GeoMat Testing Laboratories, Inc.

Soil Engineering, Environmental Engineering, Materials Testing, Geology

August 15, 2017

Project No. 16027-01

TO: Mr. Shakil Patel, AIA
25982 Hinkley Street
Loma Linda, California 92354

SUBJECT: Response to County of San Bernardino Geotechnical/Geological Report Review Sheet dated July 13, 2017, Proposed Islamic Community Center, Northwest Corner of Beaumont Avenue and Nevada Street, APN 0293-111-15-0000, Redlands, California

Dear Mr. Patel:

As requested, this letter presents our responses to the comments issued by the County of San Bernardino on July 13, 2017, Plan Check No. P201600355 (attached) following their review of the geotechnical report referenced below prepared for the subject project.

- GeoMat Testing Laboratories, Inc. (2017), "Revised Preliminary Soil Investigation Report, Proposed Islamic Community Center, Northwest Corner of Beaumont Avenue and Nevada Street, APN 0293-111-15-0000," Project Number 16027-01, dated June 26, 2017.

The above referenced geotechnical report findings and recommendations remain applicable to the project, unless superseded herein. To help facilitate the review, the County comments are reiterated on the following pages, followed by our responses.

If you have any questions regarding this report, please do not hesitate to call this office. We appreciate this opportunity to be of service.

Very truly yours,

GeoMat Testing Laboratories, Inc.

Haytham Nabilsi, GE2375
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER HAYTHAM NABILSI No. 2375 Exp. 12/31/18 GEOTECHNICAL STATE OF CALIFORNIA

Eirik Haenschke CEG 1597
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PROFESSIONAL GEOLOGIST EIRIK F. HAENSCHKE No. 1597 CERTIFIED ENGINEERING GEOLOGIST Exp. 9-30-18 STATE OF CALIFORNIA

Distribution: (3) Addressee

ATTACHED FIGURES AND APPENDICES

Figure 1	Regional Geology USGS Bull 1898
Figure 2	Regional Faults SR 113
Figure 3	Ground Water Contours 2005-1278
Figure 4	Regional Faults OFR 2003-0302
Figure 5	Depth to Groundwater SR 113
Figure 6	Depth to Groundwater Bull 1898
Figure 7	Alluvial Isopach SR 113
Figure 8	Regional Faults OFR 2003-0302

Appendix A References

REVIEW RESPONSES

Comment 1) *The engineering geologist shall consider the following published geologic maps that covers the project site: CDMG SR 113 (Geologic hazards in southwestern San Bernardino County, California), USGS Open-File Report 2005-1278 (Hydrology, description of computer models, and evaluation of selected water-management alternatives in the San Bernardino Area, California), USGS Open-File Report 2003-0302 (Geologic map of the Redlands 7.5 minute Quadrangle, San Bernardino and Redlands Counties, California), USGS B 1898 (Liquefaction susceptibility in the San Bernardino Valley and vicinity, southern California – A regional evaluation), and USGS Water-Supply Paper 1419 (Geologic and hydrologic features of the San Bernardino Area, California). The latter of these maps indicate that the site is underlain by two geologic units, alluvium associated with recent sedimentation of San Timoteo Creek and younger alluvium associated with former channels of the creek, rather than the one unit displayed by Dibblee. The response report indicates that the closest active or potentially active fault is located approximately ¾ mile southwest of the site and identifies that fault as part of the San Jacinto Fault Zone. CDMG SR 113 identifies a west-northwest-striking fault about 3,000 feet southwest of the site as the Banning Fault. Open-File Report 2003-0302 shows this closest potentially-active fault to the site as the Live Oak Canyon fault zone. This west-northwest-striking fault zone may indeed be a branch of the San Jacinto Fault Zone, but should be also be referred to by the names used by the CGS and the USGS. The variations in the nomenclature suggest the complexity of faulting in this portion of the valley.*

Response to Comment 1:

According to USGS Bull 1898 (Figure 1), the site is underlain by Holocene-age alluvial deposits derived from sedimentation of San Timoteo Creek. The alluvium has been divided into Younger Holocene (Qh2) and Older Holocene deposits (Qh1) based on pedogenic soil development. The northeastern portion of the site is mapped as Older Holocene Alluvium (age ranging from 500 to 10,000 years, and possibly as old as 15,000 years). The southwestern portion of the site is mapped as Younger Holocene Alluvium (age ranging from approximately 500 to 1,000 years), closer to the San Timoteo Wash. The subject site in relation to the younger and older alluvial units is indicated on Figure 1.

According to SR 113 (Morton, 1974) a northwest-trending fault is located approximately 3,600 feet southwest of the site; this fault is labeled “Banning Fault” according to this reference. The active San Jacinto fault is mapped approximately 1.8 miles southwest of the site according to this reference. The subject site in relation to faulting presented in SR 113 is indicated on Figure 2.

According to OFR 2003-0302 (Matti, Morton et al, 2003) a northwest-trending fault is mapped approximately 0.7 mile southwest of the site, and is labeled as the Live Oak Canyon fault zone; the location of this fault appears to coincide with the “Banning Fault” as labeled on the map accompanying SR 113. The active San Jacinto fault is mapped approximately 1.9 miles southwest of the site according to OFR 2003-0302. The subject site in relation to faulting presented in OFR 2003-0302 is indicated on Figure 3.

The nearest mapped Alquist-Priolo Earthquake Fault Zone is the northwest-trending San Jacinto fault, the trace of which is mapped approximately 1.9 miles southwest of the site according to the State of California Special Studies Zone Map, Redlands Quadrangle, dated January 1, 1977.

Discussion

Based on the locations of mapped active and potentially active fault systems in relation to the subject site, in our opinion, the potential for primary surface rupture associated with movement along mapped local fault systems is considered very low. However, the site lies within a region of complex active faulting, and as such, will be periodically subject to moderate to intense earthquake-induced ground shaking from nearby faults. We believe the engineering seismic design value for peak ground acceleration of 0.836g provided in Appendix D of our report is appropriate for the subject site.

