Geotechnical Engineering Report

MATSUYAMA ELEMENTARY SCHOOL IMPROVEMENTS

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Sacramento, California

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1. INTRODUCTION

We have completed a geotechnical engineering study for the planned improvements of Matsuyama Elementary School in Sacramento, California (Figure 1). The purpose of our study has been to explore the existing soil, geologic, and groundwater conditions at the site, and to provide geotechnical engineering conclusions and recommendations for use by the other members of the design team for design and construction of the proposed project. This report presents the results of our study.

1.1. Purpose and Scope of Services

Our scope of services for this project included the following:

1. Conduct a site reconnaissance;
2. Review historic United States Geological Survey (USGS) topographic maps, historical aerial photographs, and available groundwater date in the vicinity of the property;
3. Review previous geotechnical engineering reports and pertinent soils, groundwater, and geologic references;
4. Review of geologic maps and fault maps;
5. Obtain necessary boring permits from the Sacramento County Environmental Management Department (SCEMD);
6. Conduct subsurface explorations, including the drilling and sampling of eight borings to a maximum depth of about 21½ feet below existing grades (BGS);
7. Collect bulk and undisturbed samples of soils;
8. Conduct laboratory testing on selected soil samples;
9. Perform engineering analyses; and,
10. Preparation of this report.

1.2. Related Experience and Supplemental Information

Supplemental information reviewed during the preparation of this report included the following reports:

- Wallace-Kuhl & Associates, Inc, 2003, *Geotechnical Engineering Report*, prepared for 7446 Pocket Road Subdivision (WKA 9816.01, dated August 23, 2013), located about 0.6 miles northwest of the site;
- Wallace-Kuhl & Associates, Inc., 2008, *Geological Hazards and Geotechnical Engineering Report*, prepared for Garcia Bend Park Picnic Shade Shelter and Tennis Court (WKA No. 7515.01, dated February 23, 2007), located about 0.3 miles south of the site.

1.3. Figures and Attachments

This report contains a site Vicinity Map as Figure 1; a Site Plan showing the approximate boring locations as Figure 2; and Logs of Soil Borings as Figures 3 through 8. An explanation of the symbols and classification system used on the logs is included as Figure 9.

The following figures and attachments are included with this report:

- A Vicinity Map showing the location of the site is included as Figure 1;
- A Site Plan showing the approximate locations of the borings in Figure 2;
- Logs of Soil Borings are presented in Figures 3 through 8;
- An explanation of the symbols and classification system used on the logs appears in Figure 9;

Appendix A contains general information regarding project concepts, exploratory methods used during our study, and laboratory test results not included on the boring log.

1.4. Proposed Development

We understand the proposed improvements for the existing elementary school will include construction of a play field, a running track, volleyball and basketball courts, two playgrounds, study and respite areas and shade structures. Associated improvements will include construction of underground utilities, landscaping, concrete and asphalt pavements, and exterior flatwork.

Grading plans were not available to us at the time this report was prepared; however, based on the existing site topography and planned development, we anticipate excavations and fills on the order of one to five feet will be required for development of the property.

2. FINDINGS

2.1. Site Description

The polygon-shaped property encompasses a total area of approximately 8 acres and is identified by Sacramento County Assessor Parcel Number 031-1150-001-0000. The property is bounded on the north by a small inlet which is connected to the Sacramento River, on the southeast, by Windbridge Drive, and on the west by a residential subdivision. The site is less than one mile east of the Sacramento River (Figure 1). The neighboring blocks are developed with single-family residences on all sides. Based on Google Earth, the average elevation at the site approximately +6 to +8 feet with the World Geodetic System of 1984 (WGS84) datum.

At the time of our field explorations in September of 2023, several mature trees are located along the northern, southern, and northwestern boundaries of the property.

2.2. Subsurface Soil Conditions

Our subsurface explorations were performed on September 29, 2023, and consisted of six borings (B1 through B6) drilled and sampled to an approximate depth between 10 and 21½ feet BGS.

Borings, B1, through B6 revealed approximately five to eight feet of loose to medium stiff (medium dense) surficial sandy and silty soils. Very loose and loose silts and sands underlay the surficial soils to the explored depth.

At completion of field explorations, the borehole was backfilled with a slurry of neat cement and water as required by the Sacramento County Environmental Management Department.

No visual or olfactory evidence of petroleum hydrocarbons were noted in the soil samples collected from the boring drilled at the site.

For detailed information regarding the soil layering, please refer to the log of soil boring, Figures 3 through 8. An explanation of the Unified Soil Classification System symbols used on the boring log is included in Figure 9.

2.3. Groundwater

Groundwater was encountered during our subsurface explorations performed in September of 2023 at approximately 9 to 14 feet BGS. We measured the groundwater elevation in borings B3 and B5 approximately at -8 and -5.5 feet (WGS84), and in the other borings consistently at approximately -3 feet (WGS84), or 9- to 10-feet BGS.

Due to proximity of the property to the Sacramento River, groundwater levels in this area fluctuate with the water levels of the river.

3. CONCLUSION

3.1. Bearing Capacity and Building Support

Based on our field investigation and laboratory test results, it is our opinion the undisturbed native soils and engineered fill, properly placed and compacted in accordance with the recommendations of this report, can support athletic and recreational improvements provided the recommendations included in this report regarding site clearing, subgrade preparation, and engineered fill placement are carefully followed.

An important aspect of site development will be the adequate clearing of existing surface and subsurface features associated with the existing structures, the proper backfilling of depressions created by structure removal, and uniform compaction of all disturbed soils. During demolition we anticipate that the upper one foot of near-surface soils will become disturbed. Thorough compaction of the upper soils will be crucial to providing uniform support of the planned structures and pavements, if applicable.

3.2. Seismic Site Class

Based on the soil conditions encountered during field exploration, laboratory tests and our experience with similar soils, we understand the site soil can be classified as Site Class D, Stiff Soil, according to Table 20.3-1 of American Society of Civil Engineers (ASCE) Standard 7-16.

3.3. Seismic Design Parameters

The 2022 edition of the California Building Code (CBC) references the American Society of Civil Engineers (ASCE) Standard 7-16 for seismic design. Using the latitude and longitude for the approximate center of the project site, Table 1 provides the 2022 seismic design parameters developed using a web interface developed by ASCE (asce7hazardtool.online).

TABLE 1
2022 CBC/ASCE 7-16 SEISMIC DESIGN PARAMETERS

Latitude: 38.4820° N Longitude:121.5365° W	ASCE 7-16 Table/Figure	2022 CBC Table/Figure	Factor/ Coefficient	2022 CBC Value
0.2-second Period MCE	Figure 22-1	Figure 1613.2.1(1)	S_S	0.63g
1.0-second Period MCE	Figure 22-2	Figure 1613.2.1(2)	S_1	0.27 g

TABLE 1
2022 CBC/ASCE 7-16 SEISMIC DESIGN PARAMETERS

Latitude: 38.4820° N Longitude:121.5365° W	ASCE 7-16 Table/Figure	2022 CBC Table/Figure	Factor/ Coefficient	2022 CBC Value
Soil Class	Table 20.3-1	Section 1613.2.2	Site Class	D
Site Coefficient	Table 11.4-1	Table 1613.2.3(1)	F_a	1.30
Site Coefficient	Table 11.4-2	Table 1613.2.3(2)	F_v	2.06*
Adjusted MCE Spectral Response Parameters	Equation 11.4-1	Equation 16-20	S_{MS}	0.82 g
	Equation 11.4-2	Equation 16-21	S_{M1}	0.83 g*
Design Spectral Acceleration Parameters	Equation 11.4-3	Equation 16-22	S_{DS}	0.54 g
	Equation 11.4-4	Equation 16-23	S_{D1}	0.56 g*
Seismic Design Category	Table 11.6-1	Table 1613.2.5(1)	Risk Category I through IV	D
	Table 11.6-2	Table 1613.2.5(2)	Risk Category I through IV	D

Notes: MCE = Maximum Considered Earthquake
g = gravity
* = The value must be increased by 50 percent in accordance with the Exception for Site Class D of ASCE 7-16, Supplement 3, Section 11.4.8.

