ANTIOCH
CALIFORNIA
OPPORTUNITY LIVES HERE

ADDENDUM NO. 2

TO
CONTRACT DOCUMENTS
FOR
CONTRA LOMA ESTATES PARK RENOVATION
in
ANTIOCH, CALIFORNIA
P.W. 298-P3

ISSUED
November 2, 2023

This Addendum No. 2 must be signed by the bidder and attached to the CONTRACT PROPOSAL PACKAGE for consideration by the City. The City reserves the right to disregard any proposal, which does not include this Addendum. The City may waive this requirement at its sole discretion.

SEE ATTACHED ADDENDUM ITEMS

Prepared By: ______________________
Scott Buenting, P.E.

REGISTERED PROFESSIONAL ENGINEER
SCOTT BUENTING
No. 67422
Exp: 12/31/24
CIVIL
STATE OF CALIFORNIA

BIDDER'S CERTIFICATION

I acknowledge receipt of this Addendum No. 2 and accept all conditions contained herein.

______________________ ______________________
Bidder **By:**

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to
CONTRACT DOCUMENTS
for
CONTRA LOMA ESTATES PARK RENOVATION
in
ANTIOCH, CALIFORNIA
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Issued November 2, 2023

1) Section A-4, "Time of Completion", is modified to state the following:

   The Contractor shall commence work within ten (10) calendar days after the effective date of the Notice to Proceed and shall diligently prosecute the same to completion before the expiration of two hundred ninety (290) working days.

2) Section 2, "Time of Completion", of the Agreement is modified to state the following:

   "After this Agreement has been executed by the parties, the CONTRACTOR shall begin work within ten (10) calendar days after the effective date of the Notice to Proceed, and shall diligently prosecute all of the work under this Agreement in all parts and requirements as defined in the Contract Documents, from the effective date of said Notice to Proceed. The period of performance shall be two hundred ninety (290) working days from the Notice to Proceed."

3) The City will not provide any surveying or construction staking services. All required grades and facilities shall be laid out by the Contractor and approved by the Engineer.

4) Section C-7, "Measurement and Payment", includes descriptions of requirements and procedures for determining amount of Work performed and for obtaining payment for Work performed.

5) The base course for Stabilized Decomposed Granite Paving shall consist of Class II Aggregate Base Rock in accordance with Section 32 16 00.01.

6) Attached is the BSK Associates geotechnical report dated July 8, 2021 related to this site.

GEOTECHNICAL INVESTIGATION REPORT
CONTRA LOMA ESTATES PARK RENOVATION
MAHOGANY WAY AND MANDARIN WAY
ANTIOCH, CALIFORNIA

BSK PROJECT NO.: G21-189-11L

PREPARED FOR:

CITY OF ANTIOCH
200 H STREET
ANTIOCH, CALIFORNIA 94509

July 8, 2021

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July 8, 2021 BSK Project No. G21-189-11L

Mr. Lief McKay, ASLA, LEED-AP
Principal
rrm design group
3765 S. Higuera, Suite 102
San Luis Obispo, CA 93401

SUBJECT: **Geotechnical Investigation Report**
Contra Loma Estates Park Renovation
Mahogany Way and Mandarin Way, Antioch, California

Dear Mr. McKay:

We are pleased to submit our geotechnical investigation report for the planned renovations at Contra Loma Estates Park in Antioch, California. A Vicinity Map showing the location of the project is presented on Figure 1. This report contains a description of our site investigation methods and findings, including limited field and laboratory data. The purpose of this investigation was to obtain and classify near surface soil samples in order to provide geotechnical recommendations for the planned renovations. The scope of services, as outlined in our proposal (BSK Proposal No. GL20-21317) dated December 10, 2020, included the following:

- Project setup and limited subsurface investigation,
- Laboratory testing,
- Engineering analysis, and
- Preparation of this report.

This investigation specifically excludes the assessment of site environmental characteristics, particularly those involving hazardous substances.

1. SITE AND PROJECT DESCRIPTION

The City of Antioch (City) plans to renovate Contra Loma Estates Park (Site), located to the south-southeast of Mahogany Way and Mandarin Way, adjacent to a high-density residential neighborhood. The Site is bounded by residential parcels to the northwest, State Route 4 to the southwest, a drainage canal to the east, and Mahogany Way and residential parcels to the north. The Site is relatively flat with minor topographic relief. Renovations will include a walking path, outdoor exercise equipment, shaded picnic and barbecue area, dog park, climbing feature for older youth, a public restroom, lighting for the existing basketball court, landscape and security lighting throughout the park.

Although grading plans are not currently available for the project, we anticipate that earthwork activities for this project will be limited to cuts and fills of about 2 feet or less to attain final design grades.

If the actual project differs significantly from that described above, particularly the amount of grading anticipated, we should be contacted to review and/or revise the conclusions and recommendations presented in this report.

2. SUBSURFACE INVESTIGATION

Our field investigation was performed on June 9, 2021 and consisted of manually advancing five (5) hand auger borings (labeled HA-1 through HA-5) to depths of approximately 5 feet below the existing ground surface (BGS) each at the approximate locations shown on the Site Plan, Figure 2. Soils encountered in each hand auger were visually classified and recorded on a boring log, the results of which are tabulated in the "Subsurface Conditions" section below. The borings were logged by a geologist from BSK and backfilled with on-site soils after completion. A few, relatively undisturbed samples of the subsurface materials were obtained using a hand-held sampler with a 2.0-inch stainless steel liner driven 6-inches using a hand-held slide hammer. Prior to sealing the samples, strength characteristics of the relatively undisturbed cohesive soil samples recovered were evaluated using a hand-held pocket penetrometer. The results of these tests are shown in the "Subsurface Conditions".

Soil classifications made in the field from the excavated materials and samples collected were re-evaluated in the laboratory after further examination and testing. The soils were classified in the field in general accordance with the Unified Soil Classification System (Visual/Manual Procedure - ASTM D2488). Where laboratory tests were performed, the designations reflect the laboratory test results in general accordance with ASTM D2487. A discussion of the subsurface conditions encountered at the Site is presented in the "Subsurface Conditions" section of this report. It should be noted that the Responsible Geotechnical Engineer, Professional Engineer, or Professional Geologist uses professional judgement and visual-manual procedures in general conformance with ASTM D2488 to classify soil when the full classification suite of tests per ASTM D2487 is not conducted.

The locations of the borings were estimated by our field geologist based on rough measurements from existing features at the Site. As such, the locations of the hand auger borings should be considered approximate to the degree implied by the methods used.

3. LABORATORY TESTING

Our laboratory testing program consisted of performing dry density and moisture content, Atterberg limits, and sieve analysis tests. Most of the test results are presented on the tabulated logs, while the Atterberg limits are presented in Appendix A. Analytical testing for corrosion was performed by CERCO Analytical of Concord, California, a State-Certified laboratory, using ASTM methods as described in the CERCO report. The corrosion results are presented at the end of Appendix A.

4. SITE GEOLOGY AND SEISMICITY

According to the California Geological Survey (CGS, 2019a[1]), the Site is mapped as Holocene to Pleistocene alluvial fan deposits, which include sand, gravel, silt, and clay. These deposits are moderately to poorly sorted, and moderately to poorly bedded.

The Site is in a highly active seismic area of the San Francisco Bay Area, but it is not located within an Alquist-Priolo (AP) Earthquake Fault Zone and no known active faults traverse the Site. The closest active fault to the Site is the Greenville Fault, located about 7 miles southwest of the Site. However, the Site is located within a State mapped Seismic Hazard Zone prone to liquefaction (CGS, 2019b[2]). Liquefaction occurs when loose, water-saturated sediments lose strength and fail during strong ground shaking. Liquefaction is defined as the transformation of granular material from a solid state into a liquefied state because of increased pore-water pressure.