Comment 2) *The site is located immediately northeast of channelized San Timoteo Creek. Water-Supply Paper 1419 includes phreatic groundwater elevations for the periods 1936, 1945, and 1951. USGS OFR 2005-1278 also shows groundwater elevations in the vicinity of the site from 1945 that suggest a depth to groundwater of approximately 50 feet at the site. CDMG SR 113 presents depth to groundwater in the vicinity of the site from the 1960's. USGS B 1898 provides minimum depth to groundwater data for the site and vicinity during the period 1973 to 1983. The project geologist shall reference the groundwater data presented by these publications in the report. The use of groundwater data from individual wells located away from the site can be used to supplement these historic compilations, but should include an estimated depth to groundwater at the site based on extrapolation of groundwater gradients in the area at the time of the measurements.*

Response to Comment 2:

According to USGS Water Supply Paper 1419 (1963), phreatic ground water elevation contours are presented in relation to the subject site for the years 1936, 1945 and 1951; during which the depth to ground water ranged from approximately 70' to 105' below the existing surface grade of 1250'. The ground water levels during these years are presented below:

Water Level Contour for February-March 1951: 1135'-1145' (105' depth below surface)
Water Level Contour for March 1945: 1170'-1180' (70' depth below surface)
Water Level Contour for March 1936: 1135'-1150' (100' depth below surface)

According to USGS Open File Report 2005-1278, the 1945 ground water elevation contour beneath the subject site was 1160', corresponding to a depth of approximately 90' below the current surface grade (see Figure 4). According to this reference, the 1945 ground water elevation contour gradient is approximately 57' per mile along San Timoteo Wash, in an area bracketing the subject site. Extrapolation of the Spring 2017 ground water elevation of 1050.6' (136' depth) from a well approximately 1 mile northwest of the site (Bryn Mawr #4, State Well #01S03W31B001S, El. 1186.6'), located along the alignment of the San Timoteo Wash, would yield a ground water elevation of approximately 1108' (or 142' depth) at the subject site.

Ground water elevation contours presented in CDMG Special Report 113 (1976) indicate depth to ground water below the subject site of approximately 250' (or greater) during the 1960's (see Figure 5).

According to USGS Bulletin 1898, ground water contours indicate a minimum depth of approximately 100' below surface during 1973-1978 (see Figure 6).

Discussion:

In consideration of the above ground water data, we see no indications of ground water levels within at least 70' of the current ground surface during the last approximately 80 years. Site grading and development proposed for this project should incorporate detailed recommendations to ensure positive drainage of surface water away from the site to the adjoining streets or other suitable drainage facility. In no case should surface water be allowed to collect on site, or flow toward foundation areas in an uncontrolled manner.

Comment 3) *The response report indicates that a field engineer was on-site during the exploratory drilling, but does not indicate that the project engineering geologist conducted a geologic site reconnaissance. A geologic field site reconnaissance shall be conducted by the project engineering geologist. The date and conclusions regarding surficial geologic materials and evidence for any geologic hazards, including surface fault rupture, liquefaction, lateral spread, debris flows, etc., shall be discussed in the report.*

Response to Comment 3:

Site reconnaissance was performed by the undersigned engineering geologist on July 26, 2017. The subject site is essentially level, with a very slight northwesterly gradient. Surface soils consisted of silty sand with gravel and scattered cobbles, consistent with alluvial deposits encountered during subsurface exploration and mapped by published geologic references for the site. The western edge of the site is marked by an existing wooden rail fence. Approximately 30' beyond and parallel to the west property line lies the channelized alignment of the San Timoteo Creek flood control. The channel consists of concrete side slopes approximately 30' high west of the site. The bottom of the channel is provided with a series of spillways and basins measuring approximately 500' to 1,000' long, 100' to 200' wide, and on the order of 15' deep.

Lateral Spreading

Due to the engineered, concrete construction of the San Timoteo Creek channel, and in consideration of the dense granular nature of the alluvial deposits underlying the site, and substantial depth to groundwater beneath the site, the potential for seismically-induced lateral spreading to affect the proposed site improvements is considered very low.

Debris Flow

Terrain surrounding the subject site, west of the San Timoteo Creek channel, is essentially level; and does not appear to be in the path of any debris flow from distant hills.

Liquefaction

According to the San Bernardino County's General Plan, Geologic Hazard Overlays, the site is not in an area susceptible to liquefaction. Based on review of historic groundwater elevations in the site vicinity (generally greater than 70-feet-deep), in our opinion the potential for seismically-induced liquefaction at the site is considered very low.

Fault Rupture

The site is not located within an Alquist-Priolo earthquake fault zone, and there are no mapped fault traces mapped in the immediate site vicinity based on the references cited herein. Therefore, in our opinion the potential for surface fault rupture at the site is considered very low.

Comment 4) *CDMG SR 113 includes evidence for an inferred, northwest-trending fault that projects southeastward towards the vicinity of the site, based on seismic activity. USGS OFR 2005-1278 identifies this fault as the Banning Fault. The alluvial thickness (isopach) map presented as part of CDMG SR 113 includes evidence for a buried, northwest-striking escarpment southeast of the site, generally on trend with this inferred fault. CDMG SR 113 shows an unnamed northeast-trending groundwater barrier in the immediate vicinity of the northern portion of the site. USGS OFR 2005-1278 identifies this feature as the Bryn Mawr Barrier. The section of the response report that addresses faulting does not include an aerial photograph review for surficial evidence of active faulting, nor are any aerial photographs cited in the reference section of the report. Considerable evidence exists for the presence of as yet unmapped, high angle strike-slip and/or oblique-slip faults rupturing older alluvial materials within San Timoteo Canyon, southeast of the site. The project engineering geologist shall include a review of available aerial photographs covering the site and vicinity to address the potential for active faulting, including faulting depicted by CDMG SR 113 and USGS OFR 2005-1278. Resources are available locally at the San Bernardino County Flood Control District, the Water Resources Institute at California State University at San Bernardino, as well as from the US Department of Agriculture and US Geological Survey. Virtual three dimensional aerial photographic imagery is also available on-line from Google Earth Pro and NASA World Wind. Aerial photographic imagery utilized for the aerial photograph review shall be cited in the references section of the report.*

Response to Comment 4:

According to CDMG SR 113 (Morton, 1974) an "inferred northwest-trending fault that projects southeastward toward the site based on seismic activity" is located approximately 1 ½ miles northwest of the site (see Figure 2). Extrapolation of this fault toward the subject site shows that it passes southwest of the site, across the San Timoteo Creek channel, along the base of the southwesterly-ascending hills. CDMG SR 113 also contains an alluvial isopach map (see Figure 7) showing contours of alluvial thickness. The contours appear concentrated at a location south-southeast of the site, which may be evidence for a deeply buried escarpment feature along the base of the ascending hills southwest of the San Timoteo Creek channel, approximately ¼- to ½-mile from the subject site, which also roughly aligns with the inferred fault projection discussed above and highlighted on Figure 2.

Both CDMG SR 113 (Figure 7) and USGS OFR 2005-1278 (Figure 8) refer to a northeast-aligned groundwater barrier identified as the Bryn Mawr Barrier on Figure 8. This ground water barrier is located approximately ½-mile northwest of the subject site.

Aerial Photographs

As part of our investigation at the site, aerial photographs were reviewed at the office of the San Bernardino County Flood Control District. The following stereo pairs were reviewed:

Date	Flight/Frame No.
7-4-38	
7-4-39	AXL-6161-46&47
11-8-55	F35 2-108&109
4-5-66	C-107 #18&19
2-1-69	C-293 #98&99
1-19-05	C-553 9-52&53

Review of the above aerial photographs reveal that the subject lot was occupied by an orchard from 1938 through 1969. Curvilinear tonal variations across the ground surface appear to represent meanders associated with fluvial sediment deposition, and are consistent with the contact between younger and older Holocene alluvial units transecting the site from northwest to southeast as shown on Figure 1 (from USGS BULL 1898) and Figure 3 (from OFR 2003-0302).

