GEOTECHNICAL INVESTIGATION

MOKELUMNE RIVER WATERSIDE HABITAT ENHANCEMENT AND LEVEE REPAIR NEW HOPE TRACT, CALIFORNIA

Project No. 921.01
November 25, 2020

Prepared by

Hultgren – Tillis Engineers

A California Corporation
Specializing in Geotechnical Engineering

Hultgren-Tillis Engineers

November 25, 2020
Project No. 921.01

Reclamation District 348
c/o Wagner & Bonsignore
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Attention: Mr. Robert Wagner

Geotechnical Investigation
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Dear Mr. Wagner:

We performed a geotechnical investigation for the Mokelumne River Waterside Habitat Project on New Hope Tract in San Joaquin County, California in accordance with the proposal dated April 30, 2019. The results of the investigation are presented in the attached report.

It was a pleasure working with you on this project and we look forward to working with you during construction. If you have any questions, please call.

Sincerely,

Hultgren – Tillis Engineers

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I. INTRODUCTION

This report presents the results of our geotechnical investigation for the waterside habitat enhancement and levee repair project on New Hope Tract in San Joaquin County, California. The project consists of constructing setback levees, removing the existing levee, and constructing waterside habitat at four sites along the South Fork of the Mokelumne River. The four sites are: Area 1 (Stations 242+50 to 268+00); Area 2 (Stations 293+00 to 300+00); Area 3 (Stations 312+30 to 321+70); and Area 4 (Stations 393+00 to 404+00). A vicinity map showing the approximate location of the site is presented on Plate 1. The site layout is shown on the General Site Plan, Plate 2. The four sites are displayed on Site Plans 1 through 4, on Plates 3 through 6, respectively. The elevations presented in this report are referenced to the North American Vertical Datum of 1988 (NAVD88) unless otherwise noted.

Our scope of services was outlined in our proposal dated April 30, 2019. Our scope of services consisted of conducting a geotechnical investigation that included conducting exploration, performing laboratory testing, and developing conclusions and recommendations regarding geotechnical aspects of the project. The results of our geotechnical investigation are presented in this report.

II. FIELD EXPLORATION AND LABORATORY TESTING

A. Existing Data

The Department of Water Resources drilled eleven borings near the project site in January 1957, and four more, as part of a different project in November 1992. The logs of the borings are shown in Appendix B on Plates B-39 through B-53 (elevations presented on the 1957 boring logs are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29)).

B. Field Exploration

We explored subsurface conditions by advancing Cone Penetration Tests (CPTs), performing borings either along the crest of the existing levee alignment or the landside levee toe, and performing hand augers along the new levee alignment. The approximate CPT, boring, and hand auger locations are shown on the individual area Site Plans, Plates 3 through 6.

1. Cone Penetration Tests

We explored subsurface conditions on September 3 and September 4, 2019, by pushing the cone at six locations to depths of 60 to 63 feet below grade. The CPTs were advanced by our subcontractor with a truck-mounted CPT rig. After pushing each CPT, the holes were backfilled with grout. The CPT logs are presented in Appendix A, Plates A-1 through A-6. Soil descriptions on the CPT logs are in general accordance with the CPT Soil Behavior Type Legend presented on Plate A-7. Pore pressure dissipation test results are presented in Plates A-8 and A-13.

2. Borings

We explored subsurface conditions by drilling 19 borings between September 9 and September 16, 2020. Borings 2, 7, 10, 14, and 17 were drilled near the landside levee toe and extended to a depth of 61.5 feet below existing grade. The remainder of the borings were drilled along the levee crest and extended to a depth of 21.5 feet below the levee crest.

Our subcontractor used hollow-stem auger drilling methods with truck-mounted drilling equipment. We collected samples with a 2.5-inch outside diameter (OD), 1.9-inch inside diameter (ID) split barrel sampler. The samplers were driven with a 140-pound hammer dropping approximately 30-inches for a penetration depth of up to 18-inches. The hammer utilized an automatic trip system. We also collected Shelby samples with a 3-inch OD, 2.9-inch ID thin walled sample tube. The Shelby tube samples were advanced 24-inches using hydraulic pressure.

Our engineer logged the borings and recorded blow counts from driving the samplers. We recovered samples from the borings for further visual classification and for selection of materials for laboratory testing. Our engineer used a pocket penetrometer to evaluate unconfined compressive strength or a torvane to evaluate the soil shear strength. The borings were backfilled with grout.

We converted the field penetration resistance obtained while driving the 2.5-inch sampler to equivalent SPT N-values by multiplying by 0.8 to account for sampler size and 1.17 to account for hammer energy for a net correction of 0.93. Soil descriptions, equivalent SPT N-values and the laboratory test data are shown on the Logs of Boring on Plates B-1 through B-25, in Appendix B. The soil descriptions are presented in general accordance with the Soil Classification System presented on Plate B-38 with laboratory test results presented in the manner described by the Key to Test Data.

3. Hand Augers

We explored subsurface conditions on June 12, 2020 using hand augers. The twelve hand auger borings were advanced near the existing levee toe to a depth of 3 to 6 feet below existing grade. Our engineer logged the hand augers. We recovered samples from the hand augers for further visual classification and for selection of materials for laboratory testing. The hand augers were backfilled with cuttings. Soil descriptions and the laboratory test data are shown on the logs of Hand Augers on Plates B-26 to B-37, in Appendix B. The soil descriptions are presented in general accordance with the Soil Classification System presented on Plate B-38 with laboratory test results presented in the manner described by the Key to Test Data.

C. Laboratory Testing

The laboratory testing program consisted of moisture content and dry density measurements, Atterberg limits, minus No. 200 and sieve analyses, triaxial consolidation undrained (TxCU) shear strength testing, and consolidation tests. The laboratory test results are presented in Appendix C. Atterberg limits test results are shown on Plates C-1 through C-6. Sieve analysis test results are shown on Plates C-7 through C-15. TxCU shear strength test results are shown on Plates C-16 and C-17. Consolidation test results are shown on Plates C-18 and C-19. The moisture content and dry density, and minus No. 200 content are presented on the individual boring and hand auger logs.

III. SITE CONDITIONS

A. Geology

The United States Geological Survey (USGS) has published geologic maps for the Sacramento-San Joaquin River Delta (Atwater 1982). A portion of the Atwater geologic map that includes New Hope Tract and the geologic descriptions of the map (geology) units are presented on Plate 7. The site lies just west of the landward margin of tidal wetlands at lower river stages circa 1850. The geology map shows that within the limits of this project, New Hope Tract is covered by “Alluvial-Floodplain deposits, undivided (Qfp)”, “Flood-Basin deposits (Qb)”, and “Modesto Formation (Qm)”. The alluvial-floodplain deposits consist mainly of firm silty clay, micaceous silt, and micaceous sand with low organic content. The unit also includes historical tidal-wetland peat that has been largely exhumed (oxidized and disappeared), and unmapped bodies of peaty mud thicker than 5 feet in abandoned channels and interdistributary basins. The flood-basin deposits generally consist of firm to stiff clays and silts. The alluvial-floodplain and flood-basin deposits typically overlie the Modesto Formation (Qm), which consists mainly of loose sand and silt.

The present configuration of the Sacramento-San Joaquin River Delta began to form after the last ice age. During the ice age, sea levels were 200 to 300 feet below present levels. Sea levels rose rapidly for several thousand years then the rate of the sea level rise slowed. As sea levels rose, the Delta was inundated. The rise in sea level was slow enough to allow for the accretion of marsh vegetation and formation of a widespread inland Delta covered by marsh deposits (mapped as Qpm).

The fine-grained materials continued to accumulate as sea levels rose. The marsh formation was halted upon reclamation of land in the late 1800’s and early 1900’s within the Delta.

The initial levees in the Delta were typically created by dredging adjacent to the levee and casting up soil to create the levee. Often the initial fill consisted entirely of marsh deposits. The levees were raised and widened with time, generally with dredge materials obtained from the waterways adjacent to the levee. More recently, fill has been obtained from borrow sites within the Delta.

The reclamation of the Delta allowed the peat materials to dry. The process of drying an organic material such as peat causes it to oxidize and deplete. The ground surface within New Hope Tract has subsided since the island was reclaimed predominately due to soil oxidation and disappearance of the peat. Oxidation continues to occur throughout the Delta.

B. Surface Conditions

Aggregate base covers the levee crest along the four project areas. There are existing encroaching structures on or within the levee including overhead utility lines and poles, and siphon pipes through the levee.

The typical daily tidal range near the project site is from about Elevation 3.3 to 6.2 feet. Extreme low tides approach Elevation 1.9 feet and extreme high tides are near Elevation 8.5 feet.

Below is a summary of surface conditions in each area of study.

1. Area 1

The centerline of the levee, throughout Area 1, varies from Elevation 13.8 to Elevation 18.1 feet. The levee crest width ranges from about 18 to 23.5 feet and is generally about 20 feet.

The island interior near the landside levee toe varies from about Elevation 0.4 feet to Elevation -3.5 feet. The landside slope is generally inclined between 3.5H:1V (horizontal to vertical) and 4H:1V. The landside levee slope and toe are covered by vegetation that consists of grass and tall plants. The waterside slope is generally inclined between 1.5H:1V and 2H:1V. The waterside levee slope is covered by riprap, tall vegetation, and occasional trees.

The 100-year flood level at the site is at Elevation 13.9 feet.

At the northern end of Area 1, a siphon system crosses the existing levee near Station 268+00, and a few trailers are parked about 100 feet north of where the siphon crosses through the levee.

2. Area 2

The centerline of the levee, throughout Area 2, varies from Elevation 15.1 to Elevation 16.4 feet. The levee crest width ranges from about 15 to 30 feet and is generally about 18 feet.

The island interior near the landside levee toe varies from about Elevation -1.9 feet to Elevation -2.7 feet. The landside slope is generally inclined between 2.5H:1V and 3H:1V. The landside levee slope and toe are covered by vegetation that consists of grass and tall plants. The waterside slope is generally inclined between 1H:1V and 2H:1V. The waterside levee slope is covered by riprap, tall vegetation, and occasional trees.

The 100-year flood level at the site is at Elevation 14.5 feet.

3. Area 3

The centerline of the levee, throughout Area 3, varies from Elevation 16.2 to Elevation 17.8 feet. The levee crest width ranges from about 14 to 30 feet and is generally about 17 feet.

The island interior near the landside levee toe varies from about Elevation -1.9 feet to Elevation -2.7 feet. The landside slope is generally inclined between 2H:1V and 3.5H:1V. The landside levee slope and toe are covered by vegetation that consists of grass and tall plants. The waterside slope is generally inclined between 1.5H:1V and 2.5H:1V. The waterside levee slope is covered by riprap, tall vegetation, and occasional trees.

The 100-year flood level at the site is at Elevation 14.9 feet.

4. Area 4

The centerline of the levee, throughout Area 4, varies from Elevation 19.1 to Elevation 21.2 feet. The levee crest width ranges from about 15 to 20 feet and is generally about 20 feet.

The island interior near the landside levee toe varies from about Elevation 0 feet to Elevation 1.0 feet. The landside slope is generally inclined between 3H:1V and 4H:1V. The landside levee slope and toe are covered by vegetation that consists of grass and tall plants. The waterside slope is generally inclined between 1.5H:1V and 2H:1V. The waterside levee slope is covered by riprap, tall vegetation, and occasional trees.

The 100-year flood level at the site is at Elevation 16.4 feet.

At the northern end of Area 4, a USGS monitoring station is located approximately 50 feet east of the existing levee near Station 403+30. Just north of Area 4, West Walnut Grove Road crosses over the Mokelumne River.

C. Subsurface Conditions

We encountered between 2- and 4-inches of aggregate base within the borings drilled in the levee crest. The aggregate base is underlain by a layer of fill over alluvial deposits consisting mainly of clays, silts, and peats, with thin interbedded layers of sand. The fill thickness and composition below the levee crest varies across the site. The fine-grained alluvial deposits vary in consistency from soft to stiff. The clays vary in plasticity from low to high, and the silts generally have low plasticity.

Near the landside toe of the existing levee and along the alignment of the new levee, we generally encountered a mixture of marsh, alluvial and basin deposits in the upper 3 to 8 feet, below existing grade. The marsh deposits consisted of soft to medium stiff organic clays, organic silts, and peat. The alluvial and basin deposits generally consisted of fine-grained clays and silts. The alluvial and basin deposits were generally soft to stiff in the upper 8 feet and stiff to very stiff below 8 feet. We encountered zones of sandy alluvium within the fine-grained alluvium. Within the farmed fields, the material was generally disturbed to about 18-inches.

Below is a more detailed discussion of the subsurface conditions in each area. The following descriptions of soil and groundwater conditions summarize observations at the time of the investigation. Conditions are expected to vary across the site and with time and depend on several factors including changes in moisture content resulting from seasonal precipitation, irrigation practices, and tides.

1. Area 1

We encountered between 8 to 15 feet of fill in our crest borings. The fill consists of lean clay with variable amounts of sand, silty and clayey sand, and pockets of remolded peat. The lean clay fills were generally stiff and dry to moist and the sands were typically loose.

We encountered fill in the landside levee toe in Boring 17. The top 7 feet was fill in Boring 17, and the top 3 feet in Boring 17-Offset was fill. The fill consisted of stiff lean clay with gravel in the upper 3 feet and poorly-graded sand below the lean clay with gravel. The gravel varied in size from ½ to 1½-inches.

Below the fill, and in the borings, CPTs and hand augers that did not encounter fill, we encountered marsh, alluvial, and basin deposits to the depth explored. The consistency of these fine-grained deposits varied. Below the levee fill and in the farmed fields, the upper portion of these materials were typically very soft to medium stiff. Within the haul roads, these deposits were typically stiff in the upper 3 feet at the boring and CPT locations. The upper 1½ feet at the hand auger locations was disturbed by farming activities and was very soft to soft. At 1½ feet below existing grade, the material was medium stiff. The fine-grained materials were wet in the farmed fields and were dry to moist along the haul roads and where they were not farmed.

We encountered lean clay and lean clay with sand below these materials. The lean clays were generally soft to medium stiff in the upper 8 feet and were stiff to very stiff below 8 feet. The liquid limits of the lean clays varied from 23 to 47 and the plasticity index varied from 9 to 23.

About 20 feet below existing grade in our borings and CPTs, we encountered sand layers, except in CPT 4 where it was encountered about 13 feet below existing grade. The sand layers varied in thickness and were interbedded with layers of clay and silt. The sand layers were generally loose to medium dense with fines contents ranging from 4 to 50 percent. The interbedded sand and clay layers extended to about 40 to 45 feet below existing grade. Below the interbedded layers, we generally encountered very stiff to hard lean clays to the depth explored.

2. Area 2

We encountered about 10 feet of fill in our crest borings. The fill is predominately loose sand and stiff to very stiff clay. The fines content of the sand, between about 5 feet and 10 feet below the levee crest, varied between 19 and 36 percent. The fills were generally dry to moist.

We encountered marsh, alluvial, and basin deposits at the toe of the existing levee and along the alignment of the new levee. Below the levee fill and in the farmed fields, the upper portion of these materials were typically very soft to medium stiff. Within the haul roads, these deposits were typically stiff in the upper 3 feet at the boring and CPT locations. In CPT 3, these fine-grained alluvial and basin deposits were typically stiff in the upper 3 feet and soft to medium stiff to about 8 feet below existing grade. They were stiff to hard in Boring 10. Where we encountered marsh deposits in Hand Augers 24 and 25, they were soft to medium stiff. These materials were wet in the farmed fields and were dry to moist along the haul roads and where they were not farmed. In the boring and CPT locations, we encountered sandy lean clay about 6 to 8 feet below existing grade. The stiff to hard sandy lean clay extended to about 20 feet below existing grade. The liquid limits of the sandy lean clay varied from 36 to 40 and the plasticity index varied from 19 to 20.

About 20 to 25 feet below existing grade in our boring and CPT, we encountered sand layers. The sand layers varied in thickness and were interbedded with layers of clay and silt. The sand layers were generally loose to medium dense with fines contents ranging from 21 to 45 percent. The interbedded sand and clay layers extended to about 35 feet below existing grade in our CPT and to the bottom of Boring 10, about 61.5 feet. Below the interbedded layers in the CPT, we generally encountered very stiff to hard clays and silts to the depth explored.

3. Area 3

We encountered about 10 to 15 feet of fill in our crest borings. The fill is a mixture of poorly-graded sand with gravel, poorly-graded sand with silt, silty sand, and lean clay. The sandy material was generally loose and the lean clay was stiff.

We encountered marsh, alluvial, and basin deposits at the toe of the existing levee and along the alignment of the new levee. These fine-grained alluvial and basin deposits were typically stiff in the upper 2 feet and soft to medium stiff to about 6 feet below existing grade in CPT 2. They were stiff to hard in Boring 7. We encountered medium stiff to stiff organic silt from 2.5 feet to 5 feet below existing grade in Hand Auger 22. We encountered stiff lean clay in Hand Auger 23.

In Boring 7, we encountered fat clay to a depth of 25 feet below existing grade. The fat clay was stiff to hard and moist to wet. The liquid limits varied from 50 to 61 and the plasticity index varied from 27 to 30. Below the fat clay layer, we encountered 15 feet of loose poorly-graded sand. Below the poorly-graded sand, we encountered very stiff fat clay to the bottom of the boring, about 61.5 feet.

