GEOTECHNICAL INVESTIGATION
For
LOST ACRES ALTERNATE WATER TANK SITE
APN 064-201-37
Felton, California

Prepared For
SAN LORENZO VALLEY WATER DISTRICT
13060 Highway 9
Boulder Creek, California

Prepared By
HARO, KASUNICH AND ASSOCIATES, INC.
Geotechnical & Coastal Engineers
Project No. SC11032
June 2016

Project No. SC11032
13 June 2016

SAN LORENZO VALLEY WATER DISTRICT
13060 Highway 9
Boulder Creek, California 95006

Attention: Mr. Brian Lee

Subject: Geotechnical Investigation

Reference: Lost Acres Water Tank Replacement Project
APN 064-201-37
Lost Acres Drive
Felton, California

Dear Mr. Lee:

In accordance with your authorization, we have performed a Geotechnical Investigation for the referenced project in Felton, California.

The accompanying report presents our conclusions and recommendations, as well as the results of the geotechnical investigation on which they are based.

If you have any questions concerning the data or conclusions presented in this report, please call our office.

Respectfully Submitted,

HARO, KASUNICH AND ASSOCIATES, INC.

Christopher A. George
C.E. 50871

REGISTERED PROFESSIONAL ENGINEER
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CAG/sr

Copies: 4 to Addressee + pdf

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GEOTECHNICAL INVESTIGATION

Introduction

This report presents the findings, conclusions and recommendations of our Geotechnical Investigation for the proposed Lost Acres Alternate Water Tank Project site, located at the end of Lost Acres Drive in Felton, California (see Site Vicinity Map, Figure 1 in Appendix A). The site is proposed as an alternate site for replacement of the existing water tank at the end of nearby Valhalla Drive.

A Site Map for the proposed tank site, prepared by Paul Jensen, was provided for our use. The map, dated March 2016, was used as a base for our Boring Site Plan (see Figure 3 in Appendix A). Exploratory boring locations were not surveyed and should be considered approximate only. Ground surface elevations shown on Exploratory Boring Logs are based on contour elevations shown on the Site Map. Site descriptions, elevations, slope gradients and distances referred to in this report are based on review of the map and site reconnaissance by the engineer.

Foundation and grading plans for the replacement tank or improvements had not been developed at the time this report was prepared. Haro, Kasunich and Associates should be provided an opportunity to review the project plans prior to finalizing to evaluate if the criteria and recommendations presented were properly interpreted and implemented and determine if this report is adequate and complete for proposed project.

Purpose and Scope

The purpose of our investigation was to evaluate the soil and bedrock conditions at the referenced alternate tank site and develop geotechnical design criteria and recommendations for proposed replacement water tank foundations and associated improvements. It is presumed the most current California Building Code (CBC) edition design considerations, specifically the seismic factors and coefficients from Chapter 16, Volume II, will be followed during design and construction of the projects.

The specific scope of our services was as follows:

1. Site reconnaissance and review of available data in our files regarding the site and vicinity.

2. A field exploration program consisting of logging and interval sampling of soils encountered in three (3) exploratory borings drilled to depths of 16.5 to 26.5 feet. Standard Penetration Tests (SPT) were performed during sampling operations. The soil samples obtained were sealed and returned to the laboratory for testing.

3. Laboratory testing of select samples obtained. Moisture content and dry density tests were performed to evaluate the consistency of the in situ soils. Gradation

analysis was performed to aid in soil classification. Atterberg Limits tests were performed to evaluate the expansion potential of clay soil encountered in the course of our exploration. Unconfined compression tests were performed on selected samples to determine the in-situ strength properties of site soils.

4. Engineering analysis and evaluation of the resulting data. We developed geotechnical design parameters for ring foundations, concrete slabs-on-grade, retaining walls, and recommendations for site grading, drainage and erosion control.

5. Preparation and submittal of this report presenting the results of our investigation.

<u>Site Locations and Conditions</u>

The Lost Acres Alternate Tank Site is a 50 foot by 50 foot easement on APN 064-201-37, a 63.55 acre undeveloped parcel on Lost Acres Drive in Felton, California. The easement is located at the end of the paved portion of Lost Acres Drive. The tank site lies in a "Y" formed at the intersection of the10 foot wide unpaved extension of Lost Acres Drive and a private paved driveway to an existing residence on APN 064-351-18. Lost Acres Drive intersects with Shingle Springs Road about 500 feet northwest of the tank site.

A review of the Site Map and our field observations indicates the tank site slopes to the east at gradients of 8 to 10 percent. The east perimeter of the site has a cut slope which descends about 4 feet to the adjacent paved driveway. The tank site was cleared of brush and trees prior to our field investigation but the area north and northwest is heavily wooded. A grove of redwood trees lies about 25 feet west northwest of the tank site.

Project Description

A replacement water tank is proposed for the Lost Acres Alternate tank site. The new water tank will replace the existing redwood water tank at the end of nearby Valhalla Drive. We understand the proposed new tank will be a 16 foot high and 26 foot diameter bolted steel tank, which will hold about 60,000 gallons of water. The new tank will have reinforced concrete ring foundation and will be situated in the approximate center of the tank site easement. A base rock surfaced or paved 12' wide apron around the tank is also planned.

Grading for the project will consist of cut and fill grading to construct a level pad for the tank and apron and re-densification of near surface soil under the tank pad, excavations for ring footings, and compaction of subgrade soil and baserock on the tank apron.

Field Exploration

Subsurface conditions were investigated on 15 April 2016 by drilling three (3) exploratory borings to depths of 16.5 to 26.5 feet. The boring locations were not surveyed and should be considered approximate only. The borings were drilled with 4-inch diameter, continuous flight auger equipment mounted on a truck or a limited access drill rig. The approximate locations of the borings are shown on the Boring Site Plan (see Figure 3 in Appendix A).

Representative soil samples were obtained from the exploratory borings at selected depths, or at major strata changes. These samples were recovered using a 3.0 inch outside diameter (O.D.) Modified California Sampler (L), or by a 2.0 inch O. D. Standard Terzaghi Sampler (T). The soils encountered in the borings were continuously logged in the field and visually described in accordance with the Unified Soil Classification System (ASTM D2487).

The Logs of Test Borings are included in Appendix A of this report. The Logs depict subsurface conditions at the approximate locations shown on the Boring Site Plans. Subsurface conditions at other locations may differ from those encountered at the explored locations. Stratification lines shown on the logs represent the approximate boundaries between soil types; actual transitions may be gradual.

The penetration blow counts noted on the boring logs were obtained by driving a sampler into the soil with a 140-pound hammer dropping through a 30-inch fall. The sampler was driven up to 18 inches into the soil and the number of blows counted for each 6-inch penetration interval (Standard Penetration Test). The numbers indicated on the logs are the total number of blows that were recorded for the second and third 6-inch intervals, or the blows that were required to drive the penetration depth shown if high resistance was encountered.

Subsurface Conditions

Based on the results of our subsurface exploration, the Lost Acres Alternate Tank site is underlain by top 6 to 12 inches of clayey sand topsoil, underlain by medium dense clayey sand and stiff to very stiff sandy clay to depths of 7 to 9 feet. From 9 feet to the depths explored (16.5 to 26.5 feet), dense to very dense silty sand was encountered.

A review of "The Geologic Map of Santa Cruz County, California" (Brabb, 1989) indicates that the site is mapped as sch: Metasedimentary rocks (Mesozoic or Paleozoic) Mainly pelitic schist and quartzite.

