# R E P O R T

## SURFACE FAULT RUPTURE HAZARD EVALUATION

## AJ ROCK LLC PROPERTY

## 6695 SOUTH WASATCH BOULEVARD

## COTTONWOOD HEIGHTS, UTAH

***Prepared for***

Tara Bodecker
Dougherty Mortgage
102 W. Runnels Street
New Boston, Texas  75570

October 8, 2018

***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

October 8, 2018

Tara Bodeker
Dougherty Mortgage
102 W. Runnels Street
New Boston, Texas 75570

**SUBJECT:** Surface Fault Rupture Hazard Evaluation
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

Dear Ms. Bodecker:

This report presents results of a surface fault rupture hazard evaluation conducted by Western Geologic & Environmental LLC (Western Geologic) for the AJ Rock LLC property at roughly 6695 South Wasatch Boulevard in Cottonwood Heights City, Utah (Figure 1 – Project Location). The site is in eastern Salt Lake Valley at the western base of the Wasatch Range north of Big Cottonwood Canyon, in the SE¼ Section 23, Township 2 South, Range 1 East (Salt Lake Base Line and Meridian). Elevation of the site is about 4,820 to 5,010 feet above sea level. The site was an active gravel mining operation at the time of our field investigation in 2009 and considerable material (up to 100 feet or more in the eastern part) has been removed since the mid-1950s by gravel mining operations. Based on a May 2018 McNeil Engineering concept plan and Gordon Geotechnical summary letter (Gordon Geotechnical, 2018), current plans are for a mixed-use development comprised of two office buildings, a hotel, an apartment tower, a condominium tower, a restaurant, a mixed commercial building, and re-alignment of Wasatch Boulevard. However, it is our understanding that the development plan is still in flux except with regard to the apartment tower.

## PURPOSE AND SCOPE

Salt Lake County hazard maps show the site is crossed by three northwest-trending faults and within the Surface Fault Rupture Special Study Area where trenching studies are required. The purpose of our investigation was therefore to evaluate the hazard from surface faulting at the site. Other geologic hazards possibly present at the site were not evaluated and would be beyond the scope of this study. The following scope of services was performed in accordance with the above purpose:

- Logging of eight exploratory trenches at the site in 2009 to identify the presence and location of any active faults, assess zones of fault-related deformation, and recommend appropriate fault set-back distances and safe "buildable" areas should faults be discovered;

- Review of available geologic maps and reports; and

- Evaluation of available data and preparation of this report, which presents the results of our study.

This report has been prepared in general accordance with the Guidelines for Evaluating Surface Fault Rupture Hazards in Utah (Christenson and others, 2003) and generally meets requirements in Appendix B, Chapter 19-9, of the Cottonwood Heights City Geologic Hazards Ordinance (which follows Batatian, 2002), with the exception that no field reviews were conducted in 2009 given that trench excavation and logging were performed on weekends, with backfilling and restoration prior to each Monday, to accommodate active operations and need for unrestricted construction vehicle access. However, the exposures were digitally photographed to document subsurface conditions. The photos are not included herein, but are available upon request.

## GEOLOGY

### Seismotectonic Setting

The property is located in Salt Lake Valley at the western base of the Wasatch Range about 1.1 miles northwest of the mouth of Big Cottonwood Canyon. Salt Lake Valley is a deep, sediment-filled structural basin of Cenozoic age that is bounded by two uplifted range blocks, the Oquirrh Mountains and the Wasatch Range (to the west and east, respectively). The valley lies at the eastern edge 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 Wasatch fault zone at the western base of the Wasatch Range. Late Cenozoic normal faulting, a characteristic of the Basin and Range, began between about 17 and 10 Ma (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 Wasatch fault zone (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 active Salt Lake City segment of the WFZ, which trends across the heavily populated east side of Salt Lake Valley. The Salt Lake City segment is further divided into three subsections (from north to south): Warm Springs, East Bench, and Cottonwood. The site is located at the northern end of the Cottonwood (southernmost) subsection. Salt Lake County hazard mapping shows several traces of the WFZ trending northwestward across the site, which form a broad zone of en-echelon, down-to-the-west faulting over 1,000 feet wide. The steep escarpment in the eastern part of the site is related to multiple Holocene and late Pleistocene surface-faulting earthquakes on this fault, although considerable material has been removed by gravel mining to create subvertical walls a hundred feet high or more in this area. The Working Group on Utah Earthquake Probabilities (2016; Table 4.1-1) indicates mean timing ($\pm$ 2$\sigma$) for the last four surface-faulting earthquakes on the Salt Lake City segment is: (1) 1,300 $\pm$ 200 years, (2) 2,200 $\pm$ 200 years, (3) 4,100 $\pm$ 300 years, and (4) 5,300 $\pm$ 200 years. The Working Group on Utah Earthquake Probabilities (2016; Table 4.1-2) indicates a closed mean recurrence interval for the Salt Lake City segment, based on timing for the last four surface-faulting earthquakes, of 1,300 $\pm$ 100 years.

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 Wasatch fault 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.

**Unconsolidated Deposits**

Personius and Scott (1992, 2009) map the site in Bells Canyon glacial outwash; and clay, silt, sand, and gravel related to the transgressive stage of Lake Bonneville (units gbco, lbm, and lgb; Figure 2). Two main, west-dipping traces of the active Salt Lake City segment of the WFZ are shown on Figure 2 diverging from a single trace southeast of the site into two northwest-trending en-echelon traces that cross the project. A third main west-dipping trace is also shown near the northeastern site corner.

Personius and Scott (1992) describe surficial geologic units in the site vicinity, from youngest to oldest in age, as follows:

> ***f – Manmade fill (historic).*** Most consist of locally derived surficial deposits of variable grain size; used as engineered fills for highways, railways, and buildings; also includes assorted materials in landfills and tailing piles and ponds. Thickness >1 m.
>
> ***al1 – Stream alluvium 1 (upper Holocene).*** Sand, silt, and minor clay and gravel along Jordan River and lower reaches of its tributaries; deposits along upper reaches of tributaries consist of pebble and cobble gravel, and minor sand and silt. Poorly to moderately sorted; parallel bedding and crossbedding. Forms modern flood plain and terraces less than 5 m above modern stream level. Subject to flooding and high water table. Exposed thickness 1-3 m.

***al2 – Stream alluvium 2 (middle Holocene to uppermost Pleistocene).*** Sand, silt, clay, and local gravel along Jordan River and lower reaches of its tributaries; deposits along upper reaches of tributaries consist of pebble and cobble gravel, and minor sand and silt. Poorly to moderately sorted; parallel bedding and crossbedding. Deposited by streams graded to recessional stands of Lake Bonneville and to lakes of early Holocene age; forms terraces more than 5 m above modern stream level, usually inset into deposits of the Bonneville lake cycle. Exposed thickness 1-5 m.

***af2 – Fan alluvium 2 (middle Holocene to uppermost Pleistocene).*** Clast-supported pebble and cobble gravel, locally bouldery, in a matrix of sand and silty sand; poorly sorted; casts subangular to round. Thin to thick, parallel bedding and crossbedding; locally massive. Deposited by perennial and intermittent streams, debris flows, and debris floods (hyperconcentrated floods) graded approximately to modern stream level. May contain small deposits of units af1 and cd1, especially near fan heads and along active stream channels. No shorelines present on surfaces. Typical soil profiles range from A-Bw-Cox-Cn to A-Bt(weak)-Cox-Cn. Thickness 1 to >10 m.

***es – Eolian sand (Holocene and upper Pleistocene).*** Fine to coarse sand and minor silty sand; moderately to well sorted. Thin to medium bedding; usually crossbedded, locally massive. Forms sheets of sand and low parabolic and longitudinal dunes; deposit derived from reworked sandy deposits of the Bonneville lake cycle. Thickness 1-3 m.

***cls – Landslide deposits (Holocene to middle Pleistocene).*** Grain size and texture reflects character of deposits in source area; usually unsorted, unstratified. Deposited as slides and slump-earthflows on relatively steep slopes in mountains. Thickness 1 to >10 m.

***alp – Stream alluvium related to regressive phase (uppermost Pleistocene).*** Clast-supported pebble and cobble gravel, locally bouldery, in a matrix of sand and silt; poorly sorted, clasts subangular to round; parallel bedding and crossbedding; locally massive. Deposited by streams graded to the Provo shoreline and other shorelines of the regressive phase of the Bonneville lake cycle. Also deposited as topset beds on deltaic deposits (lpd) related to the Provo shoreline; fluvial scarps are preserved on the surfaces of some deposits. In glaciated drainages, deposits of unit alp grade upstream into deposits of unit gbco. Thickness 1-10 m.

***lpd – Deltaic deposits related to regressive phase (uppermost Pleistocene)***. Clast-supported pebble and cobble gravel, in a matrix of sand and minor silt; locally includes thin beds of silt and sandy silt. Moderately to well sorted within beds; clasts subround to round. Deposited as thin to thick, parallel and crossbedded foreset beds having original dips of 5-30°; locally deposited as topset beds. More commonly capped with topset beds of poorly sorted, silty to sandy, pebble and cobble alluvial gravel (alp). Forms large delta complexes graded to Provo shoreline at the mouths of Big and Little Cottonwood Canyons. Thickness 1-25 m.

***cls – Landslide deposits (Holocene to middle Pleistocene).*** Grain size and texture reflects character of deposits in source area; usually unsorted, unstratified. Deposited as slides and slump-earthflows on relatively steep slopes in mountains. Thickness 1 to >10 m.

***lbm – Lacustrine clay and silt related to transgressive phase (upper Pleistocene).*** Clay, silt, and minor fine sand; locally contains medium to coarse sand and pebble gravel. Good sorting within beds; deposited in very thin to thick, parallel and crossbedded, horizontal to gently dipping beds; bedding locally disrupted by soft-sediment deformation or liquefaction. Deposited in quiet-water environments, in sheltered bays between headlands, in lagoons behind barrier bars, or on lake floor in deeper water. Usually overlie coarse-grained transgressive shoreline deposits, implying deposition in increasingly deeper, quieter water. Thickness 1-25 m.

***lbg – Lacustrine sand and gravel related to transgressive phase of Lake Bonneville (upper Pleistocene).*** Clast-supported pebble, cobble, and rarely boulder gravel, in a matrix of sand and pebbly sand; locally includes interbedded silt and clay ranging from thin beds and lenses to lagoonal deposits as much as 10 m thick. Good sorting within beds; clasts subround to round. Deposited in parallel and crossbedded, thin to thick beds, dipping from horizontal to as much as 15°. Base is bouldery in some places. Deposited in beaches, bars, spits, and small deltas and lagoons. Mapped between the Provo and Bonneville shorelines (1,463-1,585 m; 4,800-5,200 ft). Commonly covered by deposits of hillslope colluvium (chs), but typically forms wave-built bench at the Bonneville shoreline and at several less well developed beach berms between the Provo and Bonneville shorelines. Thickness 1-25 m.

***gbco – Outwash of Bells Canyon age (upper Pleistocene).*** Clast-supported cobble and pebble gravel, locally bouldery, in a minor matrix of sand and silt; poorly to moderately sorted; clasts subangular to round. Thin to thick, parallel bedding and crossbedding. Deposits grade into alluvial gravel graded to Provo shoreline (alp) below Big and Little Cottonwood Canyons. Exposed thickness 1-40 m.

## Lake Bonneville and Glacial 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). Sediments from Lake Bonneville comprise much of the unconsolidated deposits in the site vicinity.

Timing of events related to the transgression and regression of Lake Bonneville are indicated in 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. Headward erosion of the Snake River-Bonneville basin drainage divide, possibly combined with landsliding in the threshold area, then caused a catastrophic incision that caused the lake level to lower by about 425 feet in less than a year (Jarrett and Malde, 1987; O'Conner, 1993). Following the Bonneville flood, the lake stabilized and formed a lower shoreline referred to as the Provo shoreline up to about 16,000 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. Great Salt Lake then experienced a brief transgression between 12,800 and 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; Oviatt, 2015). The site is located slightly above the Provo shoreline, but below the highest Bonneville shoreline.

Glaciers in Little Cottonwood and Bells Canyons advanced into eastern Salt Lake Valley from the Wasatch Range between 26,000 and 18,000 years ago (Personius and Scott, 1992, 2009). Lake Bonneville was in its transgressive stage during this time, but stood at an intermediate level prior to reaching its highest Bonneville shoreline. Till deposited by the glaciers formed prominent moraines extending into the valley, and meltwater from glaciers in Bells Canyon and Little and Big Cottonwood Canyons deposited gravelly outwash fans along the range front (Personius and Scott, 1992). The site is partly mapped in outwash deposits from Big Cottonwood Canyon (unit gbco, Figure 2). As Lake Bonneville continued rising, the glaciers retreated up their respective valleys, the outwash deposits were eventually inundated by the lake, and deposition continued in deltas extending into the lake. When Lake Bonneville receded, the deltas and outwash deposits were downcut and eroded by Big and Little Cottonwood Creeks.

## SURFACE FAULT RUPTURE HAZARD EVALUATION

### Air Photo Observations

Figure 3A shows a 1938 pre-gravel mining air photo of the site from historical photography flown for the Salt Lake Aqueduct Project (frames sla1-20 and sla1-21, original scale 1:20,000; Bowman and Beisner, 2008). The air photo center was approximately registered to the UTM NAD83 grid system by Bowman and Beisner (2008). However, we further adjusted the photo scale, rotation, and placement to correspond to range front bedrock exposures evident on the 1938 photos and 2006 U.S. Geological Survey digital orthophotography available from Utah AGRC. The 1938 photos were then enlarged and overlaid with the site boundary for stereo viewing. Several northwest-trending escarpments were observed on Figure 3A crossing the site, which correspond to locations of significant faults observed in the trenches (discussed below and shown in red, with bar and ball on downthrown side). An additional fault and graben is apparent on the photos slightly east of the Project, which would be east of the man-made escarpment and not within our study area. Figure 3B shows a 2013 LIDAR image available from the Utah AGRC. The LIDAR image shows considerable site disturbance from gravel mining operations and only a few broad correlations with some of the faults on Figure 3A.

**Subsurface Evaluation**
Eight trenches were excavated and logged at the Project in 2009 to evaluate subsurface geologic conditions and assess the potential hazard from surface faulting. No exploration was conducted in the hillside areas north of the gravel pit or above the man-made escarpment bounding the east side of the gravel pit. Subsurface exploration was also limited to accessible areas not mantled by large gravel piles, such as along roads, and further restricted by an easement for a large aqueduct crossing the site. Given this, no long continuous trench exposures were feasible. Excavation was performed by Bingelli Rock Inc (the lessees of the site) using a Sumitomo SH200 trackhoe. The trenches were excavated to a safe depth sufficient to expose lacustrine sediments from Lake Bonneville capable of displaying active faulting and providing good chronostratigraphic markers. Deep fill materials were encountered in places that complicated excavation and logging, such as from active and inactive utility lines, old pit excavations, backfilled settling ponds, and past grading activities. In some areas, the trenches could not be deep enough to expose correlative stratigraphy across exposed faults. The trenches also exposed bedded fills that appeared similar to native sediments, which we do not consider unusual given the site use as a gravel pit operation; in general, we interpreted fills where sediments contained anomalous materials or had an abnormal appearance from soil organics inclusion, conservatively erring on the side of a fill interpretation.

Figure 4 is a site plan at a scale of 1:1,200 (1 inch equals 100 feet) showing the site boundary (heavy black line), current development plan, locations for the trenches conducted for our study (in heavy blue lines), and exposed faults in the trenches (shown by small black lines, with bar and ball on the downthrown side). Faults displaying more than 4 inches (0.3 feet) of displacement in the trench exposures have been correlated across the site based on trend, displacement sense and air photo evidence (discussed above). The faults are labeled for reference purposes with "F" where west dipping and "AF" where east dipping, and are further numbered (west to east) F1 through F9 or AF1 and AF2 (Figure 4). The trenches generally provide good overlapping coverage given a presumed overall fault trend of about N15°W. Trench trends and locations were preliminarily measured in the field using a handheld GPS and compass, and subsequently surveyed by Benchmark Engineering. Our field measurements in 2009 generally corresponded well to the surveyed locations, with minor variations. We attribute these variations to slight measurement differences between the logging and surveying, such as from decisional differences in where measurements were made.

The trenches at the Project were excavated in two general alignments: (1) a southern alignment formed by T-1, 2, 7, and 8 (west to east, Figure 4); and (2) a northern alignment consisting of T-3, 4, 5, and 6 (west to east, Figure 4). T-1 extended an overall S87°W for a total distance of 125 feet (stations -5.0 feet to 120.0 feet, east to west, Figure 5) to slightly inside an eastern aqueduct easement. T-2 extended an overall S64°W for a total distance of 280 feet (stations -5.0 feet to 275.0 feet, east to west, Figure 6) from slightly inside the western side of the easement. T-3 was about 300 feet north of T-2, and extended an overall S85°E for a total distance 192.5 feet (stations -1.5 feet to 191.0 feet, west to east, Figure 7) from slightly east of the western site boundary. T-4 was about 180 feet north of T-3, and extended an overall S73°E for a total distance of 211.4 feet (stations -4.0 to 207.4 feet, west to east, Figure 8). T-5 is east of T-4 on the eastern side of the aqueduct, and extended sinuously an overall S82°E for a total distance of 339 feet (stations -5.0 feet to 334.0 feet, west to east, Figure 9). T-6 was the easternmost trench of the northern alignment, and extended an overall S77°W for a total distance of 171 feet (stations -5.0 feet to 166.0 feet, east to west, Figure 10). T-7 was slightly north of the east end of T-1, and extended an overall N79°E for a total distance of 146.3 feet (stations -3.4 feet to 143.0 feet, west to east, Figure 11). T-8 was the easternmost trench of the southern alignment, and extended an overall S77°W for a total distance of 373.1 feet (stations -3.1 feet to 370 feet, east to west, Figure 12).

Figures 5 through 12 are detailed logs of the trenches at a scale of 1:60 (1 inch equals 5 feet). Due to space restraints and the scale of the logs, all of the trenches cover multiple sheets. Except for some schematic clasts and within our defined log scale, the logs generally accurately depict notable bedding and texture observed in the trenches. With the exception of trench T-2, which was excavated west from the east end and then east from west end to meet up, original stations and logging direction are preserved on the logs. Given the lack of a field review, each trench was digitally photographed for archival purposes at 10-foot intervals. Trench logging generally followed methodology in McCalpin (1996), although no soil horizons were logged due to surficial disturbance and fill materials.

The trenches at the site mainly exposed a well-bedded sequence of fine sand and silt that coarsened eastward to sandy, cobbly, and bouldery crossbedded gravels. Alluvium may have been present at the surface overlying the above sediments, but was stripped off during early gravel pit activities and was not observed in the trenches. The depositional sequence exposed in the trenches at the site consisted of (from oldest to youngest): (1) a lower, strongly east-dipping, crossbedded sandy gravel below an intra-unit angular unconformity and an overlying west-dipping cobbly to bouldery gravel (exposed as unit 1a in T-5 and T-7, and unit 2 in T-6; Figures 9 through 11); (2) a thin unit of deformed sand to silt, likely from a low-energy landslide that occurred subaqueously in Lake Bonneville shortly after its transgression across the site (exposed as unit 1a in T-3, and 1b in T-1, T-2, T-4, and T-5; Figures 5-9); and (3) a sequence of interbedded and crossbedded sand and gravel deposits with lesser silt (exposed as unit 1c in T-1, T-5, and T-7; units 1c and 1d in T-2 and T-4; unit 1b in T-3; and unit 1g in T-8; Figures 5 through 9, 11, and 12). The sediments likely represent glacial outwash from Big Cottonwood Canyon accumulating in the delta emanating from the canyon mouth, followed by Lake Bonneville inundation and subsequent deltaic deposition in the lake. Trench T-8 also exposed lacustrine clay and gravelly clay likely deposited in a lagoon behind a longshore barrier bar (units 1e an 1f, Figure 12) , and T-6 exposed a possible pre-Lake Bonneville landslide deposit comprised of lean to fat blue-gray clay with mineralized wood debris and bone fragments in the footwall of fault F9 (unit 1, Figure 10).

All of the trenches at the site, except for T-5, exposed one or more faults that displace the Lake Bonneville stratigraphic sequence. No evidence for faulting was observed in T-5. Major faults showing more than 4 feet of displacement were observed in trenches T-3, T-6, T-7, and T-8, corresponding to three main, west-dipping, en-echelon traces (from west to east): (1) a trace formed by F1 and F2 on the west side of the project, which appears to converge northward; (2) fault F7 in the central part of the project; and (3) faults F8 and F9 in the eastern part of the project, which also converge northward (Figure 4). The faults correspond to visible west-facing escarpments on Figure 3A that form a series of steps from west to east across the site. The faulting pattern shown on Salt Lake County hazard maps is similar. Minor faults with between

0.3 and 4.0 feet of displacement were observed in T-2, T-4, and T-7, corresponding to faults F2 through F6. These faults converge northward with F1 and F7 (Figure 3A). Two antithetic faults were also exposed in the trenches: (1) AF1 on the west side of the project in the westernmost escarpment on Figure 4, and (2) AF2 on the east side, which forms a graben bounded by fourth major west-dipping fault to the east on Figure 3A. Small displacement faults with less than 0.3 feet of displacement were observed in T-1, T-2, and T-4. The small displacement faults in T-2 and T-4 are in the F3/F4 zone, whereas the faults in T-1 appear to be unrelated and do not correspond to any surficial features on Figure 3A.

