than 16 feet (5 m) above river and stream level; moderately sorted; unconsolidated; along the same drainage Qal2 is lower than Qat2 and has likely been subject to flooding, at least prior to dam building; present in broad plains along the Bear, Ogden, and Weber Rivers and larger tributaries like Deep, Cottonwood, East Canyon, Lost, and Saleratus Creeks, along Box Elder, Heiners, and Yellow Creeks, and in narrower plains of larger tributary streams; locally includes muddy, organic overbank and oxbow lake deposits; composition depends on source area, so in back valleys typically contains many quartzite cobbles recycled from the Wasatch Formation; mostly Holocene, but deposited after regression of Lake Bonneville from the late Pleistocene Provo shoreline; width in Morgan Valley is combined flood plain of Weber River and East Canyon and Deep Creeks; 6 to 20 feet (2-6 m) thick and possibly as much as 50 feet (15 m) along Weber River and thinner in the Kaysville quadrangle; greater thicknesses (>50 feet [15 m]) are reported in Morgan Valley (Utah Division of Water Rights, well drilling database), but likely include Lake Bonneville and older Pleistocene deposits.
>
> Suffixes 1 and 2 indicate ages where they can be separated, with 1 including active channels and 2 including low terraces 10 to 20 feet (3-6 m) above the Weber and Ogden Rivers, and the South Fork Ogden River that may have been in the flood plain prior to damming of these waterways. Qal2 queried in low terraces above Bear River, Saleratus Creek, and Dry Creek where deposits may not be in the flood plain.
>
> *Qaf, Qafy, Qaf3, Qaf3?, Qaf4, Qaf4?, Qaf5 – Alluvial-fan deposits (Holocene and Pleistocene).* Mostly sand, silt, and gravel that is poorly bedded and poorly sorted and that is not close to late Pleistocene Lake Bonneville and is geographically in the Huff Creek and upper Bear River drainages; variably consolidated; includes debris flows, particularly in drainages and at drainage mouths (fan heads); generally less than 60 feet (18 m) thick. Qaf with no suffix used where age uncertain or for composite fans where portions of fans with multiple ages cannot be shown separately at map scale; toes of some fans have been removed by human disturbances, so their age cannot be determined.

Where possible, subdivided into relative ages, indicated by letter and number suffixes (like Qa and Qat suffixes) and relative ages only apply to the local drainage, with unit Qafy being the lowest (youngest) fans and unit 3 may or may not post-date Lake Bonneville. Relative ages of these fans are partly based on heights above present drainages at drainage-eroded edge of fan. The relative age is queried where the age is uncertain, generally due to the height not fitting into the typical order of surfaces. The various deposits listed, Qafy and Qaf3 through Qaf5, are 20 to 140 feet (6-40 m) above and west of Saleratus Creek, and also above Yellow Creek and the Bear River. Qafy fans are active, impinge on present-day floodplains, divert active streams, and overlie low terraces.

Qac *– Alluvium and colluvium (Holocene and Pleistocene).* Unsorted to variably sorted gravel, sand, silt, and clay in variable proportions; includes stream and fan alluvium, colluvium, and, locally, mass-movement deposits too small to show at map scale; typically mapped along smaller drainages that lack flat bottoms; more extensive east of Henefer where Wasatch Formation (Tw) strata easily weather to debris that "chokes" drainages; 6 to 20 feet (2-6 m) thick. Some deposits are "perched" on benches 80 feet (25 m) and more above present-day drainages like Left Fork Heiners Creek (Heiners Creek quadrangle) and Harris Canyon (Henefer quadrangle). In the Devils Slide quadrangle, some deposits are "perched" on benches about 60 to 130 feet (18-40 m) above Quarry Cottonwood Canyon indicating the alluvium is at least partly Lake Bonneville age and older (see Qab and Qao in tables 1 and 2).

Qmdf, 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; variably vegetated; in drainages typically form mounds, an indication of more viscous Qmdf, rather than being flat like unit Qac; Qmdf queried where may not be mostly debris- and mud-flow deposits; many debris flows cannot be shown separately from alluvial fans at map scale; 0 to 40 feet (0-12 m) thick. Age(s) uncertain; deposits in drainages likely post-date the Provo shoreline of Lake Bonneville, while deposits above drainages, like north of the Right Hand Fork Peterson Creek, are likely as old as Bull Lake glaciation, but could pre-date Bull Lake glaciation and be middle Pleistocene.

Qms, Qms?, Qmsy, Qmsy?, Qmso, Qmso? *– Landslide deposits (Holocene and upper and middle? Pleistocene).* Poorly sorted clay- to boulder sized material; includes slides, slumps, and locally flows and floods; generally characterized by hummocky topography, main and internal scarps, and chaotic bedding in displaced blocks; composition depends on local sources; morphology becomes more subdued with time and amount of water in material during emplacement; Qms may be in contact with Qms when landslides are different/distinct; thickness highly variable, up to about 20 to 30 feet (6-9 m) for small slides, and 80 to 100 feet (25-30 m) thick for larger landslides. Qmsy and Qmso queried where relative age uncertain; Qms queried where classification uncertain. Numerous landslides are too small to show at map scale and more detailed maps shown in the index to geologic mapping should be examined.

Qms without a suffix is mapped where the age is uncertain (though likely Holocene and/or late Pleistocene), where portions of slide complexes have different ages but cannot be shown separately at map scale, or where boundaries between slides of different ages are not distinct. Estimated time of emplacement is indicated by relative-age letter suffixes with: Qmsy mapped where landslides deflect streams or failures are in Lake Bonneville deposits, and scarps are variably vegetated; Qmso typically mapped where deposits are "perched" above present drainages, rumpled morphology typical of mass movements has been diminished, and/or younger surficial deposits cover or cut Qmso. Lower perched Qmso deposits are at Qao heights above drainages (95 ka and older) and the higher perched deposits may correlate with high level alluvium (QTa_) (likely older than 780 ka) (see table 1). Suffixes y and o indicate probable Holocene and Pleistocene ages, respectively, with all Qmso likely emplaced before Lake Bonneville transgression. These older deposits are as unstable as other slides, and are easily reactivated with the addition of water, be it irrigation or septic tank drain fields.

Qls, Qls?, Qlsp, Qlsb, Qlsb? *– Lake Bonneville sand (upper Pleistocene).* Mostly sand with some silt and gravel deposited nearshore below and near the Provo shoreline (Qlsp) and between the Provo and Bonneville shorelines (Qlsb); Qls mapped downslope from slope break below Provo shoreline beach deposits where thin Lake Bonneville regressional sand may overlie transgressional sand; grades downslope into unit Qlf with decreasing sand content and laterally with more gravel into units Qdlp, Qdlb, and upslope with more gravel into unit Qlgb; Qls and Qlsb queried where grain size or unit identification uncertain; may be as much as 75 feet (25 m) thick, and thickest near Ogden; typically less than 20 feet (6 m) thick in Morgan Valley; may include small deltas and deltas that lack typical delta shape.

Qdlb, Qdlb? *– Transgressive and Bonneville-shoreline deltaic and lacustrine deposits (upper Pleistocene)* – Mostly sand, silty sand, and gravelly sand deposited near shore in Lake Bonneville; extensive at mouth of Weber Canyon; related to transgression to and occupation of the Bonneville shoreline with lacustrine deposits covering deltaic deposits; in Morgan Valley and near mouth of Coldwater Canyon (North Ogden quadrangle) contain more cobbles and overall more gravel; 0 to at least 40 feet (12 m) thick in Ogden and Morgan Valleys; about 400 feet (120 m) thick in bluff at the mouth of Weber Canyon. These deposits are prone to slope failures.

Qadb, Qadb? *– Transgressive and Bonneville-shoreline alluvial and deltaic deposits (upper Pleistocene).* Cobbly gravel, sand, silt, and clay deposited above (subaerial) and in Lake Bonneville (subaqueous); typically mapped where shorelines are obscure, so that line cannot be drawn between alluvial fan and delta; include rounded to subangular clasts in a matrix of sand and silt with interbeds of sand and silt; mapped above the Provo shoreline and deposited as lake transgressed to and was at the Bonneville shoreline; typically better sorted delta and lake deposits over poorly sorted alluvial-fan deposits; Qadb prominent along Deep Creek (Morgan quadrangle) and Strawberry Creek (Snow Basin quadrangle); 0 to at least 40 feet (0-12+ m) thick.

Note that the Bonneville-shoreline fan-delta unit (Qadb), at 80 to 100 feet (24-30 m) above present drainages, is typically higher than the related alluvial units (Qab, Qafb) (see table 1). A fan-delta is built when an alluvial fan enters a lake or ocean, and includes both the fan and the delta.

Qla, Qla? *– Lake Bonneville lacustrine deposits and post- and pre-Lake Bonneville alluvial deposits, undivided (Holocene and upper? Pleistocene).* Mostly poorly sorted and poorly bedded sand, silt, and clay, with some gravel; mapped where Lake Bonneville deposits are reworked by later stream action or covered by thin stream and fan deposits, and where lake deposits are thin and overlie older alluvial deposits; unit queried where may be dominantly alluvium; deposits typically eroded from shallow Norwood Formation; mostly mapped near Bonneville shoreline; also mapped in Peterson quadrangle along upper Deep Creek above Bonneville shoreline where lake deposits seem to indicate landslide dam of creek; thickness uncertain.

Tn, Tn? *– Norwood Formation (lower Oligocene and upper Eocene).* Typically light-gray to light-brown altered tuff (claystone), altered tuffaceous siltstone and sandstone, and conglomerate; unaltered tuff, present in type section south of Morgan, is rare; locally colored light shades of red and green; variable calcareous cement and zeolitization; involved in numerous landslides of various sizes; estimate 2000-foot (600 m) thick in exposures on west side of Ogden Valley (based on bedding dip, outcrop width, and topography). Norwood Formation queried where poor exposures may actually be surficial deposits. For detailed Norwood Formation information see description under heading "Sub-Willard Thrust - Ogden Canyon Area" since most of this unit is in and near Morgan Valley and covers the Willard thrust, Ogden Canyon, and Durst Mountain areas.

Cn, Cn? *– Nounan Formation (Upper Cambrian).* Medium-gray to dark-gray, very thick to thick-bedded, light to medium gray and tan-weathering, typically cliff forming, variably sandy and silty dolomite and lesser limestone, with crude laminae to partings and mottling of sandstone and siltstone that weather tan or reddish; little sandstone and siltstone in more resistant lower part; about 600 to 1150 feet (180-350 m) thick.

The Nounan Formation thickness range in our map area is based on numerous studies. It is about 800 feet (245 m) thick in the Huntsville quadrangle, using Coogan's mapping of about 300 feet (90 m) each of the Blacksmith and Langston Formations; about 900- and 999-foot (275 and 300 m) thicknesses reported at the South Fork Little Bear River in the James Peak quadrangle (Ezell, 1953; Gardiner, 1974; respectively) and 1145 feet (350 m) thick at Sharp Mountain (Hafen, 1961). To the east the Nounan thins southward from 1025 feet (312.5 m) thick in the Curtis Ridge quadrangle (Hansen, 1964) to 800 feet (245 m) thick in Sugar Pine Canyon (Creek) in the Dairy Ridge quadrangle (Gardiner, 1974; Coogan, 2006a) to 675 feet (205 m) thick in the Horse Ridge quadrangle (Coogan, 2006b). The Nounan is about 630 feet (190 m) thick in the Causey Dam quadrangle (Mullens, 1969), possibly the "average" of the 571 feet (174 m) and 696 feet (210 m) measured by Rigo (1968, aided by Mullens) and Gardiner (1974), respectively, on Baldy Ridge in the quadrangle, with Gardiner's (1974) thickness more closely matching Mullens' (1969) mapped thickness.

