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GEOCON

GEOCON PROJECT NO. S2579-05-01 **AUGUST 2023**

Project No. S2579-05-01
August 3, 2023

VIA ELECTRONIC MAIL

Daniel Miller
Project Manager
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Gold River, CA 95670

Subject: GEOTECHNICAL INVESTIGATION
COLUMBUS PARK RENOVATION
401 WEST WORTH STREET
STOCKTON, CALIFORNIA

Mr. Miller:

In accordance with your authorization of our proposal (Geocon Proposal No. LS-22-92, dated March 17, 2022), we performed a geotechnical investigation for the subject project located at 401 West Worth Street in Stockton, California.

The accompanying report presents our findings, conclusions, and recommendations for the project as presently proposed. In our opinion, no adverse geotechnical conditions were encountered that would preclude development at the site provided recommendations of this report are incorporated into the design and construction of the project.

Please contact us if you have any questions regarding this report or if we may be of further service.

Respectfully Submitted,

GEOCON CONSULTANTS, INC.

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GEOTECHNICAL INVESTIGATION

1.0 PURPOSE AND SCOPE

This report presents the results of our geotechnical investigation for the proposed renovation of the existing Columbus Park located at 401 West Worth Street in Stockton, California. The approximate site location is depicted on the Vicinity Map, Figure 1.

The purpose of our geotechnical investigation was to observe and sample the subsurface conditions encountered at the site and provide conclusions and recommendations relative to the geotechnical aspects of site improvements as presently proposed.

To prepare this report, we:

- Performed a limited geologic literature review to aid in evaluating the geologic and seismic conditions present at the site. A list of referenced material is included in Section 9.0 of this report.
- Reviewed available design plans to select exploratory boring locations.
- Performed a site reconnaissance to review project limits, determine exploration equipment access, and mark out the proposed exploration locations.
- Notified subscribing utility companies via Underground Service Alert (USA) a minimum of two working days (as required by law) prior to performing excavations at the site.
- Paid the required fees and obtained a drilling permit from the San Joaquin County Environmental Health Department (SJCEHD).
- Performed four (4) exploratory borings (B1 through B4) with a truck-mounted drill rig equipped with 6-inch diameter solid-flight augers to depths ranging from approximately 5 to 16½ feet.
- Obtained representative samples from the exploratory borings.
- Logged the borings in general accordance with the Unified Soil Classification System (USCS).
- Upon completion, backfilled the exploratory borings with neat cement grout per San Joaquin County Environmental Health Department (SJCEHD) requirements. Excess soil cuttings were spread near the boring locations.
- Performed laboratory tests to evaluate pertinent geotechnical parameters.
- Prepared this report summarizing our findings, conclusions, and recommendations regarding the geotechnical aspects of site improvements as presently proposed.

Approximate locations of the exploratory borings are shown on the Site Plan, Figure 2. Details of our field exploration program including exploratory boring logs are presented in Appendix A. Details of our laboratory testing program and test results are summarized in Appendix B.

2.0 SITE AND PROJECT DESCRIPTION

The approximate 2.2-acre site currently includes a partial basketball court, concrete walkways, and landscaping. The park site is bounded by the BNSF railroad tracks to the north, S. Van Buren Street to the east, W. Worth Street to the south, and S. Lincoln Street to the west. Site-specific topography/survey information was not available for our review as of the date of this report. Based on satellite imagery topographic information (Google Earth Pro, March 11, 2022), the site elevations range from approximately 8 to 16 feet. The current site configuration is shown on the Site Plan, Figure 2.

The planned project improvements will include constructing a picnic shade shelter, restroom building, swing area, and playgrounds, basketball courts, adult fitness area, community garden and nature classroom, a bioretention/bioswale area, ADA pathway and lighting, and landscaping (new shade trees and natural turf) throughout the park. Approximate locations and features of the proposed improvements are shown on the Site Plan, Figure 2. The restroom and storage building will likely be of concrete masonry or wood framed construction and be supported by conventional shallow foundations with interior concrete slabs-on-grade. The shade structure will likely be supported on cast-in-drilled-hole (CIDH) concrete piers. New pavements will consist of rigid Portland cement concrete (PCC) pavement. We anticipate that site grading will include cuts and fills on the order of 5 feet or less. Some underground utilities may require deeper excavations.

3.0 SOIL AND GEOLOGIC CONDITIONS

We identified soil and geologic conditions by observing exploratory borings and reviewing the referenced geologic literature (Section 9.0). Soil descriptions below include the USCS symbol where applicable. Site geology generally consists of Alluvium mapped as Holocene Basin Deposits (CGS, 2011).

3.1 Alluvium (Modesto Formation)

We encountered alluvium mapped as the Modesto Formation in each of our exploratory borings (B1 through B4) to the maximum explored depth of approximately 16½ feet. The alluvium generally consists of layers of stiff to hard lean clay (CL) and lean clay with sand (CL).

Soil conditions described in the previous paragraphs are generalized. The exploratory boring logs included in Appendix A detail soil type, color, moisture, consistency, and USCS classification of the soils encountered at specific locations and elevations.

4.0 GROUNDWATER

We did not encounter groundwater in our exploratory borings performed on June 26, 2023.

We reviewed available depth-to-groundwater data on the California Department of Water Resources (DWR) Sustainable Groundwater Management Act (SGMA) Data Viewer (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels). The SGMA Data Viewer website indicates that depth to groundwater at the site ranges from approximately 30 to 40 feet (Spring 2021).

It should be noted that fluctuations in the level of groundwater may occur due to variations in precipitation, temperature, and other factors. Depth to groundwater can also vary significantly due to localized pumping, irrigation practices, and seasonal fluctuations. Therefore, it is possible that groundwater may be higher or lower than the levels observed during our investigation.

5.0 SEISMICITY AND GEOLOGIC HAZARDS

5.1 Regional Active Faults

Based on our research, analyses, and observations, the site is not located on any known "active" earthquake fault trace. In addition, the site is not contained within an Alquist-Priolo Earthquake Fault Zone. Mapped regional active faults are located several miles away from the site. Therefore, we consider the potential for ground rupture due to onsite active faulting to be low.

5.2 Ground Shaking

We used the United States Geological Survey (USGS) Unified Hazard Tool (https://earthquake.usgs.gov/hazards/interactive/) to determine the deaggregated seismic source parameters including controlling magnitude and fault distance. The USGS estimated modal magnitude is 6.3 and the estimated Peak Ground Acceleration (PGA) for the Maximum Considered Earthquake (MCE) with a 2,475-year return period is 0.42g.

While listing PGA is useful for comparison of potential effects of fault activity in a region, other considerations are important in seismic design, including frequency and duration of motion and soil conditions underlying the site.

5.3 Liquefaction

Liquefaction is a phenomenon in which loose, saturated, cohesionless soil deposits located beneath the groundwater table lose strength when subjected to intense and prolonged ground shaking. The seismic excitation increases pore water pressure creating a buoyant effect of the loose soil. When liquefaction occurs, building foundations may sink or tilt and differential ground settlement may occur. Other effects may include sand boils (ground loss) and lateral spreading if the liquefiable soil is located adjacent to a steep free face. The areas that have the greatest potential for liquefaction are those in which the water table is less than 50 feet below ground surface and the soils are predominately clean, poorly graded sand deposits of loose to medium-dense relative density.

The site is not located in a currently established State of California Seismic Hazard Zone for liquefaction. Based on the subsurface conditions encountered at the site, including very stiff to hard cohesive soils, liquefaction is not a hazard for the site. Mitigation and specific design measures with respect to liquefaction is not necessary for the project.

5.4 Expansive Soil

Laboratory Plasticity Index (PI) and Expansion Index (EI) tests on selected near-surface soil samples indicate medium to high plasticity and corresponding medium expansion potential. Specific recommendations with respect to expansive soils are provided in this report.

5.5 Soil Corrosion Screening

We performed pH, resistivity, chloride, and sulfate tests on one sample to generally evaluate the corrosion potential of the soil with respect to proposed subsurface structures. These tests were performed in accordance with California Test Method (CTM) Nos. 643, 422, and 417. The results are presented in Table 5.5A and should be considered for design of underground structures.

TABLE 5.5A
SOIL CORROSION PARAMETER TEST RESULTS
(CALIFORNIA TEST METHODS 643, 417, AND 422)

Sample No.	Sample Depth (ft.)	pH	Minimum Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
B3-Bulk	0 – 5	7.3	1,070	11.0	41.1

Soil with a low pH (higher acidity) is considered corrosive as it can react with lime in cement to leach out soluble reaction products and result in a more porous and weaker concrete. Per Caltrans *Corrosion Guidelines* (Caltrans 2021), soil with a pH of 5.5 or lower may be corrosive to concrete or steel in contact with the ground. Based on the laboratory pH test results and Caltrans criteria, soil at the locations tested does not have a higher propensity for corrosion.