5. SUBSURFACE CONDITIONS

The table below summarizes the subsurface conditions encountered in our hand auger borings. We generally encountered alluvial soils in the upper 5 feet BGS, which is consistent with the geologic mapping by the CGS. The surficial soils consist predominantly of clayey sand and firm to hard sandy lean clay. We ran Atterberg limits testing on samples collected from the upper 5 feet BGS at borings HA-1, HA-3, and HA-5, which resulted in liquid limit values of 40, 26, and 42 and plasticity index values of 19, 6, and 25, respectively. These results are indicative of soils with a low to medium expansion potential when subjected to changes in moisture content.

TABULATED LOGS OF HAND AUGER BORINGS			
Boring (EL)	Approx. Depth Below Ground Surface (feet)	Description	Remarks
HA-1 (46')	0 – 5	**Sandy Lean Clay (CL)** – light yellowish brown, moist, firm, low to medium plasticity, fine sand, trace of fine gravel	- Performed on 6/9/2021 - At 1 foot, DD = 91 pcf and MC = 11%, PP = 2.0 - At 1.5 to 5 feet, LL = 40, PI = 19 - At 1.5 to 5 feet, 84% passing #200 sieve - Terminated at approx. 5 feet - Boring backfilled with on-site soils

[1] CGS (2019a), Seismic Hazard Zone Report for the Antioch North 7.5-Minute Quadrangle, Contra Costa County, California, Seismic Hazard Zone Report 125.
[2] CGS (2019b), Earthquake Zones of Required Investigation, Antioch North Quadrangle, California Geological Survey, Seismic Hazard Zones (released on April 4, 2019).

TABULATED LOGS OF HAND AUGER BORINGS			
HA-2 (41')	0 – 5	**Sandy Lean Clay (CL)** – light yellowish brown, moist, firm, low to medium plasticity, fine sand	- Performed on 6/9/2021 - At 3 feet, DD = 109 pcf and MC = 15%, PP = >4.5 - At 1 to 5 feet, 72% passing #200 sieve - Terminated at approx. 5 feet - Boring backfilled with on-site soils
HA-3 (48')	0 – 4	**Clayey Sand (SC)** – light yellowish brown, moist, fine to medium sand, low plasticity	- Performed on 6/9/2021 - At 2 feet, DD = 101 pcf and MC = 18% - At 1 to 4 feet, LL = 26, PI = 6 - At 1 to 4 feet, 43% passing #200 sieve - Terminated at approx. 5 feet - Boring backfilled with on-site soils
	4 – 5	**Well Graded Sand with Gravel (SW)** – light yellowish brown, moist, fine to coarse sand, fine gravel, trace fines and clayey sand	
HA-4 (54')	0 – 5	**Lean Clay with Sand (CL)** – dark brown, moist, firm, medium plasticity, fine sand	- Performed on 6/9/2021 - At 1 to 5 feet, 84% passing #200 sieve - Terminated at approx. 5 feet - Boring backfilled with on-site soils
HA-5 (53')	0 – 3½	**Sandy Lean Clay (CL)** – dark brown, moist, firm, medium plasticity, fine sand	- Performed on 6/9/2021 - At 1 to 3½ feet, LL = 42, PI = 25 - At 1 to 3½ feet, 73% passing #200 sieve - Terminated at approx. 5 feet - Boring backfilled with on-site soils
	3½ – 5	**Clayey Sand (SC)** – light brown to yellow, moist, low plasticity, fine sand, loose	

Notes/Abbreviations:
-No free groundwater observed in auger holes
-All boreholes were backfilled with on-site soil
-EL = elevation (feet)
-Elevations are based on Google Earth Pro
-LL = liquid limit
-PI = plasticity index
-DD = in-situ dry unit weight (lb per cubic foot, pcf)
-MC = in-situ moisture content (percent)
-PP = pocket penetrometer in TSF (tons/sq. ft.)

Free groundwater was not observed within the maximum exploration depth of our borings (approximately 5 feet BGS). Based on mapping of historically high groundwater depths published by the California Geological Survey (CGS, 2019a) for the Antioch North quadrangle, we expect groundwater at the Site to lie at about 10 feet BGS. It should be noted that groundwater levels can fluctuate depending on factors such as seasonal rainfall, groundwater withdrawal, and construction activities on this or adjacent properties. Soil and groundwater conditions can deviate from those conditions encountered at the exploration points during our field investigation.

Soil and groundwater conditions can deviate from those conditions encountered at the boring locations. If significant variation in the subsurface conditions is encountered during construction, it may be necessary for BSK to review the recommendations presented herein and recommend adjustments as necessary.

6. CONCLUSIONS

The planned improvements at Contra Loma Estates Park are geotechnically feasible provided the conclusions and recommendations contained in this report are properly incorporated into the design and construction of the project.

The primary geologic and seismic hazards for the proposed improvements are the potential for moderate to intense ground shaking during a seismic event at the active Greenville Fault or other nearby active faults in the area and the presence of low to moderately expansive soils near the Site's surface. The Site is located within a Seismic Hazard Zone for liquefaction. As noted previously, the Site is not located within an Alquist-Priolo (AP) Earthquake Fault Zone and no known active faults traverse the Site. Therefore, we conclude that the potential for fault-related surface rupture to affect the Site to be low. The presence of expansive soils at the Site can be addressed by deepening foundations deeper than usual, underlying slabs with "non-expansive" fill, and proper moisture conditioning.

Other potential geologic and seismic hazards that could affect the Site are liquefaction (as previously noted, the Site is within a State mapped Seismic Hazard Zone), lateral spreading, dynamic compaction/seismic settlement, and flooding. However, these geologic hazards, including liquefaction, are beyond the scope of our investigation due to the limited nature of the planned improvements.

7. RECOMMENDATIONS

Presented below are our recommendations for earthwork, foundations, seismic considerations, exterior concrete flatwork, pavers, site drainage, storm water runoff mitigation, and construction considerations associated with the planned renovation of the Site.

7.1 Site Preparation and Grading

Our general site preparation and grading recommendations are as follows:

1. The areas to be graded should be cleared of debris, significant surface vegetation and obstructions including abandoned underground pipes, foundations and concrete slabs. Stripped surface organics should be stockpiled and may be reused only in landscaping areas or disposed off-site.
2. The root system of trees to be demolished (if any) should be removed. The removal of the tree roots could disturb several feet of the near-surface soils. If these disturbed soils are not being removed by design cuts, the disturbed soils should be overexcavated and replaced with compacted engineered fill.
3. Existing pipelines crossing the Site to be abandoned should be removed whenever feasible. Abandoned pipes to remain should be capped at both ends if smaller than 2 inches in diameter or be filled with 1-sack sand-cement slurry if greater than 2 inches in diameter. Existing pipelines to remain be carefully located and protected during demolition and during construction.

4. If zones of soft or saturated soils are encountered during excavation and compaction, deeper excavations may be required to expose firm soils. This should be evaluated in the field by a BSK representative.
5. From a geotechnical standpoint only, the on-site soils are generally suitable for re-use as general engineered fill provided they are free of debris, vegetation, and other deleterious matter and properly processed so that particle sizes are not greater than 3 inches in largest dimension. At least 90 percent by weight of the fill/backfill materials should be passing the 1-inch sieve. All fill materials should be subject to evaluation and approval by a BSK representative prior to their use.
6. Proper granular bedding and shading should be used beneath and around new utilities. Imported fill material to be used as general fill should not be classified as being more corrosive than "moderately corrosive." **Imported fill, including "non-expansive" fill**, should be granular in nature, adhere to the above gradation recommendations, and conform to the minimum criteria presented in the table below (unless otherwise permitted by BSK). Highly pervious materials such as pea gravel or clean sands are not recommended because they permit transmission of water to the adjacent and/or underlying soils.