Also evident on all photographs is a pronounced cut bank located approximately 500' southwest from the subject site, across the San Timoteo Creek and railroad, along the base of the southwesterly ascending hills. The feature is approximately 1,200 feet long, aligned northwest-southeast, and concave toward northeast. The feature is crescent shaped, and appears to be on the order of 20-feet-high in the central ("crown") portion, diminishing in elevation toward the northwest and southeast ends. The feature is interpreted as a cut bank, carved by meandering action of the San Timoteo Creek channel, into the tectonically-uplifted hills ascending to the south. The relatively fresh appearance of this feature may indicate geologically recent uplift of these hills associated with complex, potentially-active and active faulting in the region.

No other linear features suggestive of faulting were observed within, or projecting directly toward the site boundaries, within alluviated areas surrounding the site.

Comment 5) *The County Hazard Overlay shows a 100 year flood plain coincident with the western boundary of the site. The response report does not directly address the potential for flooding to affect the site. Plate 1 of the response report indicates that the site lies within FEMA Flood Zone X. FEMA Zone X is used to designate areas with a 0.2% annual chance of flooding and to designate areas separated from a 100 year floodplain by levees. The project engineering geologist shall address the potential for flooding to affect the site in the report.*

Response to Comment 5:

The San Timoteo Creek channel has been extensively channelized and is managed by San Bernardino County Flood Control. In the vicinity of the subject site, the channel is provided with sloped concrete side walls (extending approximately 450 feet northwest from the Beaumont Avenue bridge), and is provided with a series of spillways and basins extending approximately 1 ½ miles upstream from the site and continuing approximately ¾ mile downstream from the site. West of the subject site, the channel is approximately 200' wide and 30' deep. In view of the presence of the flood control channel adjacent to the subject property, and elevation of the lot surface with respect to the flood control channel, we believe the potential for flooding of the site to be very low.

Comment 6) *The County Hazard Overlay does not show the site within an area of Dam Inundation. However, the County Hazard Overlay specifically limited the Dam Inundation study to the Santa Ana River below Seven Oaks Flood Control Dam. Several dams and reservoirs are located upstream of the site. The response report does not address the potential for seismically-induced flooding to affect the site. The project engineering geologist shall address the potential for seismically-induced flooding to affect the site in the report.*

Response to Comment 6:

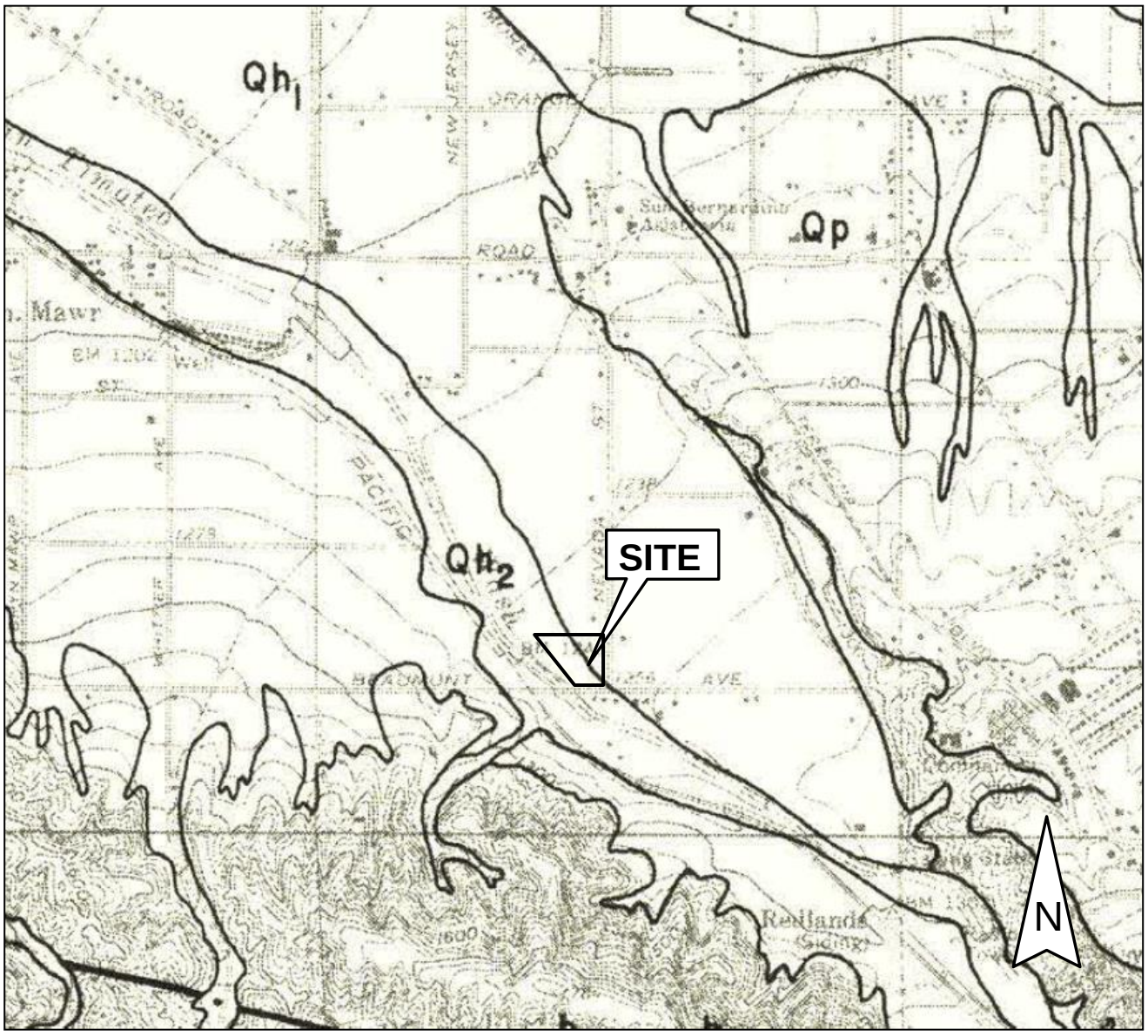
The subject site is located downstream from the Yucaipa Dams (No. 1, 2 and 3), located approximately 12 miles east of the site within the upper reaches of Live Oak Canyon. These dams appear to constitute the most potential for downstream flooding in the event of failure, given their location in a vicinity of active faulting. However, due to the distance between these dams and the subject site, which includes intervening broadly alluviated areas, and construction of the flood control channel adjacent to the site, the potential for flooding of the site related to upstream dam failure appears to be low.