## CONCLUSIONS AND RECOMMENDATIONS

The site is at the western base of the Wasatch Range slightly northwest of the mouth of Big Cottonwood Canyon on the eastern side of Salt Lake Valley. Surficial geology of the site is mapped as coarse outwash from retreating glaciers in Big Cottonwood Canyon that interfingers with transgressive Lake Bonneville sand, silt, and gravel. Salt Lake County hazards maps show the site is crossed by three northwest-trending, west-dipping main traces of the active Salt Lake City segment of the Wasatch fault zone, and the site is in the Surface Fault Rupture Special Study Area where trenching studies are required.

Eight trenches were excavated at the site in 2009 to evaluate the hazard from surface faulting and locate any active faults that may be present. All of these trenches, except for trench T-5, exposed evidence for active faulting. Trenches T-3, T-6, T-7, and T-8 exposed major faults forming three west-dipping traces evident on 1938 air photos prior to site disturbance. Trenches T-2, T-4, and T-7 also exposed several lesser faults. Table 1 is a compilation of fault data from the trenches at the site, and shows the log station of each trenched fault, fault trends, and dip angles. Small displacement faults showing less than 0.3 feet of displacement are not shown.

Given the above, the risk from surface faulting is high at the site. Based on the results of this investigation and our current understanding that surface fault rupture and deformation tend to follow past patterns, we recommend a non-buildable (setback) zone around the projected traces of the fault crossing the site as shown on Figure 4. Table 1 below shows fault parameters and setback distances calculated based on guidelines in Christenson and others (2003). The fault setback for the downthrown side of active faults at the Project was calculated using:

$$\mathbf{S = U\ (2D + F/\tan\theta)}$$

where:

*S = Setback distance from active faults;*

*U = Criticality factor (2.0 for IBC class R structures with >10 dwellings);*

*D = Expected fault displacement per event (assumed to be equal to the vertical displacement measured for a single event or, if not measured or confidently determined, the maximum estimated single-event displacement of 8.5 feet is used);*

*F = Maximum depth of footing or subgrade portion of the building (assumed to be 8 feet); and*

*$\theta$ = Dip of the fault.*

The fault setback for the upthrown side of the faults was calculated using the same parameters and:

**S= U (2D)**

**Table 1.** *Fault parameters and calculated setbacks; fault numbers correspond to Figure 4.*

| ***TRENCH 2, east to west.*** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *(Note: fault location below is distance from station 0 horizontal)* | | | | | | ***Setback Distance (S)*** | | |
| ***Fault*** | ***Station*** | ***Trend*** | ***Dip (°Θ)*** | ***D (ft.)*** | ***TanΘ*** | ***UFS*** | ***DFS*** | ***Notes*** |
| **F4** | 10.9 | N9°W | 65 | 1.0 | 2.1 | 4.0 | 11.5 | *1* |
| **F3** | 35.7-35.9 | N15°W | 68 | 2.3 | 2.5 | 9.2 | 15.7 | *1* |
| **F2** | 219.5-226.1 | N10°W - N15°W | 69 | 2.3 | 2.6 | 9.2 | 21.9 | *2,3,4* |
| **AF1** | 271.7 | N10°W | 78 | 1.2 | 4.7 | 4.8 | 8.2 | *1* |
| ***TRENCH 3, west to east.*** | | | | | | | | |
| *(Note: fault location below is distance from station 0 horizontal)* | | | | | | ***Setback Distance (S)*** | | |
| ***Fault*** | ***Station*** | ***Trend*** | ***Dip (°Θ)*** | ***D (ft.)*** | ***TanΘ*** | ***UFS*** | ***DFS*** | ***Notes*** |
| **F1** | 14.9 | N15°W | 59 | 8.5 | 1.7 | 34.0 | 43.6 | *5* |
| **AF1** | 20.2 | N12°W | 47 | 4.8 | 1.1 | 19.2 | 34.1 | *4,6* |
| **F2** | 48.8 | N16°W | 53 | 8.5 | 1.3 | 34.0 | 46.1 | *5* |
| ***TRENCH 4, west to east.*** | | | | | | | | |
| *(Note: fault location below is distance from station 0 horizontal)* | | | | | | ***Setback Distance (S)*** | | |
| ***Fault*** | ***Station*** | ***Trend*** | ***Dip (°Θ)*** | ***D (ft.)*** | ***TanΘ*** | ***UFS*** | ***DFS*** | ***Notes*** |
| **F3** | 23 | N15°W | 51 | 3.9 | 1.2 | 15.6 | 28.6 | *4* |
| **F4** | 92.5 | N13°W | 57 | 0.8 | 1.5 | 3.2 | 13.6 | *1* |
| ***TRENCH 6, east to west.*** | | | | | | | | |
| *(Note: fault location below is distance from station 0 horizontal)* | | | | | | ***Setback Distance (S)*** | | |
| ***Fault*** | ***Station*** | ***Trend*** | ***Dip (°Θ)*** | ***D (ft.)*** | ***TanΘ*** | ***UFS*** | ***DFS*** | ***Notes*** |
| **F9** | 81.6 | N33°W | 75 | 8.5 | 3.7 | 34.0 | 38.3 | *5* |
| ***TRENCH 7, west to east.*** | | | | | | | | |
| *(Note: fault location below is distance from station 0 horizontal)* | | | | | | ***Setback Distance (S)*** | | |
| ***Fault*** | ***Station*** | ***Trend*** | ***Dip (°Θ)*** | ***D (ft.)*** | ***TanΘ*** | ***UFS*** | ***DFS*** | ***Notes*** |
| **F5** | 30.8-32.0 | N18°E - N27°E | 77 | 1.2 | 4.3 | 4.8 | 8.5 | *1* |
| **F6** | 37.6-39.1 | N18°W - N10°W | 66 | 0.6 | 2.2 | 2.4 | 9.5 | *1,7* |
| **F7** | 56.6-62.3 | N18°W | 71 | 5.2 | 2.9 | 20.8 | 32.0 | *8,9* |

| *TRENCH 8, east to west.* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *(Note: fault location below is distance from station 0 horizontal)* | | | | | | *Setback Distance (S)* | | |
| *Fault* | *Station* | *Trend* | *Dip (°Θ)* | *D (ft.)* | *TanΘ* | *UFS* | *DFS* | *Notes* |
| **AF2** | 11.4 | N10°E | 78 | 1.3 | 4.7 | 5.2 | 8.6 | *1* |
| **F9** | 24.6-26.3 | N48°W | 57 | 8.5 | 1.5 | 34.0 | 46.1 | *5,10* |
| **F8** | 139.3 | N18°W | 89 | 8.0 | 57.3 | 32.0 | 32.3 | *11* |

*UFS = Upthrown fault block, DFS = Downthrown fault block.*
*1 - Minimum S of 20 feet UFS/DFS used.*
*2 - Measured dip was between 69 and 78 degrees, gentler dip used.*
*3 - DFS setback increased by width of zone of deformation (6.6 feet).*
*4 - Minimum S of 20 feet was used for UFS*
*5 - Displacement could not be measured; maximum average single-event displacement used.*
*6 - Displacement based on 8.5 feet for fault F1 and a net of 3.7 feet across F2 and AF1 (Figure 6 correlation).*
*7 - Measured dip was between 66 and 71 degrees, gentler dip used.*
*8 - Measured dip was between 71 and 80 degrees, gentler dip used.*
*9 - DFS setback increased by width of zone of deformation (5.7 feet).*
*10 - DFS setback increased by width of zone of deformation (1.7 feet).*
*11 - Measured offset was between 7.0 and 8.0 feet, higher displacement value used.*

| *Figure 4 Setback Distances* | | | | |
|---|---|---|---|---|
| | | *Setback Distance ( feet)* | | |
| *Fault* | *Dip* | *West* | *East* | *Notes* |
| **F1** | SW | 43.6 | 34.0 | *Based on T-3 above.* |
| **F2** | SW | 46.1 | 34.0 | *Based on T-3 above.* |
| **F3** | SW | 28.6 | 20.0 | *Based on T-4 above.* |
| **F4** | SW | 20.0 | 20.0 | *Minimum setbacks UFS/DFS.* |
| **F5** | NW | 20.0 | 20.0 | *Minimum setbacks UFS/DFS.* |
| **F6** | SW | 20.0 | 20.0 | *Minimum setbacks UFS/DFS.* |
| **F7** | SW | 32.0 | 20.8 | *Based on T-7 above.* |
| **F8** | SW-NW | 32.3 | 32.0 | *Based on T-8 above.* |
| **F9** | SW | 46.1 | 34.0 | *Based on T-8 above.* |
| **AF1** | NE | 19.2 | 34.1 | *Based on T-3 above.* |
| **AF2** | SE-NE | 20.0 | 20.0 | *Not considered.* |

Several small-displacement faults (less than 4 inches of displacement) were also observed in the trenches at the site. Such faults may be present in other unexplored areas. Although Christenson and others (2003) do not categorically exempt small-displacement faults from the setback guidelines, it is standard practice to exclude these faults from setbacks as they generally pose a lower life safety risk. Although these faults are common and related features of fault-zone deformation, we note that such deformation could cause structural damage that requires costly repairs or which may render a building unusable.

To reduce the risk from active surface faulting at the Project, we recommend the following:

- ***Fault Setbacks and Unexplored Areas –*** No structures intended for human occupancy should be located in the setback zones shaded in red on Figure 4. It is generally accepted practice to allow streets, driveways, yards, and other non-occupied, non-attached structures to be constructed within these areas. No habitable structures should also be located in the unexplored area shaded in gray on Figure 4 without additional subsurface exploration to evaluate if active faults are present.

- ***Excavation Inspection –*** This report does not reflect subsurface variations that may occur laterally away from an exploration trench. Such variations may occur that could become evident during construction. Thus, it is important that we observe subsurface materials exposed in future excavations (should any below-grade excavations be conducted) to take advantage of opportunities to recognize differing conditions that could affect the performance of a planned structure.

- ***Final Grading and Development Plan Review –*** The setback distances on Table 1 and Figure 4 assume an 8-foot footing depth from existing grade. However, dipping surfaces may require cuts to create level building pads and require deeper footing depths than assumed. We should therefore review the final grading and development plan to ensure proposed structures will not be in any setback zones. Based on discussions with Tom Henriod of Rockworth Companies, the northeast corner of the apartment building will have a footing depth of 24 feet below existing grade, whereas the remaining building corners will have footing depths of less than 8 feet. Given the fault characteristics from the nearest trench (T-6, Figure 4 and Table 1), a 24-foot footing depth (instead of 8 feet) would increase the setback for fault F9 by 8.7 feet in the area of the northeast building corner. However, the structure is more than 19 feet west of the current setback zone on Figure 4 and thus would still be outside this wider setback.

- ***Excavation Backfill Considerations*** – The trenches may be in areas where a structure could subsequently be placed. However, backfill may not have been replaced the excavations in compacted layers. The fill could settle with time and upon saturation. Should structures be located in an excavated area, no footings or structure should be founded over the excavation unless the backfill has been removed and replaced with structural fill, if the fill is to support a structure.

- ***Availability of Report –*** The report should be made available to architects, building contractors, and in the event of a future property sale, real estate agents and potential buyers. This 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 & Environmental LLC and should not be copied, used, or modified without express permission of the authors.

## 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 & Environmental LLC for the Client under the professional supervision of the principal and/or senior staff whose seal(s) and signatures appear hereon. Neither Western Geologic & Environmental LLC 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 & Environmental LLC.

In expressing the opinions stated in this report, Western Geologic & Environmental LLC 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 & Environmental LLC 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 & Environmental LLC


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

**ATTACHMENTS**

Figure 1. Location Map (8.5”x11”)
Figure 2. Geologic Map (8.5”x11”)
Figure 3A. 1938 Air Photo (11”x17”)
Figure 3B. 2013 LIDAR Image (11”x17”)
Figure 4. Site Plan (11”x17”)
Figures 5A-B. Trench 1 Log (two 11”x17” sheets)
Figures 6A-D. Trench 2 Log (four 11”x17” sheets)
Figures 7A-C. Trench 3 Log (three 11”x17” sheets)
Figures 8A-C. Trench 4 Log (three 11”x17” sheets)
Figures 9A-E. Trench 5 Log (five 11”x17” sheets)
Figures 10A-C. Trench 6 Log (three 11”x17” sheets)
Figures 11A-B. Trench 7 Log (two 11”x17” sheets)
Figures 12A-E. Trench 8 Log (five 11”x17” sheets)

P:\Dougherty Mortgage\Cottonwood Heights, UT - SFRHaz Evaluation - AJ Rock LLC Property - 6695 S Wasatch Boulevard #5004\Surface Fault Rupture Hazard Evaluation - AJ Rock LLC Property - 6695 S Wasatch Boulevard.doc

# 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.

Bowman, S.D., and Beisner, Keith, 2008, Historical aerial photography, 1938 Salt Lake Aqueduct Project, Salt Lake, Utah, and Wasatch Counties, Utah: Utah Geological Survey Open-File Report 537, CD-ROM, with GIS files.

Christenson, G.E., Batatian, L.D., and Nelson, C.V., 2003, Guidelines for Evaluating Surface-Fault-Rupture Hazards in Utah: Utah Geological Survey Miscellaneous Publication 03-6, 14p.

Gordon Geotechnical, 2018, Summary Letter—Surface fault rupture hazard study update, proposed Wasatch Pit Development, 6695 South Wasatch Boulevard, Cottonwood Heights, Utah: unpublished consultant's report prepared for Rockworth Companies dated May 30, 2018, Job No. 528-002-18, 4 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., 1996, Paleoseismology: San Diego, California, Academic Press Inc., Volume 62 of the International Geophysical Series, 588 p.

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.

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, Issue 110, 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.

Personius, S.F., and Scott, W.E., 1992, Surficial geologic map of the Salt Lake City segment and parts of adjacent segments of the Wasatch fault zone, Davis, Salt Lake, and Utah Counties, Utah: U.S. Geological Survey Miscellaneous Investigations Series, Map I-2106, scale 1:50,000.

____, 2009, Surficial geologic map of the Salt Lake City segment and parts of adjacent segments of the Wasatch fault zone, Davis, Salt Lake, and Utah Counties, Utah, digitized from U.S. Geological Survey Miscellaneous Investigations Series Map I-2106 (1992): Utah Geological Survey Map 243DM, 2 plates, scale 1:50,000.

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.

Scott, W.E., and Shroba, R.R., 1985, Surficial geologic map of an area along the Wasatch fault zone in Salt Lake Valley, Utah: U.S. Geological Survey Open-File Report 85-448, 18 p., scale 1:24,000.

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.

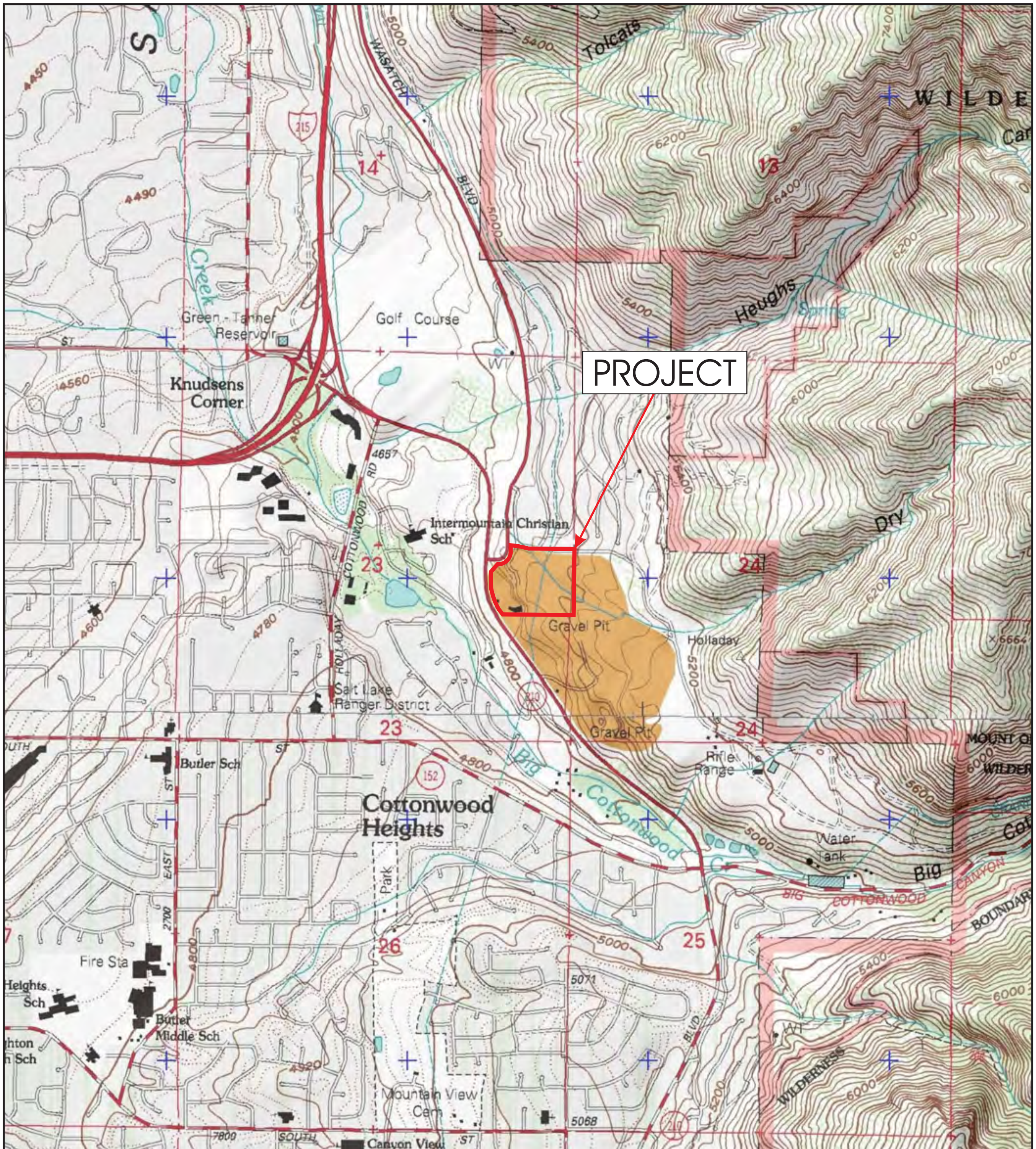
____, 1986, Geology of Utah: Salt Lake City, University of Utah Museum of Natural History and Utah Geological and Mineral Survey, 280 p.

Working Group on Utah Earthquake Probabilities, 2016, Earthquake Probabilities for the Wasatch Front Region in Utah, Idaho, and Wyoming: Utah Geological Survey Miscellaneous Publication 16-3, 164 p., with figures and appendices.

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 - Sugar House, 1997.

WESTERN GEOLOGIC

N W E S

0 1000 2000 feet

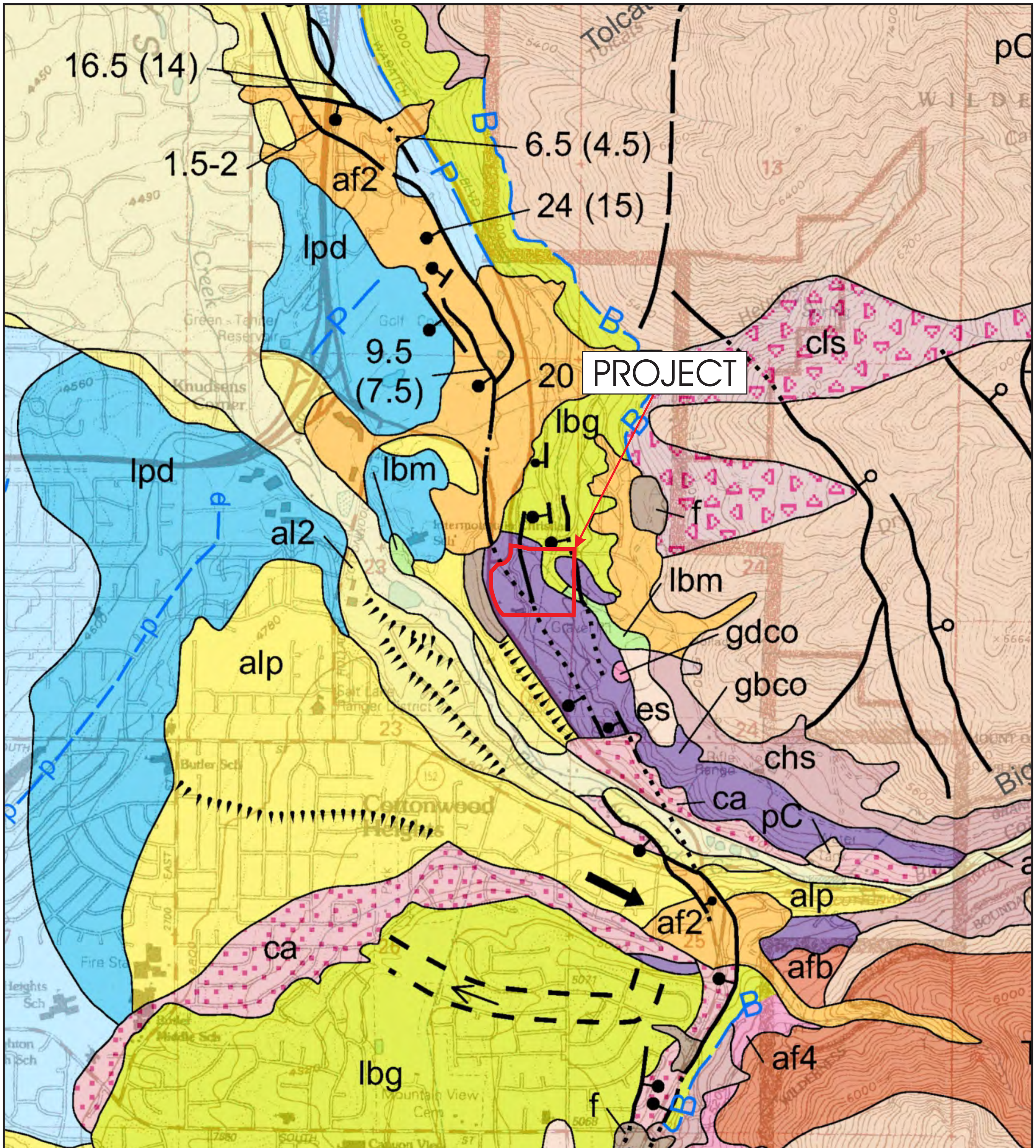
Scale 1:24,000
(1 inch = 2000 feet)

## LOCATION MAP

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 1**




Source: Personius and Scott (1992, 2009), original map scale 1:50,000. See text for description of nearby surficial geologic units.