IMPORT FILL AND "NON-EXPANSIVE" FILL CRITERIA	
Plasticity Index	12 or less
Liquid Limit	Less than 30%
% Passing #200 Sieve	8% – 40%

7. Following stripping and removal of deleterious materials, the Site should be scarified to a minimum depth of 12 inches, moisture conditioned to at least 2 percent above optimum moisture content, and re-compacted to a minimum of 90 percent relative compaction. **It is important to meet this minimum moisture conditioning due to the expansion potential of the near-surface soils.** Relative compaction refers to the in-place dry density of soil expressed as a percentage of the maximum dry density determined by ASTM D1557 compaction test procedures. Optimum moisture is the water content (percentage by dry weight) corresponding to the maximum dry density. Scarification and recompaction should extend laterally a minimum of 5 feet beyond the limits of structures and a minimum of 3 feet beyond the limits of concrete flatwork, pavers, and pavement, where feasible.
8. Where fills/backfills are greater than 7 feet in depth below finish grade, the zone below a depth of 7 feet should be compacted to a minimum of 95 percent compaction.
9. **Within proposed paved areas, including new flatwork and paver areas to be exposed to vehicular traffic**, the upper 12 inches of the soil subgrade immediately below the aggregate base layer should be compacted to a minimum of 92 percent relative compaction at least 2 percent above optimum moisture content. Subgrade preparation should extend a minimum of 1 foot laterally beyond the edge of new pavers, where feasible. The aggregate base layer underneath such flatwork, pavers, and pavement should be compacted to a minimum of 95 percent relative compaction near optimum moisture content.
10. Unless otherwise indicated above, all fill and backfill should be placed in thin lifts up to 8-inch maximum uncompacted thickness, properly moisture conditioned to at least 2 percent above optimum moisture content for clayey soils and near optimum moisture content for granular soils,

and compacted to at least 90 percent compaction per ASTM D1557. Aggregate base should be moisture conditioned to near-optimum moisture content.

11. Observations and compaction testing should be carried out by a BSK representative during grading and backfill operations to assist the contractor in obtaining the required degree of compaction and proper moisture content. Where the moisture content or compaction is outside the range required, additional compactive effort and adjustment of moisture content should be made until the specified compaction and moisture conditioning is achieved.
12. BSK should be notified at least 48 hours prior to any grading and backfill operations. The procedure and methods of grading may then be discussed between the contractor and BSK.

7.2 New Utility Trench Excavation and Backfill

All excavations should conform to current OSHA requirements for work safety. Where trenches or other excavations extend deeper than 5 feet, the excavations may become unstable and should be evaluated by the contractor to monitor stability prior to personnel entering the trenches. Shoring or sloping of any trench wall may be necessary to protect personnel and to provide stability. It is the contractor's responsibility to follow OSHA temporary excavation guidelines and grade the slopes with adequate layback or provide adequate shoring and underpinning of existing structures and improvements, as needed. Slope layback and/or shoring measures should be adjusted as necessary in the field to suit the actual conditions encountered, in order to protect personnel and equipment within excavations.

Free groundwater was not observed within the maximum depth of our exploration (approximately 5 feet BGS). As discussed in the "Subsurface Conditions" section of this report, we expect groundwater at the Site to lie at about 10 feet BGS. However, the actual depth at which groundwater may be encountered in trenches and excavations may vary. As a minimum, provisions should be made to ensure that conventional sump pumps used in typical trenching and excavation projects are available during construction in case substantial runoff water accumulates within the excavations as a result of wet weather conditions.

Material quality, placement, and compaction requirements for utility bedding and shading materials[3] should meet applicable agency requirements. Utility trench backfill above the shading materials may consist of on-site soils provided they are free of organics, debris, rock over 3 inches in largest dimension, and other deleterious material. Backfill materials should be placed in lifts not exceeding 8 inches in loose thickness, moisture conditioned, and compacted to the requirements provided in the "Site Preparation and Grading" section of this report.

Where utility trenches extend from the exterior into the interior limits of the restroom building, a 1-sack sand-cement slurry mix should be used as backfill material for a distance of 2 feet laterally on each side of the centerline of the perimeter footings to reduce the potential for the trench to act as a conduit to exterior surface water. In addition, where utilities cross through exterior footings, flexible waterproof

[3] Bedding material typically consists of sand used to backfill a few inches (typically 3 to 6 inches) below the invert elevation of a pipe. Shading material typically consists of sand used to backfill around and a few inches (typically 6 to 12 inches) above the top of a pipe.

caulking should be provided between the sleeve and the pipe. Utility trenches located in landscaped areas should also be capped with a minimum of 12 inches of compacted on-site clayey soils.

7.3 Foundation Recommendations

7.3.1 Shallow Foundations

We recommend the criteria presented in the tables below be incorporated into the design of shallow foundations for this project. Due to the expansive potential of the surficial soils, a continuous perimeter footing should be constructed for the new restroom building to reduce the potential for moisture fluctuation underneath the building, which could lead to vertical movement associated with shrinkage/swell cycles.

FOOTING DESIGN CRITERIA	
Static Allowable Bearing Capacity[1]	2,500 psf
Seismic/Wind Allowable Bearing Capacity[1]	3,750 psf
Passive Resistance (Equivalent Fluid Pressure)[2,3]	300 pcf
Allowable Lateral Sliding Resistance Adhesion[3]	500 psf
Minimum Embedment Depth[4]	18 inches
Minimum Width	12 inches (continuous) 18 inches (isolated)

Notes:

1. Includes a factor of safety of at least 3 for static loading and at least 2 for transient loading (i.e., seismic or wind conditions).
2. Neglect upper 1 foot if surface is not confined by concrete slab or pavement. **For foundations located on or proximate to sloping ground, the passive resistance should be neglected in the upper portion of the foundation until there is a horizontal distance of at least 7 feet between the slope face and the nearest edge of the foundation.**
3. The sliding resistance and passive resistance may be used concurrently, and the passive resistance can be increased by one-third for wind and/or seismic loading. Values include a factor of safety of at least 1½. The sliding resistance adhesion should be multiplied by the foundation area to obtain horizontal sliding resistance.
4. Below lowest adjacent grade considered to be bottom of slab on the interior or finished grade on the exterior.

MAT SLAB FOUNDATION CRITERIA[1]	
Static Allowable Bearing Capacity[2]	1,500 psf
Seismic/Wind Allowable Bearing Capacity[2]	2,250 psf
Passive Resistance (Equivalent Fluid Pressure)[3, 4]	300 pcf
Allowable Friction Coefficient[4]	0.30
Modulus of Vertical Subgrade Reaction[5]	120 psi/in
Minimum Slab Thickness[6] at the Edges	12 inches

Notes:

1. Mat slab foundations should be supported on a minimum of 12 inches of compacted Caltrans Class 2 aggregate base to provide enhance slab support. If moisture vapor through the slab is objectionable, the use of a vapor barrier at least 15 mils thick and capillary moisture break consisting of a minimum 6-inch-thick layer of crushed drain rock should be considered by the designer. If used, the crushed drain rock layer may substitute an equivalent amount of the recommended aggregate base layer. The crushed rock layer should be ¾-inch maximum size with no more than 10 percent by weight passing the #4 sieve.
2. Includes a factor of safety of at least 3 for static loading and at least 2 for transient loading (i.e., seismic or wind conditions).
3. Neglect upper 1 foot if surface is not confined by concrete slab or pavement. **For foundations located on or proximate to sloping ground, the passive resistance should be neglected in the upper portion of the foundation until there is a horizontal distance of at least 7 feet between the slope face and the nearest edge of the foundation.**
4. The friction coefficient and passive resistance may be used concurrently, and the passive resistance can be increased by one-third for wind and/or seismic loading. Values include a factor of safety of at least 1½.
5. Based on a one square foot bearing plate. This unadjusted value needs to be adjusted for the actual size of the mat as follows:
    a. Multiply by [(m+0.5)/(1.5 x m)] where m is the ratio of the mat length divided by its width (unitless).
    b. If a computer program is used to design the mat for this project and it requires the input of a modulus of subgrade reaction for the Site, the designer should check whether the program requires input of the unadjusted or adjusted modulus of vertical subgrade reaction.
6. Below lowest adjacent finished grade. The slab designer should determine the slab concrete thickness and reinforcing.

Provided that the foundations are designed according to the recommendations presented above and constructed properly, total and differential settlements are estimated to be less than about 1-inch and ½-inch, respectively. Differential settlement is defined in this report as the vertical difference in settlement between adjacent foundation supports or across a horizontal distance of 30 feet, whichever is less. A majority of the estimated elastic settlement is expected to occur during construction as the foundation is loaded.