As the value of S_1 is greater than 0.2 g, to implement the map-based response spectrum in design of a structure on Site Class D, the value of parameter S_{M1} must be increased by 50% (ASCE 7-16; 11.4.8, Exception). In other words, the F_v value will be 1.5 times the reported value in Table 1. This in turn results in a 50-percent increase in values of S_{D1} and T_s, resulting in an extension of the acceleration-controlled plateau of the design spectrum and Seismic Response Coefficient (C_s, ASCE 7-16; 12.8-2) to longer periods.

3.4. Excavation Conditions

The surface and near-surface soils at the site should be readily excavatable with conventional earthmoving and trenching equipment. Based on our borings, excavations associated with foundations, shallow trenches for utilities, and other excavations less than five feet deep associated with the proposed construction, should stand vertically for short periods of time (i.e., less than one day) required for construction, unless cohesionless, saturated or disturbed soils are encountered. These unstable conditions may result in caving or sloughing; therefore, the contractor should be prepared to brace or shore the excavations, if necessary.

Excavations or trenches exceeding five feet in depth that will be entered by workers should be sloped, braced, or shored to conform to current California Occupational Safety and Health Administration (Cal/OSHA) requirements. The contractor must provide an adequately constructed and braced shoring system in accordance with federal, state, and local safety regulations for individuals working in an excavation that may expose them to the danger of moving ground.

Based on subsurface data and groundwater data reviewed, we anticipate excavations extending deeper than approximately 9 feet below the current ground surface to encounter groundwater and require dewatering. Fluctuations will depend on seasonal and precipitation variations and groundwater level can be as low as -8 feet WGS84 or 14 feet below the current ground surface during a dry season. Please refer to the *Groundwater Effect on Development and Construction Dewatering* section in this report for our discussion of dewatering alternatives and the impact of dewatering on surrounding developments.

Based upon our experience in the soils in this area, temporarily sloped excavations less than eight feet in depth should be constructed no steeper than a one and one-half horizontal to one vertical (1½H:1V) inclination. Temporary slopes likely will stand at this inclination for the short-term duration of construction, provided significant pockets of loose and/or saturated granular soils are not encountered. Flatter slopes would be required if these conditions are encountered. Temporary shoring or slot cut excavation may be adopted where a temporary slope is not viable due to limited space. Permanent soil excavation and embankment slopes should be constructed no steeper than two horizontal to one vertical (2H:1V).

3.5. Soil Expansion Potential

Our borings encountered near-surface clayey silt soils. Based on our experience with similar soils, it is our opinion that these soils are capable of exerting low to moderate expansion pressures on foundation, exterior flatwork, and pavements.

3.6. Pavement Subgrade Quality

Near-surface clayey silt soils were encountered in our borings. We performed a laboratory test of the near-surface clays to evaluate the Resistance ("R") values for subgrade soils in accordance with California Test 301. The laboratory test results revealed the near-surface clay soils are good quality materials for the support of asphalt concrete pavements. We have provided pavement sections based on a Resistance ("R") value of 15 associated with these soils.

3.7. Soil Suitability for Engineered Fill Construction

The on-site soils encountered in our borings are considered suitable for use in engineered fill construction, provided these materials do not contain significant organics, debris, concrete rubble, particles larger than three inches in maximum dimension, and other deleterious materials, and are at moisture contents capable of achieving the desired degree of compaction. Existing asphalt concrete and Portland cement concrete pavements may be used as engineered fill materials provided that these materials are processed to pieces less than three inches in largest dimension, thoroughly mixed with soil, and moisture conditioned to achieve the desired degree of compaction.

3.8. Soil Corrosion Potential

A sample of near-surface soil was submitted to Sunland Analytical Lab for testing to determine pH, chloride and sulfate concentrations, and minimum resistivity to help evaluate the potential for corrosive attack upon buried concrete. The results of the corrosivity testing revealed a soil pH of 6.93 and a minimum resistivity of 990 ohm-centimeters. Chloride and sulfates were detected at concentrations of 5.1 and 67 parts per million (ppm), respectively. A copy of the analytical report is presented in Figure A3.

The California Department of Transportation Corrosion and Structural Concrete Field Investigation Branch, *Corrosion Guidelines*, Version 3.2, dated March 2021, considers a site to be corrosive to foundation elements if one or more of the following conditions exists for the representative soil and/or water samples taken: has a chloride concentration greater than or equal to 500 ppm, sulfate concentration greater than or equal to 1,500 ppm, resistivity value for of less 1,100 ohm-cm, or the pH is 5.5 or less. Based on this criterion, the on-site soils are considered corrosive to buried metal or steel reinforcement properly embedded within Portland cement concrete (PCC). The surface and near-surface soils present at the site may be moderately to highly corrosive to unprotected metal.

Generally, soil resistivity has the greatest impact on corrosion with respect to soil properties and environmental severity conditions. Soils with the poorest drainage, such as clays, and the highest moisture content have lower resistivity values and are generally the most corrosive. Conversely well drained soils like sands and gravels, have higher resistivity and are considered the least corrosive. Backfilling pipe trenches and excavations with sand or gravel improves the long-term protection in corrosive poorly draining soils. Resistivity of the tested sample suggests that the soils at this site are extremely corrosive to buried metals.

Table 19.3.1.1 – *Exposure Categories and Classes*, of American Concrete Institute (ACI) 318-19, Section 19.3 – Concrete Durability Requirements, as referenced in Section 1904.1 of the 2019/2022 *CBC*, indicates the severity of sulfate exposure for the samples tested is likely Exposure Class *S0*. Ordinary Type I-II

Portland cement is considered suitable for use on this project, assuming a minimum concrete cover as detailed in ACI 318-19, Section 20.6.1.3 is maintained for all reinforcement (ACI, 2019).

The UES consultants are not corrosion engineers. Therefore, to further define the soil corrosion potential at the site, we strongly recommend that a corrosion engineer be consulted to provide specific recommendations to resist corrosion.

3.9. Groundwater Effect on Development and Construction Dewatering

Based on our recent explorations performed at the site and historical groundwater data, we do not anticipate excavations less than about five feet below existing site grades to encounter permanent groundwater, although locally perched groundwater could be encountered. The geologic conditions across site consist of near-surface silt underlain by loose sand.

3.10. Seasonal Water

It should be noted that the near-surface soils would be in a near-saturated condition during and for a considerable period following the rainy season. Grading operations attempted following the onset of winter rains and prior to prolonged drying periods will be hampered by high soil moisture contents. Soils beneath existing asphalt pavements, exterior flatwork, and slab areas will be at an elevated moisture content regardless of the time of year. Such soils, intended for use as engineered fill, will require considerable aeration to reach a moisture content that will permit the recommended level of compaction to be achieved.

4. RECOMMENDATIONS

4.1. General

Grading plans were not available at the time this report was prepared; however, we anticipate that maximum excavations and fills on the order of five feet are planned for the athletic improvements of the site. The recommendations contained in this report are based upon this assumption.

Also, the recommendations presented below are appropriate for typical construction in the late spring through fall months. The on-site soils likely will be saturated by rainfall in the winter and early spring months and will not be compactable without drying by aeration or the addition of lime (or a similar product). Should the construction schedule require work to continue during the wet months, additional recommendations can be provided, as conditions warrant.

The Geotechnical Engineer of Record referenced herein should be considered the Geotechnical Engineer that is retained to provide geotechnical engineering observation and testing services during construction. References to Geotechnical Engineer should be understood to be the Geotechnical Engineer of Record, or his or her designated on-site representative. Site preparation should be accomplished in accordance with the provisions of this report. A representative of the Geotechnical Engineer should be present during all earthwork to evaluate compliance with our recommendations and the approved project plans and specifications.