The medium dense clayey sand, very stiff lean sandy clay and dense to very dense silty sand encountered in our borings is typical of the Metasedimentary rocks.

Groundwater

Groundwater was not encountered in any of the borings. However, groundwater levels will fluctuate with time, being dependent upon seasonal precipitation, irrigation, land use, and climate conditions as well as other factors. Therefore, water observations at the time of the field investigation may vary from those encountered during the construction phase and/or post-construction of the project. The evaluation of such factors is beyond the scope of our study.

Laboratory Testing

The laboratory testing program was directed toward determining pertinent engineering and index soil properties.

The natural moisture contents and dry densities were determined on selected samples and are recorded on the boring logs at the appropriate depths. Since the engineering behavior of soil is affected by changes in moisture content, the natural moisture content will aid in evaluation of soil compressibility, strength, and potential expansion characteristics. Soil dry density and moisture content are index properties necessary for calculation of earth pressures on engineering structures. The soil dry density is also related to soil strength and permeability.

Atterberg Limits tests and Grain size analysis tests were performed on selected soil samples to evaluate the range of moisture contents over which the soil exhibits plasticity, and to classify the soil according to the Unified Soil Classification System. The plasticity characteristics of a soil give an indication of the soil's compressibility and expansion potential. The results of the Atterberg Limits tests and grain size analysis tests indicate the near surface soils at the Lost Acres Tank Site are classified as clayey sand (SC), sandy lean clay (CL) with moderate to high expansion potential (PI = 29 to 32). The clayey sand and sandy clay extended to depths of 7 to 9 feet and was underlain by very dense silty sand bedrock.

The strength parameters of the underlying earth materials were determined from unconfined compression tests performed in the laboratory and from Standard Penetration Test (SPT) blow count measurements obtained in the field during sampling of in-situ soil. The results of the field and laboratory testing appear on the "Logs of Test Boring" opposite the sample tested.

Seismicity

The following is a general discussion of seismic considerations affecting the project area. Detailed studies of seismicity, faulting and other geologic hazards are beyond the scope of this study.

The Lost Acres Alternate Tank Site is located at Latitude 37.044528° North and Longitude 122.091083° West (Google Earth). The active San Andreas Fault and the potentially active Zayante Fault, are located about 8.57 miles (13.79 km) and 4.88 miles (7.85 km) from the project site, respectively.

The San Andreas Fault zone is a major fault zone of active displacement which extends from the Gulf of California to the vicinity of Point Arena, where the fault leaves the California coastline. Between these points, the fault is about 700 miles long. The fault zone is a break or series of breaks along the earth's crust, where shearing movement has taken place. This fault movement is primarily horizontal.

The largest historic earthquake in Northern California occurred on 18 April 1906 (M8.3+). The 17 October 1989 Loma Prieta earthquake (M6.9) is also considered to have been associated with the San Andreas Fault system. This event was the second largest earthquake in Northern California this century. Strong ground shaking was experienced throughout Santa Cruz County during both of these seismic events.

Although research on earthquake prediction has greatly increased in recent years, seismologists have not yet reached the point where they can predict when and where another large earthquake will occur. Nevertheless, on the basis of current technology, it is reasonable to assume that the proposed development will be subject to at least one moderate to severe earthquake during the fifty year period following construction.

Potential seismic hazards at the site include surface ground rupture, liquefaction effects, land sliding, and damage from strong seismic shaking.

Since no known faults cross the project site, the potential for surface ground rupture is low. Because of the very stiff and dense to very dense condition of the sandy clay and silty sand bedrock underlying the Lost Acres Alternate Tank site, the potential for seismic induced liquefaction is very low.

Slope Stability

During our field investigation and site reconnaissance, we did not observe any visual indications of slope instability at the gently sloping tank site. A review of the Preliminary Map of Landslide Deposits in Santa Cruz County (Cooper-Clark, 1974) indicates the closest mapped landslide deposit is 0.40 miles south of the site tank site. In our opinion, the potential for seismic induced landsliding on the gentle natural slopes at the Felton Heights tank sites to negatively impact the water tank and improvements is very low. However, due to the proximity of earthquakes faults, during a major earthquake there is a potential for severe ground shaking at the site. Structures designed in accordance with the most current California Building Code (2013 CBC) should perform adequately during strong seismic shaking.

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

Based on the results of our investigation, the proposed construction of a replacement water tank on the Lost Acres Alternate Tank Site is acceptable from a geotechnical standpoint, provided the following geotechnical criteria and recommendations are incorporated into the design and construction of the project.

Geotechnical considerations at the Lost Acres Alternate Tank Site include providing firm uniform bearing support for the tank foundation, the potential for strong seismic shaking, and providing adequate site drainage.

Based on our subsurface exploration and testing, the top 6 to 12 inches of soil at the tank site is loose and compressible. The underlying medium dense clayey sand, very stiff lean sandy clay, and very dense silty sand bedrock will provide firm uniform support for the replacement water tank provided the building pad is subexcavated to a minimum depth of 2½ feet below finished pad elevation and replaced as engineered fill. The clayey soil should be blended with on-site silty sand and moisture conditioned to 5% over optimum moisture prior to placement and compaction. The subexcavation should extend a minimum of 5 feet beyond the perimeter of the water tank foundation. There should be a minimum horizontal distance of 10 feet between the adjacent slope and the bottom of the ring foundation.

Concentrated surface runoff from the project site should not be allowed to flow onto the slopes at the site. The adjacent driveway has a moderately steep cut bank downslope of the proposed tank pad. We recommend roof and surface runoff be directed to collection facilities and conveyed to rock energy dissipater, trenches or pits located away from the driveway cut banks.

The project site is located within a seismically active area. The proposed replacement water tank should be designed in accordance with the most current CBC seismic design standards.

The following recommendations should be used as guidelines for preparing project plans and specifications.

Site Grading

1. The geotechnical engineer should be notified **at least four (4) working days prior to any grading or foundation excavating** so the work in the field can be coordinated with the grading contractor and arrangements for testing and observation can be made. The recommendations of this report are based on the assumption that the geotechnical engineer or representative will perform the required testing and observation during grading and construction. It is the owner's responsibility to make the necessary arrangements for these required services.

2. Where referenced in this report, Percent Relative Compaction and Optimum Moisture Content shall be based on ASTM Test Designation D1557-10.

3. Near surface soil on the tank site should be removed and replaced as engineered fill where foundations and improvements are planned. We estimate the top 2½ feet of soil on the building pad will need to be sub-excavated, uniformly blended, and redensified as engineered fill compacted to a minimum of 90 percent relative compaction. The sub-excavated soil should be evaluated by the geotechnical engineer prior to blending. Highly expansive soil should be removed offsite and replaced with select engineered fill. The sub-excavation should extend a minimum of 5 feet beyond foundation perimeters.

4. The required depth of sub-excavation and redensification is an estimate only. The geotechnical engineer should evaluate site conditions during initial grading to confirm the estimated depth of sub-excavation and suitability of on-site soil for use as engineered fill, or provide supplemental recommendations if necessary.

5. The tank pad area to be graded should be cleared of all obstructions, including fill or loose soil, trees not designated to remain and other unsuitable material. Disturbed soil resulting from demolition and clearing operations may be stockpiled for use as engineered fill provided the fill is clean of organic material, debris or other unsuitable material. Existing depressions or voids created during site clearing should be backfilled with engineered fill.

6. The remaining cleared areas should then be stripped of organic-laden topsoil. Stripping depth is anticipated to be from 4 to 6 inches. Actual depth of stripping should be determined in the field by the geotechnical engineer. Strippings should be wasted off-site or stockpiled for use in landscaped areas if desired.

