Shane's Copy

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December 17, 2004

Mr. Will Jones
c/o: Pine Valley Realty
50 West Canyon Crest Road
Alpine, Utah 84004

SUBJECT: **Supplemental Surface Fault Rupture Hazard Study**
Three Falls Ranch
Alpine City, Utah County, Utah

Dear Mr. Jones:

In response to review comments by DuRoss and Christenson (2004), and at your request, Western GeoLogic, LLC (Western GeoLogic) conducted a supplemental surface fault rupture hazard investigation at the proposed Three Falls Ranch Subdivision. The site is located in Fort Canyon in Alpine City, Utah County, in Section 12, Township 4 South, Range 1 East; and Section 7, Township 4 South, Range 2 East (Salt Lake Base Line and Meridian) (Figure 1 – Project Location). Western GeoLogic prepared a previous geologic hazards evaluation report for the subdivision in September 2004, and also conducted a supplemental debris-flow hazards evaluation in November 2004.

Seven trenches were excavated across the graben formed by the Fort Canyon fault in our September study, of which four trenches were in the western part of the site and three trenches were in the eastern part. Five of seven trenches located the fault, and a radiocarbon age estimate from a key stratigraphic horizon in one trench across the main fault confirmed a suspected late Holocene age for surface faulting. Based on the trenching and other geologic data, we provided fault setback recommendations to reduce the risk from surface fault rupture. However, DuRoss and Christenson (2004) recommended additional trenching and/or increasing fault setbacks to identify possible unmapped faults and account for uncertainties in the fault location, particularly due to the poor surface expression of the fault and wide trench spacing.

PURPOSE AND SCOPE

The purpose and scope of our investigation are to further evaluate the potential surface faulting hazard at the site and provide recommendations for development as needed. In accordance with that purpose, the following services were performed:

(1) A meeting with Alpine City officials, Chris DuRoss and Gary Christenson of the Utah Geological Survey, and yourself on October 28, 2004;

(2) A subsequent telephone discussion with Chris DuRoss of the Utah Geological Survey with regard to proposed trench locations and revisions to the fault setback map;

(3) Excavation and logging of two trenches at the site, and

(4) An evaluation of available data and preparation of this report, which presents the results of our study.

A detailed field review of the trenches and data from was conducted on November 8 for Chris DuRoss, Robert Biek, Michael Hylland, and Frank Ashland of the Utah Geological Survey. This report was prepared in general accordance with Guidelines for Evaluating Surface-Fault-Rupture Hazards in Utah (Christenson and others, 2003).

SUPPLEMENTAL TRENCHING STUDY

Over November 3rd and 4th, 2004 two additional trenches were excavated using a large trackhoe in the graben of the Fort Canyon fault. The trenches were inspected and logged by Bill Black of Western GeoLogic from November 3rd to 5th. Trenches from our previous study are numbered numerically in the order discussed in our September report; trenches 8 and 9 are the new trenches from this study (Figure 2). Trench 8 was excavated east of the loop road in the western part of the site, and extended roughly southward for a total distance of about 150 feet (Figure 2). The purpose of trench 8 was to provide overlapping coverage between trenches 3 and 4 in the western part of the graben. Trench 9 was excavated from near the southern end of trench 6, and extended roughly southward for a total distance of about 595 feet (Figure 2). The purpose of trench 9 was to provide overlapping coverage between trenches 6 and 7 in the eastern part of the graben. Detailed logs of the trenches at a scale of 1 inch equals 5 feet (1:60) are shown on figures 4 and 5, respectively; due to the length of the trenches and scale of the logs, each trench covers several sheets.

Trench 8 exposed a sequence of alluvial deposits, likely from multiple debris-flow/flood events. The oldest unit exposed in trench 8 is alluvially reworked glacial till comprised of sand with rounded cobbles and boulders in the south trench end (unit 1, Figure 4). Unit 1 is overlain by a debris flood deposit comprised of silt with sand and gravel (unit 2, Figure 4); unit 2 appears to correlate with unit 1 in trench 3. A paleosol A horizon was evident in places on top of unit 2, however the paleosol was scoured by younger debris-flood events and is incompletely exposed. Unit 2 is in turn overlain by a debris flow deposit comprised of clayey sand with discontinuous organic-rich lenses (unit 3; Figure 4); unit 3 correlates with unit 2 in trench 3. Unit 3 is overlain by an organic-rich debris-flood deposit (unit 4, Figure 4); unit 4 correlates with unit 3 in trench 3.

A modern soil A horizon is forming at the surface on top of these units. Trench 8 exposed no evidence for faulting such as vertical terminations, or backtilted or displaced bedding, and the sediments generally appeared dry and undeformed. The correlation of units between trenches 3 and 9 also suggests no surface faulting is in this part of the graben floor along the trench alignments.

Trench 9 exposed a complex sequence of alluvium overlying an old landslide deposit. Biek (2003) maps a large landslide complex in the eastern part of the site around Nephs Lake (Figure 1), the western part of which appears associated with an arcuate, north-facing scarp on air photos. However, the source area for the eastern landslide deposits is uncertain and not directly evident. The oldest deposit exposed in trench 9 is landslide colluvium containing carbonate-rich, fractured and brecciated blocks of sandstone bedrock possibly derived from the Oquirrh Formation (units 1a-b, Figure 5). No bedrock remnants of the Oquirrh Formation are found in the site vicinity. The landslide deposit also contains grusified quartz monzonite cobbles and boulders, suggesting considerable age. Unit 1c is a dense, fat clay deposit (unit 1c, Figure 4) similar to unit 2a in trench 7, which may have been a viscous, fluidized matrix in which the landslide block floated. Units 1d and 1e are additional colluvium in the landslide mass. To the north in trench 9, unit 1 is overlain by a sequence of alluvium (units 2 through 5, Figure 5) likely shed from higher slopes to the northeast along the southwest face of the First Hamongog (Figure 1). Assuming the landslide came from the First Hamongog, the alluvium would be filling in a swale on the northeast side of the landslide formed in the wake of the sliding block. Units 2-5 in trench 9 correlate with the same sequence of alluvium and colluvium (units 1-4) exposed in trench 6.

Stratigraphic subunits of the landslide (unit 1, Figure 5) appeared highly jumbled and contorted, and most were blocks that were not exposed in the opposite wall of the trench. One south- and two north-dipping contacts were evident in both trench walls at 470 feet, 335 feet, and 527 feet horizontal, respectively, that may be possible faults (Figure 5). No evidence of aligned clasts or displaced bedding was found along the contacts, suggesting a depositional origin that is also supported by stratigraphic relations in the trench. The north- and south-dipping contacts at 470 feet and 527 feet horizontal (Figure 5), respectively, are overlain by undisplaced landslide colluvium and thus could not have been from faulting, unless the landslide deposit is from two failures with no intervening deposits. A multiple-failure origin is not indicated by the stratigraphic evidence. The north-dipping contact at 335 feet horizontal is very low angle (24 degrees) and is overlain by undisplaced alluvium (unit 2), which correlates to unit 1 in trench 6 to the north and was displaced along the main fault. Assuming the contact is an antithetic fault that acted in concert with the main fault, units 2 and 3 should also be faulted. Furthermore, exposures of the antithetic fault in trenches 4 and 7 were both high angle (exceeding 75 degrees) and not shallow. Given all of the above evidence, this latter contact also appears depositional. Thus, we conclude trench 9 also exposes no evidence for faulting in the graben floor south of the main fault.

RADIOCARBON DATING

One radiocarbon sample was obtained from bulk sediment taken from the lower part of unit 2, directly overlying unit 1b, on the northern margin of the landslide deposit. The age date was submitted by Tim Thompson of IGES for the purpose of determining a limiting age for the landslide deposit in trench 9. Age from the radiocarbon result is reported both as the uncalibrated age before present (yr. B.P.), and calibrated age (2-sigma error) which follows the uncalibrated result in parentheses (cal. yr. B.P.). Sample preparation, lab analysis, and calibration were performed by Beta Analytic; radiocarbon age reported by the lab used conventional techniques with C_{13}/C_{12} corrections.

The radiocarbon result shows unit 2 has an age of 7,670 – 7,840 cal. yr. B.P. This evidence indicates that the landslide deposit (units 1a-e, Figure 5) is older than about 7,800 years, which corresponds with other evidence suggesting a relatively old age such as the grusified cobbles and boulders. Age for most-recent faulting on the main fault, as determined in trench 1, was 2,730 – 2,890 yr. cal. B.P., or about 2,800 years ago. Based on this evidence, coeval antithetic faulting with the main fault, and ages for late Holocene faulting on the Provo section of the Wasatch fault zone in Black and others (2003), the landslide deposit should be displaced by multiple events if faulting were present in the eastern part of the graben floor along the trench alignments. However, no evidence for faulting was exposed in trench 9 as discussed above.