Where foundations are located adjacent to below-grade structures (including existing footings) or near major underground utilities, the foundation should extend below a 1H:1V (horizontal to vertical) plane projected upward from the structure foundation or bottom of the underground utility to avoid surcharging the below grade structure and underground utility with foundation loads.

Concrete for foundations should be placed neat against firm native soil or engineered fill. **It is critical that foundation excavations not be allowed to dry before placing concrete.** If shrinkage cracks appear in the foundation excavations, the excavations should be thoroughly moistened to close all cracks prior to concrete placement. The foundation excavations should be monitored by a representative of BSK for compliance with appropriate moisture control and to confirm the adequacy of the bearing materials.

7.3.2 Drilled Piers

We recommend the following criteria be incorporated into the design of drilled pier foundations for this project.

DRILLED PIER FOUNDATION CRITERIA	
Static Allowable Downward Skin Friction[1]	500 psf
Seismic/Wind Allowable Downward Skin Friction[1]	650 psf
Passive Resistance (Equivalent Fluid Pressure)[2]	300 pcf
Minimum Pier Diameter	18 inches
Minimum Pier Depth Below Ground Surface	5 feet
Minimum Pier Center to Center Spacing	3D[3] (axial loading) 6D[3,4] (lateral loading)

Notes:

1. Includes a factor of safety of at least 2 for static loading and at least 1½ for transient loading (i.e., seismic or wind conditions). Uplift resistance may be taken as 2/3 of downward capacity. Weight of piers may be used to resist upward loading.
2. Neglect upper 1 foot if surface is not confined by concrete slab or pavement. **For piers located on or proximate to sloping ground, the passive resistance should be neglected in the upper portion of the piers until there is a horizontal distance of at least 7 feet between the slope face and the nearest edge of the piers.** Passive resistance should be limited to 1,500 psf and may be applied to twice the diameter of the piers. Passive resistance may be increased by 1/3 for seismic or wind loads. Value includes a factor of safety of at least 1½.
3. D = pier diameter. Minimum spacing for lateral loading only applies to piers aligned in the direction of loading (i.e., one or more piers shadow another pier).
4. For **piers spaced less than 6D apart** and where the loading direction is such that there is one or more trailing pier(s) shadowing the leading pier, reductions to lateral capacity of the trailing pier(s) should be applied as follows:
    a. For trailing[4] piers spaced 3D (D = pier diameter) apart, reduce trailing pier capacity by 50 percent (multiply contribution of trailing piers to group capacity by 0.5),
    b. For trailing piers spaced between 4D and 5D apart, reduce trailing pier capacity by 40 percent (multiply contribution of trailing piers to group capacity by 0.6),
    c. For trailing piers spaced 6D or greater apart, no reduction is needed, and
    d. For trailing piers spaced between 3D and 4D apart and 5D and 6D apart, interpolate the reduction factors provided above.

Provided that the drilled piers are designed according to the recommendations presented above and constructed properly, the total and differential settlements are estimated to be less than about ½-inch and ¼-inch, respectively. Differential settlement is defined in this report as the vertical difference in settlement between adjacent foundation supports or across a horizontal distance of 30 feet, whichever is

[4] The leading pier is defined as the pier that has no pier in front of it in the direction of lateral loading, while the trailing pier is defined as the pier that is behind (i.e., shadows) the leading pier in the direction of lateral loading.

less. A majority of the estimated elastic settlement is expected to occur during construction as the foundation is loaded.

We recommend that drilled pier steel reinforcement and concrete be placed within about 4 to 6 hours upon completion of each drilled hole. As a minimum, the holes should be poured the same day they are drilled. If the holes cannot be backfilled the same day they are drilled, the hole needs to be checked for caving, sloughing or squeezing prior to setting the rebar cage and checked again before pouring concrete. The steel reinforcement should be centered in the drilled hole. Concrete used for pier construction should be discharged vertically into the holes to reduce aggregate segregation. Under no circumstances should concrete be allowed to free-fall against either the steel reinforcement or the sides of the excavation during construction.

As discussed in the "Subsurface Conditions" section above, free groundwater could be as shallow as about 10 feet BGS at the Site. Therefore, the foundation contractor should be prepared for groundwater if piers extend deeper than about 10 feet BGS. If water more than 6 inches deep is present during concrete placement, either the water needs to be pumped out or the concrete needs to be placed into the hole using tremie methods. If tremie methods are used, the end of the tremie pipe must remain below the surface of the in-place concrete at all times. Unit prices for dewatering and/or tremie placement methods should be obtained during the bidding process.

Concrete for drilled piers should be designed and placed in general conformance with the recommendations provided in ACI 336.3R-14, Design and Construction of Drilled Piers[5]. The recommendations provided within ACI 336.3R-14 should be followed at all times and in particular when concrete placement is necessary below groundwater level, in caving or sloughing soils, or in sand, which may necessitate casing or the slurry displacement method for concrete placement. These methods require concrete placement at higher slumps than "dry" conditions and concrete mix specifications, including the addition of concrete admixtures and consideration of consolidation methods, should be provided by the design team. If temporary casing is used, it should consist of smooth walled steel. **Corrugated metal pipe (CMP) should not be used as temporary casing because it has a tendency to create voids or disturbed zones during removal.**

7.3.3 2019 CBC Mapped Seismic Design Parameters

The seismicity of the region surrounding the Site is discussed in the "Site Geology and Seismicity" section of this report. From that discussion, it is important to note that the Site is in a region of high seismic activity and will likely be subjected to moderate to intense ground shaking during the life of the project. As a result, structures for this project should be designed in accordance with applicable seismic provisions of the California Building Code (CBC) presented in the table below.

Use of the 2019 CBC mapped seismic design criteria presented in the table below is considered appropriate for the design of structural improvements for this Site if the exceptions provided in Section

[5] ACI Committee 336, 2014

11.4.8 of ASCE 7-16 apply to the planned improvements. Otherwise, the project's structural engineer should be consulted to evaluate whether a site-specific ground motion hazards analysis is required for this project. Therefore, BSK has not performed a site-specific ground motion hazards analysis for this project.

2019 CBC SEISMIC DESIGN PARAMETERS[3] (Lat: 38.001203°N, Lon: -121.826030°W)			
Seismic Design Parameter	**Value**		**Reference[1]**
Site Class	D		Table 20.3-1, ASCE 7-16
MCE_R Mapped Spectral Acceleration (g)	$S_S = 1.633$	$S_1 = 0.556$	USGS Mapped Values based on Figures 1613.3.1(1) and 1613.3.1(2), 2019 CBC
Site Coefficients	$F_a = 1.0$	$F_v = 1.744$[2]	Tables 1613.3.3(1) and 1613.3.3(2), 2019 CBC
MCE_R Mapped Spectral Acceleration Adjusted for Site Class Effects (g)	$S_{MS} = 1.633$	$S_{M1} = 0.970$	Section 1613.2.3, 2019 CBC
Design Spectral Acceleration (g)	$S_{DS} = 1.089$	$S_{D1} = 0.647$	Section 1613.2.4, 2019 CBC
Seismic Design Category (SDC)	D		Section 1613.2.5, 2019 CBC
MCE_G peak ground acceleration adjusted for Site Class effects (g)	$PGA_M = 0.739$		Section 11.8.3, ASCE 7-16

Definitions:
MCE_R = Risk-Targeted Maximum Considered Earthquake
MCE_G = Maximum Considered Earthquake Geometric Mean
Notes:

1. When referencing ASCE 7-16, Supplement 1 must also be checked for changes to ASCE 7-16.
2. See requirements for site-specific ground motions in Section 11.4.8 of ASCE 7-16. This value of F_v shall be used only for calculation of T_S.
3. **These seismic design parameters are based on the assumption that a site-specific ground motion hazard analysis is not required based on the exceptions provided in Section 11.4.8 of ASCE 7-16. Otherwise, a site-specific ground motion hazard analysis should be performed to develop the seismic design parameters for this project.**

7.4 Interior Slabs-on-Grade

If new interior concrete floor slabs-on-grade are constructed, they should be supported over properly prepared subgrade soils, as described in the "Site Preparation and Grading" section of this report. Due to the presence of expansive surficial soils at the Site, interior floor slabs should be underlain by at least 18 inches of "non-expansive" fill.