7. Following clearing and stripping, the bottom of the subexcavation and all areas to receive fill should be scarified, moisture conditioned (or allowed to dry as necessary) to produce a moisture content 3 to 5 percent over laboratory optimum value, and uniformly compacted to a minimum of 90 percent relative compaction based on ASTM Test D1557-10. The recommended depth of sub-excavation should be determined in the field by the engineer during grading.

8. If grading is performed during or shortly after the rainy season, the grading contractor may encounter compaction difficulty, such as pumping or bringing free water to the surface in the near surface soils. If compaction cannot be achieved after reducing the soil moisture content, it may be necessary to overexcavate the subgrade soil and replace it with angular crushed rock to stabilize the subgrade. The need for ground stabilization measures to complete grading effectively should be determined in the field at the time of grading, based on exposed soil conditions.

9. Engineered fill should be placed in thin lifts not exceeding 8 inches in loose thickness, moisture conditioned, and compacted to a minimum of 90 percent relative compaction. The upper 6 inches of slab or pavement subgrade and aggregate base below pavements should be compacted to a minimum of 95 percent relative compaction.

10. The on-site silty and clayey sand is acceptable for use as engineered fill. Highly expansive clay soil should be removed off site. Soil imported for use as engineered fill should consist of a predominantly granular soil conforming to the quality and gradation requirements as follows: Imported soil should be relatively free of organic material and contain no rocks or clods greater than 4 inches in diameter, with no more than 15 percent larger than 2½ inches. The material should be predominately granular with a plasticity index < 15, a liquid limit less than 35 and not more than 35 percent passing the No. 200 sieve, Engineered fill should also have sufficient binder so that footing and utility trenches will not collapse.

11. We estimate shrinkage factors of 15 to 25 percent for the on-site materials when used in engineered fills.

Cut and Fill Slopes

12. Temporary excavations should be properly shored and braced during construction to prevent sloughing and caving at sidewalls. The contractor should be aware of all CAL

OSHA and local safety requirements and codes dealing with excavations and trenches.

13 Permanent cut slopes in bedrock should be inclined no steeper than 2:1 (horizontal to vertical). The top of all cut slopes should be rounded off to reduce soil sloughing. If seepage is observed, the geotechnical engineer should provide additional recommendations. Cut slopes with these recommended gradients may require periodic maintenance to remove minor soil sloughing.

14. Compacted fill slopes should be constructed at a slope inclination not steeper than 2:1 (horizontal to vertical). Fill slopes with these recommended gradients may require periodic maintenance to remove minor soil sloughing. All fills must be adequately benched into competent material, and keys for stability will be required at the toe of fill embankments. Toe keys should be at least 6 feet wide and should extend at least 1½ feet into competent soil or bedrock. The bottom of the toe key should be sloped downward at about 2 percent toward the back of the key. Where seepage is observed, keyways should have subdrains. The location of subdrains and outlets should be determined by the geotechnical engineer in the field during grading.

15. Following grading, exposed soil should be planted as soon as possible with erosion-resistant vegetation.

16. After the earthwork operations have been completed and the geotechnical engineer has finished his observation of the work, no further earthwork operations shall be performed without the direct observation and approval of the geotechnical engineer.

Spread Footing Foundations

17. The actual dimensions of the ring-type footings should be determined by the design professional. However, as a minimum, footings should be 15 inches in width, penetrate loose soil and be embedded a minimum of 12 inches into engineered fill. The footings should be reinforced as required by the structural designer based on the actual loads transmitted to the foundations.

18. The bottom of all foundation elements should have a minimum setback of 10 feet horizontally from adjacent slopes.

19. The foundation trenches should be kept moist and be thoroughly cleaned of all slough or loose materials prior to pouring concrete. In addition, all footings located adjacent to other footings should have their bearing surfaces founded below an imaginary 1½:1 plane projected upward from the bottom edge of the adjacent footings or utility trenches.

20. Provided the water tank pad is redensified as recommended in the grading section of this report, the water tank and foundations embedded in and underlain by redensified engineered fill and medium dense to dense decomposed granite may be designed for an allowable soil bearing pressure of 2500 psf for dead plus live loads. These values may be increased by one-third to include short-term seismic and wind loads.

21. Provided our recommendations are followed during design and construction of the project, post-construction total and differential settlement of foundations are expected to be less than 1 inch and ½ inch, respectively.

22. Lateral load resistance for the tank footings may be developed in friction between the foundation bottom and the supporting subgrade. A friction coefficient of 0.30 is considered applicable. A passive resistance of 250 pcf may be used below a depth of 12 inches.

23. All footings should be reinforced in accordance with applicable CBC and/or ACI standards. We recommend the footings contain a minimum steel reinforcement of four (4) No. 4 bars; i.e., two near the top and two near the bottom of the footing.

24. The footing excavations should be thoroughly cleaned and observed by the geotechnical engineer <u>prior to placing forms and steel</u>, to verify subsurface soil conditions

are consistent with the anticipated soil conditions and the footings are in accordance with our recommendations.

Seismic Design

25. The 2013 California Building Code (CBC), effective 1 January 2014, provides guidelines for seismic design of structures. A review of our soil borings indicates the project site soils are classified as **Site Class C**, based on definitions presented Chapter 20 of ASCE 7. The project site is located at Latitude 37.04453° North and Longitude 122.09108° West.

26. The following maximum considered earthquake and five percent damped design spectral response accelerations adjusted for site class effects should be used for seismic design based on Figure 1613.3.1(1), Tables 1613.3.3(1) and 1613.3.3(2), and Equations 16-37 to 16.40 of the 2013 CBC:

A. S_{MS} = 1.500 g (0.2-second period)

B. S_{M1} = 0.780 g (1.0-second period)

C S_{DS} = 1.500 g (0.2-second period)

D. S_{D1} = 0.520 g (1.0-second period

Retaining Wall Lateral Pressures

27. Where retaining walls are designed for support of the cut or fill slopes, the walls

should be designed to resist both lateral earth pressures and any additional surcharge loads. Spread footings may be used for walls provided there is a minimum of 5 feet horizontally from the foundation to adjacent slopes. For design of fully drained retaining walls up to 8 feet high, the following design criteria may be used:

A. Active earth pressure for walls allowed to yield (up to ½ percent of wall height) is that exerted by an equivalent fluid weight of 40 pcf for a level backslope gradient and 55 pcf for a 2:1 (horizontal to vertical) backslope gradient. **This assumes a fully drained condition**.

B. Where walls are restrained from moving at the top, design for a uniform rectangular distribution equivalent to 28H psf per foot of wall height for a level backslope, and 38H psf per foot of wall height for a 2:1 backslope (where H is the height of the wall).

C. In addition, the walls should be designed for any adjacent surcharge loads which will exert a force on the wall.

D. Use a coefficient of friction = 0.30 between the base of foundations and native soil. Where retaining wall footings are poured neat against engineered fill, a passive resistance of 250 pcf (EFW) may be used. The top 12 inches of soil should be neglected when computing passive resistance.

E. For seismic design of retaining walls, a dynamic surcharge load equal to $10H^2$ per foot of wall, acting at 0.6H from the top of the wall, where H is the height of the wall, should be added to the above active lateral earth pressures.

F. Fully drained walls should be backfilled with drainage materials consisting of Class 1, Type A permeable material complying with Section 68-1.025 of Caltrans Standard Specifications, latest edition.

