MOORE TWINING ASSOCIATES, INC.

May 26, 2023 E53623.01

Mr. Gordon Fong, PE
AECOM
2020 L Street
Sacramento, CA 95811

Subject: Geotechnical Engineering Investigation Update Report
Department of Motor Vehicles
448 Dover Parkway, Delano, California

References: Geotechnical Engineering Report, Delano Department of Motor Vehicles, prepared by Wallace Kuhl & Associates, dated January 10, 2018

Building Pad Preparation: In-place Relative Compaction and Moisture Content Report, prepared by Moore Twining Associates, Inc., Project No. H12001.01, dated May 25, 2023

Dear Mr. Fong:

This report was prepared to present updated geotechnical engineering recommendations for the proposed Department of Motor Vehicles (DMV) project planned at 448 Dover Parkway in Delano, Kern County, California.

1.0 PURPOSE AND SCOPE OF UPDATE REPORT

The purpose of this report is to review the data from the referenced January 10, 2018 Wallace Kuhl Geotechnical Engineering Report used for project design, conduct site observations, review other geotechnical engineering data from reports prepared in the project area by Moore Twining Associates, Inc. (Moore Twining), conduct a limited field exploration program, evaluate the original geotechnical engineering design parameters included in the January 10, 2018 report, and provide applicable updated geotechnical engineering recommendations for the project in order for Moore Twining to assume the role of Geotechnical Engineer of Record for the project.

2.0 BACKGROUND INFORMATION

The site history, previous studies, site description, and the anticipated construction are summarized in the following subsections.

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2.1 **Site History:** Based on review of readily available online satellite images, the subject site was in agricultural use (row crops) from about 1994 to 2008, with less frequent agricultural use until about 2012. The site appears generally unused since about 2012, with activities likely including periodic discing for weed control. Site development for construction of the currently proposed Department of Motor Vehicles (DMV) project began in late 2022 and extending into early 2023. Construction activities included clearing and grubbing, erosion control, grading a building pad, excavation of building utility trenches and some other activities. After the building pad for the DMV structure was prepared and the building foundations were excavated, water frequently collected in the foundation excavations from seasonal rainfall. The rainfall resulted in saturation and softening of the foundation subgrade soil, impacting the integrity of the footing excavations, and the finished building pad subgrade. In early 2023, the construction activities were halted, and shortly thereafter the open trenches were filled and some minor grading was conducted for surface drainage purposes.

2.2 **Previous Studies and Reports:** The Geotechnical Engineering Report prepared by Wallace Kuhl, dated January 10, 2018 was prepared for project design. The report indicated: *"Four exploratory borings were drilled across the property on December 13, 2017...The results of the borings indicate the near surface soils consist of about 16½ feet of light brown to brown, loose to medium dense, clayey sand. Silty sand was encountered below the near-surface clayey sand within Borings D1 and D4 below depths of 13 and 14 feet, respectively. The sands varied in density and amount of fines present."*

The report further indicated: *"Based on the results of our subsurface exploration, the known geologic, seismic, groundwater and soil conditions, it is our opinion that the potential for liquefaction occurring at the site during seismic events is very low."*

The report also indicated: *"Laboratory testing of the near-surface soil indicate these materials possess low expansion potential...Based on the soil conditions encountered at the borings and the results of the laboratory testing, deepening of foundations, special reinforcement of foundations or floor slabs, or special moisture conditioning during site grading to resist or control soil expansion pressures, are not considered necessary on this project."*

The report included recommendations for design of shallow foundations based on an allowable bearing pressure of 3,000 pounds per square foot for foundations *"...bearing on undisturbed or re-compacted native soils, engineered fill, or a combination of those materials..."*

In addition to the January 10, 2018 report, the findings and information from a number of geotechnical investigations for nearby projects previously conducted by Moore Twining were reviewed and considered, including for major retail developments and residential projects.

Based on the referenced Building Pad Preparation: In-place Relative Compaction and Moisture Content Report prepared by Moore Twining Associates, Inc., dated May 25, 2023, the building pad

was previously constructed using onsite silty sand and clayey sand soils. The compacted fill was reported to extend to elevations of about 298 feet to 300 feet elevation, which is about 5 to nearly 7 feet below the planned building pad subgrade elevation.