4.2. Site Clearing

Grasses and organically contaminated topsoil, if any at the time of construction, should be stripped from construction areas. Trees designated for removal should include the entire root ball and all roots larger than ½-inch in diameter. Strippings may be stockpiled for later use or disposed of off-site. Adequate removal of debris and tree roots may require handpicking by laborers to clear the subgrade soils to the satisfaction of our on-site representative. Existing underground utilities to be abandoned should be completely removed, including existing trench backfill. Where practical, site clearing should extend at least five feet beyond the limits of the planned improvement areas. Strippings should not be used in general fill construction but may be used in landscaped areas provided they are kept at least five feet from paved areas, are less than one feet thick, and are moisture conditioned and compacted.

Prior to grading, remnants of any previous construction and subsurface improvements designated for removal should be relocated and construction areas should be cleared of surface and subsurface structures (including but not limited to miscellaneous surface trash, rubble, deleterious debris, fencing, etc.) associated with previous site activities to expose firm and stable soils, as determined by the Geotechnical Engineer’s representative. Initial clearing of the construction areas should include the stripping of surface vegetation and removal of tree roots exposed by the grading operations; relocation of the storm drain and subsurface irrigation lines at the shade structure site; and, removal of any surface or subsurface items that might be encountered during construction.

Existing pavements and concrete slabs designated for removal may be broken up, pulverized, and reused as engineered fill, or removed from the site. If pavement and/or concrete rubble is to be reused as engineered fill, it should be pulverized to fragments less than three inches in largest dimension and contain sufficient intermediate sized particles to form a compactable mixture and must be approved by the school district.

We consider it essential that the Geotechnical Engineer’s representative be present during site clearing activities to observe the behavior of compaction equipment and verify the compaction of the subgrade.

4.3. Site Grading

Following site clearing activities, the exposed soil should be scarified to a depth of at least twelve inches, thoroughly moisture conditioned to at least two percent above the optimum moisture content, and uniformly compacted to not less than 90 percent of the maximum dry density as determined by the ASTM D1557 test method, regardless of whether final subgrade elevation is completed by excavation, filling, or left at existing grade.

The upper 12 inches of final exterior flatwork areas should consist of non-expansive granular on-site or import soils compacted to at least 90 percent relative compaction at the optimum moisture content or above (ASTM D1557).

The upper six inches of pavement subgrade soils should be compacted to at least 95 percent relative compaction at no less than the optimum moisture content (ASTM D1557).

We recommend the Geotechnical Engineer's representative be present on a regular basis during all earthwork operations to observe and test the engineered fill and to verify compliance with the recommendations of this report and the project plans and specifications.

4.4. Engineered Fill Construction

On-site soils are suitable for engineered fill construction in structural areas provided the materials do not contain rubbish, rubble greater than three inches, and significant organic concentrations. Imported fill materials, if required, should be compactable, granular soils with an Expansion Index of 20 or less, and contain no particles greater than three inches in maximum dimension. Imported soils should be approved by our office prior to being transported to the site. In addition, if required for fire lane or vehicular pavement areas, imported fill within the upper three feet of pavement areas should possess an R-value of at least 20. Also, if import fills are required (other than aggregate base), the contractor must provide appropriate documentation that the import is clean of known contamination per Department of Toxic Substances Control (DTSC) and within acceptable corrosion limits.

Engineered fill should be placed in lifts that do not exceed six inches in compacted thickness. Native or imported materials should be thoroughly moisture conditioned to the approximate optimum moisture content and uniformly compacted to at least 90 percent of the ASTM D1557 maximum dry density.

The upper 12 inches of final building pad subgrades, including adjacent exterior flatwork areas and non-vehicular traffic areas, should be compacted to at least 90 percent relative compaction at approximately the optimum moisture content.

The upper six inches of pavement subgrades should be uniformly compacted to at least 95 percent of the maximum dry density at a moisture content of at approximately the optimum moisture content and must be stable under construction traffic prior to placement of aggregate base.

Permanent excavation and fill slopes should be constructed no steeper than two horizontal to one vertical (2:1) and should be vegetated as soon as practical following grading to minimize erosion. Slopes should be over-built and cutback to design grades and inclinations.

4.5. Utility Trench Backfill

Utility trench backfill should be mechanically compacted as engineered fill in accordance with the following recommendations. Bedding of utilities and initial backfill around and over the pipe should conform to the manufacturer's recommendations for the pipe materials selected and applicable sections of the City of Sacramento standards, if applicable. On-site soils are corrosive and may be used as general backfill material above initial pipe backfill assuming the soils are clean of rubble, organics, deleterious debris and at an appropriate moisture content necessary to achieve the desired degree of compaction. If crushed rock is used as bedding and initial pipe backfill, the rock should be covered (or wrapped) with a non-woven geotextile filter fabric (Mirafi 160N or equivalent) to prevent the migration of fine-grained soils downward into the crushed rock.

Utility trench backfill should be placed in relatively thin, level lifts, moisture conditioned to at least two percent above the optimum moisture content and mechanically compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. Actual lift thickness will depend on the material type and type of compaction equipment utilized during construction but should not be more than 12 inches.

Within the upper six inches of pavement areas within a twelve-inch horizontal margin from the edge of pavement subgrade should be compacted to at least 95 percent relative density at no less than the optimum moisture content as determined by ASTM D1557.

Trench backfill materials and compaction within street rights-of-way should conform to the applicable portions of the City of Sacramento standards, latest edition. Utility trench backfill should be continuously observed and tested during construction.

4.6. Foundation Design

Based on our understanding of the project, it is our opinion that the proposed improvements can be supported on shallow conventional foundations. Lateral forces due to wind and earthquake exerted to the canopy or other structures may require a drilled pier foundation. A summary of each foundation design is described as follows.

4.6.1. Conventional Spread Footings

Structures may be supported upon spread foundation that extend at least 18 inches below lowest adjacent soil grade. Isolated spread foundations should maintain a minimum 24 inches in plan dimension. Foundations bearing in undisturbed or recompacted native soils, engineered fill, or a combination of those materials may be sized for maximum allowable "net" soil bearing pressure of 2,000 pounds per square foot (psf) for dead plus live loads, with a 1/3 increase for total loads including wind or seismic forces. The weight of the foundation concrete extending below lowest adjacent soil grade may be disregarded in sizing computations.

All foundations should be adequately reinforced to provide structural continuity, mitigate cracking, and permit spanning of local soil irregularities. The structural engineer should determine final foundation reinforcing requirements.

Resistance to lateral displacement of shallow foundations may be computed using an allowable friction factor of 0.25 multiplied by the effective vertical load on each foundation. Additional lateral resistance may be achieved using an allowable passive earth pressure against the vertical projection of the foundation equal to an equivalent fluid pressure of 150 psf per foot of depth. These two modes of resistance should not be added unless the frictional component is reduced by 50 percent since mobilization of the passive resistance requires some horizontal movement, effectively reducing the frictional resistance.

4.6.1. Pier Foundations

Based on our experience with similar projects, we anticipate the canopy structures may be supported on drilled piers. Drilled piers should be no less than 18 inches in diameter and should extend at least five feet below the existing ground surface.

Drilled piers may be sized utilizing an allowable end-bearing capacity of 5,000 psf or allowable skin friction of 500 psf for dead plus live loads, which may be applied over the surface of the pier. This value may be increased by one-third to include the short-term wind or seismic forces. The weight of foundation concrete below grade may be disregarded in sizing computations for the end-bearing condition.

Uplift resistance of pier foundations may be computed using the following resisting forces, where applicable: 1) weight of the pier concrete (150 pounds per cubic foot), and 2) the allowable skin friction of 750 psf applied over the shaft area of the pier. Increased uplift resistance can be achieved by increasing the diameter of the pier or increasing the depth.