G. The drainage material should be at least 12 inches thick. The drains should extend from the base of the walls to within 12 inches of the top of the backfill. A perforated, rigid pipe should be placed (holes down) about 4 inches above the bottom of the wall and be tied to a suitable drain outlet. Wall backdrains should be capped at the surface with compacted clayey material to prevent infiltration of surface runoff into the backdrains. A layer of filter fabric (Mirafi 140N or equivalent) should separate the subdrain material from the overlying soil cap.

Concrete Slabs-on-Grade

28. Concrete slabs should be constructed on properly moisture conditioned and compacted subgrade soil. Soil subgrade should be prepared and compacted as recommended in the section entitled "Site Grading".

29. Slab reinforcing should be provided in accordance with the anticipated use and loading of the slab, however we recommend a minimum reinforcement of #4 bars spaced 18 inches on-center in both directions. The steel reinforcement should be held firmly in the vertical center of the slab during placement and finishing of the concrete with pre-cast concrete dobies.

30. The project design professional should determine the appropriate slab reinforcing and thickness, in accordance with the anticipated use and loading of the slab. However, we recommend a minimum reinforcement of #4 bars spaced 18 inches on-center in both directions. The steel reinforcement should be held firmly in the vertical center of the slab during placement and finishing of the concrete with pre-cast concrete dobies. In addition, we recommend that consideration be given to a minimum slab thickness of 5 inches and steel reinforcement necessary to address temperature and shrinkage considerations.

Utility Trenches

31. Trenches must be properly shored and braced during construction or laid back at an

appropriate angle to prevent sloughing and caving at sidewalls. The project plans and specifications should direct the attention of the contractor to all CAL OSHA and local safety requirements and codes dealing with excavations and trenches.

32. Utility trenches should be placed so that they do not extend below an imaginary line sloping down and away at a 1½:1 (horizontal to vertical) slope from the bottom outside edge of all footings. The structural design professional should coordinate this requirement with the utility layout plans for the project.

33. Trenches should be backfilled with granular-type material and uniformly compacted by mechanical means to the relative compaction as required by county specifications, but not less than 95 percent under paved areas and 90 percent elsewhere. The relative compaction will be based on the maximum dry density obtained from a laboratory compaction curve run in accordance with ASTM Procedure D1557-07.

34. Trenches should be capped with a minimum of 12 inches of compacted relatively impermeable soil.

Site Drainage

35. Surface drainage should include provisions for positive gradients so that surface runoff is not permitted to pond adjacent to tank foundations, pavement or other

improvements. Roof and surface runoff should be directed away from foundations to collection facilities and conveyed via buried plastic pipes to energy dissipaters, rock filled trenches, or pits at the tank site. The pipe outlet facilities should be designed so that instability and/or erosion does not occur at the outlet. Concentrated surface runoff should not be allowed to flow on the cut slopes below the tank site.

Erosion Control

36. The soil at the project site has potential for erosion where unvegetated. We recommend the following provisions be incorporated into the project plans:

A. All grading and soil disturbance shall be kept to a minimum.

B. No eroded soil shall be allowed to leave the site.

C. All bare soil should be seeded and mulched immediately after grading with barley, rye, grass and crimson clover and covered with straw.

D. Prior to the rainy season bare soil should be well vegetated or protected from erosion by installation of ground cover or properly installed erosion control blankets.

37. The migration of water or spread of extensive root systems below foundations, slabs, or pavements may cause undesirable differential movements and subsequent damage to these structures. Landscaping should be planned accordingly.

Plan Review, Construction Observation and Testing

38. Haro, Kasunich and Associates must be provided an opportunity to review project plans prior to construction to evaluate if our recommendations have been properly interpreted and implemented. We should also provide foundation excavation observations and earthwork observations and testing during construction. This allows us to confirm anticipated soil conditions and evaluate conformance with our recommendations and project plans. If we do not review the plans or provide observation and testing services during the earthwork phase of the project, we assume no responsibility for misinterpretation of our recommendations.

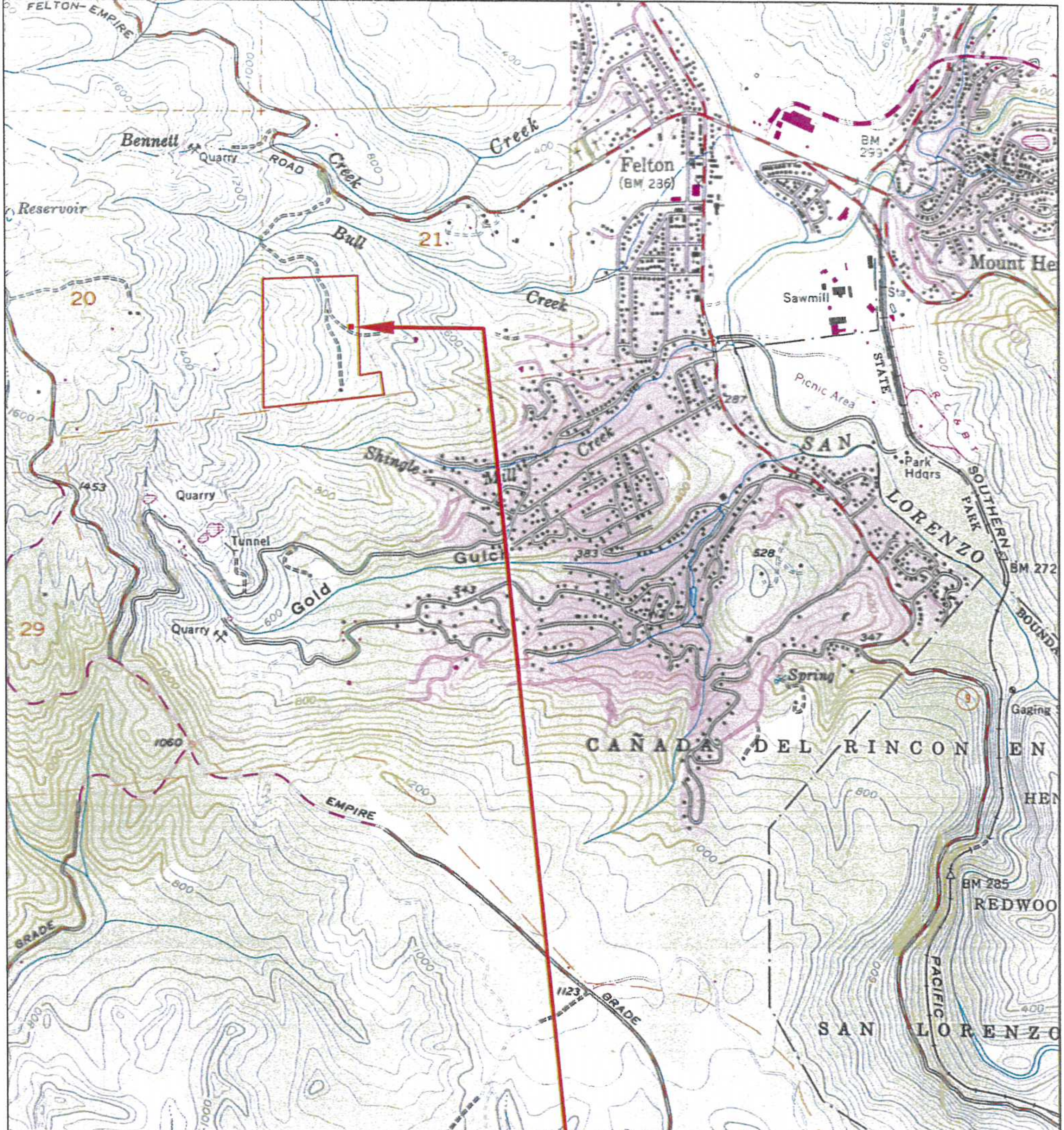
LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed in the borings. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that planned at the time, our firm should be notified so that supplemental recommendations can be given.