In CPT 2 we generally encountered interbedded clay and silty sand to the bottom of the of the sounding, about 60 feet. The clayey materials were very stiff and the sandy materials were medium dense.

4. Area 4

We encountered about 15 to 20 feet of fill in our crest borings. The fill is a mixture of poorly-graded sand with gravel, silty sand, sandy silt, and sandy lean clay. The sandy material was generally very loose to loose and the fine-grained material was very stiff.

We encountered marsh, alluvial, and basin deposits at the toe of the existing levee and along the alignment of the new levee. These fine-grained alluvial and basin deposits were typically stiff in the upper 4 feet and medium stiff to about 8 feet below existing grade in CPT 1. They were stiff to hard in Boring 2. We encountered very soft to medium stiff organic silt and lean clay in the top 3 feet in Hand Augers 20 and 21. The upper 1.5 feet at the hand auger locations was disturbed by farming activities and was very soft. These materials were wet in the farmed fields and were dry to moist along the haul roads and where they were not farmed.

About 10 feet below existing grade, we encountered thickly interbedded layers of sands and clays in Boring 2 and CPT 1 to the depth explored, about 60 feet. The layer thicknesses varied from 10 to 25 feet thick in our boring and CPT. The sandy material had variable fines content and were generally loose to medium dense. The clayey material was generally fat clay with high plasticity and was very stiff to hard.

D. Groundwater

Groundwater levels were measured in landside levee toe borings and with pore pressure dissipation tests in the CPTs. The borings were backfilled immediately after drilling and stabilized water levels were not obtained. We expect that typical groundwater levels within the levee will be near mean tide levels. New Hope Tract is below sea level and groundwater levels within the island are artificially controlled by evapo-transpiration and pumping. The groundwater levels are expected to be within a few feet of the ground surface during much of the year.

IV. DISCUSSION AND CONCLUSIONS

A. General

The project includes constructing a new offset levee and removing the existing levee to create waterside habitat at four areas along the west side of New Hope Tract. The proposed levee landside and waterside slopes will be constructed at 3H:1V and 2H:1V, respectively. The crest will be 16 feet wide. The typical design sections are shown on Plates 8 and 9.

The design includes removing a portion of the existing levee. The construction work should be performed outside of flood season. The new setback levee needs to extend to sufficient height to provide flood protection prior to degrading the existing levee. We recommend that the new setback levee should be constructed to at least 3 feet above Mean Higher High Water along its entire length prior to degrading the existing levee. Additionally, we conclude that the existing levee should only be degraded if the contractor will be able to complete the setback levee prior to flood season. Typical staging details have been presented on Plates 10 and 11.

The primary geotechnical engineering concerns include the presence of marsh and alluvial deposits, the risk of deformation during fill placement, the connection of the offset levees to the existing levees, and encroachments near the landside levee toe and through the levee. These concerns and other considerations for design and construction of the project are discussed below.

B. Levee Safety Considerations

An evaluation of overall levee safety and reliability requires consideration of various factors including overtopping from flood stages, seepage through and below the levee, static stability of slopes, settlement and creep deformation of the levee, wind-generated wave run-up, waterside erosion protection, and resistance to earthquake forces. A complete assessment of the levee is beyond the scope of this study. The focus of our investigation is the offset levees and habitat benches.

C. Marsh Deposit Foundation Soils

In addition to the normal factors for consideration in levee design, the proposed levee on New Hope Tract will be founded on soft to medium stiff marsh and alluvial deposits that extend up to 8 feet below the landside toe roadway. The presence of these marsh and alluvial deposits may have a significant effect on the safety of the levee relative to levees constructed on firm soil. The presence of these soils requires consideration of principles for design and construction on soft ground. Routine practices for constructing on soft ground include broad berms to buttress slopes, construction in stages, and providing tolerance to allow for long-term settlement and deformation. Peat also exhibits creep (long-term deformation under sustained loading) that must be considered in design.

A concern for fill on soft ground is overstressing the ground and causing ground failure. Fills placed too quickly could exceed the strength of the weak foundation materials (marsh and alluvial soils) at the site. We checked the factor of safety for the fill placement assuming the entire fill is constructed at once. The surface materials include relatively weak materials. To minimize the risk of ground movement during fill placement, we conclude that the fill thickness is too large to place in one sequence and the fill should be constructed in stages. The foundation materials will gain strength as the soil consolidates allowing subsequent stages of fill to be placed while maintaining a reasonable level of safety.

We conclude that two stages is the minimum required for construction of the proposed levee, and the first stage of fill should be limited to 10 feet thick. We conclude that a minimum 1 month waiting period between stages is needed. The waiting period will allow for visual inspection of the fills for signs of deformation and yielding. Typical staging details are presented on Plates 10 and 11.

During final design, we should review project plans to check the fill thicknesses needed to construct the various reaches of levee.

D. Seepage

The project plans include excavating the existing levee to tidal levels and placing fill to create a setback levee located 75 feet to 110 feet inland. Constructing setback levees and excavating waterside benches are not common practice in the Delta. We evaluated both underseepage and through seepage of the new levee. The details and results of our analysis is presented in Appendix D. The results indicated that the new levee meets generally accepted factors of safety against seepage forces.

Periodic monitoring for seepage will be needed after construction of the project, especially during extreme high tides and floods. If seepage is observed, then remedial measures may be required.

E. Encroachments and Existing Vegetation

A USGS monitoring station is located approximately 50 feet east of the existing levee in the northern tip of Area 4 near Station 11+25. West Walnut Grove Road crosses the Mokelumne River through a bridge overpass located at the northern end of Area 4. We conclude that new fills should end before the footprint of the structure. The placement of fill near the bridge could cause settlement and deformation to its foundations.

A siphon system crosses the existing levee at Station 268+00 near the northern tip of Area 1, and a few trailers are parked approximately 100 feet landside from the siphon. These structures should be considered during design, and the waterside improvements should not be included in these areas.

As a general practice, trees, brush, heavy vegetation, and encroachments located within the footprint of the levee is undesirable. After trees die, the root system decays and may leave a void. The active or decayed root system of a tree could provide a convenient path for seepage to flow through a levee. Trees and other dense vegetation make it difficult to inspect levees and can obscure problems with the levee. The vegetation also makes it difficult to repair or rehabilitate the levee because the vegetation must be removed first. We conclude that trees, dense vegetation, and encroachments should be removed from the footprint of the levee and not be allowed in the future.

F. Slope Stability

The results of our stability analysis are presented in Appendix E. The results indicate that the factors of safety for the levees are above the minimum factors of safety required by the USACE.

G. Settlement and Lateral Deformation

The proposed levee will be underlain by up to 8 feet of soft to medium stiff marsh and alluvial deposits. The base of the marsh and alluvial deposits ranges from about Elevation -7 feet to Elevation -12 feet. Fill will be placed to create the proposed levee which will induce consolidation of the underlying marsh deposits and cause the crest to settle. We performed analysis to estimate settlement of the levee based on the theory of consolidation. Primary consolidation occurs from compression of the marsh soils beginning when weight is placed on the soil. The initial weight is transferred to the water within the soil. The water builds up pressure causing flow to occur. As the water flows out of the soil, the soil structure compresses and continues to compress until the water flow is complete and the water pressure returns to hydrostatic levels.

Secondary compression is deformation without flow of water. With most soils, the amount of secondary compression is small relative to the primary consolidation and is not a concern. With peat and to a lesser extent, organic soil, secondary compression is a significant phenomenon and will cause continued settlement of the levee and the loss of freeboard. The secondary compression will continue for many years at a diminishing rate with time.

The levee crest and landside slope will settle under the weight of the new fill. We estimate that the new levee crest will settle about 6-inches, and the landside slope will settle about 3-inches. We conclude the levee should be designed to accommodate 6-inches of settlement by building the levee 6-inches above the planned final crest elevation during initial construction.

Deformation of the levee can lead to cracking in the levee crest and slopes. In setback levees, cracking can also occur where the proposed levee abuts the existing levee. The existing levee has already settled under its own weight, while the proposed levee will start to settle during and after construction causing differential settlement and cracking in the abutment areas. Cracks are prevalent throughout the Delta levee system. The cracking is undesirable and, will be a continuing concern for the levee. Deformation cannot be avoided, and cracking should be expected.

H. Levee Fill Material

Embankments are usually less costly if they can be constructed with on-site materials rather than imported materials. We understand imported fill will be needed to supplement the existing levee fills in order to construct the setback levee. At the locations we explored within the existing levee, we encountered variable fills consisting of lean clays, silts, and sands. We conclude that the new setback levee should be constructed as a zoned embankment. The zone of the setback levee extending from below the levee crest to the waterside slope should be constructed with low-permeability imported fill meeting the USACE Sacramento District levee fill criteria. The landside slope of the setback levee may be constructed with existing levee fills (on-site material) or with imported fill. The keyway should be backfilled with imported fill. The levee zones are shown on Plates 8 and 9.

I. Levee Foundations

The near surface soils have been disturbed by farming practices. We estimate that local farming practices have disturbed the field up to a depth of 18-inches. Shrinkage cracks may extend deeper in some areas. These cracks and disturbances could be a path for seepage beneath the new levee embankment. We conclude that the footprint of the new levee should be scarified to 18-inches, moisture conditioned and recompacted.

In addition to the subgrade preparation, we conclude that a keyway should be constructed below the new levee to reduce the potential for seepage to flow below the levee near its interface with the foundation soil. The interface between the new fill and the foundation soils are a preferential seepage path which, without seepage control measures, may cause erosion of the foundation. The keyway should extend a minimum of 3 feet below grade and should be backfilled with low permeability material. The keyway should be centered on the levee centerline where feasible.

Where existing landside levee berms will be located below the planned setback levee, the berms should be overexcavated and replaced with imported fill. The overexcavation should not encroach upon the levee toe and the backcut should be inclined at 2H:1V or flatter.

The proposed levee alignment will cross several existing ditches. Water and recent sediments in the ditches need to be removed beneath the footprint of the planned levee embankment prior to placing fill. The fill placed in the ditches should be placed in lifts and compacted similar to the methods used to construct the remainder of the levee.

Gravel roads, drainage pipes, buried utility lines, and other similar linear features could create seepage paths beneath the levee. Removing these features needs to be included in the plans.

V. RECOMMENDATIONS

A. Levee Configuration

We recommend that the design generally conform to the details shown on Plates 8 and 9. The levee may be constructed with a combination of existing levee fill and imported fill. The zone of the levee extending from below the levee crest to the waterside slope should be constructed with low-permeability imported fill. The landside slope should be constructed with existing levee fills.

A keyway should be placed below the center of the levee and should be constructed from imported fill meeting the requirements below. The keyway should be 3 feet deep and 16 feet wide at the base. The slopes should extend up to the ground surface at 2H:1V.

The fills should be constructed in two stages. The initial fill thickness should be limited to 10 feet. There should be a minimum 1 month waiting period between stages. Typical staging details are presented on Plates 10 and 11.

B. Earthwork

1. Site Preparation

The site should be cleared and grubbed of surface and subsurface deleterious matter including trees, grasses, other vegetation and debris designated for removal. The site should be stripped to sufficient depth to remove vegetation and soil containing roots. Tree roots greater than 1-inch in diameter should be removed. Stripped and grubbed materials should be removed from the site and should not be used as fill.

From the existing levee crest, aggregate base may be removed and collected for use on the new levee crest.

2. Fill Materials

The zone of the setback levee extending from below the levee crest to the waterside slope should be constructed with low-permeability imported fill. The landside slope of the setback levee may be constructed on-site material or with imported fill.

Imported fill should meet the USACE Sacramento District levee fill criteria. Imported fill material should have at least 30 percent fines passing the No. 200 sieve and 100 percent passing the 2-inch sieve. The fines should have a plasticity index of at least 8 and less than 40, and a maximum liquid limit of 45. On site soil will not meet the requirements of imported fill.

Aggregate base should meet the requirements for Caltrans Class 2 aggregate base.

At least seven calendar days prior to importing fill, the contractor should submit samples of import fill to the geotechnical engineer's office together with the results of laboratory test data verifying the suitability of the material. The source of the import borrow area should be identified and the geotechnical engineer should be given access to visit the import borrow area prior to and during importing operations.

3. Compaction

Surfaces within the footprint of the levee should be scarified to a depth of at least 18-inches. The scarified soil should be moisture conditioned to at least optimum moisture content and compacted to at least 90 percent relative compaction. ASTM test method D-1557 should be used to establish the reference values for computing optimum moisture content and relative compaction.

Fill should be placed in lifts 8-inches or less in loose thickness and moisture conditioned to at least optimum moisture content. Moisture conditioning should be performed prior to compaction. Each lift should be methodically compacted to at least 90 percent relative compaction. A sheepsfoot compactor or equivalent equipment should be used for compacting clay soils. Material that fails to meet the moisture or compaction criteria should be loosened by ripping or scarifying, moisture conditioned, and then recompacted. Fill should be placed on horizontal surfaces. The fill should be benched into the existing landside levee slope to allow recompaction of some of the existing soil. The horizontal bench width into the existing slope should not exceed 5 feet.

On the levee crest and ramps, the upper 6-inches of subgrade should be compacted to at least 95 percent relative compaction and rolled to provide a smooth, firm-yielding surface. Subgrade soils should be proof-rolled prior to placing aggregate base. Soft or pumping areas should be aerated or excavated and recompacted.

Aggregate base should be placed in thin lifts no greater than 6-inches in loose thickness and in a manner that avoids segregation, moisture conditioned as necessary, and compacted to at least 95 percent relative compaction.

4. Slopes

Fill slopes should be inclined at 3H:1V or flatter on the landside and 2H:1V or flatter on the waterside. Fill slopes should be constructed fat and trimmed back to expose well-compacted fill. Finished slopes should be trackwalked perpendicular to the slope face with a bulldozer after completion. The slopes should be hydroseeded to promote vegetation. The slopes may need to be hydroseeded between stages to prevent erosion or rilling during wet weather. Vegetation should be limited to grasses or other vegetation that can be mowed or disced to allow inspection of the landside levee slope. Trees, bushes, and brush should not be allowed within the footprint of the levee slopes.

5. Erosion protection

Slope protection will be needed on the waterside slope. The protective facing will need to extend over the portion of slope face that will be exposed to wave action, including the estimated height of run-up. The traditional scheme for erosion protection is riprap facing. Riprap should be quarried rock materials with an angular to subangular shape.

C. Geotechnical Services During Construction

Before construction, we should review project grading plans and specifications for conformance with the intent of our recommendations. During construction we should observe and/or test the geotechnical aspects of grading including but not limited to subgrade preparation, placement and compaction of fill, and finish grading. If conditions are encountered during construction that are not consistent with those described herein, we should be contacted to review our recommendations and provide alternatives, if appropriate.

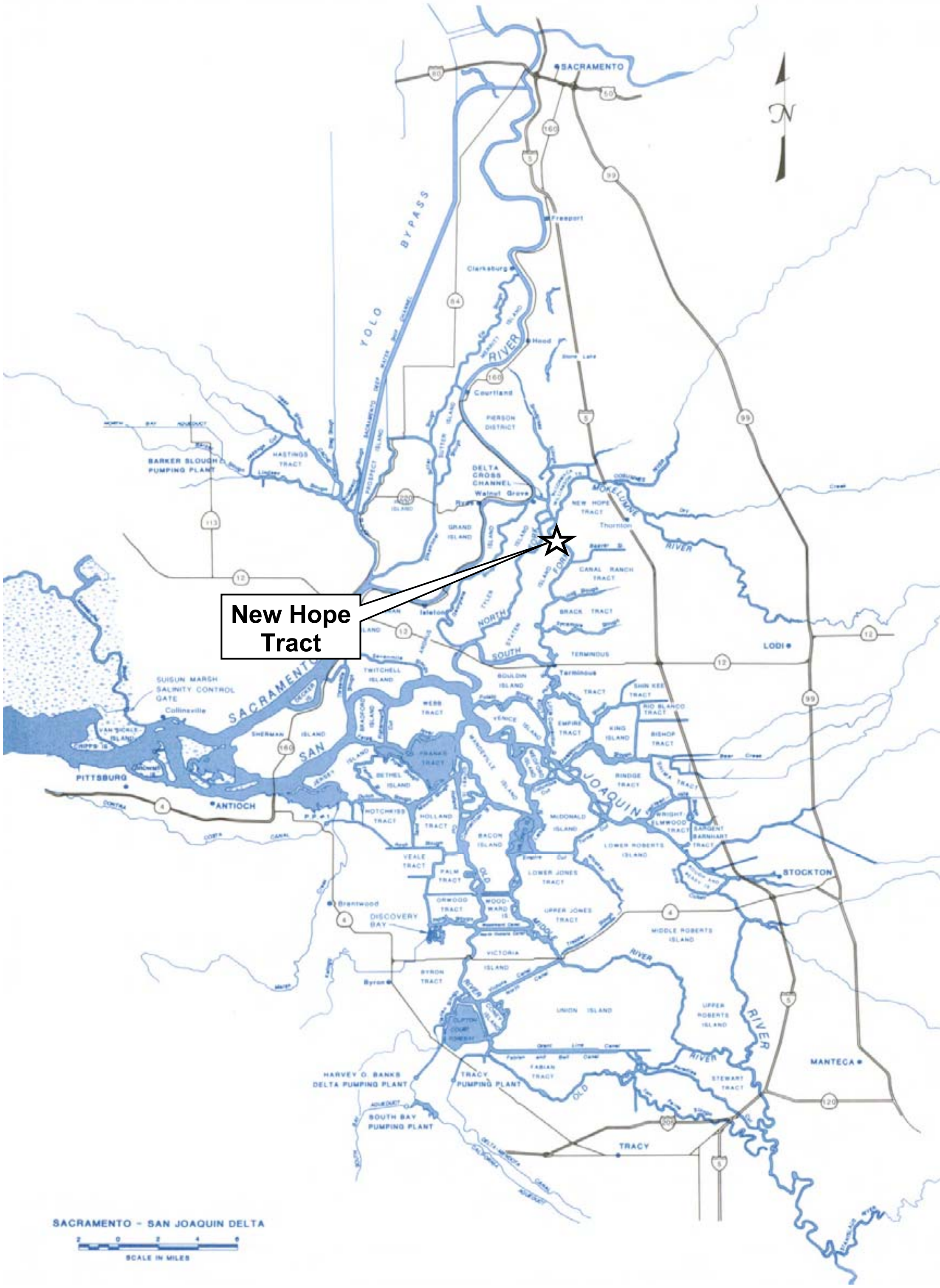
REFERENCES

REFERENCES

Atwater, Brian F. 1982. United Stated Department of the Interior Geological Survey, Geologic Maps of the Sacramento-San Joaquin Delta, California.