2.3 Site Description: The project site is located east of Dover Parkway, approximately 1,300 feet north of Woolomes Avenue in Delano, California. The site is located between the intersections of South Belmont Avenue and Dover Parkway and Del Sol Parkway and Dover Parkway.

The subject site includes a previously graded building pad area. As part of this investigation, the site was visited by the undersigned geotechnical engineer on February 10, 2023. A description of the site observations is included in Section 3.0 of this report.

2.4 Anticipated Construction: Based on the project drawings prepared by Nacht & Lewis, the DMV building is anticipated to include 12,371 square feet of interior conditioned space. Various sheets from the project plans prepared by the project architect, Nacht & Lewis, indicate the DMV structure will include concrete masonry unit (CMU) walls and CMU pilasters with an interior concrete slab on grade floor. The roof will be supported on a system of steel joists. Covered walkways are planned on the west side of the building and a carport will be attached to the east side of the building.

Appurtenant construction will include concrete flatwork around the entire exterior of the structure. Other site improvements will include a trash enclosure, asphalt concrete parking and drive areas, concrete pavement areas, and a motorcycle test area. Isolated landscape areas are also planned throughout the project site.

It is our understanding the building was designed based upon the 2019 California Building Code.

Based on the topographic survey performed after the previously excavated trenches in the building pad area were backfilled and some grading was performed on the site to facilitate drainage, a surface elevation of ~304 feet was indicated for the top of the building pad area. Based on the anticipated finish floor elevation of 305.6 feet, the existing grade is slightly below the planned finished subgrade for the building pad. As indicated in this report, over-excavation and compaction is recommended for the building pad. Areas outside the building pad are anticipated to require up to about 2 +/- feet of fill to achieve planned grade.

3.0 SITE OBSERVATIONS AND SUPPLEMENTAL EXPLORATION

In preparation of this update report, a site visit was made by Read Andersen, RGE on February 10, 2023. At that time, the building pad for the DMV structure had previously been graded, and footing and utility trenches had been excavated. The site was relatively flat, with exception that the building pad had been built up above the surrounding grade and some shallow slopes occurred between the pad and the surrounding grades. Some vegetation growth was noted near the site boundaries. Some areas of the building pad areas were covered with plastic. Foundation formwork and sleeves for utility penetrations had also been installed. The grade in the parking lot west of the building pad appeared to have been used as a borrow area to make grade for the building pad. Some areas of previous ponding of water and rutting from rubber tired vehicles were noted to the south and southwest of the building pad area. Soft surface soils and dessication cracking were observed in these areas. The soils exposed in the foundation excavations were primarily clayey sand and silty sand soils. The exposed footing trench sidewalls were undermined in some areas, which appeared to be the result of previous rainwater ponding in the foundation excavations. Dessication cracking was noted in some areas of the exposed soils at the pad subgrade surface and the bottom of some of the footing excavations. However, some of the footing excavations contained overly moist soils where freewater had recently collected in the bottom of the excavations. As indicated in this report, shortly after our site observations, the formwork, pipe sleeves and other construction materials were reportedly removed from the site and the trenches within the building pad were loosely filled with onsite soils in order to establish surface drainage.

During the site visit, shallow exploratory borings were drilled with a hand auger below the pad subgrade and below the footing subgrade. The maximum depth of exploration was estimated to be about 8 to 9 feet below the finished pad elevation. In addition, a nuclear density gauge was used to measure the in place density and moisture content of the bottom of the footing excavations in some areas. The intent of the sampling was to visually classify the soils and to obtain samples for laboratory testing. At the completion of the drilling and sampling operations, the boring holes were backfilled with soil cuttings and gravel.

4.0 NEAR SURFACE SOILS AND RESULTS OF LABORATORY TESTING

The near surface soils encountered in the shallow hand auger borings primarily consisted of silty sands and clayey sands. The near surface soils in the building pad to a depth of about 5½ to 6 feet below site grade (BSG) appeared to be fill soils placed from the previous building pad grading. In a few of the borings, a poorly graded sand was encountered at an approximate depth of about 6 feet below the pad elevation in the southwest portion of the pad (building gridline 3-B), and at a depth of about 6 ½ feet below the pad elevation below the northernmost carport footing at building gridline 2-H. In addition, a thin layer of sandy lean clay was encountered in one of the borings.