Soil resistivity is the measure of the soil's ability to transmit electric current. Corrosion of buried ferrous metal is proportional to the resistivity of the soil. A lower resistivity indicates a higher propensity for transmitting electric currents that can cause corrosion of buried ferrous metal items. In general, the higher the resistivity, the lower the rate for corrosion. Per Caltrans *Corrosion Guidelines*, resistivity serves as an indicator parameter for the possible presence of soluble salts and it is not included as a parameter to define a corrosive area for structures. A minimum resistivity value for soil less than 1,500 ohm-cm may indicate the presence of high quantities of soluble salts and a higher propensity for corrosion. Based on the laboratory minimum resistivity test results and Caltrans criteria, soil at the locations tested does have a higher propensity for corrosion.

Table 5.5B presents a summary of concrete requirements set forth by the California Building Code (CBC) Section 1904 and American Concrete Institute (ACI) 318 for possible chloride exposure. Chlorides can break down the protective oxide layer on steel surfaces resulting in corrosion. Sources of chloride include, but are not limited to, deicing chemicals, salt, brackish water, seawater, or spray from these sources.

TABLE 5.5B
REQUIREMENTS FOR CONCRETE EXPOSED TO CHLORIDE-CONTAINING SOLUTIONS
(AFTER ACI 318 TABLES 19.3.1.1 and 19.3.2.1)

Chloride Severity	Exposure Class	Condition	Maximum Water to Cement Ratio by Weight	Minimum Compressive Strength (psi)
Not Applicable	C0	Concrete dry or protected from moisture	N/A	2,500
Moderate	C1	Concrete exposed to moisture but not to external sources of chlorides	N/A	2,500
Severe	C2	Concrete exposed to moisture and an external source of chlorides	0.40	5,000

The appropriate Chloride Severity/Exposure Class should be determined by the project designer based on the specific conditions at the location of the proposed structure. Further guidance is provided in ACI 318. Per Caltrans *Corrosion Guidelines*, soil with a chloride concentration of 500 ppm or higher may be corrosive to steel structures or steel reinforcement in concrete. Based on Caltrans criteria, soil at the locations tested is not corrosive with respect to chloride content.

Table 5.5C presents a summary of concrete requirements set forth by CBC Section 1904 and ACI 318 for sulfate exposure. Similar to chlorides, sulfates can break down the protective oxide layer on steel leading to corrosion. Sulfates can also react with lime in cement to soften and crack concrete.

TABLE 5.5C
REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS
(AFTER ACI 318 TABLES 19.3.1.1 and 19.3.2.1)

Sulfate Severity	Exposure Class	Water-Soluble Sulfate (SO_4) Content		Cement Type (ASTM C 150)	Maximum Water to Cement Ratio by Weight[1]	Minimum Compressive Strength (psi)
		Percent By Mass	Parts Per Million (ppm)			
Not Applicable	S0	$SO_4 < 0.10$	$SO_4 < 1,000$	No Type Restriction	N/A	2,500
Moderate	S1	$0.10 \leq SO_4 < 0.20$	$1,000 \leq SO_4 < 2,000$	II	0.50	4,000
Severe	S2	$0.20 \leq SO_4 \leq 2.00$	$2,000 \leq SO_4 \leq 20,000$	V	0.45	4,500
Very Severe	S3 – Option 1	$SO_4 > 2.00$	$SO_4 > 20,000$	V+Pozzolan or Slag	0.45	4,500
	S3 – Option 2			V	0.40	5,000

Notes:
1. Maximum water to cement ratio limits are different for lightweight concrete, see ACI 318 for details.

Based on the laboratory test results, the Sulfate Severity is classified as "Not Applicable" and the Exposure Class is S0. The concrete mix design(s) should be developed accordingly. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration.

Geocon does not practice in the field of corrosion engineering and the above information is provided as screening criteria only. If corrosion sensitive improvements are planned, we recommend that further evaluations by a corrosion engineer be performed to incorporate the necessary precautions to avoid premature corrosion on buried metal pipes and metal or concrete structures in direct contact with the soils.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 General

6.1.1 No soil or geologic conditions were encountered during our investigation that would preclude development of the site as planned, provided the recommendations contained in this report are incorporated into the design and construction of the project.

6.1.2 The primary geotechnical constraint identified in our investigation is the presence of near surface expansive clay soil throughout the site. Mitigation recommendations for this constraint are provided in this report.

6.1.3 Conclusions and recommendations provided in this report are based on our review of referenced literature, analysis of data obtained from our field exploration program, laboratory testing program, and our understanding of the proposed development at this time.

6.1.4 We should review the project plans as they develop further, provide engineering consultation as needed during final design, and perform geotechnical observation and testing services during construction.

6.2 Seismic Site Class / Seismic Design Criteria

6.2.1 Seismic design of the structures should be performed in accordance with the provisions of the 2019 California Building Code (CBC) which is based on the American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI) publication: *ASCE/SEI 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures* (ASCE/SEI, 2017). We used the *Structural Engineers Association of California* (SEAOC) and *Office of Statewide Health Planning and Development* (OSHPD) web application *Seismic Design Maps* (https://seismicmaps.org/) to evaluate site-specific seismic design parameters in accordance with ASCE 7-16.

For seismic design purposes, sites are classified as Site Class "A" through "F" as follows:

- Site Class A – Hard Rock;
- Site Class B – Rock;
- Site Class C – Very Dense Soil and Soft Rock;
- Site Class D – Stiff Soil;
- Site Class E – Soft Clay Soil; and
- Site Class F – Soils Requiring Site Response Analysis.

Based on the subsurface conditions at the site and measured penetration resistance in our borings, the Site Classification is Site Class "D – Stiff Soil" per Table 20.3-1 of ASCE/SEI 7-16. For the purposes of evaluating code-based seismic parameters for design, we assumed a seismic Risk Category I or II (per the CBC) for the project. Results are summarized in Table 6.2.1.

TABLE 6.2.1
ASCE 7-16 SEISMIC DESIGN PARAMETERS
SITE CLASS "D" – STIFF SOIL

Parameter	Value	ASCE 7-16 Reference
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	0.741g	Figure 22-1
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.288g	Figure 22-2
Site Coefficient, F_A	1.207	Table 11.4-1
Site Coefficient, F_V	2.025	Table 11.4-2
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	0.895g	Eq. 11.4-1
Site Class Modified MCE_R Spectral Response Acceleration (1 sec), S_{M1}	0.873*	Eq. 11.4-2
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.597g	Eq. 11.4-3
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.582g*	Eq. 11.4-4

* Per Supplement 3 of ASCE7-16 (effective November 5, 2021), a ground motion hazard analysis (GMHA) shall be performed for projects on Site Class "D" sites with 1-second spectral acceleration (S_1) greater than or equal to 0.2g, which is true for this site. However, Supplement 3 of ASCE 7-16 provides an exception stating that that the GMHA may be waived provided that the parameter S_{M1} is increased by 50% for all applications of S_{M1}. The values for parameters S_{M1} and S_{D1} presented above have been increased in accordance with Supplement 3 of ASCE 7-16.

6.2.2 Table 6.2.2 presents additional seismic design parameters for projects with Seismic Design Categories of D through F in accordance with ASCE 7-16 for the mapped maximum considered geometric mean (MCE_G).

TABLE 6.2.2
ASCE 7-16 SITE ACCELERATION DESIGN PARAMETERS

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.309g	Figure 22-7
Site Coefficient, F_{PGA}	1.291	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.399g	Section 11.8.3 (Eq. 11.8-1)

6.2.3 Conformance to the criteria presented in Tables 6.2.1 and 6.2.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur if a maximum level earthquake occurs. The primary goal of seismic design is to protect life and not to avoid structural damage, since such design may be economically prohibitive.

6.3 Soil Excavation Characteristics

6.3.1 In our opinion, grading and excavations at the site may be accomplished with standard to moderate effort using heavy-duty grading/excavation equipment. We do not anticipate project excavations to generate oversized rock material (greater than 6 inches in dimension) or boulders.

6.3.2 Temporary excavation slopes must meet Cal-OSHA requirements as appropriate. Excavation sloping, benching, the use of trench shields, and the placement of trench spoils should conform to the latest applicable Cal-OSHA standards. The contractor should have a Cal-OSHA-approved “competent person” onsite during excavation to evaluate trench conditions and to make appropriate recommendations where necessary. It is the contractor’s responsibility to provide sufficient and safe excavation support as well as protecting nearby utilities, structures, and other improvements which may be damaged by earth movements.

6.3.3 The excavation support recommendations provided by Cal-OSHA are generally geared towards protecting human life and not necessarily towards preventing damage to nearby structures or surface improvements. The contractor should be responsible for using the proper active shoring systems or sloping to prevent damage to any structure or improvements near underground excavations.