URS. 2015. *Guidance Document for Geotechnical Analyses, Sacramento, California*, dated April 29, 2015.

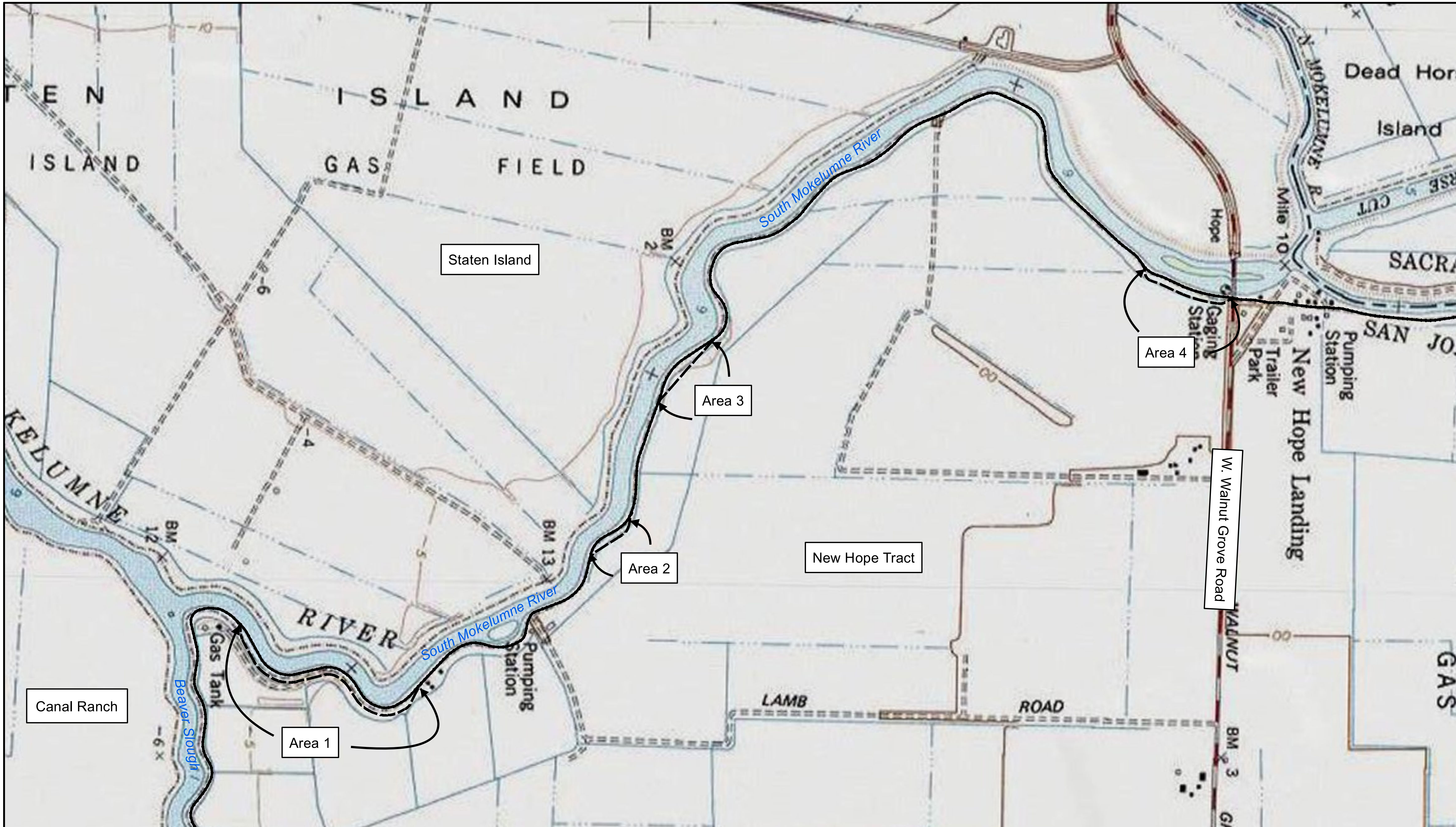
PLATES



Source: Sacramento-San Joaquin Delta Atlas by California Department of Water Resources (1995)

Not to Scale

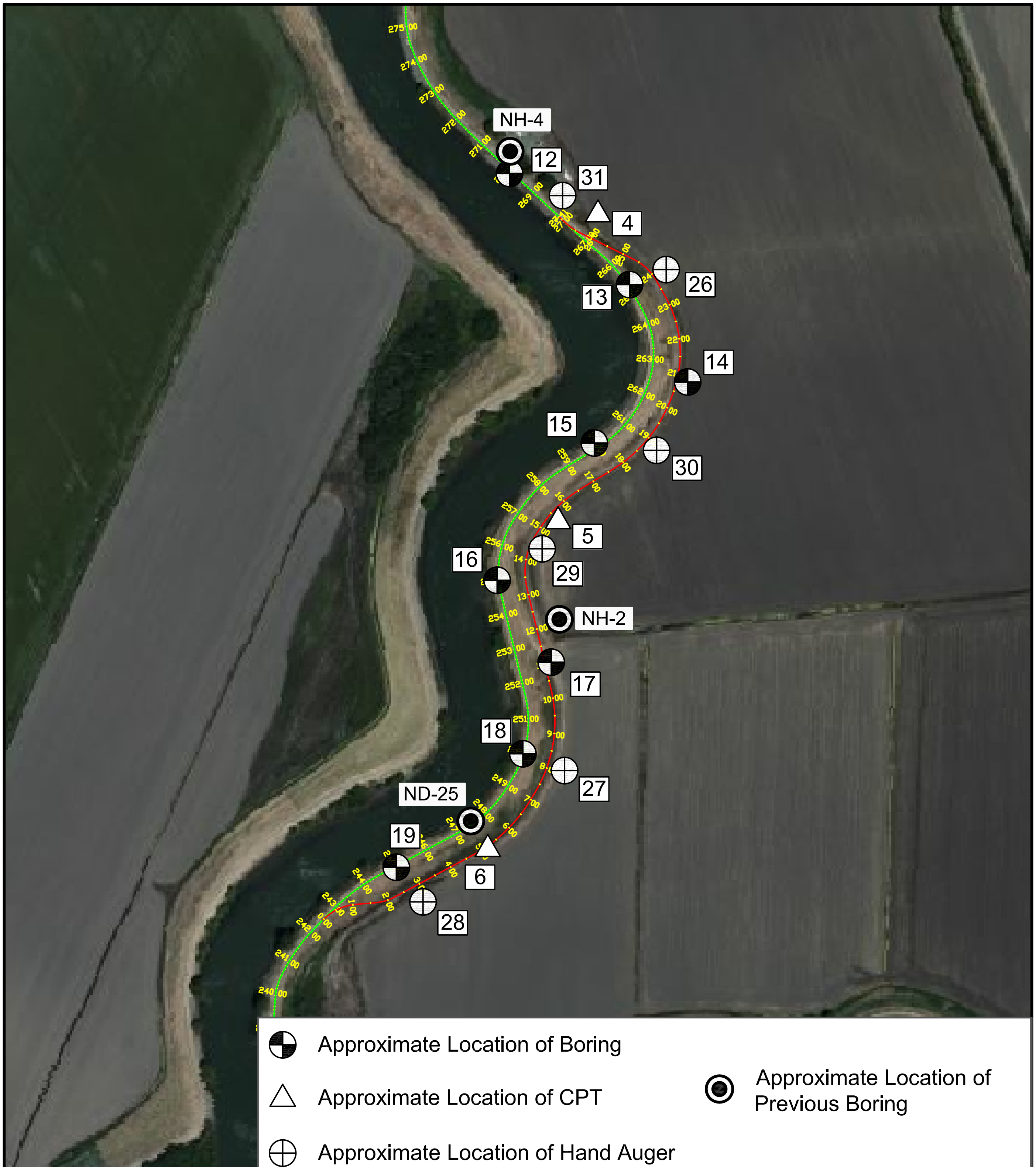
Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California		**Vicinity Map**
Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 1



0 1,000 feet

1 inch = 1,000 feet

Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California	**General Site Plan**	
Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 2



