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June 27, 2022

Project No.: 303277-004
Report No.: 22-6-61

Attention: Poul Hanson
Oxnard Union High School District
309 South K Street
Oxnard, CA 93030

Project: Hueneme High School Portable Classroom Relocation
500 West Bard Road
Oxnard, California

Subject: Response to Engineering Geology and Seismology Review

References:
1. Earth Systems Southern California,
2. Earth Systems Pacific, August 16, 2021, Geohazards Evaluation for Proposed Relocatable Classroom Buildings at Hueneme High School, 500 West Bard Road, Oxnard, California.
3. California Geological Survey, June 7, 2022, Engineering Geology and Seismology Review for Hueneme High School – Portable Classroom Relocation, 500 West Bard Road, Oxnard, CA, CGS Application No. 03-CGS5416, DSA Application No. 03-121617.

This letter responds to geotechnical concerns expressed in the referenced Engineering Geology and Seismology Review with respect to the proposed relocation of portable classroom buildings to be located on the Hueneme High School campus in the City of Oxnard, California. The comments are presented below in italics and the responses are in plain text. The numbering of the comments corresponds to the numbering in the referenced Review.

10. *Consideration of Geology in Geotechnical Engineering Recommendations: Additional information is requested. A geotechnical report should be provided for our review to confirm that the geologic conditions are addressed.*

The referenced Geohazards Evaluation included geotechnical data from a 2012 study performed by Earth Systems for a carport-mounted solar array along the west side of the campus and slightly north of the currently proposed site for the portable classroom relocation. As noted in the Geohazards Evaluation, the site is underlain by alluvium capped by asphaltic concrete. The upper 3 to 6.5 feet consist of sandy clays, and those overlie sands and silty sands to depths of about 22 feet, then silts and clays with minor interbeds of sand to depths of at least 50 feet. The clays that underlie the pavement are highly expansive and were found to have an expansion index of 112.

The proposed portable classrooms are not going to be supported by conventional foundation systems that would be bottomed into the underlying soils. They are proposed to be supported by wood foundations mounted on top of asphalt pavement. Thus, the underlying soil types are not critical to the structural design of the project with the exception that mitigation of liquefaction related differential settlements and ground oscillation (lateral spreading) will be necessary. As noted in the referenced Geohazards Evaluation, differential settlements of up to 1.1 inches and lateral movements of 0.8 feet could be experienced during a significant earthquake.

To mitigate the liquefaction related phenomena, Earth Systems recommends that a geogrid reinforced mat be constructed beneath the relocatable buildings. The intent of the geogrid reinforced mat is to stiffen underlying soils so that they act as a block that would result in more uniform settlement beneath the structures.

To create the geogrid reinforced mats, native soils beneath the proposed buildings should be excavated a minimum of 5 feet below existing grade. The limits of overexcavation should be extended laterally to a distance of at least 5 feet beyond the outside edges of the foundation element wherever no existing structures are located within 10 feet of the outside edge of the overexcavation zone. If existing structures are within 10 feet of the lateral overexcavation limit, the overexcavation width may be reduced to 3 feet outside the building perimeter in that direction only. The bases of the overexcavation zones should be relatively level.

The bottoms of the remedial excavations should be scarified to a depth of 6 inches, uniformly moisture conditioned to above optimum moisture content; and compacted to achieve a relative compaction of at least 90 percent of the ASTM D 1557 maximum dry density. Following compaction of the bottom, a layer of geogrid should be placed on the prepared subgrade that extends across the entire area of overexcavation and up the sidewalls of the remedial excavation. The reinforcing geogrids should consist of Tensar Interax NX850, or equivalent as approved by the Geotechnical Engineer. Where more than one geogrid roll is required, the rolls should be overlapped at least 3 feet. A 1-foot layer of one-inch minus “clean” aggregate base material should be placed and compacted over the bottom layer of geogrid. (“Clean” refers to an aggregate base without asphalt fragments.) The aggregate base material should be uniformly moisture conditioned to at or above optimum moisture content and compacted to achieve a relative compaction of at least 95 percent of the ASTM D 1557 maximum dry density. A second layer of geogrid should be placed over the compacted aggregate base material, rolls overlapped by 3 feet where necessary, and extended across the entire excavation; however, this layer does not need to extend up the sidewalls. Another foot of “clean” aggregate base material should be placed and compacted on top of the second geogrid layer. Once the second lift of aggregate base material has been placed and compacted, those portions of the first layer of geogrid that extended up the excavation walls should be laid out on top of the perimeter areas of the second layer of aggregate base. The remedial excavation may then be brought up to finished subgrade elevation using the excavated soil compacted to at least 90 percent of the ASTM D 1557 maximum dry density. The area may then be paved to match the existing structural paving section.