2. This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are called to the attention of the Architects and Engineers for the project and incorporated into the plans, and that the necessary steps are taken to ensure that the Contractors and Subcontractors carry out such recommendations in the field. The conclusions and recommendations contained herein are professional opinions derived in accordance with current standards of professional practice. No other warranty expressed or implied is made.

3. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside our control. Therefore, this report should not be relied upon after a period of three years without being reviewed by a geotechnical engineer.

APPENDIX A



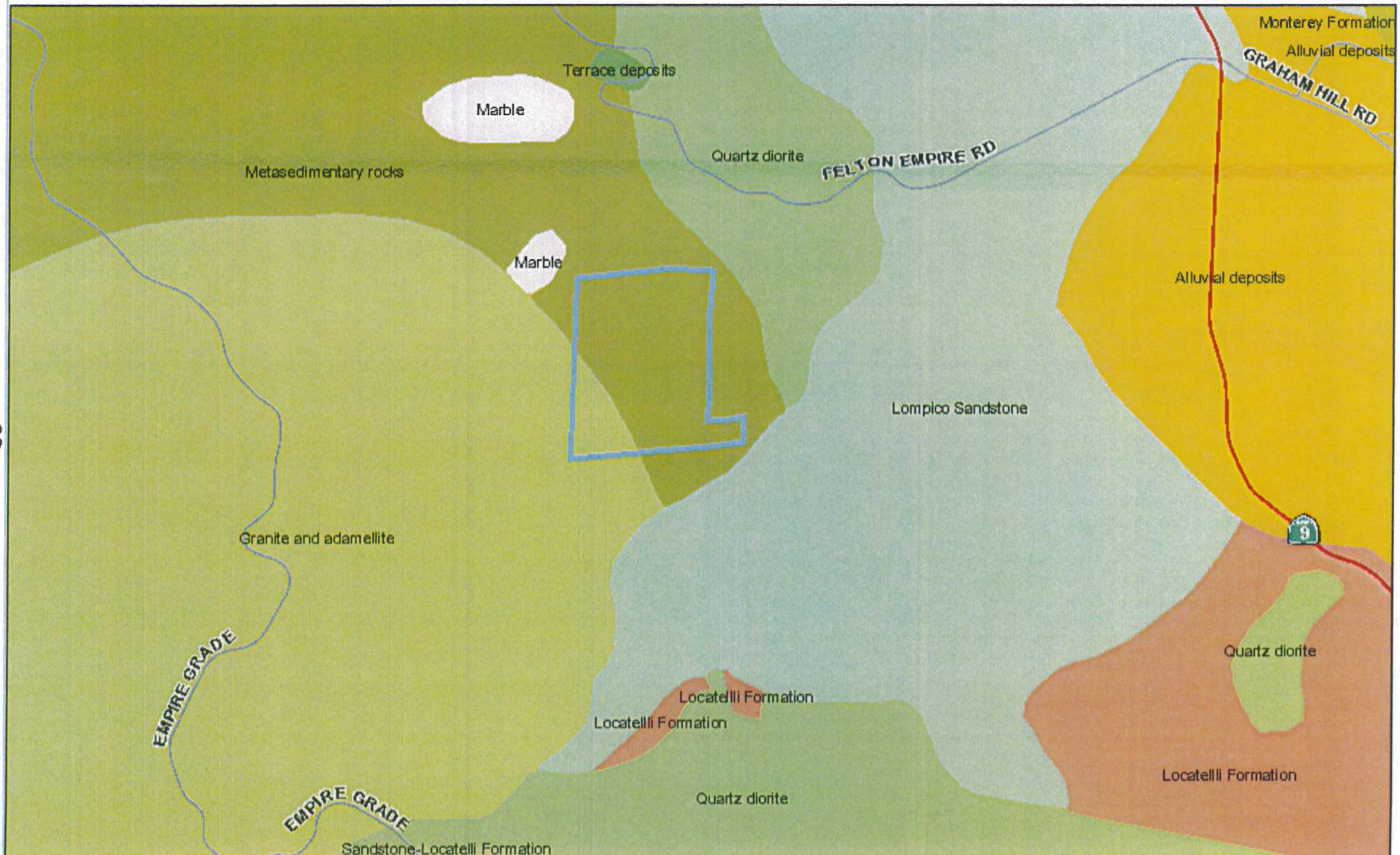
SLVWD LOST ACRE TANK SITE

SITE VICINITY MAP
San Lorenzo Valley Water District - Lost Acre Tank Site
APN 064-201-37 Lost Acre Drive
Felton, California

SCALE: 1:24,000 (1" = 2,000')	
DRAWN BY: JD	
DATE: May 2016	**HARO, KASUNICH & ASSOCIATES, INC.** GEOTECHNICAL AND COASTAL ENGINEERS 116 E. LAKE AVENUE, WATSONVILLE, CA 95076 (831) 722-4175
REVISED:	
JOB NO. SC11032	
FIGURE NO. 1	SHEET NO. 28

FROM:
USGS Felton Topographic Quadrangle, 1955, photorevised 1980. 40 ft. contour interval

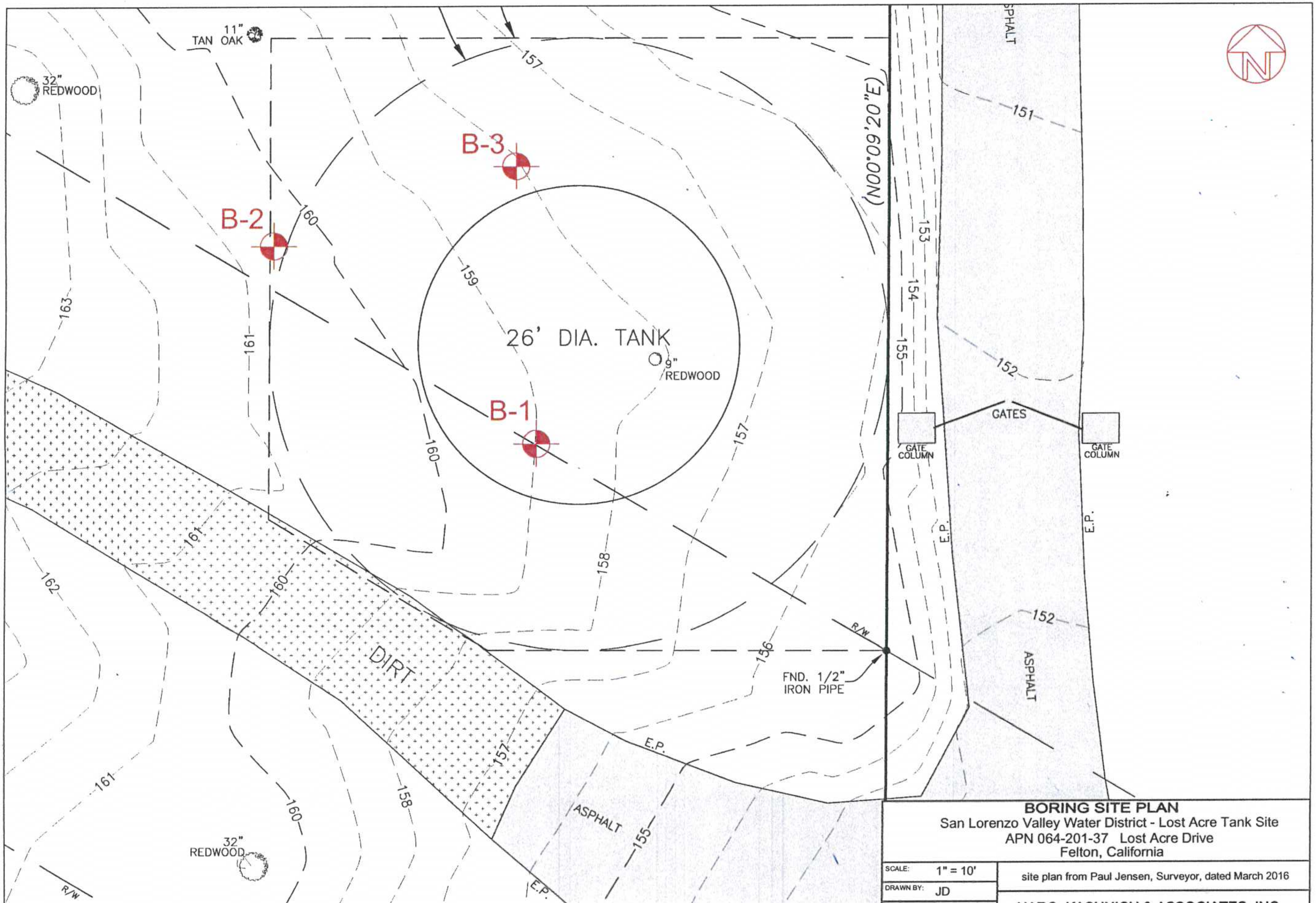
APN 064-201-37 Lost Acres Alternate Tank Site GISWeb Geologic Map