Comment 7) *The response report does not directly address the occupancy use and/or Risk Categories of the proposed structures. Page 6 of Appendix D lists the Risk Category of the proposed structures as Category I for purposes of seismic design. However, Table 1604.5 in Chapter 16 of the 2016 California Building Code defines Risk Category I as "buildings and other structures that represent a low hazard to human life in the event of failure," with examples that include agricultural facilities, certain temporary facilities, and minor storage facilities. Based on the proposed use of the facilities as a place of worship, along with the required number of parking stalls (245) shown on Plate 1, the Risk Category of the proposed structures should be at least Category II, and may be Category III if the proposed maximum occupancy load will be greater than 300 people.*

Response to Comment 7:

S_{DS}=1.443g and S_{D1}=0.981g > 0.75g. Based on these two terms the Seismic Design Category is automatically "E" for Occupancy Building I, II, and III. After this point, the structural engineer determines the minimum permissible analysis based on the above Seismic Design Category and the Structure Period, T.

REGIONAL GEOLOGIC MAP – USGS BULL 1898



Qh_2 YOUNGER HOLOCENE ALLUVIAL DEPOSITS—Undissected to slightly dissected surfaces. Pedogenic soil development ranges from none to weak; the most well-developed soils have A horizons and thin C_{ox} horizons. Geomorphologic and soil evidence suggests that these materials were deposited within approximately the last 500 to 1,000 years

Qh_1 OLDER HOLOCENE ALLUVIAL DEPOSITS—Moderately dissected surfaces. Pedogenic soil development ranges from soils with A horizons and thin C_{ox} horizons to soils with A, weak argillic, and C_{ox} horizons. Geomorphologic and soil evidence suggests that these materials were deposited between approximately 500 to 1,000 years ago and 10,000 years ago, although deposits as old as 15,000 years may be included

Source: USGS Bull 1898 (Liquefaction susceptibility in the San Bernardino Valley and vicinity, southern California – A regional evaluation)

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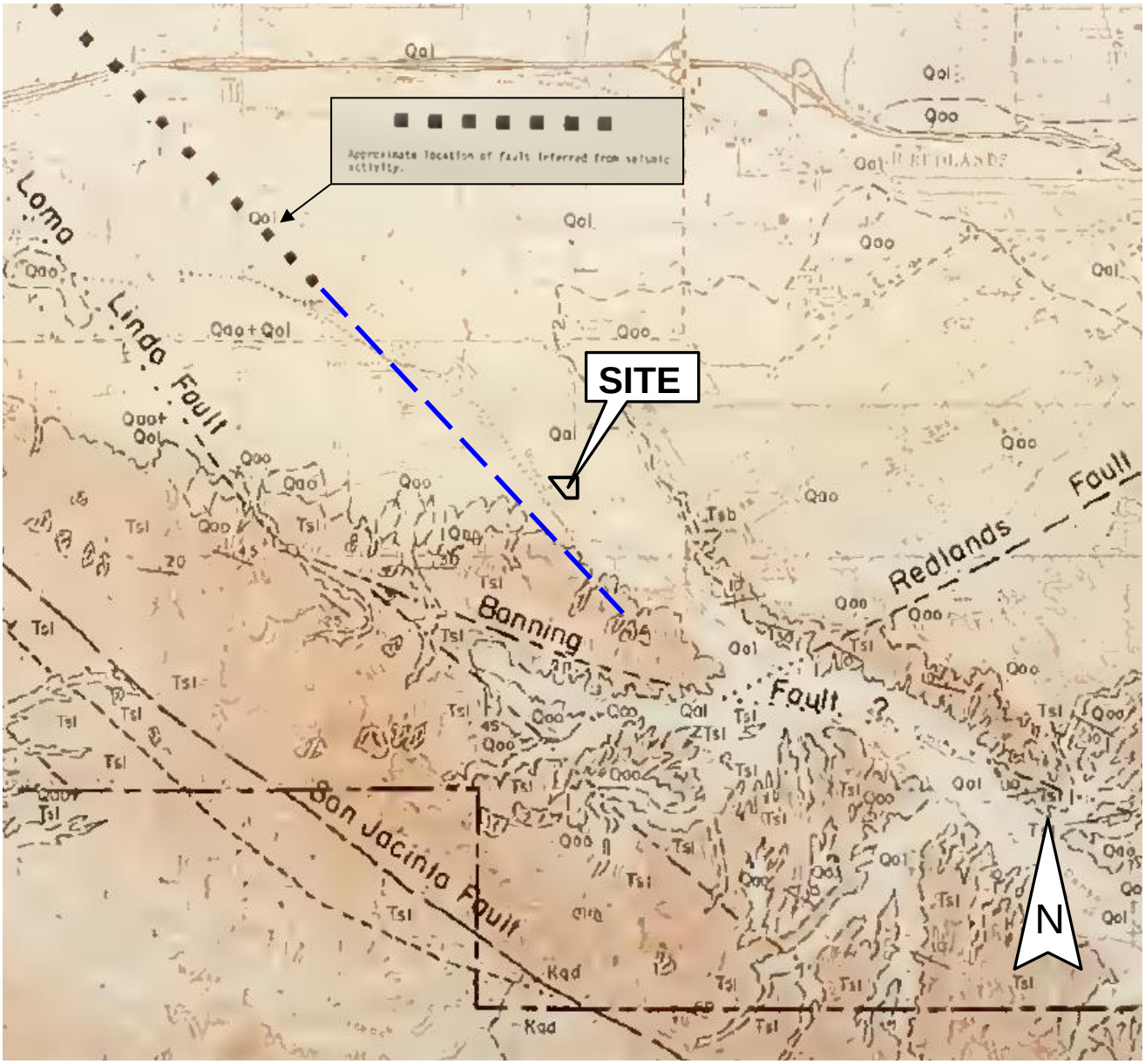
FIGURE 1

REGIONAL FAULTS – SR 113



GENERALIZED GEOLOGIC MAP OF
SOUTHWESTERN SAN BERNARDINO COUNTY, CALIFORNIA

Compilation By D. M. Morton, 1974
U. S. Geological Survey

0 1 2 3 4 Miles

0 10,000 Feet

Source: CDMG SR 113 (Geologic hazards in southwestern San Bernardino County, California)