The upper 12 inches of skin friction should be disregarded unless the pier is completely surrounded by concrete or pavements for a distance of at least three feet from the edge of the foundation pier.

Lateral resistance of pier foundations may be evaluated by applying a passive earth pressure of equivalent to a fluid pressure of 150 psf per foot of depth.

Sizing of drilled piers to resist lateral loads can be evaluated using Section 1807.1 of the 2019 CBC. An allowable lateral soil bearing pressure of 150 psf per foot of depth may be used for to calculate CBC parameters S_1 (equation 18-1) and S_3 (equations 18-2 and 18-3) based on the design-specific embedment depth.

The structural engineer should determine if reinforcement of the piers is required and determine the reinforcing requirements. End bearing can be accounted for only if the bottom of the pier excavations should not contain loose or disturbed soils prior to placement of the concrete and reinforcement (if required). Cleaning of the bearing surface should be verified by the Geotechnical Engineer's representative prior to concrete placement. Concrete and reinforcement (if required) should be placed in the pier excavations as soon as possible, after the excavations are completed. The intent of this recommendation is to minimize the chances of sidewall caving into the excavations. Although we do not anticipate excessive sloughing of the sidewalls during pier construction, we recommend that the pier contractor be prepared to case the pier holes if conditions require.

If the drilled piers are constructed in the "dry" (with dry being less than two inches of water at the base of the excavation), the concrete may be placed by the free-fall method, using a short hopper or back-chute to direct the concrete flow out of the truck into a vertical stream of flowing concrete with a relatively small diameter. The stream is directed to avoid hitting the sides of the excavation or any reinforcing cages. For the free-fall method of concrete placement, we recommend the concrete mix be designed with a slump of five to seven inches.

If groundwater is encountered, such that more than six inches of water accumulates at the bottom of the pier excavation, concrete should be placed using a tremie. For concrete placed using the tremie method, a design slump of six to eight inches, and a maximum aggregate size of ¾-inch is recommended. The required slump should be obtained by using plasticizers or water-reducing agents. Addition of water on-site to establish the recommended slump should not be allowed.

When extracting temporary casings or tremie methods from drilled pier excavations (if required), care should be taken to maintain a head of concrete to prevent infiltration of water and soil into the shaft area. The head of concrete should always be greater than the head of water trapped outside the pier or tremie, taking into account the differences in unit weights of concrete and water.

4.7. Exterior Flatwork

Exterior flatwork should be underlain by at least four inches of Class 2 aggregate base compacted to at least 95 percent relative compaction. Exterior flatwork concrete should be at least four inches thick. Consideration should be given to thickening the edges of the slabs at least twice the slab thickness where wheel traffic is expected over the slabs. Expansion joints should be provided to allow for minor vertical movement of the flatwork. Exterior flatwork should be constructed independent of other structural elements by the placement of a layer of felt material between the flatwork and the structural element. Doweling of new flatwork into existing improvements (i.e., adjacent buildings, existing flatwork, etc.) is not recommended. The slab designer should determine the final thickness, strength and joint spacing of exterior slab-on-grade concrete. The slab designer should also determine if slab reinforcement for crack control is required and determine final slab reinforcing requirements.

Areas adjacent to exterior flatwork should be landscaped to maintain more uniform soil moisture conditions adjacent to and under flatwork. We recommend final landscaping plans not allow fallow ground adjacent to exterior concrete flatwork.

Practices recommended by the Portland Cement Association (PCA) for proper placement, curing, joint depth and spacing, construction, and placement of concrete should be followed during exterior concrete flatwork construction.

4.8. Site Drainage

Final site grading should be accomplished to provide positive drainage of surface water away from structures and prevent ponding of water adjacent to the foundations. The grade adjacent to the relocated structures should be sloped away from foundations at a minimum two percent slope for a distance of at least five feet, where possible. Ponding of surface water should not be allowed adjacent to the structure or exterior concrete flatwork.

4.9. Pavement Design

Laboratory testing of the anticipated pavement subgrade soils indicates these materials exhibit good subgrade qualities for support of asphalt concrete pavements. Based on our experience in the area, we have selected an R-value of 15 for the calculation of alternate asphalt pavement sections presented below.

The pavement sections provided in Table 2 have been calculated based on Traffic Indices (TI's) assumed appropriate for the project, laboratory results (see Figure A2) and an assumed R-value of 15. The procedures used for pavement design are in general conformance with Chapters 600 to 670 of the *California Highway Design Manual*, dated July 1, 2020 (Caltrans, 2020). The project civil engineer should determine the appropriate traffic index and pavement section based on anticipated traffic conditions. If needed, we can provide alternative pavement sections for different traffic indices.

We emphasize that the performance of pavement is critically dependent upon uniform and adequate compaction of the soil subgrade, as well as all engineered fill and utility trench backfill within the limits of the pavements. Final pavement subgrade preparation (i.e., scarification, moisture conditioning and compaction) should be performed after underground utility construction is completed and just prior to aggregate base placement.

The upper six inches of pavement subgrade soils should be compacted to at least 95 percent relative compaction at no less than two percent above the optimum moisture content (ASTM D1557).

Pavement subgrades should be stable and unyielding under heavy wheel loads of construction equipment. To help identify unstable subgrades within the pavement limits, a proof roll test is typically be performed with a fully loaded, water truck on the exposed subgrades prior to placement of aggregate base. The proof-roll should be observed by the Geotechnical Engineer's representative.

TABLE 6
PAVEMENT DESIGN ALTERNATIVES

Traffic Index (TI)	Pavement Use	Subgrades R-value = 15		
		Type A Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)	Portland Cement Concrete (inches)
5.0	Automobile Parking Only	3*	8*	--
		--	6	4
6.0	Automobile, Light Truck Traffic, and Fire Lanes	3.5*	10*	--
		--	6	5
7.0	Moderate Truck Traffic, Trash Enclosures, Delivery/Loading Areas	4*	13*	--
		--	7	6
8.0	Heavy Truck Traffic	5*	15*	--
		--	8	7

Note: * = Asphalt concrete thickness contains the Caltrans safety factor.

All aggregate bases should be compacted to at least 95 percent of the maximum dry density (ASTM D1557). Placement of aggregate base upon completed pavement subgrades should be accomplished within 72 hours to prohibit significant drying of the subgrade soils. Materials quality and construction of the structural section should conform to the applicable provisions of the Caltrans Standard Specifications and the City or County Standards, latest editions.

Efficient drainage of all surface water to avoid infiltration and saturation of the supporting aggregate base and subgrade soils is important to pavement performance. Weep holes could be provided at drainage inlets, located at the subgrade/base interface, to allow accumulated water to drain from beneath the pavements. Consideration should be given to using full-depth curbs between landscape/unpaved areas and pavements to serve as a cut-off for water that could migrate into the pavement base materials or subgrade soils.

Concrete slabs used in pavement areas should be constructed with thickened edges in accordance with American Concrete Institute design standards, latest edition. Reinforcing for crack control, if desired, should be provided in accordance with ACI guidelines. Reinforcement must be located at mid-slab depth to be effective. Joint spacing and details should conform to the current PCA or ACI guidelines. PCC should achieve a minimum compressive strength of 3,500 pounds per square inch at 28 days.

All pavement materials and construction methods of structural pavement sections should conform to the applicable provisions of the Caltrans Standard Specifications, latest edition.

4.10. Geotechnical Engineering Construction Observation Services

Site preparation should be accomplished in accordance with the recommendations of this report. Representatives of the Geotechnical Engineer should be present during site preparation and all grading operations to observe and test the fill to verify compliance with our recommendations and the job specifications. Testing frequency will depend on how the site is graded and should be determined during the rough grading operations. These services are beyond the scope of work authorized for this investigation.

