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Mr. Ron Johnson
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**SUBJECT: Response to Comments and Addendum Letter No. 2
Temporary Shoring and use of
Native Soil as Backfill
C-4016 New Allied Science Building
Contra Costa College
2600 Mission Bell Drive
San Pablo, California**

Dear Mr. Johnson,

This addendum letter presents additional geotechnical recommendations pertaining to the C-4016 New Allied Science Building project located at Contra Costa College in San Pablo, California. This letter was prepared in response to comments received via email from Mr. Jeff Smith, structural engineer, of Rutherford + Chekene dated January 17, 2018 with regard to Kleinfelder's geotechnical report entitled "Geotechnical Engineering Investigation Report, C-4016 New Allied Science Building, Contra Costa College, 2600 Mission Bell Drive, San Pablo, California," dated October 17, 2017 (File No. 20181569.001A/PLE17R67485). These previously prepared plans have been revised to eliminate the soldier pile wall. We previously prepared a letter report with recommendations for the soldier pile wall in our letter dated March 14, 2018. We have modified this report accordingly.

Recommendations provided herein address the temporary shoring and reuse of native soils for backfill. Our understanding of the proposed project is based on telephone conversations with Mr. Smith and our review of project plans entitled "100 Percent Schematic Design, Phase 3 – DSA Increment 2," for Contra Costa College New Science Building, compiled by SmithGroupJJR, dated January 19, 2018. We previously provided an addendum letter entitled, "Response to Comments and Addendum Letter No. 1, Foundation Uplift Anchors, C-4016 New Allied Science Building, Contra Costa College," dated March 2, 2018 (File No. 20181569.002A/SAC18L74494) which provided recommendations for uplift anchors associated with the design of buckling-restrained braced frame (BRBF) seismic force-resisting system foundations. Recommendations provided in this report are consistent with the requirements of the 2016 California Building Code (CBC). The recommendations provided in the referenced geotechnical report should also be adhered to, as appropriate.

SITE SUBSURFACE CONDITIONS

The subsurface data is based on the soil borings included in the referenced geotechnical report (Kleinfelder, 2017) which are summarized in Table 1.

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Table 1 – Summary of Subsurface Conditions

Soil/Rock Description	Depth (ft)	Unit Weight, γ (pcf)	Assumed Friction Angle, ϕ (deg.)	Recommended Cohesion, c (psf)
Sandy CLAY	Varies 0 to 20	120	0	1,000
CLAYSTONE	20 to 40	130	0	4,000

SUPPLEMENTAL LABORATORY TESTING

In order to further characterize the soils within the area of the proposed permanent soldier pile wall, a representative of Kleinfelder performed a site reconnaissance to collect a bulk sample of the near-surface site soils near the wall location for additional geotechnical laboratory testing. The laboratory testing program included maximum dry density, Atterberg limits, sieve analysis, and one-dimensional swell tests in accordance with ASTM standards to evaluate the physical characteristics and engineering properties of the clay soils proposed to be retained by the soldier pile tie-back wall. A summary of the laboratory tests and results is presented in Table 2, below.

Table 2 – Summary of Laboratory Testing

Test	ASTM Standard	Result
Modified Proctor	D1557A	DD = 116.6 pcf, MC = 13.5 %
Atterberg Limits	D4318	LL = 45, PI = 23 (CL)
Sieve Analysis	C136 / C117	99 % passing No. 4 90.9 % passing No. 200
One-Dimensional Swell/Collapse	D4546	800 psf for 0 % Swell

Notes: DD=Dry Density, MC=Moisture content, LL=Liquid Limit, PI=Plasticity Index

EARTHWORK RECOMMENDATIONS

Expansive Soils

As discussed in the referenced geotechnical report, near-surface, clayey soils were encountered within the building footprint and are considered moderately to highly expansive. Expansive soils are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Changes in soil moisture content due to rainfall, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors may cause unacceptable settlement or heave of structures, retaining walls, or concrete slabs supported-on-grade. Depending on the extent and location of expansive soils below finished subgrade, these soils could have a detrimental effect on the proposed construction.