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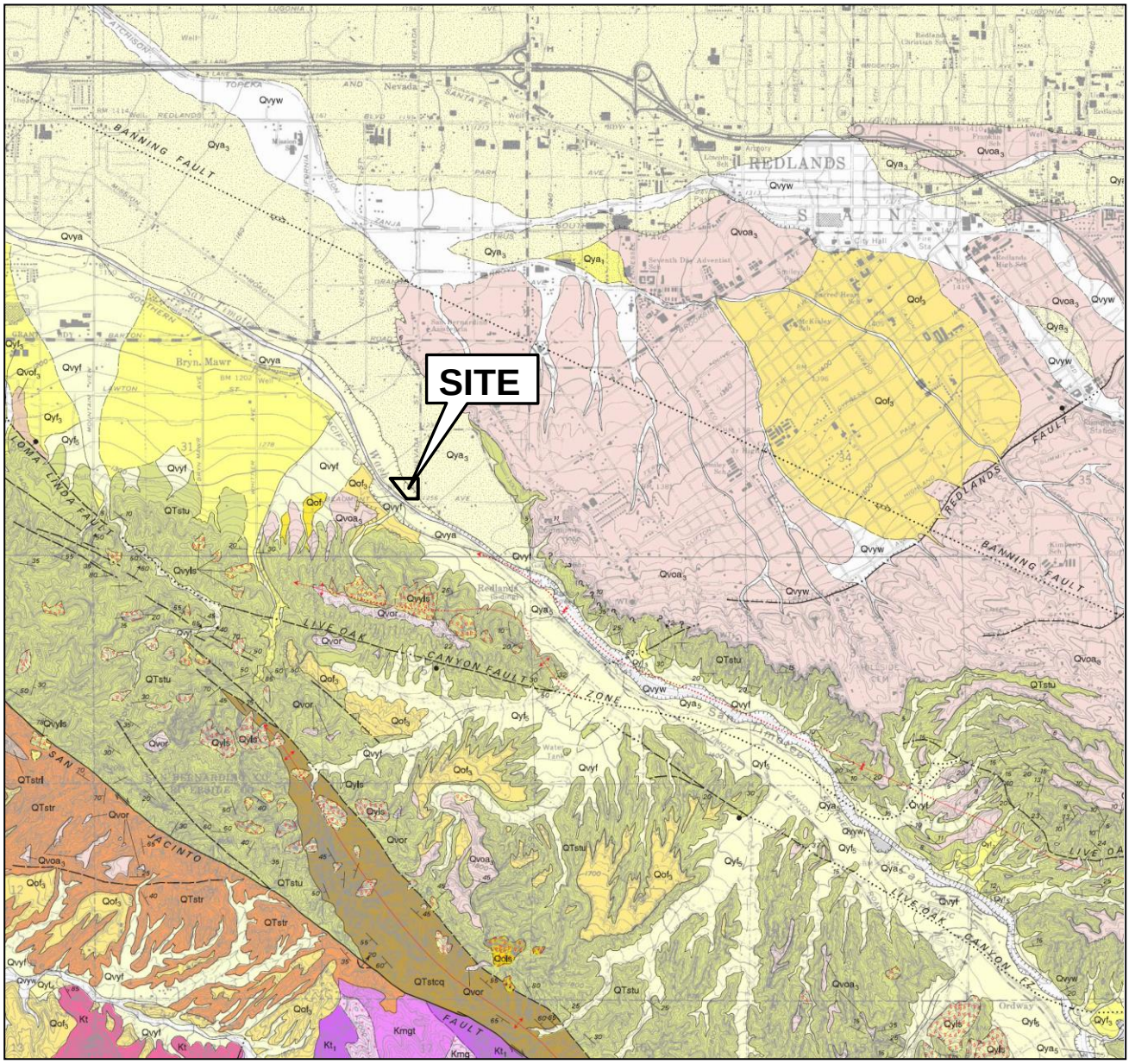
FIGURE 2

REGIONAL FAULTS – OFR 2003-0302



GEOLOGIC MAP OF THE REDLANDS 7.5' QUADRANGLE, SAN BERNARDINO AND RIVERSIDE COUNTIES, CALIFORNIA

Jonathan C. Matti,[1] Douglas M. Morton,[2] Brett F. Cox,[3] and Katherine J. Kendrick[3]

Digital preparation by

Pamela M. Cossette,[4] Bradley Jones,[1] and Steven A. Kennedy[1]

2003

1 0 1 MILE

1 .5 0 1 KILOMETER

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FIGURE 3

1945 GW CONTOURS – OFR 2005-1278

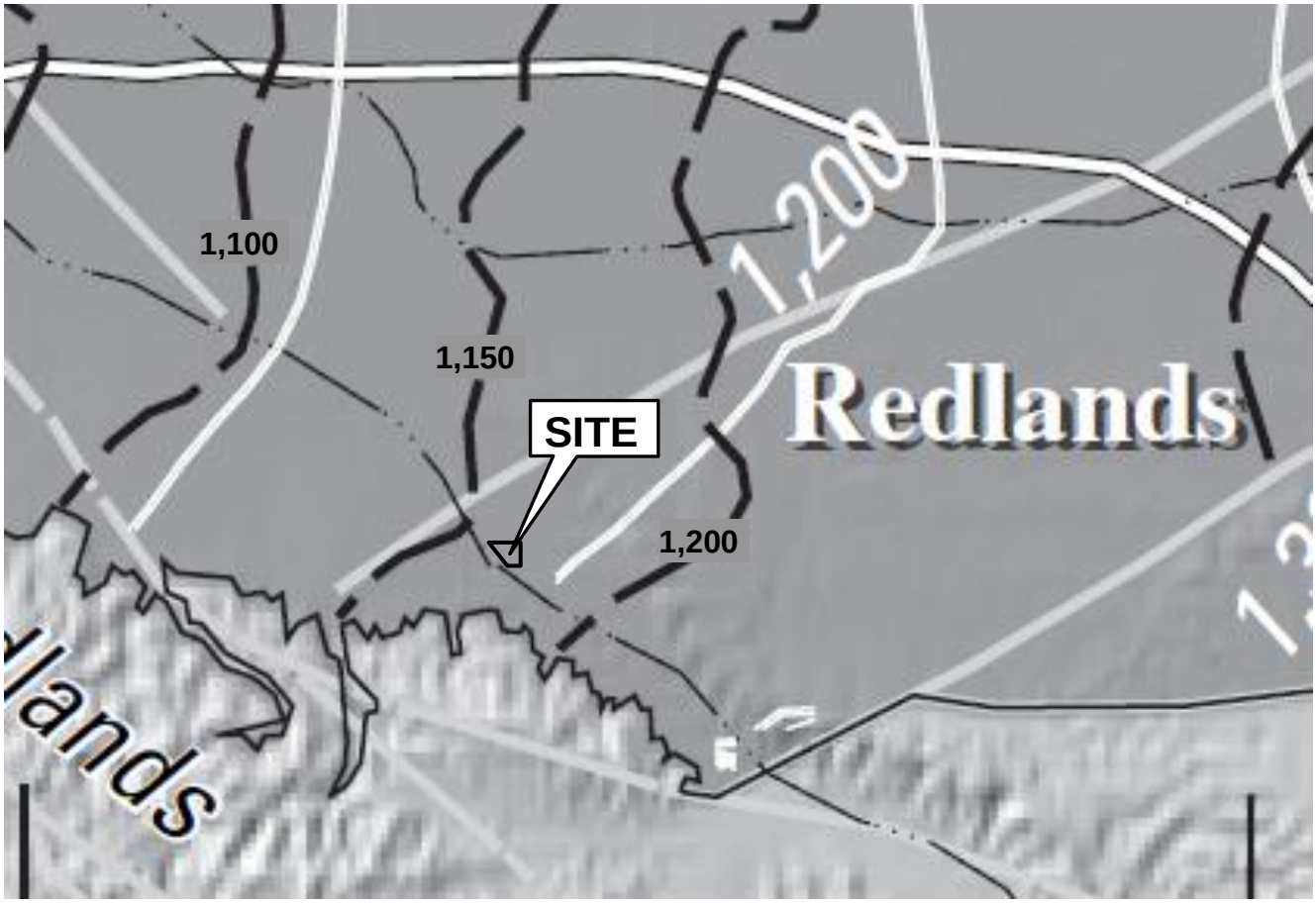

Figure 42. Measured ground-water levels and simulated hydraulic heads for the unconfined part of the valley-fill aquifer in the San Bernardino area, California, 1945. Measured contours adapted from unpublished map by F.B. Laverty (San Berndardino Valley Municipal Water District, written commun., 1998).

