REPORT

GEOLOGIC HAZARDS RECONNAISSANCE

PROPOSED CEDAR COVE ESTATES LOT 36

ABOUT 2740 EAST BYBEE DRIVE

OGDEN, WEBER COUNTY, UTAH

Prepared for

Brandon Durbano
2716 East Bybee Drive
Ogden, Utah 84403

September 3, 2019

Prepared by

Western Geologic & Environmental LLC
2150 South 1300 East, Suite 500
Salt Lake City, Utah 84106

Voice: 801.359.7222
Fax: 801.990.4601
Web: www.westerngeologic.com

WESTERN GEOLOGIC & ENVIRONMENTAL LLC
2150 SOUTH 1300 EAST, SUITE 500
SALT LAKE CITY, UTAH 84106 USA

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

September 3, 2019

Brandon Durbano
2716 East Bybee Drive
Ogden, Utah 84403

SUBJECT: Geologic Hazards Reconnaissance
Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive
Ogden, Weber County, Utah

Dear Mr. Durbano:

This report presents the results of a reconnaissance-level engineering geology and geologic hazards review and evaluation conducted by Western Geologic & Environmental LLC (Western Geologic) for proposed lot 36 in the Cedar Cove Estates subdivision at about 2740 East Bybee Drive in Ogden, Utah (Figure 1 – Project Location). The Project is on generally south-facing slopes overlooking the Weber River about 3,750 feet southwest of Broad Hollow at the western base of the Wasatch Range, and is in the NE¼ Section 26, Township 5 North, Range 1 West (Salt Lake Base Line and Meridian). Elevation of the site ranges between about 4,652 and 4,696 feet above sea level. The Project currently consists of a 0.96-acre parcel identified as Cedar Cove Estates Lot 13-A-R (Weber County Assessor Parcel No. 07-723-0013). The parcel is developed by an existing home on the west. Based on a July 2019 Reeve & Associates plan, the existing parcel will be subdivided into two 0.48 acre parcels identified as Cedar Cove Estates lots 35 (on the west) and 36 (on the east). No formal development plans were provided, but it is our understanding that lot 36 will be developed by a new home and the existing home will remain on lot 35.

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 Ogden Quadrangle (Figure 1) shows no surface-water impoundments, springs, or active drainages at the property. No springs, seeps, or wetland areas were also observed at the Project or in the vicinity during our field reconnaissance. Slopes at the site appeared very dry. The nearest spring on Figure 1 is Hamre Spring about 1,450 feet northeast of the site.

The subsurface hydrology in the area is dominated by the East Shore aquifer system. This aquifer system is comprised of a shallow, unconfined water table zone, and the deeper, often confined, Sunset and Delta aquifers (Feth and others, 1966). The depth to the shallow unconfined aquifer varies somewhat depending on topography and climatic and seasonal fluctuations. It is influenced by seepage from irrigation systems, and infiltration from precipitation and urban runoff. The Sunset aquifer (typical depth 250-400 feet) and Delta aquifer (typical depth 500-700 feet) provide water that generally meets the standards for public drinking water supply. Based on topography the regional groundwater flow is expected to be to the south toward the Weber River floodplain.

Elevation of the shallow aquifer varies somewhat based on seasonal and climatic fluctuations. Depth to groundwater at the site is unknown but is likely greater than 30 feet based on our experience in the area. No well logs were found within 0.5 miles of the Project in the Utah Division of Water Rights Well Drillers' Database. However, groundwater levels may vary annually from climatic fluctuations, and also seasonally from snowmelt runoff and man-made sources such as landscape irrigation. Seasonal variations would be typical for an alpine environment. Perched conditions may also be found above less-permeable, fine-grained lacustrine sediments underlying the site that could cause locally shallower groundwater levels.

GEOLOGY

Surficial Geology

The site is located about 3,750 feet southwest of Broad Hollow at western base of the Wasatch Range, 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 mainly younger Quaternary landslide deposits (unit Qmsy). The hatched scarp on Figure 2 north of the site marks an embayment in the deltaic sediments characteristic of a prehistoric flow failure. Such failures are commonly found in the downcut slopes bordering the Weber River floodplain in the area.

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

> ***Qh, Qh?*** - *Human disturbances (Historical).* Mapped disturbances obscure original deposits or rocks by cover or removal; only larger disturbances that pre-date the 1984 aerial photographs used to map the Ogden 30 x 60- minute quadrangle are shown; includes engineered fill, particularly along Interstate Highways 80 and 84, the Union Pacific Railroad, and larger dams, as well as aggregate operations, gravel pits, sewage-treatment facilities, cement plant quarries and operations, brick plant and clay pit, Defense Depot Ogden (Browning U.S. Army Reserve Center), gas and oil field operations (for example drill pads) including gas plants, and low dams along several creeks, including a breached dam on Yellow Creek.
>
> ***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.
>
> ***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.

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).

Qat2, Qat3 *– Stream-terrace alluvium (Holocene and Pleistocene).* Sand, silt, clay, and gravel in terraces inset into late Pleistocene Weber River delta above Weber River flood plain; moderately to well-sorted, pebble and cobble gravel and gravelly sand with subangular to rounded clasts; unconsolidated to weakly consolidated; upper surfaces slope gently downstream; locally includes thin and small mass-movement and alluvial-fan deposits; subdivided into relative ages, indicated by number suffixes, with 2 being the lowest/youngest terraces and 3 divided by a scarp on the map into an upper and lower terrace; terraces 20 to 50 feet (6-16 m) above the Weber River; exposed thickness less than 20 to 50 feet (6-16 m) (after Yonkee and Lowe, 2004). These terraces do not fit into table 1 or 2 because they post-date the regression of Lake Bonneville from the Provo shoreline and appear to be graded to lake levels below the Gilbert shoreline.

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.

Qmc - *Landslide and colluvial deposits, undivided (Holocene and Pleistocene).* Poorly sorted to unsorted clay- to boulder-sized material; mapped where landslide deposits are difficult to distinguish from colluvium (slope wash and soil creep) and where mapping separate, small, intermingled areas of landslide and colluvial deposits is not possible at map scale; locally includes talus and debris flow and flood deposits; typically mapped where landslides are thin (“shallow”); also mapped where the blocky or rumpled morphology that is characteristic of landslides has been diminished (“smoothed”) by slope wash and soil creep; composition depends on local sources; 6 to 40 feet (2-12 m) thick. These deposits are as unstable as other landslide units (Qms, Qmsy, Qmso).