WESTERN GEOLOGIC

N W E S

0 1000 2000 feet

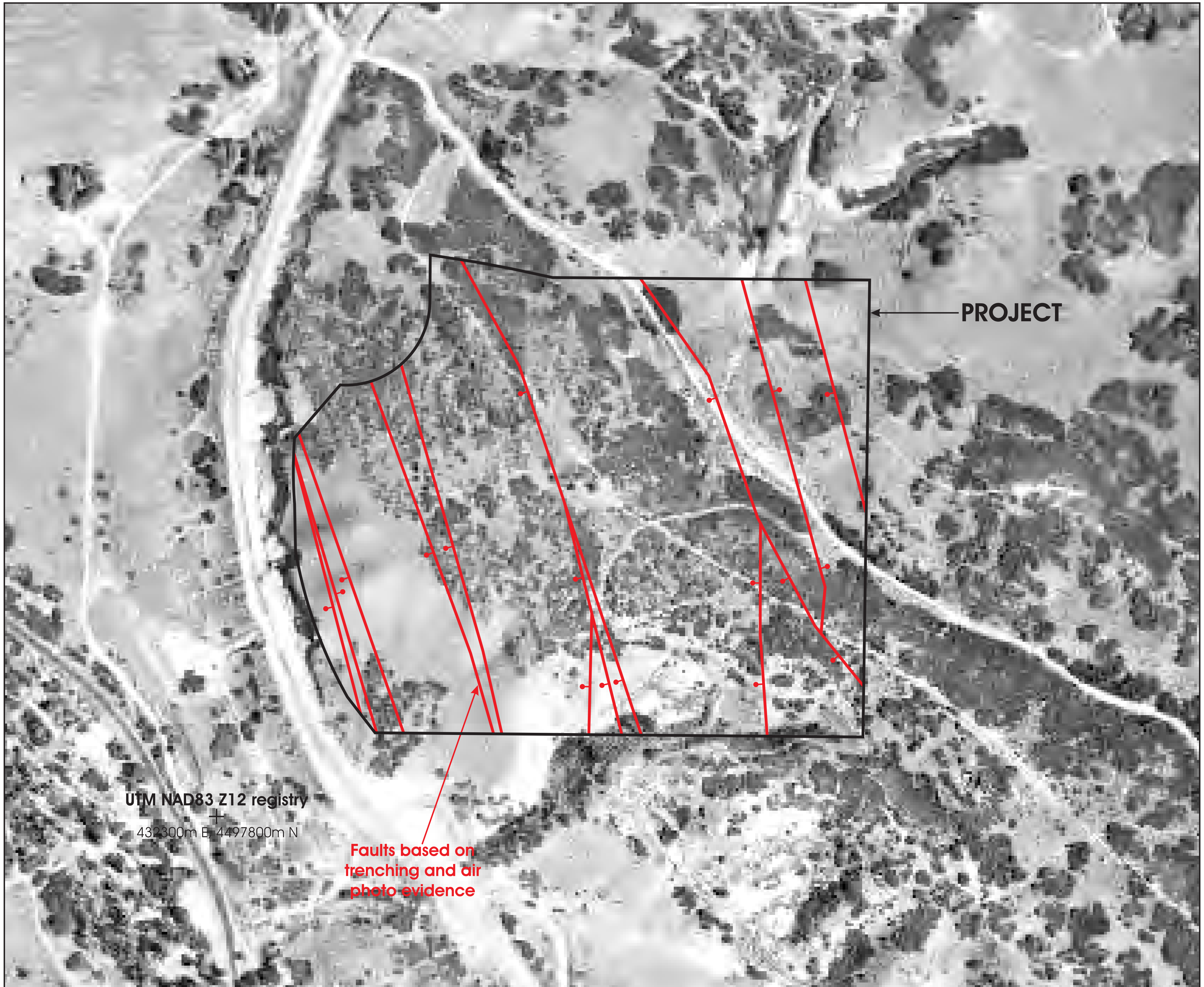
Scale 1:24,000
(1 inch = 2000 feet)

## GEOLOGIC MAP

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 2**




Air Photo Source: 1938 U.S. Bureau of Reclamation Salt Lake Aqueduct historical photography, reproduced and georeferenced in Bowman and Beisner (2008), frame sla1-20, approximate original scale 1:20,000.

WESTERN GEOLOGIC

## 1937 AIR PHOTO

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 3A**




Air Photo Source: Utah AGRC, 50cm bare earth DEM LIDAR, 2013.

WESTERN GEOLOGIC

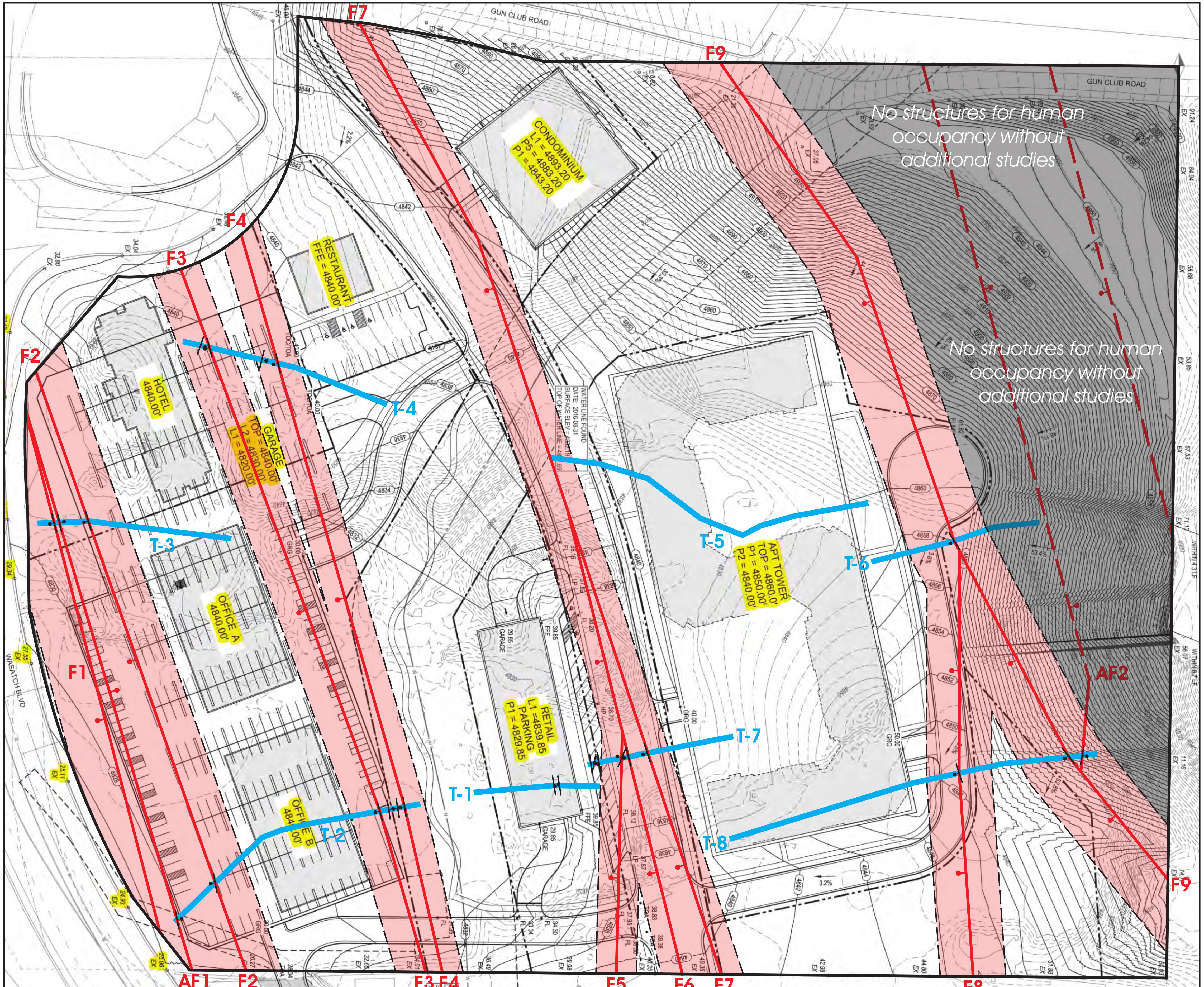
## 2013 LIDAR IMAGE

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 3B**

WESTERN GEOLOGIC




## EXPLANATION

Faults based on trenching and air photo evidence (Figures 3A-B); bar and ball on downthrown side, dashed where approximately located.

Trench for this study.

Setback zones (see text for explanation).

0 100 200 feet

Scale 1 inch equals 100 feet

N W E S

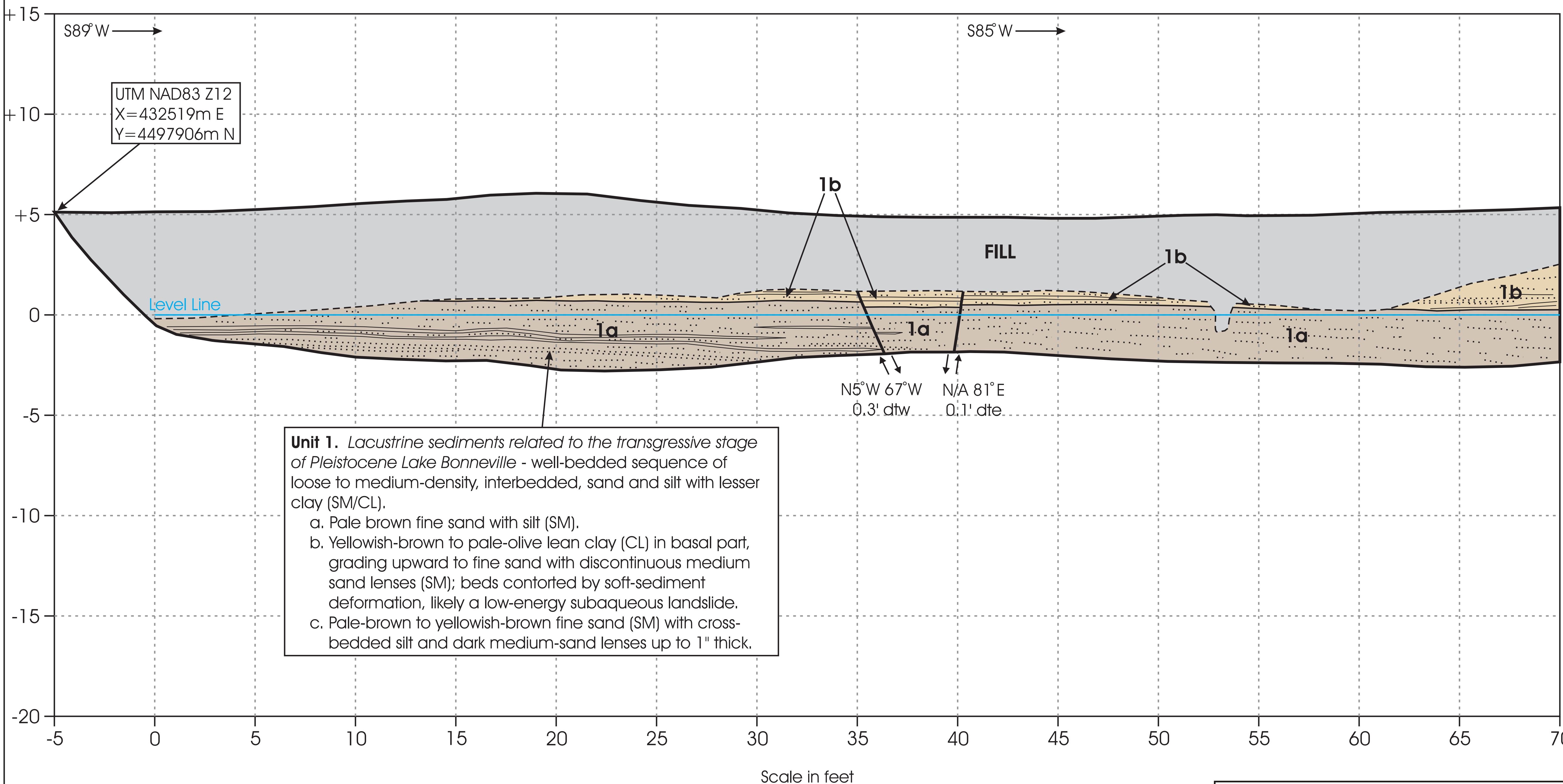
Base Map: McNeil Engineering concept grading plan SK2A dated May 5, 2018.

## SITE PLAN

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 4**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

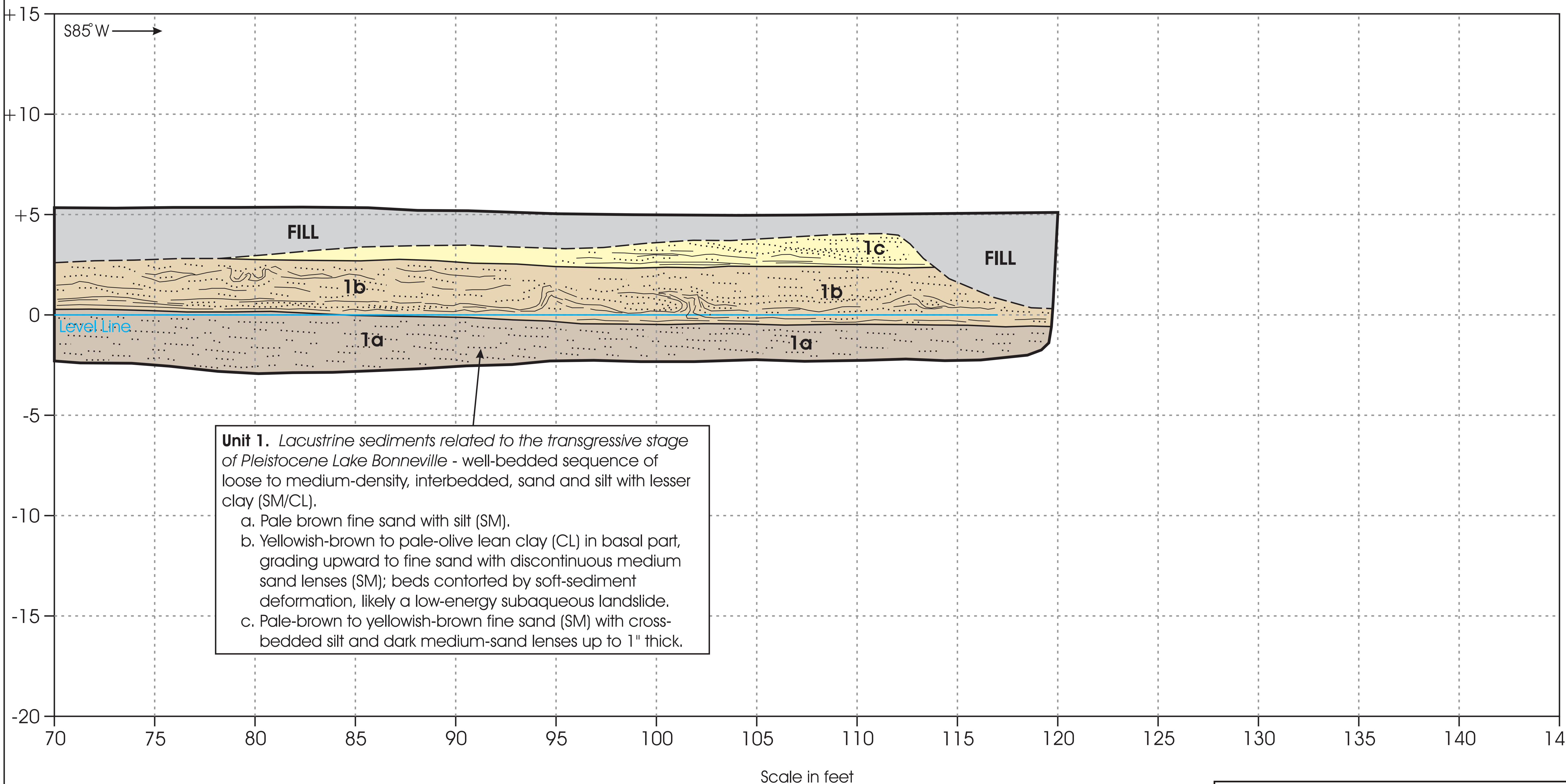
Trench logged by Bill Black, P.G. on
April 25, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 1 LOG, SHEET 1**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 5A**




**Unit 1.** *Lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, sand and silt with lesser clay (SM/CL).

a. Pale brown fine sand with silt (SM).

b. Yellowish-brown to pale-olive lean clay (CL) in basal part, grading upward to fine sand with discontinuous medium sand lenses (SM); beds contorted by soft-sediment deformation, likely a low-energy subaqueous landslide.

c. Pale-brown to yellowish-brown fine sand (SM) with cross-bedded silt and dark medium-sand lenses up to 1" thick.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
April 25, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

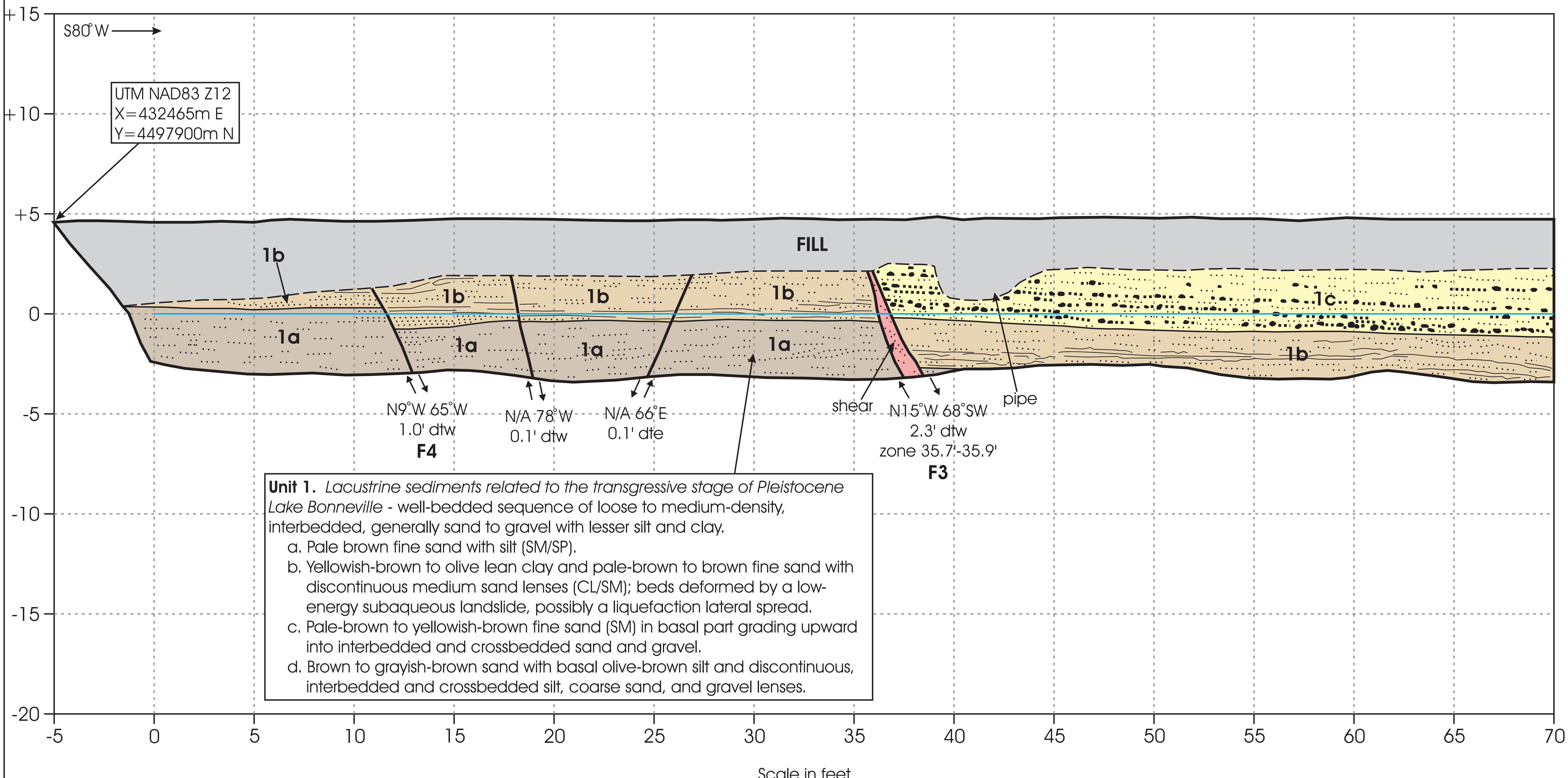
WESTERN GEOLOGIC

**TRENCH 1 LOG, SHEET 2**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 5B**




**Unit 1.** *Lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, generally sand to gravel with lesser silt and clay.

a. Pale brown fine sand with silt (SM/SP).
b. Yellowish-brown to olive lean clay and pale-brown to brown fine sand with discontinuous medium sand lenses (CL/SM); beds deformed by a low-energy subaqueous landslide, possibly a liquefaction lateral spread.
c. Pale-brown to yellowish-brown fine sand (SM) in basal part grading upward into interbedded and crossbedded sand and gravel.
d. Brown to grayish-brown sand with basal olive-brown silt and discontinuous, interbedded and crossbedded silt, coarse sand, and gravel lenses.