LEGEND

Existing Levee Alignment

Proposed Levee Alignment

N

SCALE

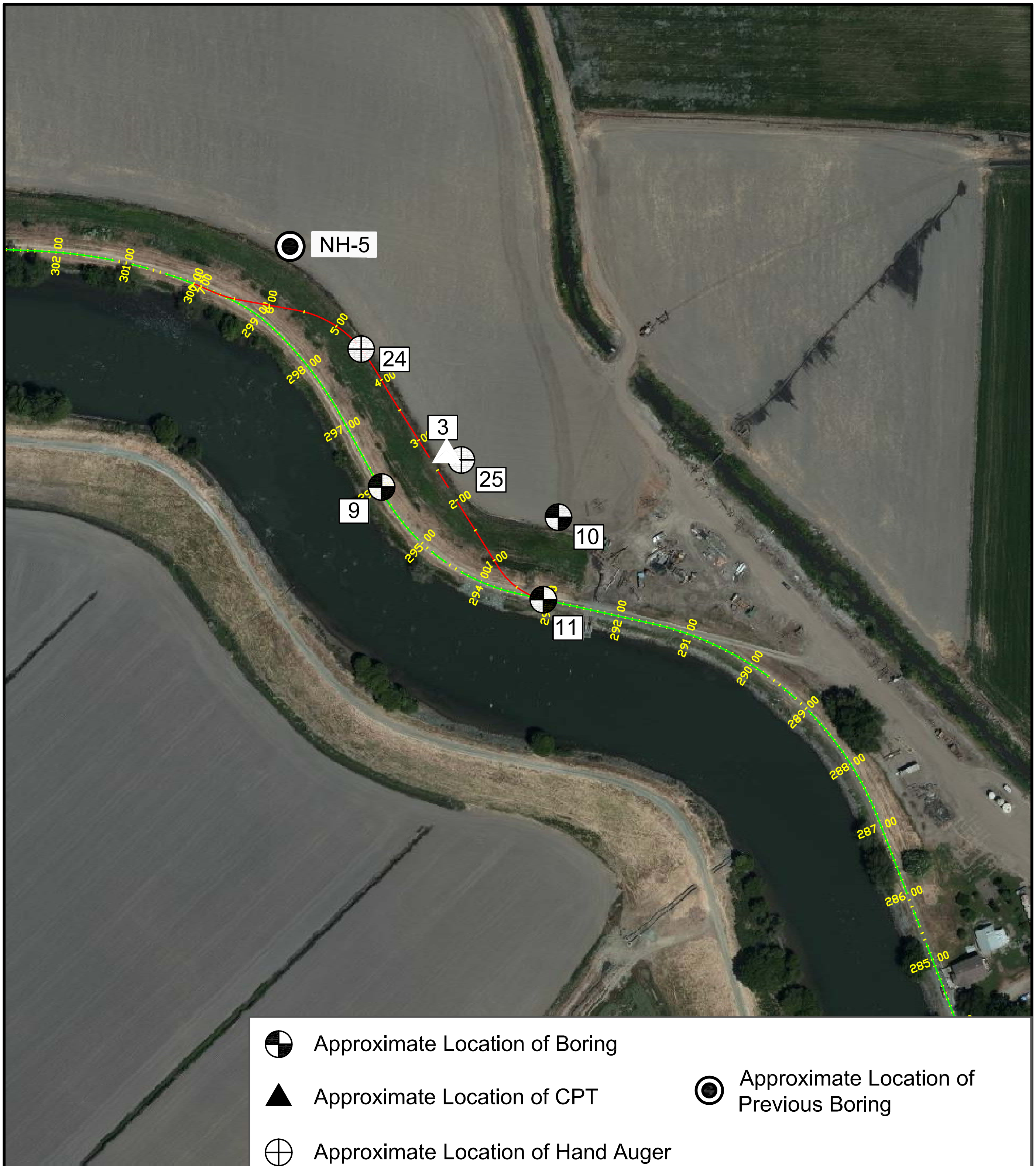
0 400 feet

1 inch = 400 feet

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Site Plan - Area 1

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 3



Approximate Location of Boring

Approximate Location of CPT

Approximate Location of Previous Boring

Approximate Location of Hand Auger

LEGEND

Existing Levee Alignment

Proposed Levee Alignment

N

SCALE

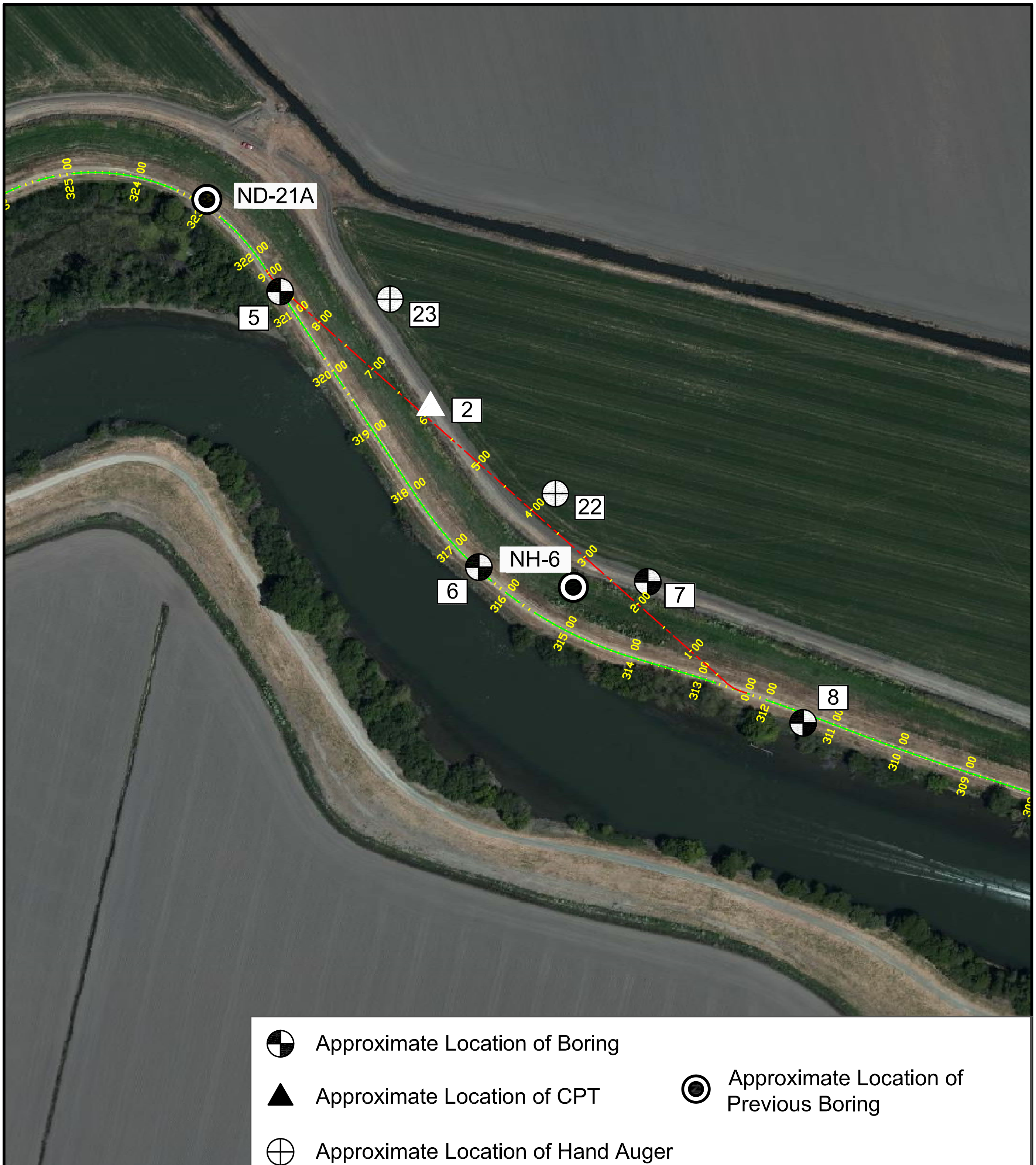
0 200 feet

1 inch = 200 feet

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Site Plan - Area 2

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 4



Approximate Location of Boring

Approximate Location of CPT

Approximate Location of Previous Boring

Approximate Location of Hand Auger

LEGEND

Existing Levee Alignment

Proposed Levee Alignment

N

SCALE

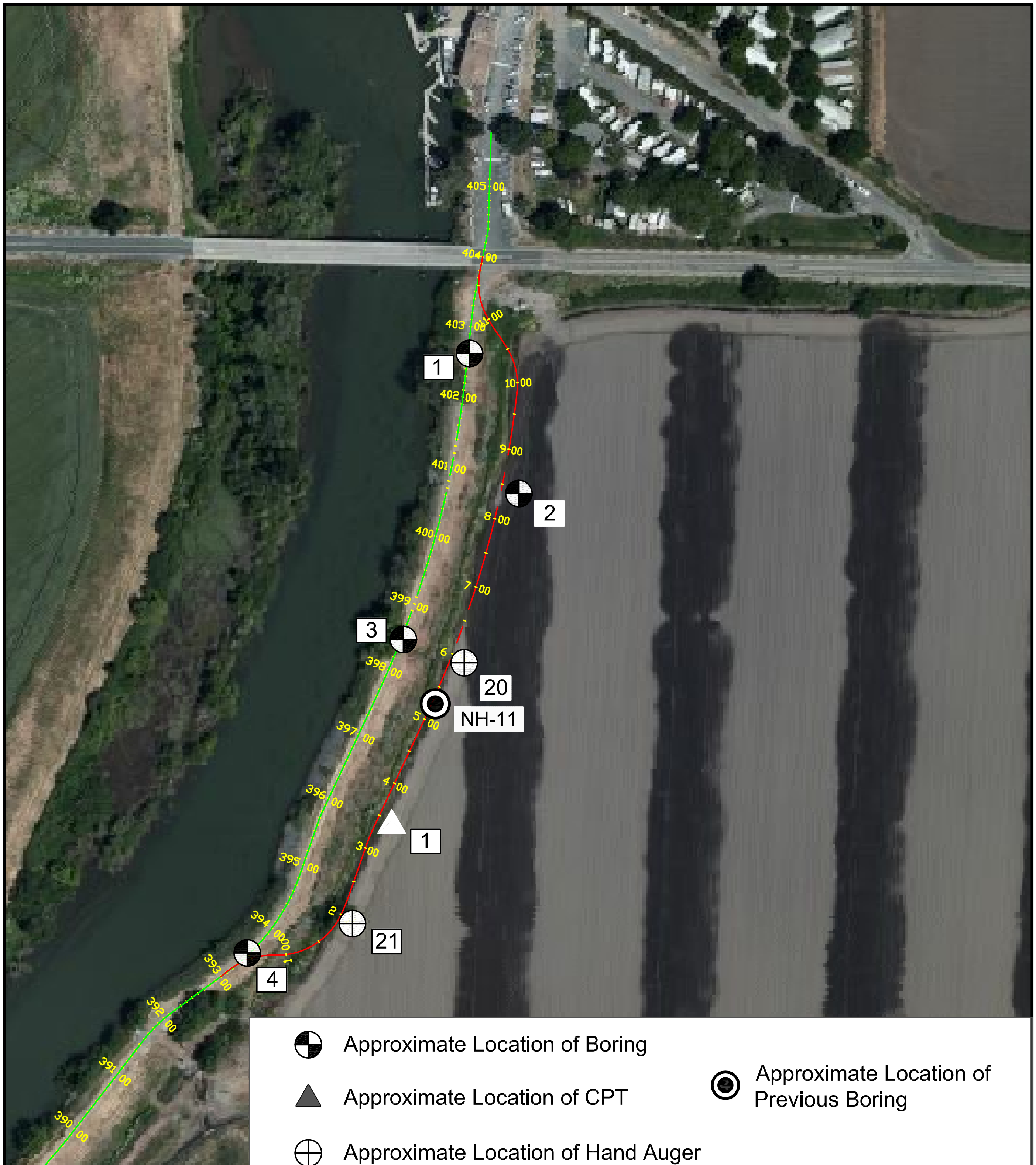
0 200 feet

1 inch = 200 feet

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Site Plan - Area 3

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 5



LEGEND

Existing Levee Alignment

Proposed Levee Alignment

N

SCALE

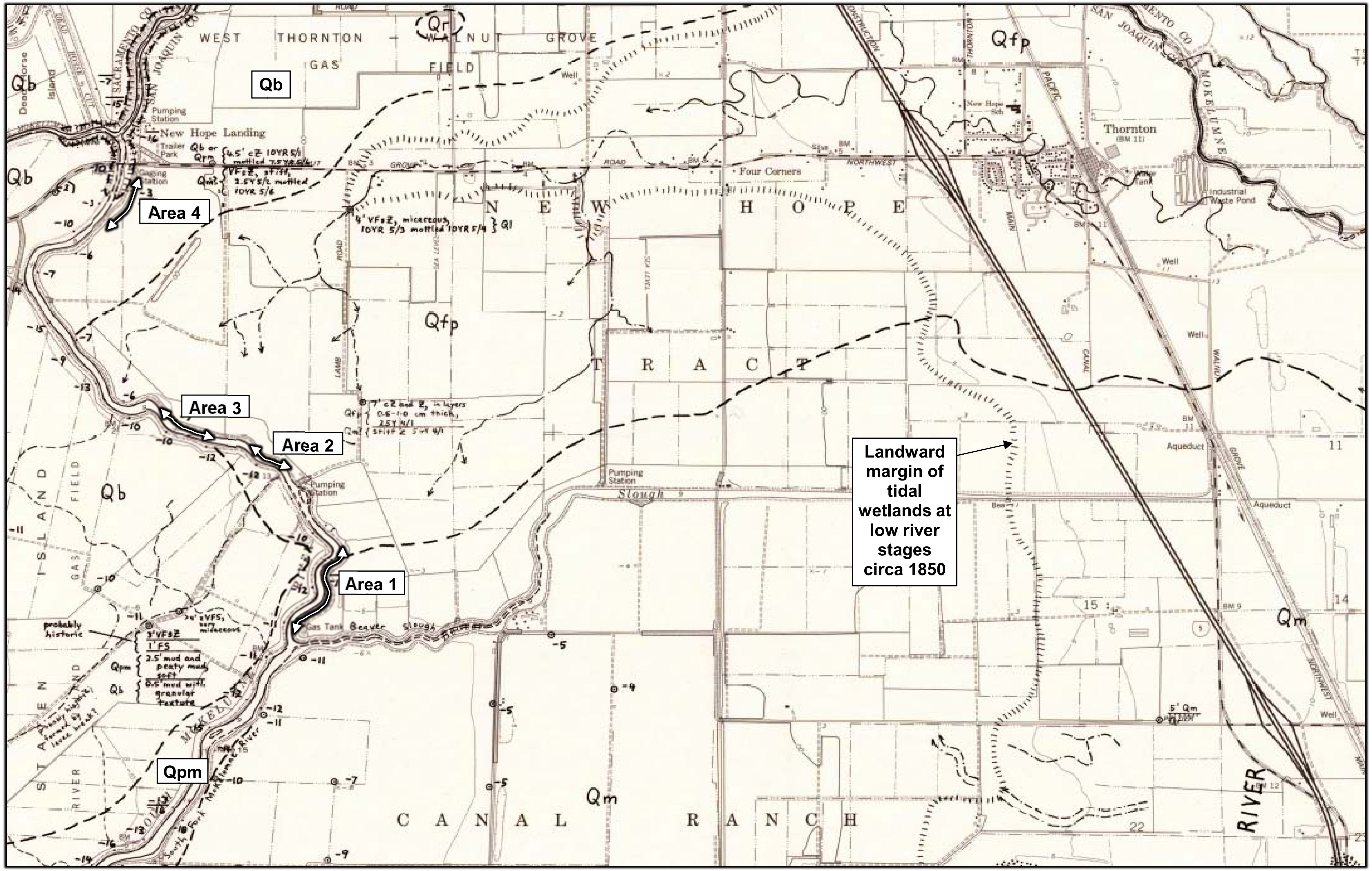
0 200 feet

1 inch = 200 feet

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Site Plan - Area 4

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. 6



Qb: Flood-basin deposits (Holocene)
Qpm: Peat and mud of tidal wetlands and waterways (Holocene)
Qfp: Alluvial-floodplain deposits, undivided
Qm: Modesto Formation (Pleistocene)

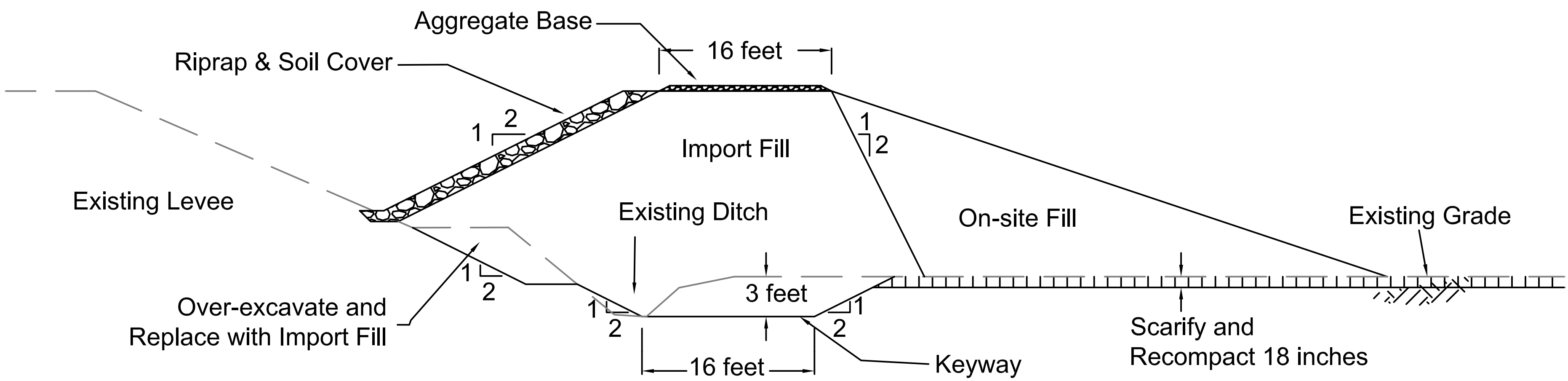
Source: Geology Map of the Sacramento-San Joaquin Delta by Brian F. Atwater 1982.

Not to Scale

Elevations at base of soft deposits
-10: Basal deposits peat or peaty mud
-14: Basal deposits mud
(-1): Soft deposits missing; firm or stiff deposits at ground surface at indicated elevation

Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California	**Geology Map**

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 7

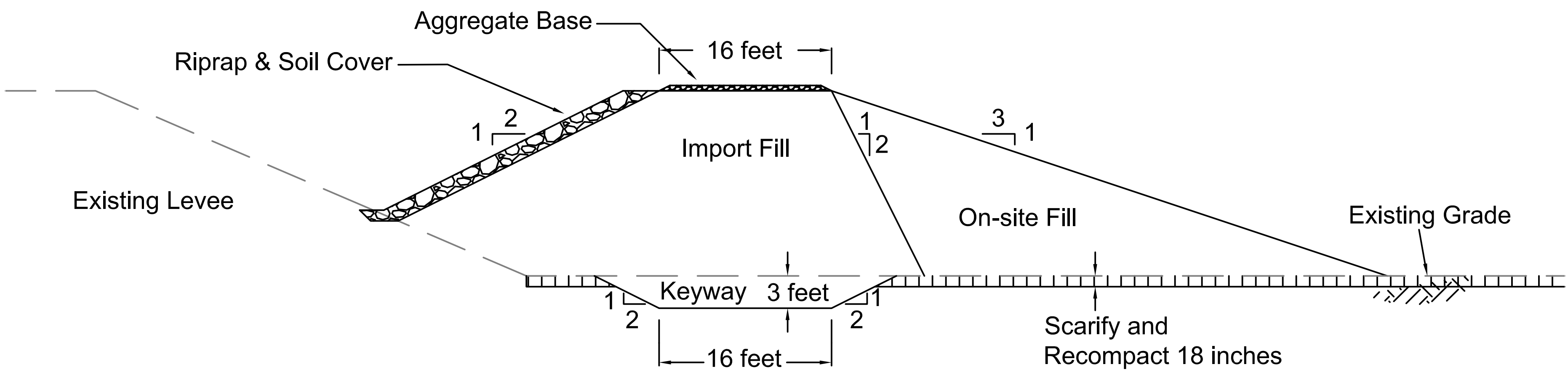


Notes:

1. Levee crest elevation includes a 6-inch overbuild to allow for settlement.
2. Import Fill should meet the requirements presented in our report.
3. Aggregate base should meet Caltrans Class II specifications.
4. Keyway should begin at top of ditch.
5. Staging details are presented on Plates 10 and 11.
6. Over-excavate landside berms within footprint of proposed levee and replace with import fill. Back-cut into existing levee should be no steeper than 2H:1V.

NOT TO SCALE

Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California	**Typical Design Configuration** **Areas 1 and 4**	
Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 8

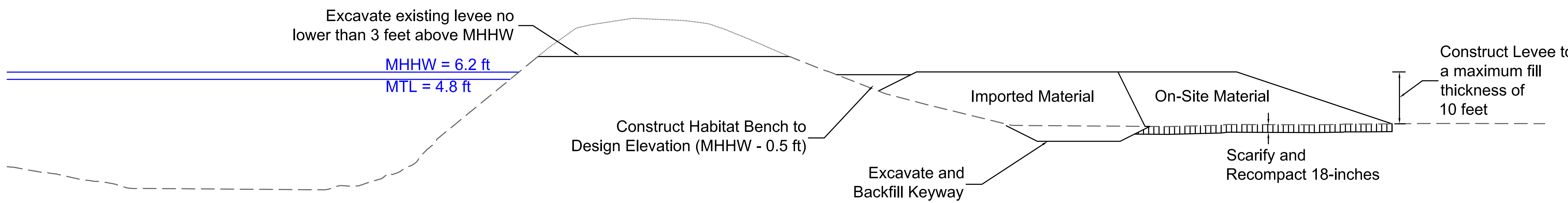


Notes:

1. Levee crest elevation includes a 6-inch overbuild to allow for settlement.
2. Import Fill should meet the requirements presented in our report.
3. Aggregate base should meet Caltrans Class II specifications.
4. Keyway should begin at top of ditch.
5. Staging details are presented on Plates 10 and 11.
6. Over-excavate landside berms within footprint of proposed levee and replace with import fill. Back-cut into existing levee should be no steeper than 2H:1V.

NOT TO SCALE

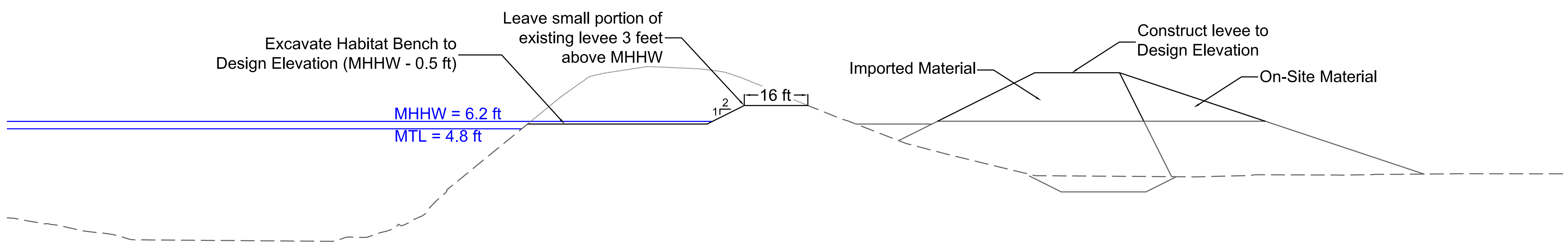
Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California	**Typical Design Configuration** **Areas 2 and 3**	
Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 9



STAGE 1

Stage 1 Notes:

1. Excavate and backfill keyway per details shown on Plates 8 and 9. Keyway backfill should meet the specifications for Import Fill
2. Scarify and recompact 18-inches below planned levee.
3. Initial fill should be limited to 10 feet in thickness.
4. Habitat bench may be constructed between the existing and the setback levees.
5. The levee should not be degraded below Elevation 9.2 feet (3 feet above MHHW).
6. After initial 10 feet is placed, 1 month waiting period begins.



STAGE 2

Stage 2 Notes:

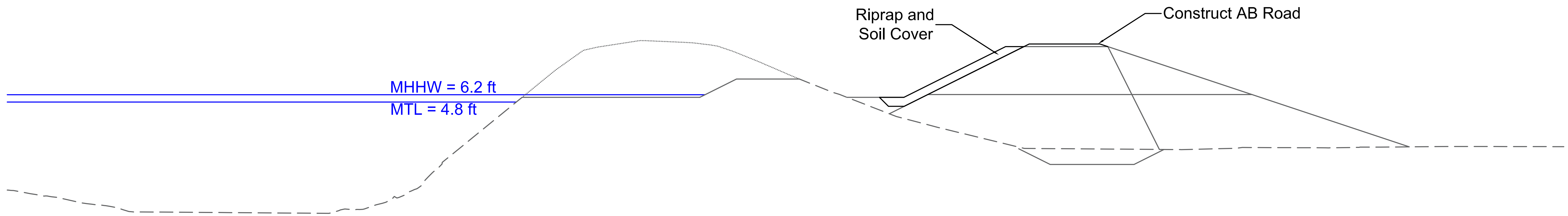
1. After waiting period, the remaining portion of the setback levee may be constructed.
2. Once the new levee has been brought uniformly to 3 feet above MHHW (Elevation 9.2 feet), the existing levee may be degraded below Elevation 9.2 feet.
3. Excavate existing levee to Habitat Bench Design Elevation.
4. Leave a portion of the existing levee intact. The remaining levee should be at least 16 feet wide and a minimum of 3 feet above MHHW.