Qct - *Colluvium and talus, undivided (Holocene and Pleistocene).* Unsorted clay- to boulder-sized angular debris (scree) at the base of and on steep, typically partly vegetated slopes; shown mostly on steep slopes of resistant bedrock units; 6 to 30 feet (2-9 m) thick.

Qlf, Qlf?, Qlfb, Qlfb? - *Fine-grained lacustrine deposits (Holocene and upper Pleistocene).* Mostly silt, clay, and fine-grained sand deposited near- and off-shore in Lake Bonneville; typically mapped as Qlf below the Provo shoreline (P) because older transgressive (Qlfb) deposits are indistinguishable from younger regressive deposits; mapped as Qlfb above the Provo shoreline because these deposits can only be related to the

Bonneville shoreline (B) and transgression; grades upslope with more sand into Qls or Qlsp; typically eroded from shallow Norwood Formation in Ogden and Morgan Valleys and at least 12 feet (4 m) thick near Mountain Green. Qlf and Qlfb queried where grain size is uncertain.

In the Kaysville quadrangle, Qlf deposits that are below the Gilbert (G) shoreline are at least partly the same age as this shoreline (Holocene-latest Pleistocene) and post-date late Pleistocene Lake Bonneville. Qlf deposits below the Holocene (H) highstand shoreline are Holocene. Both ages of deposits are generally less than 15 feet (5 m) thick.

Deeper water fine-grained deposits overlie older shoreline and delta gravels (Qlf/Qdlb) at the mouths of several drainages along the Weber River. These gravels were deposited above the Provo shoreline during transgression of Lake Bonneville to the Bonneville shoreline (see unit Qdlb).

Qadp, Qadp? *- Provo-shoreline and regressive 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; mapped below/near the Provo shoreline and related to the Provo and slightly lower regressional shorelines; deposits prominent east of Brigham City, at mouth of North Ogden Canyon, and on bench north of the Weber River; deposited as delta foreset beds with original dips of 30 to 35 degrees that allow separation from mixed lacustrine deposits (Qdlp); deltaic deposits at least 40 feet (12 m) thick and contain subrounded to well-rounded pebble and cobble gravel in a matrix of sand and silt with interbeds of sand and silt; capped by gently dipping alluvial-fan and stream topset beds that are less than 16 feet (5 m) thick, are poorly to moderately sorted, silty to sandy, subangular to well-rounded pebble and cobble gravel, and contain subangular to angular clasts in a matrix of sand and silt with interbeds of sand and silt (see units lpd and alp of Personius, 1990).

East of Brigham City at the mouth of Box Elder Canyon these deposits have been extensively excavated for sand and gravel. King estimates these deposits are about 200 feet (60 m) thick (from topographic contours) south of the mouth of Box Elder Creek, while Smith and Jol (1992) implied they are 400 feet (120 m) thick to the west of the Ogden map area.

The Provo shoreline fan-delta sediments were eroded from Bonneville-shoreline lacustrine and alluvial deposits, contain 20 to 70 percent rounded recycled Lake Bonneville clasts (Personius, 1990), and were redeposited during and soon after the Bonneville flood, which occurred during the drop of Lake Bonneville to the Provo shoreline. The Qadp unit probably includes Provo-stillstand deltaic deposits, sub-Provo-stillstand (regressional) alluvial-fan and lacustrine-deltaic deposits that contain abundant reworked materials from the Provo-shoreline delta, and locally overlying alluvial-fan deposits. Personius (1990) noted that deposits at the mouth of Box Elder Canyon are a fan-delta. A fan-delta is built when an alluvial fan enters a lake or ocean, and includes both the fan and the delta.

Qlg, Qlg?, Qlgp, Qlgb, Qlgb? - *Lake Bonneville gravel and sand (upper Pleistocene).* Mostly interbedded pebble and cobble gravel and sand deposited along beaches and slightly offshore; varies from clast supported to only rare gravel clasts in a matrix of sand and silt; grades downslope and, locally, laterally into finer grained deposits (Qls, Qlsp, Qlsb); mapped as Qlg downslope from topographic slope break of Provo and regressive beaches (Qlgp) because gravel and sand may be related to Lake Bonneville transgression on this gentler slope; also mapped as Qlg where Provo shoreline not distinct or relationships to shorelines uncertain; Qlg and Qlgb queried where grain size or unit identification uncertain; up to about 100 feet (30 m) thick in gravel pits but less than 20 feet (6 m) thick on most valley slopes. Constructional landforms (beach ridges, bars, and spits) and transgressive (t) shorelines limited in Ogden map area.

Qlgp is mapped in beaches near and below the erosional bench at the Provo shoreline (P); gravel typically subrounded to rounded, but locally along bedrock mountain fronts marked by a carbonate-cemented, poorly sorted, angular pebble to boulder gravel in a sandy matrix.

Qlgb is mapped in beaches mostly just downslope from Bonneville shoreline (B), typically an eroded bench, and above Provo shoreline; deposited during transgression to and occupation of the Bonneville shoreline; clasts typically subrounded to rounded but contains subangular to angular clasts on steep bedrock mountain fronts; mountain front Bonneville shoreline benches covered by locally mappable (> 6 feet [2 m] thick) colluvium and talus (Qmt, Qc, Qct).

Xfcb, Xfcb? - *Biotite-rich schist (Paleoproterozoic).* Medium-gray to dark-brown, strongly foliated, biotite-rich schist with widespread garnet and sillimanite; displays alternating biotite-rich and quartz-feldspar-rich bands that are rotated into complex fold patterns; cut by garnet-bearing pegmatite dikes; also contains some thin layers of amphibolite, quartz-rich gneiss, and granitic gneiss; gradational contacts with migmatitic gneiss.

Citations, tables, and/or figures referenced above are not provided herein but are in Coogan and King (2016).

Seismotectonic Setting
The property is located along the western base of the Wasatch Range, a major north-south trending mountain range marking the eastern boundary of the Basin and Range physiographic province (Stokes, 1977, 1986). The Basin and Range province 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 WFZ 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 WFZ is one of the longest and most active normal-slip faults in the world, and extends for 213 miles along the western base of the Wasatch Range from southeastern Idaho to north-central Utah (Machette and others, 1992). The fault zone generally trends north-south and, at the surface, can form a zone of deformation up to several hundred feet wide containing many subparallel west-dipping main faults and east-dipping antithetic faults. Previous studies divided the fault zone into 10 segments, each of which rupture independently and are capable of generating large-magnitude surface-faulting earthquakes (Machette and others, 1992). The central five segments of the fault (Brigham City, Weber, Salt Lake, Provo, and Nephi) have each produced two or more surface-faulting earthquakes in the past 6,000 years (Black and others, 2003). The site is located along the Weber segment of the WFZ, which extends for about 35 miles from the southern edge of the Plain View salient near North Ogden to the northern edge of the Salt Lake salient near North Salt Lake (Machette and others, 1992). The nearest trace of the Weber segment is mapped about 650 feet east of the Project (Figure 2, heavy black line with bar and ball on downthrown side).