DISCUSSION AND CONCLUSIONS

DuRoss and Christenson (2004) recommended additional trenching, wider setbacks, and/or trenching of building footprints in the fault and graben zones to further reduce risk from surface fault rupture. Two additional trenches (discussed above) were excavated in the graben floor to provide overlapping coverage between our original trenches on the west and east sides of the site. The trenches exposed no new evidence for surface faulting. Based on discussions with Chris DuRoss of the Utah Geological Survey, we also proposed increasing the setback distances to double the setbacks calculated in our September report, or to a minimum of 50 feet on each side of the faults, whichever is more. Mr. DuRoss concurred with this proposal. The setback south of the antithetic fault in trench 4 was further increased to incorporate possible landslide or fault shears of uncertain origin indicated by DuRoss and Christenson (2004). The setback zone south of the main fault in trench 6 was not changed, because it was already wider than calculated setbacks in our September report to account for a large zone of deformation. The setbacks were reduced to the original distances calculated in our September report near known fault locations in the trenches.

Based on the results of our investigations and our current understanding that surface fault rupture and deformation tend to follow past patterns, we therefore recommend a setback zone around the projected fault traces as shown on Figure 2. The setback zone exceeds fault setback guidelines in Christenson and others (2003) to account for the widely spaced trenches and poor surface expression of the fault. No structures designed for occupancy should be located within the setback zones on Figure 2. It is generally accepted practice to allow streets, driveways, yards, and other non-occupied structures to be constructed within these areas. Given the field evidence the widened setback zones should adequately reduce risk from the hazard at the site. DuRoss and Christenson (2004) indicate that Alpine City might also consider foundation excavation inspections for lots in high-hazard areas as shown on Figure 3. Additional trenching could also be performed during individual home layout should the owner desire to reduce the setback distances recommended. However the recommendations provided in this supplemental report should now be sufficient for subdivision-level approval.

With regard to tectonic subsidence, DuRoss and Christenson (2004) indicate all lots within the subdivision should be designated as having a potential hazard, and hazard-reduction measures provided as needed. We concur with their assessment. It should be noted, however, that tectonic subsidence is not a life-safety issue, and hazard-reduction measures are not typically considered cost effective for single-family dwellings.

Figure 3 presents a revised hazard summary for the subdivision based on the increased fault setbacks and tectonic subsidence hazard. No other changes are needed to the recommendations provided in our September report.

In conclusion, the site is considered suitable for the proposed development if the recommendations in our reports are followed. We recommend that this existence of this report, and all previous reports and reviews, be disclosed to homeowners and potential buyers so that they can understand and be willing to accept the risk from inherent geologic hazards at the site.

The information in this report relates only to the referenced property and should not be extrapolated or construed to apply to any other site or property. This investigation was performed with the usual care and thoroughness of the consulting profession. Western GeoLogic has pursued those avenues of investigation that based on the scope of work, the readily available data, and our experience seemed prudent. Obviously, no definitive representations can be made with respect to those site attributes outside the scope of work. The exploratory trenches may be in areas where structures could subsequently be placed. The backfill was *not* placed in the trenches in compacted layers as engineered fill. The trench fill is likely to settle with time and upon saturation. No footings or structural supports should be founded over trench excavations unless the backfill has been removed and replaced with structural fill or other recommendations from the geotechnical report are followed.

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

Sincerely,

Western GeoLogic, LLC



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



Craig V Nelson, R.G., C.E.G.
Principal Engineering Geologist

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ATTACHMENTS

Figure 1. Location Map
Figure 2. Fault and Setback Map
Figure 3. Hazards Summary
Figure 4a-c. Trench 8 Log
Figure 5a-h. Trench 9 Log

REFERENCES

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.

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, 14 p.

DuRoss, C.B., and Christenson, G.E., Review of geologic-hazards report for the proposed Three Falls Ranch subdivision, Alpine, Utah: Utah Geological Survey unpublished Technical Memorandum, Job No. 04-07, 6 p.

FROM: Darden Hood, Director (mailto:mailto:dhood@radiocarbon.com)
(This is a copy of the letter being mailed. Invoices/receipts follow only by mail.)

December 10, 2004

Dr. David Nielsen
IGES
14740 S Heritagecrest Way, Ste. D
Bluffdale, UT 84065
USA

RE: Radiocarbon Dating Result For Sample TFRT9RC-2

Dear Dr. Nielsen:

Enclosed is the radiocarbon dating result for one sample recently sent to us. It provided plenty of carbon for an accurate measurement and the analysis went normally. The report sheet contains the method used, material type, applied pretreatments and, where applicable, the two sigma calendar calibration range.

As always, this report has been both mailed and sent electronically. All results (excluding some inappropriate material types) which are less than about 20,000 years BP and more than about ~250 BP include this calendar calibration page (also digitally available in Windows metafile (.wmf) format upon request). Calibration is calculated using the newest (1998) calibration database with references quoted on the bottom of the page. Multiple probability ranges may appear in some cases, due to short-term variations in the atmospheric 14C contents at certain time periods. Examining the calibration graph will help you understand this phenomenon. Don't hesitate to contact us if you have questions about calibration.

We analyzed this sample on a sole priority basis. No students or intern researchers who would necessarily be distracted with other obligations and priorities were used in the analysis. We analyzed it with the combined attention of our entire professional staff.

Information pages are also enclosed with the mailed copy of this report. If you have any specific questions about the analysis, please do not hesitate to contact us.

The cost of the analysis was charged to the VISA card provided. A receipt is enclosed. Thank you. As always, if you have any questions or would like to discuss the results, don't hesitate to contact me.

Sincerely,

Darden Hood

Dr. David Nielsen

Report Date: 12/10/2004

IGES

Material Received: 11/30/2004

Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 198627	6900 +/- 50 BP	-23.3 o/oo	6930 +/- 50 BP
SAMPLE : TFRT9RC-2			
ANALYSIS : AMS-Advance delivery			
MATERIAL/PRETREATMENT : (organic sediment): acid washes			
2 SIGMA CALIBRATION : Cal BC 5890 to 5720 (Cal BP 7840 to 7670)			

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12=-23.3:lab. mult=1)

Laboratory number: **Beta-198627**

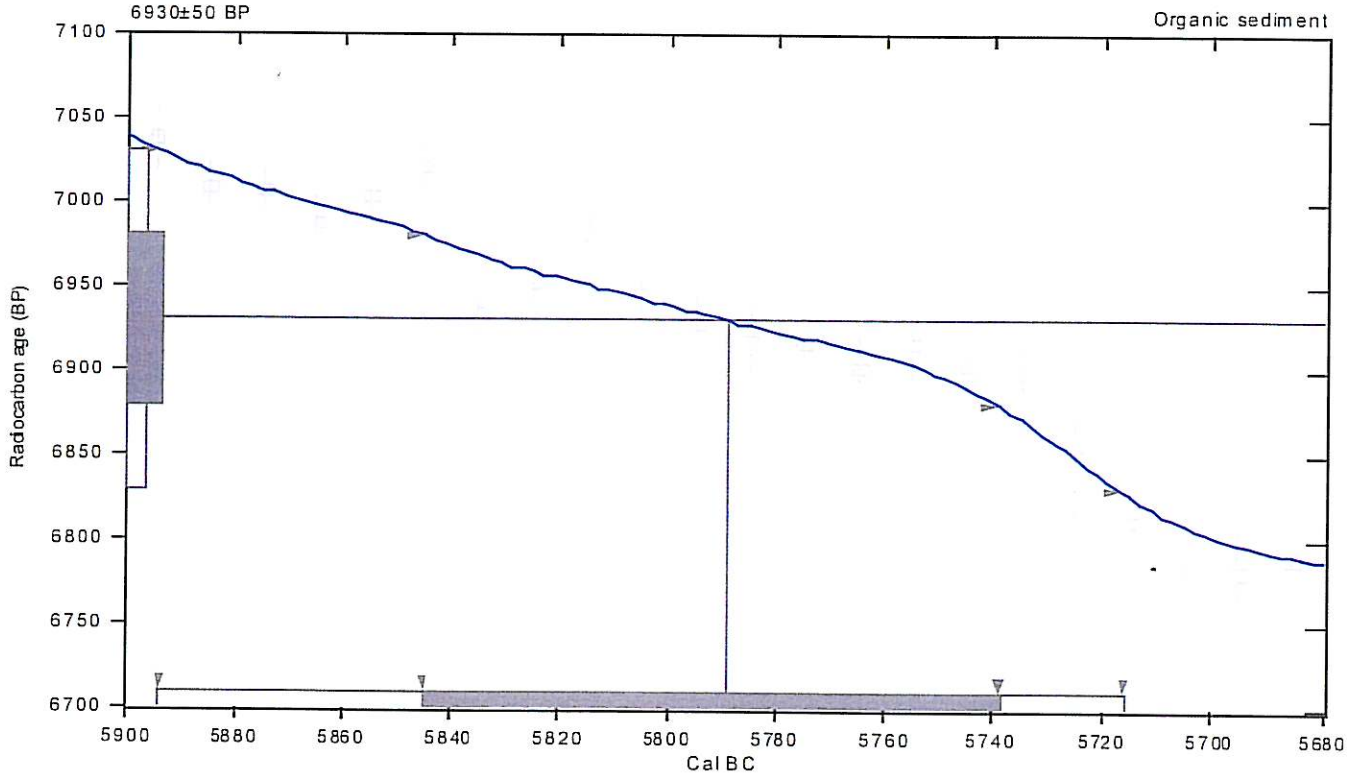
Conventional radiocarbon age: **6930±50 BP**