6.3.4 Permanent cut and fill slopes should be constructed no steeper than 2H:1V (horizontal to vertical). To mitigate potential erosion, slopes should be vegetated as soon as possible and surface drainage should be directed away from the tops of slopes.

6.3.5 If grading occurs during or after the wet season (typically winter and spring), or in periods of precipitation, in-place and excavated soils will likely be wet. Earthwork contractors should be aware of moisture sensitivity of the near-surface granular soils and potential compaction/workability difficulties.

6.3.6 Earthwork and pad preparation operations in these conditions will likely be difficult with low productivity. Often, a period of at least one month of warm and dry weather is necessary to allow the site to dry sufficiently so that heavy grading equipment can operate effectively.

6.4 Materials for Fill

6.4.1 Excavated soils generated from cut operations at the site are suitable for use as fill in structural areas provided they do not contain deleterious matter, organic material, or cementations larger than 6 inches in maximum dimension.

6.4.2 Import and low-expansive import fill material should be primarily granular with a "very low" expansion potential (Expansion Index less than 20), a Plasticity Index less than 15, be free of organic material and construction debris, and not contain rock/cementations larger than 6 inches in greatest dimension. Low-expansive fill (LEF) may also consist of lime-treated native soils. If lime-treatment is selected, additional laboratory testing will be required to determine the percentage of lime required to meet the intent of our low-expansive fill recommendations. For planning purposes, typical lime application rates for soil stabilization range from 3 to 5 percent.

6.4.3 Environmental characteristics and corrosion potential of import soil materials should also be considered. Proposed import materials should be sampled, tested, and approved by Geocon prior to its transportation to the site.

6.5 Grading

6.5.1 All earthwork operations should be observed and all fills tested for recommended compaction and moisture content by a representative of Geocon.

6.5.2 References to relative compaction and optimum moisture content in this report are based on the latest American Society for Testing and Materials (ASTM) D1557 Test Procedure. Structural areas should be considered the areas extending a minimum of 5 feet beyond the outside dimensions of structures, including footings or overhangs carrying structural loads.

6.5.3 Prior to commencing grading, a pre-construction conference with representatives of the client, grading contractor and Geocon should be held at the site. Site preparation, soil handling and/or the grading plans should be discussed at the pre-construction conference.

6.5.4 Site preparation should begin with removal of complete removal of existing paved areas and underground utilities within new improvement areas, organic-rich topsoil, and debris, if applicable. Excavations or depressions resulting from site clearing operations, or other existing excavations or depressions, should be restored with engineered fill in accordance with the recommendations of this report.

6.5.5 At the time of our investigation, site vegetation primarily consisted of a light growth of annual grasses. Existing trees and associated root systems within proposed development areas should be removed. Surface vegetation consisting of grasses and other similar vegetation should be removed by stripping to a sufficient depth to remove organic-rich topsoil. We estimate required stripping depths will range from approximately 2 to 3 inches. The actual stripping depth should be determined based on site conditions prior to grading. Material generated during stripping is not suitable for use within 5 feet of building pads or within pavement areas but may be placed in landscaped or non-structural areas or exported from the site.

6.5.6 The most effective site preparation alternatives will depend on site conditions prior to grading. We should evaluate site conditions and provide supplemental recommendations immediately prior to grading, if necessary.

6.5.7 After site preparation, exposed soil should be scarified 12 inches, uniformly moisture-conditioned at least 2% above optimum moisture content and compacted to at least 90% relative compaction. Scarification and recompaction operations should be performed in the presence of a Geocon representative to evaluate performance of the subgrade under compaction equipment loading and to identify any loose or unstable soil conditions that could require additional excavation.

6.5.8 Engineered fill consisting of onsite native sources and/or import fill material should be compacted in horizontal lifts not exceeding 8 inches (loose thickness) and brought to final design elevations. Each lift should be moisture-conditioned at least 2% above optimum moisture content and compacted to at least 90% relative compaction. The top 12 inches of building pads, whether completely at-grade, by excavation, or filling should be uniformly moisture-conditioned at or above optimum moisture content and compacted to at least 90% relative compaction.

6.5.9 Due to the expansive clay soils at the site, the upper 12 inches of building pads should consist of low-expansive fill (LEF) meeting the requirements of Section 6.4.3 of this report. The LEF should be moisture-conditioned at or above optimum moisture content and compacted to at least 90% relative compaction.

6.5.10 The top 6 inches of final vehicular pavement and concrete flatwork subgrade, whether completed at-grade, by excavation, or by filling, should be uniformly moisture-conditioned at least 2% above optimum moisture content, compacted to at least 95% relative compaction and be stable. The 95% relative compaction requirement applies to the top 6 inches of pavement area subgrade; however, underlying materials must be sufficiently compacted and stable. We recommend proof-rolling the subgrade with a loaded water truck (or similar equipment with high contact pressure) to verify the stability of the subgrade prior to placing aggregate base (AB). We note that deeper scarification, moisture-conditioning, and compaction efforts may be required in order to achieve overall stability and compaction.

6.5.11 Underground utility trenches should be backfilled with properly compacted material. Pipe bedding, shading, and backfill should conform to the requirements of the appropriate utility authority. Soil excavated from trenches should be adequate for use as general backfill above shading provided it does not contain deleterious matter, vegetation, or cementations larger than 6 inches in maximum dimension. We note that site soils will likely require additional effort to suitably moisture condition and compact. Trench backfill should be placed in loose lifts not exceeding 8 inches. Lifts should be compacted to a minimum of 90% relative compaction at or near optimum moisture content. Compaction should be performed by mechanical means only; jetting of trench backfill is not recommended.

6.6 Foundations – Restroom and Storage Building

6.6.1 Provided the site is graded in accordance with the recommendations of this report, the proposed restroom and storage building may be supported on conventional shallow foundations bearing on undisturbed, natural soil or engineered fill. The top 12 inches of the building pads should be comprised of LEF meeting the requirements of Paragraph 6.4.2 of this report.

6.6.2 To reduce potential for seasonal moisture variations beneath the building, foundations should consist of continuous perimeter footings with isolated interior spread footings. Perimeter footings should be continuous around the entire perimeter of the structure without breaks or discontinuities. Continuous footings should be at least 12 inches wide and spread footings should be at least 18 inches square. All footings should be embedded at least 18 inches below lowest adjacent pad grade.

6.6.3 Underground utilities running parallel to footings should not be constructed in the zone of influence of footings. The zone of influence may be taken to be the area within 18 inches laterally of the footing, beneath the footings, and within a 1:1 plane extending out and down from the bottom of the footing.

6.6.4 Foundations proportioned as recommended above and bearing within native alluvial or engineered fill may be designed for an allowable soil bearing capacity of 3,000 pounds per square foot (psf) for combined dead plus live loads. This value may be increased by one-third to evaluate all loads, including wind or seismic forces.

6.6.5 Foundations designed in accordance with the recommendations above should experience total settlements of less than 1 inch and differential settlements of approximately ½ inch over the length of the building . The majority of the settlement will be immediate and will occur as the loads are applied during construction.

6.6.6 Allowable passive pressure used to resist lateral movement of footings may be assumed to be equal to a fluid weighing 300 pounds per cubic foot (pcf). The allowable coefficient of friction to resist sliding of footings is 0.30 for concrete against soil. Combined passive resistance and friction may be utilized for footing design provided that the frictional resistance is reduced by 50%.

6.6.7 Continuous footings should be reinforced with at least two No. 4 reinforcement bars, one each placed near the top and bottom of the footing to allow footings to span isolated soil irregularities. The reinforcement recommended above is for soil characteristics only and is not intended to replace reinforcement required for structural considerations. The project structural engineer should evaluate the need for additional reinforcement.

6.6.8 A Geocon representative should observe foundation excavations prior to placing reinforcing steel or concrete to observe that the exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.

6.7 Interior Slabs-on-Grade

6.7.1 Conventional interior concrete slabs-on-grade are suitable for the proposed building provided the upper 12 inches of the building pad consists of LEF meeting the requirements of Section 6.4.2 of this report. This recommendation is based on the assumption that slabs will be at least 4 inches thick, and be supported on a minimum 4-inch-thick rock section. *The 4-inch-thick rock section is in addition to the 12 inches of LEF*. If a thinner or thicker slab or rock section is planned, we should be consulted to provide revised recommendations.

6.7.2 Slab thickness and reinforcement should be determined by the structural engineer based on anticipated loading. However, at a minimum, building slabs should be at least 4 inches thick and reinforced with No. 3 reinforcing bars placed 18 inches on center, each way. Structural requirements may require additional reinforcement or thicker concrete slabs.

6.7.3 If the near-surface soils of building pads become dry prior to constructing concrete slabs-on-grade, building pads should be re-moistened by soaking or sprinkling such that the upper 12 inches of soil is at or above optimum moisture content at least 48 hours before concrete placement. Our representative should verify moisture conditions prior to slab-on-grade construction.