WESTERN GEOLOGIC

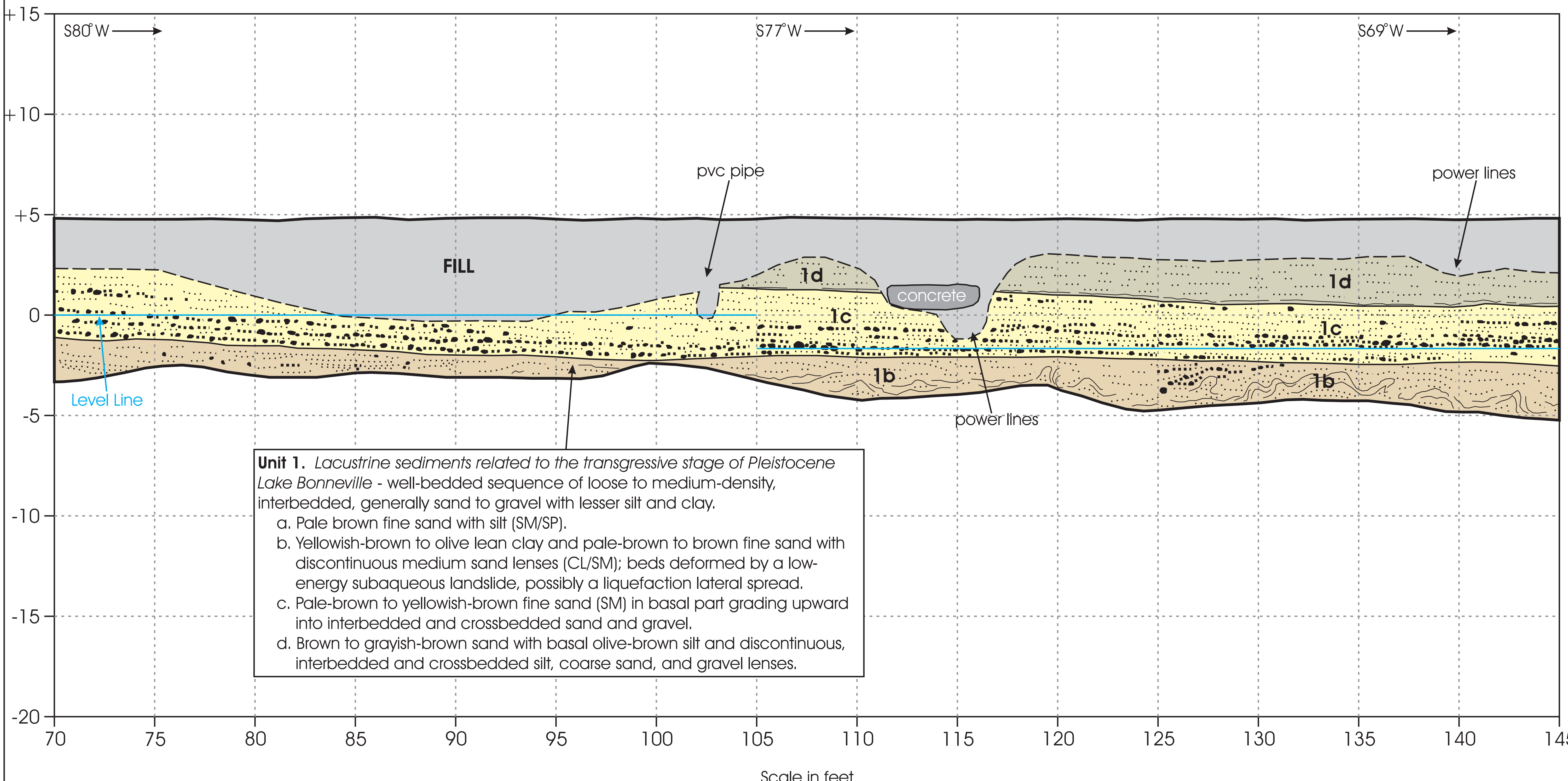
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
April 25-26 and May 9, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

**TRENCH 2 LOG, SHEET 1**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 6A**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

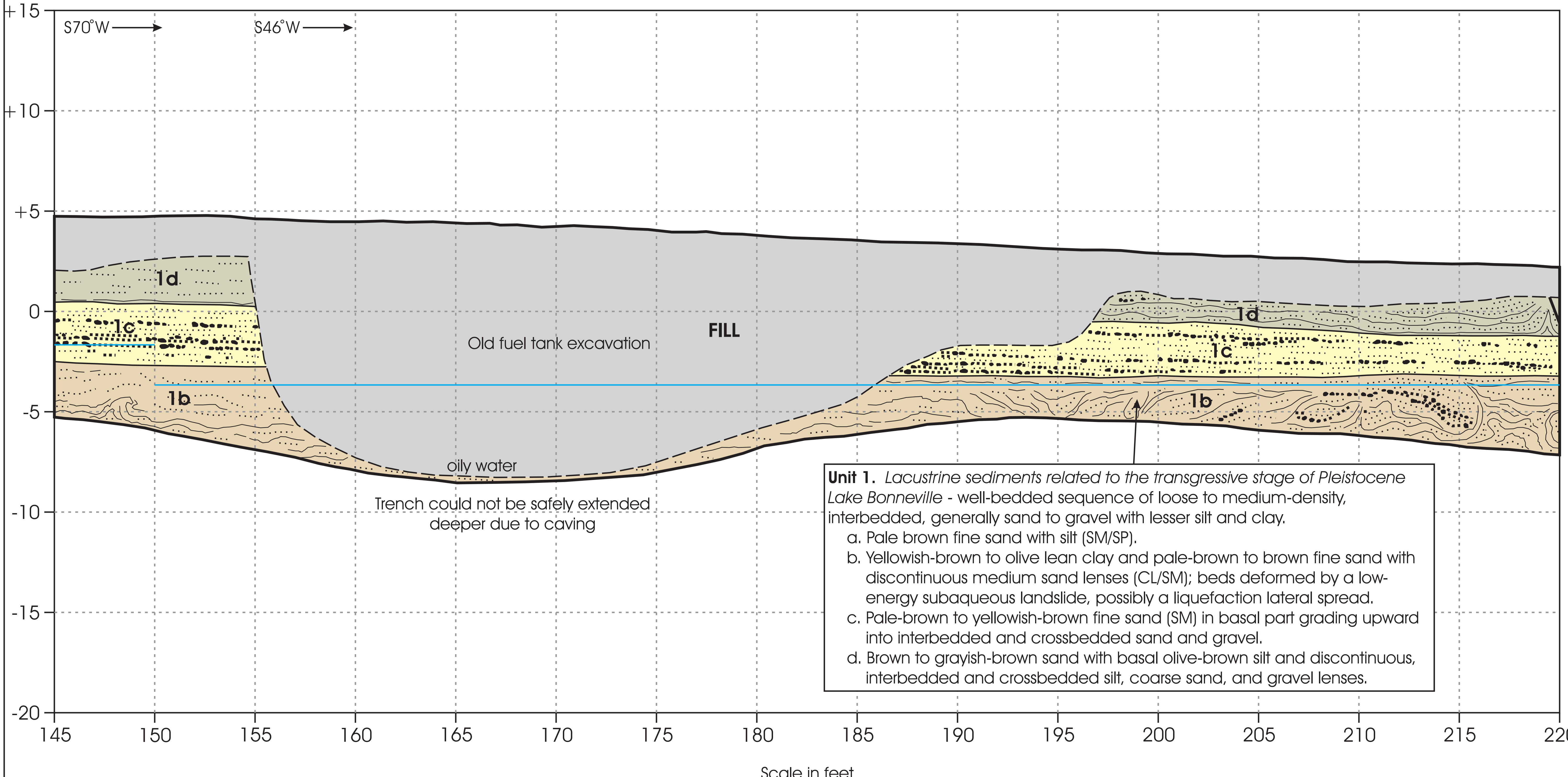
Trench logged by Bill Black, P.G. on
April 25-26 and May 9, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 2 LOG, SHEET 2**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 6B**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
April 25-26 and May 9, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

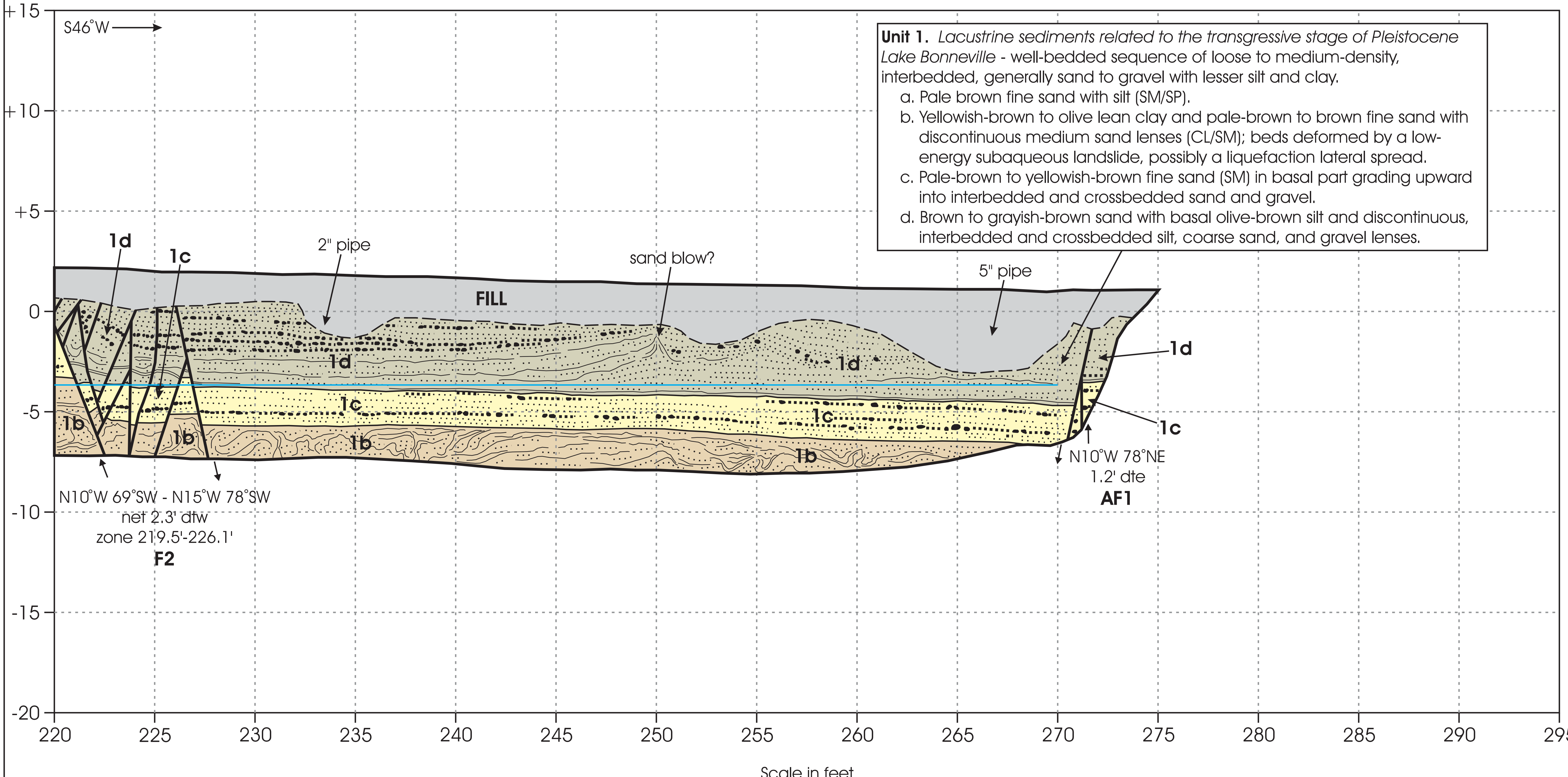
WESTERN GEOLOGIC

**TRENCH 2 LOG, SHEET 3**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 6C**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

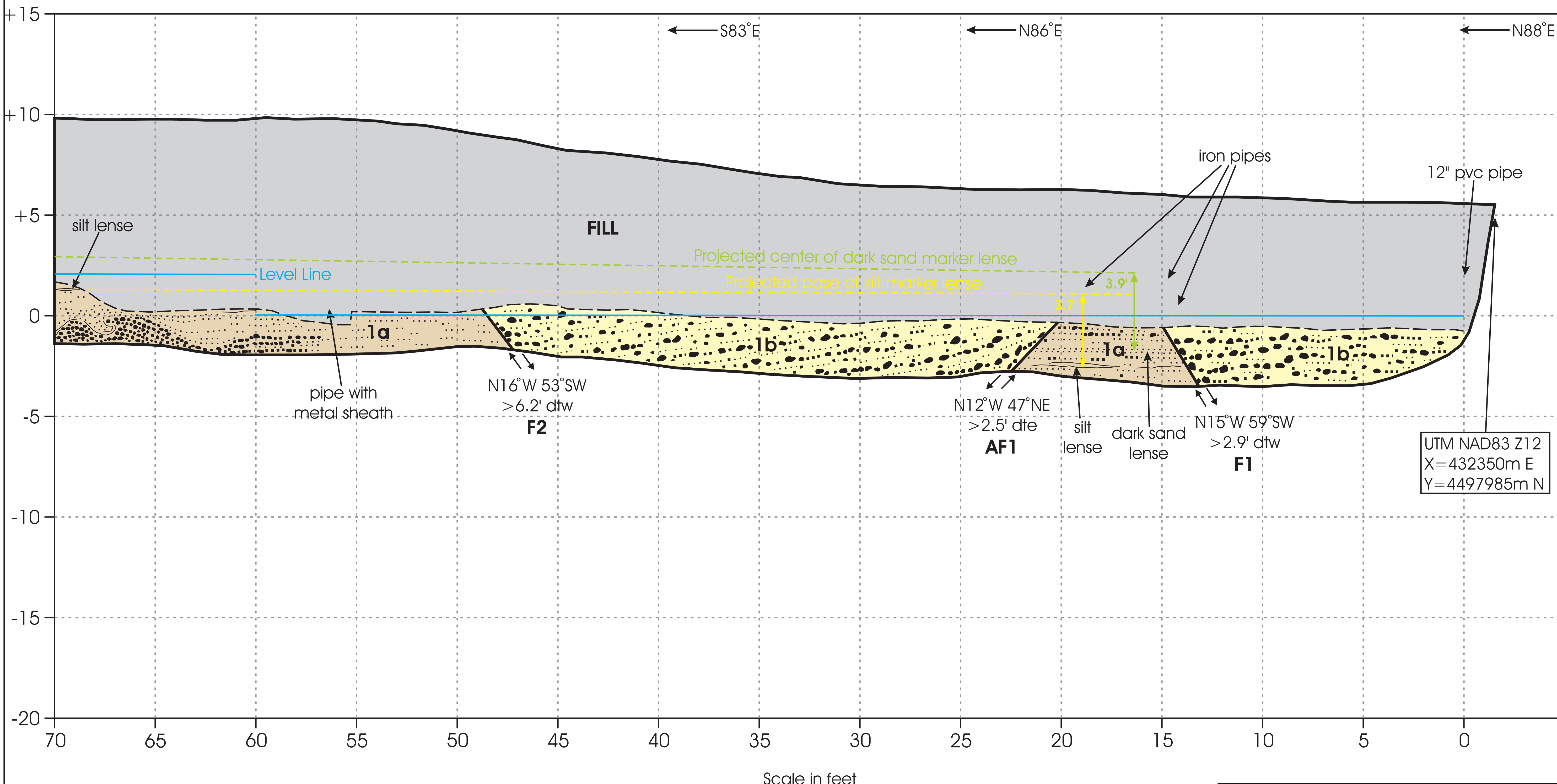
Trench logged by Bill Black, P.G. on
April 25-26 and May 9, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 2 LOG, SHEET 4**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 6D**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

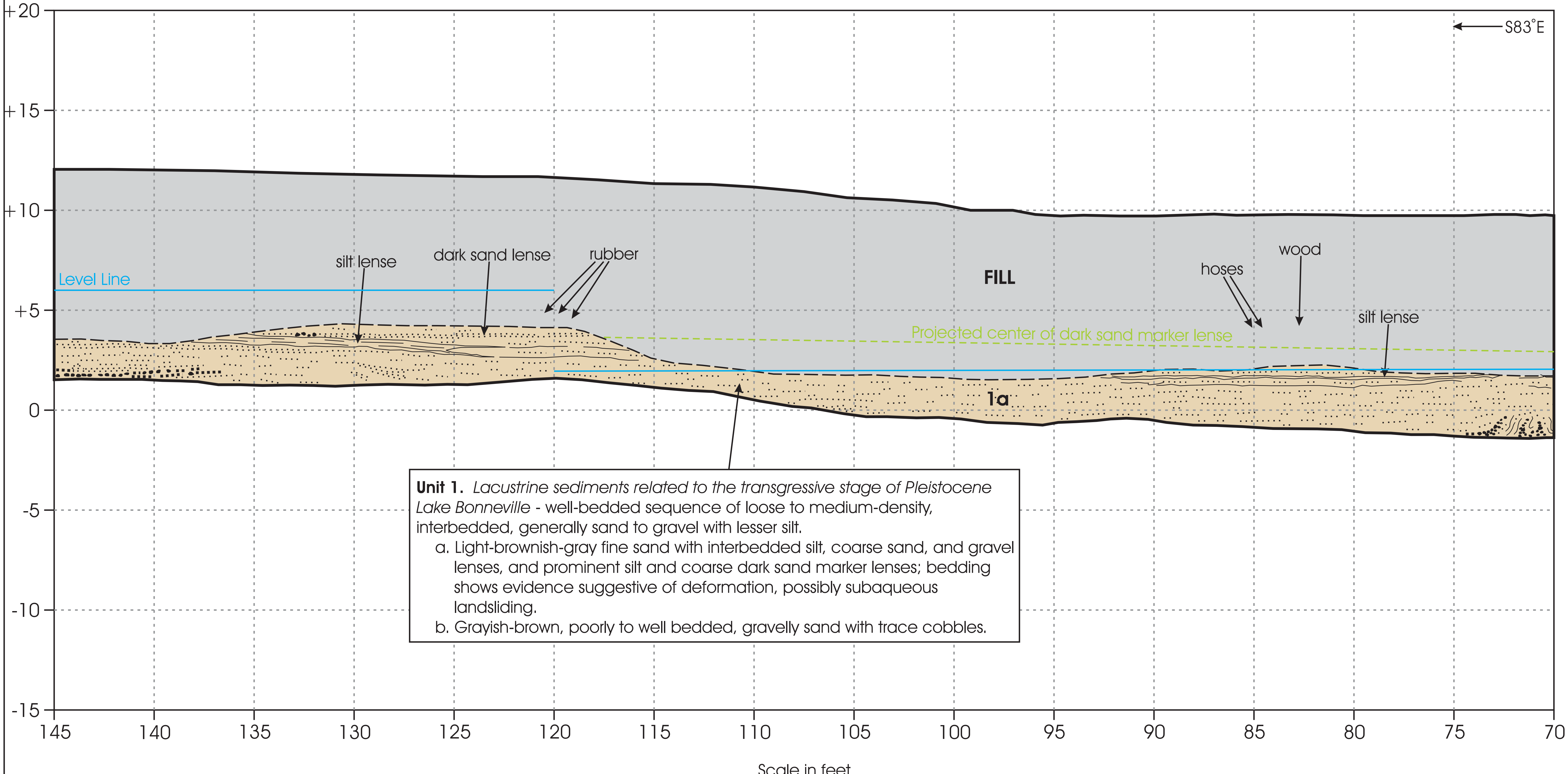
Trench logged by Bill Black, P.G. on
May 2, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 3 LOG, SHEET 1**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 7A**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