2 Sigma calibrated result: (95% probability) **Cal BC 5890 to 5720 (Cal BP 7840 to 7670)**

Intercept data

Intercept of radiocarbon age with calibration curve: Cal BC 5790 (Cal BP 7740)

1 Sigma calibrated result: (68% probability) Cal BC 5840 to 5740 (Cal BP 7800 to 7690)



References:

Database used

INTCAL98

Calibration Database

Editorial Comment

Stuiver, M., van der Plicht, H., 1998, Radiocarbon 40(3), pxii-xiii

INTCAL98 Radiocarbon Age Calibration

Stuiver, M., et. al., 1998, Radiocarbon 40(3), p1041-1083

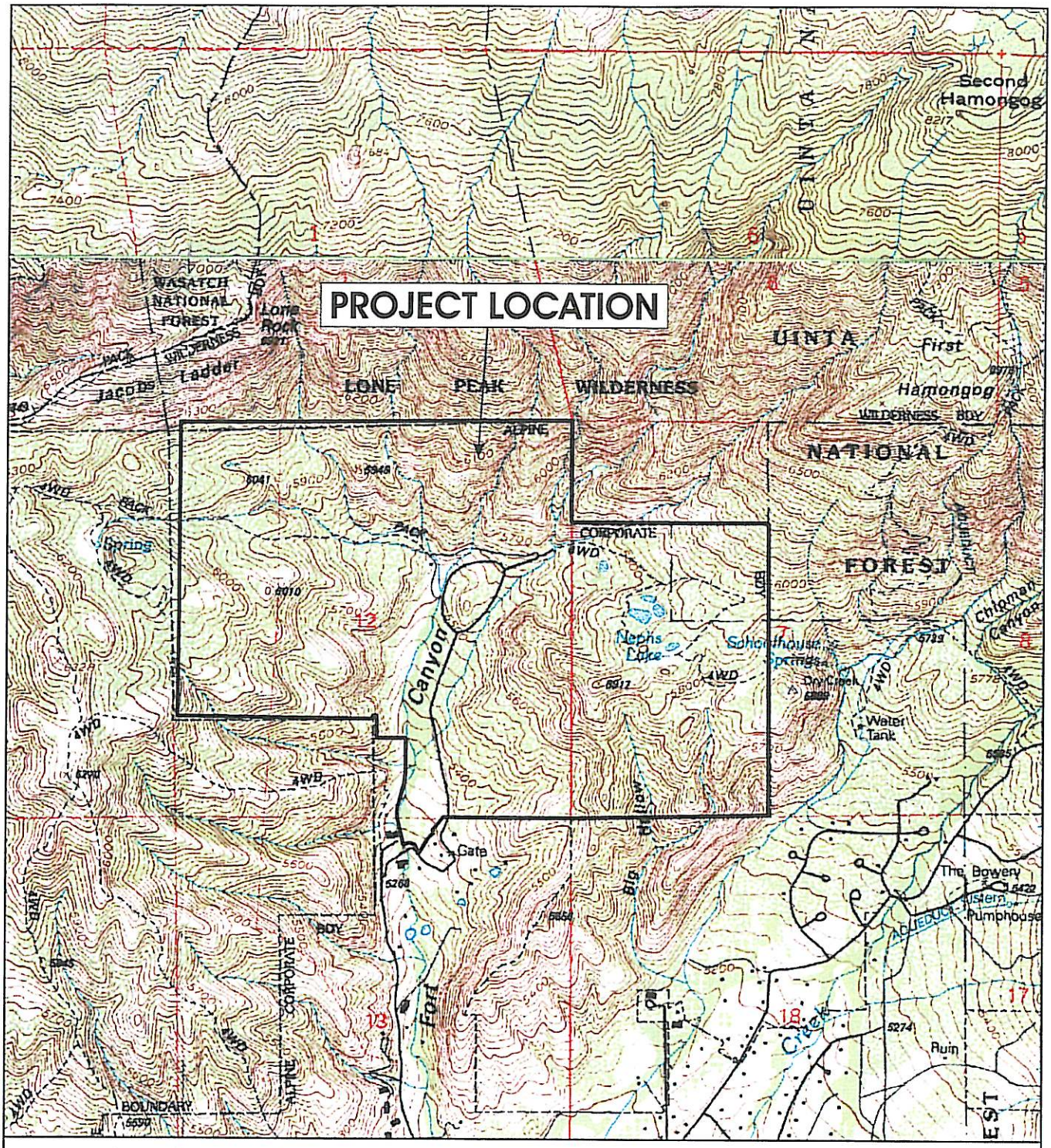
Mathematics

A Simplified Approach to Calibrating C14 Dates

Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2), p317-322

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • E-Mail: beta@radiocarbon.com



Source: U.S. Geological Survey 7.5 Minute Series Topographic Maps, Utah - DRAPER, 1963; and LEHI, 1994.