Several paleoseismic studies have been conducted on the Weber segment to evaluate its Holocene earthquake history. Nelson and others (2006) report finding evidence for four large-magnitude earthquakes at the Garner Canyon and East Ogden sites, including what they infer was a partial segment rupture (with 1.6 feet of displacement) around 500 years ago. This partial segment rupture was not evident at the Kaysville site of McCalpin and others (1994), although chronologic intervals for the remaining three earthquakes were similar. DuRoss and others (2009) indicate that paleoseismic data from the 2007 Rice Creek site support a preferred scenario of six surface-faulting earthquakes in Holocene time, with four events since about 5,400 years ago, a fifth event from 5,500 to 7,530 years ago, and a sixth event about 7,810 to 9,930 years ago. The preferred recurrence interval (mean time between events) based on this chronology is 1,500 years (DuRoss and others, 2009). Timing for events at the Rice Creek site was reportedly similar to those at the Garner Canyon, East Ogden, and Kaysville sites, except for one previously undiscovered event.

The site is also in the central portion of the Intermountain Seismic Belt (ISB), a generally north-south trending zone of historical seismicity along the eastern margin of the Basin and Range province extending 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; the largest of these earthquakes was a M_S 7.5 event in 1959 near Hebgen Lake, Montana. However, none of these earthquakes occurred along the WFZ or other known late Quaternary faults (Arabasz and others, 1992; Smith and Arabasz, 1991). The closest of these events was the 1934 Hansel Valley (M_S 6.6) event north of the Great Salt Lake.

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).

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 site is located below the Bonneville shoreline, which is in higher slopes about 2,600 feet to the east (Figure 2, heavy blue line and 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. Oviatt and others (1992) deem this low stage the end of the Bonneville lake cycle. Drainages that fed Lake Bonneville began downcutting through stranded deltaic complexes (such as the Weber Delta) and near-shore deposits as the lake receded from the Provo shoreline. 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 August 29, 2019 Bill D. Black, P.G. of Western Geologic conducted a brief reconnaissance of the property and nearby area. Weather at the time of the site visit was partly cloudy with temperatures in the low 80's (°F). A photographic record of our reconnaissance is included in the Appendix. The site is on south-facing slopes overlooking the Weber River floodplain about 0.8 miles northwest of the mouth of Weber Canyon. Native vegetation at the site is sparse and generally consists of grasses and weeds. The lower (southern part of the site) is a relative flat area that has been landscaped. A steep slope rises northward from this level area to a gentle bench. Undeformed lacustrine sand beds were evident in the slope where it is not mantled by sandy slope colluvium. No evidence of active or ephemeral drainages, seeps or springs, ongoing or previous slope instability, characteristic debris flow features, bedrock outcrops, or other geologic hazards was observed.

Air Photo Observations

Black and white aerial photography from 1997, high-resolution orthophotography from 2012, and bare earth DEM LIDAR from 2013 available from the Utah AGRC were reviewed to obtain information about the geomorphology of the Project area (Figures 3A-3C). Slopes at the site are below the crest of a south-facing terrace overlooking the Weber River. The terrace is an erosional remnant of the former Weber River floodplain. The oversteepened slopes bordering the terrace have experienced instability from a variety of causes in both prehistoric and historic time and the area further northwest has been impacted by a prehistoric flow failure (Figures 3A-B). The Project is off of the eastern flank of this failure and undeformed lacustrine sand beds were observed at the site during our reconnaissance and on Figures 3A-B further north. Slopes at the site are gentle on the southwest and northeast, but are steep in between (Figure 3C). No other geologic hazards were evident at the site or in the area 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
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. The Utah Geological Survey Quaternary Fault Database (Black and others, 2003; January 2017 update) shows numerous class A faults within 60 miles of the Project that may pose potential seismic sources.

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. Based on 2015 IBC provisions, a site class of D (stiff soil), and a risk category of II, 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: 41.14243º N, -111.91197º W)

S_S	*1.264 g*
S_1	*0.478 g*
S_{MS} (F_a x S_S)	*1.264 g*
S_{M1} (F_v x S_1)	*0.728 g*
S_{DS} (2/3 x S_{MS})	*0.842 g*
S_{D1} (2/3 x S_{M1})	*0.485 g*
Site Coefficient, F_a	*= 1*
Site Coefficient, F_v	*= 1.522*
PGA, Peak Ground Acceleration	*0.559 g*

Given the above information, earthquake ground shaking poses a high risk to the site. Earthquake ground shaking is a regional hazard common to all Wasatch Front areas. The hazard is mitigated by design and construction in accordance with appropriate building codes.

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.

No active faults are mapped or were observed at the site during our reconnaissance or on air photos. The nearest active (Holocene-age) fault to the site is the Weber segment of the WFZ about 650 feet east of the Project. Given the above, the risk from surface faulting is 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.

The Project is in an area of potentially strong ground shaking and susceptible soils, although groundwater is likely more than 30 feet deep. No evidence for prior liquefaction was observed at the Project during our reconnaissance, although the area further northwest has been impacted by a prehistoric flow failure. Weber County GIS mapping shows the site in an area of low-moderate liquefaction potential (code 4). Given all the above, the risk from liquefaction appears to currently be low. However, the risk may vary if perched or locally shallow groundwater conditions are present.

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 about 650 feet west of the WFZ. We would not anticipate at this distance that the site will experience significant seismic tilting. Given this, we rate the risk 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 relative elevations and distance to the nearest large body of water (Pineview Reservoir), we rate the risk from seismic seiches and storm surges 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.

No active or ephemeral drainages are mapped crossing the site, were evident on air photos, or were observed during our reconnaissance. Weber County hazard maps also indicate that the site is not in a FEMA hazard zone subject to flooding (zone X). Given the above, we rate the risk from stream flooding as low.