NOT TO SCALE

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

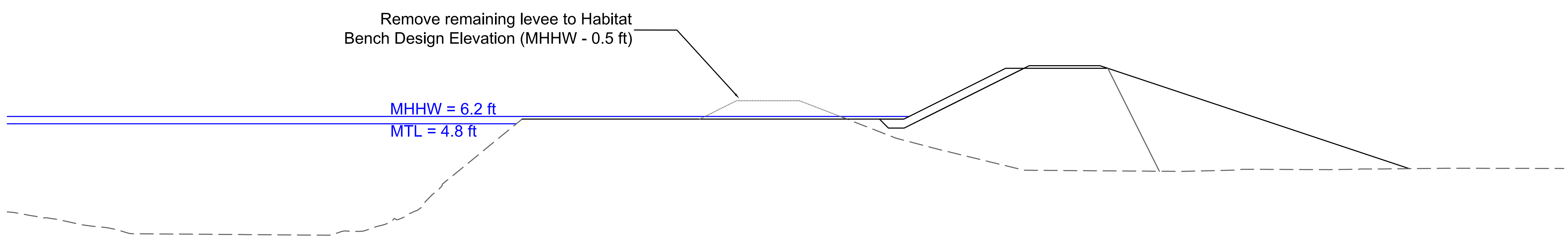
Typical Staging Details
1 of 2

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. 10



Stage 3 Notes:
1. Construct waterside improvements, including riprap and soil cover.
2. After waterside improvements are completed, construct AB road on top of levee.

STAGE 3



STAGE 4

Stage 4 Notes:
1. Remove remaining levee portion to Habitat Bench Design Elevation.

NOT TO SCALE

Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California	**Typical Staging Details** **2 of 2**	
Hultgren - Tillis Engineers	Project No. 921.01	Plate No. 11

APPENDIX A

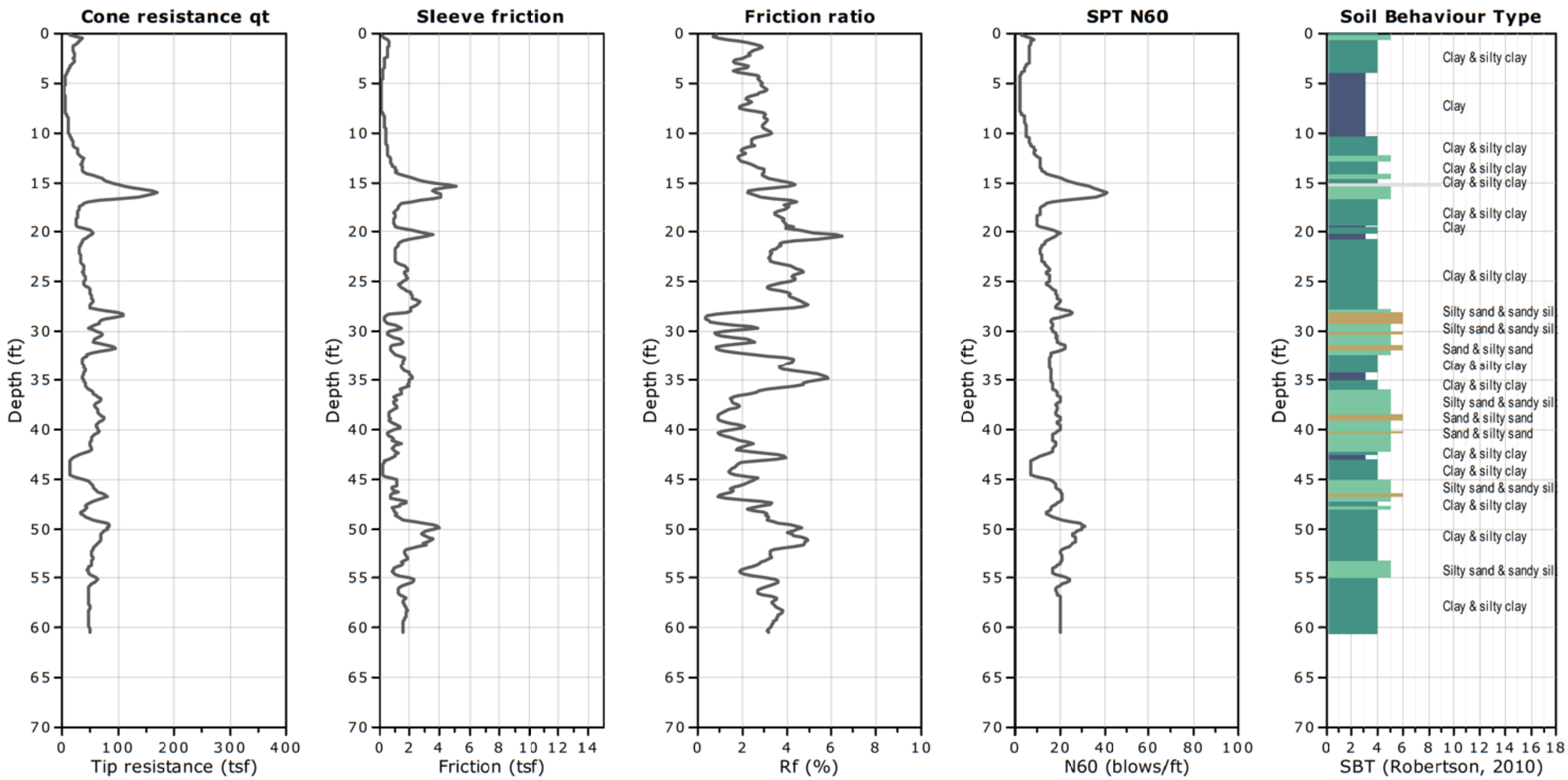
Logs of CPTs

GREGG DRILLING, INC.
www.greggdrilling.com

CPT: CPT-1

CLIENT: HULTGREN-TILLIS ENGINEERS
SITE: NEW HOPE TRACT - 13945 WEST WALNUT GROVE ROAD, WALNUT GROVE, CA

FIELD REP: JOE HEAVIN
Total depth: 60.37 ft, Date: 9/3/2019



SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

CPeT-IT v.19.0.1.19 - CPTU data presentation & interpretation software - Report created on: 9/5/2019, 8:26:40 AM
Project file: C:\Users\Frank Stolfi\OneDrive - Gregg Drilling\MA-2019\194046MA\REPORT\194046.cpt

GREGG DRILLING, INC.
www.greggdrilling.com

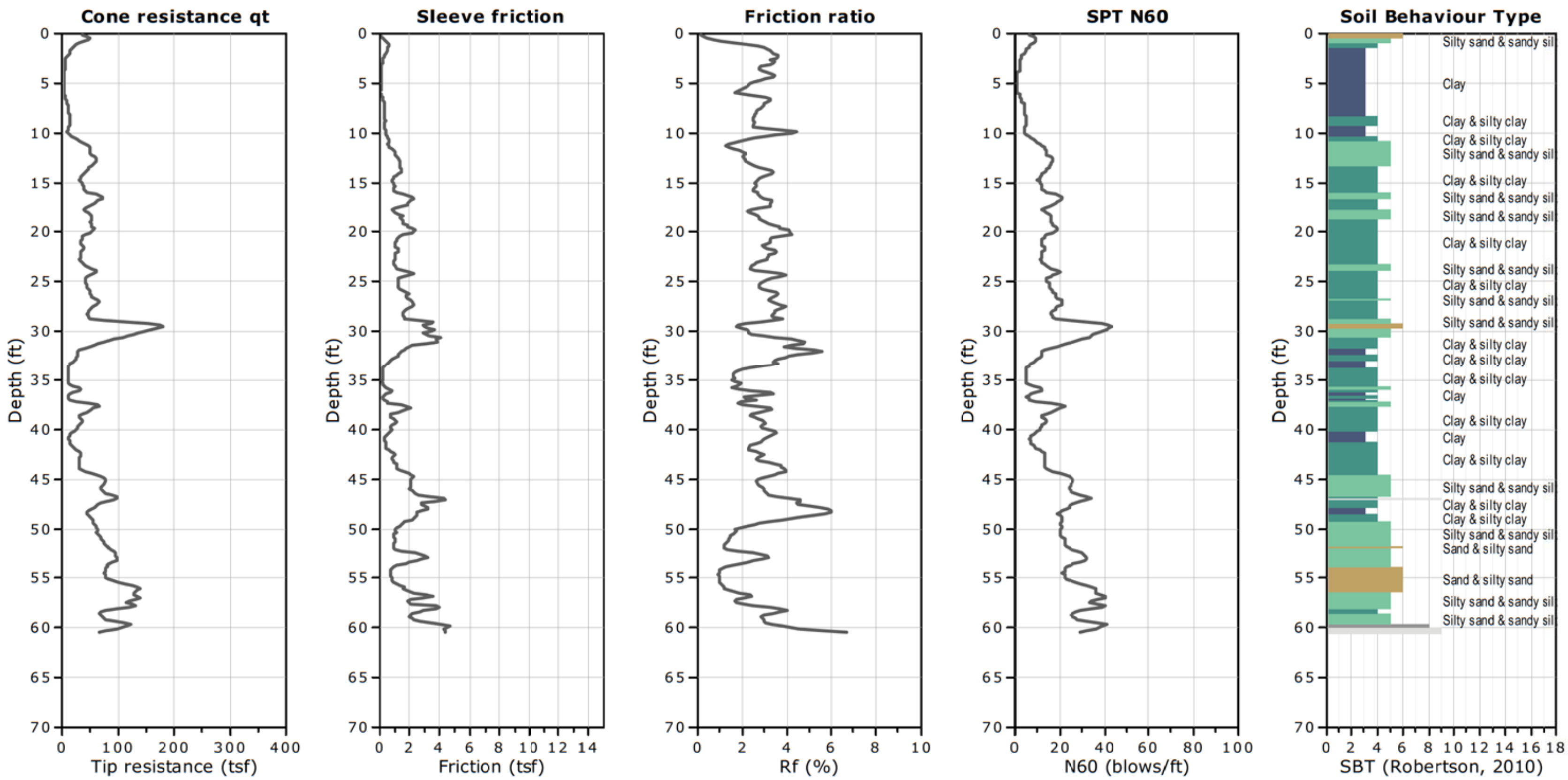
CPT: CPT-2

CLIENT: HULTGREN-TILLIS ENGINEERS

SITE: NEW HOPE TRACT - 13945 WEST WALNUT GROVE ROAD, WALNUT GROVE, CA

FIELD REP: JOE HEAVIN

Total depth: 60.37 ft, Date: 9/3/2019



SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

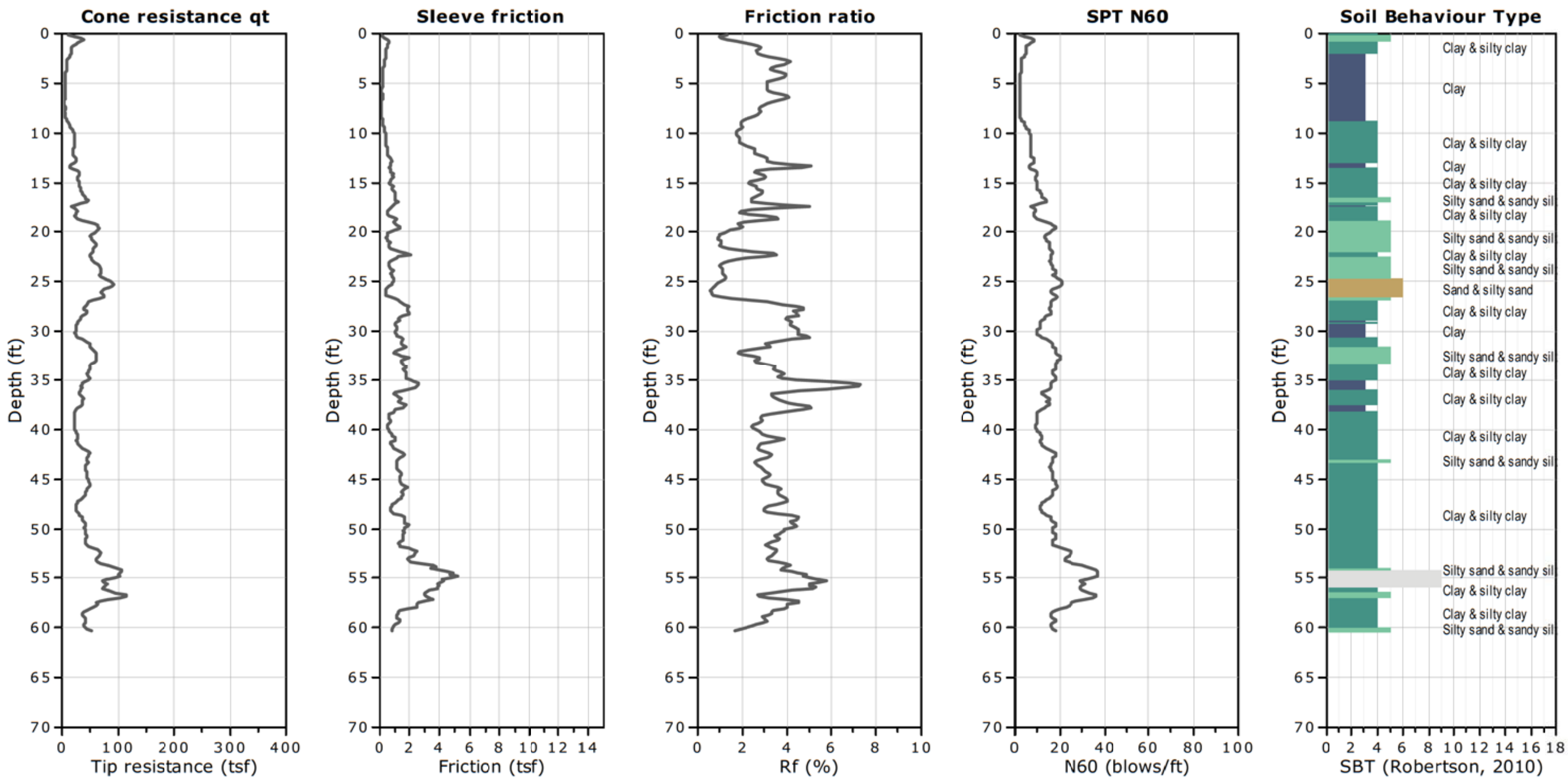
CPeT-IT v.19.0.1.19 - CPTU data presentation & interpretation software - Report created on: 9/5/2019, 8:26:41 AM
Project file: C:\Users\Frank Stolfi\OneDrive - Gregg Drilling\MA-2019\194046MA\REPORT\194046.cpt