June 3, 2016

1:17,280
0 750 1,500 3,000 ft
0 240 480 960 m

FIGURE 2



KEY:

B-1 = SOIL BORING LOCATION

PAUL JENSEN
PROFESSIONAL LAND SURVEYOR #4627
BOULDER CREEK, CALIFORNIA

BORING SITE PLAN
San Lorenzo Valley Water District - Lost Acre Tank Site
APN 064-201-37 Lost Acre Drive
Felton, California

SCALE: 1" = 10'	site plan from Paul Jensen, Surveyor, dated March 2016
DRAWN BY: JD	
DATE: May 2016	**HARO, KASUNICH & ASSOCIATES, INC.** GEOTECHNICAL AND COASTAL ENGINEERS 116 E. LAKE AVENUE, WATSONVILLE, CA 95076 (831) 722-4175
REVISED:	
JOB NO. SC11032	
FIGURE NO. 3	SHEET NO. 30

PRIMARY DIVISIONS			GROUP SYMBOL	SECONDARY DIVISIONS
COARSE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVELS — MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS (LESS THAN 5% FINES)	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
			GP	Poorly graded gravels or gravel-sand mixtures, little or no fines.
		GRAVEL WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines.
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines.
	SANDS — MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS (LESS THAN 5% FINES)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures, non-plastic fines.
			SC	Clayey sands, sand-clay mixtures, plastic fines.
FINE GRAINED SOILS — MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT IS LESS THAN 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
			OL	Organic silts and organic silty clays of low plasticity.
	SILTS AND CLAYS — LIQUID LIMIT IS GREATER THAN 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
			CH	Inorganic clays of high plasticity, fat clays.
			OH	Organic clays of medium to high plasticity, organic silts.
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils.

GRAIN SIZES

U.S. STANDARD SERIES SIEVE: 200, 40, 10, 4 — CLEAR SQUARE SIEVE OPENINGS: 3/4", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS PER FOOT*
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH (TSF)**	BLOWS PER FOOT*
VERY SOFT	0 - ¼	0 - 2
SOFT	¼ - ½	2 - 4
FIRM	½ - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	OVER 4	OVER 32

SAMPLING METHOD

STANDARD PENETRATION TEST	T	
MODIFIED CALIFORNIA	L or M	
PITCHER BARREL	P	
SHELBY TUBE	S	
BULK	B	

H_2O

Final	
Initial	
Water level designation	

*Number of blows of 140 lb hammer falling 30 inches to drive a 2" O.D. (1⅜" I.D.) split spoon sampler (ASTM D-1586)

**Unconfined compressive strength in tons/ft² as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D-1586), pocket penetrometer, torvane, or visual observation.

Key To Logs

SCALE: No Scale
DRAWN BY:
DATE:
REVISED:
JOB NO.:

HARO, KASUNICH & ASSOCIATES, INC.
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FIGURE NO. 4

SHEET NO.

Haro, Kasunich & Associates, Inc.
Coastal and Geotechnical Engineers

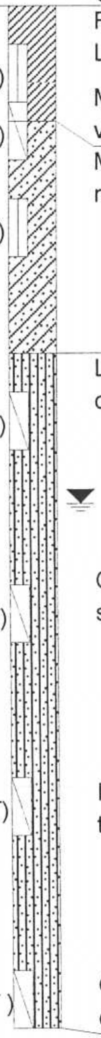
Lost Acres Tank Site

PROJECT NO. SC11032

LOGGED BY CAG | DATE DRILLED 4-15-16 | BORING DIAMETER 6" | BORING NO. B-1

G.S. = 159.0'

Depth, ft.	Sample No. and type	SOIL DESCRIPTION	Unified Soil Classification	Blows/foot 350 ft - lbs.	Qu - t.s.f. Penetrometer	Dry Density p.c.f.	Moisture % dry wt.	MISC. LAB RESULTS
0		Roots and organic material (top 6") Brown sandy Lean CLAY, moist, stiff	CL	32				
	1-1 (L)	Mottled olive gray orange very sandy Lean CLAY, very moist, very stiff				98	22.2	(1-1-2) Atterberg Limits LL = 45.9% PI = 29
	1-2 (T)			27			25.6	
5		Mottled olive orange brown Clayey SAND, moist, medium dense	SC	50/6"				
	1-3 (L)					111	17.6	(1-1-2) GSA % Gravel = 0.3 % Sand = 39.4 % Silt and Clay = 60.3
10	1-4 (T)	Light brown Silty SAND with CLAY and angular coarse SAND, moist, dense	SM	48			12.7	
15	1-5 (T)	Olive orange Silty SAND with mica and angular small gravels, moist, very dense	SM	50/4"			12.0	
20	1-6 (T)	Interbedded thin layers of orange and brown fine to medium SAND, very moist, very dense		50/3"			13.0	
25	1-7 (T)	Gray, orange brown Silty SAND, very moist, very dense	SM	50/4"			15.0	
		Boring terminated at 26.5 feet						
30								
35								



SuperLog CivilTech Software, USA www.civiltech.com File: C:\superlog4\HKALOGS\SC11032 Lost Acres Tank Site.log Date: 6/13/2016

HARO, KASUNICH AND ASSOCIATES, INC.