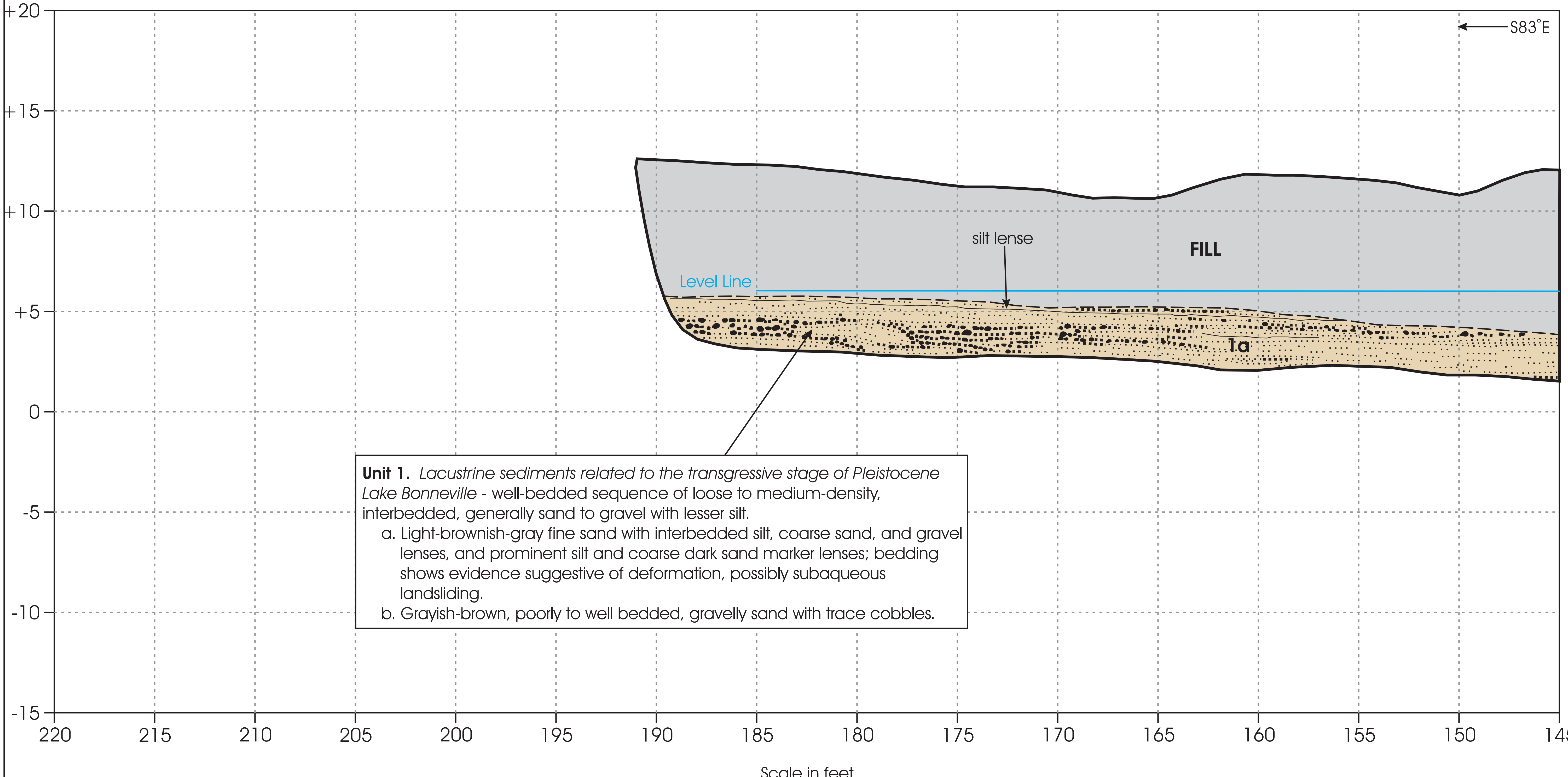
Trench logged by Bill Black, P.G. on
May 2, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 3 LOG, SHEET 2**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 7B**




**Unit 1.** *Lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, generally sand to gravel with lesser silt.

a. Light-brownish-gray fine sand with interbedded silt, coarse sand, and gravel lenses, and prominent silt and coarse dark sand marker lenses; bedding shows evidence suggestive of deformation, possibly subaqueous landsliding.

b. Grayish-brown, poorly to well bedded, gravelly sand with trace cobbles.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

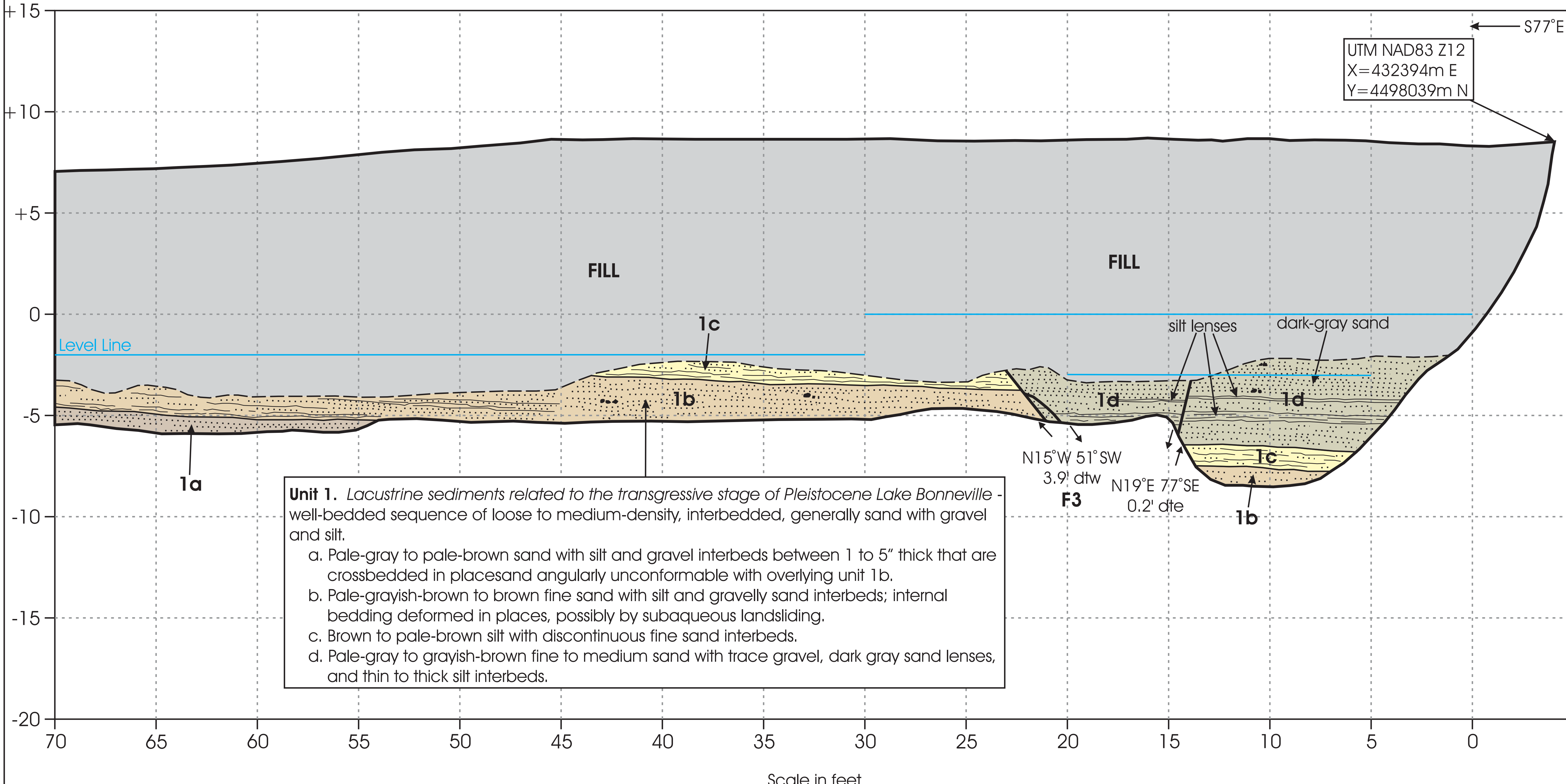
Trench logged by Bill Black, P.G. on
May 2, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 3 LOG, SHEET 3**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 7C**




**Unit 1.** *Lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, generally sand with gravel and silt.

a. Pale-gray to pale-brown sand with silt and gravel interbeds between 1 to 5" thick that are crossbedded in placesand angularly unconformable with overlying unit 1b.
b. Pale-grayish-brown to brown fine sand with silt and gravelly sand interbeds; internal bedding deformed in places, possibly by subaqueous landsliding.
c. Brown to pale-brown silt with discontinuous fine sand interbeds.
d. Pale-gray to grayish-brown fine to medium sand with trace gravel, dark gray sand lenses, and thin to thick silt interbeds.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

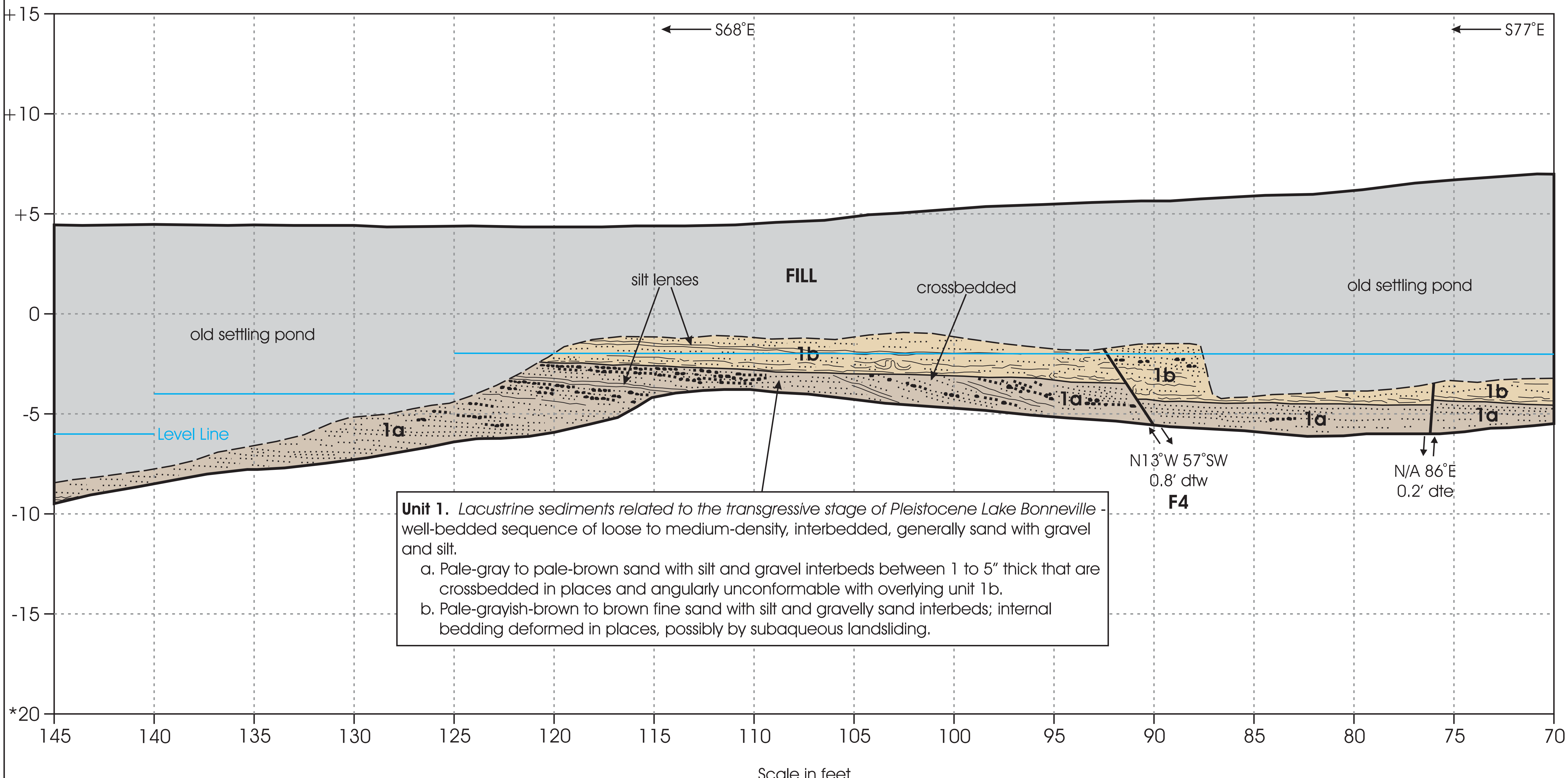
Trench logged by Bill Black, P.G. on
May 3 and 16, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 4 LOG, SHEET 1**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 8A**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

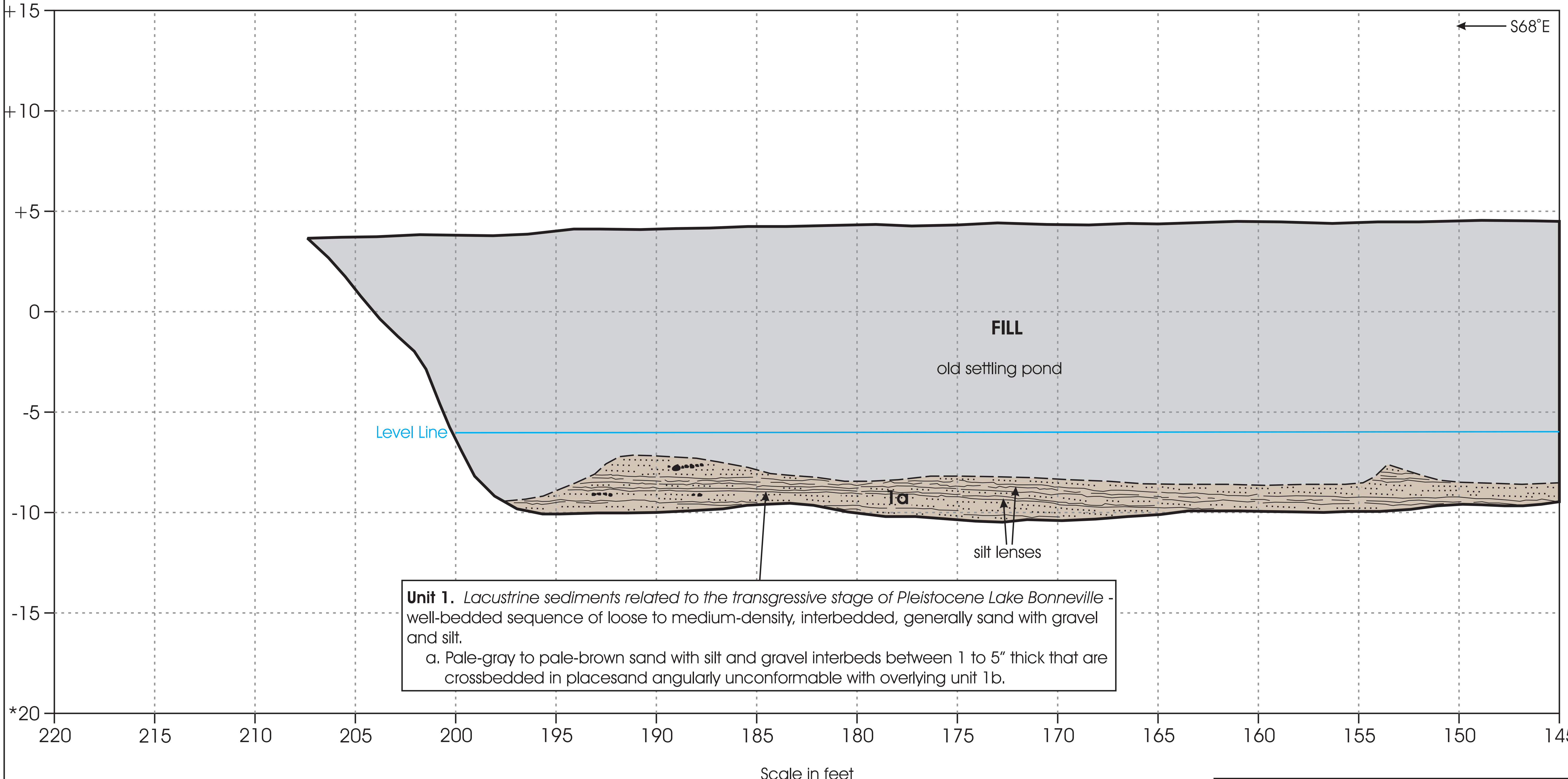
Trench logged by Bill Black, P.G. on
May 3 and 16, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

## TRENCH 4 LOG, SHEET 2

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 8B**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

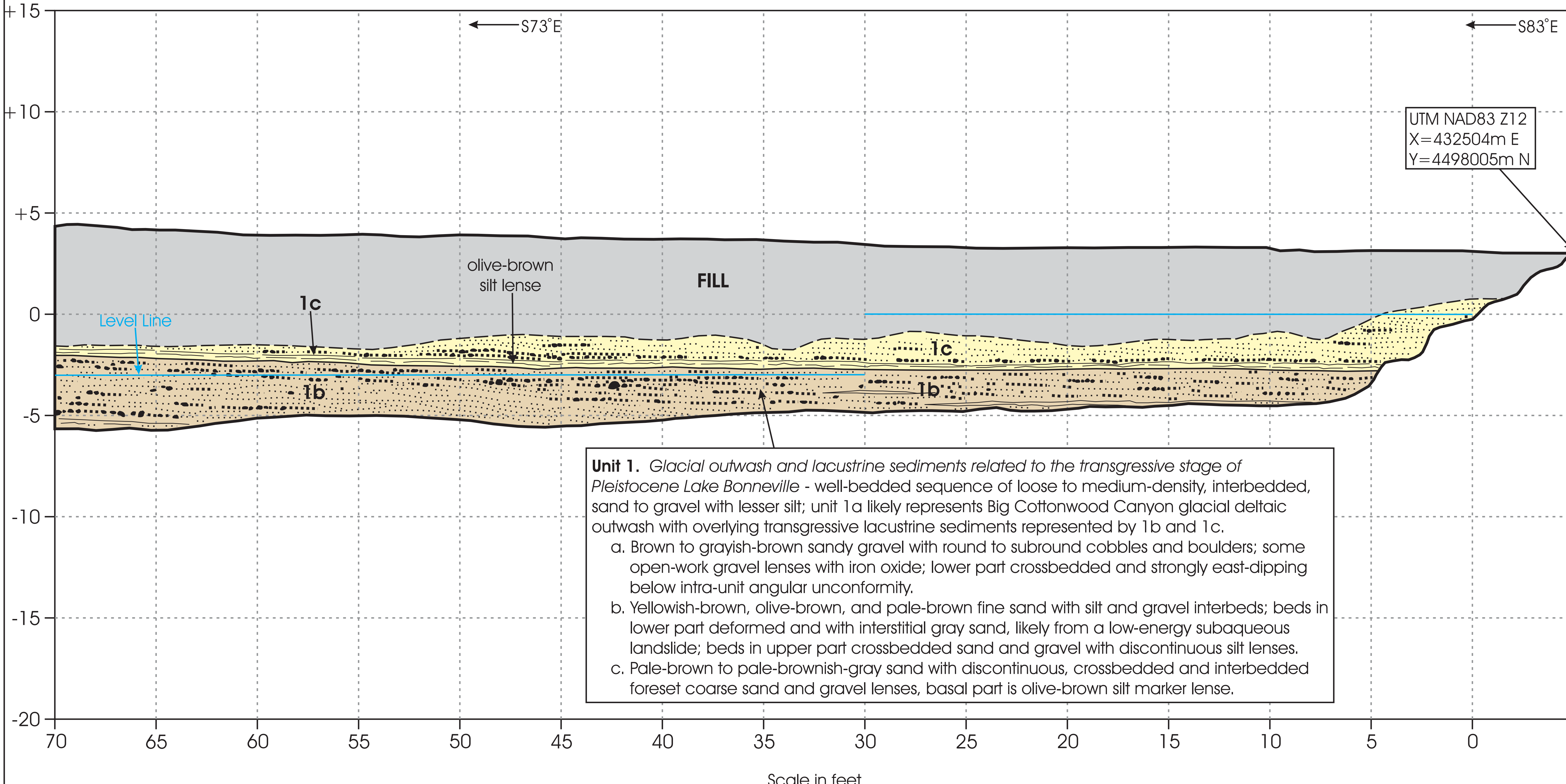
Trench logged by Bill Black, P.G. on
May 3 and 16, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 4 LOG, SHEET 3**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 8C**