GREGG DRILLING, INC.
www.greggdrilling.com

CPT: CPT-3

CLIENT: HULTGREN-TILLIS ENGINEERS
SITE: NEW HOPE TRACT - 13945 WEST WALNUT GROVE ROAD, WALNUT GROVE, CA

FIELD REP: JOE HEAVIN
Total depth: 60.20 ft, Date: 9/3/2019



SBTn legend
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

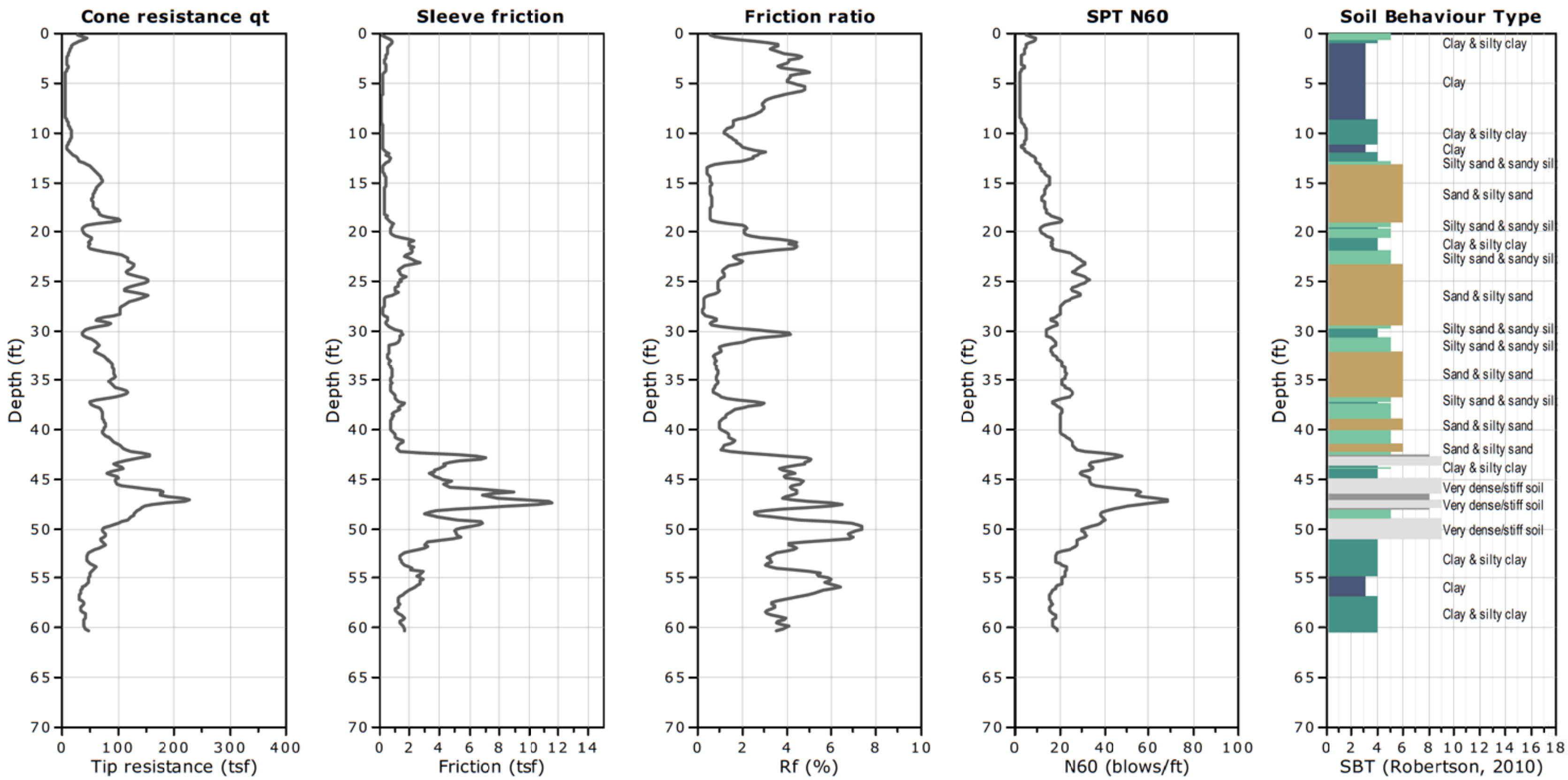
CPeT-IT v.19.0.1.19 - CPTU data presentation & interpretation software - Report created on: 9/5/2019, 8:26:41 AM
Project file: C:\Users\Frank Stolfi\OneDrive - Gregg Drilling\MA-2019\194046MA\REPORT\194046.cpt

GREGG DRILLING, INC.
www.greggdrilling.com

CPT: CPT-4

CLIENT: HULTGREN-TILLIS ENGINEERS
SITE: NEW HOPE TRACT - 13945 WEST WALNUT GROVE ROAD, WALNUT GROVE, CA

FIELD REP: JOE HEAVIN
Total depth: 60.20 ft, Date: 9/4/2019



SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

CPeT-IT v.19.0.1.19 - CPTU data presentation & interpretation software - Report created on: 9/5/2019, 8:26:42 AM
Project file: C:\Users\Frank Stolfi\OneDrive - Gregg Drilling\MA-2019\194046MA\REPORT\194046.cpt

GREGG DRILLING, INC.
www.greggdrilling.com

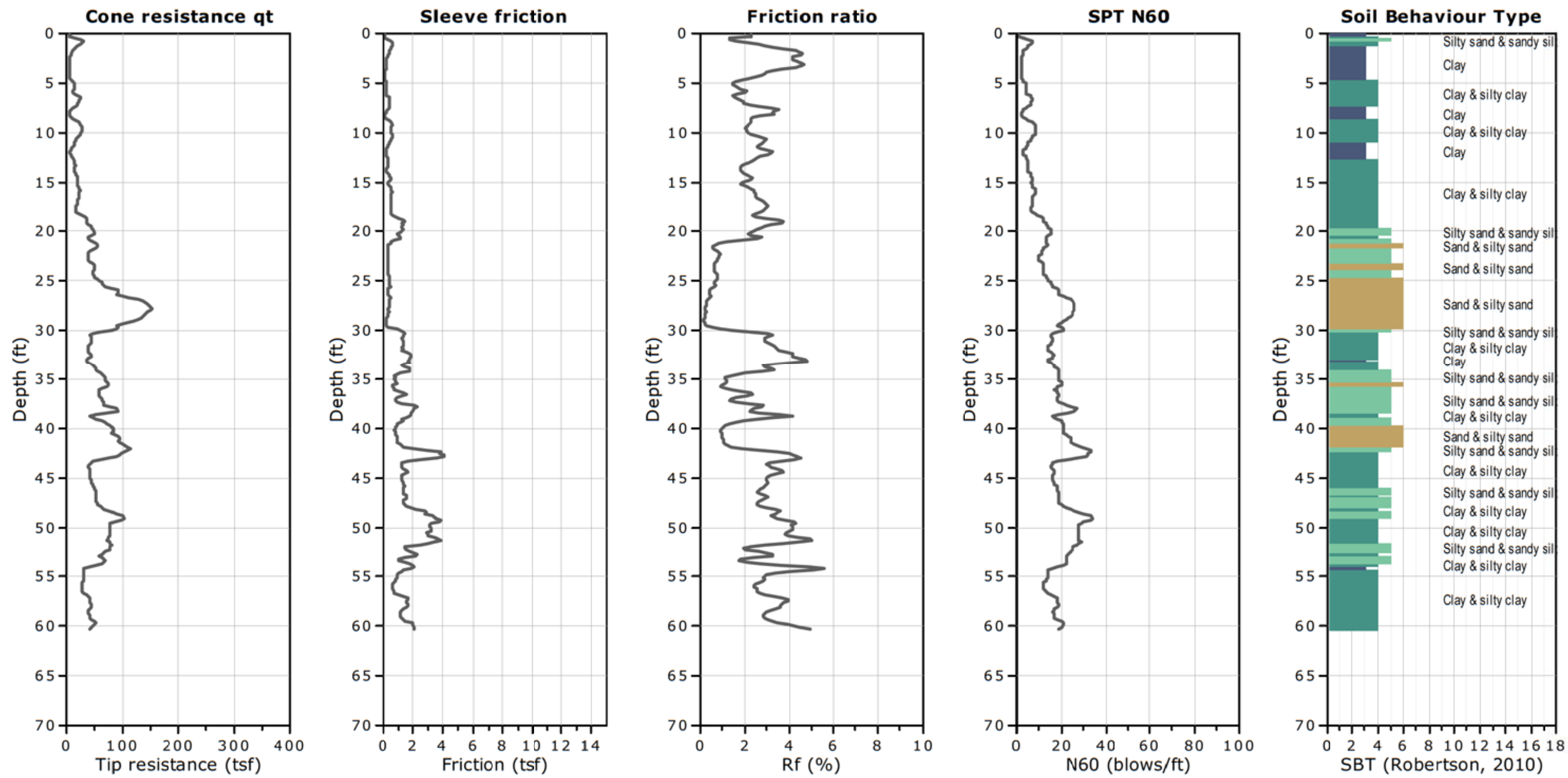
CPT: CPT-5

CLIENT: HULTGREN-TILLIS ENGINEERS

SITE: NEW HOPE TRACT - 13945 WEST WALNUT GROVE ROAD, WALNUT GROVE, CA

FIELD REP: JOE HEAVIN

Total depth: 60.20 ft, Date: 9/4/2019



SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

CPeT-IT v.19.0.1.19 - CPTU data presentation & interpretation software - Report created on: 9/5/2019, 8:26:42 AM
Project file: C:\Users\Frank Stolfi\OneDrive - Gregg Drilling\MA-2019\194046MA\REPORT\194046.cpt

GREGG DRILLING, INC.
www.greggdrilling.com

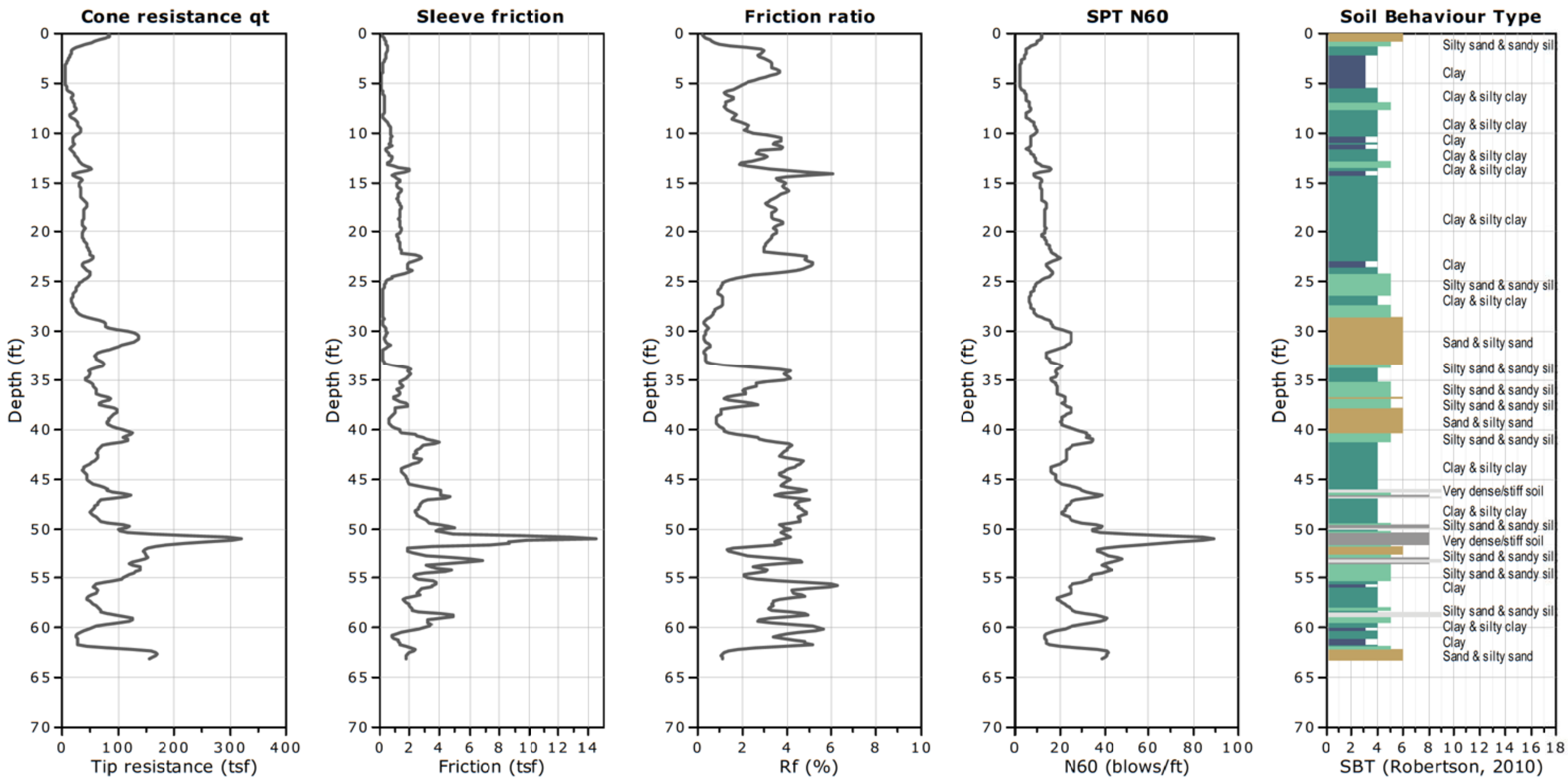
CPT: CPT-6

CLIENT: HULTGREN-TILLIS ENGINEERS

SITE: NEW HOPE TRACT - 13945 WEST WALNUT GROVE ROAD, WALNUT GROVE, CA

FIELD REP: JOE HEAVIN

Total depth: 63.16 ft, Date: 9/4/2019



SBTn legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

CPeT-IT v.19.0.1.19 - CPTU data presentation & interpretation software - Report created on: 9/5/2019, 8:26:43 AM
Project file: C:\Users\Frank Stolfi\OneDrive - Gregg Drilling\MA-2019\194046MA\REPORT\194046.cpt

Cone Penetration Test Data & Interpretation

The Cone Penetration Test (CPT) data collected are presented in graphical and electronic form in the report. The plots include interpreted Soil Behavior Type (SBT) based on the charts described by Robertson (2009 & 2010). Typical plots display SBT based on the non-normalized charts of Robertson (2010). For CPT soundings deeper than 30m, we recommend the use of the normalized charts of Robertson (2009) which can be displayed as SBTn, upon request. The report can also include spreadsheet output of computer calculations of basic interpretation in terms of SBT and SBTn and various geotechnical parameters using current published correlations based on the comprehensive review by Lunne, Robertson and Powell (1997), as well as recent updates by Robertson and Cabal (Guide to Cone Penetration Testing, 2015). The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed. Gregg Drilling does not warranty the correctness or the applicability of any of the geotechnical parameters interpreted by the software and does not assume any liability for use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used in the software. Some interpretation methods require input of the groundwater level to calculate vertical effective stress. An estimate of the in-situ groundwater level has been made based on field observations and/or CPT results, but should be verified by the user.

A summary of locations and depths is available in Table 1. Note that all penetration depths referenced in the data are with respect to the existing ground surface. Note that it is not always possible to clearly identify a soil type based solely on q_t, f_s, and u_2. In these situations, experience, judgment, and an assessment of the pore pressure dissipation data should be used to infer the correct soil behavior type.