Shallow Groundwater
Given evidence discussed in the Hydrology Section above, groundwater at the site is likely more than 30 feet deep. Although shallower levels may occur seasonally, as would be expected for an alpine environment, we do not anticipate that groundwater will pose a significant development constraint. We therefore rate the risk from shallow groundwater as low. Perched conditions may occur locally that could produce shallower groundwater depths and care should be taken that proper site drainage is maintained.

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.

The Project is near the eastern flank of a prehistoric flow failure (Figures 3A-C) in an area mapped as being underlain by younger landslide colluvium on Figure 2. However, our onsite and air photo observations indicate slopes at the Project are underlain by undeformed lacustrine deltaic sediments with a thin colluvial mantle. No evidence of recent or ongoing slope instability was observed during our reconnaissance. Analysis of 2013 LIDAR data indicates slopes at the Project have an overall gradient of 23.8% (4.2:1 horizontal:vertical, from north to south).

Given all the above, the risk from landslides appears equivocal (moderate). ETE (2007) performed a slope stability analysis for the adjoining lot 12 on the north that found static and pseudo-static factors of safety of 1.585 and 1.258 (respectively), both of which are above minimum acceptable values. However, ETE (2007) recommended an engineered retaining wall be employed for structures closer than 20 feet to the slope toe. Given the above and site layout, it appears a home at the Project will require engineered retaining. A licensed geotechnical engineer should evaluate and provide the design, and care should be taken that no substantial cuts are made in the slopes without prior geotechnical analysis.

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 Project is not in an area subject to alluvial-fan flooding and no debris-flow channels, levees, or other debris-flow features were observed. We therefore rate the hazard from debris flows to the Project as low.

Rock Fall
No significant bedrock outcrops were observed at the site or in higher slopes that could present a source area for rock fall clasts. We therefore rate the hazard from rock falls to the Project as low.

Problem Soil and Rock

The U.S. Department of Agriculture Natural Resources Conservation Service (https://websoilsurvey.nrcs.usda.gov/app/) maps the soil at the Project as "Hillfield-Timpanogos-Parleys complex, 30 to 60 percent slopes, eroded." This soil is described as a terrace escarpment soil formed in alluvium and/or lacustrine deposits. The typical profile reportedly consists of an A horizon formed in silt loam to a depth of 6 inches and a C horizon formed in silt loam and stratified fine sandy loam to clay loam from 6 to 60 inches. Given the above, the risk from problem soil appears low. However, we recommend a geotechnical engineering evaluation be conducted for the Project prior to construction to provide recommendations regarding site grading, subgrade preparation, and footing and foundation design.

CONCLUSIONS AND RECOMMENDATIONS

Earthquake ground shaking is the only geologic hazard identified as posing a high relative risk to the Project. This hazard is a regional hazard common in all Wasatch Front areas. Landslides also pose a moderate (equivocal) risk.

We recommend the following:

- ***Seismic Design* –** All habitable structures developed at the property should be designed and constructed to current seismic building codes to reduce the risk of damage, injury, or loss of life from earthquake ground shaking.

- ***Geotechnical Evaluation*** – A design-level geotechnical engineering study should be conducted prior to construction to evaluate soil foundation conditions and provide recommendations regarding engineered retaining, site grading, seismic design, subgrade preparation, and footing and foundation design.

- ***Report Availability*** – This report and any subsequent reports regarding geologic conditions at the property should be made available to the architect and building contractor, as well as real estate agents and potential buyers in the event of a future sale. 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 the authors and should not be copied, used, or modified without their express permission.

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 the Project. Should you have any questions, please call.

Sincerely,
Western Geologic & Environmental LLC

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

Reviewed By:

Kevin J. Thomas, P.G.
Principal 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. 2012 Air Photo (8.5"x11")
Figure 3C. LIDAR Analysis (8.5"x11")
Appendix. Photographic Record of Site Reconnaissance

C:\Users\GLENDA\Documents\Western Geologic and Environmental\PROJECTS\Durbano, Brandon\Ogden, UT - Geo Haz Recon - About 2740 E Bybee Drive #5228\Geo Haz Recon - Proposed Cedar Cove Lot 36 - About 2740 E Bybee Drive.docx

WG&E Project No. 5228

REFERENCES

Anderson, R.E., 1989, Tectonic evolution of the intermontane system--Basin and Range, Colorado Plateau, and High Lava Plains, *in* Pakiser, L.C., and Mooney, W.D., editors, Geophysical framework of the continental United States: Geological Society of America Memoir 172, p. 163-176.

Arabasz, W.J., Pechmann, J.C., and Brown, E.D., 1992, Observational seismology and evaluation of earthquake hazards and risk in the Wasatch Front area, Utah, *in* Gori, P.L. and Hays, W.W., editors, Assessment of Regional Earthquake Hazards and Risk along the Wasatch Front, Utah: Washington, D.C, U.S. Geological Survey Professional Paper 1500-D, Government Printing Office, p. D1-D36.

Black, B.D., Hecker, Suzanne, Hylland, M.D., Christenson, G.E., and McDonald, G.N., 2003, Quaternary fault and fold database and map of Utah: Utah Geological Survey Map 193DM, CD-ROM.

Boore, D.M., Joyner, W.B., and Fumal, T.E., 1993, Estimation of Response Spectra and Peak Acceleration from Western North America Earthquakes--An interim report: U.S. Geological Survey Open-File Report 93-509.

Bowman, S.D., and Lund, W.R., 2016, Guidelines for conducting engineering-geology investigations and preparing engineering-geology reports in Utah, *in* Bowman, S.D., and Lund, W.R., editors, Guidelines for investigating geologic hazards and preparing engineering-geology reports, with a suggested approach to geologic-hazard ordinances in Utah: Utah Geological Survey Circular 122, p. 15–30.

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, scale 1:100,000, 141 p. with appendices.

DuRoss, C.B., Personius, S.F., Crone, A.J., McDonald, G.N., and Lidke, D.J., 2009, Paleoseismic Investigation of the Northern Weber Segment of the Wasatch Fault Zone at the Rice Creek Trench Site, North Ogden, Utah: Utah Geological Survey Special Study 130, Paleoseismology of Utah Volume 18, 37 p. with trench logs.

Feth, J.H., Barker, D.A., Moore, L.G., Brown, R.J., and Veirs, C.E., 1966, Lake Bonneville—Geology and hydrology of the Weber delta district, including Ogden, Utah: U.S. Geological Survey Professi9onal Paper 518, 76 p.