6.8 Slab-on-Grade Moisture Protection Considerations

6.8.1 Migration of moisture through concrete slabs or moisture otherwise released from slabs is not a geotechnical issue. However, for the convenience of the owner and design team, we are providing the following general suggestions for consideration by the owner, architect, structural engineer, and contractor. The suggested procedures may reduce the potential for moisture-related floor covering failures on concrete slabs-on-grade, but moisture problems may still occur even if the procedures are followed. If more detailed recommendations are desired, we recommend consulting a specialist in this field.

6.8.2 A minimum 10-mil-thick vapor retarder meeting ASTM E1745 Class C requirements may be placed directly below the slab provided the water-cement ratio of the concrete is 0.45 or less. To reduce the potential for punctures, a higher quality vapor barrier (15 mil, Class A or B) may be used. The vapor retarder, if used, should extend to the edges of the slab, and should be sealed at all seams and penetrations.

6.8.3 A layer of clean ½- or ¾- inch crushed rock, with no more than 5 percent passing the No. 200 sieve, may be placed below the vapor barrier to serve as a capillary break.

6.8.4 The concrete water/cement ratio should be as low as possible. The water/cement ratio should not exceed 0.45 for concrete placed directly on the vapor retarder. This is critically important to reduce the potential for differential curing and subsequent excessive shrinkage cracking. Midrange plasticizers could be used to facilitate concrete placement and workability.

6.8.5 Proper finishing, curing, and moisture vapor emission testing should be performed in accordance with the latest guidelines provided by the American Concrete Institute, Portland Cement Association, and ASTM.

6.9 Foundations – Shade Structures

6.9.1 Proposed shade structure foundations may consist of CIDH concrete friction piers. CIDH piers should have a minimum diameter of 12 inches, a minimum embedment depth of 6 feet, and be designed using an allowable unit skin friction of 500 pounds per square foot (psf) to resist vertical downward loads. An allowable unit skin friction of 350 psf plus the weight of the pier may be used to resist uplift loads. Due to the presence of higher plasticity at the proposed canopy locations, skin friction in the upper 12 inches of the pier should be neglected in determining the downward and upward pier capacities. The allowable downward capacity and allowable uplift capacity may be increased by one-third when considering transient wind or seismic loads. Piers should have a minimum center-to-center spacing of at least three pier diameters.

6.9.2 Allowable passive pressure used to resist lateral movement of the piers may be assumed to be equal to a fluid weighing 300 pounds per cubic foot (pcf) with a maximum earth pressure of 3,000 psf. The allowable passive pressure may be applied over two pier diameters for isolated piers with a minimum center-to-center spacing of at least three pier diameters. The allowable passive pressure assumes a horizontal surface extending at least 5 feet or three times the surface generating the passive pressure, whichever is greater. The top 12 inches feet should not be included in the design for lateral resistance.

6.9.3 The bottom of pier excavations should be cleaned of loose cuttings prior to the placement of steel and concrete. Experience indicates that backspinning the auger does not remove loose material, and a flat cleanout plate is necessary. Concrete should be placed within the excavation as soon as possible after the auger/cleanout plate is withdrawn to reduce the potential for caving.

6.9.4 Suction effects created during auger withdrawal from the piers (during construction) can induce caving in granular soils. The contractor should be aware and prepared to mitigate for these potential caving conditions during construction.

6.9.5 If seepage or groundwater is encountered, water should be pumped from the pier excavation prior to placement of concrete.

6.9.6 A Geocon representative should be present during pier drilling to confirm that subsurface conditions encountered are consistent with those expected. If unexpected conditions are encountered, foundation modifications may be required.

6.10 Concrete Sidewalks and Flatwork

6.10.1 Sidewalk, curb, and gutter within City right-of-way should be designed and constructed in accordance with the latest City of Stockton standards and details as applicable.

6.10.2 Due to the presence of expansive near-surface soils, onsite exterior flatwork will likely experience seasonal movement. Therefore, some cracking and/or vertical offset should be anticipated. We are providing the following recommendations to reduce distress to concrete flatwork. Recommendations include moisture conditioning subgrade soils, using low-expansive fill underlayment, providing thickened edges or deepened cut-off curbs (turned-down edges) adjacent to landscaped areas, and providing adequate construction and control joints. It should be noted that even with implementation of these measures, minor slab movement or cracking could still occur.

- Concrete flatwork, excluding concrete pavements subject to wheel loads, should be at least 4 inches thick and underlain by at least 6 inches of low-expansive fill (LEF). LEF may consist of Class 2 AB or soil meeting the requirements of Section 6.4.2 of this report. LEF should be compacted in accordance with the recommendations of this report. In addition, doweling could be provided at joints to reduce the potential for vertical offset.
- Concrete flatwork should include thickened edges, at least 12 inches wide, or similar moisture cut-off provisions that extend the full depth of the LEF or AB underlayment.
- The upper 12 inches of subgrade soil in exterior flatwork areas should be uniformly moisture-conditioned at least 2% above optimum moisture content and compacted to at least 90% relative compaction prior to placing LEF.
- Crack control and construction joints should be provided in accordance with ACI and/or PCA guidelines. Construction joints that abut building foundations should include a felt strip, or approved equivalent, that extends the full depth of the exterior slab. Exterior slabs should be structurally independent of building foundations except at doorways where doweling should be provided to reduce vertical offset.

6.11 Hot Mix Asphalt Pavement

6.11.1 We performed Resistance-Value (R-Value) testing on a representative bulk soil sample from the proposed pavement areas. Our testing resulted in an R-Value less than 5 (Appendix B). Table 6.11.1 provides alternative pavement sections based on the design methods of Caltrans' *Highway Design Manual* using a design subgrade R-value of 5.

TABLE 6.11.1
FLEXIBLE PAVEMENT SECTIONS

	Sports Courts Traffic Index = 4.5	Parking Areas Traffic Index = 5.0	Driveways, Light Truck Traffic, Fire Truck Areas Traffic Index = 6.0
HMA, inches	2.5	3.0	3.5
AB, inches	8.5	10.0	12.5
Total Section, inches	11.0	13.0	16.0

6.11.2 The recommended pavement section is based on the following assumptions:

1. Pavement subgrade soil has an R-Value of at least 5.
2. Class 2 AB has a minimum R-Value of 78 and meets the requirements of Section 26 of Caltrans' *Standard Specifications*.
3. Class 2 AB and the top 6 inches of subgrade are compacted to 95% or higher relative compaction at or near optimum moisture content.
4. Pavement subgrade should be compacted in accordance with the recommendations presented in this report.
5. HMA should conform to Section 39 of Caltrans' latest *Standard Specifications*.
6. Periodic maintenance of HMA pavements is performed.

6.11.3 To reduce the potential for water from landscaped areas migrating under pavement into the AB, consideration should be given to using full-depth curbs in areas where pavement abuts irrigated landscaping. The full-depth curbs should extend at least 6 inches or more into the soil subgrade beneath the AB. Alternatively, modified drop-inlets that contain weep-holes may be used to encourage accumulated water to drain from beneath the pavement.

6.11.4 Asphalt pavement section recommendations for driveways and parking areas are based on the design procedures of Caltrans' *Highway Design Manual* (Design Manual), Chapter 600. It should be noted that most rational pavement design procedures are based on projected street or highway traffic conditions and, hence, may not be representative of vehicular loading that occurs in parking lots and driveways. Pavement proximity to landscape irrigation, reduced traffic speed and short turning radii increase the potential for pavement distress to occur in parking lots even though the volume of traffic is significantly less than that of an adjacent street. The Design Manual indicates that the resulting pavement sections for parking lots are "minimized to keep initial costs down but are reasonable because additional AC surfacing can be added later, if needed, and generally without incurring traffic hazards or traffic handling problems." It is generally not economically feasible to design and construct the entire parking lot and driveways for the unique loading conditions previously described. Periodic maintenance of the pavement in these areas, therefore, should be anticipated.

6.12 Rigid Concrete Pavement

6.12.1 If rigid PCC pavement is used in automobile/light-truck traffic areas and in front of trash bin areas, we recommend that the concrete be at least 6 inches thick. PCC pavement should be underlain by at least 6 inches of Class 2 AB meeting the requirements of Section 26 of Caltrans' *Standard Specifications* and compacted to at least 95% relative compaction. Subgrade soils should be prepared and compacted in accordance with the recommendations of this report.

6.12.2 Subgrade soils should be prepared and compacted in accordance with the recommendations of this report. Subgrade should be finished to a smooth, unyielding surface and proof-rolled with a loaded water truck to verify stability.

6.12.3 PCC should have a minimum 28-day compressive strength of 3,500 pounds per square inch (psi). Adequate construction and crack control joints should be used to control cracking inherent in concrete construction. We note that the American Concrete Pavement Association (ACPA) recommends a maximum joint spacing no greater than 24X the slab thickness for PCC pavements directly underlain by granular bases.