BY: sr | FIGURE NO. 5

Haro, Kasunich & Associates, Inc.
Coastal and Geotechnical Engineers

Lost Acres Tank Site

PROJECT NO. SC11032

LOGGED BY CAG   DATE DRILLED 4-15-16   BORING DIAMETER 6"   BORING NO. B-2

G.S. = 160.5'

Depth, ft.	Sample No. and type	Symbol	SOIL DESCRIPTION	Unified Soil Classification	Blows/foot 350 ft - lbs.	Qu - t.s.f. Penetrometer	Dry Density p.c.f.	Moisture % dry wt.	MISC. LAB RESULTS
0			Top 4 inches dark brown gray, Clayey SAND, very moist, firm	SC	21				
	2-1-1 (L)		Orange olive SAND and CLAY with roots, very moist, very stiff	CL			105	21.0	(2-1-1) Atterberg Limits LL = 47.6% PI = 32 (2-1-1) Unconfined Qu = 3.7 ksf
	2-2 (T)				33			21.2	
5	2-3 (L)		Mottled orange olive Sandy CLAY, moist, stiff	CL	37			19.2	
			Interbedded layers of light brown medium SAND with thin layers of SILT and CLAY, moist with mica, dense	SM					
10	2-4 (T)				35			15.7	
15	2-5 (T)		Mottled orange olive Silty SAND with CLAY and mica, very moist, dense	SM	36			18.4	
			Boring terminated at 16.5 feet						
20									
25									
30									
35									

SuperLog CivilTech Software, USA www.civiltech.com File: C:\superlog4\HKALOGS\SC11032 Lost Acres Tank Site.log Date: 6/13/2016

HARO, KASUNICH AND ASSOCIATES, INC.

BY: sr   FIGURE NO. 6

Haro, Kasunich & Associates, Inc.
Coastal and Geotechnical Engineers

Lost Acres Tank Site

PROJECT NO. SC11032

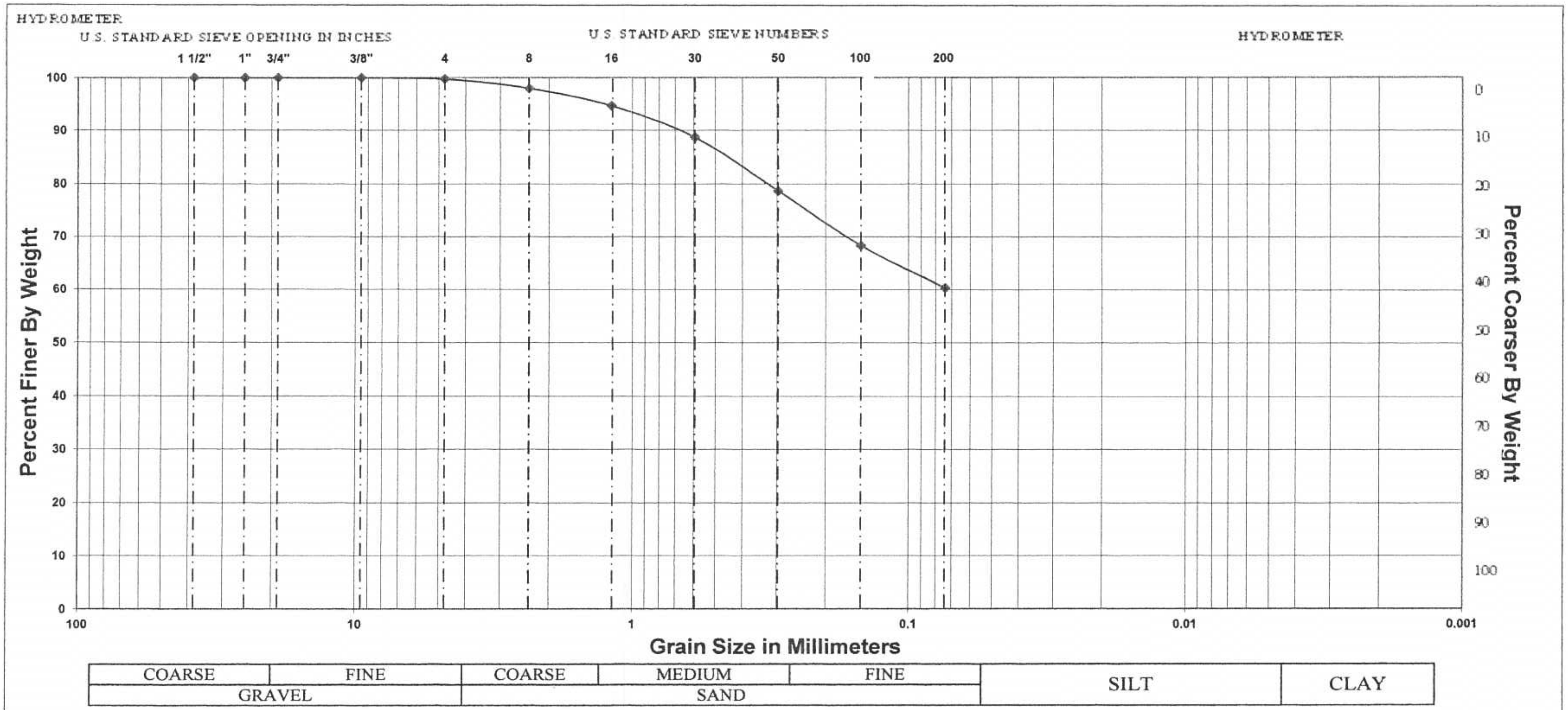
LOGGED BY CAG   DATE DRILLED 4-15-16   BORING DIAMETER 6"   BORING NO. B-3

Depth, ft.	Sample No. and type	SOIL DESCRIPTION	Unified Soil Classification	Blows/foot 350 ft - lbs.	Qu - t.s.f. Penetrometer	Dry Density p.c.f.	Moisture % dry wt.	MISC. LAB RESULTS
0		G.S. = 158.0'						
	3-1 (B)	Dark orange brown Clayey SAND, very miost, loose	SC	34				
	3-2 (L)					94 108	22.1 16.1	(3-2-2) Atterberg Limits LL = 45.6% PI = 29
5	3-3 (T)	Light brown Sandy CLAY, moist, very stiff	CL	20			14.8	(3-2-1) Unconfined Qu = 3.09 ksf
		Light brown medium to coarse SAND with SILT and angular gravels, very moist, dense	SM					
10	3-4 (T)			30			13.2	
15	3-5 (T)	Same		33			13.1	
		Boring terminated at 16.5 feet						
20								
25								
30								
35								

SuperLog CivilTech Software, USA www.civiltech.com File: C:\superlog4\HKALOGS\SC11032 Lost Acres Tank Site.log Date: 6/13/2016

HARO, KASUNICH AND ASSOCIATES, INC.

BY: sr   FIGURE NO. 7



Gravel Content:	**0.3%**
Sand Content:	**39.4%**
Fines Content	**60.3%**
Cumulative Sum	**100.0%**