Due to the expansive soil properties discussed above and the inability to adequately characterize the potential lateral pressures from expansion on the retaining walls, clayey soils are typically not recommended to be used as backfill adjacent to retaining structures. As such, the referenced

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geotechnical report recommended that all retaining wall backfill consist of imported, non-expansive fill. However, we understand that the proposed permanent soldier pile wall at the northwest corner of the building will retain a cut consisting of native clayey soil. As a result, we have provided recommendations in this letter for design of the proposed soldier pile tie-back wall supporting native clayey soils.

Reuse of Onsite Materials

On-site clay soils encountered across the site are considered suitable for reuse as general engineered fill provided that they are not placed within the upper 2 feet of areas supporting improvements (e.g. building pad subgrades, exterior flatwork, etc.) unless chemically treated with sufficient high-calcium quicklime to reduce the expansion potential to meet non-expansive fill requirements. Engineered fill consisting of native clayey soils placed deeper than 2 feet from finished soil grades should be compacted to between 88 and 92 percent relative compaction at a moisture content at least 3 percent above optimum. As stated above, the upper 2 feet of finished soil grades supporting improvements should consist of lime treated soil or imported non-expansive fill.

Chemical stabilization of the clay soils can be accomplished by mixing with high-calcium quicklime. For estimating purposes, quicklime application rates of 4 to 5 pounds per cubic foot of soil treated may be assumed. The actual quicklime application rate should be evaluated by laboratory testing of soil samples obtained from on-site borrow areas prior to construction. Lime treatment should be performed by a specialty contractor experienced in this work and should be performed in accordance with Caltrans Standard Specifications. Lime-treated areas can have significantly elevated pH levels (pH over 10) and may not be appropriate for use in landscaped areas. If used beneath improvements, appropriate corrosion protection should be provided. Final lime application rates should be determined such that a stabilized fill material with an expansion index of less than 20 (based on ASTM test method D4829) is achieved. The lime-stabilized soil should be compacted to at least 90 percent relative compaction at a moisture content of at least 2 percent above optimum, based on ASTM D1557. The upper 6 inches of subgrades supporting exterior slabs or pavements should be compacted to at least 93 percent of the maximum dry density.

TEMPORARY SHORING

General

As requested by the structural engineer, we are providing the following comments and recommendations regarding temporary shoring for the project. Shoring may be required where space or other restrictions do not allow a sloped excavation. This may include excavations within/near roadways and near or around existing utilities and structures. Since selection of appropriate shoring systems will be dependent on construction methods and scheduling, we recommend the Contractor be solely responsible for the design, installation, maintenance, and performance of temporary shoring systems. Shoring, bracing, or underpinning required for the project (if any) should be designed by a professional engineer registered in the State of California.

Discontinuous shoring systems are not recommended for excavations deeper than about 8 feet at the site based on the soils and groundwater conditions encountered. Continuous shoring systems such as Slide Rail, internally braced systems, trench boxes, or other applicable shoring systems may be suitable provided Cal OSHA regulations are met and damage to existing adjacent improvements does not result from their use.

Where trenches are excavated in and/or near existing roadways, structures or underground utilities, we recommend shoring systems be designed to provide positive restraint of trench walls. Where positive restraint of trench walls is not provided, lateral deformation of the trench walls may result in ground cracks, settlement and/or other ground movements that may affect adjacent underground utilities as well as surface improvements. If trench walls deflect laterally in pavement areas, parallel cracks may develop in the pavement and underlying soils that may require repair. The Contractor should be made aware of this potential condition in order that preventative measures can be implemented or repair measures provided for.

Lateral Earth Pressures

Where there is insufficient space to lay back the slopes for the planned excavations, shoring will be required. For design of cantilevered shoring (i.e., soldier piles, sheet piles, or similar shoring systems), a triangular distribution of lateral earth pressure may be used. For design of braced shoring, a uniform distribution of earth pressure is recommended. Sheet pile, soldier pile, or similar shoring systems either incapable of deflection or which are fully constrained against deflection may be designed for an equivalent fluid at-rest pressure. Table 3, below, provides approximate lateral earth pressures for use in preliminary shoring design based on an angle of internal friction of 0 degrees, an apparent cohesion of 1,000 psf, and a moist soil unit weight of 120 pcf for native clay soils and a level ground surface (without surcharge loading) adjacent to the top of the shoring. The earth pressure values provided below are ultimate values. Therefore, a factor of safety of at least 1.5 should be used for design of the lateral force resisting system. Since this is a temporary system, seismic pressures are not provided. Final design of shoring systems should be performed by the contractor based on their review of the trench wall soil conditions.