6.12.4 Steel reinforcement, if used, should be detailed in accordance with PCA, ACI, or similar guidelines. Alternatively, macro synthetic fibers (Euclid Chemical Tuf-Strand SF or equivalent) mixed into the concrete mix may be considered in lieu of conventional steel reinforcement provided they meet the requirements of ASTM C1116 and ASTM D7508 for Type III Synthetic Fibers.

6.12.5 Adequate dowels should also be used at joints to facilitate load transfer and reduce vertical offset. In addition, the recommendations in Section 6.11.4 pertaining to deepened curbs, moisture cut-offs, and subsurface drainage apply to concrete pavements, sidewalks and flatwork, as well as asphalt pavements.

6.12.6 In general, we recommend that concrete pavements be detailed, designed, constructed, and maintained in accordance with industry standards such as those provided by the ACI and ACPA.

6.13 Site Drainage and Moisture Protection

6.13.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to building foundations. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with the 2019 CBC or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices.

6.13.2 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

6.13.3 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. We recommend use of area drains to collect excess irrigation water and transmit it to drainage structures or impervious above-grade planter boxes. In addition, where landscaping is planned adjacent to the pavement or flatwork, we recommend construction of a cutoff wall (deepened curb) along the edge of the pavement/flatwork that extends at least 4 inches into the soil subgrade below the bottom of the base material.

6.13.4 The soil conditions at the site (low-permeability clays) are not conducive to water infiltration devices such as vegetated swales. However, Low Impact Development (LID) devices can be installed to reduce velocity and the amount of water entering the storm drain system. The LID devices should be properly constructed to prevent water infiltration into the surrounding soil. If water infiltrates the expansive soils, distress may be caused to adjacent pavements, flatwork, or structures. Vegetated swales and basin areas (if used) should be lined with an impermeable liner (e.g. high-density polyethylene, HDPE, with a thickness of about 12 mil or equivalent polyvinyl chloride liner) to reduce infiltration.

6.13.5 We recommend that roof drains be connected to water-tight subdrains that direct the water to the storm drain system. However, we understand that LID and Leadership in Engineering and Environmental Design (LEED) requests disconnecting the roof drains to help obtain certification. The water from the roof drains should be directed away from buildings. Consideration should be given to draining roofs to lined planter boxes or placing liners below the proposed landscape areas to prevent infiltration of the water. Geocon can be contacted for additional recommendations.

6.13.6 We recommend implementing measures to reduce infiltrating irrigation water near buildings, flatwork, or pavements. Such measures may include:

- Selecting drought-tolerant plants that require little or no irrigation, especially within 3 feet of buildings, slabs-on-grade, or pavements.
- Using drip irrigation or low-output sprinklers.
- Using automatic timers for irrigation systems.
- Using appropriately spaced area drains.

The project landscape architect should consider incorporating these measures into the landscaping plans.

6.13.7 Experience has shown that even with these provisions, subsurface seepage may develop in areas where no such water conditions existed prior to site development. This is particularly true where a substantial increase in surface water infiltration has resulted from an increase in landscape irrigation.

7.0 FURTHER GEOTECHNICAL SERVICES

7.1 Plan and Specification Review

7.1.1 We should review the foundation and grading plans prior to final design submittal to assess whether our recommendations have been properly incorporated and evaluate if additional analysis and/or recommendations are required.

7.2 Testing and Observation Services

7.2.1 The recommendations provided in this report are based on the assumption that we will continue as Geotechnical Engineer of Record throughout the construction phase and provide construction observation and testing services. Providing these services during construction are important in order to maintain continuity of geotechnical interpretation and confirm that field conditions encountered during construction are similar to those anticipated during design. Testing and observation services by the Geotechnical Engineer of Record are necessary to verify that construction has been performed in accordance with this report, approved plans, and specifications. If we are not retained for these services, we cannot assume any responsibility for other's interpretation of our recommendations or the future performance of the project.

8.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, we should be notified so that supplemental recommendations can be given.

This report is issued with the understanding that it is the responsibility of the owner or their representative to ensure that the information and recommendations contained herein are brought to the attention of the design team for the project and incorporated into the plans and specifications and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

The recommendations contained in this report are preliminary until verified during construction by representatives of our firm. Changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. Additionally, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated partially or wholly by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

Our professional services were performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices used in the site area at this time. No warranty is provided, express or implied.

9.0 REFERENCES

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11. Structural Engineers Association of California (SEAOC) and Office of Statewide Health Planning and Development (OSHPD), Seismic Design Maps, https://seismicmaps.org/, accessed July 24, 2023.
12. United States Geological Survey (USGS), Unified Hazard Tool https://earthquake.usgs.gov/hazards/interactive/.
13. USGS and California Geological Survey, Quaternary fault and fold database for the United States, accessed July 24, 2023, at: https://www.usgs.gov/natural-hazards/earthquake-hazards/faults.
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GEOCON 8/3/2023 USER Brown M PATH C:\Users\Brown M\OneDrive - Geocon, Inc\GIS_Graphics\Projects\S2579-05-01_Columbus_Park_Gh\01_ReportMaps\Figure_1_Vicinity_Map.mxd

N

0 0.5

Scale in Miles

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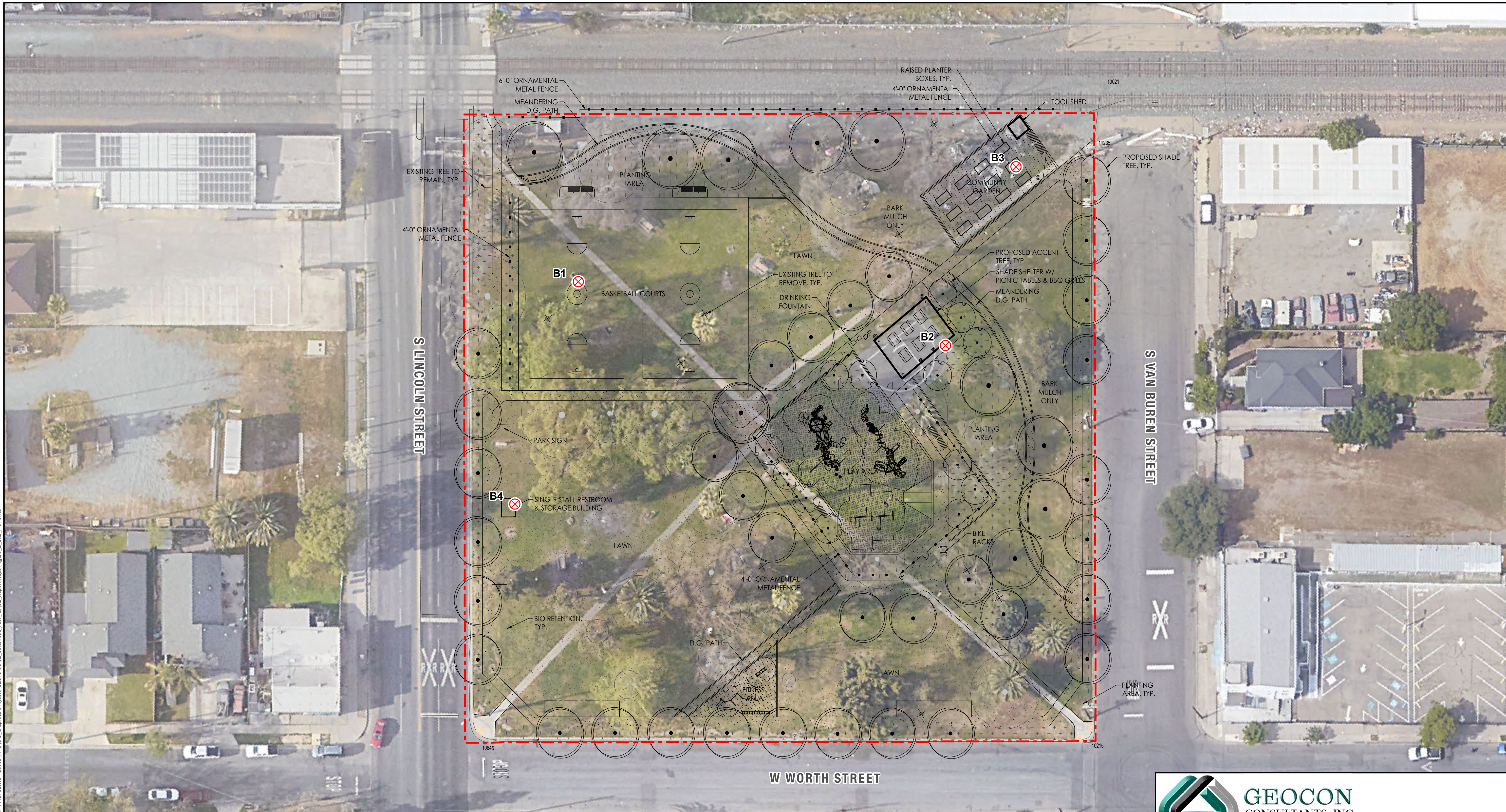
Columbus Park Renovation

401 W Worth Street
Stockton, California

VICINITY MAP

S2579-05-01	August 2023	Figure 1



Proposed Devleopment Plan: Callander Associates (5/26/2023)

Legend

B4 ⊗ Approximate Boring Location

[- -] Approximate Site Boundary

0 50

Scale in Feet

N

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SITE PLAN

S2579-05-01	August 2023	Figure 2

APPENDIX A

APPENDIX A

FIELD EXPLORATION

We performed our geotechnical field exploration on June 26, 2023. Our field exploration program consisted of drilling four (4) exploratory borings (B1 through B4) at the approximate locations depicted on the Site Plan, Figure 2.