Source: USGS Open-File Report 2005-1278 (Hydrology, description of computer models, and evaluation of selected water-management alternatives in the San Bernardino Area, California)

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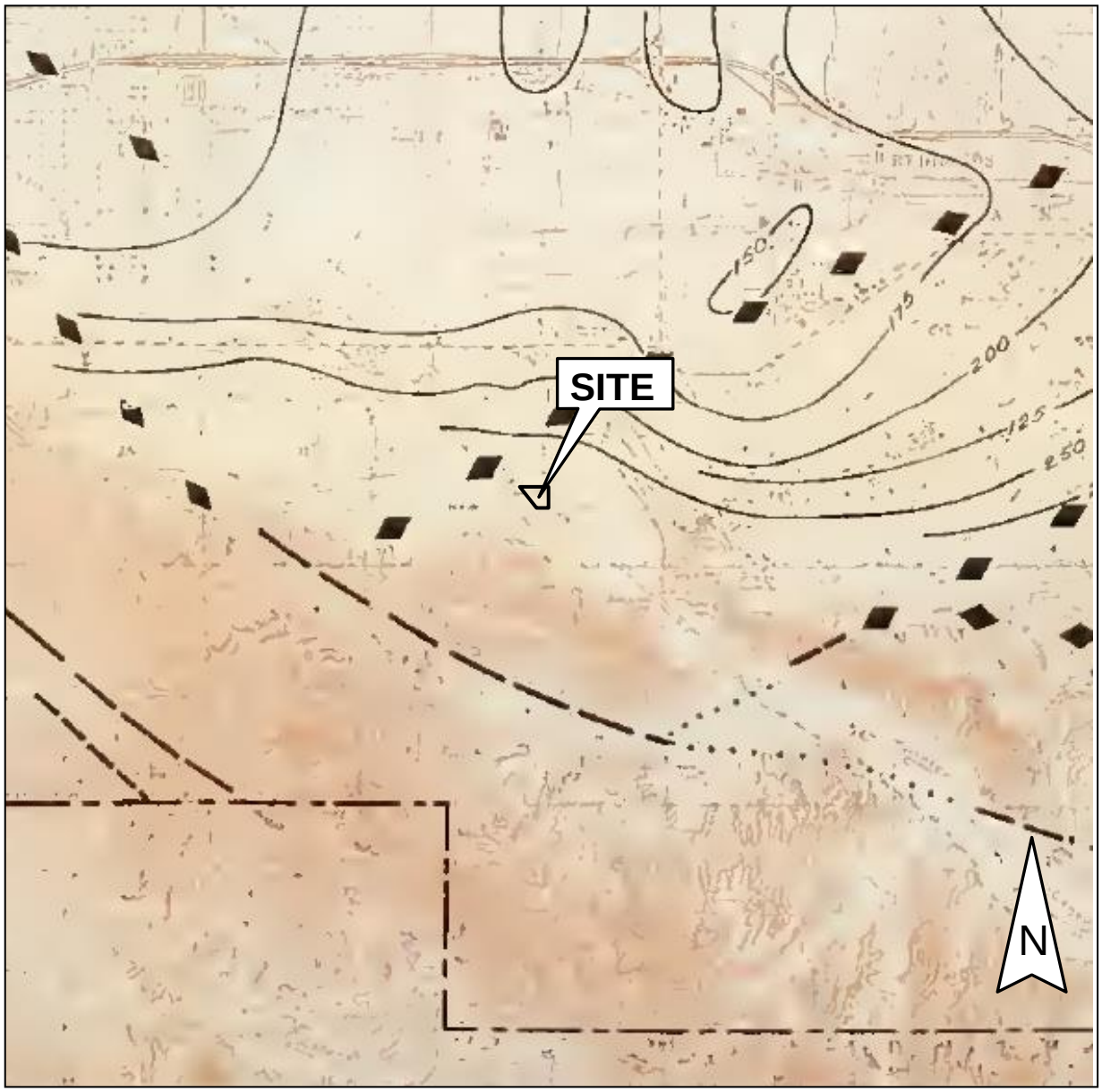
FIGURE 4

GROUND WATER ELEVATIONS (1960's) – SR 113



MAP SHOWING SURFACE WATERS AND MARSHES IN THE LATE 1800s, AND GENERALIZED DEPTH TO GROUND WATER (1960),* UPPER SANTA ANA VALLEY, SOUTHWESTERN SAN BERNARDINO COUNTY, CALIFORNIA

Compiled By Donald L. Fife, 1974

175

Line of equal depth to ground water in feet

Source: CDMG SR 113 (Geologic hazards in southwestern San Bernardino County, California)