Table 3 - Lateral Earth Pressures for Braced Shoring in Clay Soils

Condition	Level Backfill
Active Pressure (psf)	41H
At-rest/Restrained Pressure (psf)	85H
Passive Pressure (psf/ft) for Native Stiff Clay	275

Notes: 1. H is shored height in feet.

Lateral Deflection of Shoring Systems

Lateral deflection of a shored excavation is heavily dependent on the relative stiffness of the shoring system, the amount of bracing and/or tie-backs, and the quality of workmanship during installation. The limiting condition of maximum active earth pressure for soft to firm silts is generally reached when the shoring tilts or deflects laterally about 1 percent of the shoring wall height in stiff cohesive materials. If the shoring tilts or deflects less than the limiting condition, the lateral earth pressure will lie between the active and at-rest earth pressures. This soil movement can extend horizontally as far back as 2H back from the top of cantilever retaining structures, with vertical movements approximately equal to the horizontal. The movement tends to be greatest close to the excavation and becomes less with increasing distance away. Backfilling void spaces behind shoring with sand or pea gravel may reduce the potential for vertical and lateral movements around the excavation.

The shoring designer should perform a deflection analysis of the shoring system. If movements are greater than the tolerance of existing project features (utilities, pavements, structures, etc.) tie-backs, dead-man anchors, or cross bracing may be needed to reduce deflections. Design using the at-rest pressure and/or more stringent tie-back or bracing systems may be required in the vicinity of improvements that cannot withstand lateral movements.

Lateral Resistance

All soldier or sheet piles should extend to a sufficient depth below the excavation bottom to provide the required lateral resistance. Embedment depths should be determined using methods based on the principles of force and moment equilibrium. To account for three-dimensional effects on a soldier pile, the passive pressure may be assumed to act on an area 2 times the width of the embedded portion of the pile, provided adjacent piles are spaced at least 3 diameters, center-to-center. A minimum factor of safety of 1.2 should be applied to the calculated embedment depth and to determine the allowable passive pressure. The shoring professional should evaluate the final design conditions and shoring type to select the appropriate factor of safety for design.

The passive earth pressure, similar to active earth pressures, is mobilized when the shoring below the excavation bottom tilts or deflects laterally. The limiting condition of maximum passive earth pressure is generally reached when the shoring deflects laterally below the base of the excavation about 0.2 percent of the embedment depth below the bottom of the excavation in dense sands and about 2 percent of the embedment depth below the bottom of the excavation in stiff cohesive material. If the shoring system is restrained against movement, the lateral resistance below the base of the excavation will lie somewhere between the passive and at-rest earth pressure conditions. Accordingly, if lateral deflection at the base of the excavation is objectionable, the at-rest earth pressure should be used in design for lateral resistance.

Surcharge Pressures

Shoring systems should be designed to resist lateral pressures due to hydrostatic forces, if present, and surface loads adjacent to excavations. We anticipate surface loads will be imposed by construction equipment, foundations, exterior flatwork, etc. Actual surcharge pressures will depend upon the geometry (i.e., point-, strip- or rectangular-shaped loaded area), the size of the loaded area, the position of the loaded area relative to the shoring, and the magnitude of the load. Thirty-five and fifty-five percent of any areal surcharge placed adjacent to the shoring may be assumed to act as a uniform horizontal pressure against the shoring for active and at-rest earth pressure conditions, respectively. It is common in shoring design to use an appropriate Boussinesq theory solution to evaluate surcharge load pressures. Special cases, such as combinations of sloping and shoring or other surcharge loads (not specified above) may require an increase in the design values recommended above. These conditions should be evaluated by the shoring designer.

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Protection of Existing Utilities, Structures, and Pavements

The shoring designer should complete a survey of existing utilities, pavements, and structures adjacent to those portions of the proposed excavation that will be shored. The purpose of this review would be to evaluate the ability of existing pipelines or conduits to withstand horizontal movements associated with a shored excavation. If existing utilities, pavements, and structures are not capable of withstanding anticipated lateral movements, alternative, more robust shoring systems may be required. It may be necessary to repair cracks in pavements adjacent to shored portions of excavations due to lateral displacements of the shoring systems and the ground that it retains.