15. *Site-Specific Ground Motion Analysis: Additional information is requested. If the consultants' site-specific analysis will be used by the design team, the following comments should be addressed. The consultants deterministic MCE spectrum is lower than expected based on comparison with results from the National Seismic Hazard Model (from Petersen and others, 2014). We recommend the consultants provide detailed input parameters used in the deterministic analysis, the fault parameters and Z values in particular. A printout or screen capture of the calculator are commonly provided for our review, which facilitates a more efficient and accurate review process. Additionally, we note the spectra in columns 7 and 9 in the site-specific analysis table appear to be missing values from the 1 second period on. We recommend the consultants provide any discussion, revised analyses, and other information in a letter for our review.*

The data presented in the referenced Geohazards Evaluation report was reviewed to assess why the site-specific MCE Spectra values were lower than those generated by CGS. As part of that process, it was discovered that entry errors existed for the period and the geometry of the Oak Ridge fault. Furthermore, for this review, a deaggregation was performed using the same coordinates, Site Class, and Unified Hazard Tool analysis edition {Dynamic: Conterminous U.S. 2014 (Update) (v4.20)] that were used in the original analysis. Data generated by the deaggregation included modal magnitudes of 7.70 for the Oak Ridge fault. (The magnitude used in the referenced report was 7.4 per the UCERF2 data (2008).

Additional data used in the new analysis assumed that the southward projection of the Oak Ridge fault was located 1 km north of the site, the fault is a reverse fault with a southward dip of 65°, and the site is on the hanging wall. The input value for R_{RUP} was 10.4 km, R_{JB} was 1.0 km, Rx was 11.5 km, Z_{TOR} was 1 km, W was 18.4 km, and Z_{BOT} was 19.4 km.

Once the new magnitude was input into the Earth Systems spreadsheet, the attached set of Site-Specific Spectral Response Values were generated. The MCE Spectra values for periods greater than one second are greater than those presented in the referenced report. Furthermore, the revised analysis yielded an S_{D1} value of 1.105 g versus the previously reported 1.065 g.

Please call if you have any questions, or if we can be of further service.

Respectfully submitted,

EARTH SYSTEMS PACIFIC

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Anthony P. Mazzei 6/27/22
Geotechnical Engineer

Attach: Engineering Geology and Seismology Review Sheet
Revised Spectral Response Values Table

Copies:
2 - Poul Hanson at Oxnard UHSD (1 via US mail, 1 via email)
1 - Alan Camerano at DC Architects (via email)
1- CGS Report Upload
1 - Project File

Ted Lawrence
Assistant Superintendent of Business Services
Oxnard Union High School District
1800 Solar Drive
Oxnard, CA 93030

June 7, 2022

Subject: **Engineering Geology and Seismology Review for Hueneme High School – Portable Classroom Relocation**
500 West Bard Road, Oxnard, CA
CGS Application No. 03-CGS5416 DSA Application No. 03-121617

Dear Mr. Lawrence:

In accordance with your request and transmittal of documents received on April 21, 2022, the California Geological Survey (CGS) has reviewed the engineering geology and seismology aspects of the consulting report prepared for the subject project at Hueneme High School in Oxnard. It is our understanding that this project involves the relocation of portable buildings on an existing campus. This review was performed in accordance with Title 24, California Code of Regulations, 2019 California Building Code (CBC) and followed CGS Note 48 guidelines. We reviewed the following report:

> **Geohazards Evaluation Report for Proposed Relocatable Classroom Buildings at Hueneme High School, 500 West Bard Road, Oxnard, California:** Earth Systems Pacific, 1731 Suite A, Walter Street, Ventura, CA 92618; company Project No. 303277-004, report dated August 16, 2021, 14 pages, 4 appendices.