If Universal Engineering Sciences is not retained to provide geotechnical engineering observation and testing services during construction, the Geotechnical Engineer retained to provide these services should indicate in writing that they agree with the recommendations of this report or prepare supplemental recommendations as necessary. A final report by the Geotechnical Engineer providing construction testing services should be prepared upon completion of the project.

4.11. Additional Services

Our firm should be retained to review the final plans and specifications to determine if the intent of our recommendations has been implemented in those documents. We would be pleased to submit a proposal to provide these services upon request.

5. LIMITATIONS

Our recommendations are based upon the information provided regarding the proposed project, combined with our analysis of site conditions revealed by the field exploration and laboratory testing programs. We have used engineering judgment based upon the information provided and the data generated from our study. This report has been prepared in substantial compliance with generally accepted geotechnical engineering practices that exist in the area of the project at the time the report was prepared. No warranty, either express or implied, is provided.

If the proposed construction is modified or re-sited; or, if it is found during construction that subsurface conditions differ from those we encountered at the exploration locations, we should be afforded the opportunity to review the new information or changed conditions to determine if our conclusions and recommendations must be modified.

We emphasize that this report is applicable only to the proposed construction and the investigated site and should not be utilized for construction on any other site. The conclusions and recommendations of this report are considered valid for a period of two years. If design is not completed and construction has not started within two years of the date of this report, the report must be reviewed and updated, if necessary.

Universal Engineering Sciences (UES)

Roozbeh Afshar

REGISTERED PROFESSIONAL ENGINEER
ROUZBEH AFSHARHASANI
No. 87032
CIVIL
STATE OF CALIFORNIA

Roozbeh Afshar, PhD, PE
Principal Engineer

Kristie Stromgren, E.I.T
Staff Engineer

6. REFERENCES

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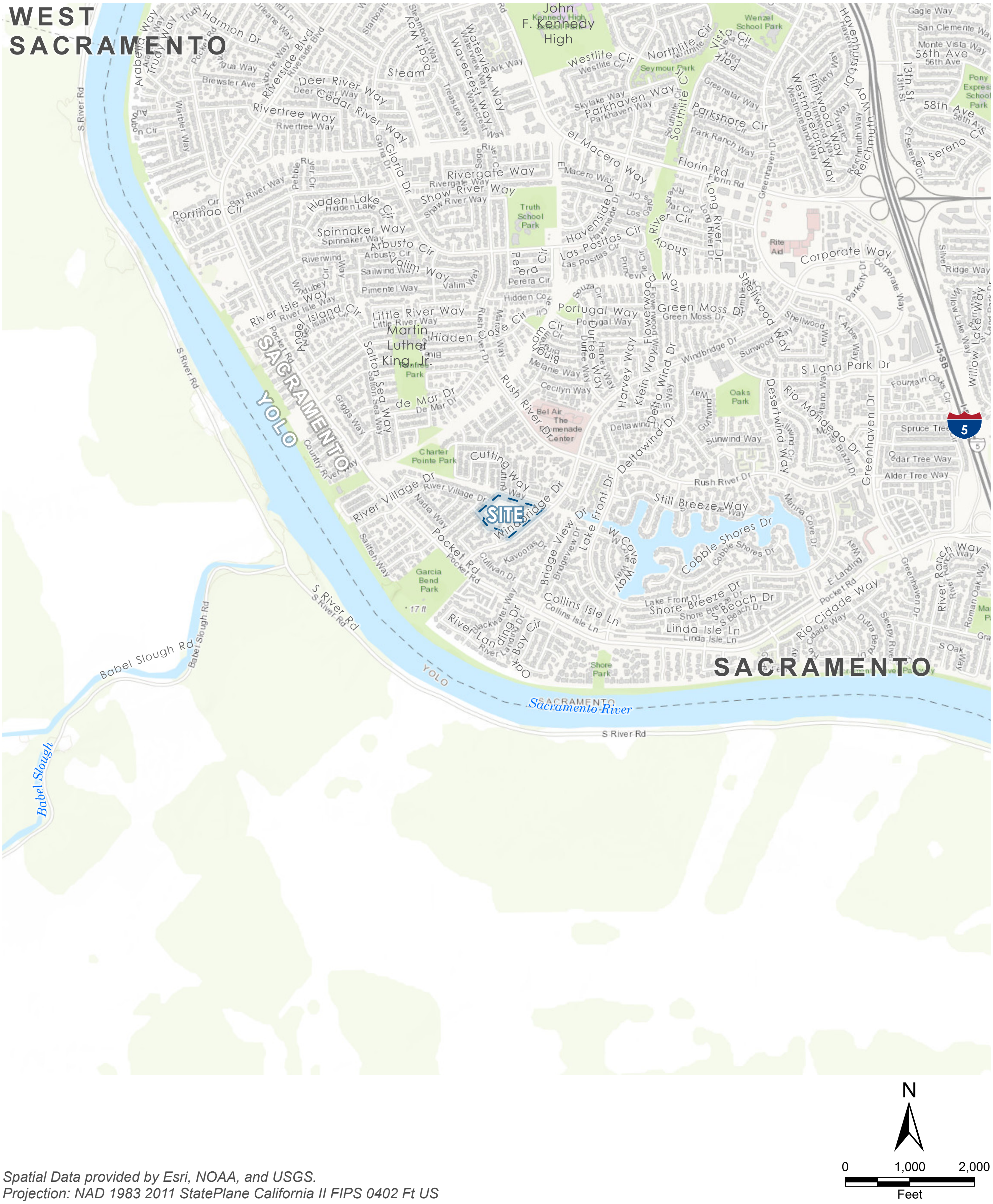
FIGURES



Spatial Data provided by Esri, NOAA, and USGS.
Projection: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

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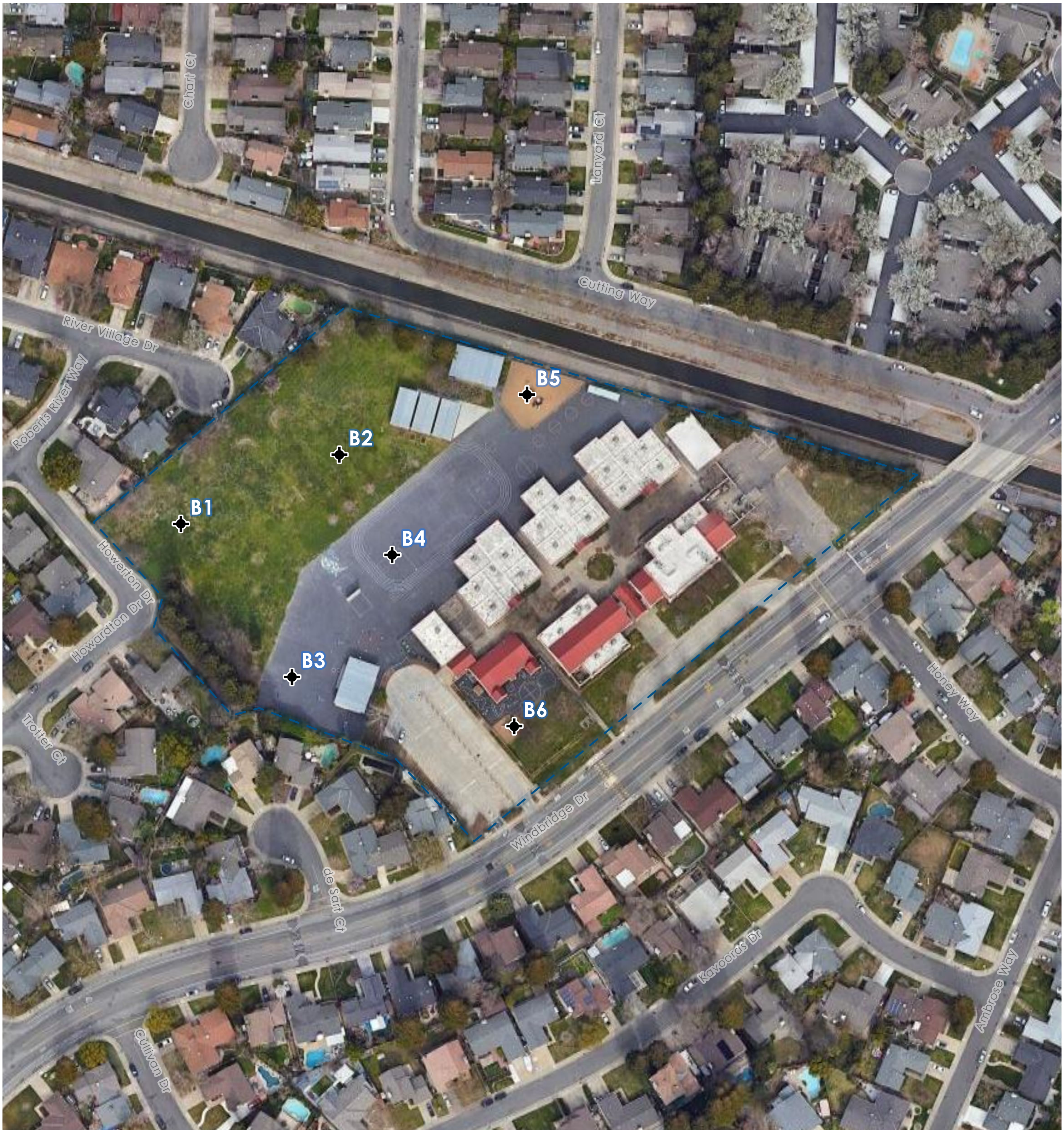
VICINITY MAP