**Unit 1.** *Glacial outwash and lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, sand to gravel with lesser silt; unit 1a likely represents Big Cottonwood Canyon glacial deltaic outwash with overlying transgressive lacustrine sediments represented by 1b and 1c.

a. Brown to grayish-brown sandy gravel with round to subround cobbles and boulders; some open-work gravel lenses with iron oxide; lower part crossbedded and strongly east-dipping below intra-unit angular unconformity.

b. Yellowish-brown, olive-brown, and pale-brown fine sand with silt and gravel interbeds; beds in lower part deformed and with interstitial gray sand, likely from a low-energy subaqueous landslide; beds in upper part crossbedded sand and gravel with discontinuous silt lenses.

c. Pale-brown to pale-brownish-gray sand with discontinuous, crossbedded and interbedded foreset coarse sand and gravel lenses, basal part is olive-brown silt marker lense.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
May 16-17 and 24, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

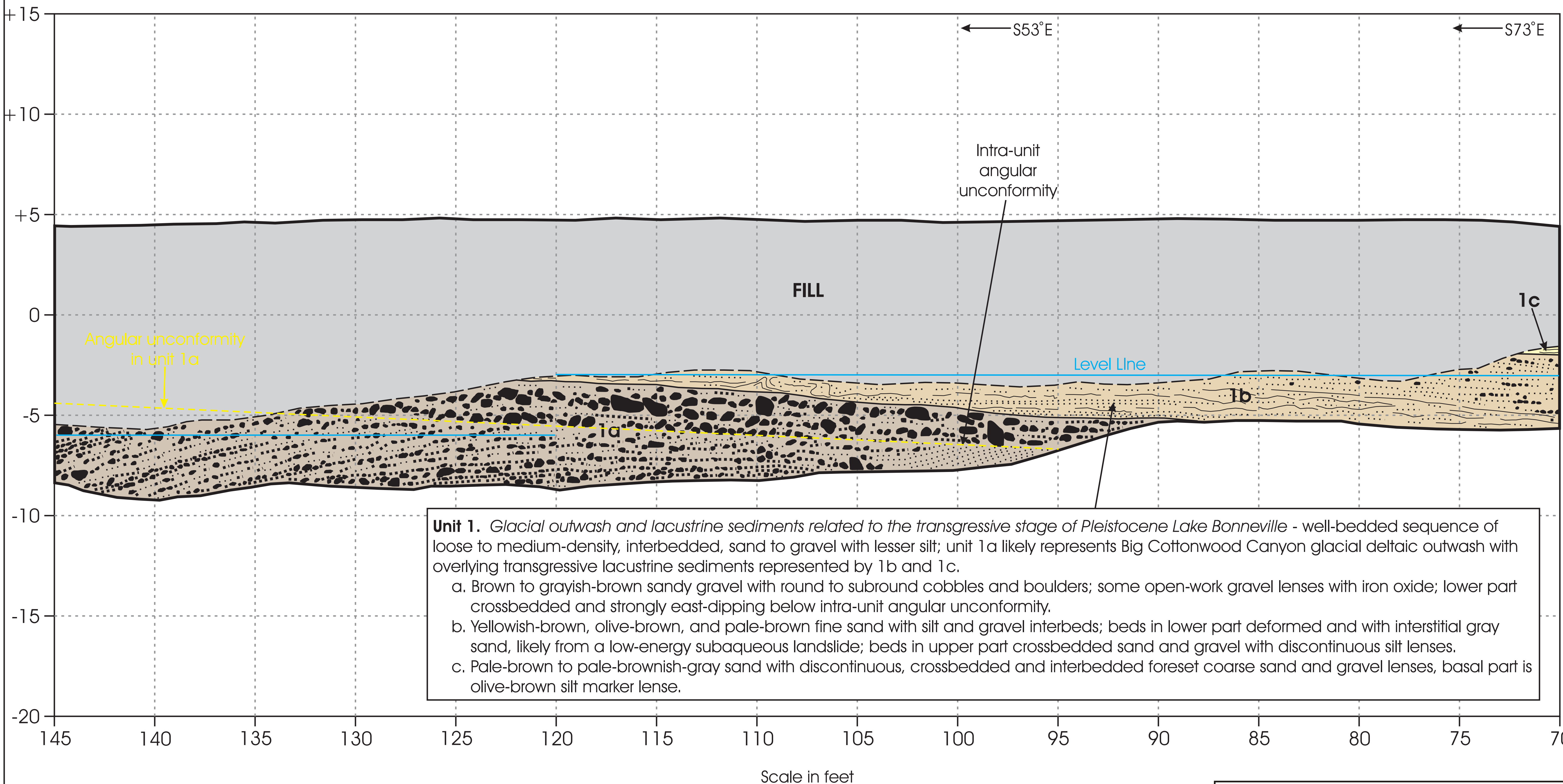
WESTERN GEOLOGIC

**TRENCH 5 LOG, SHEET 1**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 9A**




**Unit 1.** *Glacial outwash and lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, sand to gravel with lesser silt; unit 1a likely represents Big Cottonwood Canyon glacial deltaic outwash with overlying transgressive lacustrine sediments represented by 1b and 1c.

a. Brown to grayish-brown sandy gravel with round to subround cobbles and boulders; some open-work gravel lenses with iron oxide; lower part crossbedded and strongly east-dipping below intra-unit angular unconformity.

b. Yellowish-brown, olive-brown, and pale-brown fine sand with silt and gravel interbeds; beds in lower part deformed and with interstitial gray sand, likely from a low-energy subaqueous landslide; beds in upper part crossbedded sand and gravel with discontinuous silt lenses.

c. Pale-brown to pale-brownish-gray sand with discontinuous, crossbedded and interbedded foreset coarse sand and gravel lenses, basal part is olive-brown silt marker lense.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

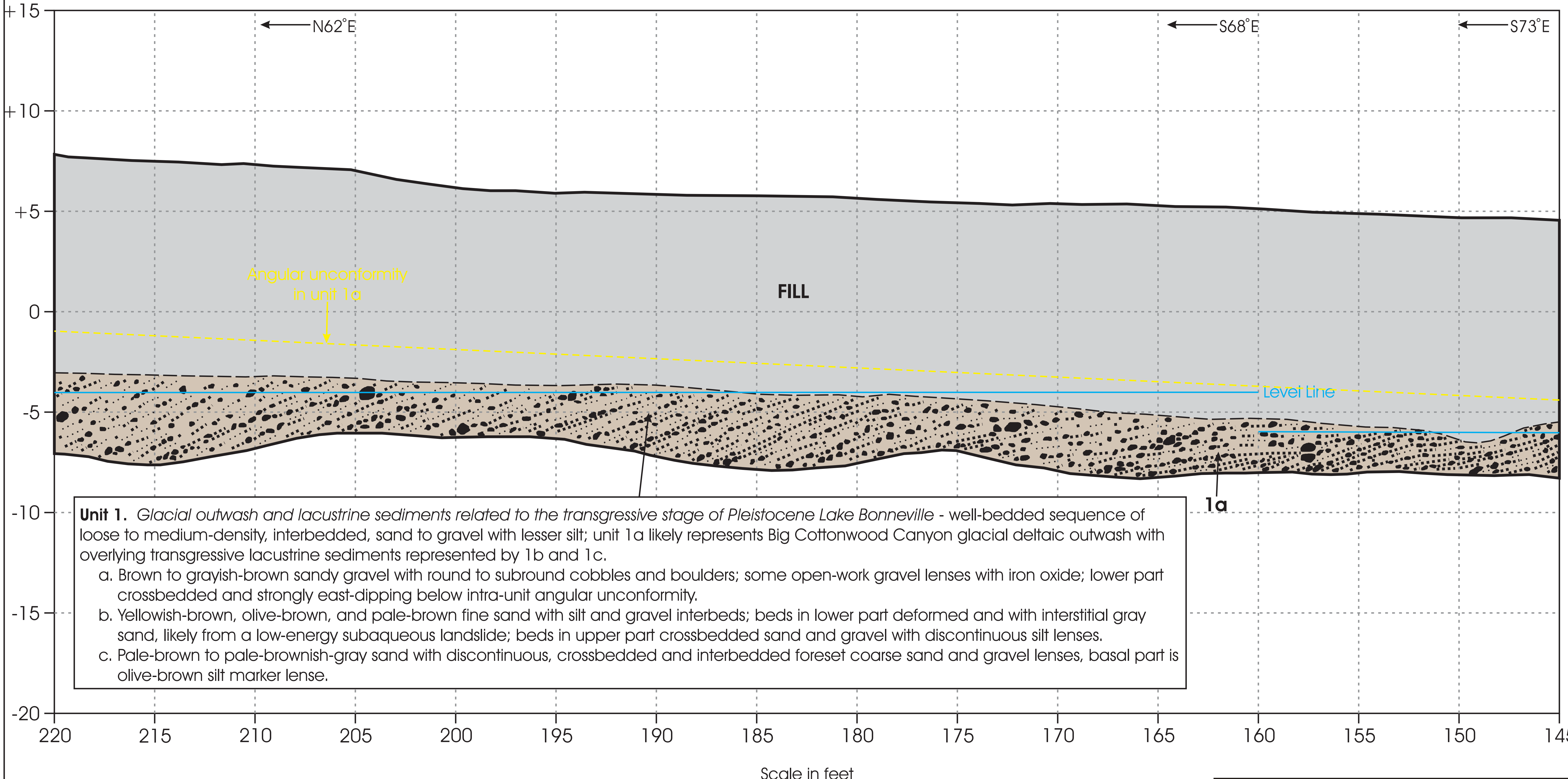
Trench logged by Bill Black, P.G. on
May 16-17 and 24, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 5 LOG, SHEET 2**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 9B**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

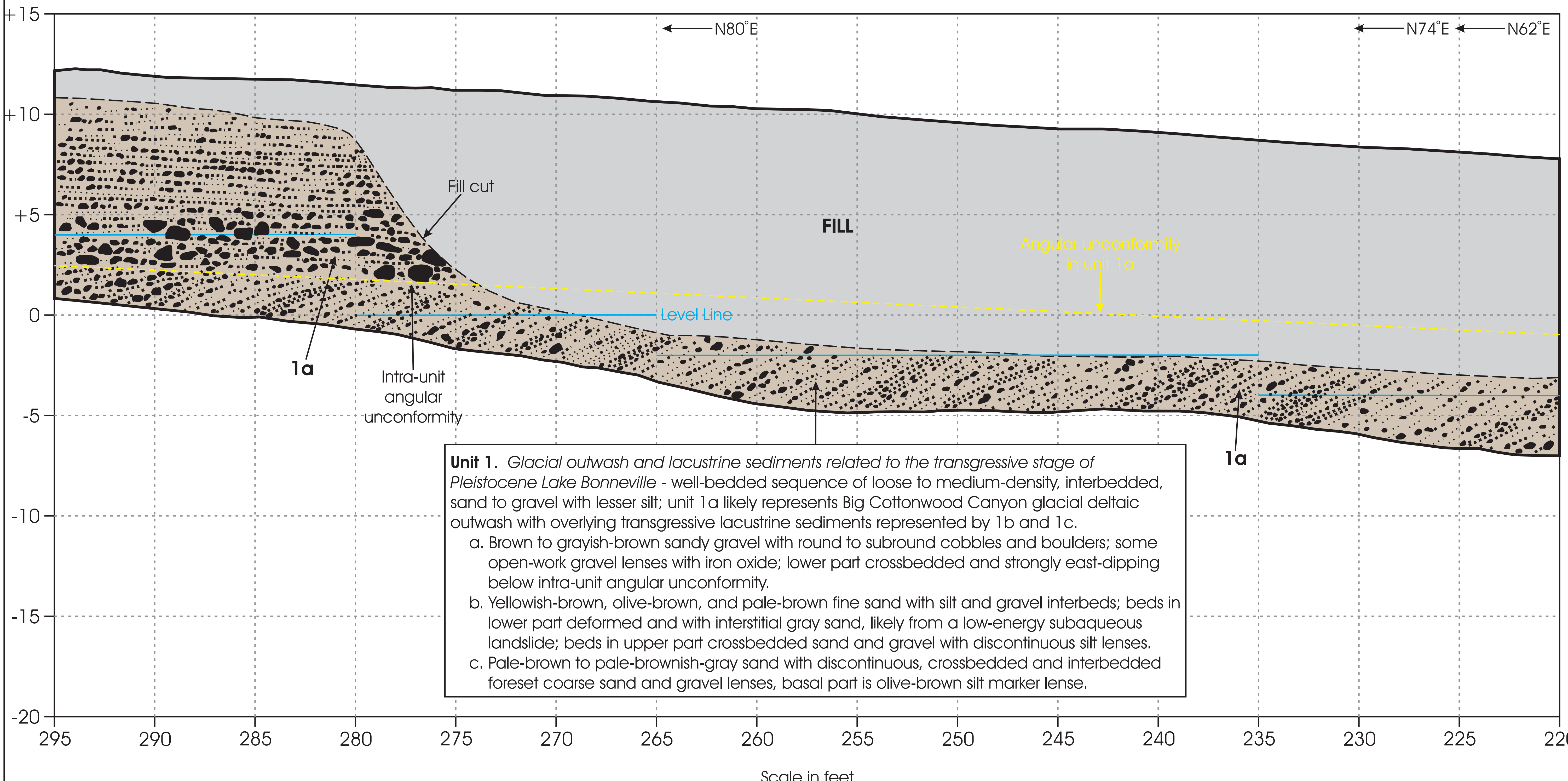
Trench logged by Bill Black, P.G. on
May 16-17 and 24, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 5 LOG, SHEET 3**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 9C**




**Unit 1.** *Glacial outwash and lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, sand to gravel with lesser silt; unit 1a likely represents Big Cottonwood Canyon glacial deltaic outwash with overlying transgressive lacustrine sediments represented by 1b and 1c.

a. Brown to grayish-brown sandy gravel with round to subround cobbles and boulders; some open-work gravel lenses with iron oxide; lower part crossbedded and strongly east-dipping below intra-unit angular unconformity.

b. Yellowish-brown, olive-brown, and pale-brown fine sand with silt and gravel interbeds; beds in lower part deformed and with interstitial gray sand, likely from a low-energy subaqueous landslide; beds in upper part crossbedded sand and gravel with discontinuous silt lenses.

c. Pale-brown to pale-brownish-gray sand with discontinuous, crossbedded and interbedded foreset coarse sand and gravel lenses, basal part is olive-brown silt marker lense.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

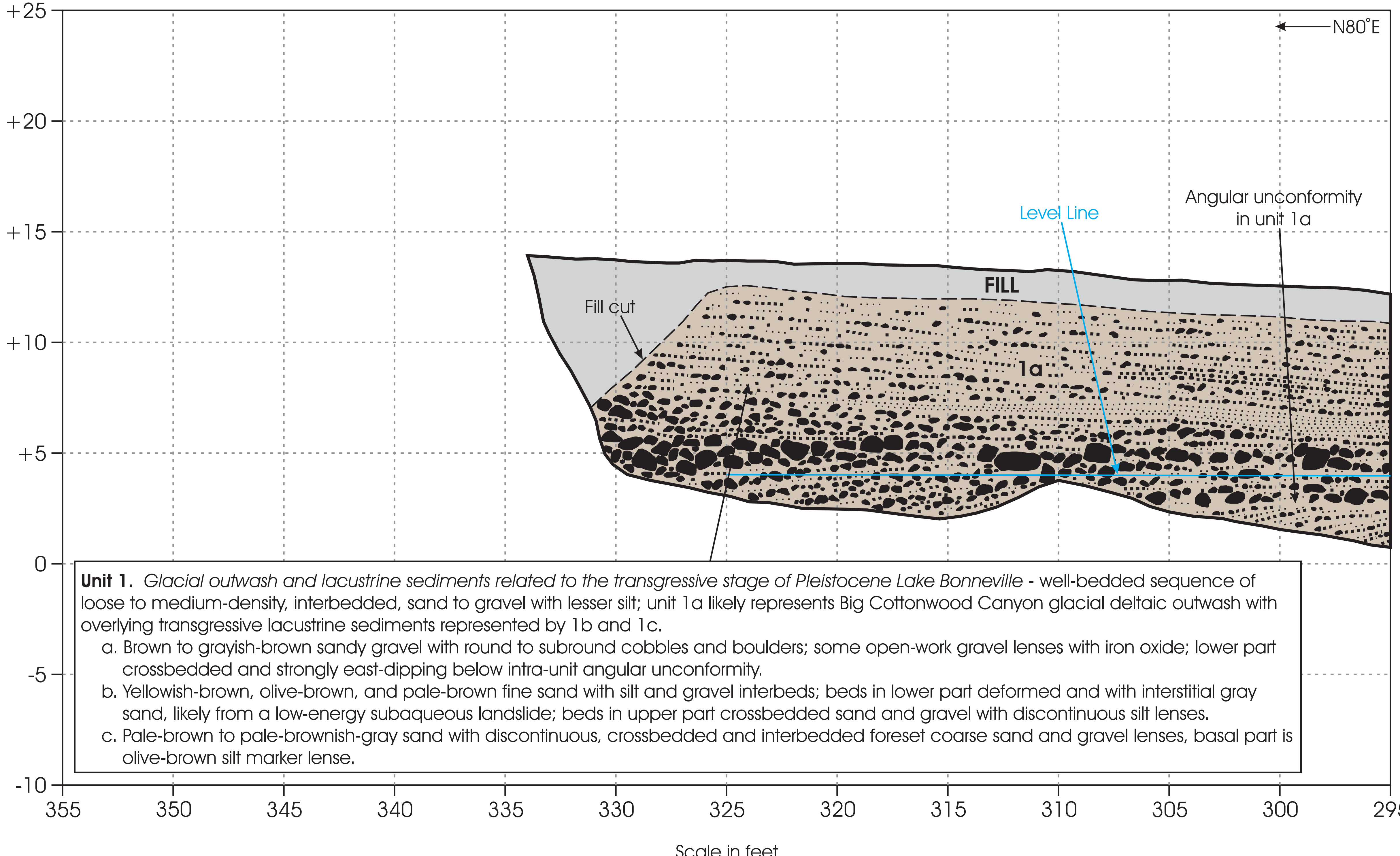
Trench logged by Bill Black, P.G. on
May 16-17 and 24, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 5 LOG, SHEET 4**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 9D**




**Unit 1.** *Glacial outwash and lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, sand to gravel with lesser silt; unit 1a likely represents Big Cottonwood Canyon glacial deltaic outwash with overlying transgressive lacustrine sediments represented by 1b and 1c.

a. Brown to grayish-brown sandy gravel with round to subround cobbles and boulders; some open-work gravel lenses with iron oxide; lower part crossbedded and strongly east-dipping below intra-unit angular unconformity.

b. Yellowish-brown, olive-brown, and pale-brown fine sand with silt and gravel interbeds; beds in lower part deformed and with interstitial gray sand, likely from a low-energy subaqueous landslide; beds in upper part crossbedded sand and gravel with discontinuous silt lenses.

c. Pale-brown to pale-brownish-gray sand with discontinuous, crossbedded and interbedded foreset coarse sand and gravel lenses, basal part is olive-brown silt marker lense.