Concrete floor slabs should be supported on at least 6 inches of crushed drain rock to enhance subgrade support for the slab. This material should be considered part of the required minimum of 18 inches of "non-expansive" fill. If this material is desired to be used as a capillary break, it should be ¾-inch maximum size with no more than 10 percent by weight passing the #4 sieve. Aggregate base should not be used as capillary break because this material is not as effective as the open graded material described above. It is important that placement of the crushed rock layer and concrete slab be done as soon as possible after compaction of the "non-expansive" fill material to reduce drying of the subgrade.

A Structural Engineer should design reinforcing and slab thickness. The floor slab should be separated from footings, structural walls, and utilities and provisions made to allow for settlement or swelling movements at these interfaces. If this is not possible from a structural or architectural design standpoint, it is recommended that the slab connection to footings be reinforced such that there will be resistance to potential differential movement.

7.4.1 Floor Slab Moisture

Subsurface moisture and moisture vapor naturally migrate upward through the soil and, where the soil is covered by a building or pavement, this subsurface moisture will collect. To reduce the impact of the subsurface moisture and potential impact of future introduced moisture (such as landscape irrigation or precipitation), a vapor barrier should be incorporated into the floor slab design in all areas where moisture sensitive floor coverings, coating, underlayments, adhesives, moisture sensitive goods, humidity-controlled environments, or climate-cooled environments are anticipated initially or in the future. The vapor barrier should consist of a minimum 15 mil extruded polyolefin plastic, such as 15 mil Stego® Wrap vapor barrier or equivalent. The vapor barrier material should not include any recycled or woven materials and should have a permeance (as tested before and after mandatory conditioning per ASTM E1745 Section 7.1, latest edition) of less than 0.01 perms and should comply with ASTM E1745 Class A requirements. The vapor barrier should also meet Sections 8.1 and 9.3 of ASTM E1745 and subsequent documentation should be provided by the vapor barrier manufacturer. The vapor barrier should be installed in accordance with ASTM E1643, latest edition, including proper perimeter seal, such as Stego® Crete Claw® tape.

The vapor barrier should be placed directly over the crushed rock layer recommended in the "Interior Slabs-on-Grade" section of this report. **A sand layer should not be placed between the vapor barrier and the concrete slab or it could serve as a reservoir for trapped moisture that could lead to long-term vapor transmission through the slab.**

7.5 Exterior Concrete Flatwork and Pavers

New exterior concrete flatwork and pavers at grade will be constructed on soils subject to swell/shrink cycles. Some of the adverse effects of swelling and shrinking can be reduced with proper moisture treatment. The intent is to reduce the fluctuations in moisture content by moisture conditioning the soils, sealing the moisture in, and controlling it. Near-surface soils to receive exterior concrete flatwork or pavers should be moisture conditioned according to the recommendations in the "Site Preparation and Grading" section of this report. In addition, all exterior flatwork and pavers should be supported on a minimum of 6 inches of "non-expansive" fill. If a layer of sand is used beneath pavers, it can replace an equivalent amount of the 6-inch layer of "non-expansive" fill. Where concrete flatwork and pavers are to be exposed to vehicle traffic, the 6-inch layer of "non-expansive" fill should consist of Caltrans Class 2 aggregate base.

New pedestrian concrete flatwork should have a minimum thickness of 4 inches and minimum reinforcing of No. 4 bars at 18 inches on center (both directions). The rebar should be discontinued at expansion joints. Longitudinal slip dowels should be used at expansion joints. Vehicular concrete should be designed as discussed in the "Portland Cement Concrete Pavements" section of this report. Final design of exterior concrete flatwork is the responsibility of the civil or structural engineer for the project.

Exterior flatwork and pavers will be subjected to edge effects due to the drying out of subgrade soils. To protect against edge effects adjacent to unprotected areas, such as vacant or landscaped areas, lateral cutoffs, such as inverted curbs (i.e., turndown edges) that extend at least 2 inches below the aggregate base or "non-expansive" fill layer into the subgrade soils, are recommended. Alternatively, a moisture barrier at least 80 mils thick extending at least 6 inches below the aggregate base or "non-expansive" fill layer into the subgrade soils could be installed at the edge of the flatwork and pavers.

Due to the presence of low to moderately expansive soils near the site surface, flatwork should have control joints (i.e., weakened plane joints) spaced no more than 8 feet on centers. Prior to construction of the flatwork and pavers, the aggregate base should be moisture conditioned to near optimum moisture content. If the aggregate base is not covered within about 30 days after placement, the soils below this material will need to be checked to confirm that their moisture content is at least 2 percent over optimum. If the moisture is found to be below this level, the aggregate base layer over flatwork and paver areas will need to be soaked until the proper moisture content is reached. Where flatwork is adjacent to curbs, reinforcing bars should be placed between the flatwork and the curbs. Expansion joint material should be used between flatwork/pavers and buildings, including concrete driveways.

7.6 Portland Cement Concrete Pavements

If used, Portland Cement Concrete (PCC) pavement should have a minimum thickness of 6 inches supported over 6 inches of Caltrans Class 2 aggregate base. This section is equivalent to a Traffic Index of at least 6.0 to 6.5 based on our experience and is expected to support traffic loading from a fire engine, a delivery truck, or a maintenance truck. The aggregate base and subgrade for PCC pavements should be properly moisture conditioned and compacted. Construction joints should be located no more than 12 feet apart in both directions. Concrete compressive strength should be tested in lieu of third point loading for rupture strength. A minimum 28-day compressive strength of 3,000 pounds per cubic foot (psi) should be specified for the concrete mix design. The PCC pavement should be continuously reinforced using No. 4 bars (or larger) spaced no more than 18 inches on center in both directions. Final design of the PCC pavement is the responsibility of the civil or structural engineer for the project.

7.7 Pervious Concrete Walkways

If used, we recommend that the pervious concrete section for walkways be a minimum of 5-inches thick over a minimum of 12 inches of durable, open graded coarse gravel reservoir layer underlain by Mirafi® RS280i geotextile fabric. The minimum recommended thickness of the reservoir layer provided takes into consideration the soil expansion potential of the surficial soils at the Site. If the designer intends to use a different geotextile other than Mirafi® RS280i, BSK should be given an opportunity to review the type of fabric to be used before the project documents are finalized and issued for bidding and construction. If desired, the thickness of the reservoir layer could be increased to 18 inches for added storage capacity.

The reservoir layer typically consists of coarse aggregate No. 57 per ASTM C33/C33M-18, which is similar to crushed drain rock having a 1-inch maximum size with no more than 10 percent by weight passing the No 4 sieve. Mirafi® RS280i geotextile fabric has a high flow rate (typically 85 gallons per minute per square feet), which should permit almost unobstructed water flow through it, while helping maintain stability of the underlying subgrade. The geotextile fabric seams should be overlapped a minimum of 1 foot or as required by the manufacturer, whichever results in the greatest overlap.

Pervious concrete should be set back a minimum of 5 feet laterally from the perimeter of the restroom building.

7.8 Effect of Plants on Foundation, Flatwork, and Paver Performance

Because of the low to moderately expansive nature of some of the on-site soils, trees and other large plants can significantly contribute to differential settlement of a foundation, flatwork, pavers, and paved areas. The roots of trees and large plants can absorb the moisture from the soil, causing the soil to shrink much faster than other soil areas exposed to the weather. The soil where the moisture is lost more rapidly will sink lower than the surrounding soil, causing differential settlement in overlying or adjacent improvements. Certain trees and plants are known to be more water-consuming than others. Research studies indicate that a tree should be at least as far away from a building, flatwork, pavers, and pavement as the mature height of the tree to minimize the effect of drying caused by the tree. A plant and tree specialist should be consulted to avoid the issues described herein.