So the Nounan thins to the south and east over the Tooele arch (see Hintze, 1959). Williams (1948) reported that the Nounan was Late Cambrian in age, using unpublished fossil collections (in part from Maxey, 1941). In the Wellsville Mountains north of our map, Oviatt (1986) reported the upper Nounan was Dresbachian (Late Cambrian) in age based on Dunderbergia(?) and Crepicephalus zone trilobite fauna.

Zpu, Zpu? *– Formation of Perry Canyon, Upper member (Neoproterozoic).* Olive drab to gray, thin-bedded slate to argillite to phyllite to micaceous meta-siltstone to meta-graywacke to meta-sandstone in variable proportions such that unit looks like both the "greywacke-sandstone" and "mudstone" members of previous workers; unit identification based on underlying diamictite in Mantua quadrangle; rare meta-gritstone and meta-diamictite (actually conglomerate?); locally schistose; meta-sandstone contains poorly sorted lithic, quartz, and feldspar grains in silty to micaceous matrix; meta-sandstone is quartzose in outcrops on west margin of Mantua quadrangle (Crittenden and Sorensen, 1985a) and medial zone of sandstone is feldspathic east of Ogden Valley, where mapped and described as argillite member of Maple Canyon Formation by Crittenden (1972) and Sorensen and Crittenden (1979); thickness uncertain, but appears to be about 600 feet (180 m) thick on west flank of Grizzly Peak in the Mantua quadrangle and about 1000 feet (300 m) thick between Ogden Canyon and North Ogden divide. In Ogden Valley typically non-resistant and tan weathering such that gray to green to dark-gray fresh color is seldom seen except in cut slopes and excavations. This unit is prone to slope failures.

Zpd, Zpd? *– Diamictite member (Neoproterozoic).* Tan to gray weathering, gray to dark-gray meta-diamictite containing pebble to boulder-sized quartzite and granitoid (quartzo-feldspathic gneiss) clasts in dark-gray sandy (up to granule size) to micaceous argillite matrix; fuschsite-bearing quartzite clasts minor but distinctive; local meta-pillow lava (unit Zpb) and meta-limestone at and near base, and local altered intrusive diorite (unit Zpi) (Crittenden and Sorensen, 1985b); appears to be up to 200 to 400 feet (60-120 m) thick in our map area but is about 1000 feet (300 m) thick to the west in the Willard quadrangle.

From Balgord and others (2013, and Balgord, 2011) detrital zircon uranium-lead and lead-lead maximum depositional ages on the upper part of the diamictite are about 650 to 690 Ma with about a 120 million year gap to about 800 Ma on the lower part of the diamictite. This major unconformity is within the metavolcanic (Zpb) unit to the west of the map area on Fremont Island, such that the diamictite above the metavolcanics and where the meta-volcanics are missing in the Ogden map area may be considerably younger than the lower diamictite.

In Perry Canyon a "felsic tuff" is present at the base of the diamictite (or top of "mudstone"), and it contains columbite-tantalite and monazite (reworked felsic lava flow of Balgord, 2011, p. 60; volcanic sandstone in her figure 16, p. 53).

The diamictite reportedly has a large volcanic component in the klippe north of the North Ogden divide with the majority of clasts being mafic volcanic rocks from the underlying meta-basalt (Zpb) and a few large "basement" clasts in a greenish-colored matrix with about 50% sand and silt (Balgord, 2011). This implies the klippe diamictite lacks the quartzite and granitoid clasts of the typical diamictite, and may be a volcanic unit rather than part of the diamictite member.

Near Lewis Peak in the North Ogden quadrangle, the diamictite contains typical granitoid and quartzite clasts with minor sedimentary and volcanic rock clasts of cobble to boulder size in a dark gray quartzose pebbly to sandy to micaceous argillite matrix (after Balgord, 2011). Granitoid clasts look like they are from the Farmington Canyon Complex.

Citations, tables, and figures noted in the above descriptions are not provided herein, but are in Coogan and King (2016).

Seismotectonic Setting

The property is located near the northwestern margin of Ogden Valley, a roughly 40-square mile back valley described by Gilbert (1928) as a structural trough similar to Cache and Morgan Valleys to the north and south, respectively. The back valleys of the northern Wasatch Range are in a transition zone between the Basin and Range and Middle Rocky Mountains provinces (Stokes, 1977, 1986). The Basin and Range is characterized by a series of generally north-trending elongate mountain ranges, separated by predominately alluvial and lacustrine sediment-filled valleys and typically bounded on one or both sides by major normal faults (Stewart, 1978). The boundary between the Basin and Range and Middle Rocky Mountains provinces is the prominent, west-facing escarpment along the Wasatch fault zone at the base of the Wasatch Range. Late Cenozoic normal faulting, a characteristic of the Basin and Range, began between about 17 and 10 million years ago in the Nevada (Stewart, 1980) and Utah (Anderson, 1989) portions of the province. The faulting is a result of a roughly east-west directed, regional extensional stress regime that has continued to the present (Zoback and Zoback, 1989; Zoback, 1989). The back valleys are morphologically similar to valleys in the Basin and Range, but exhibit less structural relief (Sullivan and others 1988).

Ogden Valley occupies a structural trough created by up to 2,000 feet of vertical displacement on normal faults bounding the east and west sides of the valley. The Ogden Valley southwestern margin fault and North Fork fault (Black and others, 2003) are shown on Figure 2 trending northwestward about 4,400 feet to the southwest and 3,900 feet to the east, respectively. The most-recent movement on these faults is pre-Holocene (Sullivan and others, 1986). The site is also situated near the central portion of the Intermountain Seismic Belt (ISB). The ISB is a north-south-trending zone of historical seismicity along the eastern margin of the Basin and Range province which extends for approximately 900 miles from northern Arizona to northwestern Montana (Sbar and others, 1972; Smith and Sbar, 1974). At least 16 earthquakes of magnitude 6.0 or greater have occurred within the ISB since 1850, with the largest of these events the M_S 7.5 1959 Hebgen Lake, Montana earthquake. However, none of these events have occurred along the Wasatch fault zone or other known late Quaternary faults in the region (Arabasz and others, 1992; Smith and Arabasz, 1991). The closest of these events to the site was the 1934 Hansel Valley (M_S 6.6) event north of the Great Salt Lake and south of the town of Snowville.

Lake Bonneville History

Lakes occupied nearly 100 basins in the western United States during late-Quaternary time, the largest of which was Lake Bonneville in northwestern Utah. The Bonneville basin consists of several topographically closed basins created by regional extension in the Basin and Range (Gwynn, 1980; Miller, 1990), and has been an area of internal drainage for much of the past 15 million years. Lake Bonneville consisted of numerous topographically closed basins, including the Salt Lake and Cache Valleys (Oviatt and others, 1992). Portions of Ogden Valley were inundated by Lake Bonneville at its highstand, which is generally below about 5,160 to 5,200 feet along the valley margins.

Timing of events related to the transgression and regression of Lake Bonneville is indicated by calendar age estimates of significant radiocarbon dates in the Bonneville Basin (Oviatt, 2015). Approximately 30,000 years ago, Lake Bonneville began a slow transgression (rise) to its highest level of 5,160 to 5,200 feet above mean sea level. The lake rise eventually slowed as water levels approached an external basin threshold in northern Cache Valley at Red Rock Pass near Zenda, Idaho. Lake Bonneville reached the Red Rock Pass threshold and occupied its highest shoreline, termed the Bonneville beach, around 18,000 years ago. During the transgression and highstand, major drainages that emanate from within the Wasatch Range (such as the Weber River) formed large deltaic complexes in the lake at their canyon mouths. Headward erosion of the Snake River-Bonneville basin drainage divide then caused a catastrophic incision of the threshold and the lake level lowered by roughly 360 feet in fewer than two months (Jarrett and Malde, 1987; O'Conner, 1993). The Project is slightly below the lake highstand elevation. One discontinuous Bonneville shoreline is mapped on Figure 2 about 3,600 feet southeast of the Project (blue line labeled "B").

Following the Bonneville flood, the lake stabilized and formed a lower shoreline referred to as the Provo shoreline between about 16,500 and 15,000 years ago. Climatic factors then caused the lake to regress rapidly from the Provo shoreline, and by about 13,000 years ago the lake had eventually dropped below historic levels of Great Salt Lake. Drainages that fed Lake Bonneville, including Sheep Creek and North Fork in Ogden Valley, began downcutting through stranded deltaic complexes and near-shore deposits as the lake receded from the Provo shoreline. Oviatt and others (1992) deem this low stage the end of the Bonneville lake cycle. Great Salt Lake then experienced a brief transgression around 11,600 years ago to the Gilbert level at about 4,250 feet before receding to and remaining within about 20 feet of its historic average level (Lund, 1990).

SITE CHARACTERIZATION

Empirical Observations

On October 7, 2016, Bill D. Black of Western GeoLogic conducted a brief reconnaissance of the property. Weather at the time of the site reconnaissance was clear and sunny with temperatures in the 40's (°F). The Project is near the northwestern margin of Ogden Valley on gently rolling northeast-facing slopes. The site is a former field graded for agricultural use and vegetated by alfalfa. Slopes at the site are relatively gentle and dip at about an overall 11:1 (horizontal:vertical) gradient to the northeast. A swale trends northeastward across the western and northern parts of the site, but no active drainage was observed.

The site is in an area of residential development that began in about the late 1970s. An unlined canal crosses the western part of the site and flows to the southeast; the canal is fed by Liberty Creek Spring to the northwest and was flowing at the time of our reconnaissance. The canal did not appear to be a bermed structure and is excavated below native grades. No evidence for debris flows, springs, seeps, ongoing or recent slope instability, or other geologic hazards was observed at the property. Given our surficial observations, we anticipate near-surface soils to consist of gravelly sand with silt.

Air Photo Observations

Orthophotography from 1997 and 2012 (Figures 3A and 3C), and 1-meter bare earth DEM LIDAR from 2011 (Figure 3B) available from the Utah AGRC were reviewed to obtain information about the geomorphology of the Project area. The Project is on gentle northeast-facing slopes overlooking the valley floor to the east. No geomorphic evidence for any geologic hazards was observed at the site on the air photos.

GEOLOGIC HAZARDS

Assessment of potential geologic hazards and the resulting risks imposed is critical in determining the suitability of the site for development. Table 1 below shows a summary of the geologic hazards reviewed at the site, as well as a relative (qualitative) assessment of risk to the Project for each hazard. A "high" hazard rating (H) indicates a hazard is present at the site (whether currently or in the geologic past) that is likely to pose significant risk and/or may require further study or mitigation techniques. A "moderate" hazard rating (M) indicates a hazard that poses an equivocal risk. Moderate-risk hazards may also require further studies or mitigation. A "low" hazard rating (L) indicates the hazard is not present, poses little or no risk, and/or is not likely to significantly impact the Project. Low-risk hazards typically require no additional studies or mitigation. We note that these hazard ratings represent a conservative assessment for the entire site and risk may vary in some areas. Careful selection of development areas can minimize risk by avoiding known hazard areas.