WESTERN GEOLOGIC

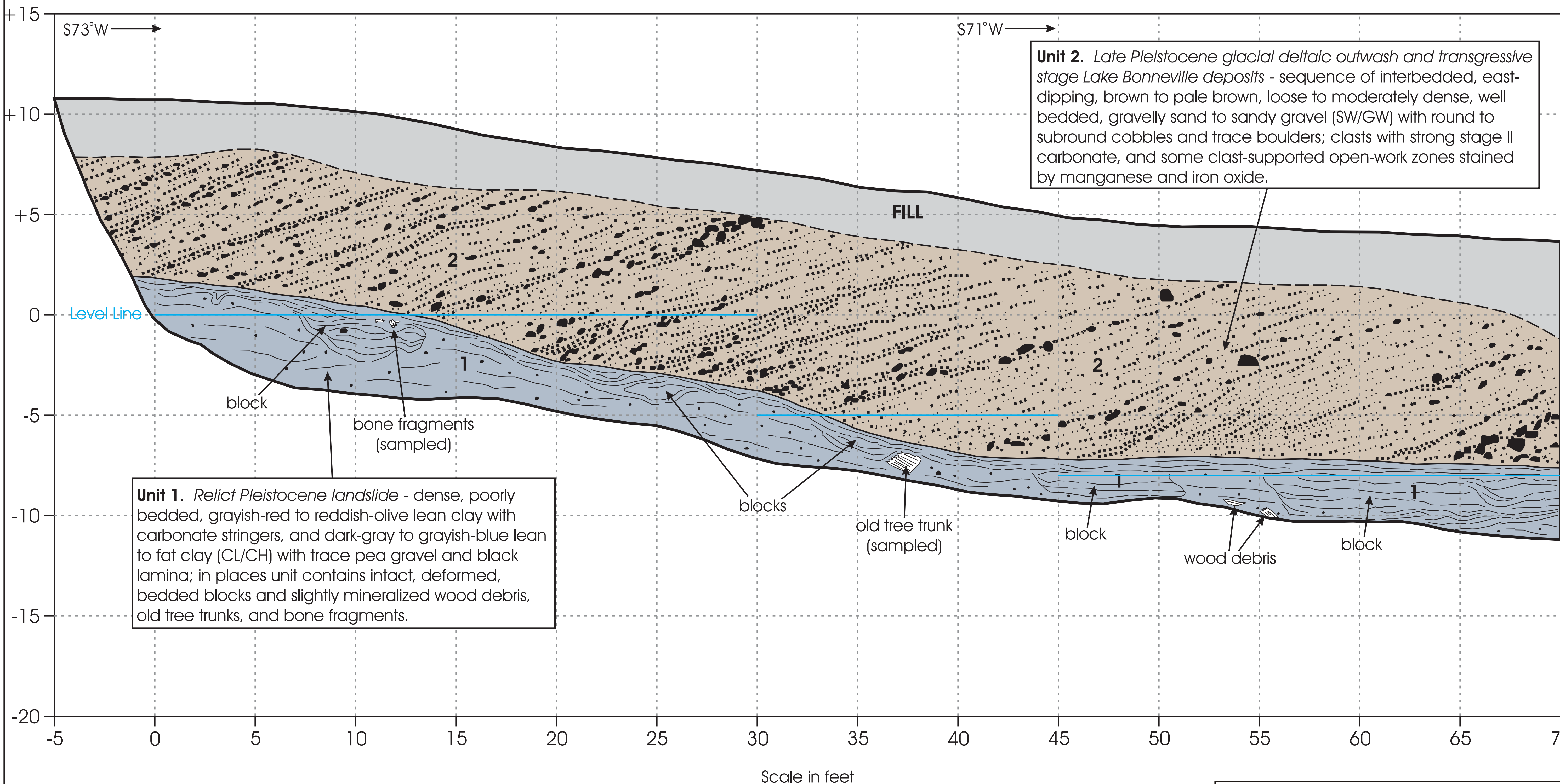
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
May 16-17 and 24, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

**TRENCH 5 LOG, SHEET 5**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 9E**




**Unit 2.** *Late Pleistocene glacial deltaic outwash and transgressive stage Lake Bonneville deposits* - sequence of interbedded, east-dipping, brown to pale brown, loose to moderately dense, well bedded, gravelly sand to sandy gravel (SW/GW) with round to subround cobbles and trace boulders; clasts with strong stage II carbonate, and some clast-supported open-work zones stained by manganese and iron oxide.

**Unit 1.** *Relict Pleistocene landslide* - dense, poorly bedded, grayish-red to reddish-olive lean clay with carbonate stringers, and dark-gray to grayish-blue lean to fat clay (CL/CH) with trace pea gravel and black lamina; in places unit contains intact, deformed, bedded blocks and slightly mineralized wood debris, old tree trunks, and bone fragments.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

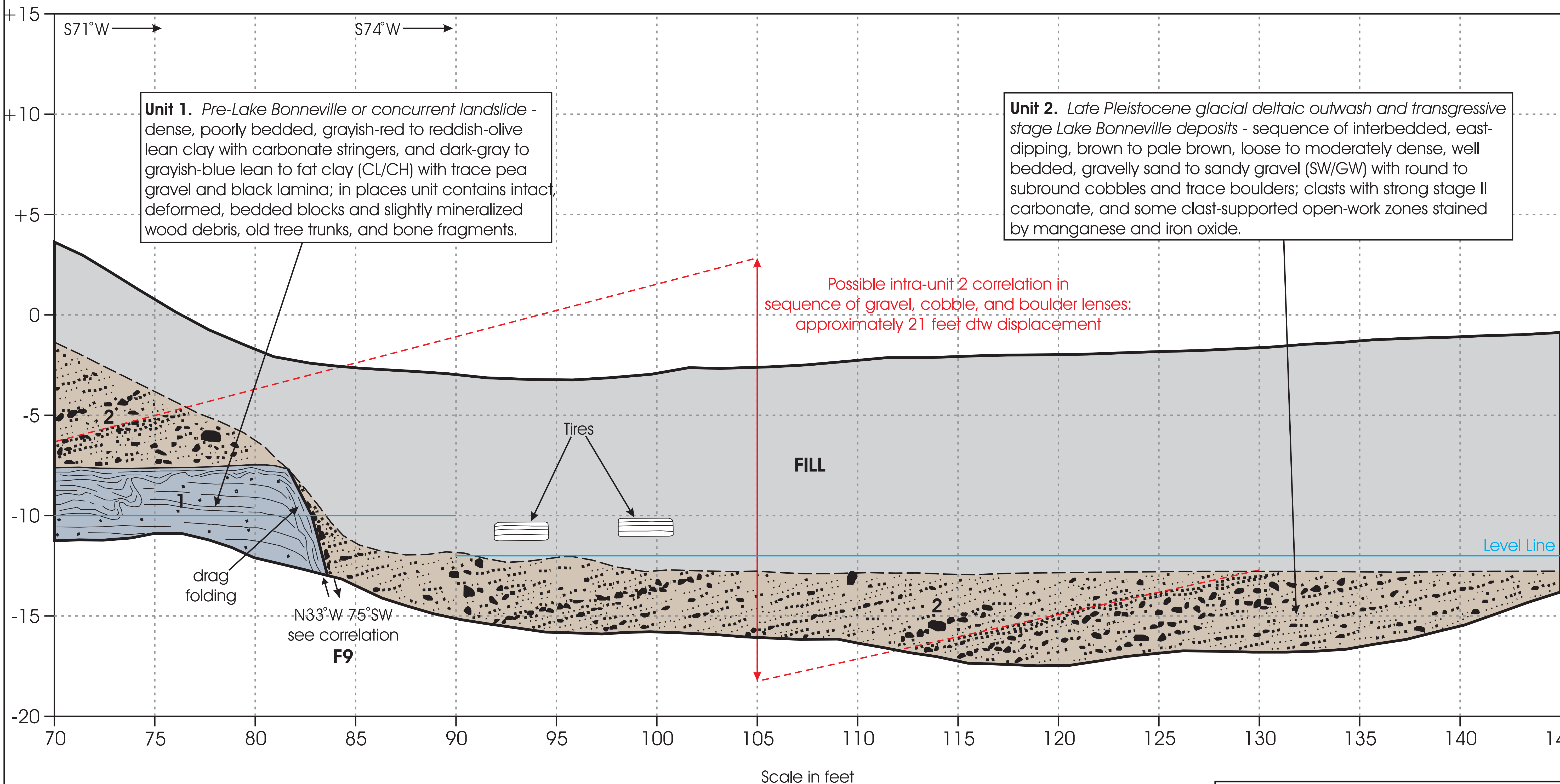
Trench logged by Bill Black, P.G. on
May 23, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 6 LOG, SHEET 1**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 10A**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
May 23, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

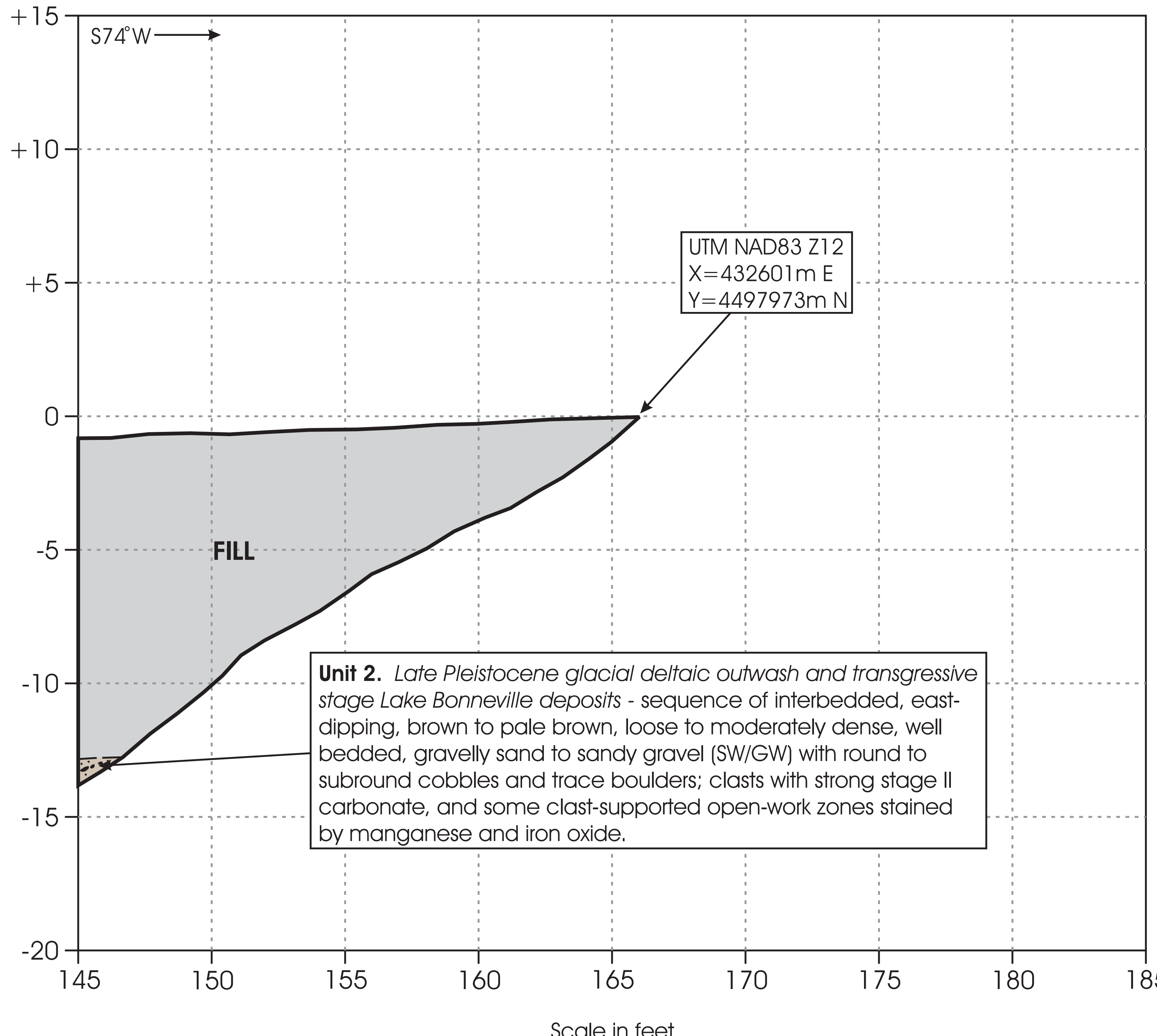
WESTERN GEOLOGIC

## TRENCH 6 LOG, SHEET 2

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 10B**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

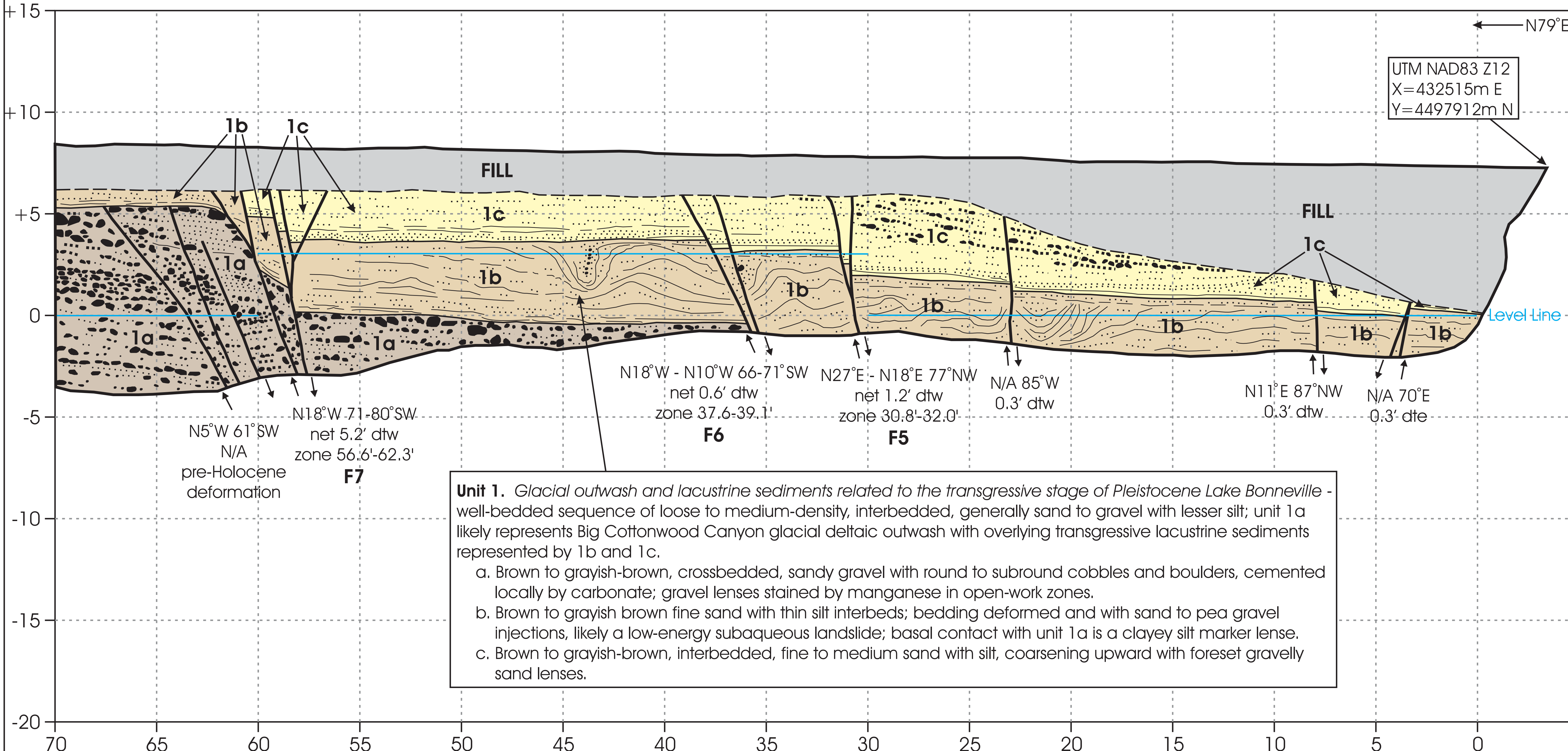
Trench logged by Bill Black, P.G. on
May 23, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 6 LOG, SHEET 3**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 10C**




**Unit 1.** *Glacial outwash and lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to medium-density, interbedded, generally sand to gravel with lesser silt; unit 1a likely represents Big Cottonwood Canyon glacial deltaic outwash with overlying transgressive lacustrine sediments represented by 1b and 1c.

a. Brown to grayish-brown, crossbedded, sandy gravel with round to subround cobbles and boulders, cemented locally by carbonate; gravel lenses stained by manganese in open-work zones.
b. Brown to grayish brown fine sand with thin silt interbeds; bedding deformed and with sand to pea gravel injections, likely a low-energy subaqueous landslide; basal contact with unit 1a is a clayey silt marker lense.
c. Brown to grayish-brown, interbedded, fine to medium sand with silt, coarsening upward with foreset gravelly sand lenses.

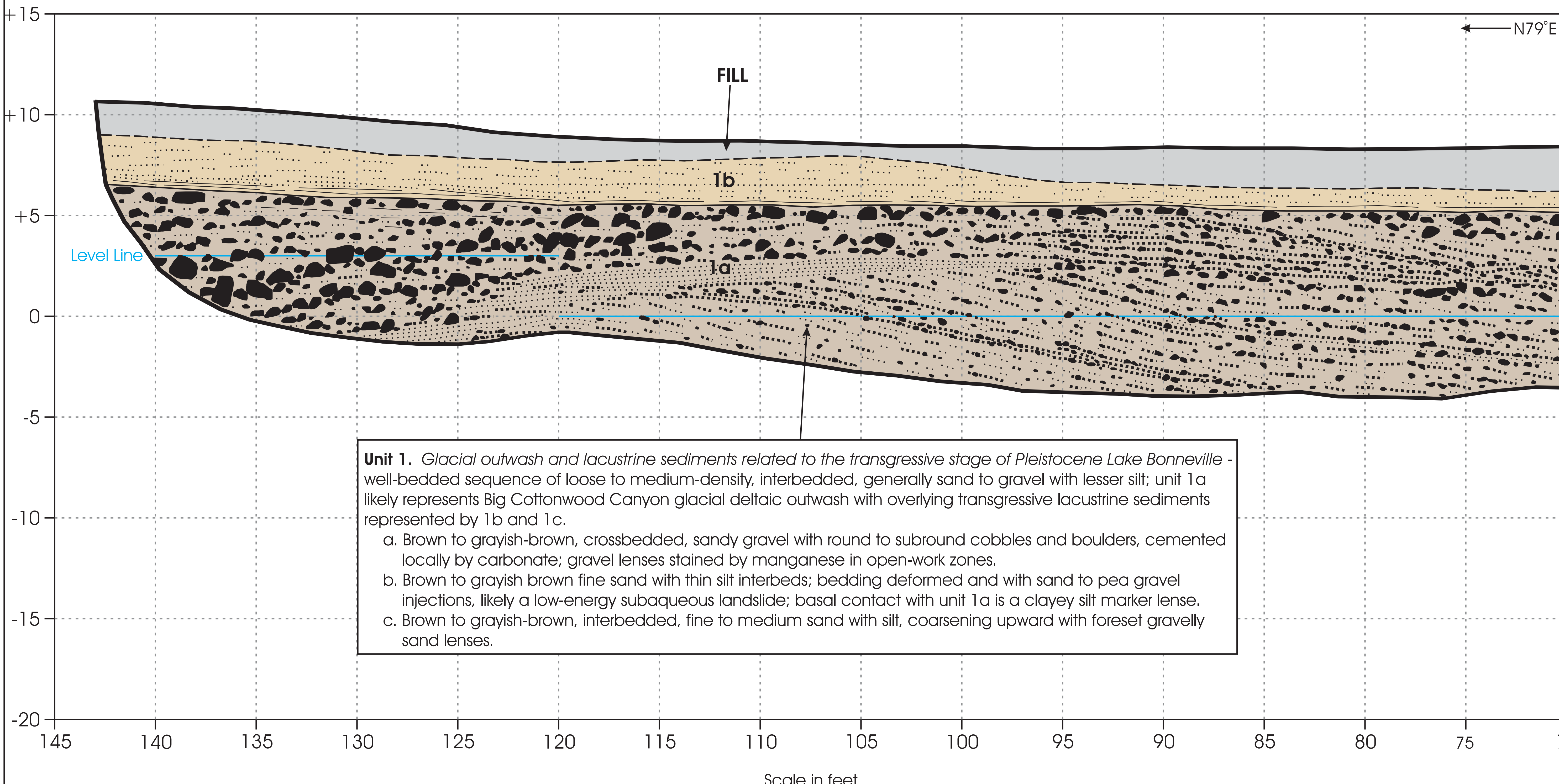
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
May 30, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

**TRENCH 7 LOG, SHEET 1**

**SURFACE FAULT RUPTURE**
**HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 11A**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

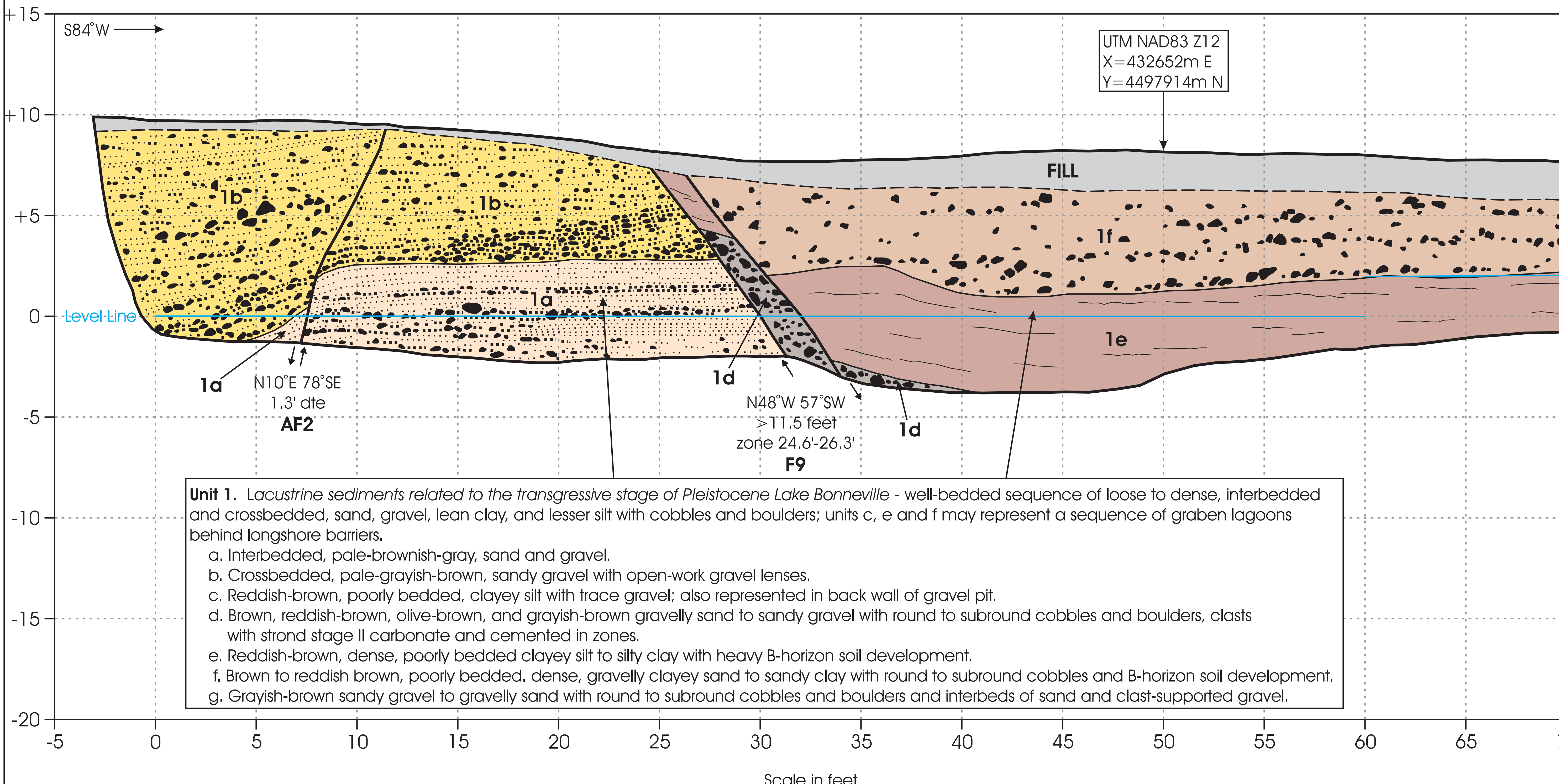
Trench logged by Bill Black, P.G. on
May 30, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 7 LOG, SHEET 2**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 11B**