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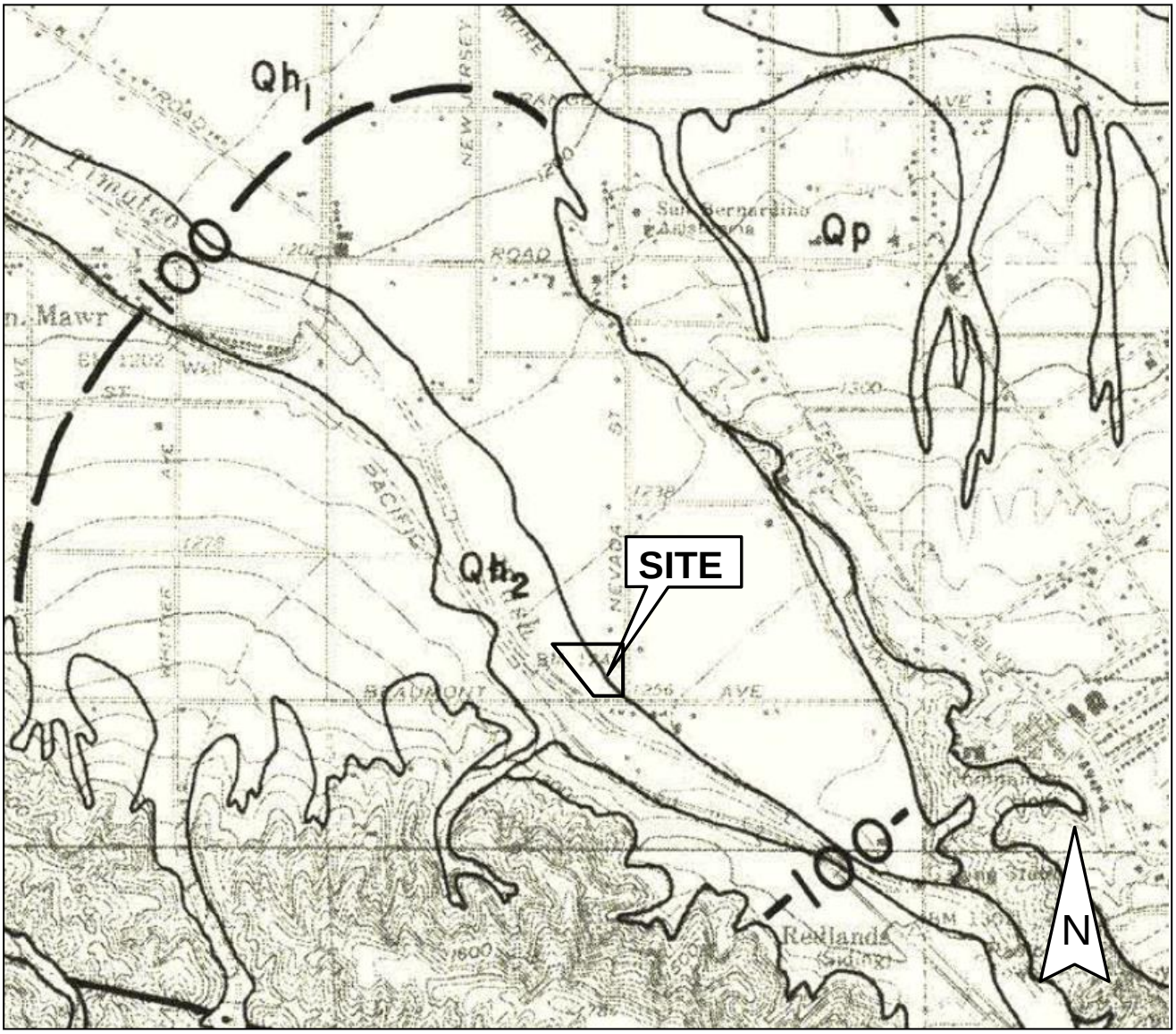
FIGURE 5

REGIONAL GEOLOGIC MAP – USGS BULL 1898



CONTOUR MAP SHOWING MINIMUM DEPTH TO GROUND WATER, SAN BERNARDINO VALLEY AND VICINITY, 1973-1983

— 50 ——— – – – CONTOUR LINE SHOWING MINIMUM DEPTH TO GROUND WATER DURING 1973–1983 PERIOD—Dashed where location uncertain; depth in feet below land surface. Contour interval 20 ft at depths less than 50 ft, 25 ft between 50 and 100 ft, and 50 ft at depths greater than 100 ft

Source: USGS Bull 1898 (Liquefaction susceptibility in the San Bernardino Valley and vicinity, southern California – A regional evaluation)

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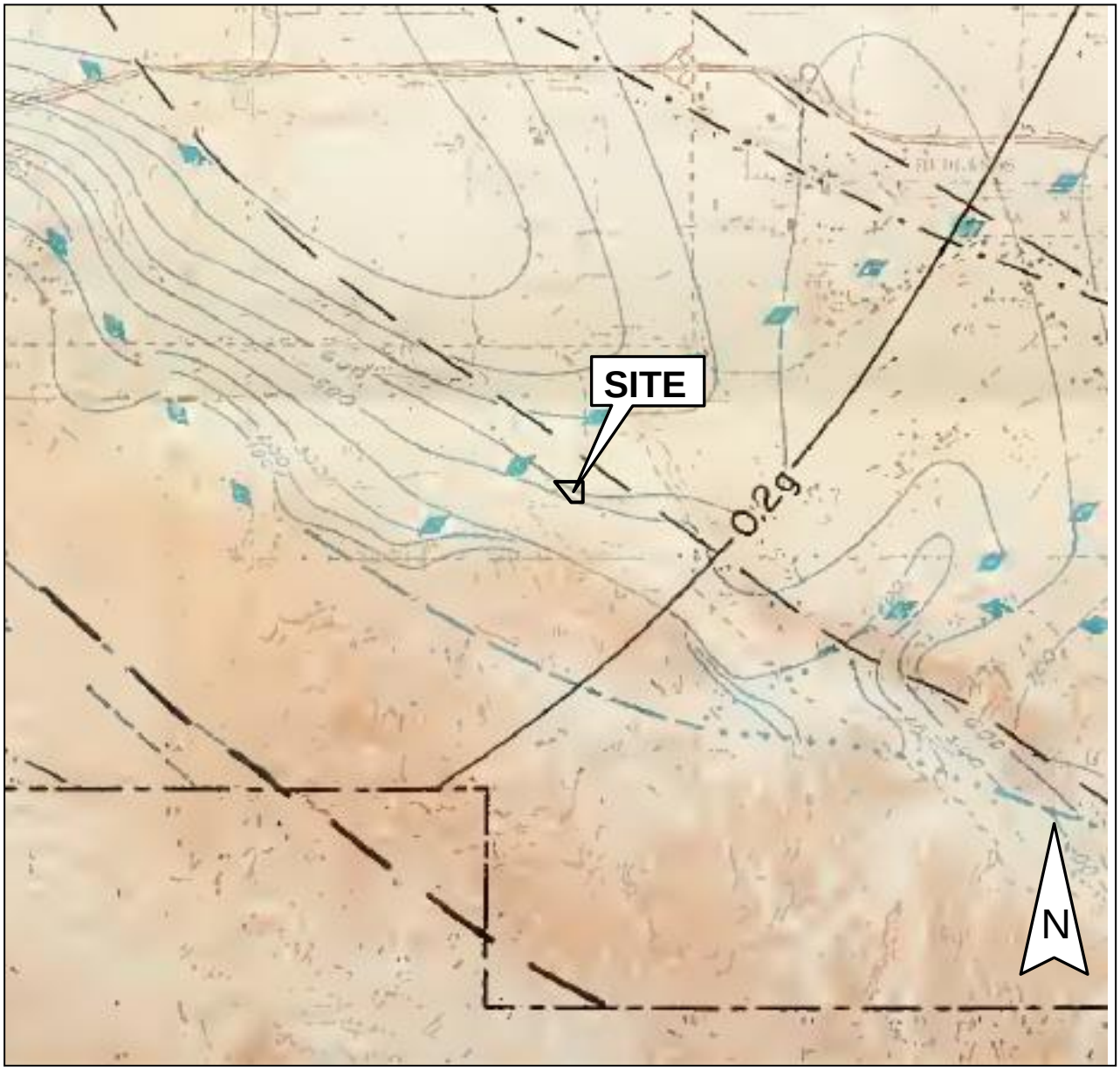
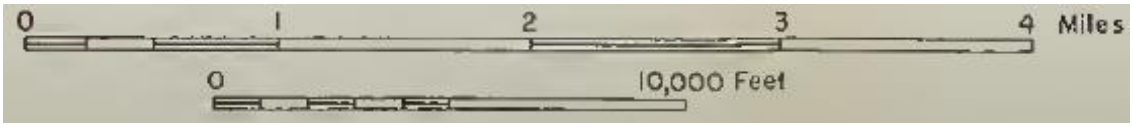
FIGURE 6