The results of laboratory soil classification testing conducted on a near surface sample considered representative of the fill materials encountered in the building pad area classified as a clayey sand based on a liquid limit of 23, a plasticity index of 9 and 44.4 percent passing the No. 200 sieve. An expansion index test indicated an Expansion Index of 16. The results of laboratory moisture content

tests conducted on shallow samples obtained in the footing excavations (generally the upper ~6 inches below the bottom of the footing trench) indicated moisture contents ranging from 10 to 14 percent moisture. Three (3) bulk samples were tested in accordance with ASTM D1557, which indicated maximum dry densities of 125.0, 127.2 and 127.2 pounds per cubic foot at optimum moisture contents of 10.2 percent, 9.6 percent and 10.0 percent, respectively.

5.0 CONCLUSIONS

5.1 Based on the geotechnical data reviewed as part of preparation of this update report, our site observations and limited supplemental exploration, the site is considered suitable for support of the proposed project from a geotechnical engineering perspective, provided the recommendations contained in this report are followed. The recommendations of the referenced January 10, 2018 Geotechnical Engineering Report may be used for design, with exception of where new or revised recommendations have been prepared in this report. Refer to the recommendations in Section 6.0 of this report, which supersede the January 10, 2018 report. It should be noted that the recommended design consultation and construction monitoring by Moore Twining are integral to this conclusion. Provided the recommendations of this report are incorporated into the project, Moore Twining assumes the role of Geotechnical Engineer of Record.

5.2 The near surface soils encountered in the shallow hand auger borings conducted as part of this update report primarily consisted of silty sands and clayey sands. Poorly graded sand was encountered at a depth of about 6 to 6 ½ feet below the pad elevation at several locations in the building pad.

5.3 The results of an Expansion Index test conducted on a clayey sand sample considered representative of the fill soils within the building pad indicated a very low expansion potential based on an Expansion Index of 16.

5.4 Based on review of the earthwork inspections conducted by Moore Twining during preparation of the building pad in late 2022, onsite clayey sand and silty sand fill materials were compacted beginning at an estimated elevation ranging from about 298 to 300 feet. As indicated in this report, shortly after our February 10, 2023 site observations, the footing and utility trenches within the building pad were loosely filled with onsite soils in order to establish some surface drainage. The trench backfill was not placed as engineered fill. In order to prepare a new building pad for support of the proposed structure, it is recommended that the fills placed as part of the originally prepared building pad, and subsequent trench backfill, all be removed to expose undisturbed native soils so that a new engineered pad can be graded for support of the proposed structure. With this approach, the fill placed by the previous contractor would not remain for support of the building. The Site Preparation recommendations in Section 6.4 of this report have been prepared based on this approach.

5.5 The January 10, 2018 report provided estimates of infiltration rates for the site soils. As part of this update report, testing to estimate an infiltration rate for the soils was not conducted. However, it is not recommended to rely on the infiltration rate included in the January 10, 2018 report for design of any facility at this site. It is our understanding infiltration systems are not being designed for the project. In the event infiltration systems are to be designed, site specific testing would be recommended to estimate infiltration rates and develop recommendations for these improvements.

5.6 The January 10, 2018 report characterized corrosion risk based on Caltrans guidelines. Based on the National Association of Corrosion Engineers corrosion severity ratings, the result of the minimum resistivity test included in the report would indicate a "highly corrosive" corrosion potential. Therefore, buried metal objects should be protected in accordance with the designer's and/or material manufacturer's recommendations based on a "highly corrosive" corrosion potential.