Existing Trench Backfill Conditions

In areas where existing trench backfills are exposed in or located adjacent to excavations for the proposed improvements, the shoring design criteria presented above may not be valid. The shoring designer should consider the presence of existing utility trenches in and near the proposed excavation areas as well as methods to protect the utilities. If existing trench backfill materials are encountered in excavations on the site, the shoring designer should be notified immediately to observe and address the encountered conditions. It should be noted that trench wall collapses have occurred where these conditions were not recognized and addressed during construction.

Monitoring

Where existing facilities adjacent to an excavation must be protected, horizontal and vertical movements of the shoring system should be monitored by establishing survey points, installation of inclinometers, or a combination of both prior to excavation such that the vertical and horizontal positions of the monitoring points can be recorded to the nearest 0.01 feet. The results should be reviewed by a qualified Geotechnical Engineer on a daily basis for a period of at least one week during excavation and following construction of the shoring system. Measurements should be obtained on a weekly basis thereafter. Detailed recommendations for monitoring should be provided by a qualified Geotechnical Engineer after a review of the planned shoring system.

Construction Vibrations

The Contractor should use means and methods that will limit vibrations at the locations adjacent structures/facilities. Where construction operations such as sheet pile driving, demolition, or similar activities induce significant ground vibrations near critical facilities we recommend vibration monitoring be performed. As a guide, peak particle velocities from construction vibrations within adjacent structures/facilities should be limited to less than 1 inch/second when measured using an accelerometer. More stringent requirements may be needed adjacent to historic structures, buildings in poor conditions, or buildings where vibration sensitive equipment is being operated. We suggest the need for vibration monitoring be evaluated on a case-by-case basis.

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Shoring Removal

Shoring systems typically are removed as part of the trench backfill process. Depending on the shoring system used, the removal process may create voids along the sides of the trench excavation. If these voids are left in place and are significantly large, backfill may shift laterally into the voids resulting in settlement of the backfill and overlying improvements. Therefore, care should be taken to remove the shoring system and backfill the trench in such a way as to not create these voids. If the shoring system requires removal after backfill is in place, resulting voids should be filled with cement slurry or grout.

Design Groundwater Conditions

Due to the hilly terrain and shallow claystone present within the northeast region of the project area, groundwater may be present perched above the interfaces of soil/bedrock, different weathering zones, or different fracture density zones in the rock mass. Perched groundwater is expected to be most prevalent during the winter and spring months, and declining throughout the summer and early fall.

Actual groundwater levels at any given location will vary with seasonal variations in rainfall and runoff, stream levels, irrigation practices, and other factors. A site-specific hydrogeologic evaluation of seasonal fluctuations is beyond the scope of this study.

SITE DRAINAGE

As discussed in this letter and the referenced geotechnical report, the shrink-swell characteristics resulting from wetting and drying of the onsite site soils can have detrimental effects on the proposed construction. Therefore, proper site drainage is highly emphasized around the proposed structural improvements for long-term performance of the planned building, retaining walls, and exterior concrete flatwork. Landscaping planters are considered a primary source of seepage and moisture intrusion into subsurface soils.

Further discussion on site drainage for the project is discussed in Section 6.8, SITE DRAINAGE, of the referenced geotechnical report.

CLOSURE

Unless specifically superseded in this addendum, the recommendations in the above-referenced geotechnical report remain applicable. This document is intended to provide specific recommendations for the subject project. Accordingly, it cannot be considered an independent document, as it does not contain adequate background information. This document is directed only to the personnel with detailed knowledge of the subject project. Please attach this addendum to the above-referenced geotechnical report. The conclusions and recommendations presented in this addendum were prepared under the conditions and limitations presented in our above-referenced October 2017 geotechnical investigation report.

We trust this information meets your current needs. We appreciate the opportunity to be of professional service to you on this project. If you have any questions, please do not hesitate to contact us at (916) 366-1701.

Respectfully submitted,

KLEINFELDER, INC.

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