MATSUYAMA ELEMENTARY SCHOOL

Sacramento, California

FIGURE	1
DRAWN BY	KS
CHECKED BY	RA
PROJECT MGR	RA
DATE	11/2023
4630.2300091.0016	



Approximate Site Boundary Athletic Improvements

Approximate Boring Locations

N

0 75 150
Feet

Aerial imagery provided by Esri.
Projection: NAD 1983 2011 StatePlane California II FIPS 0402 Ft US

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SITE PLAN

MATSUYAMA ELEMENTARY SCHOOL

Sacramento, California

FIGURE	2
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CHECKED BY	RA
PROJECT MGR	RA
DATE	11/2023
4630.2300091.0016	

Project:	**Matsuyama Elementary School**
Project Location:	**Sacramento, CA**
Project Number:	**4630.2300091.0016**

LOG OF SOIL BORING B1

Date(s) Drilled	**9/29/23**	Logged By	**JB**	Checked By	**RA**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**Cal-Nev Geo Exploration**	Total Depth of Drill Hole	**11.5 feet**
Drill Rig Type	**CME 55 HD Crawler Drill**	Diameter(s) of Hole, inches	**4**	Approx. Surface Elevation, ft WSG84	**6.0**
Groundwater Depth [Elevation], feet	**9.0 [-3.0]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Soil Cuttings/Neat Cement**
Remarks	**Bulk (0'-5')**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: SAMPLE NUMBER	SAMPLE DATA: NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
5			Dark brown with orange and black mottling, loose, sandy SILT (ML)		B1 -BULK (0-5)				
					B1-1I	9			
0	5				B1-2I	6			
			Gray, wet, very loose, SAND (SP) with silt	▼					
-5	10				B1-3I	2			
			Boring terminated at 11½ feet below ground surface Groundwater was encountered at 9 feet below ground surface.						

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FIGURE 3

Project: Matsuyama Elementary School Project Location: Sacramento, CA Project Number: 4630.2300091.0016	**LOG OF SOIL BORING B2** Sheet 1 of 1

Date(s) Drilled	**9/29/23**	Logged By	**JB**	Checked By	**RA**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**Cal-Nev Geo Exploration**	Total Depth of Drill Hole	**11.5 feet**
Drill Rig Type	**CME 55 HD Crawler Drill**	Diameter(s) of Hole, inches	**4**	Approx. Surface Elevation, ft WSG84	**7.0**
Groundwater Depth [Elevation], feet	**10.0 [-3.0]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Soil Cuttings/Neat Cement**
Remarks	**Bulk (0'-5'), RV**			Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			Dark brown, moist, loose, sandy SILT (ML)						
5					B2-BULK (0-5) B2-1I	9	19.9	100	RV=15
	5				B2-2I	5			
0									
	10		Brownish-gray to dark brownish-gray with orange mottling, wet, loose silty SAND (SP)		B2-3I	6			

Boring terminated at 11½ feet below ground surface
Groundwater was encountered at 10 feet below ground surface.

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FIGURE 4

Project: Matsuyama Elementary School
Project Location: Sacramento, CA
Project Number: 4630.2300091.0016

LOG OF SOIL BORING B3

Sheet 1 of 1

Date(s) Drilled	**9/29/23**	Logged By	**JB**	Checked By	**RA**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**Cal-Nev Geo Exploration**	Total Depth of Drill Hole	**21.5 feet**
Drill Rig Type	**CME 55 HD Crawler Drill**	Diameter(s) of Hole, inches	**4**	Approx. Surface Elevation, ft WSG84	**6.0**
Groundwater Depth [Elevation], feet	**14.0 [-8.0]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Soil Cuttings/Neat Cement**
Remarks				Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			ASPHALT						
5			Dark brown with orange mottling, moist, medium stiff to stiff, SILT (ML) with some sand and gravel						
					B3-1I	8	33.3	85	
	5				B3-2I	13			
0			grades medium dense						
			Gray to dark gray, very moist, loose, silty SAND (SP)						
	10								
-5					B3-3I	8			
			▼						
	15								
-10			grades very loose		B3-4I	4			
	20								
-15					B3-5I	2			

Boring terminated at 21½ feet below ground surface
Groundwater was encountered at 14 feet below ground surface.

BORING LOG 4630.2300091.0016 - MATSUYAMA ELEMENTARY SCHOOL.GPJ WKA.GDT 12/7/23 1:45 PM

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FIGURE 5

Project: Matsuyama Elementary School	LOG OF SOIL BORING B4
Project Location: Sacramento, CA	Sheet 1 of 1
Project Number: 4630.2300091.0016	

Date(s) Drilled	9/29/23	Logged By	JB	Checked By	RA
Drilling Method	Solid Flight Auger	Drilling Contractor	Cal-Nev Geo Exploration	Total Depth of Drill Hole	10.0 feet
Drill Rig Type	CME 55 HD Crawler Drill	Diameter(s) of Hole, inches	4	Approx. Surface Elevation, ft WSG84	7.0
Groundwater Depth [Elevation], feet	10.0 [-3.0]	Sampling Method(s)	2.0" Modified California with 6-inch sleeve	Drill Hole Backfill	Soil Cuttings/Neat Cement
Remarks				Driving Method and Drop	140lb auto. hammer with 30" drop

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			ASPHALT						
			Dark gray, moist, medium dense, sandy SILT (ML)						
5					B4-1I	11			
			grades loose		B4-2I	8			
	5								
0			Grayish-brown, wet, very loose, clayey SAND (SM)						
					B4-3I	2			
	10		Boring terminated at 10 feet below ground surface Groundwater was encountered at 10 feet below ground surface.						