Gilbert, G.K., 1928, Studies of Basin and Range Structure: U.S. Geological Survey Professional Paper 153, 89 p.

Gwynn, J.W. (Editor), 1980, Great Salt Lake--A scientific, historical, and economic overview: Utah Geological Survey Bulletin 166, 400 p.

Jarrett, R.D., and Malde, H.E., 1987, Paleodischarge of the late Pleistocene Bonneville flood, Snake River, Idaho, computed from new evidence: Geological Society of America Bulletin, v. 99, p. 127-134.

Lund, W.R. (Editor), 1990. Engineering geology of the Salt Lake City metropolitan area, Utah: Utah Geological and Mineral Survey Bulletin 126, 66 p.

Machette, M.N., Personius, S.F., and Nelson, A.R., 1992, Paleoseismology of the Wasatch fault zone—A summary of recent investigations, interpretations, and conclusions, *in* Gori, P.L., and Hays, W.W., editors, Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah: U.S. Geological Survey Professional Paper 1500, p. A1-A71.

McCalpin, J.P., Forman, S.L., and Lowe, Mike, 1994, Reevaluation of Holocene faulting at the Kaysville site, Weber segment of the Wasatch fault zone, Utah: Tectonics, v. 13, no. 1, p. 1-16.

Miller, D.M., 1990, Mesozoic and Cenozoic tectonic evolution of the northeastern Great Basin, *in* Shaddrick, D.R., Kizis, J.R., and Hunsaker, E.L. III, editors, Geology and Ore Deposits of the Northeastern Great Basin: Geological Society of Nevada Field Trip No. 5, p. 43-73.

Nelson, A.R., Lowe, Mike, Personius, Stephen, Bradley, Lee-Ann, Forman, S.L., Klauk, Robert, and Garr, John, 2006, Holocene earthquake history of the northern Weber segment of the Wasatch fault zone, Utah: Utah Geological Survey Miscellaneous Publication 05-08, 39 p.

O'Connor, J.E., 1993, Hydrology, hydraulics, and geomorphology of the Bonneville flood: Geological Society of America Special Paper 274, 83 p.

Oviatt, C.G., 2015, Chronology of Lake Bonneville, 30,000 to 10,000 yr B.P.: Quaternary Science Reviews, v. 110 (2015), p. 166-171.

Oviatt, C.G., Currey, D.R., and Sack, Dorothy, 1992, Radiocarbon chronology of Lake Bonneville, Eastern Great Basin, USA: Paleogeography, Paleoclimatology, Paleoecology, v. 99, p. 225-241.

Sbar, M.L., Barazangi, M., Dorman, J., Scholz, C.H., and Smith, R.B., 1972, Tectonics of the Intermountain Seismic Belt, western United States--Microearthquake seismicity and composite fault plane solutions: Geological Society of America Bulletin, v. 83, p. 13-28.

Smith, R.B., and Arabasz, W.J., 1991, Seismicity of the Intermountain Seismic Belt, *in* Slemmons, D.B., Engdahl, E.R., Zoback, M.D., and Blackwell, D.D., editors, Neotectonics of North America: Geological Society of America, Decade of North American Geology Map v. 1, p. 185-228.

Smith, R.B. and Sbar, M.L., 1974, Contemporary tectonics and seismicity of the western United States with emphasis on the Intermountain Seismic Belt: Geological Society of America Bulletin, v. 85, p. 1205-1218.

Stewart, J.H., 1978, Basin-range structure in western North America, a review, *in* Smith, R.B., and Eaton, G.P., editors, Cenozoic tectonics and regional geophysics of the western Cordillera: Geological Society of America Memoir 152, p. 341-367.

____, 1980, Geology of Nevada: Nevada Bureau of Mines and Geology Special Publication 4.

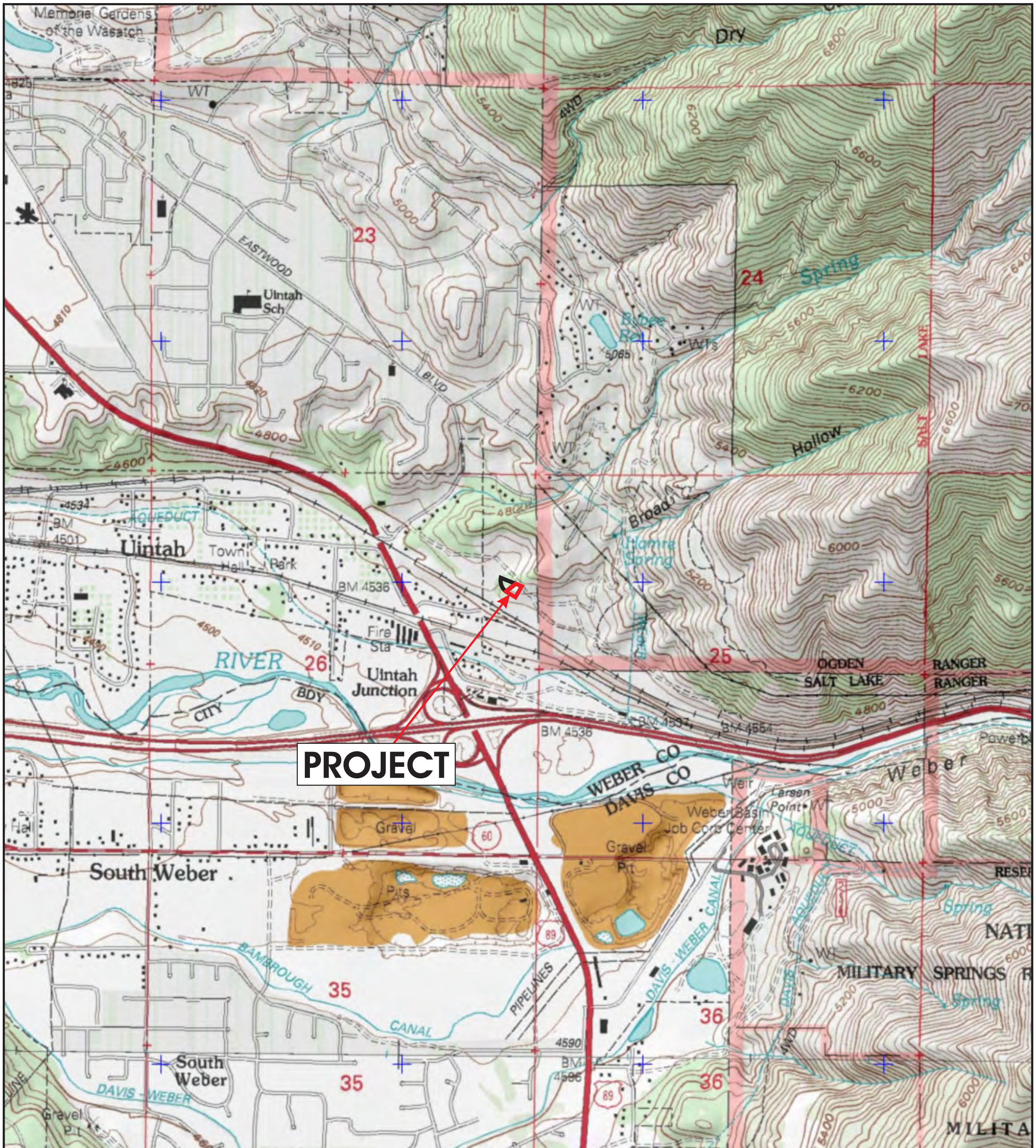
Stokes, W.L., 1977, Physiographic subdivisions of Utah: Utah Geological and Mineral Survey Map 43, scale 1:2,400,000.