A root barrier should be considered between trees and adjacent improvements and should be designed and installed following the recommendations of a landscape architect.

7.9 Site Drainage

Proper site drainage is important for the long-term performance of future improvements. The Site should generally be graded to provide positive drainage towards drain inlets, catch basins, or bioretention areas. The Site should be graded so as to carry surface water away from structures at a minimum of 2 percent in flatwork and paver areas and 5 percent in landscaped areas to a minimum of 10 feet laterally from a structure's perimeter foundations as required by the 2019 CBC. Water should not be allowed to pond anywhere on-site.

7.10 Storm Water Runoff Mitigation

Storm runoff regulations require pretreatment of runoff and infiltration of storm water to the extent feasible. Typically, this results in the use of bioretention areas, vegetated swales, infiltration trenches, or permeable pavement near or within parking lots. These features are not well-suited to fine-grained soils (silts and clays) because these soils have relatively low permeability and require significant time for infiltration to occur. In addition, allowing water to pond on expansive soils will cause the soils to swell, which can cause distress to adjacent pavements, slabs, and lightly loaded structures.

Implementation of storm water infiltration criteria will likely result in increased distress and reduced service life of flatwork and pavers if not carefully designed in fine-grained soils such as those covering the surface of the Site. Bioretention areas, vegetated swales, and infiltration areas should be located in landscaped areas and well away (typically 5 to 10+ feet laterally) from slopes, foundations, flatwork, pavers, and pavements. If it is not possible to locate these infiltration systems away from such improvements, alternatives that isolate the infiltrated water, such as flow-through planters, could be considered. When using an infiltration system in clay soils, underdrains should be used. Improvements should be located such that there is at least 1 foot of horizontal distance between the edge of improvements and the top edge of the bioswale excavation for every 1 foot of vertical bioswale depth. If this is not possible, then concrete curbs for pavements or lateral restraint for exterior flatwork and pavers located directly adjacent to a vertical bioswale cut should be adequately keyed into the native soil and should be engineered (i.e., to generate sufficient passive pressure) to reduce the potential for rotation or lateral movement of the curbs. Due to the potential adverse effects on project performance, BSK should review the geotechnical aspects of the storm water infiltration system and its location before the project plans are finalized.

Based on our experience, we expect the near surface clayey soils encountered at the Site to have very low permeability. Therefore, we classify the Site's surficial soils as predominantly hydrologic soil group D per Chapter 7 of Part 630 Hydrology National Engineering Handbook (United States Department of Agriculture, 2007). Hydrologic soil group D soils have a saturated hydraulic conductivity of between 0.06 and 0.14 inches/hour.

It should be noted that during periods of prolonged precipitation, the underlying soils tend to become saturated to greater and greater depths/extents. Therefore, infiltration rates tend to decrease with prolonged rainfall.

7.11 Corrosion

A soil sample was collected during our field investigation from a depth of approximately 1½ to 5 feet BGS from the hand auger boring HA-1 and was submitted for corrosion testing. The sample was tested by CERCO Analytical (CERCO), a State-certified laboratory in Concord, California, for redox potential, pH, resistivity, chloride content, and sulfate content in accordance with ASTM test methods. The test results are presented at the end of Appendix A. Also included is the evaluation by CERCO Analytical of the corrosion test results.

Based upon the resistivity measurements, the sample tested is classified as "corrosive" by CERCO Analytical. The sulfate ion concentration was 38 mg/kg (ppm). This result is indicative of an exposure category S0 per Table 19.3.1.1 of ACI 318-19. For an S0 exposure class, Table 19.3.2.1 indicates that the minimum f'c of the concrete is 2,500 psi. All buried iron, steel, cast iron, ductile iron, galvanized steel, and dielectric coated steel or iron be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping, such as ductile iron firewater pipelines, should be protected against corrosion. Because we are not corrosion specialists, we recommend that a corrosion specialist be consulted for advice on proper corrosion protection for underground piping which will be in contact with the soils and other design details.

The above are general discussions. A more detailed investigation may include more or fewer concerns and should be directed by a corrosion expert. BSK does not practice corrosion engineering. Consideration should also be given to soils in contact with concrete that will be imported to the project site during construction, such as topsoil and landscaping materials. For instance, any imported soil materials should not be any more corrosive than the on-site soils and should not be classified as being more corrosive than "moderately corrosive." Also, on-site cutting and filling may result in soils contacting concrete that were not anticipated at the time of this investigation.

7.12 Plan Review and Construction Observation

We recommend that BSK be retained by the Client to review the geotechnical aspects of the project plans and specifications before they go out to bid. It has been our experience that this review provides an opportunity to detect misinterpretation or misunderstandings of our recommendations prior to the start of construction.

Variations in soil types and conditions are possible and may be encountered during construction. To permit correlation between the soil data obtained during this investigation and the actual soil conditions encountered during construction, we recommend that BSK be retained to provide observation and testing services during site earthwork. This will allow us the opportunity to compare actual conditions exposed during construction with those encountered in our investigation and to provide supplemental recommendations if warranted by the exposed conditions. Earthwork should be performed in accordance with the recommendations presented in this report, or as recommended by BSK during construction. BSK should be notified at least two weeks prior to the start of construction and prior to when observation and testing services are needed.

8. ADDITIONAL SERVICES AND LIMITATIONS

8.1 Additional Services

The review of plans and field observation and testing during construction by BSK are an integral part of the conclusions and recommendations made in this report. If BSK is not retained for these services, the Client will be assuming BSK's responsibility for any potential claims that may arise during or after construction due to the misinterpretation of the recommendations presented herein. The recommended tests, observations, and consultation by BSK during construction include, but are not limited to:

- review of plans and specifications;
- observations of site grading, including stripping and engineered fill construction;
- observation of foundation construction, including drilled piers; and
- in-place density testing of fills, backfills, finished subgrades, and aggregate base.

8.2 Limitations

The findings, conclusions, and recommendations contained in this report are based on our field observations and subsurface exploration, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil and subsurface conditions could vary between or beyond the points explored. If soil conditions are encountered during construction that differ from those described herein, we should be notified immediately in order that a review may be made and any supplemental recommendations provided. If the scope of the proposed construction changes from that described in this report, our recommendations should also be reviewed.

We prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the Site area at the time of our study. No warranty, either express or implied, is made. The recommendations provided in this report are based on the assumption that an adequate program of tests and observations will be conducted by BSK during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the Client and only for the purposes stated within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report, or if conditions at the Site have changed. If this report is used beyond this period, BSK should be contacted to evaluate whether site conditions have changed since the report was issued.

Also, land or facility use, on and off-site conditions, regulations, or other factors may change over time, and additional work may be required with the passage of time. Based on the intended use of the report, BSK may recommend that additional work be performed and that an updated report be issued.

The scope of services for this report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this Site.

BSK conducted subsurface exploration and provided recommendations for this project. We understand that BSK will be given an opportunity to perform a formal geotechnical review of the final project plans and specifications. In the event BSK is not retained to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted, we will assume no responsibility for misinterpretation of our recommendations.

We recommend that all foundation excavations and earthwork during construction be monitored by a representative from BSK, including site preparation, foundation excavations, and placement of engineered fill, trench backfill, and aggregate base. The purpose of these services would be to provide BSK the opportunity to observe the actual soil conditions encountered during construction, evaluate the applicability of the recommendations presented in this report to the soil conditions encountered, and recommend appropriate changes in design or construction procedures if conditions differ from those described herein.

9. CLOSURE

BSK appreciates the opportunity to provide our services to you and trust this report meets your needs at this time. If you have any questions concerning the information presented, please contact us at 925-315-3151.