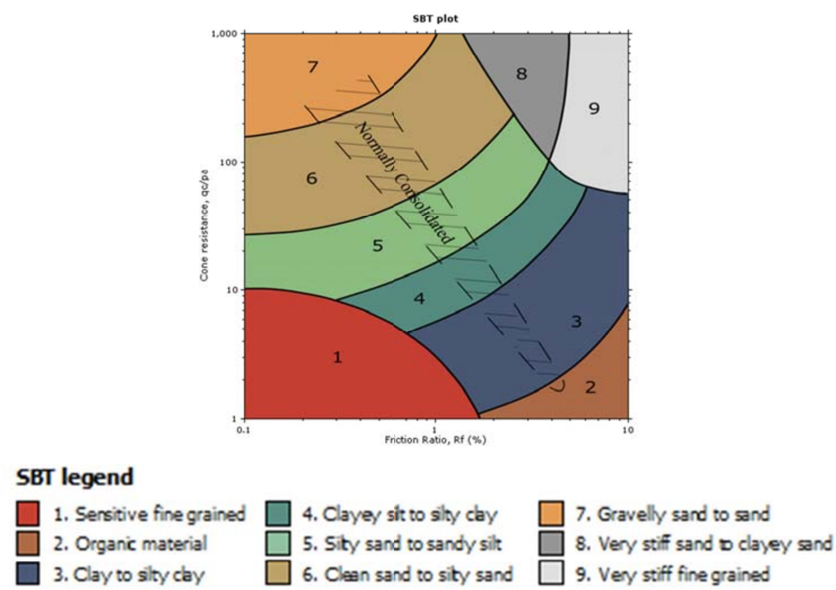
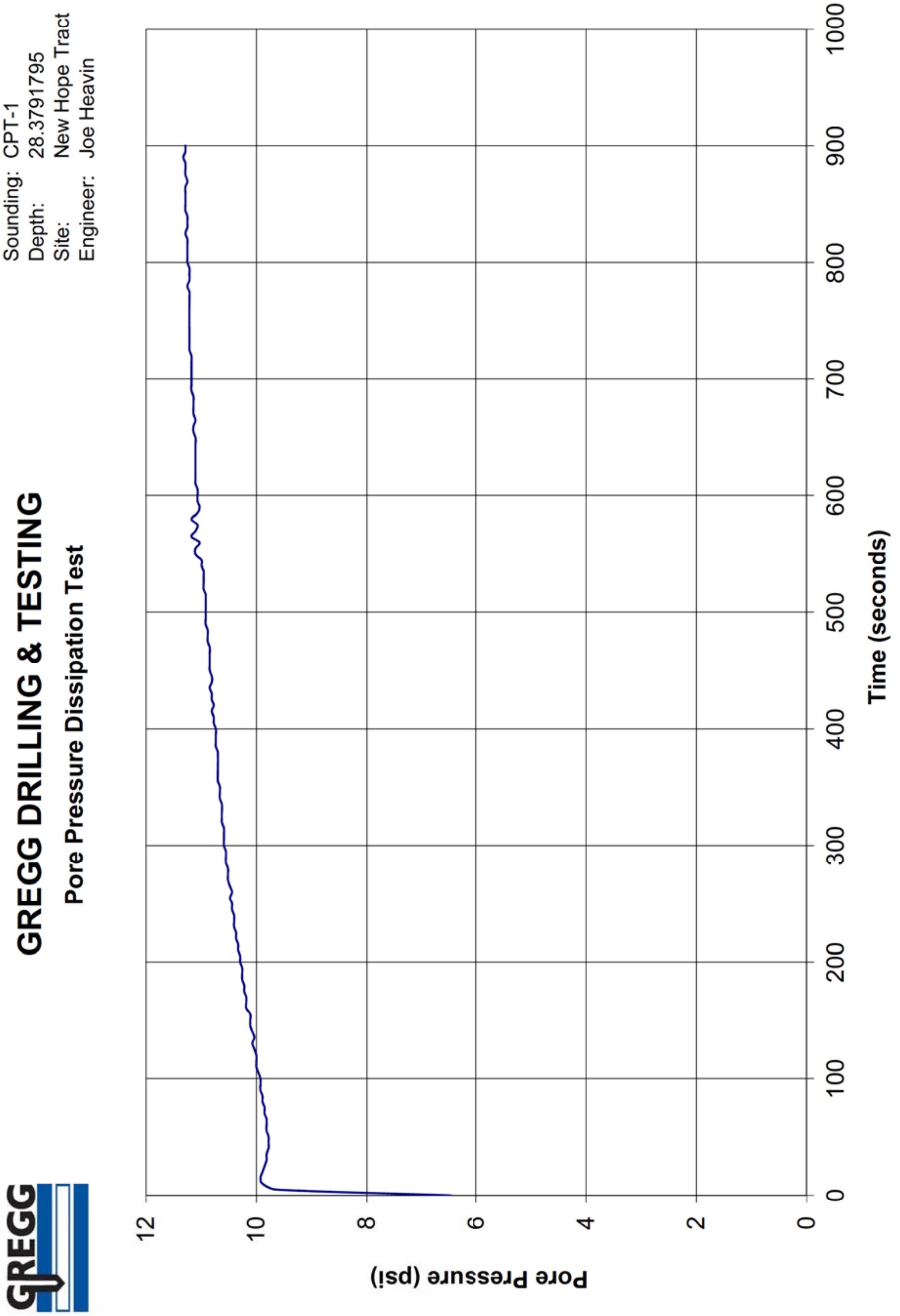
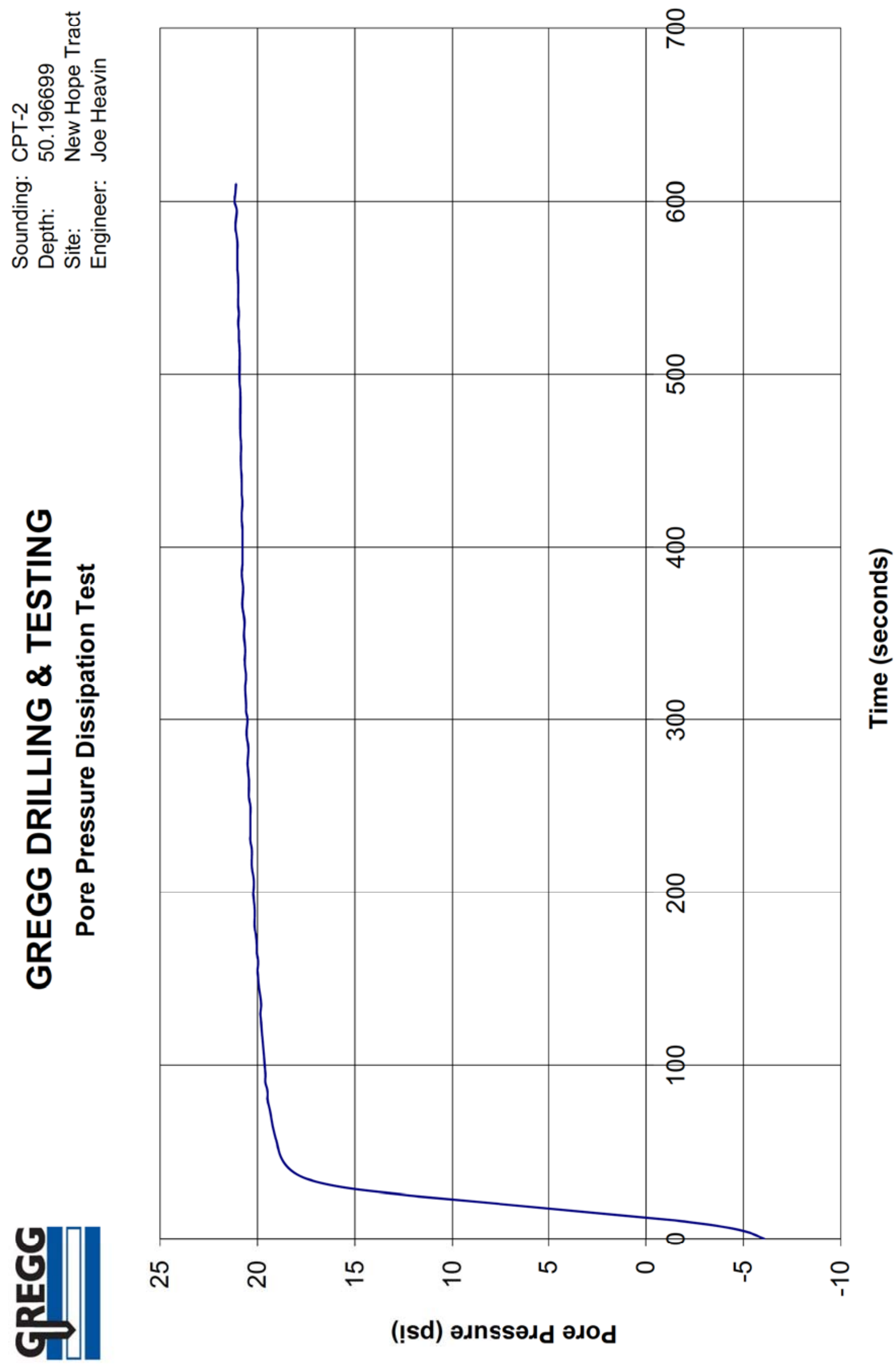


Figure SBT (After Robertson, 2010) – Note: Colors may vary slightly compared to plots

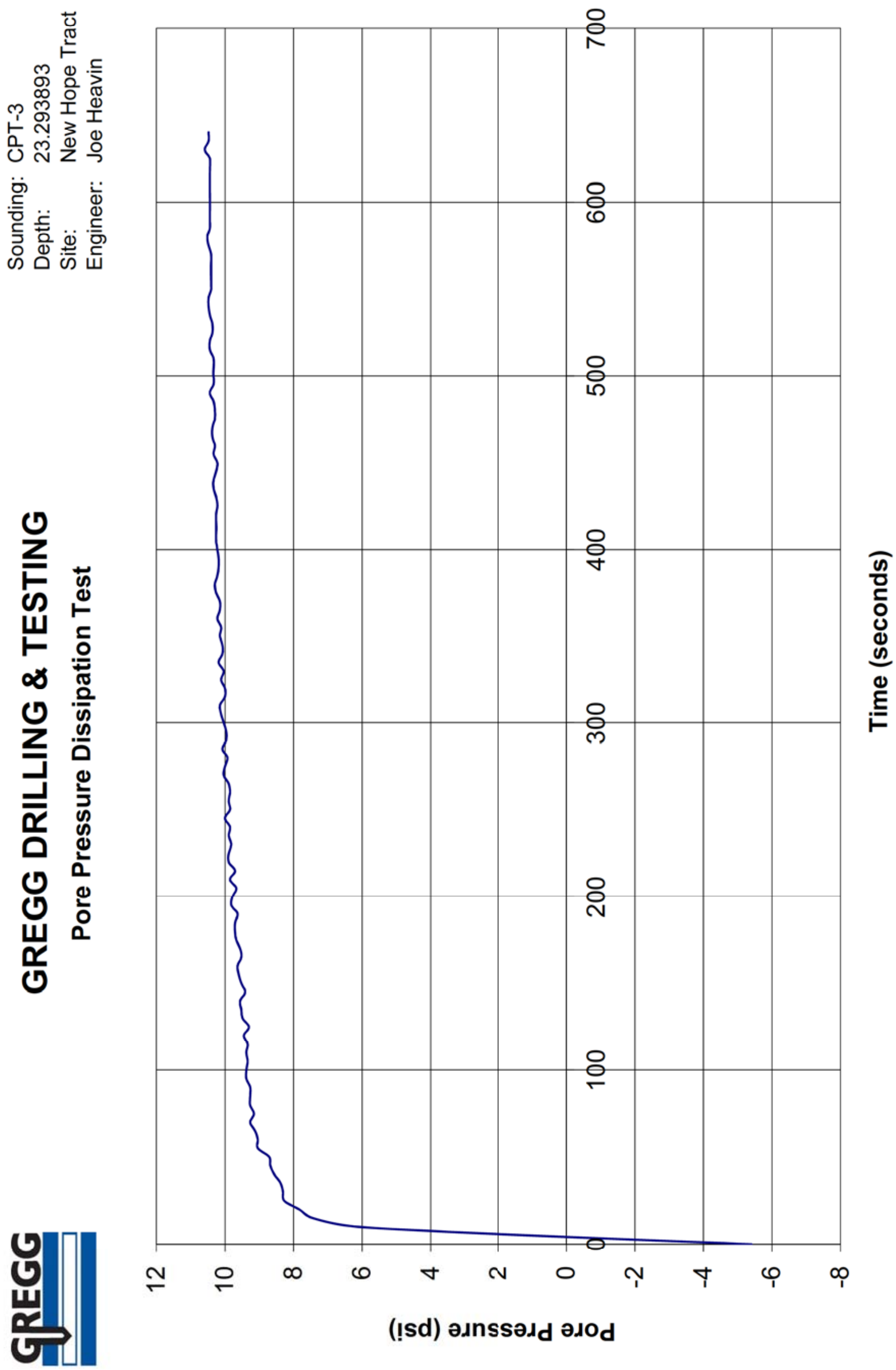

GREGG DRILLING & TESTING
Pore Pressure Dissipation Test
Sounding: CPT-1
Depth: 28.3791795
Site: New Hope Tract
Engineer: Joe Heavin
Pore Pressure (psi)
Time (seconds)
0
2
4
6
8
10
12
0
100
200
300
400
500
600
700
800
900
1000