6.0 UPDATED GEOTECHNICAL ENGINEERING RECOMMENDATIONS

Based on our review of the referenced January 10, 2018 Geotechnical Engineering Report, the history of the previous construction, and our limited supplemental exploration and observations, updated geotechnical engineering recommendations for the project are included below to supplement the design recommendations for foundations and underslab aggregate base; and to replace the recommendations for site/subgrade preparation included in the referenced January 10, 2018 report. The recommended design consultation and observation of clearing, and earthwork operations by Moore Twining are integral to the proper application of the recommendations.

It is our understanding a project earthwork specification will be used to define the site/subgrade preparation requirements for the project. Moore Twining will consult with the project civil engineer to incorporate the recommendations of this report into the project earthwork specifications.

Where the requirements of the project specifications, a governing agency, utility agency or pipe manufacturer differ from the recommendations of this report, the more stringent recommendations should be applied to the project.

6.1 Foundations

6.1.1 Foundation settlement estimates were not included in the January 10, 2018 Geotechnical Engineering Report. A structural engineer experienced in foundation design should recommend the thickness, design details and concrete specifications for the foundations based on the estimated settlements. The following static settlements should be anticipated for design: 1) a total static settlement of 1 inch; and 2) a differential static settlement of ½-inch in 40 feet.

6.1.2 The referenced January 10, 2018 Geotechnical Engineering Report included seismic design parameters based on the 2016 California Building Code, and ASCE 7-10. The following seismic factors were developed in accordance with ASCE 7-16 (2019 California Building Code) using online data obtained from the Ground Motion Parameter Calculator provided by the Structural Engineers Association of California website (https://seismicmaps.org/) based upon a Site Class D, a latitude of 35.75184 degrees and a longitude of -119.24959 degrees. The data provided in the table were not determined based upon a ground motion hazard analysis. The structural engineer should review the values in the table below and determine whether a ground motion hazard analysis is required for the project considering the seismic design category, structural details, and requirements of ASCE 7-16 (Section 11.4.8 and other applicable sections). If required, Moore Twining should be notified and requested to conduct the additional analysis, develop updated seismic factors for the project, and update the following values.

Item	**ASCE 7-16 Value**
Site Class	D
Maximum Considered Earthquake (geometric mean) peak ground acceleration adjusted for site effects (PGA_M)	0.405
Mapped Maximum Considered Earthquake (geometric mean) peak ground acceleration (PGA)	0.315
Spectral Response At Short Period (0.2 Second), Ss	0.722
Spectral Response At 1-Second Period, S_1	0.272
Site Coefficient, Fa	1.222
Site Coefficient, Fv	See Note 1
Maximum considered earthquake spectral response acceleration for short period, S_{MS}	0.883
Maximum considered earthquake spectral response acceleration for 1 second, S_{M1}	See Note 1

Item	ASCE 7-16 Value
Five percent damped design spectral response acceleration for short period, S_{DS}	0.588
Five percent damped design spectral response acceleration at 1-second period, S_{D1}	See Note 1

Notes: 1. Requires ground motion hazard analysis per ASCE Section 21.2 (ASCE 7-16, Section 11.4.8), unless an Exception of Section 11.4.8 of ASCE 7-16 is applicable for the project design.

6.2 Interior Concrete Slab-on-Grade

The recommendations provided herein are intended only for the design of interior concrete slabs-on-grade and their proposed uses, which do not include construction loading. The contractor should assess the slab section and determine its adequacy to support any proposed construction loading.

6.2.1 A structural engineer experienced in slab-on-grade design should recommend the thickness, design details and concrete specifications for the proposed slabs-on-grade for a total static settlement of 1 inch, a differential static settlement of ½ inch in 40 feet, and heave of up to ½ inch differential in 40 feet.

6.2.2 Interior slabs-on-grade and adjacent walkways should be supported on a minimum of 4 inches of Class 2 aggregate base (compacted to a minimum of 95 percent relative compaction) over subgrade soils prepared in accordance with the recommendations included in the Site Preparation section (Section 6.4) of this report.