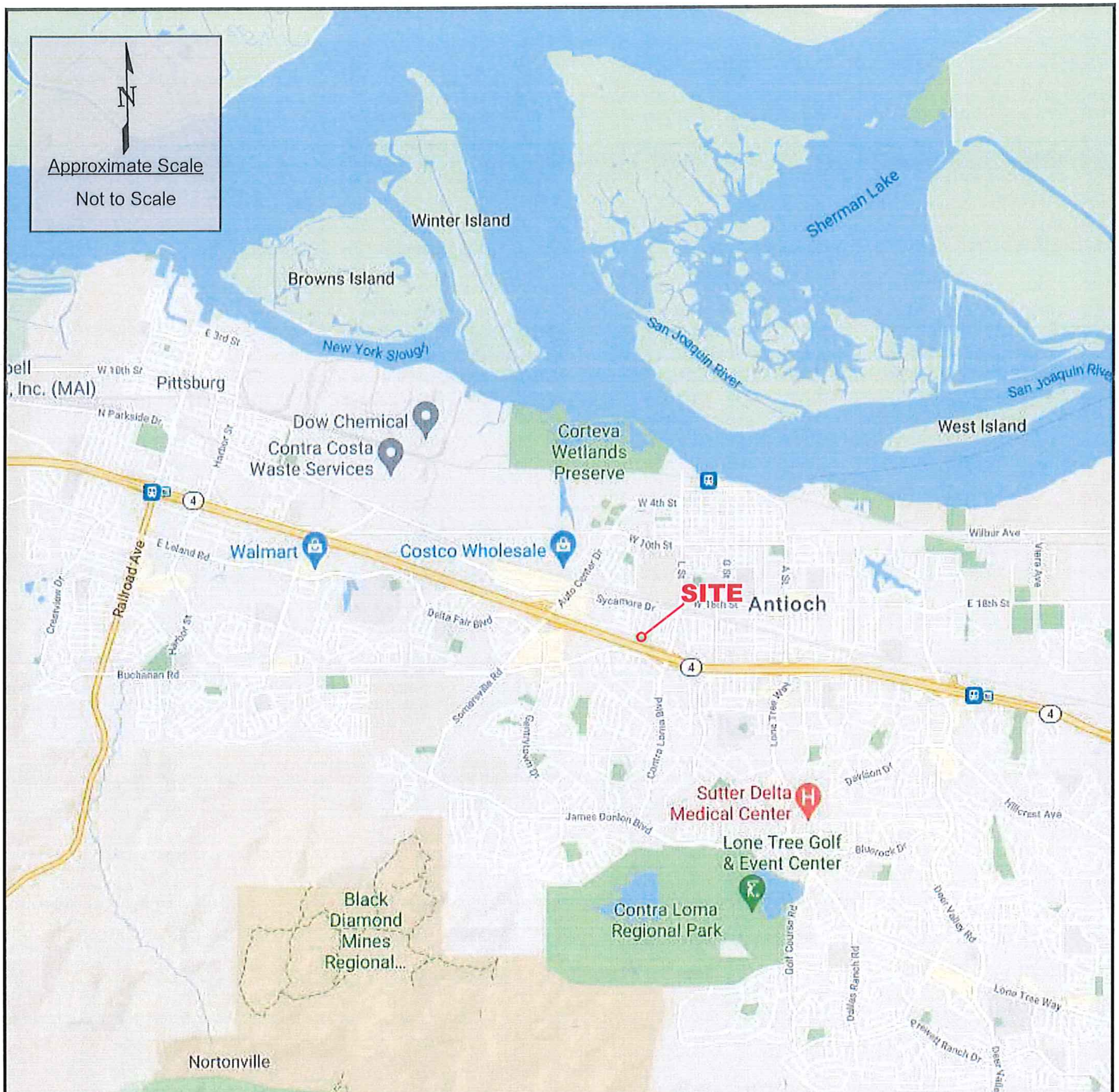
Respectfully submitted,
BSK Associates

Omar K Khan
Project Geologist

Cristiano Melo, PE, GE #2756
Livermore Branch Manager

REGISTERED PROFESSIONAL ENGINEER
CRISTIANO B.C. DEMELO
No. 2756
Exp. 09/30/24
GEOTECHNICAL
STATE OF CALIFORNIA

FIGURES



References: 1. https://maps.google.com, 2021
Note: Location is approximate

BSK ASSOCIATES

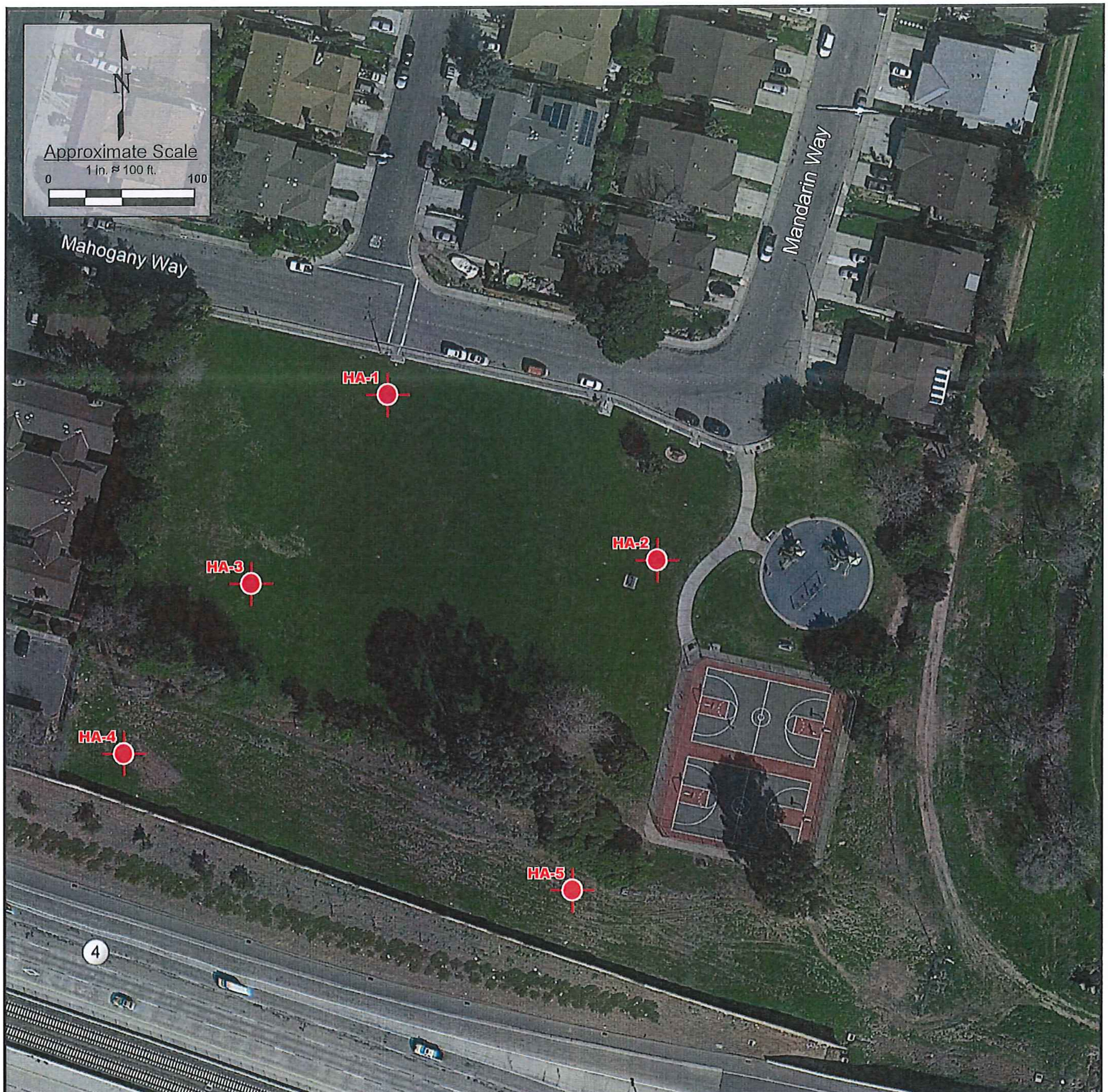
PROJECT NO.	G21-189-11L
DRAWN:	06/30/21
DRAWN BY:	D. Tower
CHECKED BY:	O. Khan
FILE NAME:	VicMap.indd

VICINITY MAP

Contra Loma Estates Park Renovation
Mahogany Way and Mandarin Way
Antioch, California