Sample Description: Orange Brown Sandy CL- Lean Clay
Group Symbol: CL

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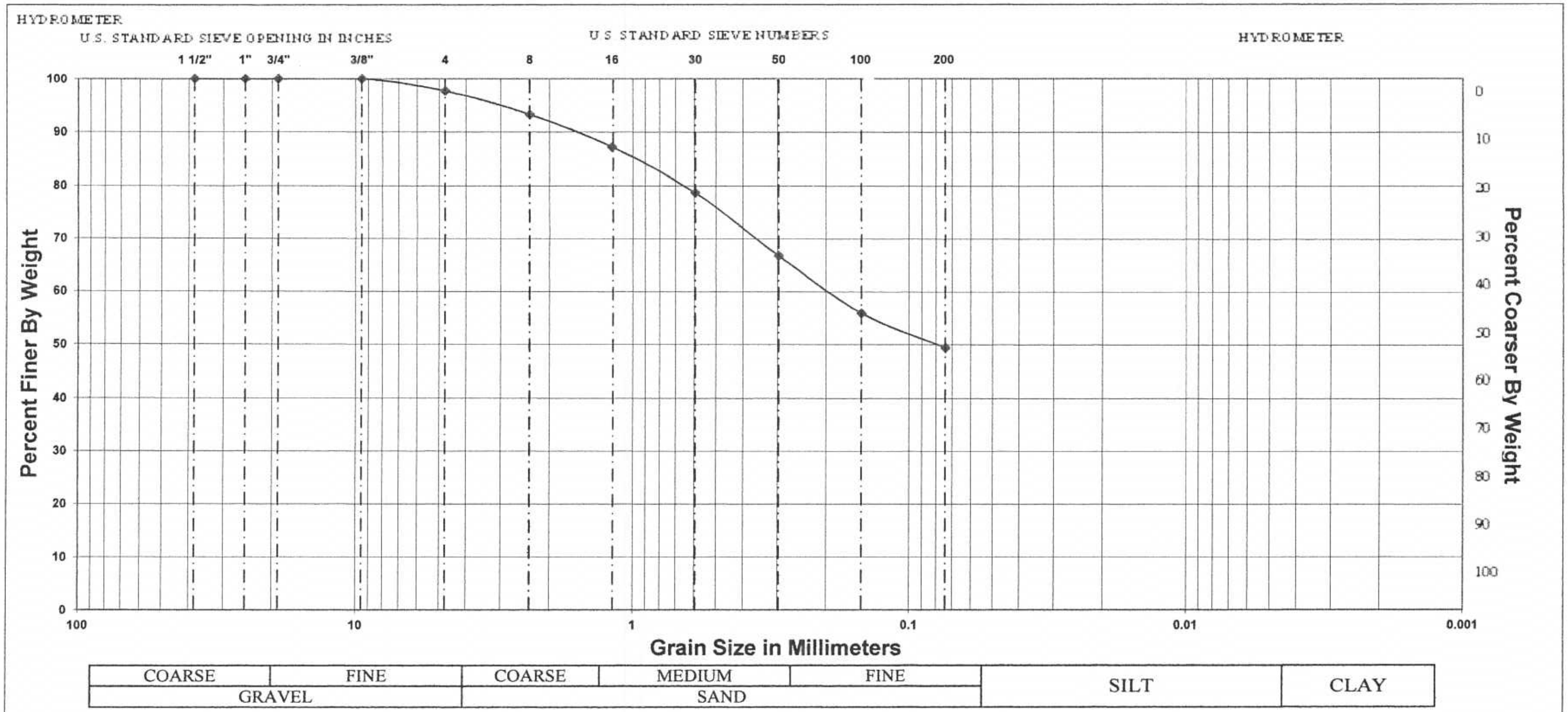
HKA Project No: SC 11032	***GRAIN SIZE ANALYSIS***
Sample No: 1-1-2	
Date: April 25, 2016	**Lost Acres Tank Site**
	Figure No. 8



Gravel Content:	**2.3%**
Sand Content:	**48.3%**
Fines Content	**49.4%**
Cumulative Sum	**100.0%**

Sample Description: Orange Brown CL-Lean Clayey Sand
Group Symbol: SC

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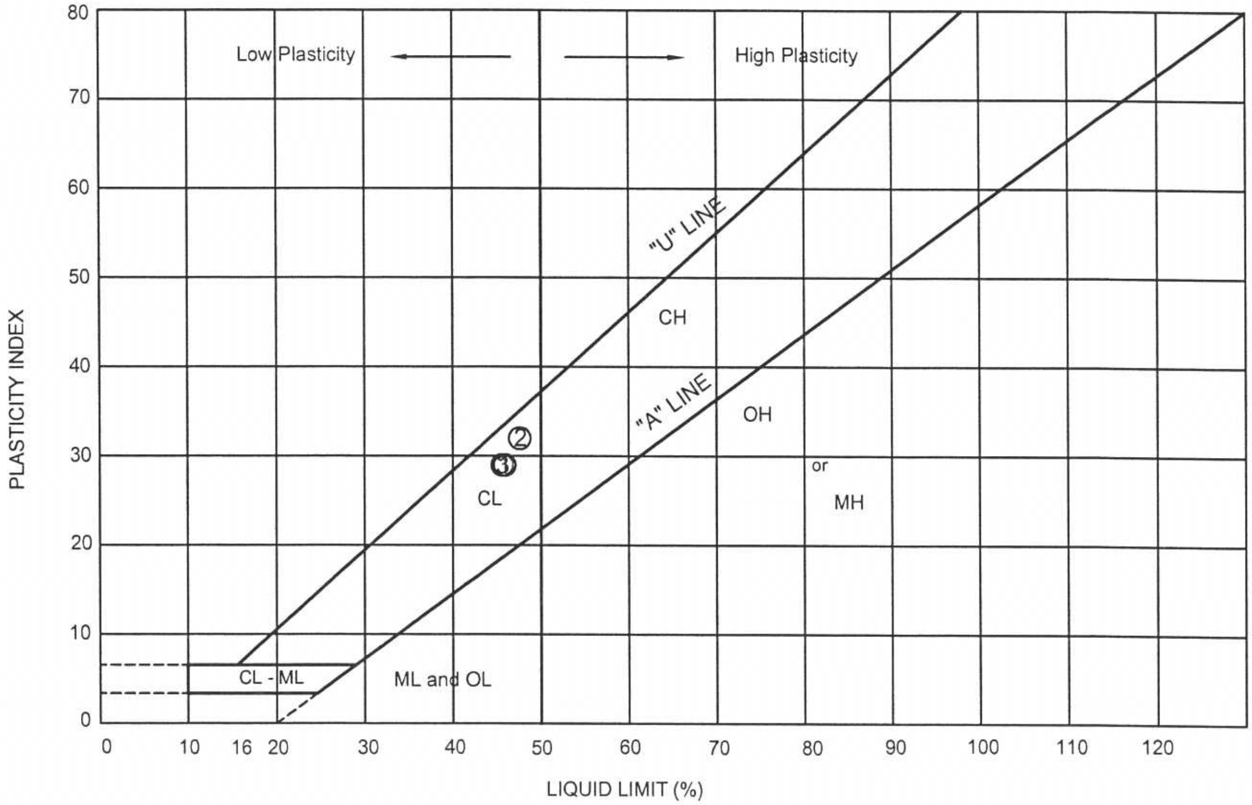
HKA Project No:	SC 11032
Sample No:	3-2-2
Date:	April 25, 2016

GRAIN SIZE ANALYSIS

Lost Acres Tank Site

Figure No. 9

PLASTICITY CHART



PLASTICITY DATA

Key Symbol	Sample Number	Depth (feet)	Natural Water Content W(%)	Plastic Limit (%)	Liquid Limit (%)	Plasticity Index	Liquidity Index (W - PL)/(LL - PL)	Unified Soil Classification Symbol
①	1-1-1	2.0	22.2	17.4	45.9	29	+0.168	CL
②	2-1-1	2.0	21.0	16.2	47.6	32	+0.153	CL
③	3-2-2	1.5	22.1	16.7	45.6	29	+0.187	CL

ATTERBERG LIMITS TEST RESULTS

SLVWD LOST ACRES TANK SITE
FELTON, CALIFORNIA

SCALE:	No Scale
DRAWN BY:	MC
DATE:	JUNE 2016
REVISED:	
JOB NO.:	SC11032

HARO, KASUNICH & ASSOCIATES, INC.
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FIGURE NO. 10

SHEET NO.