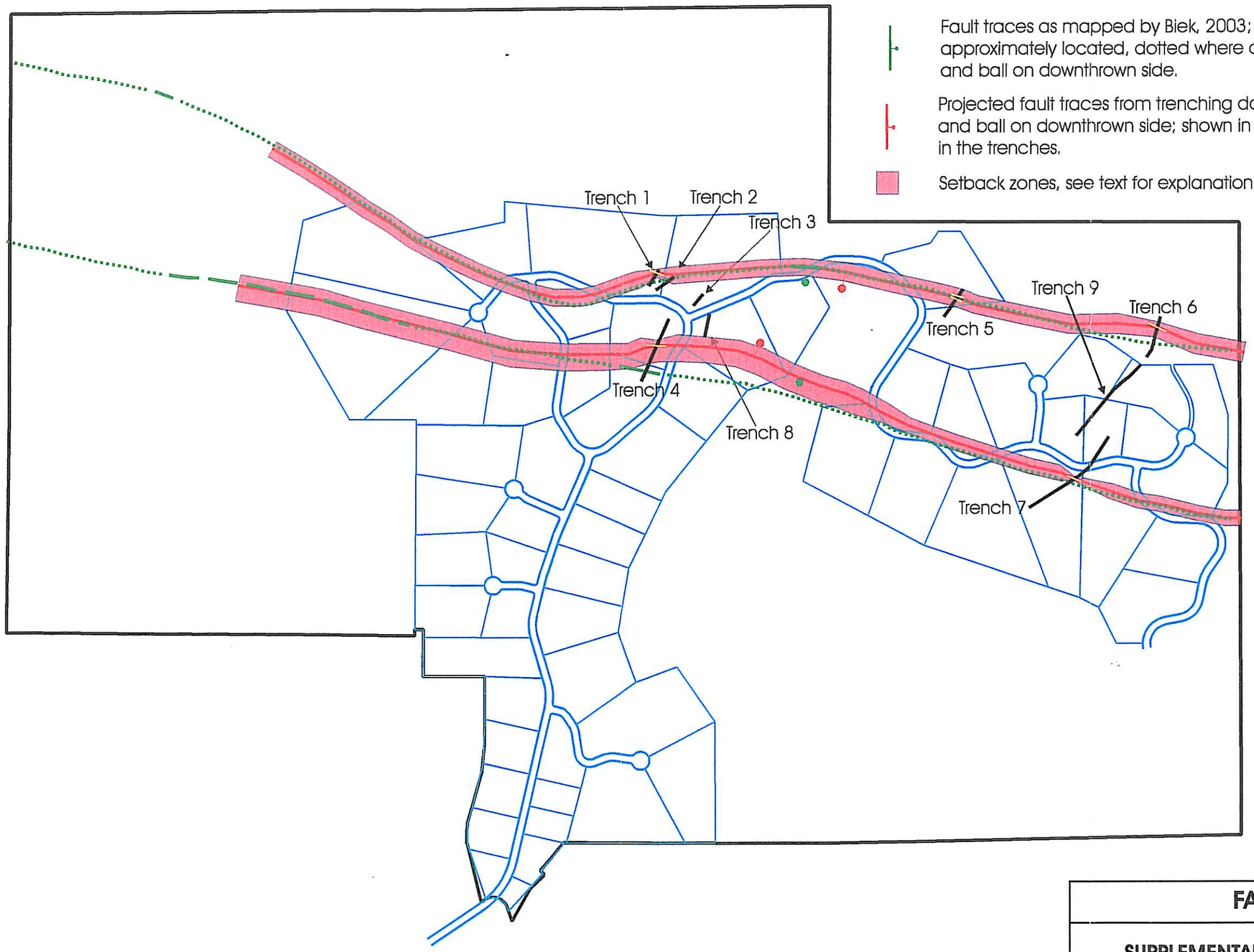
LOCATION MAP

SUPPLEMENTAL SURFACE FAULTING HAZARDS EVALUATION

Three Falls Ranch
Alpine City, Utah County, Utah

FIGURE 1

WESTERN GEOLOGIC



Fault traces as mapped by Biek, 2003; dashed where approximately located, dotted where concealed; bar and and ball on downthrown side.

Projected fault traces from trenching data and air photos; bar and ball on downthrown side; shown in yellow where exposed in the trenches.

Setback zones, see text for explanation.

N
W E
S

Scale 1:8,400
(1 inch = 700 feet)

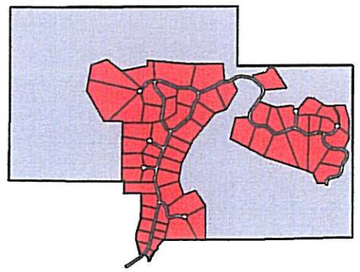
WESTERN GEOLOGIC

FAULT & SETBACK MAP

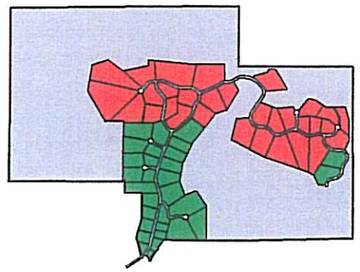
SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 2

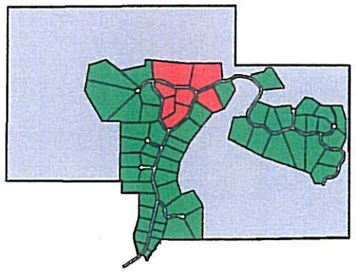
4a. Earthquake Ground Shaking



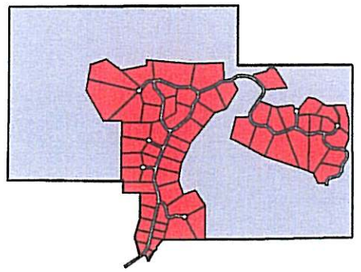
4b. Surface Fault Rupture



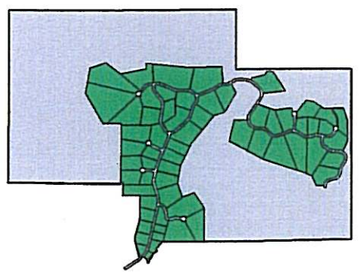
4c. Liquefaction and Lateral-spread Ground Failure



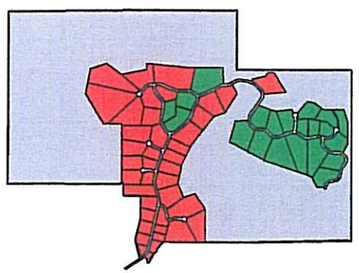
4d. Tectonic Subsidence



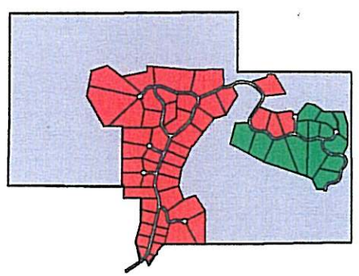
4e. Seismic Seiche and Storm Surge



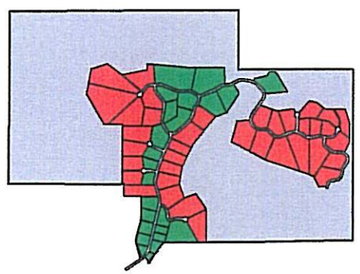
4f. Stream Flooding



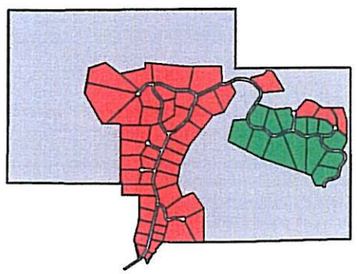
4g. Shallow ground water



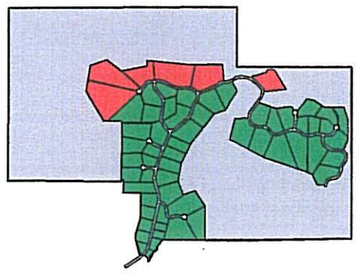
4h. Landslide and Slope Failures



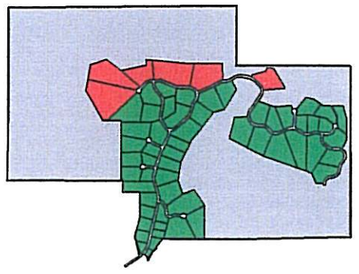
4i. Debris Flows



4j. Rock Fall



4k. Snow Avalanche



EXPLANATION

Lots in red have a higher potential for the hazard
Lots in green have the lowest potential for the hazard
Gray indicates areas not evaluated
Lot boundaries as of August 2004 and subject to change

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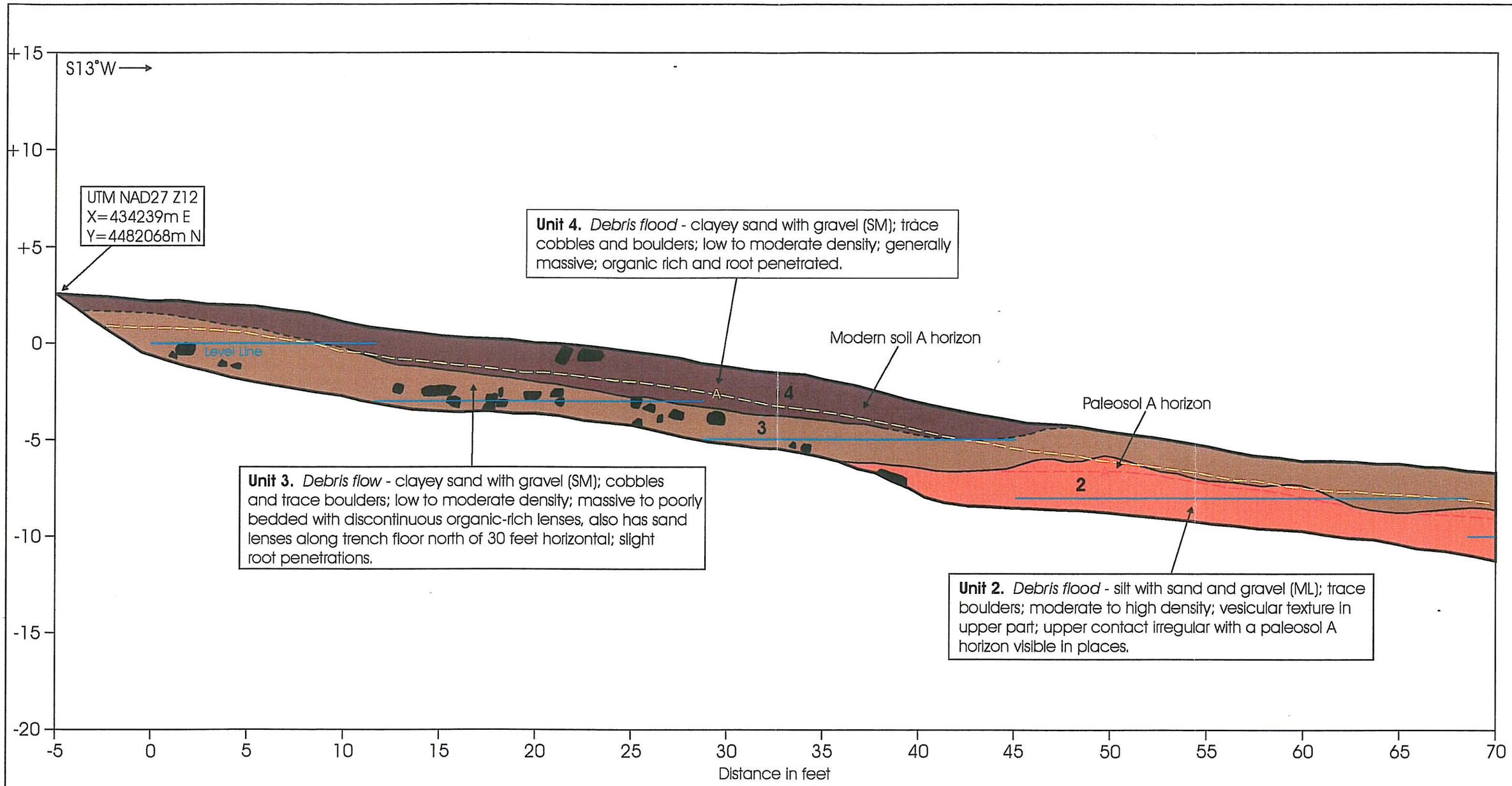
HAZARDS SUMMARY