6.2.3 A vapor retarder should be placed below interior slabs where moisture could permeate into the interior and create problems. Refer to the American Concrete Institute's Guide to Concrete Floor and Slab Construction (ACI 302-1R) for selection and installation of moisture vapor retarders. It is recommended that a 15-mil vapor retarder, such as Stegowrap 15 or equal, be used where moisture could permeate into the interior and create problems, such as where flooring or floor slab applications will contain moisture sensitive materials (or other slab applications or uses). The vapor retarder

should overlay a compacted 4 inch (minimum) layer of non-recycled Class 2 aggregate base as recommended in this report. It should be noted that placing the PCC slab directly on the vapor retarder may increase the potential for cracking and curling; however, ACI recommends the placement of the vapor retarding membrane directly below the slab unless a watertight roofing system is in place prior to slab construction to reduce the amount of vapor emission through the slab-on-grade. It is recommended that the slab be moist cured for a minimum of 7 days to reduce the potential for excessive cracking. The underslab membrane should have a high puncture resistance (minimum of approximately 2,400 grams of puncture resistance), high abrasion resistance, rot resistant, and mildew resistant. It is recommended that the membrane be selected in accordance with the current ASTM C 755, Standard Practice For Selection of Vapor Retarder For Thermal Insulation and conform to the current ASTM D1745 Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs and ASTM E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Waters, or as Ground Cover. It is recommended that the vapor barrier installation conform to the current ACI Manual of Concrete Practice, Guide for Concrete Floor and Slab Construction (302.1R), Addendum, Vapor Retarder Location and current ASTM E 1643, Standard Practice for Installation of Water Vapor Retarders Used In Contact with Earth or Granular Fill Under Concrete Slabs. In addition, it is recommended that the manufacturer of floor covering, floor covering adhesive or other slab material applications be consulted to determine if the manufacturers have additional recommendations regarding the design and construction of the slab-on-grade, testing of the slab-on-grade, slab preparation, application of the adhesive, installation of the floor covering and maintenance requirements. It should be noted that the recommendations presented in this report are not intended to achieve a specific vapor emission rate.

6.2.4 Additional measures to reduce moisture migration should be implemented for floors that will receive moisture sensitive coverings. These include: 1) constructing a less pervious concrete floor slab by maintaining a water-cement ratio of 0.52 or less in the concrete for slabs-on-grade, 2) ensuring that all seams and utility protrusions are sealed with tape to create a "water tight" moisture barrier, 3) placing concrete walkways or pavements adjacent to the structure, 4) providing adequate drainage away from the structure, 5) moist cure the slabs for at least 7 days, and 6) locating lawns, irrigated landscape areas, and flower beds away from the structure.

6.3 Exterior Slabs-On-Grade

The recommendations for exterior slabs provided below are not intended for use for slabs subjected to vehicular traffic, rather lightly loaded walkways, patios, etc.

6.3.1 Exterior slabs should be supported on a minimum of 4 inches of Class 2 aggregate base placed over subgrade soils prepared in accordance with the recommendations included in the Site Preparation (Section 6.4) section of this report, and the project specifications, whichever is the most stringent.

6.3.2 Where exterior slabs are planned adjacent to landscape areas, as a minimum, the exterior slabs should include a thickened edge or moisture cutoff extending to the slightly below the bottom of the aggregate base section.

6.4 Site Preparation

6.4.1 A preconstruction meeting including, as a minimum, the owner, civil engineer, architect, general Contractor, earthwork subcontractor, and Moore Twining should be scheduled at least one week prior to the start of clearing and grubbing. The purpose of the meeting should be to discuss critical project requirements and scheduling.

6.4.2 All topsoil, vegetation, organics, etc. should be removed from the areas of proposed improvements. The general depth of stripping should be sufficiently deep to remove the root systems and organic material. The actual depth of stripping should be reviewed by Moore Twining at the time of construction. These materials will not be suitable for use as engineered fill; however, stripped topsoil may be stockpiled and reused in landscape areas at the discretion of the owner.