Table 1. *Geologic hazards summary.*

Hazard	H	M	L	...Hazard Rating
Earthquake Ground Shaking	X			
Surface Fault Rupture			X	
Liquefaction and Lateral-spread Ground Failure			X	
Tectonic Deformation			X	
Seismic Seiche and Storm Surge			X	
Stream Flooding			X	
Shallow Groundwater		X		
Landslides and Slope Failures			X	
Debris Flows and Floods			X	
Rock Fall			X	
Problem Soil			X	

Earthquake Ground Shaking
Ground shaking refers to the ground surface acceleration caused by seismic waves generated during an earthquake. Strong ground motion is likely to present a significant risk during moderate to large earthquakes located within a 60 mile radius of the project area (Boore and others, 1993). Seismic sources include mapped active faults, as well as a random or "floating" earthquake source on faults not evident at the surface. Mapped active faults within this distance include the East and West Cache fault zones; the Brigham City, Weber, Salt Lake, and Provo segments of the Wasatch fault zone; the East Great Salt Lake fault zone; the Morgan fault; the West Valley fault zone; the Oquirrh fault zone; and the Bear River fault zone (Black and others, 2003).

The extent of property damage and loss of life due to ground shaking depends on factors such as: (1) proximity of the earthquake and strength of seismic waves at the surface (horizontal motions are the most damaging); (2) amplitude, duration, and frequency of ground motions; (3) nature of foundation materials; and (4) building design (Costa and Baker, 1981). Based on 2012/2015 IBC provisions, a site class of D (stiff soil), and a risk category of II, USGS calculated uniform-hazard and deterministic ground motion values with a 2% chance of exceedance in 50 years are as follows:

Table 2. *Seismic hazards summary.*
(Site Location: 41.31906° N, -111. 86106° W)

S_S	*1.019 g*
S_1	*0.355 g*
S_{MS} (F_a x S_S)	*1.113 g*
S_{M1} (F_v x S_1)	*0.600 g*
S_{DS} (2/3 x S_{MS})	*0.742 g*
S_{D1} (2/3 x S_{M1})	*0.400 g*
Site Coefficient, F_a	= *1.093*
Site Coefficient, F_v	= *1.690*

Given the above information, earthquake ground shaking poses a high risk to the site. The hazard from earthquake ground shaking can be adequately mitigated by design and construction of homes in accordance with appropriate building codes. The architect, builder, and/or Project geotechnical engineer should confirm and evaluate the seismic ground-shaking hazard and provide appropriate seismic design parameters as needed.

Surface Fault Rupture
Movement along faults at depth generates earthquakes. During earthquakes larger than Richter magnitude 6.5, ruptures along normal faults in the intermountain region generally propagate to the surface (Smith and Arabasz, 1991) as one side of the fault is uplifted and the other side down dropped. The resulting fault scarp has a near-vertical slope. The surface rupture may be expressed as a large singular rupture or several smaller ruptures in a broad zone. Ground displacement from surface fault rupture can cause significant damage or even collapse to structures located on an active fault.

The nearest active fault to the site is the Weber segment of the Wasatch fault zone about 3.6 miles to the west, and no evidence of active surface faulting is mapped or was evident at the site. Based on this, the hazard from surface faulting is rated as low.

Liquefaction and Lateral-spread Ground Failure
Liquefaction occurs when saturated, loose, cohesionless, soils lose their support capabilities during a seismic event because of the development of excessive pore pressure. Earthquake-induced liquefaction can present a significant risk to structures from bearing-capacity failures to structural footings and foundations, and can damage structures and roadway embankments by triggering lateral spread landslides. Earthquakes of Richter magnitude 5 are generally regarded as the lower threshold for liquefaction. Liquefaction potential at the site is a combination of expected seismic (earthquake ground shaking) accelerations, groundwater conditions, and presence of susceptible soils.

Although ground-shaking levels are high and the lacustrine sediments underlying the site may contain sandy layers, groundwater appears to be about 40 feet deep. Given this, we do not anticipate that soils underlying the site are likely susceptible to liquefaction. We therefore rate the risk as low. Weber County hazard mapping similarly shows the site in a zone of low liquefaction potential.

Tectonic Deformation
Tectonic deformation refers to subsidence from warping, lowering, and tilting of a valley floor that accompanies surface-faulting earthquakes on normal faults. Large-scale tectonic subsidence may accompany earthquakes along large normal faults (Lund, 1990). Tectonic subsidence is believed to mainly impact those areas immediately adjacent to the downthrown side of a normal fault. The site is not on the downthrown side of any active faults. Given this, we rate the hazard from tectonic subsidence as low.

Seismic Seiche and Storm Surge
Earthquake-induced seiche presents a risk to structures within the wave-oscillation zone along the edges of large bodies of water, such as the Great Salt Lake. Given the elevation of the subject property and distance from any large bodies of water, the risk from seismic seiches and storm surges is rated as low.

Stream Flooding
Stream flooding may be caused by direct precipitation, melting snow, or a combination of both. In much of Utah, floods are most common in April through June during spring snowmelt. High flows may be sustained from a few days to several weeks, and the potential for flooding depends on a variety of factors such as surface hydrology, site grading and drainage, and runoff.

Except for the unlined canal, no active drainages were observed crossing the site or are shown on Figure 1. Weber County hazard maps also indicate that the site is not in a FEMA hazard zone subject to flooding. Given all the above, we rate the risk from stream flooding as low. However, site hydrology and drainage should be addressed in the civil engineering design for the development, in accordance with all applicable local government development guidelines.

Canals are typically not subject to floods since flows are controlled, although canals crossing steep slope areas may be prone to failures (such as from piping, erosion, or landslides) that produce flooding. Catastrophic canal failures have historically caused property damage and loss of life in Utah (Bowman, 2016). A 50-foot setback is typically recommended from active drainages per Weber County guidelines, although canals are not subject to this setback (Rick Grover, Director, Weber County Planning, verbal communication, October 7, 2016). Although the canal crossing the site is not in steep slopes, appears to have a low risk for failure, and would not typically be subject to mandated setbacks, the above setback distance would reduce the risk of encountering shallow groundwater in areas adjacent to the canal (as discussed below). We note that the existing residential home to the south of the property on Figure 3C appears to be at a 50-foot setback distance from the canal.

Shallow Groundwater
Given evidence discussed in the Hydrology Section above, groundwater at the site is likely about 40 feet deep and not likely to pose a development constraint. However, shallower levels may be found in areas adjacent to the unlined canal crossing the property. Given this, we rate the risk from shallow groundwater as moderate. We believe a 50-foot setback (as discussed in Stream Flooding above) would reduce the risk of encountering localized shallow groundwater in areas adjacent to the canal. If the proposed home at the site will be closer than 50 feet to the canal and have a basement, we recommend the hazard from shallow groundwater be evaluated in a geotechnical engineering evaluation prior to building, and foundation-drainage recommendations be provided if groundwater is determined to pose a potential constraint.

Landslides and Slope Failures

Slope stability hazards such as landslides, slumps, and other mass movements can develop along moderate to steep slopes where a slope has been disturbed, the head of a slope loaded, or where increased groundwater pore pressures result in driving forces within the slope exceeding restraining forces. Slopes exhibiting prior failures, and also deposits from large landslides, are particularly vulnerable to instability and reactivation.

No landslides are mapped at the Project or in the area, and no evidence of recent or ongoing slope instability was observed at the site during our reconnaissance or on air photos. Slopes at the site are also relatively gentle (overall 11:1 gradient). Given the above, we rate the risk from landslides as low.

Debris Flows

Debris flow hazards are typically associated with unconsolidated alluvial fan deposits at the mouths of large range-front drainages, such as those along the Wasatch Front. Debris flows have historically significant damage in the Wasatch Front area. The site is near the distal edge of a large alluvial-fan complex mapped north of Nordic Valley Ski Area on Figure 2. However, no evidence of debris-flow channels, levees, or other debris-flow features was observed. Based on the above, we rate the hazard from debris flows at the site as low.

Rock Fall

No bedrock outcrops were observed at the site or in higher nearby slopes that could present a source area for rock fall clasts. Based on the above, we rate the hazard from rock falls as low.

Swelling and Collapsible Soils

Surficial soils that contain certain clays can swell or collapse when wet. Given our site observations and anticipated subsurface conditions, such soils appear unlikely to be present and the risk from problem soils is therefore low. However, a geotechnical engineer should be contacted to observe and document the foundation excavation to recognize differing subsurface conditions that may affect performance of the planned structure.

CONCLUSIONS AND RECOMMENDATIONS

Earthquake ground shaking is the only geologic hazard identified as posing a high relative risk to the Project. Shallow groundwater may also be locally present in areas adjacent to the unlined canal crossing the site, and is therefore identified as posing a moderate risk. The following recommendations are provided to reduce risk from these hazards and for proper site development:

- ***Seismic Design*** – The proposed home should be constructed to current seismic hazards to reduce the risk from earthquake ground shaking.

- ***Excavation Observation*** – We recommend a geotechnical engineer be contacted to observe the foundation excavation to recognize differing subsurface conditions that may affect performance of the planned structure and provide recommendations regarding the foundation design. The foundation design should be in accordance with all applicable development codes.

- ***Localized Shallow Groundwater*** – If the proposed home will have a basement and be closer than 50 feet to the unlined canal crossing the property, we recommend the hazard from shallow groundwater be evaluated in a geotechnical engineering evaluation prior to building, and foundation-drainage recommendations be provided if groundwater is determined to pose a potential constraint. Locating the home more than 50 feet from the canal would eliminate the need for such additional studies.

- ***Availability of Report*** - This report should be made available to architects, building contractors, and in the event of a future property sale, real estate agents and potential buyers. The report should be referenced for information on technical data only as interpreted from observations and not as a warranty of conditions throughout the site. The report should be submitted in its entirety, or referenced appropriately, as part of any document submittal to a government agency responsible for planning decisions or geologic review. Incomplete submittals void the professional seals and signatures we provide herein. Although this report and the data herein are the property of the client, the report format is the intellectual property of Western Geologic and should not be copied, used, or modified without express permission of the authors.

The site appears suitable for the proposed development given the geologic characterizations in this report and assuming our recommendations are followed.

LIMITATIONS

This investigation was performed at the request of the Client using the methods and procedures consistent with good commercial and customary practice designed to conform to acceptable industry standards. The analysis and recommendations submitted in this report are based upon the data obtained from site-specific observations and compilation of known geologic information. This information and the conclusions of this report should not be interpolated to adjacent properties without additional site-specific information. In the event that any changes are later made in the location of the proposed site, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or approved in writing by the engineering geologist.

This report has been prepared by the staff of Western GeoLogic for the Client under the professional supervision of the principal and/or senior staff whose seal(s) and signatures appear hereon. Neither Western GeoLogic, nor any staff member assigned to this investigation has any interest or contemplated interest, financial or otherwise, in the subject or surrounding properties, or in any entity which owns, leases, or occupies the subject or surrounding properties or which may be responsible for environmental issues identified during the course of this investigation, and has no personal bias with respect to the parties involved.

The information contained in this report has received appropriate technical review and approval. The conclusions represent professional judgment and are founded upon the findings of the investigations identified in the report and the interpretation of such data based on our experience and expertise according to the existing standard of care. No other warranty or limitation exists, either expressed or implied.