Based on our review, the data and report presented by Earth Systems Pacific do not adequately address the seismic and geologic issues of the site. Their evaluation indicates fault rupture and deep-seated slope instability are not design concerns for the project. Differential seismic settlement on the order of approximately 1 inch over a horizontal distance of 30 feet is possible at the site. However, we request additional information regarding geotechnical documentation and the ground motion analysis. Additional discussion is provided in the attached Checklist Comments.

In conclusion, ***the engineering geology and seismology issues at this site are not adequately assessed in the referenced report***. It is recommended that additional information be provided as requested in the attached Note 48 Checklist Review Comments portion of this letter. The consultants are reminded that one copy of all supplemental documents should be submitted, should include the CGS application number, and should be uploaded directly to CGS at this link: https://www.conservation.ca.gov/cgs/upload-school. If you have any further questions about this review letter, please contact the primary reviewer at ron.rubin@conservation.ca.gov

Respectfully submitted,

Ron Rubin
Engineering Geologist
PG 7730, CEG 2488

CERTIFIED ENGINEERING GEOLOGIST
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Concur:

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Enclosures:

Note 48 Checklist Review Comments
Keyed to: *Note 48 - Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings*

Copies to:

Patrick V. Boales, *Certified Engineering Geologist*, and Anthony P. Mazzei, *Registered Geotechnical Engineer*
Earth Systems Pacific, 1731 Suite A, Walter Street, Ventura, CA 92618

Richard D. Duncan, *Architect*
DC Architects, 1490 North Claremont Boulevard, Suite 201, Claremont, CA 91711

Douglas Humphrey, *Regional Manager*
Division of State Architect, 355 South Grand Avenue, Suite 2100, Los Angeles, CA 90071

Note 48 Checklist Review Comments

In the numbered paragraphs below, this review is keyed to the paragraph numbers of California Geological Survey Note 48 (November, 2019 edition), *Checklist for the Review of Engineering Geology and Seismology Reports for California Public Schools, Hospitals, and Essential Services Buildings.*

Project Location

1. Site Location Map, Street Address, County Name: Adequately addressed.
2. Plot Plan with Exploration Data and Building Footprint: Adequately addressed.
3. Site Coordinates: Adequately addressed. Latitude and Longitude provided in report: 34.1598, -119.1838

Engineering Geology/Site Characterization

4. Regional Geology and Regional Fault Maps: Adequately addressed.
5. Geologic Map of Site: Adequately addressed.
6. Geologic Hazard Zones: Adequately addressed. The consultants' report indicates the site lies within a CGS-defined Zone of Required Investigation for liquefaction.
7. Subsurface Geology: Adequately addressed. The consultants indicate the site is underlain by fill and alluvium. Groundwater was encountered at a depth of approximately 4½ feet in the site investigation.
8. Geologic Cross Sections: Adequately addressed.
9. Geotechnical Testing of Representative Samples: Adequately addressed.
10. Consideration of Geology in Geotechnical Engineering Recommendations: **Additional information is requested.** A geotechnical report should be provided for our review to confirm that the geologic conditions are addressed.
11. Conditional Geotechnical Topics: Not applicable.

Seismology & Calculation of Earthquake Ground Motion

12. Evaluation of Historic Seismicity: Adequately addressed. The consultants provide a summary of historical seismicity in the region.
13. Classify the Geologic Subgrade (Site Class): Adequately addressed. The consultants classify the site soil profile as Site Class D.
14. General Procedure Ground Motion Analysis: Adequately addressed. The consultants report the following parameters derived from a map-based analysis:
    S_S = 1.603 and S_1 = 0.587
15. Site-Specific Ground Motion Hazard Analysis: **Additional information is requested.** If the consultants' site-specific analysis will be used by the project design team, the following comments should be addressed. The consultants' deterministic MCE spectrum is lower than expected based on comparison with results from the National Seismic Hazard Model (from Petersen and others, 2014). We recommend the consultants provide detailed input parameters used in the deterministic analysis, the fault parameters and Z values in particular. A printout or screen-capture of the calculator are commonly provided for our review, which facilitates a more efficient and accurate review process. Additionally, we note the spectra in columns 7 and 9 in the site-specific analysis table appear to be missing

values from the 1 second period on. We recommend the consultants provide any discussion, revised analyses, and other information in a letter for our review.