Borings were performed using a truck-mounted CME 55 drill rig equipped with 6-inch diameter solid-flight augers. Soil sampling was performed using an automatic 140-pound hammer with a 30-inch drop. We obtained samples using a 3-inch OD split-spoon (California Modified) sampler and a 2 ½ inch OD Standard Penetration Test (SPT) sampler. We recorded the number of blows required to drive the sampler the last 12 inches (or portion thereof) of the 18-inch sampling interval on the boring logs. Upon completion, the borings were backfilled with neat cement grout.

We visually examined, classified, and logged the subsurface conditions in the exploratory borings in general accordance with the American Society for Testing and Materials (ASTM) Practice for Description and Identification of Soils (Visual-Manual Procedure D2488-90). This system uses the Unified Soil Classification System (USCS) for soil designations. The logs depict soil and geologic conditions encountered and depths at which we obtained samples. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, drill rig penetration rates, excavation characteristics, and other factors. The transition between materials may be abrupt or gradual. Where applicable, we revised the field logs based on subsequent laboratory testing. Logs of exploratory borings are presented herein.

UNIFIED SOIL CLASSIFICATION

MAJOR DIVISIONS				TYPICAL NAMES
COARSE-GRAINED SOILS (MORE THAN HALF IS COARSER THAN NO. 200 SIEVE)	**GRAVELS** MORE THAN HALF COARSE FRACTION IS LARGER THAN NO.4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, SILTY GRAVELS WITH SAND
			GC	CLAYEY GRAVELS, CLAYEY GRAVELS WITH SAND
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO.4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS WITH OR WITHOUT GRAVEL
			SC	CLAYEY SANDS WITH OR WITHOUT GRAVEL
FINE-GRAINED SOILS (MORE THAN HALF IS FINER THAN NO. 200 SIEVE)	**SILTS AND CLAYS** LIQUID LIMIT 50% OR LESS		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTS WITH SANDS AND GRAVELS
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, CLAYS WITH SANDS AND GRAVELS, LEAN CLAYS
			OL	ORGANIC SILTS OR CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OR CLAYS OF MEDIUM TO HIGH PLASTICITY
	HIGHLY ORGANIC SOILS		PT	PEAT AND OTHER HIGHLY ORGANIC SOILS

BORING/TRENCH LOG LEGEND

- No Recovery
- Shelby Tube Sample
- Bulk Sample
- SPT Sample
- Modified California Sample
- Groundwater Level (At Completion)
- Groundwater Level (Seepage)

PENETRATION RESISTANCE

SAND AND GRAVEL			SILT AND CLAY			
RELATIVE DENSITY	BLOWS PER FOOT (SPT)*	BLOWS PER FOOT (MOD-CAL)*	CONSISTENCY	BLOWS PER FOOT (SPT)*	BLOWS PER FOOT (MOD-CAL)*	COMPRESSIVE STRENGTH (tsf)
VERY LOOSE	0 - 4	0 - 6	VERY SOFT	0 - 2	0 - 3	0 - 0.25
LOOSE	5 - 10	7 - 16	SOFT	3 - 4	4 - 6	0.25 - 0.50
MEDIUM DENSE	11 - 30	17 - 48	MEDIUM STIFF	5 - 8	7 - 13	0.50 - 1.0
DENSE	31 - 50	49 - 79	STIFF	9 - 15	14 - 24	1.0 - 2.0
VERY DENSE	OVER 50	OVER 79	VERY STIFF	16 - 30	25 - 48	2.0 - 4.0
			HARD	OVER 30	OVER 48	OVER 4.0

*NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE LAST 12 INCHES OF AN 18-INCH DRIVE

MOISTURE DESCRIPTIONS

FIELD TEST	APPROX. DEGREE OF SATURATION, S (%)	DESCRIPTION
NO INDICATION OF MOISTURE; DRY TO THE TOUCH	S<25	DRY
SLIGHT INDICATION OF MOISTURE	25≤S<50	DAMP
INDICATION OF MOISTURE; NO VISIBLE WATER	50≤S<75	MOIST
MINOR VISIBLE FREE WATER	75≤S<100	WET
VISIBLE FREE WATER	100	SATURATED

QUANTITY DESCRIPTIONS

APPROX. ESTIMATED PERCENT	DESCRIPTION
<5%	TRACE
5 - 10%	FEW
11 - 25%	LITTLE
26 - 50%	SOME
>50%	MOSTLY

GRAVEL/COBBLE/BOULDER DESCRIPTIONS

CRITERIA	DESCRIPTION
PASS THROUGH A 3-INCH SIEVE AND BE RETAINED ON A NO. 4 SIEVE (#4 TO 3")	GRAVEL
PASS A 12-INCH SQUARE OPENING AND BE RETAINED ON A 3-INCH SIEVE (3"-12")	COBBLE
WILL NOT PASS A 12-INCH SQUARE OPENING (>12")	BOULDER

LABORATORY TEST KEY

- CP – COMPACTION CURVE (ASTM D1557)
- CR – CORROSION ANALYSIS (CTM 422, 643, 417)
- DS – DIRECT SHEAR (ASTM D3080)
- EI – EXPANSION INDEX (ASTM D4829)
- GSA – GRAIN SIZE ANALYSIS (ASTM D422)
- MC – MOISTURE CONTENT (ASTM D2216)
- PI – PLASTICITY INDEX (ASTM D4318)
- R – R-VALUE (CTM 301)
- SE – SAND EQUIVALENT (CTM 217)
- TXCU – CONSOLIDATED UNDRAINED TRIAXIAL (ASTM D4767)
- TXUU – UNCONSOLIDATED UNDRAINED TRIAXIAL (ASTM D2850)
- UC – UNCONFINED COMPRESSIVE STRENGTH (ASTM D2166)

BEDDING SPACING DESCRIPTIONS

THICKNESS/SPACING	DESCRIPTOR
GREATER THAN 10 FEET	MASSIVE
3 TO 10 FEET	VERY THICKLY BEDDED
1 TO 3 FEET	THICKLY BEDDED
3 5/8-INCH TO 1 FOOT	MODERATELY BEDDED
1 1/4-INCH TO 3 5/8-INCH	THINLY BEDDED
3/8-INCH TO 1 1/4-INCH	VERY THINLY BEDDED
LESS THAN 3/8-INCH	LAMINATED

STRUCTURE DESCRIPTIONS

CRITERIA	DESCRIPTION
ALTERNATING LAYERS OF VARYING MATERIAL OR COLOR WITH LAYERS AT LEAST 1/4-INCH THICK	STRATIFIED
ALTERNATING LAYERS OF VARYING MATERIAL OR COLOR WITH LAYERS LESS THAN 1/4-INCH THICK	LAMINATED
BREAKS ALONG DEFINITE PLANES OF FRACTURE WITH LITTLE RESISTANCE TO FRACTURING	FISSURED
FRACTURE PLANES APPEAR POLISHED OR GLOSSY, SOMETIMES STRIATED	SLICKENSIDED
COHESIVE SOIL THAT CAN BE BROKEN DOWN INTO SMALLER ANGULAR LUMPS WHICH RESIST FURTHER BREAKDOWN	BLOCKY
INCLUSION OF SMALL POCKETS OF DIFFERENT SOIL, SUCH AS SMALL LENSES OF SAND SCATTERED THROUGH A MASS OF CLAY	LENSED
SAME COLOR AND MATERIAL THROUGHOUT	HOMOGENOUS

CEMENTATION/INDURATION DESCRIPTIONS

FIELD TEST	DESCRIPTION
CRUMBLES OR BREAKS WITH HANDLING OR LITTLE FINGER PRESSURE	WEAKLY CEMENTED/INDURATED
CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE	MODERATELY CEMENTED/INDURATED
WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE	STRONGLY CEMENTED/INDURATED