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FIGURE 6

Project: Matsuyama Elementary School
Project Location: Sacramento, CA
Project Number: 4630.2300091.0016

LOG OF SOIL BORING B5

Date(s) Drilled	**9/29/23**	Logged By	**JB**	Checked By	**RA**
Drilling Method	**Solid Flight Auger**	Drilling Contractor	**Cal-Nev Geo Exploration**	Total Depth of Drill Hole	**21.5 feet**
Drill Rig Type	**CME 55 HD Crawler Drill**	Diameter(s) of Hole, inches	**4**	Approx. Surface Elevation, ft WSG84	**8.0**
Groundwater Depth [Elevation], feet	**13.5 [-5.5]**	Sampling Method(s)	**2.0" Modified California with 6-inch sleeve**	Drill Hole Backfill	**Soil Cuttings/Neat Cement**
Remarks				Driving Method and Drop	**140lb auto. hammer with 30" drop**

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE	SAMPLE NUMBER	NUMBER OF BLOWS	MOISTURE CONTENT, %	DRY UNIT WEIGHT, pcf	ADDITIONAL TESTS
			Dark grayish-brown, moist, medium dense, SILT (ML) with sand						
5					B5-1I	13	38.0	80	UC=1.49 tsf
	5				B5-2I	11	41.0	73	CR
0			Dark grayish-brown with orange mottling, moist, very loose sandy SILT (ML) with fine gravel						
	10				B5-3I	2			
-5			▼						
	15				B5-4I	5	32.0		AL
-10									
	20				B5-5I	4			
			Boring terminated at 21½ feet below ground surface Groundwater was encountered at 13½ feet below ground surface.						

SAMPLE DATA / TEST DATA

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FIGURE 7

Project: Matsuyama Elementary School	# LOG OF SOIL BORING B6
Project Location: Sacramento, CA	Sheet 1 of 1
Project Number: 4630.2300091.0016	

Date(s) Drilled	9/29/23	Logged By	JB	Checked By	RA
Drilling Method	Solid Flight Auger	Drilling Contractor	Cal-Nev Geo Exploration	Total Depth of Drill Hole	20.0 feet
Drill Rig Type	CME 55 HD Crawler Drill	Diameter(s) of Hole, inches	4	Approx. Surface Elevation, ft WSG84	6.0
Groundwater Depth [Elevation], feet	9.0 [-3.0]	Sampling Method(s)	2.0" Modified California with 6-inch sleeve	Drill Hole Backfill	Soil Cuttings/Neat Cement
Remarks				Driving Method and Drop	140lb auto. hammer with 30" drop

ELEVATION, feet	DEPTH, feet	GRAPHIC LOG	ENGINEERING CLASSIFICATION AND DESCRIPTION	SAMPLE DATA: SAMPLE	SAMPLE DATA: SAMPLE NUMBER	SAMPLE DATA: NUMBER OF BLOWS	TEST DATA: MOISTURE CONTENT, %	TEST DATA: DRY UNIT WEIGHT, pcf	TEST DATA: ADDITIONAL TESTS
	0		Medium brown with orange mottling, medium stiff, SILT (ML) with some sand						
5									
					B6-1I	7	24.0	91	UC= 1.16 tsf
	5								
0					B6-2I	8	53.0	61	
	8		Gray, wet, loose, SAND (SP) with silt						
	9		▼ (groundwater)						
	10								
-5					B6-3I	4			
			increasing silt		B6-4I	5			
	15								
-10									
					B6-5I	5			
	20		Boring terminated at 20 feet below ground surface Groundwater was encountered at 9 feet below ground surface.						

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FIGURE 8

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487)

MAJOR DIVISIONS		USCS[4]	CODE	CHARACTERISTICS
COARSE GRAINED SOILS (More than 50% of soil > no. 200 sieve size)	GRAVELS[1] (More than 50% of coarse fraction > no. 4 sieve size)	GW		Well-graded gravels or gravel - sand mixtures, trace or no fines
		GP		Poorly graded gravels or gravel - sand mixtures, trace or no fines
		GM		Silty gravels, gravel - sand - silt mixtures, containing little to some fines[2]
		GC		Clayey gravels, gravel - sand - clay mixtures, containing little to some fines[2]
	SANDS[1] (50% or more of coarse fraction < no. 4 sieve size)	SW		Well-graded sands or sand - gravel mixtures, trace or no fines
		SP		Poorly graded sands or sand - gravel mixtures, trace or no fines
		SM		Silty sands, sand - gravel - silt mixtures, containing little to some fines[2]
		SC		Clayey sands, sand - gravel - clay mixtures, containing little to some fines[2]
FINE GRAINED SOILS (50% or more of soil < no. 200 sieve size)	SILTS & CLAYS LL < 50	ML		Inorganic silts, gravely silts, and sandy silts that are non-plastic or with low plasticity
		CL		Inorganic lean clays, gravelly lean clays, sandy lean clays of low to medium plasticity[3]
		OL		Organic silts, organic lean clays, and organic silty clays
	SILTS & CLAYS LL ≥ 50	MH		Inorganic elastic silts, gravelly elastic silts, and sandy elastic silts
		CH		Inorganic fat clays, gravelly fat clays, sandy fat clays of medium to high plasticity
		OH		Organic fat clays, gravelly fat clays, sandy fat clays of medium to high plasticity
HIGHLY ORGANIC SOILS		PT		Peat
ROCK		RX		Rocks, weathered to fresh
FILL		FILL		Artificially placed fill material

OTHER SYMBOLS

= Drive Sample: 2-1/2" O.D. Modified California sampler

= Drive Sampler: no recovery

= SPT Sampler

= Initial Water Level

= Final Water Level

= Estimated or gradational material change line

= Observed material change line

Laboratory Tests

CR = Corrosion
PI = Plasticity Index
EI = Expansion Index
UCC = Unconfined Compression Test (TSF)
TR = Triaxial Compression Test
GR = Gradational Analysis (Sieve/Hydro)
FC = Wash (Fines Content)
PP = Pocket Penetrometer Test (TSF)
PID = Photo Ionization Detector Test (PPM)
RV = Resistance ("R") Value

REF = Refusal (>50 blows in 6 inches)

GRAIN SIZE CLASSIFICATION

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS (b)	Above 12"	Above 300
COBBLES (c)	12" to 3"	300 to 75
GRAVEL (g)	3" to No. 4	75 to 4.75
coarse	3" to 3/4"	75 to 19
fine	3/4" to No. 4	19 to 4.75
SAND	No. 4 to No. 200	4.75 to 0.075
coarse	No. 4 to No. 10	4.75 to 2.00
medium	No. 10 to No. 40	2.00 to 0.425
fine	No. 40 to No. 200	0.425 to 0.075
SILT & CLAY	Below No. 200	Below 0.075

Trace - Less than 5 percent
Few - 5 to 10 percent
Little - 15 to 25 percent
Some - 35 to 45 percent
Mostly - 50 to 100 percent

* Percents as given in ASTM D2488

NOTES:

1. Coarse grained soils containing 5% to 12% fines, use dual classification symbol (ex. SP-SM).
2. If fines classify as CL-ML (4<PI<7), use dual symbol (ex. SC-SM).
3. Silty Clays, use dual symbol (CL-ML).
4. Borderline soils with uncertain classification list both classifications (ex. CL/ML).

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UNIFIED SOIL CLASSIFICATION SYSTEM
MATSUYAMA ELEMENTARY SCHOOL
Sacramento, California

FIGURE	9
DRAWN BY	KS
CHECKED BY	RA
PROJECT MGR	RA
DATE	11/2023
4630.2300091.0016	

APPENDIX A

A. GENERAL INFORMATION

The performance of a geotechnical engineering study for the proposed Matsuyama Elementary School improvements project in Sacramento, California was authorized by Chris Ralston with Sacramento City Unified School District on September 9, 2023. Authorization was for a study as described in our proposal letter dated August 15, 2023 sent to Mr. Ralston whose mailing address is 425 First Avenue in Sacramento, California 95818; telephone (916) 278-2333.

The project architectural consultant Is LPA Design Studios whose mailing address is 431 I Street, Suite 107, in Sacramento, California 95814; telephone (916) 287-2400.

For the purpose of our study, we made reference to the Topographical, Utility Survey and Geotech Survey Scope Map, dated August 3, 2023, prepared by LPA Design Studios.

B. FIELD EXPLORATIONS

As part of our study for the proposed improvements, our field exploration included the drilling and sampling of six borings (B1 through B6) at the approximate locations shown on Figure 2.