The investigation was prepared in accordance with the approved scope of work outlined in our proposal for the use and benefit of the Client; its successors, and assignees. It is based, in part, upon documents, writings, and information owned, possessed, or secured by the Client. Neither this report, nor any information contained herein shall be used or relied upon for any purpose by any other person or entity without the express written permission of the Client. This report is not for the use or benefit of, nor may it be relied upon by any other person or entity, for any purpose without the advance written consent of Western GeoLogic.

In expressing the opinions stated in this report, Western GeoLogic has exercised the degree of skill and care ordinarily exercised by a reasonable prudent environmental professional in the same community and in the same time frame given the same or similar facts and circumstances. Documentation and data provided by the Client, designated representatives of the Client or other interested third parties, or from the public domain, and referred to in the preparation of this assessment, have been used and referenced with the understanding that Western GeoLogic assumes no responsibility or liability for their accuracy. The independent conclusions represent our professional judgment based on information and data available to us during the course of this assignment. Factual information regarding operations, conditions, and test data provided by the Client or their representative has been assumed to be correct and complete. The conclusions presented are based on the data provided, observations, and conditions that existed at the time of the field exploration.

It has been a pleasure working with you on this project. Should you have any questions, please call.

Sincerely,
Western GeoLogic, LLC

LICENSED PROFESSIONAL GEOLOGIST
10-9-2016
BILL DUANE BLACK
NO. 5224898-2250
STATE OF UTAH

Bill. D. Black, P.G.
Senior Engineering Geologist

Reviewed by:

LICENSED PROFESSIONAL GEOLOGIST
CRAIG V NELSON
5251804
STATE OF UTAH

Craig V. Nelson, P.G.
Principal Engineering Geologist

ATTACHMENTS

Figure 1. Location Map (8.5”x11”)
Figure 2. Geologic Map (8.5”x11”)
Figure 3A. 1997 Air Photo (8.5”x11”)
Figure 3B. 2011 LIDAR Image (8.5”x11”)
Figure 3C. 2012 Air Photo (8.5”x11”)

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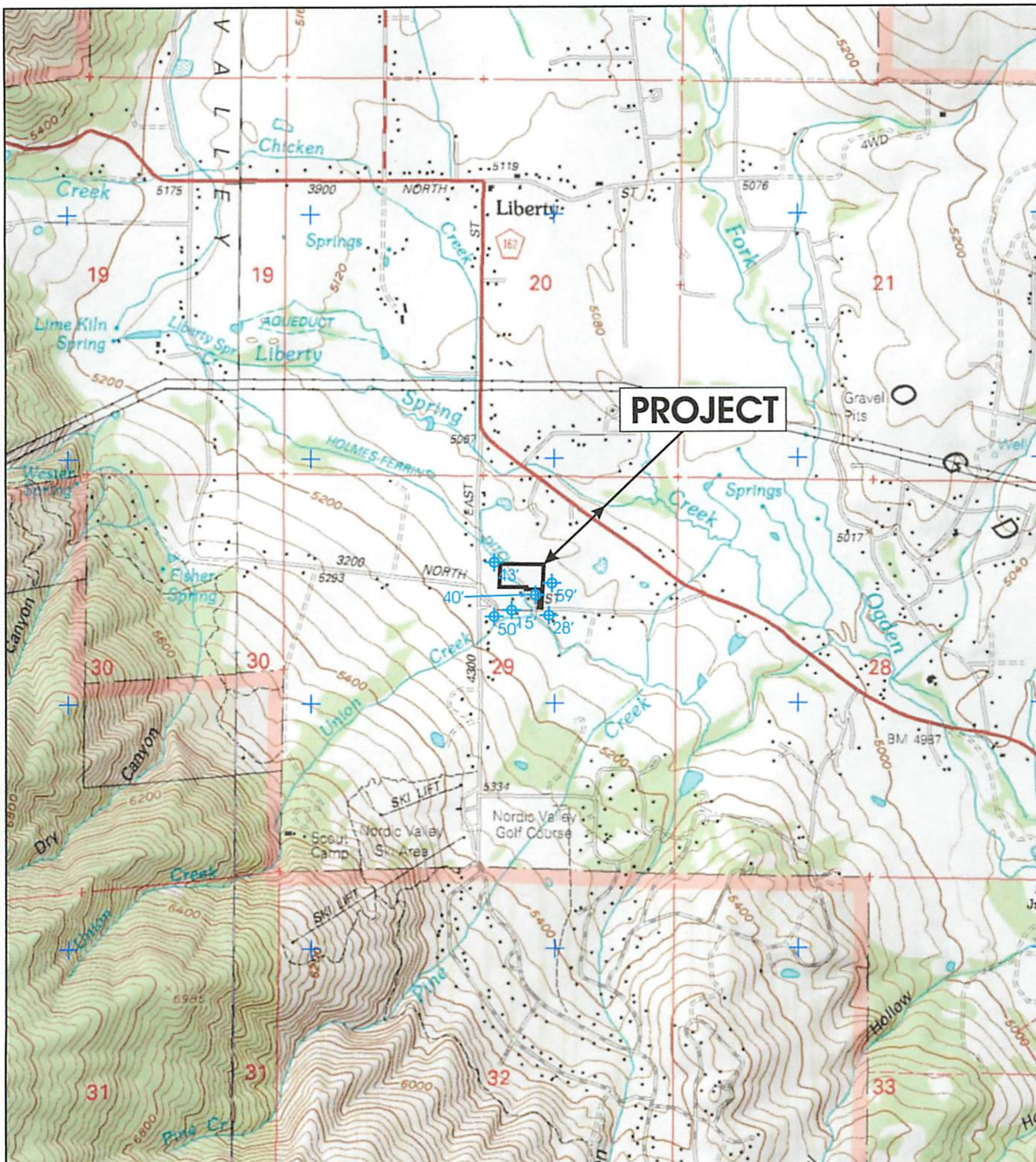


Source: U.S. Geological Survey 7.5 Minute Series Topographic Maps, Utah - Huntsville, 1998;
Project location NE1/4, Section 29, T7N, R1E (SLBM).

40' Nearby water wells and static groundwater depth

N
W E
S

0 1000 2000 feet

Scale 1:24,000
(1 inch = 2000 feet)

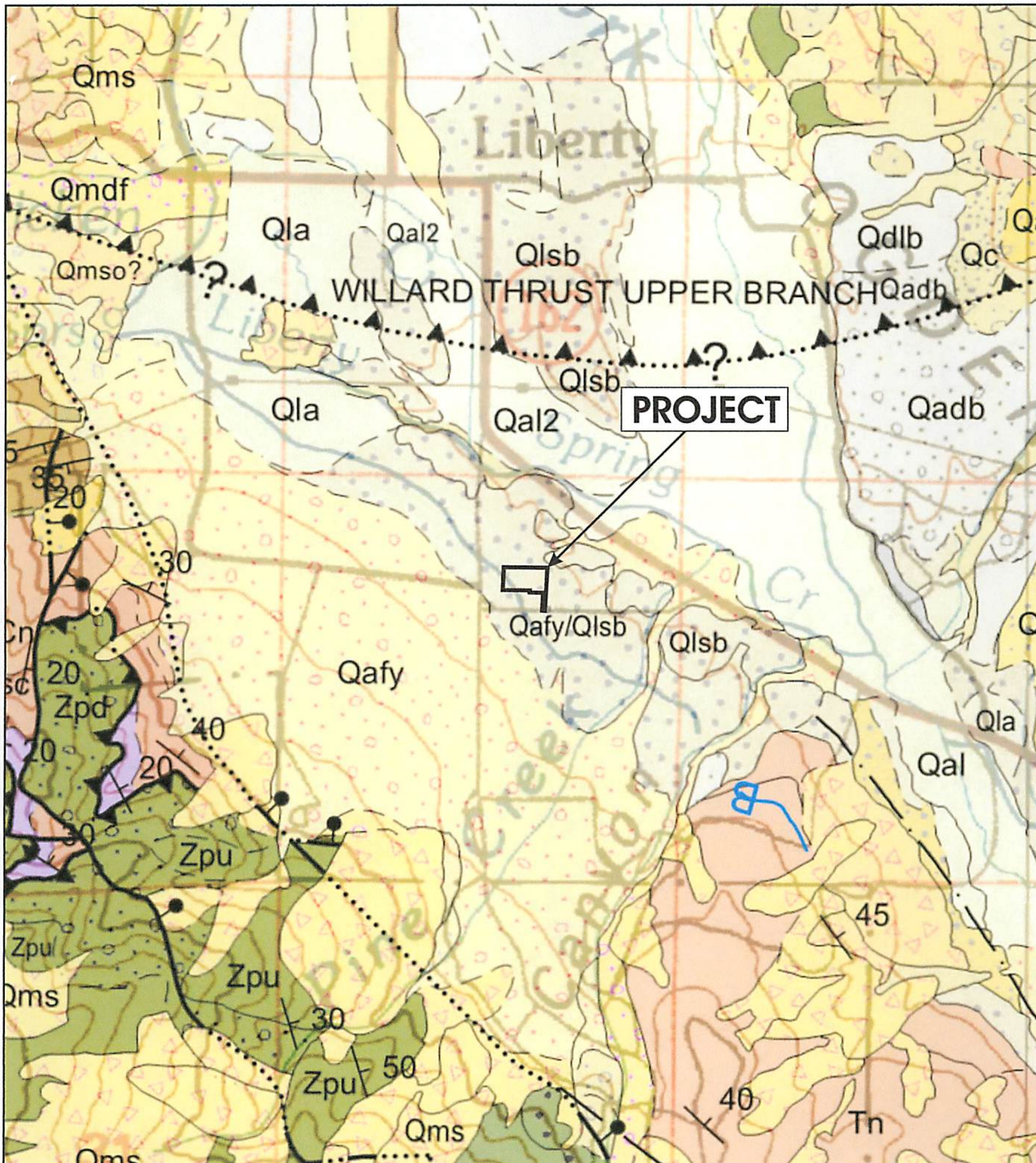
WESTERN GEOLOGIC

LOCATION MAP

GEOLOGIC HAZARDS RECONNAISSANCE

Residential Lot
3644 East 3300 North
Eden, Weber County, Utah

FIGURE 1



Source: Coogan and King (2016), original map scale 1:100,000.
See text for explanation of nearby surficial geologic units.