ALLUVIAL ISOPACH – SR 113



GENERALIZED GEOLOGIC MAP OF
SOUTHWESTERN SAN BERNARDINO COUNTY, CALIFORNIA

Compilation By D. M. Morton, 1974
U. S. Geological Survey



Source: CDMG SR 113 (Geologic hazards in southwestern San Bernardino County, California)

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FIGURE 7

REGIONAL FAULTS – OFR 2003-0302

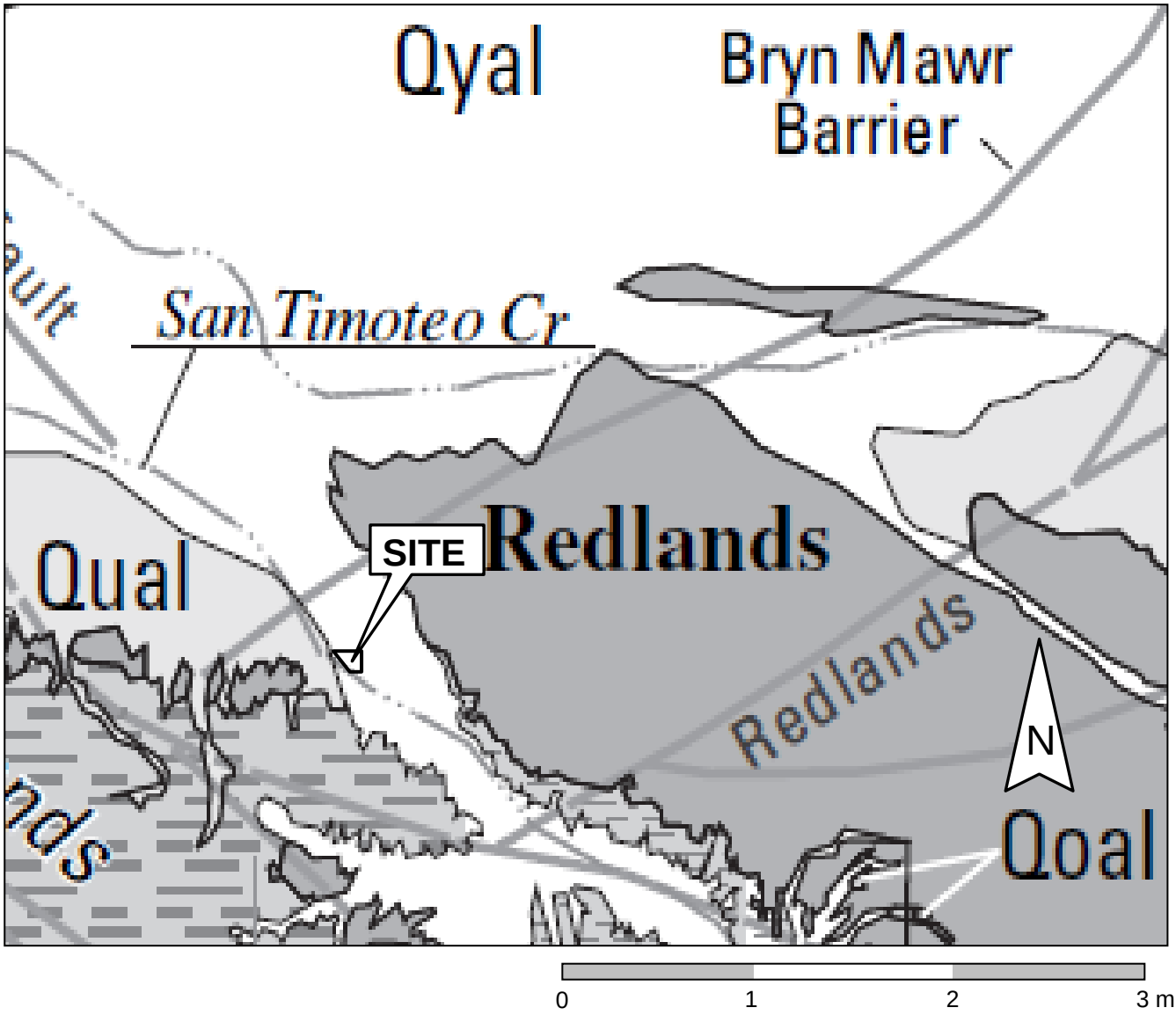

Figure 5. Generalized surficial geology of the San Bernardino area, California, adapted from Morton (1974) and Dutcher and Garrett (1963).

Source: USGS Open-File Report 2003-0302 (Geologic map of the Redlands 7.5 minute Quadrangle, San Bernardino and Redlands Counties, California)

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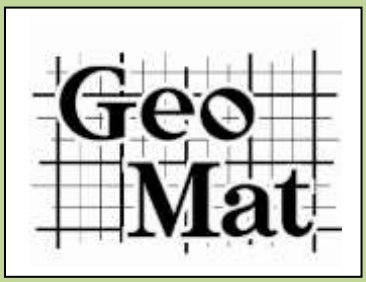
FIGURE 8

Appendix A



REFERENCES

Danskin, W.R. et al, 2005 “Hydrology, description of computer models, and evaluation of selected water-management alternatives in the San Bernardino Area, California,” US Geological Survey Open-File Report 2005-1278.

Dutcher, L.C. and Garrett, A.A., 1963, Geologic and hydrologic features of the San Bernardino Area, California, US Geological Survey Water-Supply Paper 1419.

Matti, J.C. and Carson, S.E., 1991, Liquefaction susceptibility in the San Bernardino Valley and vicinity, southern California – A regional evaluation, US Geological Survey Bulletin 1898.

Matti, J.C., Morton, D.M. et al, 2003, “Geologic map of the Redlands 7.5 minute Quadrangle, San Bernardino and Redlands Counties, California,” US Geological Survey Open-File Report 2003-0302.

Rodgers, D.A, et al, 1976, “Geologic hazards in Southwestern San Bernardino County, California,” California Division of Mines and Geology Special Report 113.

Shakil Patel & Associates’ Islamic Community Center of Redlands, Northwest Corner of Beaumont Avenue and Nevada Street, Redlands, California, Site Plan Phase III, Sheet A103, Plan Dated February 2, 2016.

USGS, Geologic Map of the Sunnymead and South 1/2 Redlands Quadrangles, Thomas W. Dibblee, Jr., 2003.

Geologic Map of the San Bernardino and Santa Ana 30’x60’ Quadrangles, California, Version 1.0, Morton and Miller, 2006.

San Bernardino County Land Use Plan, General Plan, Geologic Hazard Overlays, FH31C, Redlands

State of California, Department of Water Resources, Water Data Library.

State of California, Department of Conservation, CGS Information Warehouse: Regulatory Maps

USGS, Earthquake Hazards Program, U.S. Seismic Design Maps