IGNEOUS/METAMORPHIC ROCK STRENGTH DESCRIPTIONS

FIELD TEST	DESCRIPTION
MATERIAL CRUMBLES WITH BARE HAND	WEAK
MATERIAL CRUMBLES UNDER BLOWS FROM GEOLOGY HAMMER	MODERATELY WEAK
1/8-INCH INDENTATIONS WITH SHARP END FROM GEOLOGY HAMMER	MODERATELY STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **ONE** BLOW FROM GEOLOGY HAMMER	STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **COUPLE** BLOWS FROM GEOLOGY HAMMER	VERY STRONG
HAND-HELD SPECIMEN CAN BE BROKEN WITH **MANY** BLOWS FROM GEOLOGY HAMMER	EXTREMELY STRONG

IGNEOUS/METAMORPHIC ROCK WEATHERING DESCRIPTIONS

DEGREE OF DECOMPOSITION	FIELD RECOGNITION	ENGINEERING PROPERTIES
SOIL	DISCOLORED, CHANGED TO SOIL, FABRIC DESTROYED	EASY TO DIG
COMPLETELY WEATHERED	DISCOLORED, CHANGED TO SOIL, FABRIC MAINLY PRESERVED	EXCAVATED BY HAND OR RIPPING (Saprolite)
HIGHLY WEATHERED	DISCOLORED, HIGHLY FRACTURED, FABRIC ALTERED AROUND FRACTURES	EXCAVATED BY HAND OR RIPPING, WITH SLIGHT DIFFICULTY
MODERATELY WEATHERED	DISCOLORED, FRACTURES, INTACT ROCK-NOTICEABLY WEAKER THAN FRESH ROCK	EXCAVATED WITH DIFFICULTY WITHOUT EXPLOSIVES
SLIGHTLY WEATHERED	MAY BE DISCOLORED, SOME FRACTURES, INTACT ROCK-NOT NOTICEABLY WEAKER THAN FRESH ROCK	REQUIRES EXPLOSIVES FOR EXCAVATION, WITH PERMEABLE JOINTS AND FRACTURES
FRESH	NO DISCOLORATION, OR LOSS OF STRENGTH	REQUIRES EXPLOSIVES

IGNEOUS/METAMORPHIC ROCK JOINT/FRACTURE DESCRIPTIONS

FIELD TEST	DESCRIPTION
NO OBSERVED FRACTURES	UNFRACTURED/UNJOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 1 TO 3 FOOT INTERVALS	SLIGHTLY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 4-INCH TO 1 FOOT INTERVALS	MODERATELY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT 1-INCH TO 4-INCH INTERVALS WITH SCATTERED FRAGMENTED INTERVALS	INTENSELY FRACTURED/JOINTED
MAJORITY OF JOINTS/FRACTURES SPACED AT LESS THAN 1-INCH INTERVALS; MOSTLY RECOVERED AS CHIPS AND FRAGMENTS	VERY INTENSELY FRACTURED/JOINTED

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KEY TO LOGS

Figure A1

PROJECT NO. **S2579-05-01** PROJECT NAME **Columbus Park Renovation**

BORING B1

ELEV. (MSL.) ____________ DATE COMPLETED **6/26/2023**

ENG./GEO. **H. Losberger** DRILLER **Taber Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 6" SSA** HAMMER TYPE **Automatic**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
0	B1-Bulk			CL	**ALLUVIUM** Stiff, moist, dark brown Lean CLAY, trace rootlets				R, CP
1									
2	B1-1.5 B1-2.0					17	100.7	20.7	
3					- hard, light yellowish brown with black speckling, trace sand and weak cementations				
4	B1-4.0 B1-4.5				- PP>4.5 tsf	46	95.1	22.8	
5					BORING TERMINATED AT 5 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED WITH NEAT CEMENT GROUT				

Figure A2, Log of Boring, page 1 of 1

IN PROGRESS S2579-05-01 COLUMBUS PARK.GPJ 07/27/23

GEOCON

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

PROJECT NO. **S2579-05-01** PROJECT NAME **Columbus Park Renovation**

BORING B2

ELEV. (MSL.) ___________ DATE COMPLETED 6/26/2023

ENG./GEO. H. Losberger DRILLER Taber Drilling

EQUIPMENT Truck Mounted CME 55 w/ 6" SSA HAMMER TYPE Automatic

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
0					**CONCRETE** 4 inches				
					AGGREGATE BASE (AB) 8 inches				
1	B2-Bulk			CL	**ALLUVIUM**				PI, EI, #200 wash
	B2-1.5				Very stiff, moist, dark brown, Lean CLAY with sand, trace roots				
2	B2-2.0				PP=3.25 tsf	15	101.8	17.8	
3					- dark yellowish brown, trace weak cementations and rootlet voids				
	B2-3.5								
4	B2-4.0					26	103.6	18.0	
5					- trace weak cementation and rootlets				
	B2-5.5								
6	B2-6.0					30			
7									
8	B2-8.0			CL	Hard, yellowish brown with black mottling, Lean CLAY, few sand, PP>4.5 tsf				#200 wash
	B2-8.5					50			
9									
10					- very stiff, trace rootlets				
	B2-10.5								
11	B2-11.0					25			
12									
13									
14									
15					- hard, with white mottling and weak cementations				
	B2-15.5								
16	B2-16.0					65			

BORING TERMINATED AT 16.5 FEET
GROUNDWATER NOT ENCOUNTERED
BACKFILLED WITH NEAT CEMENT GROUT

Figure A3, Log of Boring, page 1 of 1

IN PROGRESS S2579-05-01 COLUMBUS PARK.GPJ 07/27/23

GEOCON

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

PROJECT NO. **S2579-05-01** PROJECT NAME **Columbus Park Renovation**

BORING B3

ELEV. (MSL.) ___________ DATE COMPLETED **6/26/2023**

ENG./GEO. **H. Losberger** DRILLER **Taber Drilling**

EQUIPMENT **Truck Mounted CME 55 w/ 6" SSA** HAMMER TYPE **Automatic**

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
0	B3-Bulk			CL	**ALLUVIUM** Stiff, moist, dark brown Lean CLAY, with rootlets				CP, PI, #200 wash
1									
2	B3-1.5 B3-2.0					17	103.9	16.2	
3					- very stiff, yellowish brown with black speckling, trace sand and weak cementations				
4	B3-4.0 B3-4.5					37	96.7	17.9	
5					BORING TERMINATED AT 5 FEET GROUNDWATER NOT ENCOUNTERED BACKFILLED WITH NEAT CEMENT GROUT				

Figure A4, Log of Boring, page 1 of 1

IN PROGRESS S2579-05-01 COLUMBUS PARK.GPJ 07/27/23

GEOCON

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. **S2579-05-01** PROJECT NAME **Columbus Park Renovation**

BORING B4

ELEV. (MSL.) ___________ DATE COMPLETED 6/26/2023

ENG./GEO. H. Losberger DRILLER Taber Drilling

EQUIPMENT Truck Mounted CME 55 w/ 6" SSA HAMMER TYPE Automatic

DEPTH IN FEET	SAMPLE INTERVAL & RECOVERY	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)	ADDITIONAL TESTS
0	B4-Bulk			CL	**ALLUVIUM** Stiff, moist, dark brown, Lean CLAY, trace roots				PI, #200 wash
1	B4-1.0 B4-1.5						102.7	14.4	
2	B4-2.0					19			
3					- hard, light yellowish brown, trace sand, trace rootlets and weak cementation				
4	B4-3.5 B4-4.0					57	100.3	17.9	
5					- very stiff, yellowish brown with black speckling, few sand - PP= 3.75 tsf				
6	B4-5.5 B4-6.0					29			#200 wash
7									
8	B4-8.0 B4-8.5								
9						25			
10					- trace to few sand				
11	B4-10.5 B4-11.0					25			
12									
13									
14									
15					- with white mottling - PP= 3.75 tsf				
16	B4-15.5 B4-16.0					24			

BORING TERMINATED AT 16.5 FEET
GROUNDWATER NOT ENCOUNTERED
BACKFILLED WITH NEAT CEMENT GROUT

Figure A5, Log of Boring, page 1 of 1

GEOCON

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

APPENDIX B

APPENDIX B

LABORATORY TESTING PROGRAM

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected soil samples were tested for their in-place dry density and moisture content, plasticity characteristics, fines content, corrosion potential, expansion potential, and R-Value. The results of the laboratory tests are presented on the following pages.