GEOLOGIC MAP

GEOLOGIC HAZARDS RECONNAISSANCE
Residential Lot
3644 East 3300 North
Eden, Weber County, Utah

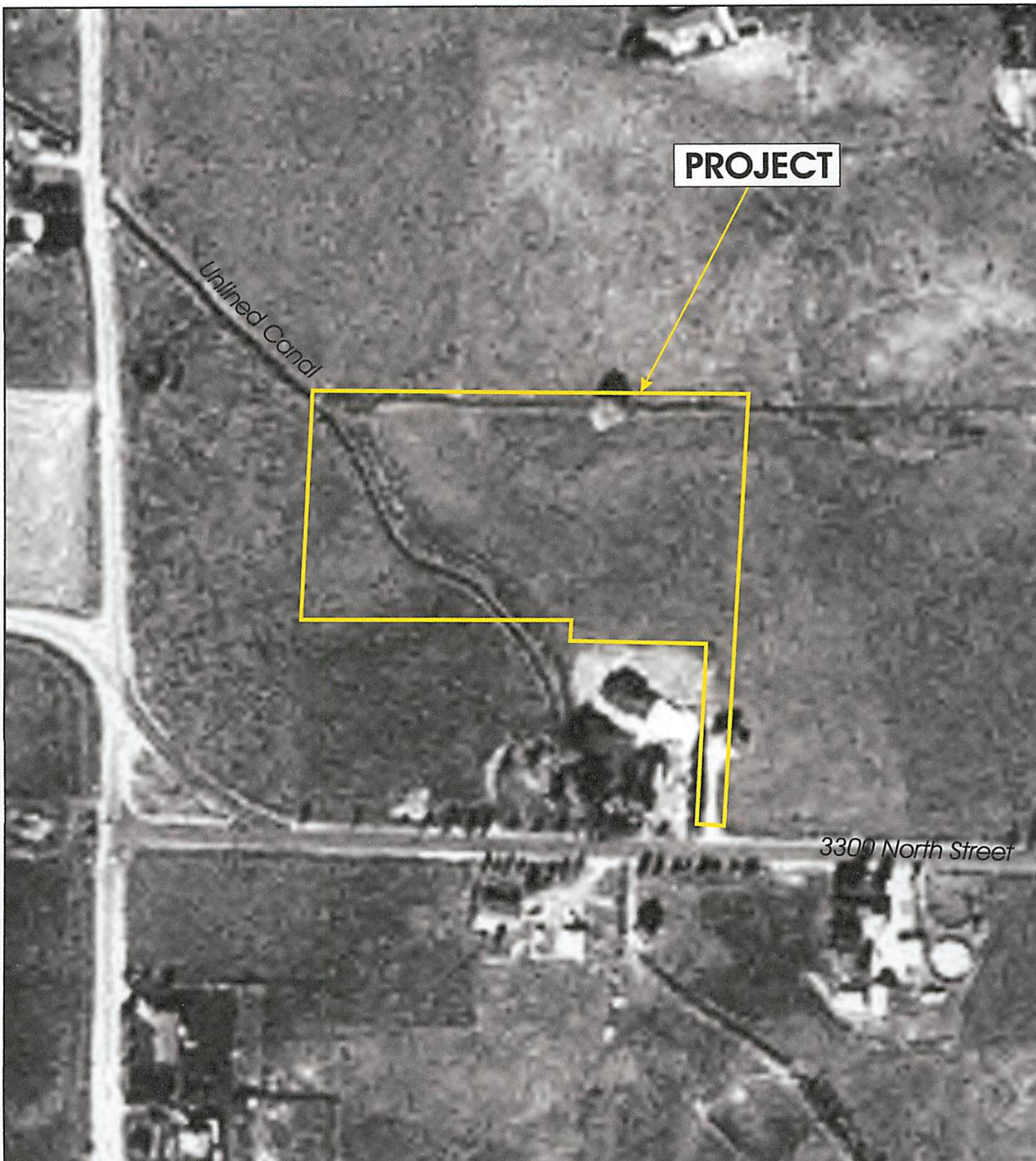
FIGURE 2

WESTERN GeoLogic

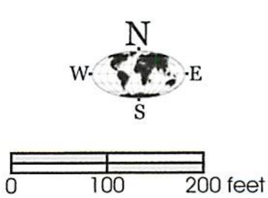
N W E S

0 1000 2000 feet

Scale 1:24,000
(1 inch = 2000 feet)



Source: Utah AGRC Digital Orthophoto Quadrangle.



Scale 1:2,400
(1 inch = 200 feet)

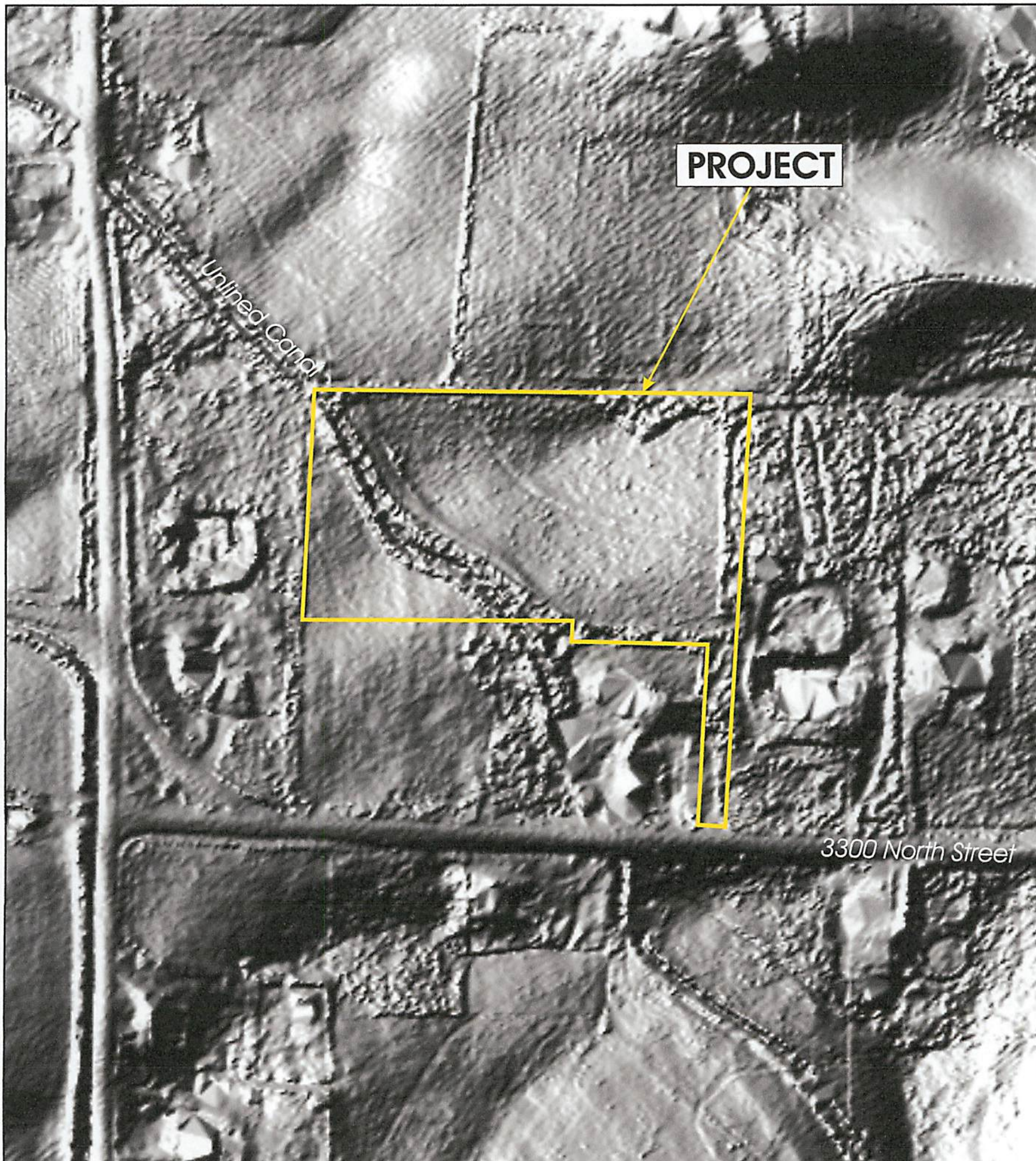
WESTERN GEOLOGIC

1997 AERIAL PHOTO

GEOLOGIC HAZARDS RECONNAISSANCE

Residential Lot
3644 East 3300 North
Eden, Weber County, Utah

FIGURE 3A



Source: Utah AGRC, 2011 LIDAR DEM, one meter resolution.

WESTERN GeoLogic

N W E S

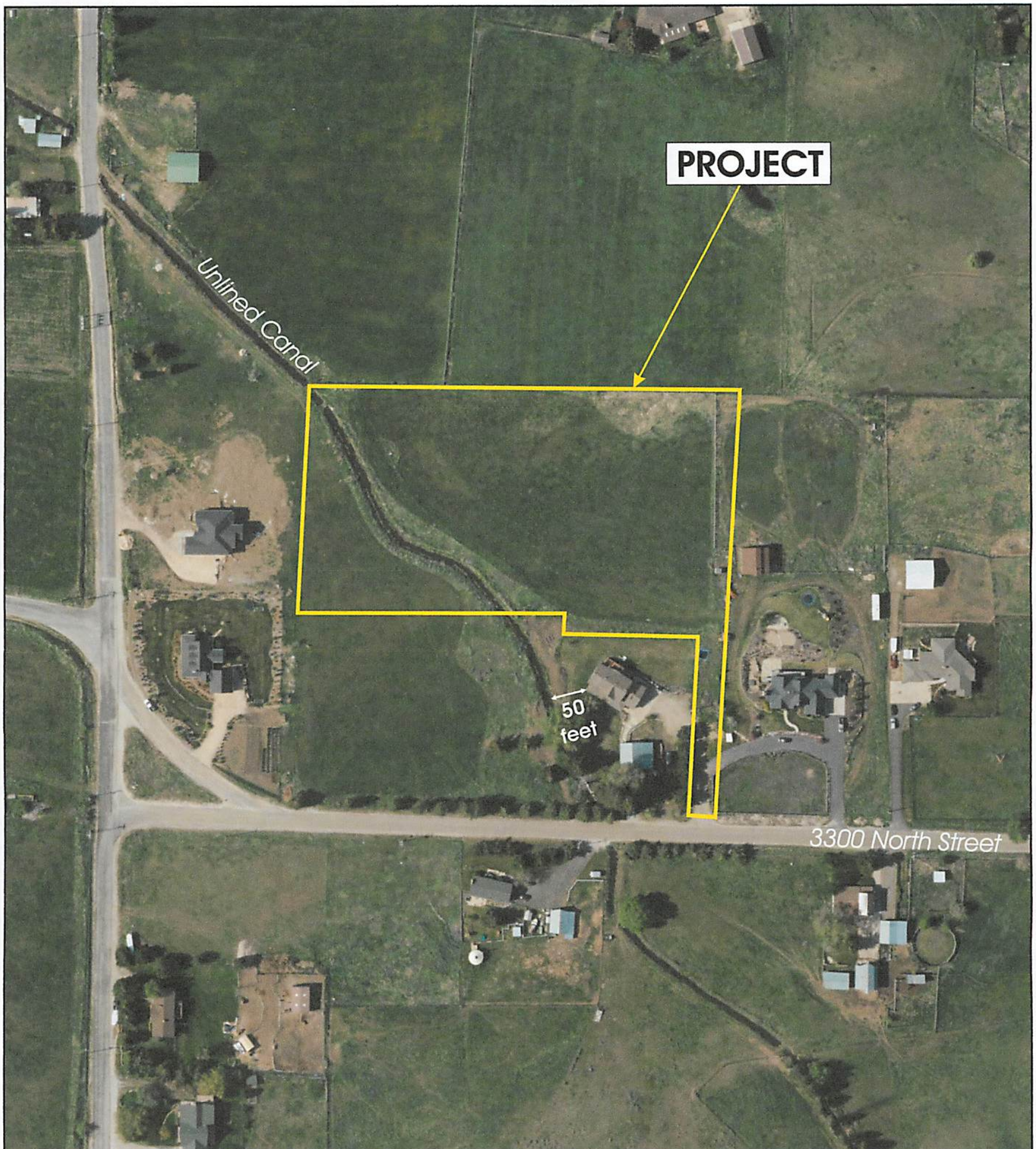
0 100 200 feet

Scale 1:2,400
(1 inch = 200 feet)

2011 LIDAR IMAGE

GEOLOGIC HAZARDS RECONNAISSANCE
Residential Lot
3644 East 3300 North
Eden, Weber County, Utah

FIGURE 3B



Source: Utah AGRC, 2012 High Resolution Orthophoto, six inch resolution.