6.4.3 After stripping, the building pad area should be over-excavated to an elevation of 298 feet, and to a depth of at least 1.5 feet below bottom of all footings, whichever requires the deeper excavation. Slot cutting only below foundations will not be allowed. The over-excavation limits should include the entire building footprint, all foundations, and adjacent walkways, a minimum of 5 feet horizontally beyond the edges of the foundations, and a minimum of 5 feet beyond all walkways adjacent to the building, whichever is greater. After excavation of the near surface soils to the depths recommended above, Moore Twining should be requested to verify that the exposed soils are consistent with the anticipated conditions, and verification

from the Contractor's surveyor should be provided that the horizontal and vertical over-excavation limits required for the project have been achieved (See Section 6.4.4). After these conditions are satisfied, the exposed bottom should be proofrolled in accordance with Section 6.4.5 of this report to identify potential soft, or unstable areas. Where soft or unstable soils are identified during proofrolling, the contractor should conduct remedial preparation to achieve stability in accordance with the project specifications to the satisfaction of the geotechnical engineer. Upon approval of the proofrolling, the bottom of the excavations should be scarified to a minimum depth of 8 inches, moisture conditioned or aerated to optimum moisture content and three (3) percent above optimum moisture content and compacted as engineered fill followed by placement of engineered fill to pad grade. If unstable soil conditions persist, stabilization should be conducted in accordance with the project specifications.

6.4.4 Extra care should be taken to ensure that the horizontal and vertical extent of the excavation and compaction for the building pad preparation conform to the site preparation recommendations presented herein. The Contractor should verify in writing to the Owner that the horizontal and vertical over-excavation limits were completed in conformance with the recommendations of this report, the project plans, and the project specifications (the most stringent applies). The verification should include an as-built plan created with survey data from a licensed surveyor hired by the Contractor showing the elevation of the bottom of the excavation and the horizontal extent of the excavation recommended in this report were achieved.

6.4.5 Proofrolling of the excavation bottom for the building pad, prepared subgrade, and aggregate base sections should be conducted using a rubber tired vehicle weighing at least 25 tons, with the tires inflated to the manufacturer's operating pressure. The entirety of the areas should be proofrolled, with each succeeding pass offset by not greater than one tire width. A representative of the qualified geotechnical engineer should be scheduled by the Contractor to observe the proof rolling activities. If depressions more than one-half (½) inch occur, the Contractor shall perform remedial grading to achieve this requirement.

6.4.6 After stripping, pavement areas, exterior flatwork and areas to receive fill outside the building pad preparation limits should be scarified to a depth of 12 inches, moisture conditioned, compacted as engineered fill, and the areas should then be filled to grade with engineered fill. Prior to placement of fill, proof rolling, under the observation of Moore Twining, should be performed. The extent of the preparation should include all the pavement and flatwork areas and a minimum of three (3) feet beyond the edge of the flatwork,

pavements and curbs. Exterior flatwork should be underlain by a minimum of four (4) inches of aggregate base.

6.4.7 After stripping, miscellaneous lightly loaded foundations such as planter walls, trash enclosure screen walls, site walls, etc. should be over-excavated to a minimum of 1 foot below preconstruction site grade, and to a depth of 1 foot below the bottom of the foundation, whichever is greater. The zone of engineered fill shall extend to a minimum of three (3) feet beyond the limits of the foundation, or up to improvements to remain, whichever occurs first. Upon approval of the over-excavation limits, the soils at the bottom of the excavation should be scarified to a minimum depth of 8 inches, moisture conditioned or aerated to achieve the recommended moisture content and compacted as engineered fill.

6.4.8 All fill required to bring the site to final grades should be placed as engineered fill.

6.4.9 The moisture content, density and stability of the compacted soils should be maintained until the placement of the aggregate base, vapor retarder and concrete slabs/paving. If soft or unstable soils are encountered during excavation or compaction operations, our firm should be notified so the soils conditions can be examined and additional recommendations provided to address the pliant areas.

6.4.10 If the subgrade is prepared, and then disturbed by equipment workers, weather or other sources, we recommend that the exposed subgrade to receive slabs be tested to verify adequate compaction. If adequate compaction is not verified, the disturbed subgrade should be over-excavated, scarified, and compacted as engineered fill.

6.4.11 It is noted that the January 10, 2018 report states: *"The on-site soils likely will be saturated by rainfall in the winter and early spring months, and will not be compactable without aeration or chemical treatment to dry the soils."* Stabilization of wet soils, where required, should be conducted in accordance with the project specifications.