16. Deaggregated Seismic Source Parameters: Not applicable.
17. Time Histories of Earthquake Ground Motion: Not applicable.

Fault Rupture Hazard Evaluation

18. Active Faulting & Coseismic Deformation Across Site: Adequately addressed. The consultants conclude the site does not lie within an Earthquake Fault Zone, and no known faults exist at the site. A down-dip projection of onshore section of the Oak Ridge fault exists approximately 1 km north of the site.

Liquefaction/Seismic Settlement Analysis

19. Geologic Setting for Occurrence of Liquefaction: Adequately addressed. The consultants identify the presence of potentially liquefiable subsurface materials at the site. They utilized a depth of 4½ feet for the historically highest depth to groundwater at the site, and note the CGS Seismic Hazard Zone Report covering the site area indicates a depth approximately 5 to 10 feet. The data presented appear to support these conclusions.
20. Seismic Settlement Calculations: Adequately addressed. Based on their settlement analyses, the consultants conclude: "…**the total liquefaction-related settlement could potentially range up to about 2.2 inches.**" And: "…**differential settlement could range up to about 1.1 inches** over a horizontal distance of 30 feet at the ground surface." The data presented appear to support these conclusions.
21. Other Liquefaction Effects: Not applicable.
22. Mitigation Options for Liquefaction/Seismic Settlement: Not applicable.

Slope Stability Analysis

23. Geologic Setting for Occurrence of Landslides: Adequately addressed. The consultants conclude: "…the subject site is relatively flat. As a result, it appears that the hazards posed by landsliding and rock fall are considered nil."
24. Determination of Static and Dynamic Strength Parameters: Not applicable.
25. Determination of Pseudo-Static Coefficient (K_{eq}): Not applicable.
26. Identify Critical Slip Surfaces for Static and Dynamic Analyses: Not applicable.
27. Dynamic Site Conditions: Not applicable.
28. Mitigation Options for Landsliding/Other Slope Failure: Not applicable.

Other Geologic Hazards or Adverse Site Conditions

29. Expansive Soils: Adequately addressed.
30. Corrosive/Reactive Geochemistry of the Geologic Subgrade: Adequately addressed.
31. Conditional Geologic Assessment: Adequately addressed. No significant conditional hazards of potential concern were identified by the consultants.

Report Documentation

32. Geology, Seismology, and Geotechnical References: Adequately addressed.
33. Certified Engineering Geologist: Adequately addressed.
    Patrick V. Boales, Certified Engineering Geologist #1346
34. Registered Geotechnical Engineer: Adequately addressed.
    Anthony P. Mazzei, Registered Geotechnical Engineer #2823

34.1598 -119.1838 Lat/Long

Site Specific Spectral Response Values
Probabilistic and Deterministic Response Spectra for MCE compared to Code Spectra
for 5% Viscous Damping Ratio