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 3



WESTERN GEOLOGIC

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

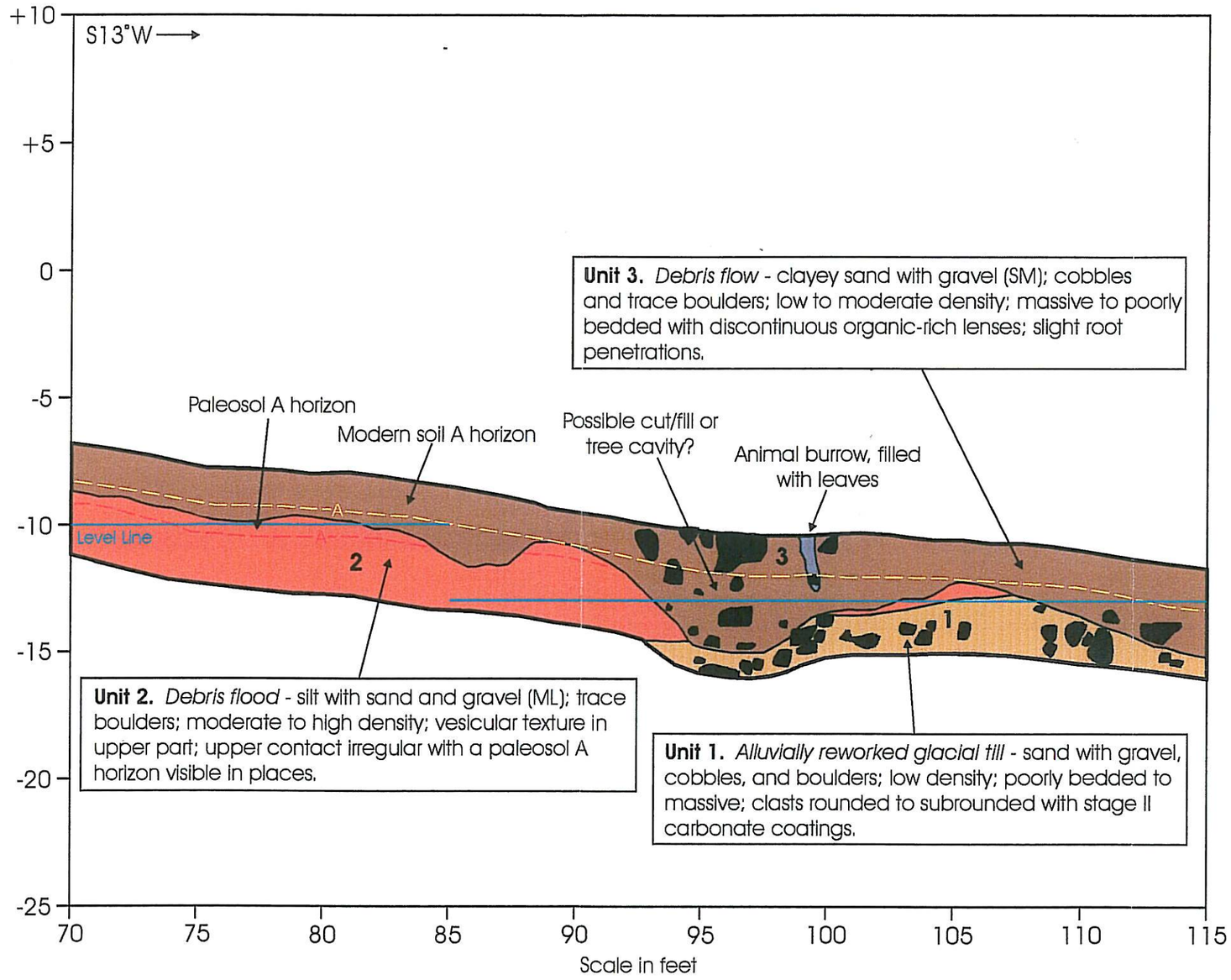
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
East Trench Wall Logged

Trench logged by Bill Black, P.G. on November 4, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 8 LOG (-5' - 70')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 4a



WESTERN GEOLOGIC

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

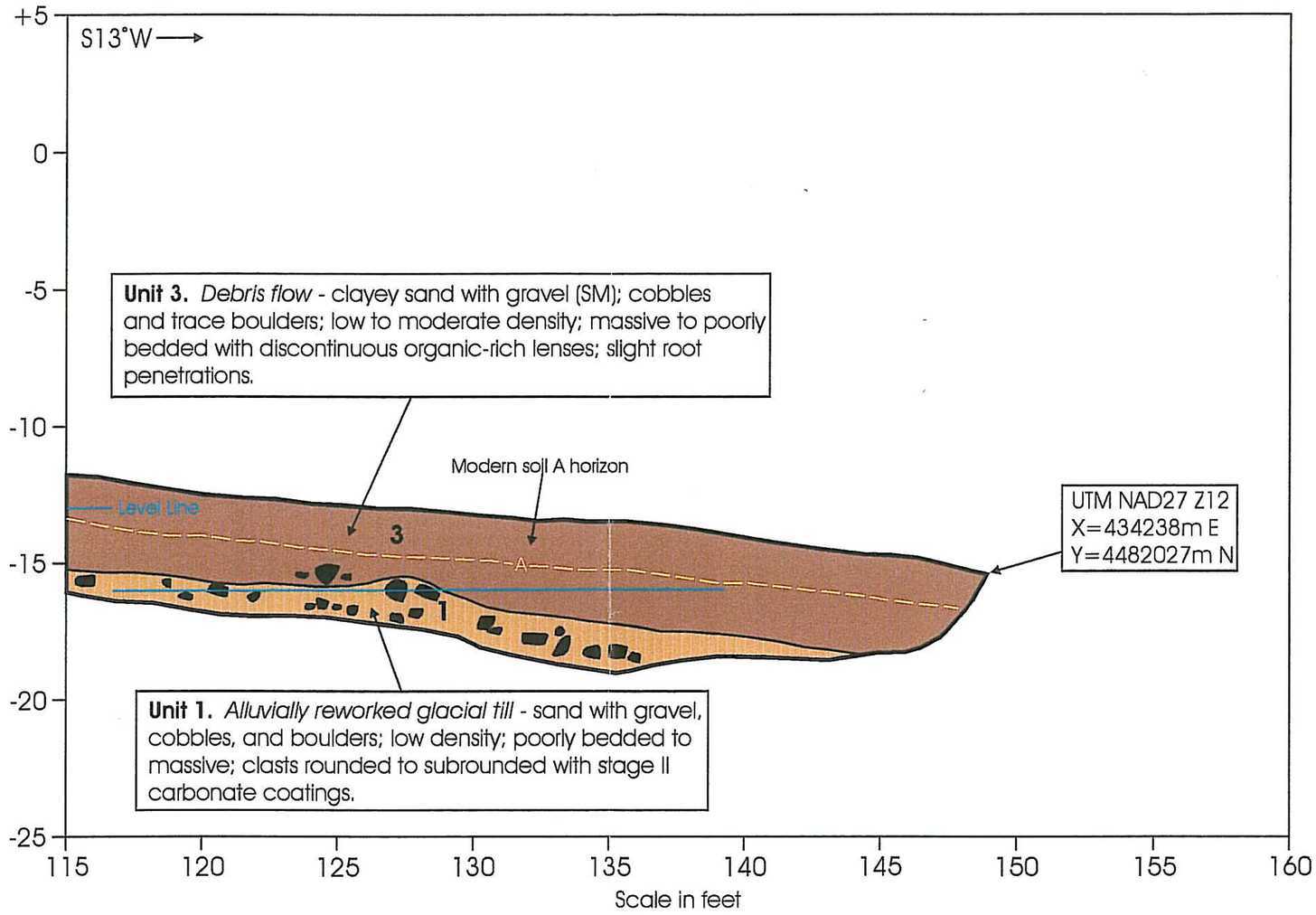
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
East Trench Wall Logged