6.5 Engineered Fill Materials

6.5.1 The near surface soils are anticipated to consist primarily of clayey sands and silty sands; however, poorly graded sand and sandy lean clay are also anticipated. The existing near surface soils may be reused as engineered fill below the aggregate base section recommended below concrete slabs-on-grade and pavements, provided they are free of organics (less than 3 percent by weight), have an expansion index of less than 25, do not contain particles larger than 3 inches in dimension, are free of debris and are properly aerated/moisture conditioned to achieve the recommendations of this report for engineered fill.

6.5.2 The compactibility of the onsite soils is dependent upon the moisture contents, subgrade conditions, degree of mixing, type of equipment, as well as other factors. The evaluation of such factors was beyond the scope of this report; therefore, we recommend that they be evaluated by the contractor during preparation of bids and construction of the project.

6.5.3 Import fill soil should be non-expansive and granular in nature with the following acceptance criteria recommended.

Percent Passing 3-Inch Sieve	100
Percent Passing No. 4 Sieve	85 - 100
Percent Passing No. 200 Sieve	20 - 50
Plasticity Index	Less than 15
Expansion Index (ASTM D4829)	Less than 25
*R-Value	Minimum 20
Sulfates	< 0.05 % by weight
Minimum Resistivity	> 2,000 ohm-cm

* In paved parking and drive areas.

Prior to being transported to the site, the import material shall be certified by the Contractor and the supplier (to the satisfaction of the Owner) that the soils do not contain any environmental contaminates regulated by local, state or federal agencies having jurisdiction. In addition, Moore Twining should be requested to sample and test the material to determine compliance with the above geotechnical criteria. Contractors should provide a minimum of 7 working days to complete the testing.

6.5.4 Native and imported engineered fill soil should be placed in loose lifts approximately 8 inches thick, moisture-conditioned to between optimum moisture content and three (3) percent above optimum moisture content, and compacted to a dry density of at least 92 percent of the maximum dry density as determined by ASTM Test Method D1557, with exception that the upper 12 inches of fill and subgrade compacted in pavement areas should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM Test Method D1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable.

6.5.5 Utility trenches should be a minimum of 24 inches in width to allow for in-place density testing by traditional (nuclear density test) methods and the backfill should be compacted in accordance with the recommendations for engineered fill. Trenches should also meet the minimum width required by ASTM D2321, which indicates the minimum width shall be not less than the greater of either the pipe outside diameter plus 16 inches or the pipe outside diameter times 1.25, plus 12 inches, in accordance with the pipe manufacturer's requirements or as specified by the project civil engineer, whichever is more stringent. Utility trench backfill should be moisture conditioned and compacted as engineered fill. The material specifications for bedding and initial backfill materials (such as select granular material) should be specified by the project design engineer.

6.5.6 In-place density testing should be conducted in accordance with ASTM D 6938 (nuclear methods) at a frequency of at least:

Minimum In-place Density Test Frequency

Area	**Minimum Test Frequency**
Building Pad	1 test per 2,500 square feet per lift
Pavements	1 test per 2,500 square feet per lift
Utility Pipe, Walkways and Structure Backfill	1 test per 100 linear feet of trench per compacted lift

In addition to these minimum test frequencies, observation and testing of the preparation of the building pad should be conducted on a continuous basis by the qualified geotechnical engineer.

6.5.7 Recycled materials (such as asphalt concrete or Portland cement concrete) cannot be used in fill materials within the building pad.

6.5.8 Aggregate base shall comply with State of California Department of Transportation requirements for Caltrans Class 2 aggregate base, with the exception that aggregate base below the building shall not contain recycled materials. Documentation that the aggregate base to be used for the project meets the Class 2 material requirements (R-value, gradation, sand equivalent, durability, etc.) and is free of recycled materials, where planned below the building, should be provided by the Contractor to the Owner. If recycled aggregate base materials are used below pavements, the material submittal shall include sulfate test data (maximum 0.05 percent by weight). Also, prior to being transported to the site, all aggregate base materials (non-recycled, and recycled materials) shall be certified by the Contractor and the supplier (to the satisfaction of the Owner) that the soils do not contain any environmental contaminates regulated by local, state or federal agencies having jurisdiction. All aggregate base should be compacted to a minimum of 95 percent relative compaction.