**Unit 1.** *Lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to dense, interbedded and crossbedded, sand, gravel, lean clay, and lesser silt with cobbles and boulders; units c, e and f may represent a sequence of graben lagoons behind longshore barriers.

a. Interbedded, pale-brownish-gray, sand and gravel.
b. Crossbedded, pale-grayish-brown, sandy gravel with open-work gravel lenses.
c. Reddish-brown, poorly bedded, clayey silt with trace gravel; also represented in back wall of gravel pit.
d. Brown, reddish-brown, olive-brown, and grayish-brown gravelly sand to sandy gravel with round to subround cobbles and boulders, clasts with strond stage II carbonate and cemented in zones.
e. Reddish-brown, dense, poorly bedded clayey silt to silty clay with heavy B-horizon soil development.
f. Brown to reddish brown, poorly bedded. dense, gravelly clayey sand to sandy clay with round to subround cobbles and B-horizon soil development.
g. Grayish-brown sandy gravel to gravelly sand with round to subround cobbles and boulders and interbeds of sand and clast-supported gravel.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

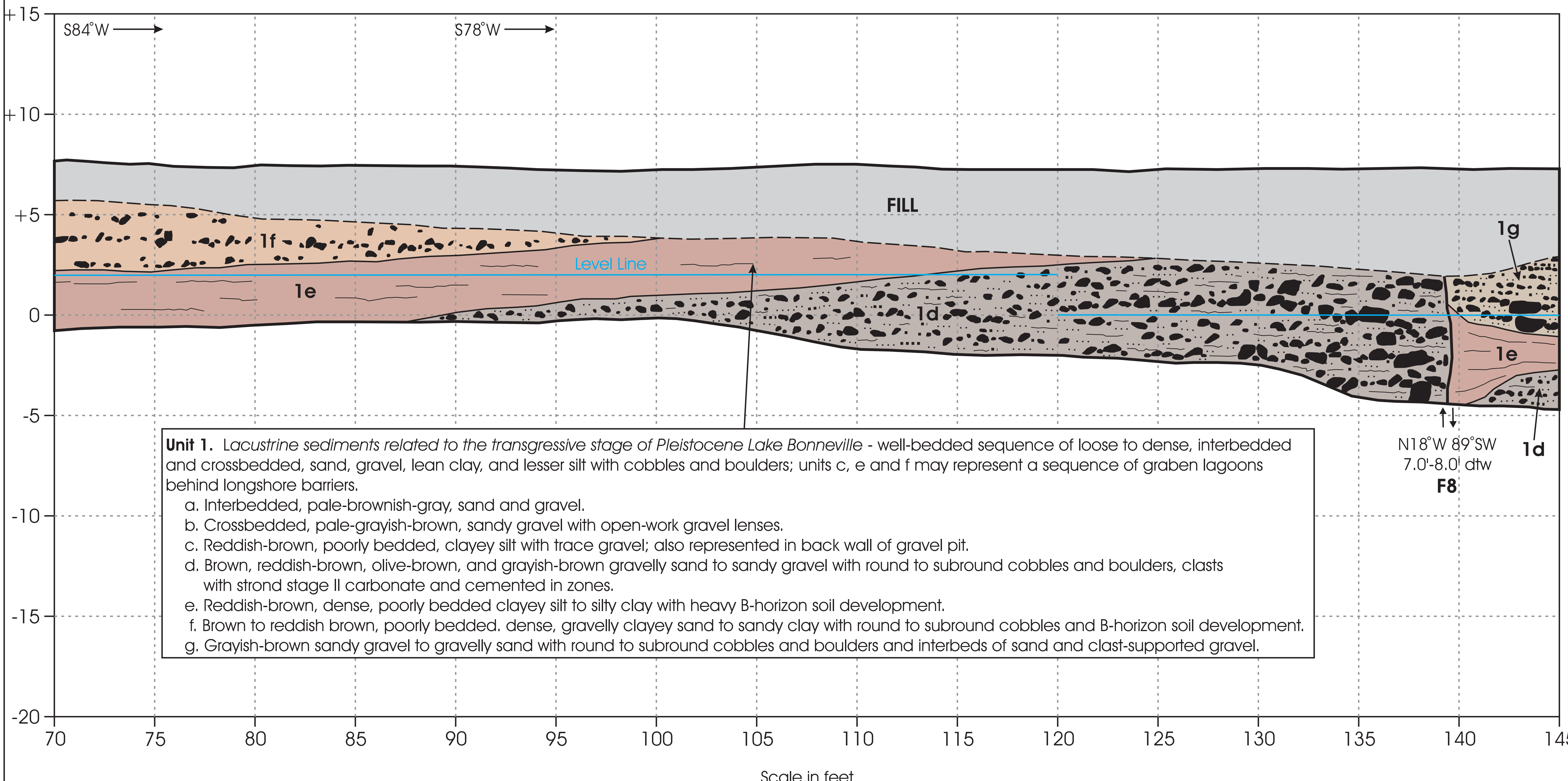
Trench logged by Bill Black, P.G. on
May 30-31, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 8 LOG, SHEET 1**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 12A**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
May 30-31, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

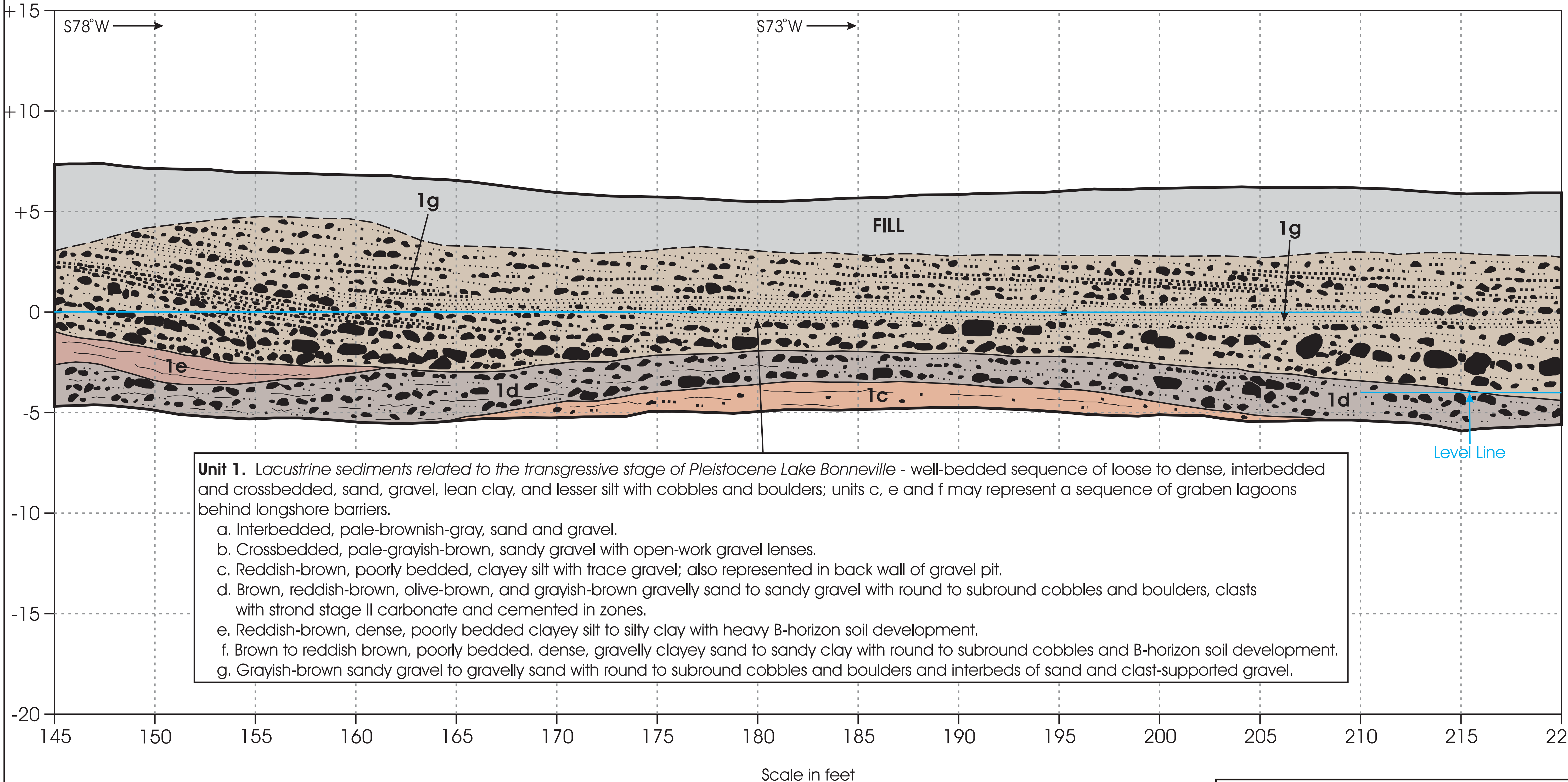
## TRENCH 8 LOG, SHEET 2

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 12B**

WESTERN GEOLOGIC




**Unit 1.** *Lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to dense, interbedded and crossbedded, sand, gravel, lean clay, and lesser silt with cobbles and boulders; units c, e and f may represent a sequence of graben lagoons behind longshore barriers.

a. Interbedded, pale-brownish-gray, sand and gravel.
b. Crossbedded, pale-grayish-brown, sandy gravel with open-work gravel lenses.
c. Reddish-brown, poorly bedded, clayey silt with trace gravel; also represented in back wall of gravel pit.
d. Brown, reddish-brown, olive-brown, and grayish-brown gravelly sand to sandy gravel with round to subround cobbles and boulders, clasts with strond stage II carbonate and cemented in zones.
e. Reddish-brown, dense, poorly bedded clayey silt to silty clay with heavy B-horizon soil development.
f. Brown to reddish brown, poorly bedded. dense, gravelly clayey sand to sandy clay with round to subround cobbles and B-horizon soil development.
g. Grayish-brown sandy gravel to gravelly sand with round to subround cobbles and boulders and interbeds of sand and clast-supported gravel.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

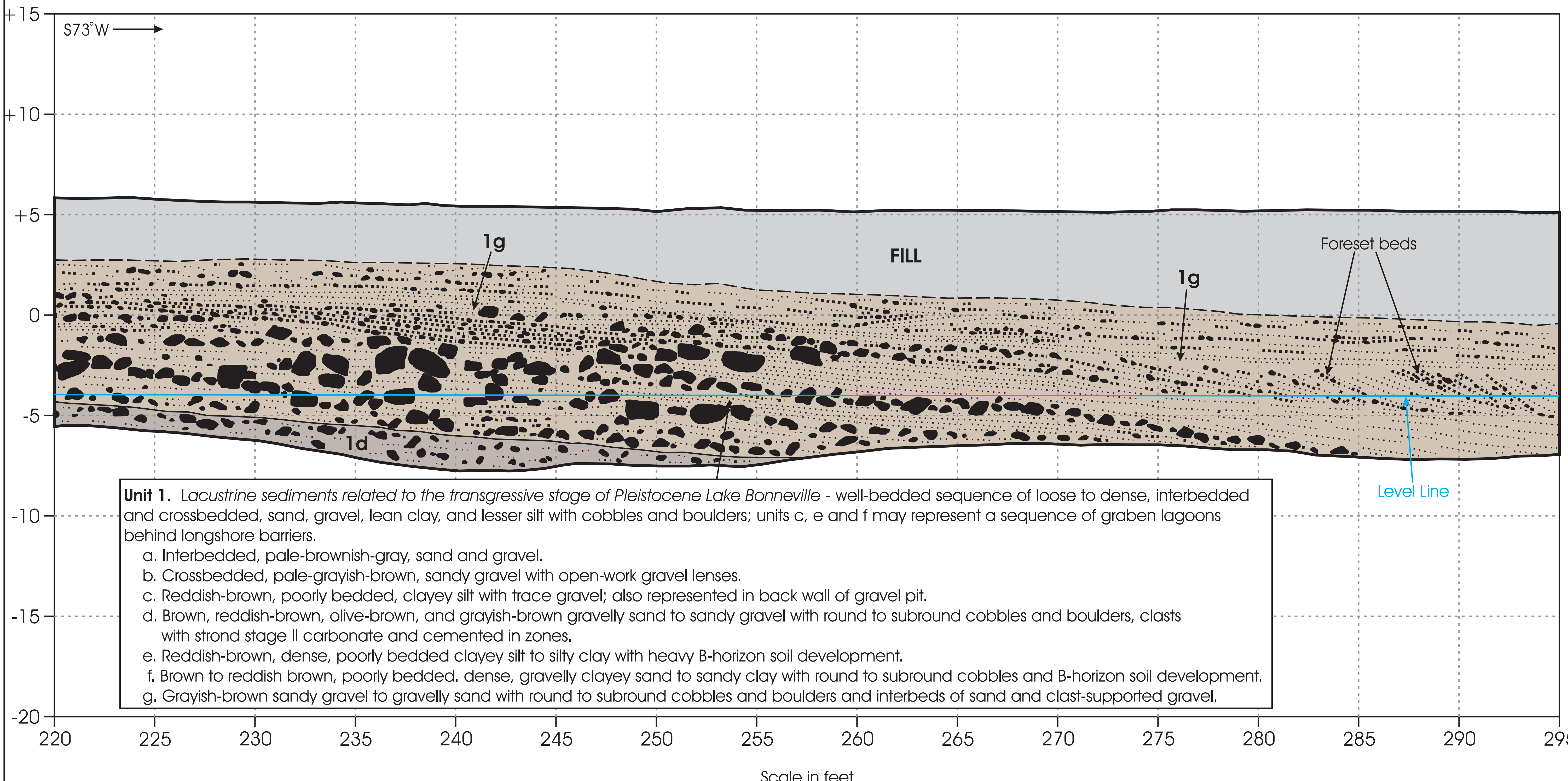
Trench logged by Bill Black, P.G. on
May 30-31, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 8 LOG, SHEET 3**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 12C**




SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
May 30-31, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

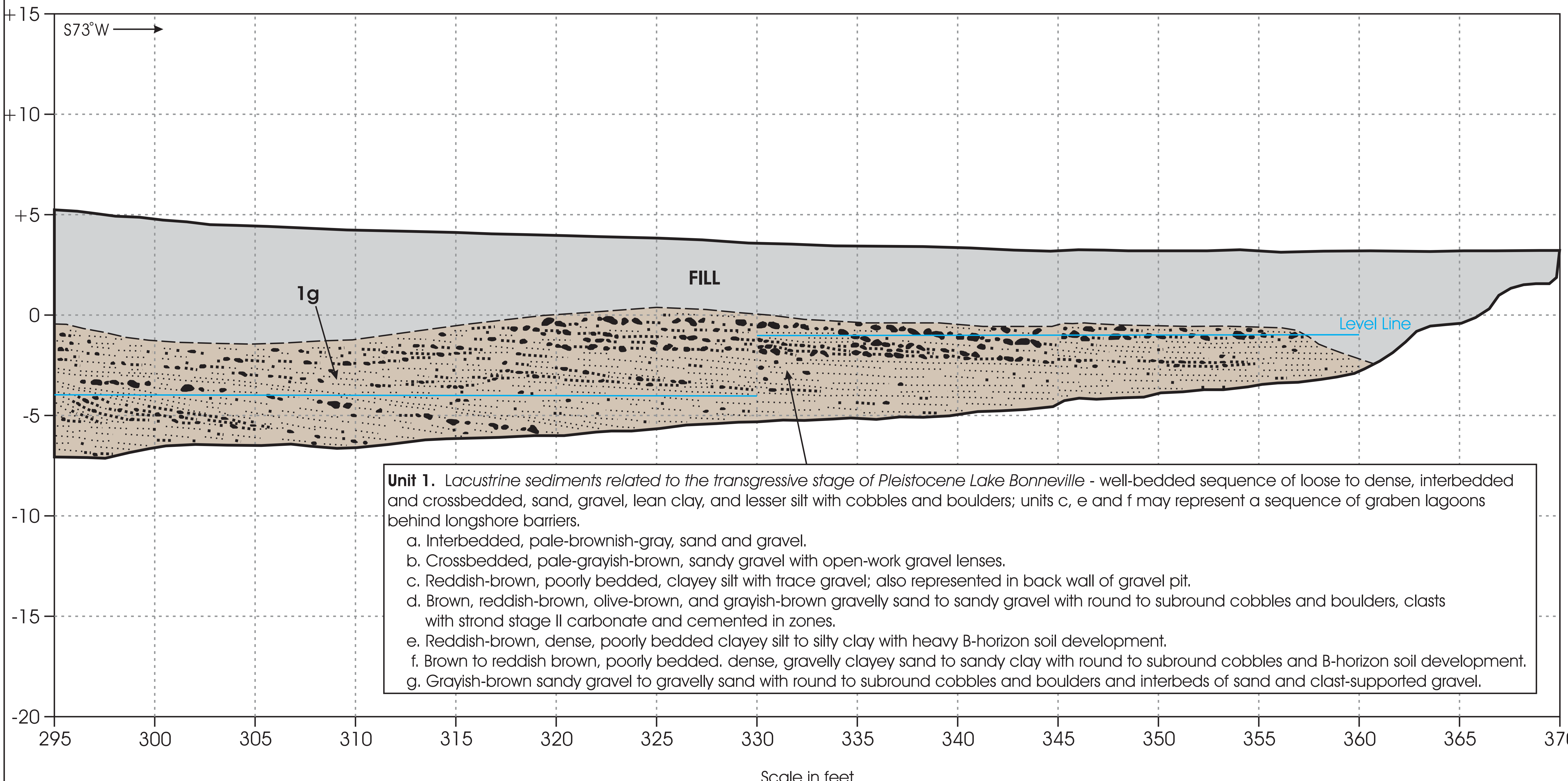
WESTERN GEOLOGIC

**TRENCH 8 LOG, SHEET 4**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**

AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 12D**




**Unit 1.** *Lacustrine sediments related to the transgressive stage of Pleistocene Lake Bonneville* - well-bedded sequence of loose to dense, interbedded and crossbedded, sand, gravel, lean clay, and lesser silt with cobbles and boulders; units c, e and f may represent a sequence of graben lagoons behind longshore barriers.

a. Interbedded, pale-brownish-gray, sand and gravel.
b. Crossbedded, pale-grayish-brown, sandy gravel with open-work gravel lenses.
c. Reddish-brown, poorly bedded, clayey silt with trace gravel; also represented in back wall of gravel pit.
d. Brown, reddish-brown, olive-brown, and grayish-brown gravelly sand to sandy gravel with round to subround cobbles and boulders, clasts with strond stage II carbonate and cemented in zones.
e. Reddish-brown, dense, poorly bedded clayey silt to silty clay with heavy B-horizon soil development.
f. Brown to reddish brown, poorly bedded. dense, gravelly clayey sand to sandy clay with round to subround cobbles and B-horizon soil development.
g. Grayish-brown sandy gravel to gravelly sand with round to subround cobbles and boulders and interbeds of sand and clast-supported gravel.

SCALE: 1 inch = 5 feet
(no vertical exaggeration)
South Trench Wall Logged

Trench logged by Bill Black, P.G. on
May 30-31, 2009
Log reviewed by Craig V Nelson, P.G., R.G., C.E.G in 2009

WESTERN GEOLOGIC

**TRENCH 8 LOG, SHEET 5**

**SURFACE FAULT RUPTURE HAZARD EVALUATION**
AJ Rock LLC Property
6695 South Wasatch Boulevard
Cottonwood Heights, Utah

**FIGURE 12E**