Trench logged by Bill Black, P.G. on November 4, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 8 LOG (70' - 115')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 4b



WESTERN GEOLOGIC

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

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

Trench logged by Bill Black, P.G. on November 4, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 8 LOG (115' - 160')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 4c

S44°W →

UTM NAD27 Z12
X=435116m E
Y=4481976m N

Paleosol A horizon

Modern soil A horizon

Level Line

Unit 5. *Colluvium* - clayey sand with silt and trace gravel (SM); generally massive; low to moderate density; modern soil A horizon and weak B horizon forming at surface on top of unit; root penetrated; correlates with unit 3 in trench 6 to north, but finer.

Unit 3. *Alluvium* - clayey gravel with sand (GM); grusified small cobbles along upper contact and indistinct gravel channels; contains pea gravel coated with carbonate; moderate to high density; weak paleosol A horizon on top of unit; vesicular texture; occasional root penetrations in upper part; correlates with unit 2 in trench 6 to north.

+15 +10 +5 0 -5 -10 -15 -20

-10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65

Distance in feet

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

WESTERN GEOLOGIC

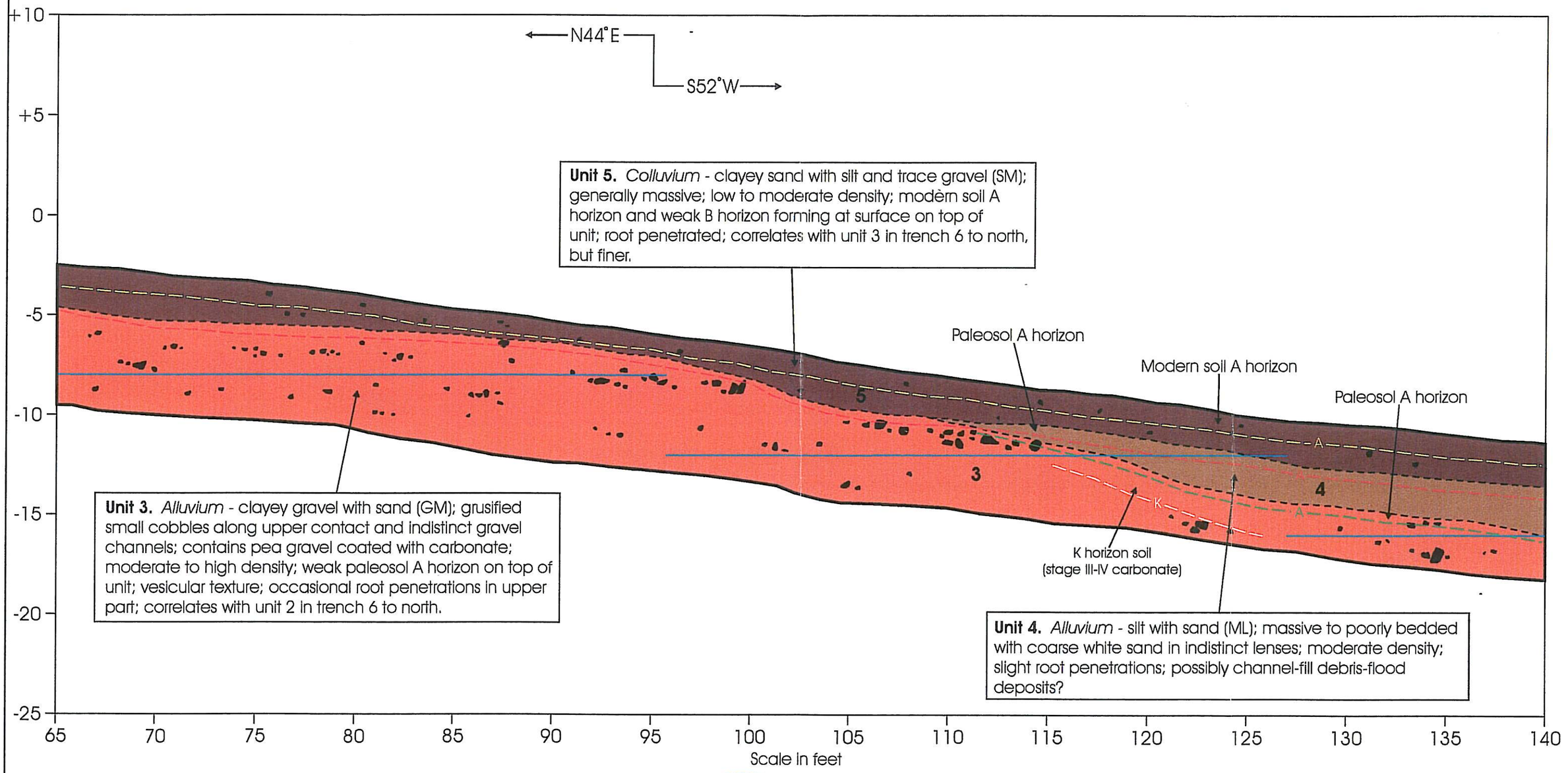
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
East Trench Wall Logged

Trench logged by Bill Black, P.G. on November 5, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 9 LOG (-10' - 65')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 5a



WESTERN GEOLOGIC

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

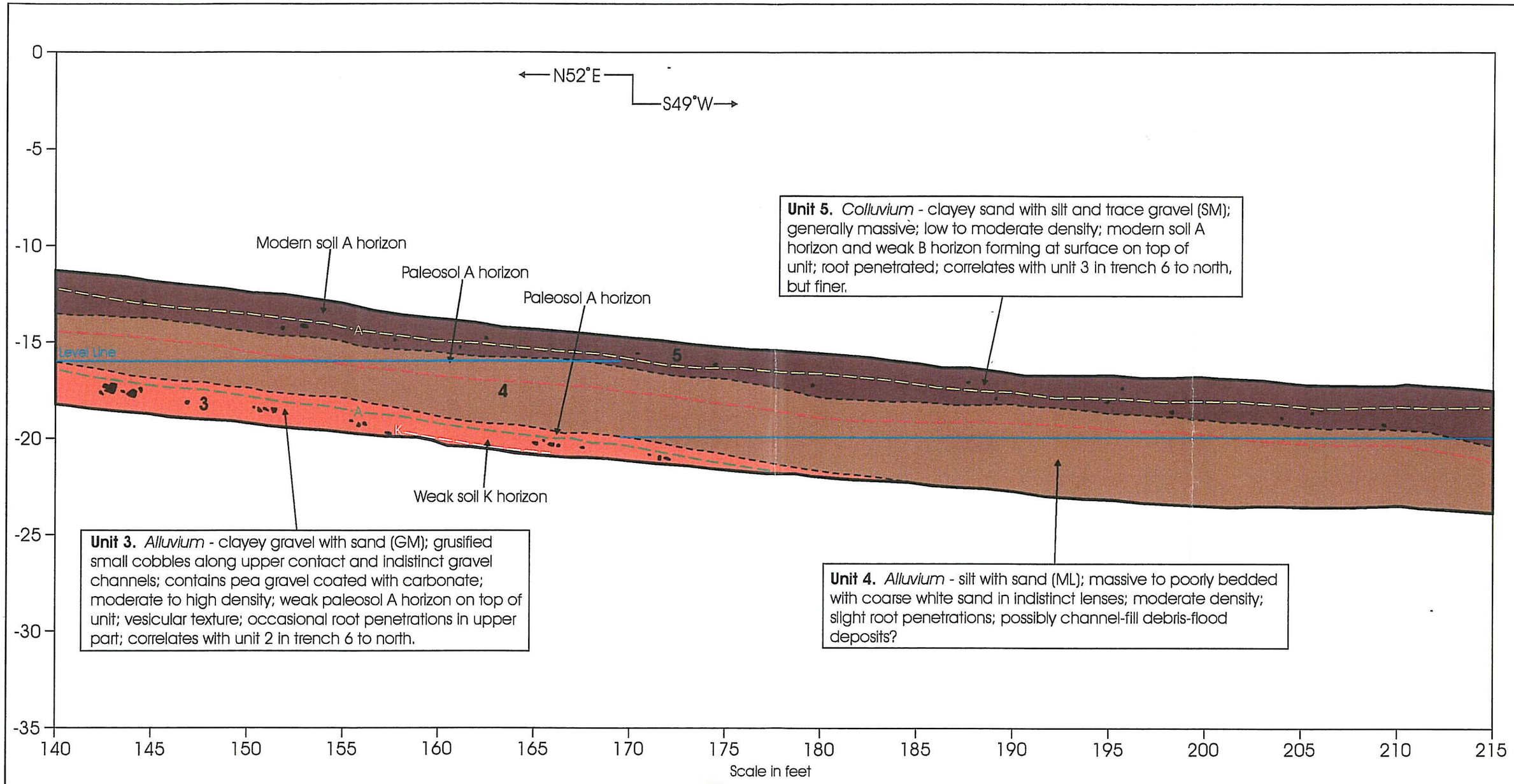
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
East Trench Wall Logged