6.5.9 In the event gravel/crushed rock materials are used as trench backfill, all open graded materials shall be fully encased in a geotextile filter fabric, such as Mirafi 140N, to prevent migration of fine grained soils into the porous material. Gravel shall be densified by placing the material in thin (4 to 6 inch) lifts and compacting each lift with a minimum of three (3) passes using vibratory compactors.

6.5.10 Where utility trenches with granular bedding/initial backfill materials extend into the building, a slurry cutoff collar should be used across the trench to reduce the potential for seepage to migrate from the more permeable trench backfill materials outside the building to below the building footprint.

7.0 DESIGN CONSULTATION

7.1 Moore Twining should be retained to review those portions of the contract drawings and specifications that pertain to earthwork, and foundations to determine whether they are consistent with our recommendations.

8.0 CONSTRUCTION MONITORING

8.1 It is recommended that Moore Twining be retained to conduct the necessary observation, field-testing services and provide results so that action necessary to remedy indicated deficiencies can be taken in accordance with the plans and specifications. Upon completion of the work, the geotechnical engineer should provide a written summary of the observations, field testing and conclusions regarding the conformance of the completed work to the intent of the plans and specifications. This service is not, however, part of this current contractual agreement.

8.2 The construction monitoring is an integral part of this investigation. This phase of the work provides Moore Twining the opportunity to verify the anticipated subsurface and make alternative recommendations if the conditions differ from those anticipated.

8.3 If Moore Twining is not retained to provide engineering observation and field testing services during construction activities related to earthwork, foundations, pavements and trenches; then, Moore Twining will not be responsible for compliance of any aspect of the construction with our recommendations or performance of the structures or improvements if the recommendations of this report are not followed.

9.0 NOTIFICATION AND LIMITATIONS

9.1 The conclusions and recommendations presented in this report are based on the information provided regarding the proposed construction, and the results of the field and laboratory investigation, the previous geotechnical report, and our experience with other projects.

9.2 The nature and extent of subsurface variations between borings may not become evident until construction.

9.3 If variations or undesirable conditions are encountered during construction, Moore Twining should be notified promptly so that these conditions can be reviewed and the recommendations reconsidered where necessary.

9.4 If the proposed construction is relocated or redesigned, or if there is a substantial lapse of time between the submission of our report and the start of work (more than 12 months) at the site, or if conditions have changed due to natural cause or construction operations at or adjacent to the site, the conclusions and recommendations contained in this report should be considered invalid unless the changes are reviewed and our conclusions and recommendations modified or approved in writing.

9.5 The conclusions and recommendations contained in this report are valid only for the project discussed herein. The entity or entities that use or cause to use this report or any portion thereof for another structure or site not covered by this report shall hold Moore Twining, its officers and employees harmless from any and all claims and provide Moore Twining's defense in the event of a claim.

9.6 This report is issued with the understanding that it is the responsibility of the client to transmit the information and recommendations of this report to developers, owners, buyers, architects, engineers, designers, contractors, subcontractors, and other parties having interest in the project so that the steps necessary to carry out these recommendations in the design, construction and maintenance of the project are taken by the appropriate party.

9.7 This report should not be construed as an environmental audit or study.

9.8 Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally-accepted engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

9.9 This investigation report should not be used in the preparation of a Storm Water Pollution Prevention Plan (SWPPP). Use of this report or any data included in the report in preparation of an SWPPP would be at the owner's sole risk.

9.10 Reliance on this report by a third party (i.e., that is not a party to our written agreement) is at the party's sole risk. If the project and/or site are purchased by another party, the purchaser must obtain written authorization and sign an agreement with Moore Twining in order to rely upon the information provided in this report for design or construction of the project.

We appreciate the opportunity to be of service. If you have any questions regarding this report, or if we can be of further assistance, please contact us at your convenience.

Respectfully Submitted,

MOORE TWINING ASSOCIATES, INC.
Geotechnical Engineering Division

Read L. Andersen, RGE
Manager