FIGURE

1



References: 1. http://earth.google.com, 2021

Legend

HA-1 Approximate Hand Auger Location

BSK ASSOCIATES

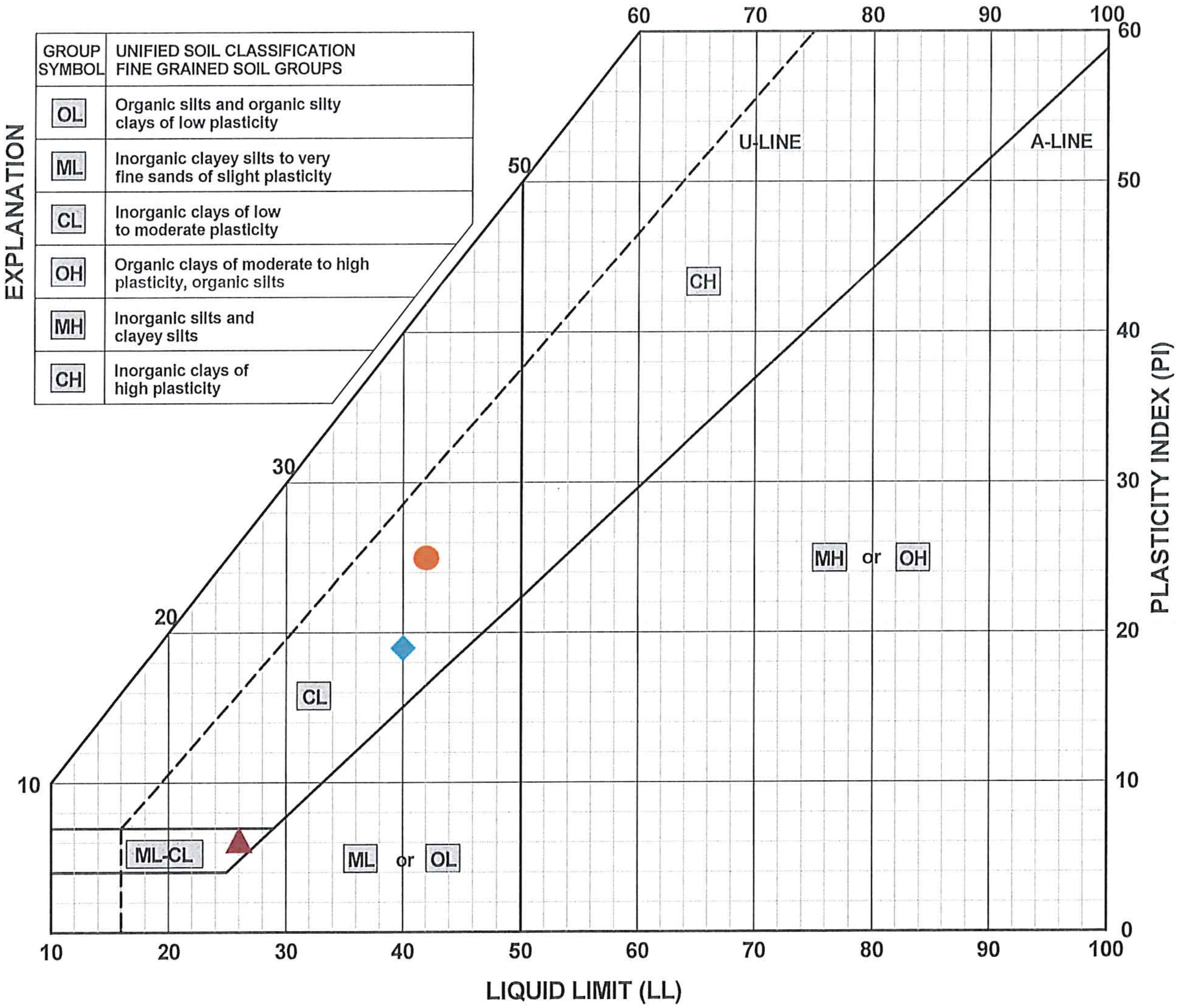
PROJECT NO. G21-189-11L	**SITE PLAN**	FIGURE
DRAWN: 06/30/21		
DRAWN BY: D. Tower		2
CHECKED BY: O. Khan	Contra Loma Estates Park Renovation Mahogany Way and Mandarin Way Antioch, California	
FILE NAME: Figures.indd		

APPENDIX A

Laboratory Test Results

EXPLANATION

GROUP SYMBOL	UNIFIED SOIL CLASSIFICATION FINE GRAINED SOIL GROUPS
OL	Organic silts and organic silty clays of low plasticity
ML	Inorganic clayey silts to very fine sands of slight plasticity
CL	Inorganic clays of low to moderate plasticity
OH	Organic clays of moderate to high plasticity, organic silts
MH	Inorganic silts and clayey silts
CH	Inorganic clays of high plasticity



LEGEND:	SOURCE	DEPTH (ft)	LL	PL	PI	DESCRIPTION
	HA-1	1.5-5.0	40	21	19	Sandy Lean Clay (CL)
	HA-3	1.0-4.0	26	20	6	Clayey Sand (SC)
	HA-5	1.0-3.5	42	17	25	Sandy Lean Clay (CL)

BSK ASSOCIATES

PROJECT NO. G21-189-11L
DRAWN: 06/30/21
DRAWN BY: D. Tower
CHECKED BY: O. Khan
FILE NAME: SitePlan.indd

ATTERBERG LIMITS

Contra Loma Estates Park Renovation
Mahogany Way and Mandarin Way
Antioch, California

FIGURE A-1

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 **462 2771** Fax. 925 **462 2775**
www.cercoanalytical.com

25 June, 2021

Job No. 2106085
Cust. No. 12667

Mr. Omar Khan
BSK Associates Engineers & Laboratories
399 Lindbergh Avenue
Livermore, CA 94551

Subject: Project No.: G21-189-11L
Project Name: Contra Loma Estates Park - Antioch
Corrosivity Analysis – ASTM Test Methods

Dear Mr. Kahn:

Pursuant to your request, CERCO Analytical has analyzed the soil sample submitted on June 15, 2021. Based on the analytical results, this brief corrosivity evaluation is enclosed for your consideration.

Based upon the resistivity measurement, this sample is classified as "corrosive". All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be properly protected against corrosion depending upon the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

The chloride ion concentration is 34 mg/kg and is determined to be insufficient to attack steel embedded in a concrete mortar coating.

The sulfate ion concentration is 38 mg/kg and is determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at this location.

The pH of the soil is 8.36 which does not present corrosion problems for buried iron, steel, mortar-coated steel and reinforced concrete structures.

The redox potential is 270-mV and is indicative of potentially "slightly corrosive" soils resulting from anaerobic soil conditions.

This corrosivity evaluation is based on general corrosion engineering standards and is non-specific in nature. For specific long-term corrosion control design recommendations or consultation, please call *JDH Corrosion Consultants, Inc. at (925) 927-6630.*

We appreciate the opportunity of working with you on this project. If you have any questions, or if you require further information, please do not hesitate to contact us.

Very truly yours,
CERCO ANALYTICAL, INC.

for

J. Darby Howard, Jr., P.E.
President

JDH/jdl
Enclosure

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax. 925 462 2775
www.cercoanalytical.com

Client: BSK Associates Engineers & Laboratories
Client's Project No.: G21-189-11L
Client's Project Name: Contra Loma Estates Park - Antioch
Date Sampled: 9-Jun-21
Date Received: 15-Jun-21
Matrix: Soil
Authorization: Signed Chain of Custody

Date of Report: 25-Jun-2021

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
2106085-001	HA-1, Sample 2 @ 1.5-5'	270	8.36	-	830	-	34	38

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Reporting Limit:	-	-	10	-	50	15	15
Date Analyzed:	21-Jun-2021	21-Jun-2021	-	21-Jun-2021	-	22-Jun-2021	22-Jun-2021

* Results Reported on "As Received" Basis
N.D. - None Detected

Cheryl McMillen
Laboratory Director

Quality Control Summary - All laboratory quality control parameters were found to be within established limits