Trench logged by Bill Black, P.G. on November 5, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 9 LOG (65' - 140')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 5b



WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224899-2250
STATE OF UTAH

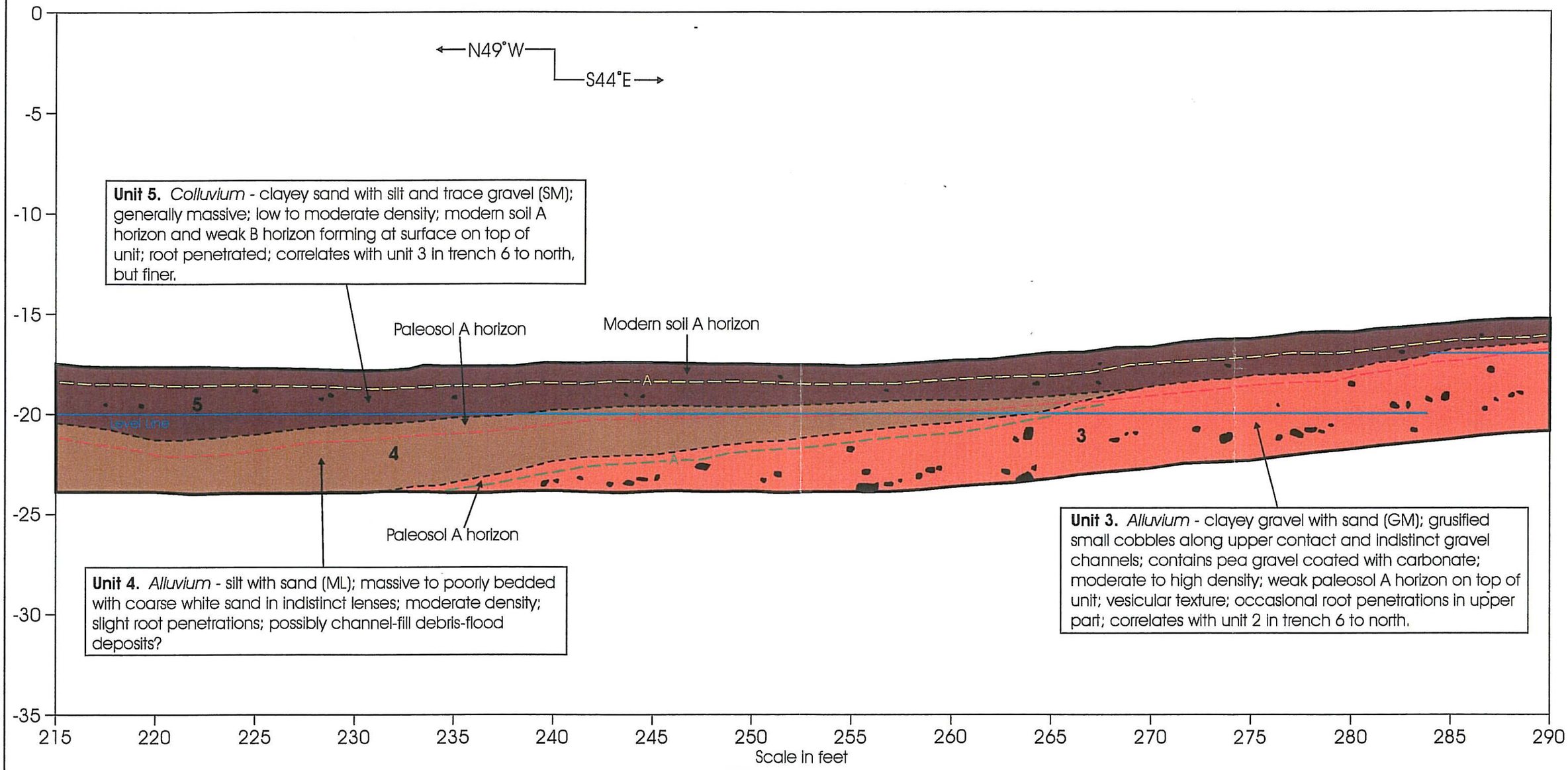
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
East Trench Wall Logged

Trench logged by Bill Black, P.G. on November 5, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 9 LOG (140' - 215')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 5c



WESTERN GEOLOGIC

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

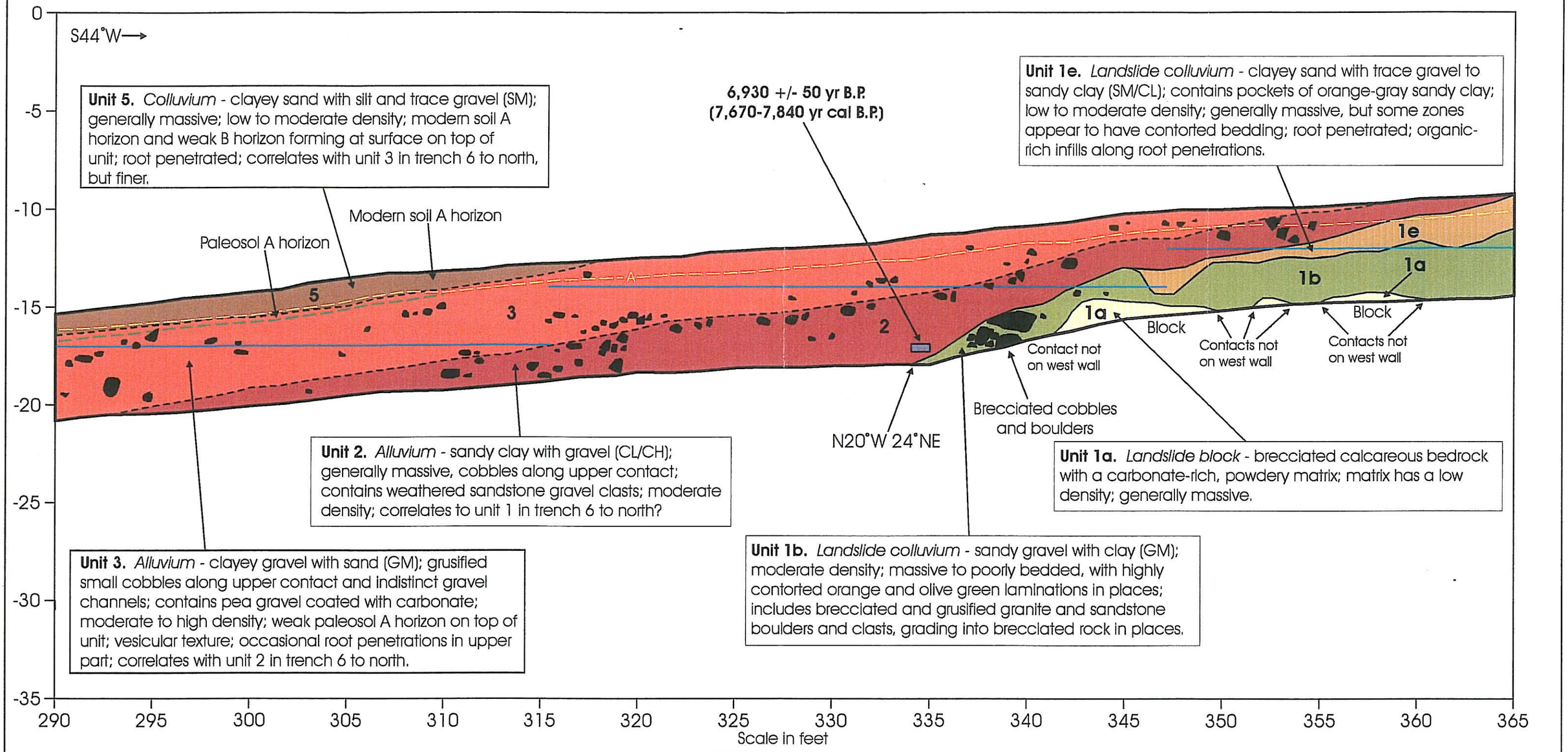
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
East Trench Wall Logged