____, 1986, Geology of Utah: Salt Lake City, University of Utah Museum of Natural History and Utah Geological and Mineral Survey, 280 p.

Zoback, M.L., 1989. State of stress and modern deformation of the northern Basin and Range province: Journal of Geophysical Research, v. 94, p. 7105-7128.

Zoback, M.L. and Zoback, M.D., 1989. Tectonic stress field of the conterminous United States: Boulder, Colorado, Geological Society of America Memoir, v. 172, p. 523-539.

FIGURES



Source: U.S. Geological Survey 7.5 Minute Series Topographic Maps, Utah - Ogden, 1998;
Project location NE1/4, Section 26, T5N, R1W (SLBM).

LOCATION MAP

GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive
Ogden, Weber County, Utah

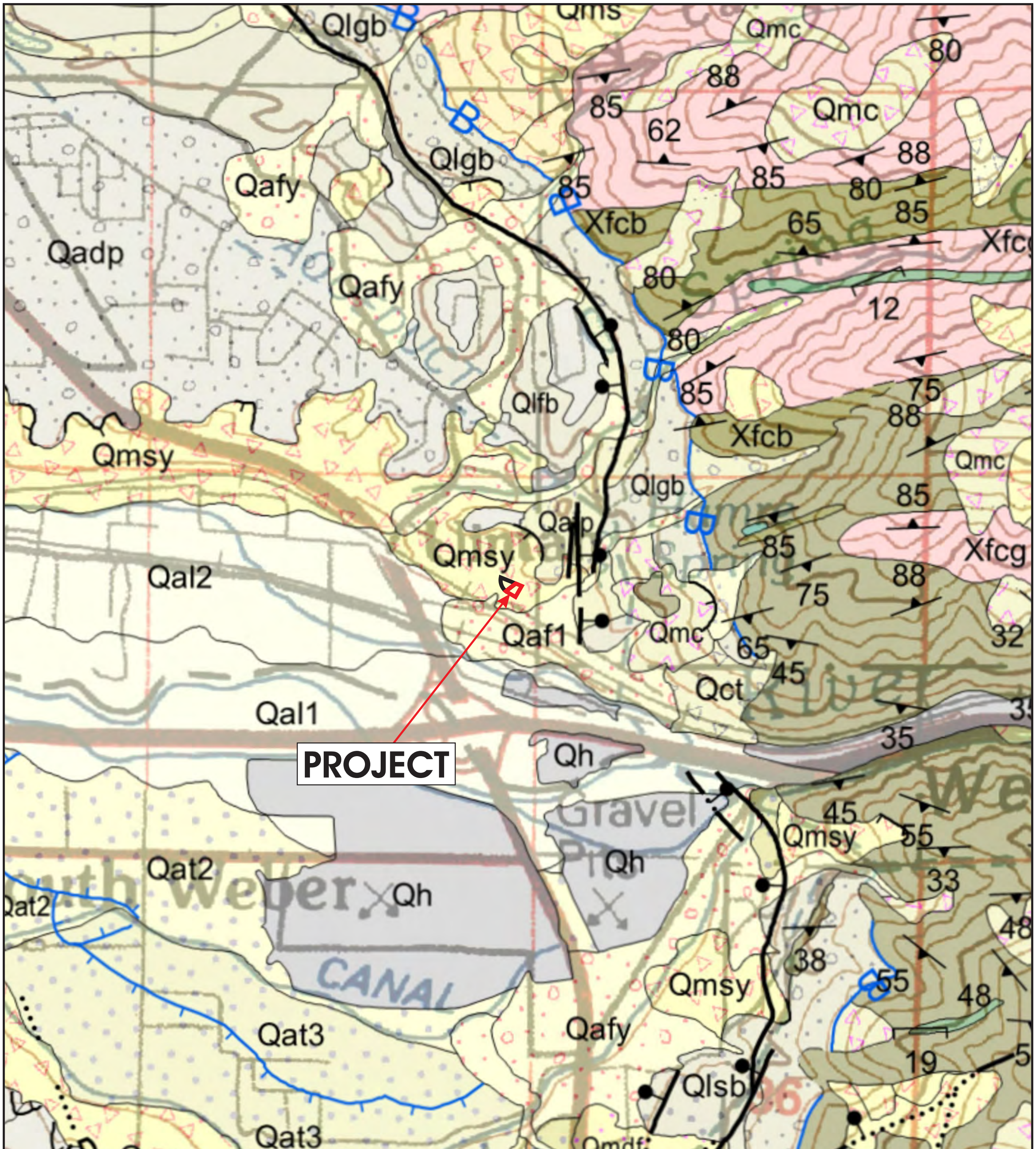
FIGURE 1

WESTERN GEOLOGIC

N W E S

0 1000 2000 feet

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



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

WESTERN GeoLogic

N W E S

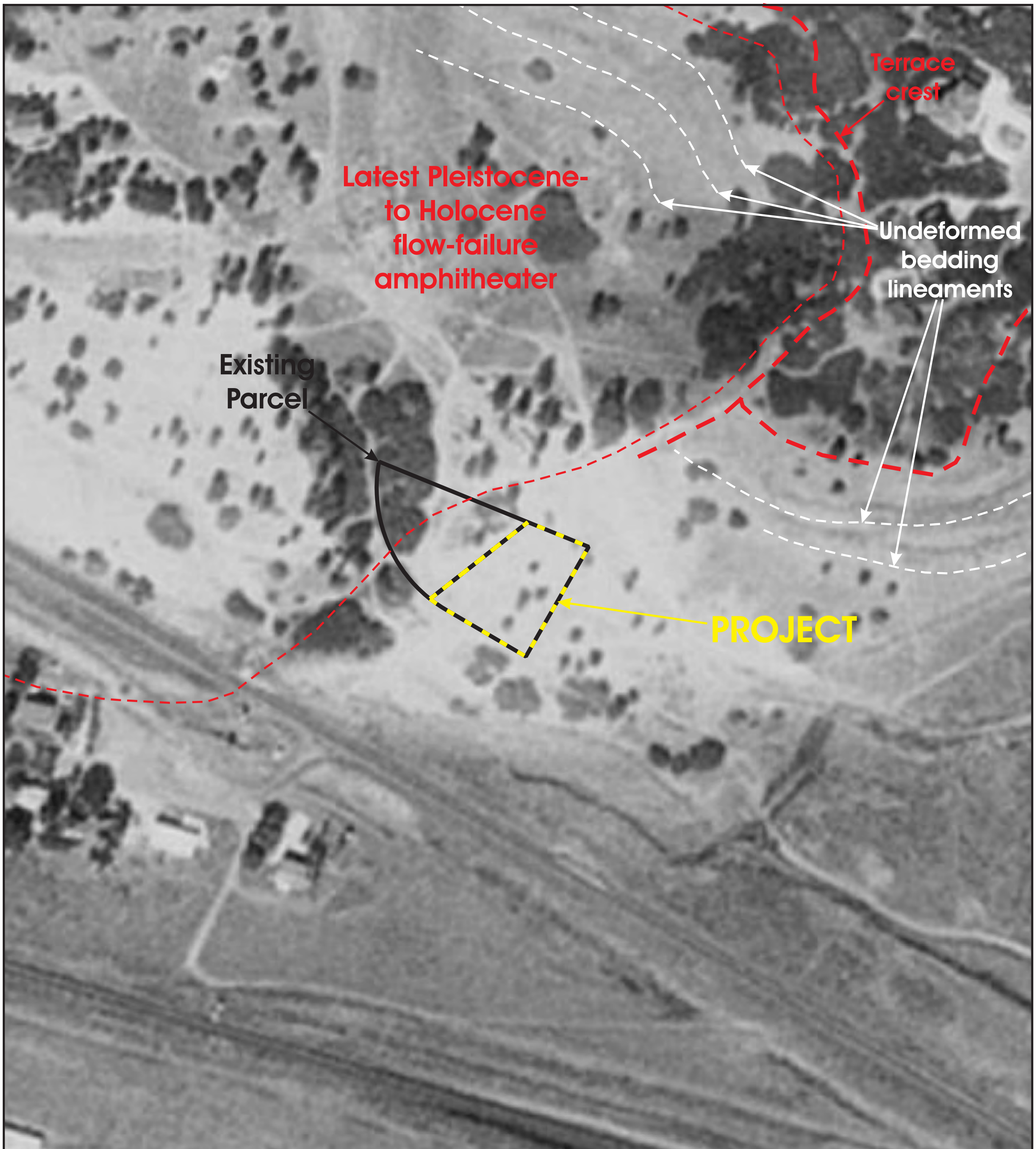
0 1000 2000 feet

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

GEOLOGIC MAP

GEOLOGIC HAZARDS RECONNAISSANCE
Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive
Ogden, Weber County, Utah

FIGURE 2



Source: Utah AGRC 1997 Digital Orthophoto, 1 m resolution.

WESTERN GEOLOGIC

N W E S

0 100 200 feet

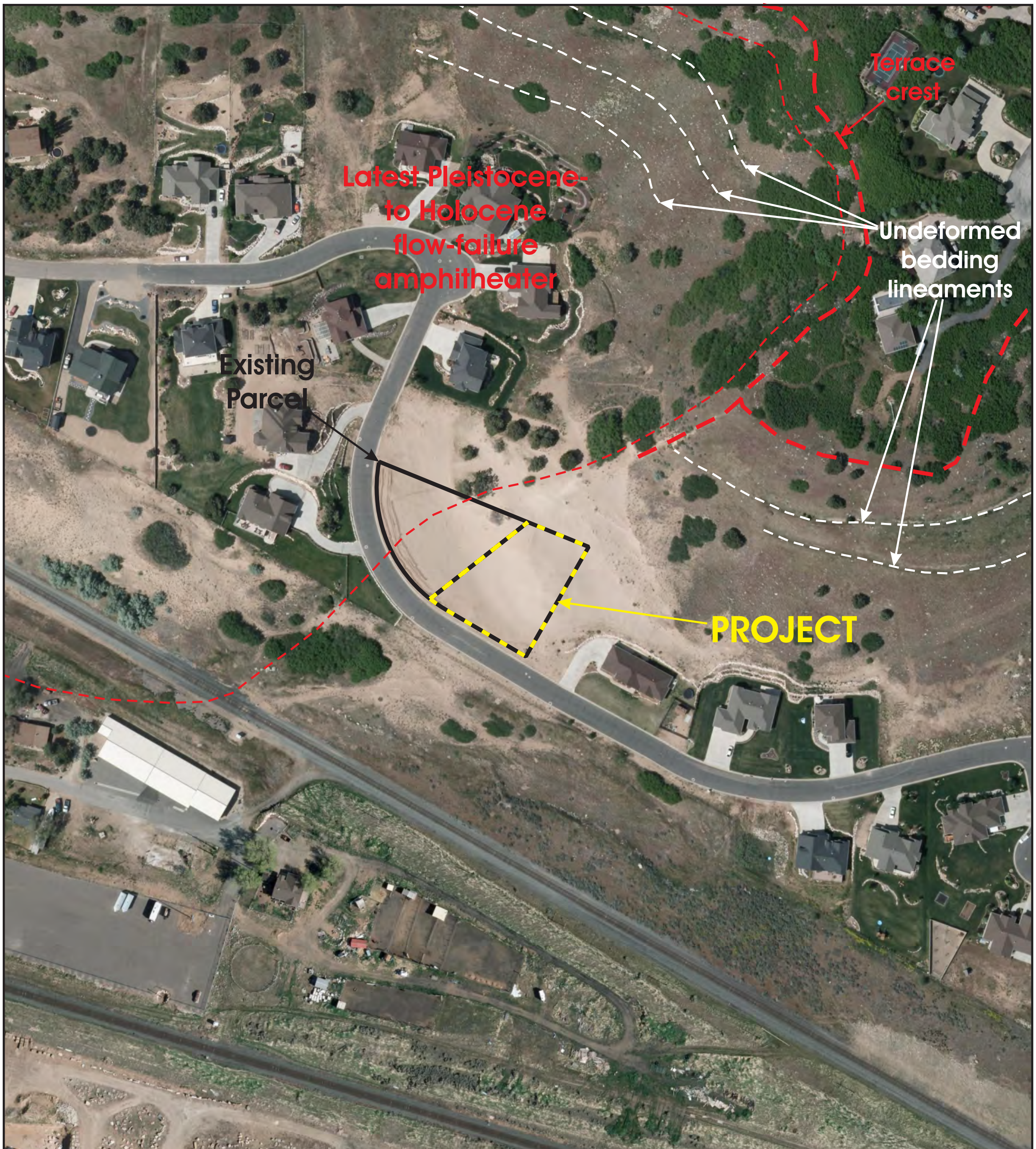
Scale 1:2,400
(1 inch = 200 feet)