WESTERN GEOLOGIC

N
W E
S

0 100 200 feet

Scale 1:2,400
(1 inch = 200 feet)

2012 AIR PHOTO

GEOLOGIC HAZARDS RECONNAISSANCE
Residential Lot
3644 East 3300 North
Eden, Weber County, Utah

FIGURE 3C

WESTERN GEOLOGIC, LLC
2150 SOUTH 1300 EAST, SUITE 500
SALT LAKE CITY, UT 84106 USA

Phone: 801.359.7222 Fax: 801.990.4601 Email: cnelson@westerngeologic.com

October 1, 2016

Bobby Cvitkovich
3430 Big Piney Drive
Eden, Utah. 84310
Phone: (385) 405-1862

VIA EMAIL: Stitch730@hotmail.com

PROPOSAL Geologic Hazards Reconnaissance
Residential Lot
3644 East 3300 North
Eden, Weber County, Utah

Dear Mr. Cvitkovich:

Western GeoLogic is pleased to present this proposal to perform a reconnaissance-level geologic hazards evaluation at the subject site, as requested by Weber County Planning Department staff. The scope of work and this proposal were prepared pursuant to our prior discussions and at your request. The site consists of a 3.66-acre parcel identified as Weber County Assessor Parcel Number 22-023-0014. It is our understanding that proposed development at the site will consist of a single-family residential home, although we are unaware of any formal development plans.

SCOPE OF WORK

The Project is in northwestern Ogden Valley on relatively gentle northeast-facing slopes about 1.9 miles southwest of Wolf Creek Resort. Our preliminary review of unpublished geologic mapping for the area shows the site is underlain by unconsolidated alluvium overlying lacustrine sediments associated with Pleistocene Lake Bonneville. No mapped landslides are at the site.

Based on our understanding of the site geology, Western GeoLogic proposes to conduct a brief site reconnaissance of the site and nearby vicinity to inspect the geomorphology and surficial deposits at the site, and to review historic aerial photographs and/or LIDAR imagery to look for evidence of potential geologic hazards. We will also compile and review readily available geologic information pertaining to the Project and assess relative risk from geologic hazards. Purpose of the above will be to identify geologic hazards that may pose a high risk to the home.

Our report will be prepared by a Utah licensed professional geologist, and include an assessment of surficial geologic conditions and relative risk posed by geologic hazards. The report will also provide site-specific recommendations to address high-risk hazards, such as may be present. A geotechnical engineering report is recommended to provide seismic design, footing and foundation, and site grading recommendations. This latter report must be prepared by a Utah licensed professional engineer. Our evaluation provides baseline information for the geotechnical study, thus a cooperative effort is typically beneficial. The geotechnical engineering evaluation may involve only a brief foundation excavation observation to confirm presumed soil conditions.

We do not anticipate conducting any subsurface exploration for our investigation, although we recommend that we examine any future excavations that may be conducted (such as for the geotechnical engineering evaluation) to document subsurface and/or differing conditions that may impact the proposed home. We will present our findings in a letter report. This report will include, at a minimum, the following:

1. A Vicinity Map showing the location of the property.

2. A Geologic Map showing the surficial geology of the property and surrounding area.

3. An Air Photo and/or LIDAR image showing the site and nearby surficial geologic hazards.

4. A discussion of potential geologic hazards that may impact the site, including:

    - Landslides;
    - Debris Flows;
    - Rockfalls;
    - Stream Flooding;
    - Surface Fault Rupture;
    - Soil Liquefaction;
    - Shallow Groundwater; and
    - Earthquake Ground Shaking.

5. Recommendations for development and/or additional analyses, as may be required based on our findings.

CONDITIONS, SCHEDULE AND FEES

Western GeoLogic proposes to undertake the above scope of work on a TIME-AND-MATERIALS basis in general accordance with the attached "General Conditions" as presented on Attachment 1. Western GeoLogic proposes to perform this work according to the following estimated breakdown:

Labor: Senior Engineering Geologist, 8 hours @ $120.00/hour	$960.00
Labor: Principal Engineering Geologist, 1 hour @ $120.00/hour	$120.00
Labor: Office Administration, 2 hours @ $60.00/hour	$120.00
Related expenses: mileage	$50.00
TOTAL	**$1,250.00**

Mileage will be billed at $0.62 per mile. Additional related expenses will be billed at cost plus 15%. We agree not to exceed the above estimated cost without justification and your prior authorization.

The above fee is based on the following conditions:

1. You will assist Western GeoLogic by providing free and clear access to the property to the extent possible. Our observations may be limited by restrictive site conditions and/or access, such as from snow cover or landowner restrictions.

2. We will provide a digital Adobe "pdf" file of the report. Printed and bound copies may be provided at your option, but are at additional cost and will require additional delivery time. You may alternatively choose to have the report printed yourself. Should you choose the latter, care should be taken that all attachments are printed at their original size.

3. No time is included for attendance at planning commission or other meetings, should attendance at such meetings be required in support of the planned development after submittal of our report. Additional fees for such attendance will be incurred on a time and materials basis, and will be invoiced separately since they are typically incurred after report submittal. Any additional fees MUST be paid on receipt of the invoice in accordance with the attached "General Conditions."

4. Our evaluation and report will follow requirements provided in Chapter 27 of the Weber County Land Use Code (Section 104-27). We also recommend a geotechnical engineering evaluation be conducted for the site to provide specific seismic and other design recommendations, as discussed above. The geotechnical investigation must be contracted by you separately and may be required by county staff in addition to our geologic report.

We will be able to initiate our study following receipt of your written authorization to proceed, subject to staff availability and coordination. The proposed field program should require less than a day to complete, and the report will be complete within five to ten business days following the field program. Printing and mail delivery of any hard copies will require additional time that cannot be constrained.

We trust you will find this proposal acceptable and look forward to working with you on this project. If you have any questions regarding the proposed scope of work or any other aspects of our proposal, please call.

Sincerely,
Western GeoLogic, LLC

Craig V. Nelson, P.G.
Principal Engineering Geologist

Attachments: General Conditions

D:\Users\Bill\Desktop\Working Proposals\Cvitkovich, Bobby\Proposal - 3644 E 3300 N Eden Hazards Recon Study.docx

AUTHORIZATION TO PROCEED AND ACCEPTANCE OF TERMS AND CONDITIONS

PROJECT NAME: Geologic Hazards Reconnaissance
Residential Lot
3644 East 3300 North
Eden, Weber County, Utah

FEE: **$1,250**

DELIVERY SCHEDULE: Within Five Business Days Following Field Work Completion

The undersigned agrees to the scope of work, terms, and conditions offered herein and authorizes Western GeoLogic to proceed.

Robert C. Cvitkovich Jr. — 02 October 16

Authorized Representative (printed name) — Date

Robert C Cvitkovich Jr

Signature — Title

GENERAL CONDITIONS

1.0 BILLING

1.1 An invoice will be submitted with the report and will be paid on report delivery. The payment schedule is irrespective of any third-party client payment arrangements or schedule. Payment is required regardless of the findings and recommendations in the report or suitability of the site for the proposed development.

1.2 Interest of 1.5% per month (but not exceeding the maximum rate allowable by law) will be payable on all outstanding amounts not paid within 30 days, payment thereafter to be applied first to accrued interest and then to the principal unpaid amount. Any attorney's fees or other costs incurred in collecting any delinquent amount shall be paid by the Client.

1.3 In the event that the Client requests termination of the work prior to completion of a report, WESTERN GEOLOGIC, LLC reserves the right to complete such analyses and records as are necessary to place its files in order and, where considered by it necessary to protect its professional reputation, to complete a report on the work performed to date. A termination charge to cover the cost thereof in an amount not to exceed 30% of all charges incurred up to the date of the stoppage of the work may, at the discretion of Western GeoLogic, LLC, be made.

2.0 WARRANTY AND LIABILITY

2.1 Western GeoLogic, LLC warrants that its services are performed, within the limits prescribed by its Clients, in a manner consistent with that level of care and skill ordinarily exercised by members of the same professions currently practicing in the same locality under similar conditions. No other warranty or representation, either expressed or implied, is included in its proposals, contracts or reports.

2.2 Western GeoLogic, LLC has neither created nor contributed to the existence of any hazardous, radioactive, toxic or otherwise dangerous substance or condition at the site, and its compensation hereunder is in no way commensurate with the potential risk of injury or loss that may be caused by exposure to such substances or conditions. Accordingly, notwithstanding any other provision herein, the liability of Western GeoLogic, LLC, its employees, subcontractors and agents for any injury or loss arising from any such pre-existing or client generated dangerous substance or condition at or near the project site, shall not exceed $1,000.

2.3 Western GeoLogic, LLC, its employees, subcontractors and agents shall not be liable for indirect or consequential damages, including without limitation loss of use and loss of profits.

2.4 In addition to the limitations provided in 2.2 and 2.3, and notwithstanding any other provision herein, the liability of Western GeoLogic, LLC employees, subcontractors and agents shall be limited to injury or loss to the extent caused by the negligence of Western GeoLogic, LLC, its subcontractors and/or agents hereunder, and the liability of Western GeoLogic, LLC for injury or loss arising from (1) professional errors or omissions and/or (2) environmental impairment or pollution and/or (3) radiation, nuclear reaction, or radioactive substances or conditions shall not exceed $5,000 or our fee, whichever is greater.

2.5 The liability of Western GeoLogic, LLC, its employees, subcontractors and agents for any other claim(s) of any kind shall not exceed $100,000.