Trench logged by Bill Black, P.G. on November 5, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 9 LOG (215' - 290')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 5d



WESTERN GEOLOGIC

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

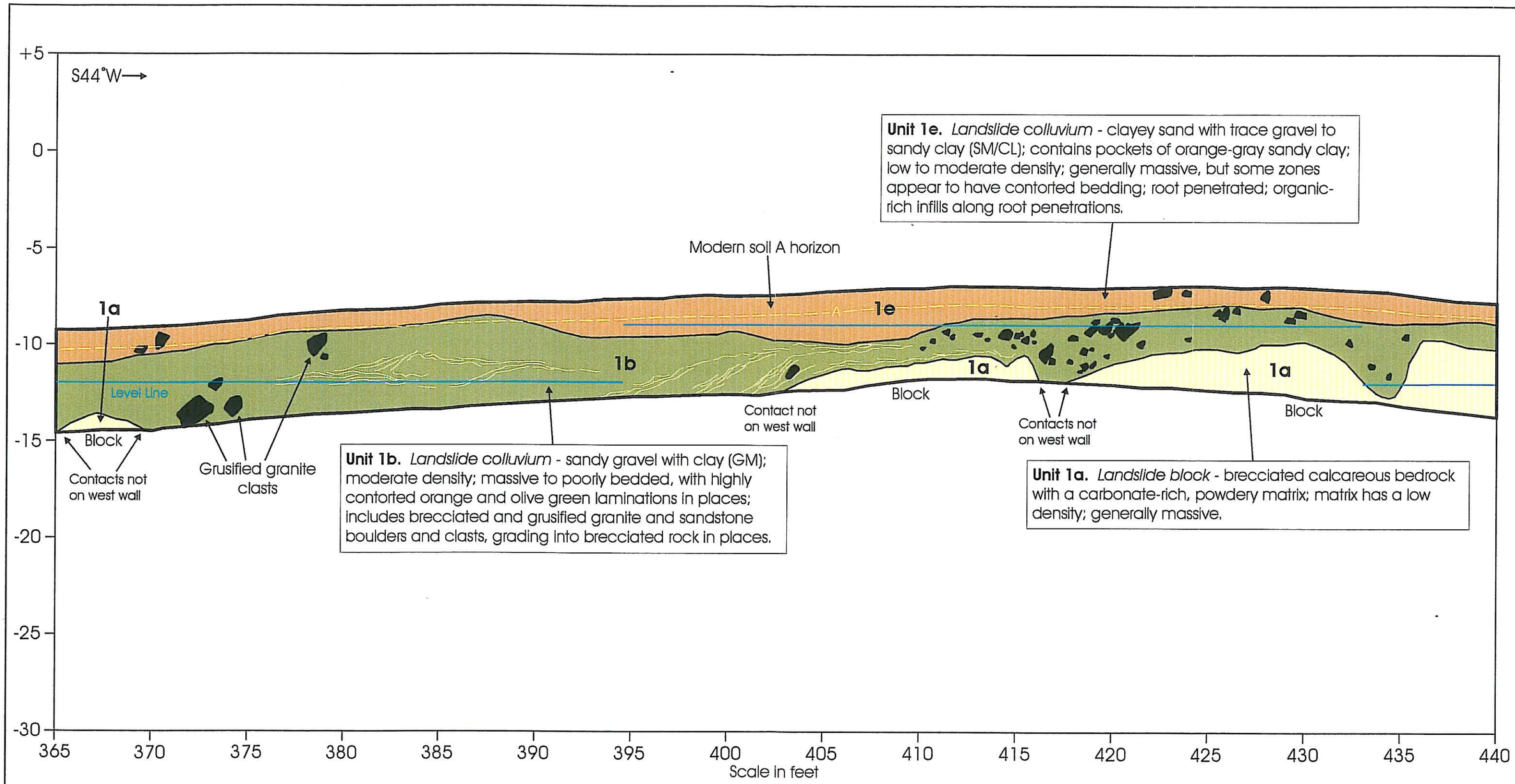
SCALE: 1 inch = 5 feet
(no vertical exaggeration)
East Trench Wall Logged

Trench logged by Bill Black, P.G. on November 5, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 9 LOG (290' - 365')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 5e



Unit 1e. *Landslide colluvium* - clayey sand with trace gravel to sandy clay (SM/CL); contains pockets of orange-gray sandy clay; low to moderate density; generally massive, but some zones appear to have contorted bedding; root penetrated; organic-rich infills along root penetrations.

Unit 1b. *Landslide colluvium* - sandy gravel with clay (GM); moderate density; massive to poorly bedded, with highly contorted orange and olive green laminations in places; includes brecciated and grusified granite and sandstone boulders and clasts, grading into brecciated rock in places.

Unit 1a. *Landslide block* - brecciated calcareous bedrock with a carbonate-rich, powdery matrix; matrix has a low density; generally massive.

WESTERN GEOLOGIC

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

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

Trench logged by Bill Black, P.G. on November 5, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 9 LOG (365' - 440')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 5f

S44°W→

Unit 1b. *Landslide colluvium* - sandy gravel with clay (GM); moderate density; massive to poorly bedded, with highly contorted orange and olive green laminations in places; includes brecciated and grusified granite and sandstone boulders and clasts, grading into brecciated rock in places.

Unit 1e. *Landslide colluvium* - clayey sand with trace gravel to sandy clay (SM/CL); contains pockets of orange-gray sandy clay; low to moderate density; generally massive, but some zones appear to have contorted bedding; root penetrated; organic-rich infills along root penetrations.

Modern soil A Horizon

1b

Level Line

1a

1e

Block

1d

Block

Contacts not on west wall

N30°W 56°SW

1b

1a

1d

Contacts not on west wall

Block

Contacts not on west wall

Unit 1a. *Landslide block* - brecciated calcareous bedrock with a carbonate-rich, powdery matrix; matrix has a low density; generally massive.

Unit 1d. *Landslide colluvium* - gravelly clay to clayey gravel (CL/GM); poorly bedded to massive; clasts subangular to angular; moderate density.

0
-5
-10
-15
-20
-25
-30
-35

440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515

Scale in feet

WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224888-2250
STATE OF UTAH

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

Trench logged by Bill Black, P.G. on November 5, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 9 LOG (440' - 515')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 5g

S44°W→

Unit 1b. *Landslide colluvium* - sandy gravel with clay (GM); moderate density; massive to poorly bedded, with highly contorted orange and olive green laminations in places; includes brecciated and grusified granite and sandstone boulders and clasts, grading into brecciated rock in places.

Modern soil A horizon

Level Line

1d

1a

1b

1e

1c

Block

Contacts not in west wall

N42°W 23°NW

Unit 1e. *Landslide colluvium* - clayey sand with trace gravel to sandy clay (SM/CL); contains pockets of orange-gray sandy clay; low to moderate density; generally massive, but some zones appear to have contorted bedding; root penetrated; organic-rich infills along root penetrations.

UTM NAD27 Z12
X=435001m E
Y=4481843m N

Unit 1a. *Landslide block* - brecciated calcareous bedrock with a carbonate-rich, powdery matrix; matrix has a low density; generally massive.

Unit 1d. *Landslide colluvium* - gravelly clay to clayey gravel (CL/GM); poorly bedded to massive; clasts subangular to angular; moderate density.

Unit 1c. *Landslide deposit* - clay-rich fluidized matrix of landslide; fat clay (CH); generally massive; high density, requires special teeth on backhoe to cut; polishes to a near mirror finish in cut walls; correlates to unit 2a in trench 7.

-5
-10
-15
-20
-25
-30
-35
-40

515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590

Scale in feet

WESTERN GEOLOGIC

LICENSED PROFESSIONAL GEOLOGIST
BILL DUANE BLACK
NO. 5224888-2250
STATE OF UTAH

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

Trench logged by Bill Black, P.G. on November 5, 2004
Reviewed by Craig V Nelson, P.G., R.G., C.E.G.

TRENCH 9 LOG (515' - 590')

SUPPLEMENTAL SURFACE FAULTING HAZARD EVALUATION
Three Falls Ranch
Alpine City,
Utah County, Utah

FIGURE 5h