1997 AERIAL PHOTO

GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive
Ogden, Weber County, Utah

FIGURE 3A



Source: Utah AGRC, 2012 High Resolution Orthophoto, 12.5 cm resolution.

N W E S

0 100 200 feet

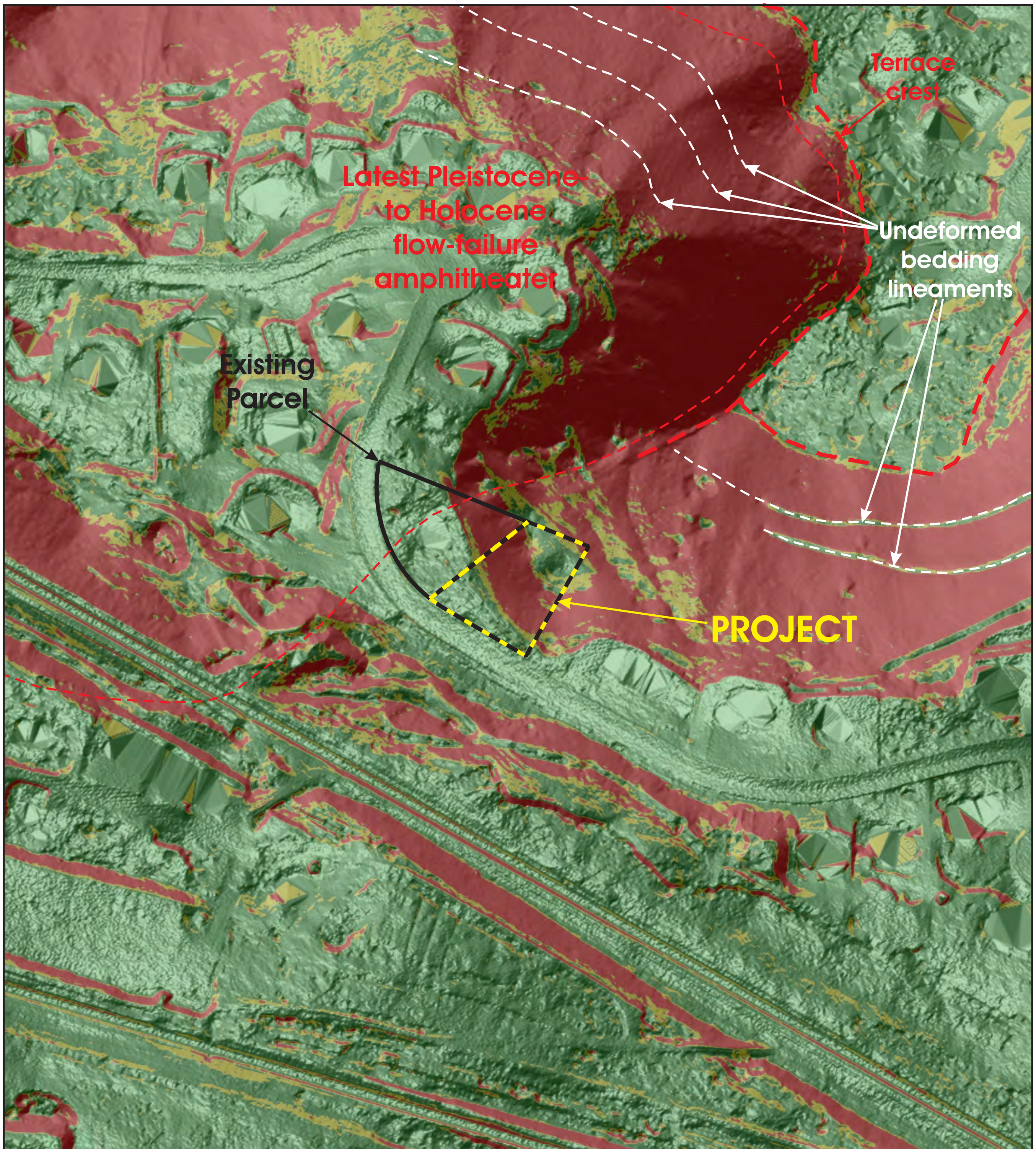
Scale 1:2,400
(1 inch = 200 feet)

2012 AIR PHOTO

GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive
Ogden, Weber County, Utah

FIGURE 3B



Source: Utah AGRC, 2016 LIDAR Bare Earth DEM, 50 cm resolution;
slope gradients <20% shaded in green, 20-30% in yellow, and >30% in red.

N / W / E / S

0 100 200 feet

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

LIDAR ANALYSIS

GEOLOGIC HAZARDS RECONNAISSANCE

Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive
Ogden, Weber County, Utah

FIGURE 3C

APPENDIX

Photographic Record of Site Reconnaissance
Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive - Ogden, Weber County, Utah

Photo 1. View north across Project.

Photo 2. View east across Project.

Photographic Record of Site Reconnaissance
Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive - Ogden, Weber County, Utah

Photo 3. View south across Project.

Photo 4. View west across Project.

Photographic Record of Site Reconnaissance
Proposed Cedar Cove Estates Lot 36
About 2740 East Bybee Drive - Ogden, Weber County, Utah

Photo 5. Cyclically bedded lacustrine sand beds in slope at Project.

Photo 6. Toe of steep slope at Project.