The borings were performed on September 29, 2023 to depths ranging from about 10 to 21½ feet below existing site grades utilizing a CME-55 track-mounted drilling rig equipped with six-inch-diameter solid flight augers, provided by V&W Drilling of Galt, California. At various intervals, soil samples were recovered with a 2-inch outside diameter (O.D.) and modified California split-spoon sampler. The sampler was driven by an automatic 140-pound hammer freely falling 30 inches. The number of blows of the hammer required to drive the 18-inch-long samplers each six-inch interval was recorded. The sum of the blows required to drive the sampler the lower 12-inch interval, or portion thereof, is designated the penetration resistance or "blow count" for that particular drive.

The modified California samples were retained in 2-inch diameter by 6-inch long, thin-walled brass tubes contained within the sampler. After recovery, the field representative visually classified the soil recovered in the tubes. After the samples were classified, the ends of the tubes were sealed to preserve the natural moisture contents.

Descriptions of the soils encountered in the boring locations are presented on Figures 3 through 8. An explanation of the Unified Soil Classification System symbols used in the descriptions is presented on Figure 9.

In addition to the driven samples, representative bulk samples of near-surface soils also were collected and retained in plastic bags. Driven and bulk samples were taken to our laboratory for additional soil classification and selection of samples for testing.

C. LABORATORY TESTING

Selected soil samples were tested to determine in-situ dry unit weight (ASTM D2937), and moisture content (ASTM D4643). The results of these tests are included on the boring logs at the depth each sample was obtained.

One representative soil sample was subjected to Atterberg Limits Test (ASTM D4318). The results of this test are presented in Figure A1.

One representative sample of near-surface soil were subjected to Resistance (“R”) value testing in accordance with California Test 301. The results of the R-value test are presented in Figure A2.

One sample of the near-surface soil was submitted to Sunland Analytical to determine the soil pH, minimum resistivity (California Test 643), Sulfate concentration (California Test 417) and Chloride concentration (California Test 422). The results of these tests are presented in Figures A3.

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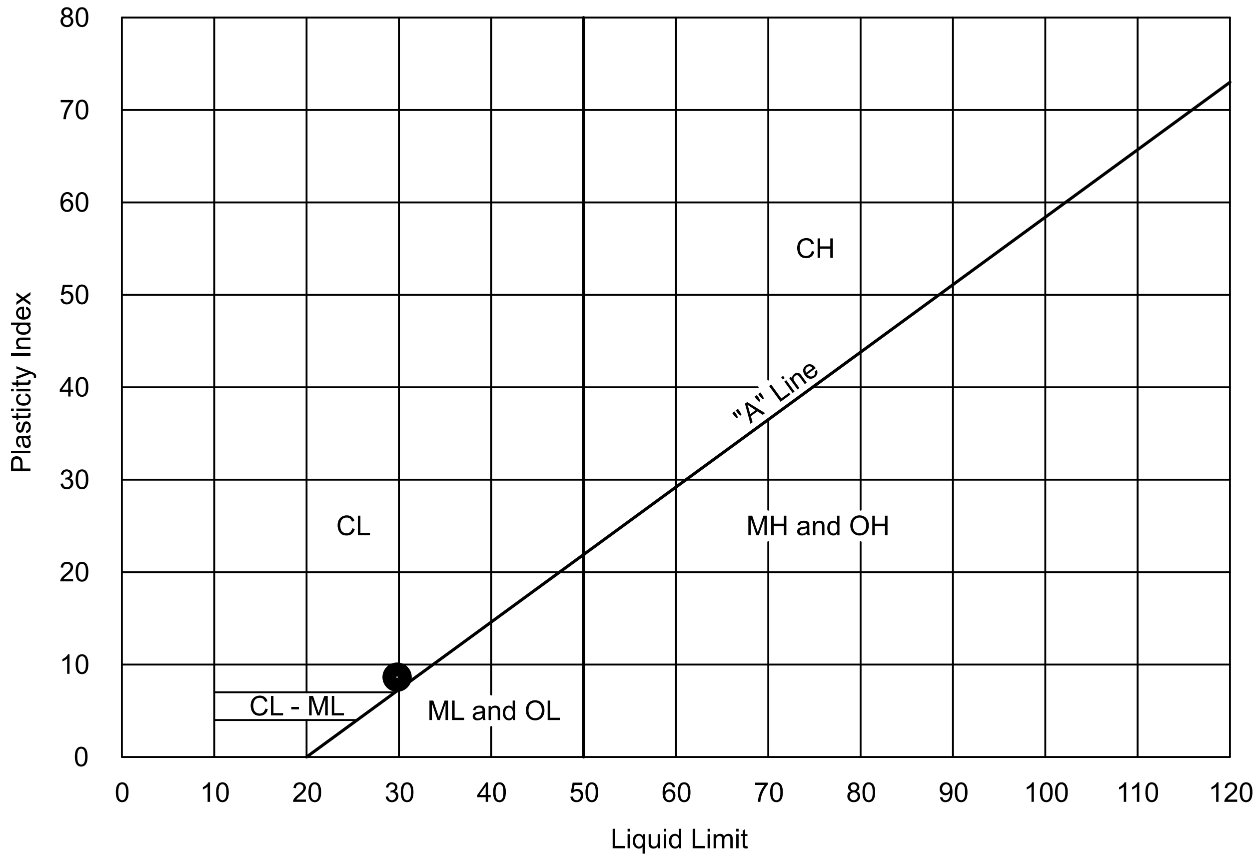
APPENDIX A

ATTERBERG LIMITS

ASTM D4318



KEY SYMBOL	LOCATION	SAMPLE DEPTH	ATTERBERG LIMITS		PASSING No. 200 SIEVE (%)	UNIFIED SOIL CLASSIFI-CATION SYMBOL
			LIQUID LIMIT (%)	PLASTICITY INDEX (%)		
●	B5	15	30	9	---	ML

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ATTERBERG LIMITS

MATSUYAMA ELEMENTARY SCHOOL

Sacra□en□o, California

FIGURE	A1
DRAWN BY	KS
CHECKED BY	RA
PROJECT MGR	RA
DATE	11/2023

4630.2300091.0016

RESISTANCE VALUE TEST RESULTS

(California Test 301)

MATERIAL DESCRIPTION: Dark brown, sandy SILT (ML)

LOCATION: B2

Specimen No.	Dry Unit Weight (pcf)	Moisture @ Compaction (%)	Exudation Pressure (psi)	Expansion (dial, inches x 1000)	Expansion (psf)	R Value
3	101	23.7	516	155	671	41
20	100	24.6	368	91	394	22
4	98	25.5	242	44	191	9

R-Value at 300 psi exudation pressure = 15

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RESISTANCE VALUE TEST RESULTS

MATSUYAMA ELEMENTARY SCHOOL

Sacramento, California

FIGURE	A2
DRAWN BY	KS
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PROJECT MGR	RA
DATE	11/2023
4630.2300091.0016	

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 10/18/2023
Date Submitted 10/13/2023

To: Roozbeh Foroozan
Universal Engineering Science
3050 Industrial Blvd
West Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager RA

The reported analysis was requested for the following location:
Location : 4630.2300091.0016 Site ID : B5-2II.
Thank you for your business.

* For future reference to this analysis please use SUN # 90767-188276.

EVALUATION FOR SOIL CORROSION

Soil pH	6.93		
Minimum Resistivity	0.99	ohm-cm (x1000)	
Chloride	5.1 ppm	00.00051 %	
Sulfate	67.0 ppm	00.00670 %	

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

UES	**CORROSION TEST RESULTS**	FIGURE	A3
	MATSUYAMA ELEMENTARY SCHOOL	DRAWN BY	KS
	Sacramento, California	CHECKED BY	RA
		PROJECT MGR	RA
		DATE	11/2023
		4630.2300091.0016	