Natural Period T (seconds)	GeoMean Probab. 2% in 50 year MCE Spectrum	Max Rotated Probab. 2% in 50 year MCEr Spectrum	Max 84th Percentile Determ. MCE Spectrum	Determ. Lower Limit MCE Spectrum	Determ. MCE Spectrum	Site Specific MCE, Ground Response (SaM)	Site Specific MCE Spectrum Comparator	2019 CBC MCE Spectrum	Site Specific Design Spectrum (Sa)	2019 CBC Design Spectrum
	(1) 2475-year (ASCE 21.2.1)	(2) 2475-year (ASCE 21.2.1.1)	(3) (ASCE 21.2.2)	(4) (3) * 1.00=Scaling (ASCE 21.2.2)	(5) Max (3),(4) (ASCE 21.2.2)	(6) Min (2),(5) (ASCE 21.2.3)	(6b) Max (6),1.5*(8) (ASCE 21.2.3)	(7)	(8) (ASCE 21.3)	(9) 2/3*(7)
0.00	0.746	0.733	1.004	1.004	1.004	0.733	0.733	0.641	0.489	0.428
0.05	0.992	0.974	1.079	1.079	1.079	0.974	0.974	0.904	0.649	0.603
0.10	1.237	1.215	1.449	1.449	1.449	1.215	1.215	1.167	0.810	0.778
0.15	1.455	1.429	1.768	1.768	1.768	1.429	1.429	1.429	0.953	0.953
0.20	1.672	1.642	2.040	2.040	2.040	1.642	1.642	1.603	1.095	1.069
0.30	1.905	1.913	2.384	2.384	2.384	1.913	1.913	1.603	1.275	1.069
0.40	1.877	1.883	2.507	2.507	2.507	1.883	1.883	1.603	1.255	1.069
0.50	1.848	1.936	2.477	2.477	2.477	1.936	1.936	1.603	1.291	1.069
0.75	1.548	1.619	2.135	2.135	2.135	1.619	1.619	1.603	1.079	1.069
1.00	1.247	1.442	1.875	1.875	1.875	1.442	1.442	1.468	0.961	0.978
1.50	0.956	1.105	1.408	1.408	1.408	1.105	1.105	0.978	0.737	0.652
2.00	0.666	0.799	1.097	1.097	1.097	0.799	0.799	0.734	0.533	0.489
3.00	0.415	0.516	0.702	0.702	0.702	0.516	0.516	0.489	0.344	0.326
4.00	0.281	0.362	0.490	0.490	0.490	0.362	0.362	0.367	0.242	0.245
5.00	0.206	0.275	0.351	0.351	0.351	0.275	0.275	0.294	0.183	0.196
8.00	0.138	0.185	0.203	0.203	0.203	0.185	0.185	0.183	0.123	0.122
10.00	0.131	0.175	0.104	0.104	0.104	0.104	0.117	0.117	0.078	0.078

C_{RS}:	0.893	
C_{R1}:	0.889	
Site Specific To:	0.190	$= 0.2*S_{D1}/S_{DS}$
Site Specific Ts:	0.952	$= S_{D1}/S_{DS}$

The value of Fa used in Column (3) is defined within ASCE 21.2.2 Supplement 1. This Fa value only applies within Column (3).

Site Coefficients	
F_{PGA}	1.10
F_a	1.00
F_v	2.50

Probabilistic spectrum from 2014 USGS Ground Motion Mapping Program adjusted for site conditions and scaled to represent maximum response in a horizontal plane, in accordance with ASCE 7-16 Section 21.2

Mapped MCE Acceleration Values		
PGA	0.694	g
S_S	1.603	g
S_1	0.587	g

Risk Coefficients have been applied to Column (2); If Method 1 was utilized the Risk Coefficients, CRS and CR1 are presented above, if Method 2 was utilized the Risk Coefficients were obtained from the USGS Risk Targeted Ground Motion Calculator (https://earthquake.usgs.gov/designmaps/rtgm).

Seismic Site Class	**D**
Risk Category	**III**

Reference: ASCE 7-16, Chapters 21.2, 21.3, 21.4, 21.5, 11.4, and 11.8

Calculation Utilized ASCE7-16, Section 21.2.1.1 - Method 1

Site-Specific Design Acceleration Values		
PGA_M	**0.746**	**g**
S_{DS}	**1.162**	**g**
S_{D1}	**1.105**	**g**

Short-Period Seismic Design Category:	1-Second Period Seismic Design Category:
D	D

Vertical Coefficient (C_V)
1.42

Site-Specific MCE_R, 5% damped, Spectral Response Acceleration Parameter		
S_{MS}	**1.742**	**g**
S_{M1}	**1.658**	**g**

1 g = 980.6 cm/sec^2 =32.2 ft/sec^2

PSV (ft/sec) = 32.2(S_a)T/(2p)

Key: Probab. = Probabilistic, Determ. = Deterministic, MCE = Maximum Considered Earthquake