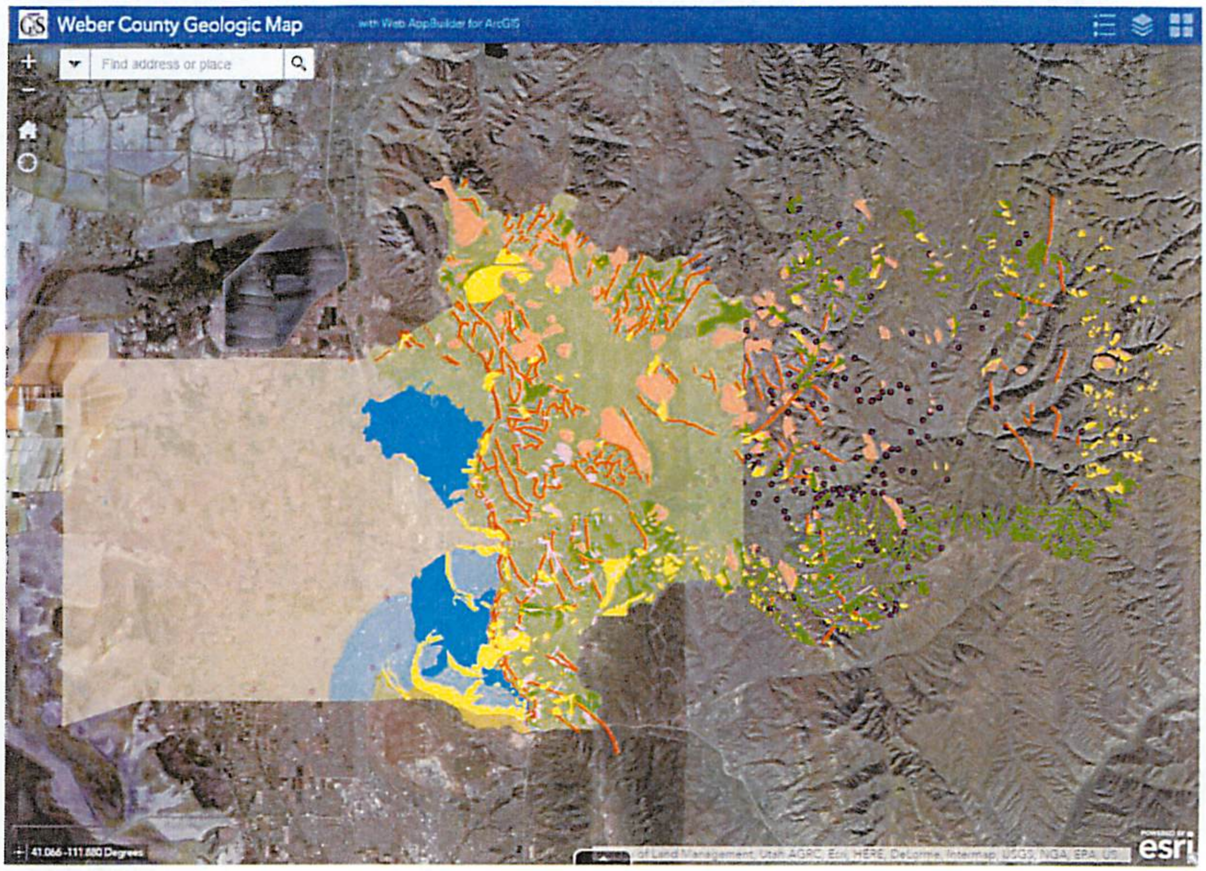
2.6 Increased liability limits may be negotiated upon the Client's written request, prior to commencement of services, and agreement to pay an additional fee.

2.7 The Client agrees to indemnify and hold harmless Western GeoLogic, LLC, it's employees, subcontractors and agents against and from any claim, liability, attorneys' fees or other defense costs incurred because of (i) injury or loss caused by the actions or omissions of the Client, it's employees or it's other agents, contractors or subcontractors, or (ii) any third party claim arising from the performance of services hereunder by Western GeoLogic, LLC, its agents or subcontractors, to the extent the liability and costs exceed the relevant amount of Western GeoLogic, LLC's liability specified in sections 2.2-2.6 above and does not result solely from the negligence or willful misconduct of Western GeoLogic, LLC, its agents or subcontractors.

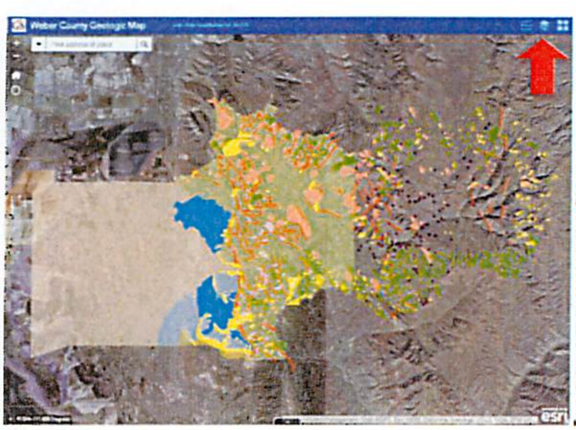
2.8 In the event the Client makes a claim against Western GeoLogic, LLC, at law or otherwise, for any alleged error, omission or other act arising out of the performance of its professional services, and to the extent the Client fails to prove such claim, then the Client shall pay all costs, including attorney's fees, incurred by Western GeoLogic, LLC in defending itself against the claim.

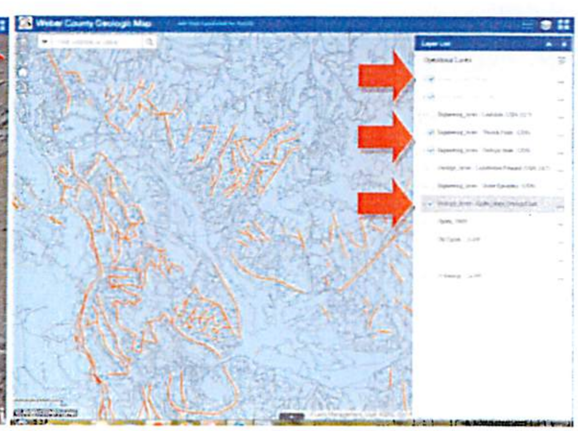
Step by step directions to navigate the Weber County Geologic Website:
https://weber.maps.arcgis.com/apps/webappviewer/index.html?id=bd557ebafc0e4ed58471342bb03fdac5

No login required-just hit cancel, the overall map will load and look like the following:

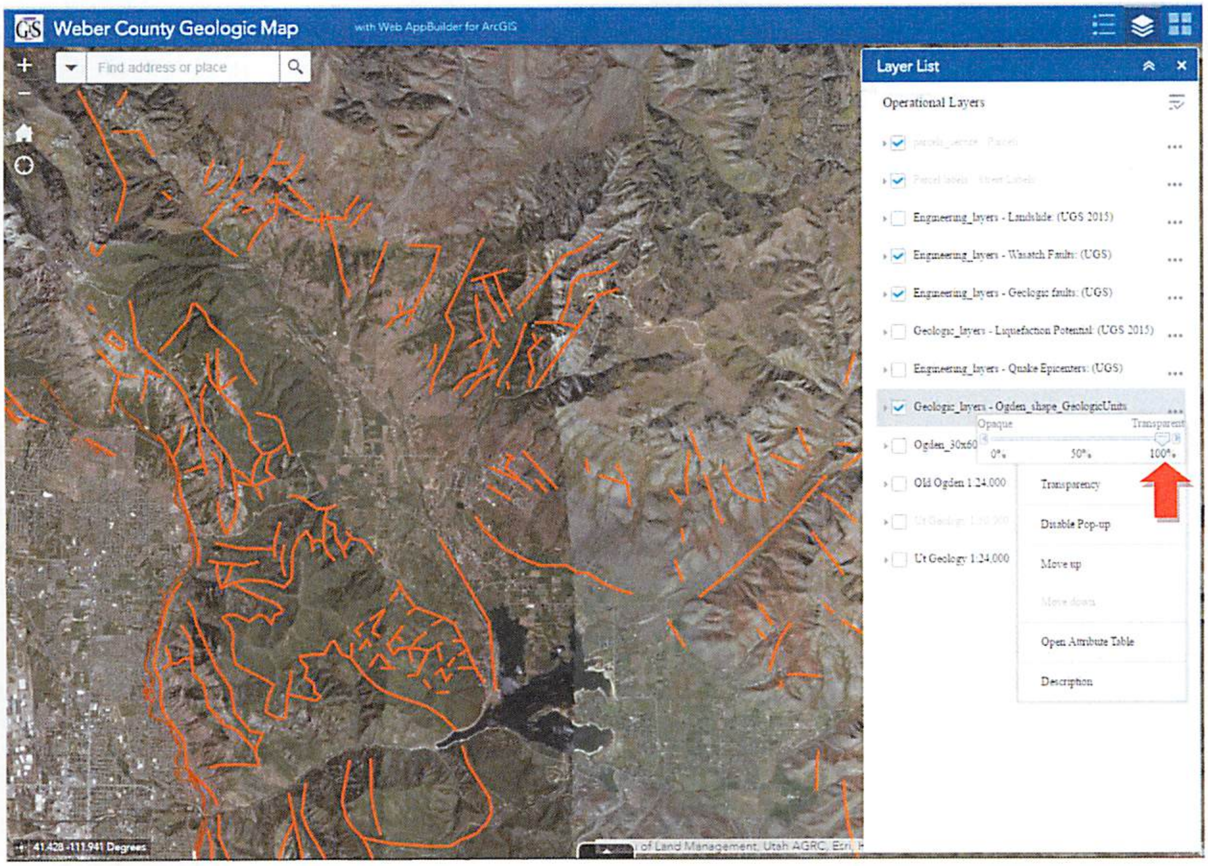


Shut off all of the layers except "parcels_secure-Parcels", "Parcel Labels-Street Labels", "Engineering_Layers-Wasatch Faults" and "Engineering_Layers_Geologic Faults" and then select the "Geologic-layers_Ogden-shape_ GeologicUnits" as shown below:



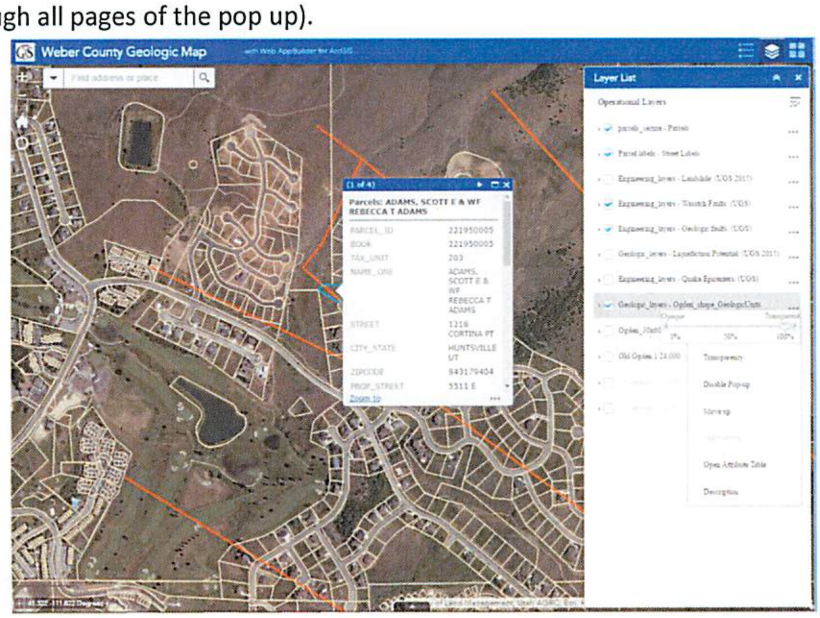


Once the shape files have loaded, turn the transparency to 100% by clicking on the "..." next to the applicable layer and moving the toggle to 100%:

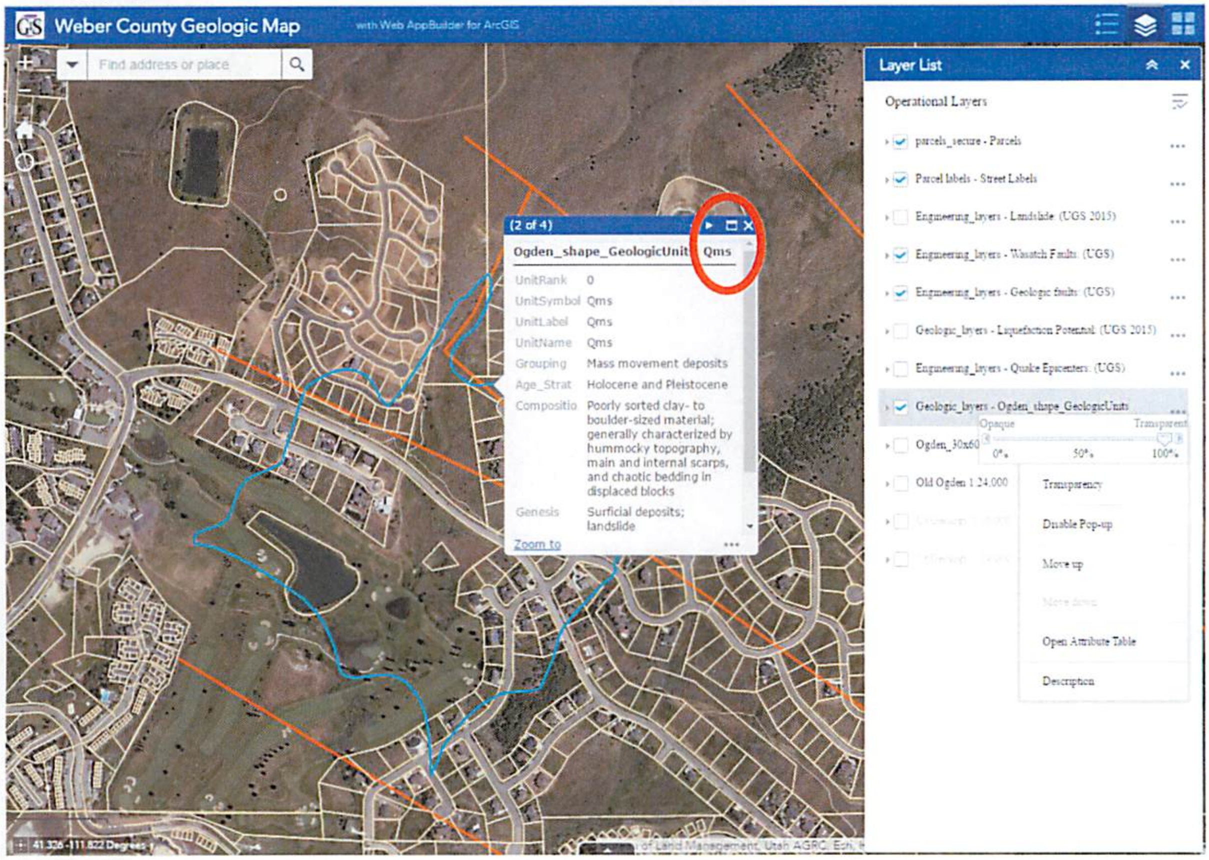


The map does not allow for a search by parcel number yet, so you will need to find the site in question and allow the parcel data to load once you have zoomed into the site. Once the parcel data has loaded click on the parcel and review the information in the pop up (The first page of the pop up is the ownership information, select the arrow in the upper left hand side of the pop up to advance to the next page for geology. Some parcels have more than one geologic unit that impacts the parcel so you will want to arrow through all pages of the pop up).

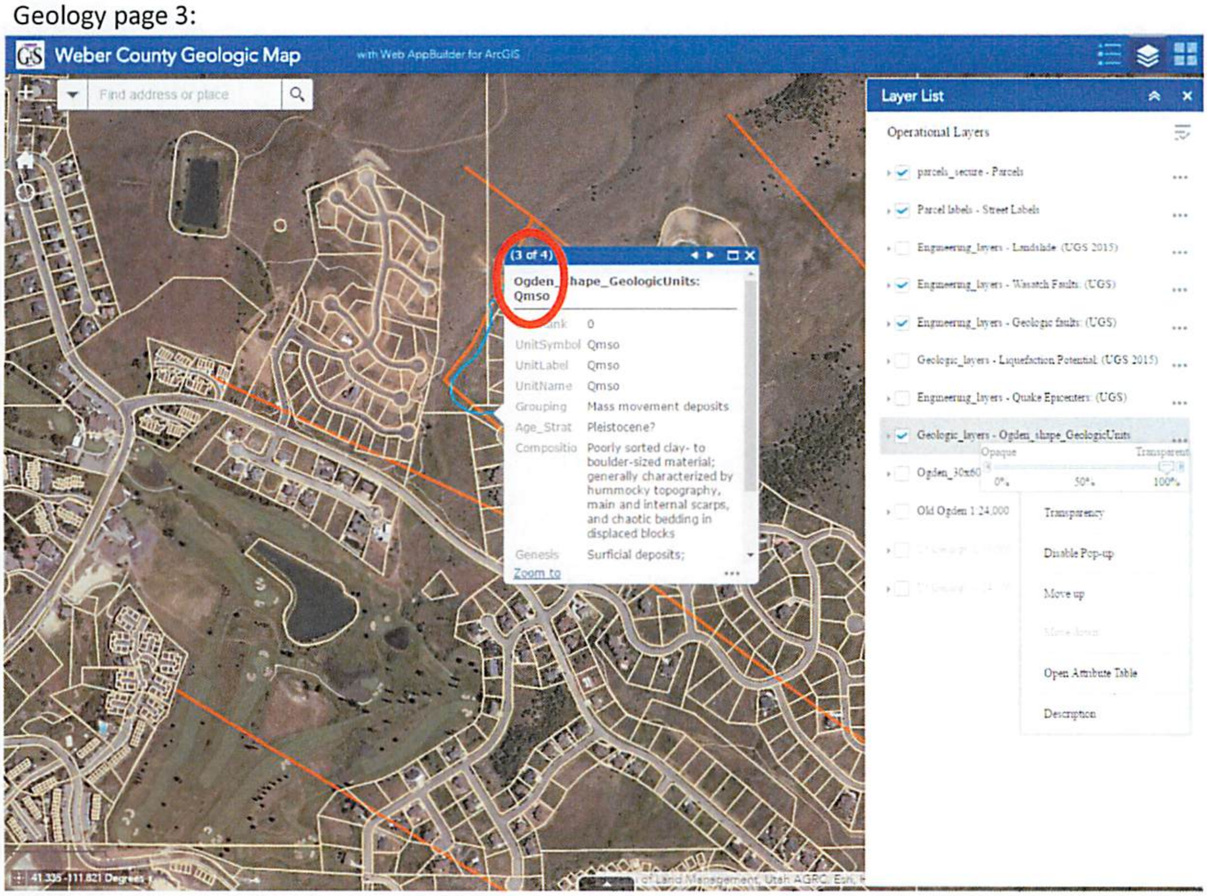
Ownership page 1:



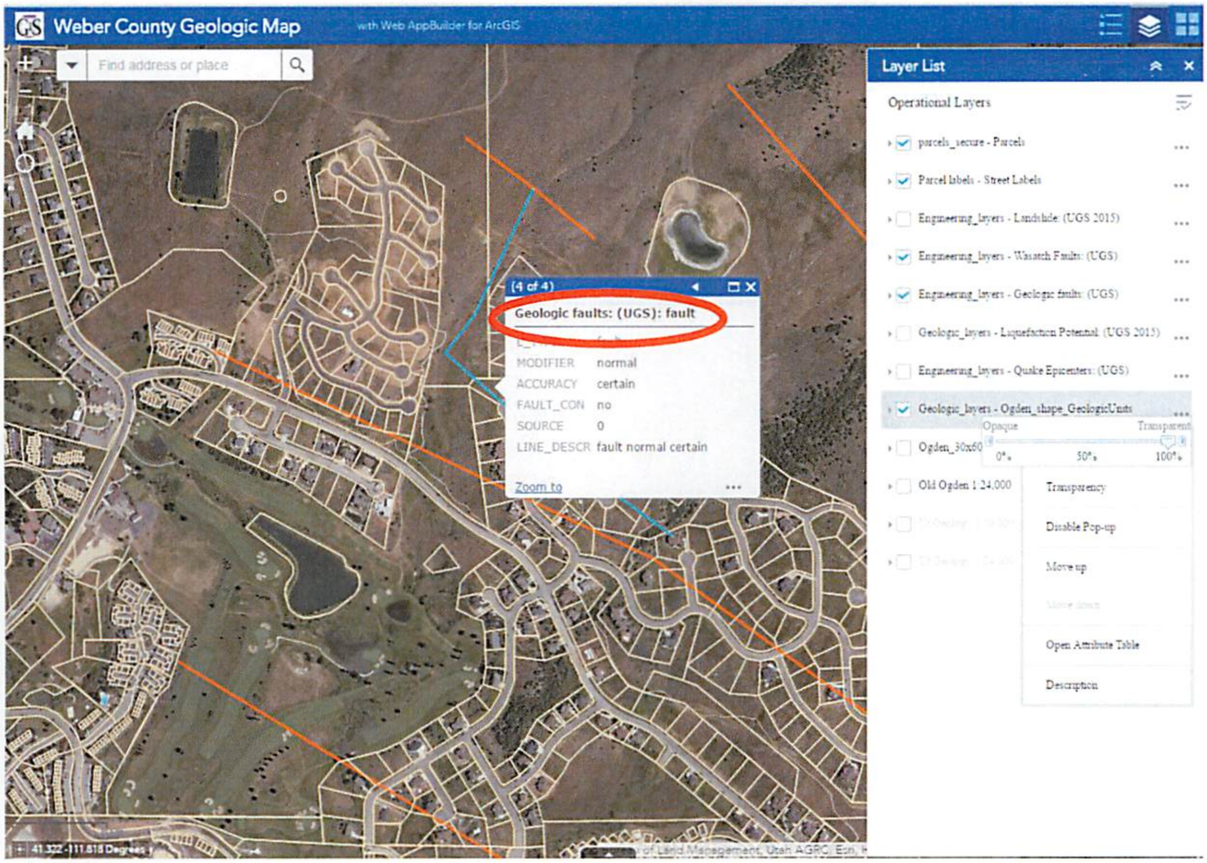
Geology page 2:



Geology page 3:



Geology page 4:



If the geologic unit associated with the parcel in question is identified in the list of units below or has a fault line identified on the site, a geologic site reconnaissance is required to determine if the building lot falls within a potential geologic hazard study area. If it is found that additional studies are necessary, a geologic and possibly a geotechnical analysis will be required if the engineering geologist hired by the applicant determines it necessary.

The geologic site reconnaissance or geologic report clearing the lot for building will be required to be submitted with the initial building permit packet. The geologic site reconnaissance and/or geologic study need to be stamped and signed by a qualified engineering geologist.

The following is a list of potential geological hazards study areas:

Qab, Qac, Qadp, Qaf, Qaf1, Qaf2, Qaf3, Qaf4, Qaf5, Qafy, Qafb, Qafo, Qafoe, Qaoe, Qafp, Qc, Qct, Qg, Qga, Qgao, Qgay, Qgo, Qgap, Qgm, Qgmo, Qgmp, Qgmy, Qgp, Qgr, Qgw, Qgy, Qm, Qmc, Qmd, Qmdf, Qmg, Qml, Qmo, Qmtr, Qms, Qms1, Qms2, Qms3, Qms4, Qmso, Qmsy, Qmy, QTms, Tcg, Tfb, Tf, Thv, Tn, Ts, Tsl, Tsn, Tsnf, Tw, Ty, Xf, Xfs, Zarx, Zkc, Zmc, Zmcc, Zmcg, Zpc, Zpu, ZYp, ZYpm, ZYpp

***Please note that this list is subject to change based on direction received from the UGS**

site reconnaissance

(385) 405 - 1862

Approved Geologist List:

Bill Black w/ Western Geologic - left message → $1250.00 - End of next week
D: 801-502-4927 - 1850.00
bblack@westerngeologic.com - parcel.

Greg Schlenker w/GCS Geoscience - left message
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gschlen@q.com

Timothy Thompson w/ GeoStrata - left message
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timt@geostrata-llc.com

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