TABLE B1
EXPANSION INDEX TEST RESULTS
ASTM D4829

Sample Number	Depth (feet)	Moisture Content (%)		Expansion Index	Classification*
		Before Test	After Test		
B2-Bulk	1 – 5	12.5	26.3	60	Medium

**Expansion Potential Classification per ASTM D4829.*

TABLE B2
R-VALUE TEST RESULTS
ASTM D2844

Sample Number	Depth (feet)	Soil Classification	R-Value
B1-Bulk	0 – 5	Lean Clay (CL)	<5

Sample ID	Depth (feet)	Liquid Limit	Plastic Limit	Plasticity Index	Expansion Index	%<#200 Sieve	Water Content (%)	Dry Density (pcf)
B1-2	2						20.7	100.7
B1-4	4						22.8	95.1
B2-Bulk	1-5	47	17	30	60	83.8		
B2-2	2						17.8	101.8
B2-4	4						18.0	103.6
B2-8	8					90.3		
B3-1.5	1.5						16.2	103.9
B3-4.5	4.5						17.9	96.7
B4-Bulk	0-5	45	17	28		97.4		
B4-1	1						14.4	102.7
B4-3.5	3.5						17.9	100.3
B4-6	6					94.8		

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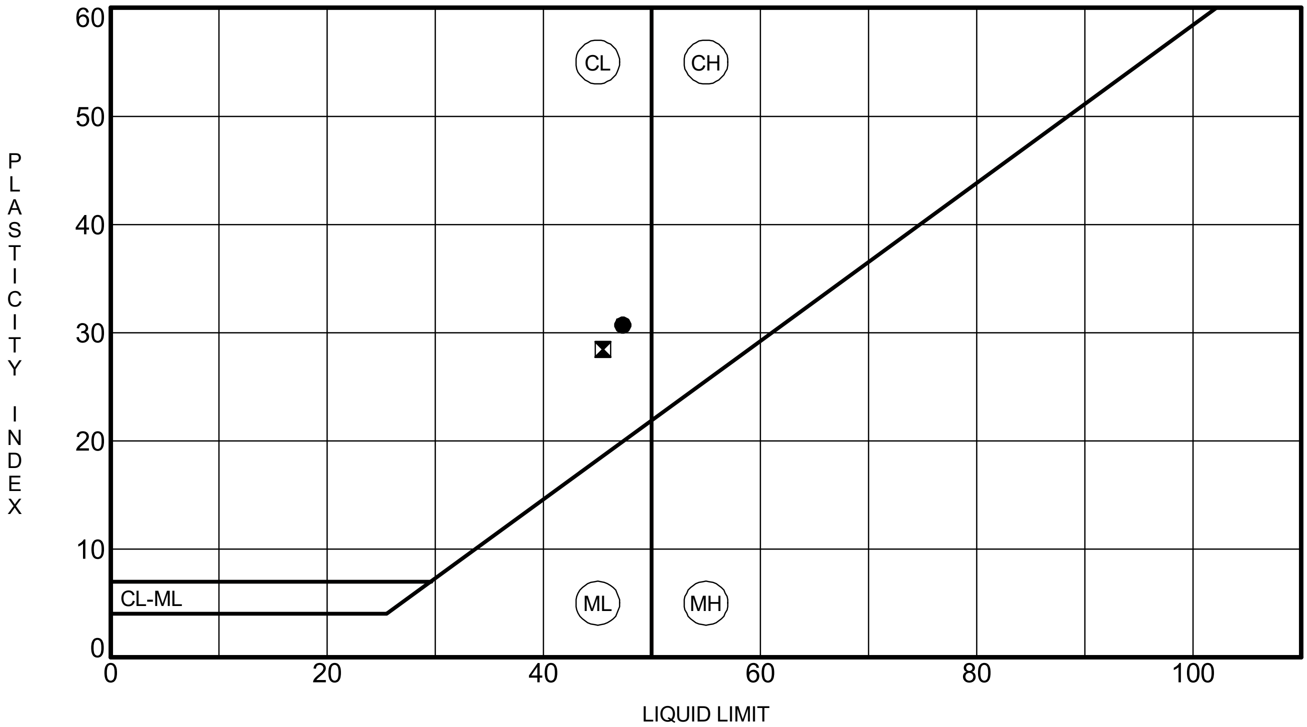
Summary of Laboratory Results

Project: Columbus Park Renovation
Location: Stockton, California
Number: S2579-05-01
Figure: B1



	Sample No.	Liquid Limit	Plastic Limit	Plasticity Index	% Pass #200 Sieve	Unified Soil Classification Description	Preparation Method
●	**B2-Bulk**	**47**	**17**	**30**	**83.8**	**LEAN CLAY with SAND(CL)**	**dry**
⧗	**B4-Bulk**	**45**	**17**	**28**	**97.4**	**LEAN CLAY(CL)**	**dry**

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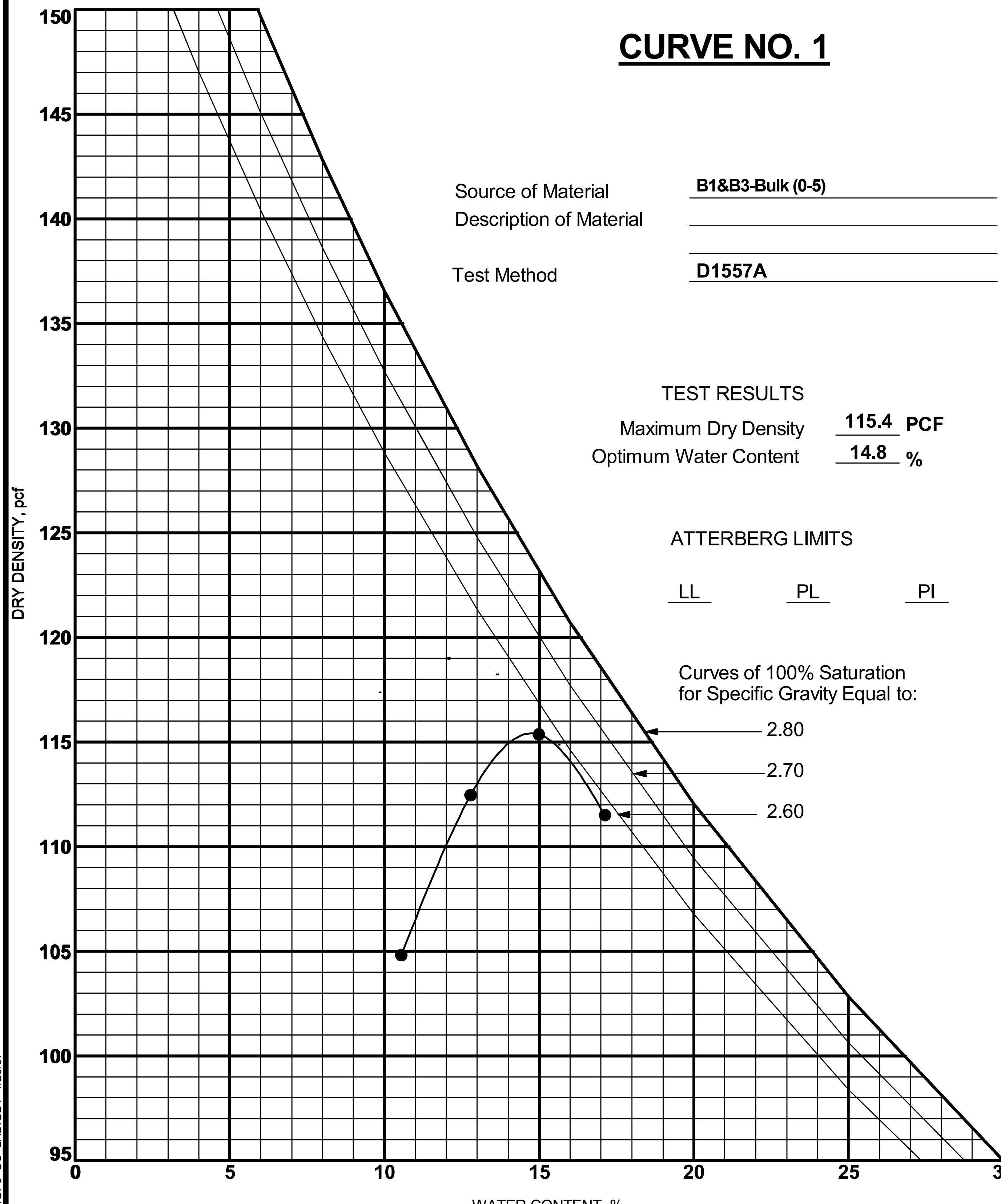
ATTERBERG LIMITS (ASTM D4318)

Project: Columbus Park Renovation
Location: Stockton, California
Number: S2579-05-01
Figure: B2 Date:

CURVE NO. 1



Source of Material: B1&B3-Bulk (0-5)

Description of Material:

Test Method: D1557A

TEST RESULTS

Maximum Dry Density 115.4 PCF

Optimum Water Content 14.8 %

ATTERBERG LIMITS

LL	PL	PI

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MOISTURE-DENSITY RELATIONSHIP

Project: Columbus Park Renovation

Location: Stockton, California

Number: S2579-05-01

Figure: B3