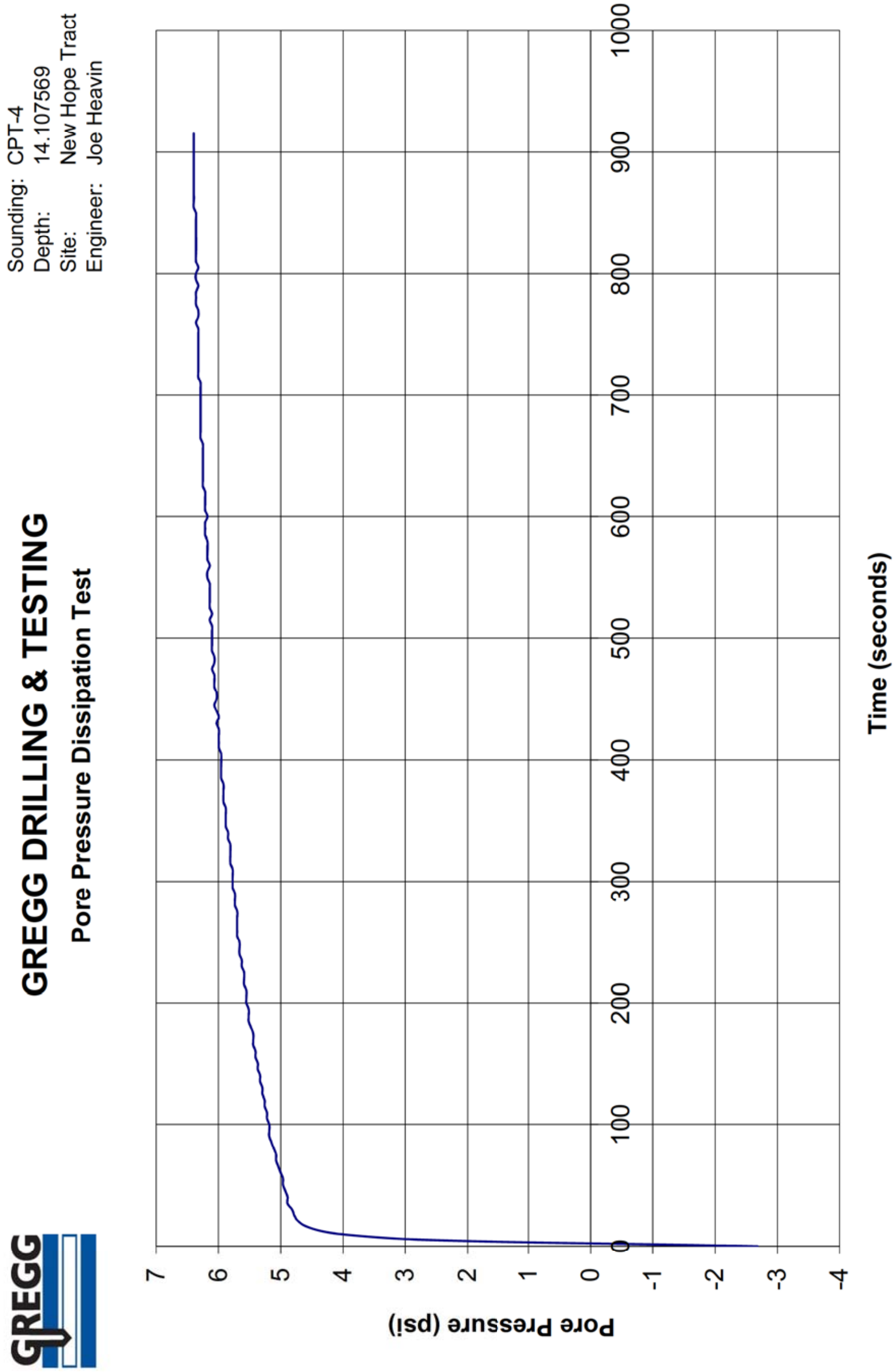


Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

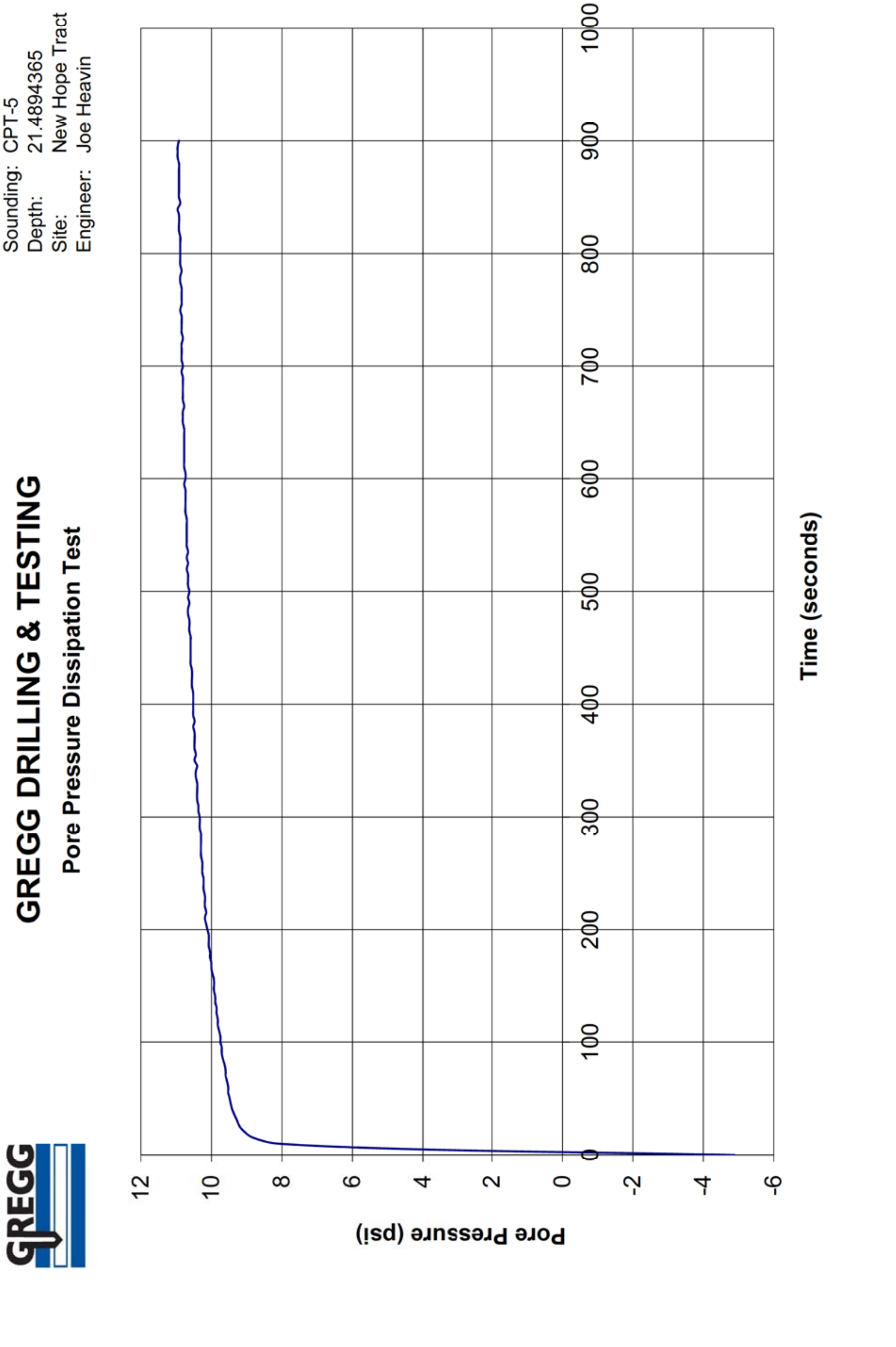
Project No. 921.01

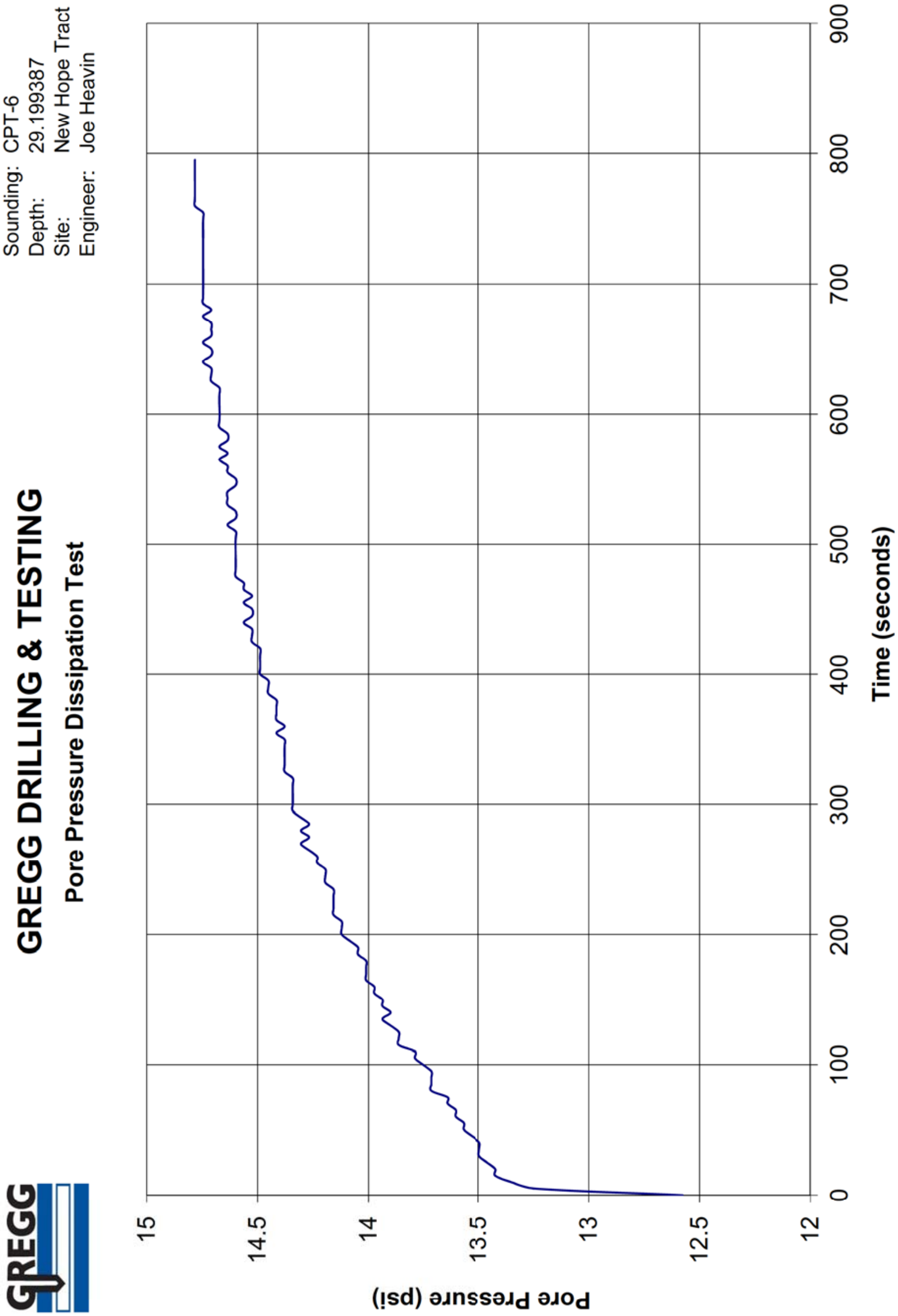
Plate No. A-9


GREGG DRILLING & TESTING
Pore Pressure Dissipation Test
Sounding: CPT-3
Depth: 23.293893
Site: New Hope Tract
Engineer: Joe Heavin
Pore Pressure (psi)
12
10
8
6
4
2
0
-2
-4
-6
-8
0
100
200
300
400
500
600
700
Time (seconds)



GREGG
GREGG DRILLING & TESTING
Pore Pressure Dissipation Test
Sounding: CPT-4
Depth: 14.107569
Site: New Hope Tract
Engineer: Joe Heavin
Pore Pressure (psi)
7
6
5
4
3
2
1
0
-1
-2
-3
-4
0
100
200
300
400
500
600
700
800
900
1000
Time (seconds)


GREGG DRILLING & TESTING
Pore Pressure Dissipation Test
Sounding: CPT-5
Depth: 21.4894365
Site: New Hope Tract
Engineer: Joe Heavin
Pore Pressure (psi)
12
10
8
6
4
2
0
-2
-4
-6
Time (seconds)
0
100
200
300
400
500
600
700
800
900
1000



GREGG DRILLING & TESTING
Pore Pressure Dissipation Test
Sounding: CPT-6
Depth: 29.199387
Site: New Hope Tract
Engineer: Joe Heavin
Pore Pressure (psi)
15
14.5
14
13.5
13
12.5
12
Time (seconds)
0
100
200
300
400
500
600
700
800
900

APPENDIX B

Logs of Borings

Date	: 9/16/2019
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: 19.9
Latitude	: 38.22522
Longitude	: -121.49090

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
					Aggregate base (3.5-inches), (fill)					
			SP		Poorly-Graded Sand with Gravel (SP), gray, moist, very loose, roots, (fill)					
5	M	5	SM		Silty Sand (SM), brown, moist, loose, (fill)		2.3	10	83	-200=32
			CL		Sandy Lean Clay (CL), light brown, moist, very stiff, low plasticity, (fill)					
10	M	7						10	87	-200=43
			SM		Silty Sand (SM), brown, moist, loose, (fill)					
15	M	13			Brown with red brown mottling		3.0	38	76	
			ML		Silt (ML), brown, moist, very stiff, low plasticity, with red brown mottling					
20	M	9			Dark gray with brown mottling, stiff, roots		1.5			

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 1
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-1

Date	:	9/9/2019
Drilling Method	:	Hollow-Stem Auger
Elevation (Feet)	:	0.3
Latitude	:	38.22468
Longitude	:	-121.49065

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Lean Clay (CL), dark brown, moist, stiff to very stiff, roots					
	M	6		CL		Gray brown with red brown mottling		2.5	20	103	
5	T	P									
						Sandy Lean Clay (CL), yellowish brown, dry to moist, hard, low plasticity		4.5+			
				CL	▽						
10	M	19				Very stiff		3.0	26	97	-200=69
						Clayey Sand (SC), gray, wet, medium dense					
15	M	17		SC							
20	M	20		SP-SM		Poorly-Graded Sand with Silt (SP-SM), gray, wet to moist, medium dense		4.3			
						Fat Clay (CH), olive gray, moist, hard, high plasticity					
25				CH							
30	M	7		SP		Poorly-Graded Sand (SP), gray, wet, loose					
						Fat Clay (CH), blue gray, moist to wet, very stiff, high plasticity		2.5	37	84	LL=57 PI=28
				CH							
35											
				SP-SM		Poorly-Graded Sand with Silt (SP-SM), gray, wet, loose					
40	M	5		CL		Sandy Lean Clay (CL), olive, moist, stiff, low plasticity		1.3	28	96	-200=60
				SP-SM		Poorly-Graded Sand with Silt (SP-SM), gray, wet, loose					

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 2
(Page 1 of 2)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-2

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 9/9/2019 Drilling Method : Hollow-Stem Auger Elevation (Feet) : 0.3 Latitude : 38.22468 Longitude : -121.49065 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				SP-SM							
50	M	17		CH		Fat Clay (CH), blue gray, moist, very stiff, medium plasticity		3.5			
55				SM		Silty Sand (SM), yellowish brown and gray, moist, medium dense					
60	M	28		CH		Fat Clay (CH), gray, wet, firm, high plasticity		0.8			
				SP		Poorly-Graded Sand (SP), dark gray, wet, medium dense					

Bottom of boring at 61.5 feet
Groundwater encountered at 8 feet during drilling

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 2
(Page 2 of 2)

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. B-3

Date : 9/16/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 19.6
Latitude : 38.22411
Longitude : -121.49121

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Aggregate base (2.4-inches), (fill)					
				ML		Sandy Silt (ML), brown, moist, very stiff, (fill)					
5	M	4						2.3	11	74	-200=65
				SM		Silty Sand (SM), brown, moist, loose, (fill)					
10	M	7		ML		Sandy Silt (ML), brown, moist, stiff, low plasticity, (fill)		1.7			
15	M	10		ML		Silt (ML), brown with dark gray, moist, very stiff, low plasticity		2.5	12	76	-200=56 LL=45 PI=16
20	M	8						2.8			

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 3
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-4

Date : 9/16/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 20
Latitude : 38.22289
Longitude : -121.49196

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Aggregate base (3.6-inches), (fill)					
				SP		Poorly-Graded Sand with Gravel (SP), reddish brown, dry to moist, very loose, (fill)					
5	M	4							9	76	-200=49
						Silty Sand (SM), reddish brown, moist, very loose, (fill)					
10	M	7				Loose					
				SM							
15	M	9							12	85	-200=40
						Brown with reddish brown mottiling					
20									16	104	
	M	3		SP		Poorly-Graded Sand (SP), dark gray, wet, very loose					

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 4
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-5

Date : 9/16/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 16.4
Latitude : 38.21008
Longitude : -121.48906

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Aggregate base (3-inches), (fill)					
				SP		Poorly-Graded Sand with Gravel (SP), brown, dry, very loose, subangular gravel (1/4-inch to 1/2-inch), (fill)					
5	M	7		SM		Silty Sand with Gravel (SM), yellowish brown, moist, very loose, (fill)					-200=16
				SP		Poorly-Graded Sand with Gravel (SP), dark yellowish brown, moist, loose, (fill)					
10	M	7		CL		Lean Clay (CL), brown, moist, very stiff, low plasticity		2.8	24	102	
15	M	6				Stiff		1.8	16	84	LL=NP PI=NP -200=35
				SM		Silty Sand (SM), light reddish brown, moist, loose					
20	M	7		Pt		Peat (Pt), black, moist, very stiff		2.1	83	50	

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 5
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-6

Date : 9/16/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 16.4
Latitude : 38.20902
Longitude : -121.48807

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Aggregate base (3.5-inches), (fill)					
				SM		Silty Sand (SM), brown, dry, very loose, (fill)					
				SM		Silty Sand with Gravel (SM), brown, moist, very loose, (fill)			18	110	
5	M	5		Pt		Peat (Pt), black, moist, stiff, (fill)		1.8			
				SM		Silty Sand (SM), brown, moist, loose, (fill)					
				CL		Lean Clay (CL), gray, moist, stiff, low plasticity, (fill)					
10	M	9		CH		Fat Clay (CH), gray, moist, very stiff, high plasticity		2.3	21	106	LL=52 PI=35
15	M	4		SM		Silty Sand (SM), brown, moist, very loose		2.3	22	101	-200=23 LL=80 PI=36
				ML		Elastic Silt (MH), dark olive gray, moist, very stiff Medium plasticity					
20	M	4		Pt		Peat (Pt), black, moist, stiff, fibrous texture		1.0	112	39	

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 6
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-7

Date : 9/9/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : -2.5
Latitude : 38.20897
Longitude : -121.48724

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
0			(CH)			Fat Clay (CH), dark brown, moist, hard, high plasticity					
5	T	P						4.5+	32	82	LL=61 PI=30
	T	P							24	112	
						Bluish gray and olive brown, very stiff		3.0			
10	M	11						1.8	28	96	LL=50 PI=27
				CH		Stiff Becomes olive brown					
					▽						
15	M	13				Very stiff		2.0			
20	M	11				Stiff		1.0	35	88	
25			(SP)			Poorly-Graded Sand (SP), light yellowish brown, wet, loose					
30	M	5							24	99	-200=4
				SP							
35											
40	M	21						2.0	28	97	LL=NP PI=NP
			(CH)	CH		Fat Clay (CH), bluish gray, wet, very stiff, high plasticity					

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 7
(Page 1 of 2)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-8

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				CH							
50	M	39		SM		Silty Sand (SM), gray, wet, medium dense		3.8			
				CH		Fat Clay (CH), bluish gray, wet, very stiff, high plasticity		3.0			
55											
60	M	31						4.0			

Date : 9/9/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : -2.5
Latitude : 38.20897
Longitude : -121.48724

Bottom of boring at 61.5 feet
Groundwater encountered at 14 feet during drilling

Date : 9/16/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 14.5
Latitude : 38.20843
Longitude : -121.48647

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Aggregate base (2.4-inches), (fill)					
				SM		Silty Sand (SM), yellowish brown, moist, very loose, (fill)					
5	M	5				Loose			25	91	-200=67 LL=34 PI=11
				CL		Sandy Lean Clay (CL), brown, moist, stiff, low plasticity					
10	M	5		ML		Sandy Silt (ML), brown, moist, stiff, (fill)					-200=59
				SP-SM		Poorly-Graded Sand with Silt (SP-SM), yellowish brown, moist, loose, (fill)					
15	M	5		CL		Lean Clay (CL), gray with brown mottling, moist, stiff, low plasticity		1.0			
20	M	7		Pt		Peat (Pt), black, very stiff, fibrous texture		2.5	87	48	

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 8
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-10

Date : 9/13/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 15.8
Latitude : 38.20700
Longitude : -121.48168

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Aggregate base (3.6-inches), (fill)					
				SP		Poorly-Graded Sand with Gravel (SP), brown, dry, very loose, (fill)					
5	M	6		SM		Silty Sand (SM), brown, moist, loose, (fill)					-200=19
10	M	7							20	101	LL=31 PI=15 -200=85
				CL		Lean Clay with Sand (CL), brown with red mottling, moist, very stiff, low plasticity, brown with red brown mottling		2.3			
15	M	3		CH		Fat Clay with Sand (CH), gray, moist to wet, stiff, high plasticity		1.5			
				Pt		Peat (Pt), black, moist, stiff, fibrous texture					
20	M	3						1.3	107	41	

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 9
(Page 1 of 1)

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. B-11

Date	: 9/10/2019
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: -1.6
Latitude	: 38.20689
Longitude	: -121.48081

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
			CL		Lean Clay (CL), brown, moist, hard, low plasticity					
								21	96	
	T	P								
5										
			CL		Sandy Lean Clay (CL), gray, moist, stiff, medium plasticity			22	101	(D) LL=36 PI=19 (W) LL=38 PI=20 Consol LL=40 PI=20
	T	P								
				▽			1.5			
10	M	10			Very stiff		2.5	24	103	
15	M	19			Hard		4.5+	24	102	-200=76
					Wet					
20	M	12			Very stiff		2.5	25	101	-200=50
			SP		Poorly-Graded Sand (SP), gray, wet, very loose					
25	M	2	SC		Clayey Sand (SC), dark greenish gray, moist, very loose			28	96	-200=21
			CH		Fat Clay with Sand (CH), yellowish gray, wet, stiff, high plasticity					
30	M	7					1.0	38	83	(D) LL=55 PI=32 (W) LL=49 PI=29 -200=45
			SC		Clayey Sand (SC), yellowish gray, wet, medium dense					
35	M	20						30	93	
			CH		Fat Clay (CH), blue gray, wet, stiff, high plasticity					
40	M	7					1.5	37	84	
			SP		Poorly-Graded Sand (SP), gray, wet, very loose					

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 10
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Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-12

Date	:	9/10/2019
Drilling Method	:	Hollow-Stem Auger
Elevation (Feet)	:	-1.6
Latitude	:	38.20689
Longitude	:	-121.48081

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	M	7				Sandy Silt (ML), gray, wet, firm, medium plasticity	0.50	0.5	49	73	LL=48 PI=20
50	M	29		ML		Very stiff		3.8			
											-200=68
55	M	40						3.0	27	98	
				SP		Poorly-Graded Sand (SP), gray, wet, dense					
				ML		Sandy Silt (ML), gray, wet, firm, medium plasticity					
60	M	21						2.0			

Bottom of boring at 61.5 feet
Groundwater encountered at 8 feet during drilling

Date : 9/13/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 16.1
Latitude : 38.20657
Longitude : -121.48088

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
					Aggregate base (3.6-inches), (fill)					
			SP		Poorly-Graded Sand with Gravel (SP), brown, dry, very loose, (fill)					
			CL		Lean Clay with Sand (CL), brown, moist, stiff, low plasticity, little gravel, (fill)					
5	M	4	SC		Clayey Sand (SC), brown, moist, very loose, (fill)		1.5	9	106	-200=36
10	M	4	CL		Lean Clay with Sand (CL), olive brown, moist, stiff, low plasticity		1.8			
15	M	3	CH		Fat Clay (CH), olive gray, wet, firm, medium to high plasticity		0.8			
20	M	2	ML		Sandy Silt (ML), very dark brown, moist, stiff, low plasticity		1.1			

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 11
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-14

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Date : 9/13/2019 Drilling Method : Hollow-Stem Auger Elevation (Feet) : 14.5 Latitude : 38.20196 Longitude : -121.47662					
						Aggregate base (3-inches), (fill)					
				CL		Lean Clay (CL), brown, moist, medium plasticity, (fill)					
5	M	13		Pt		Peat (Pt), black, moist, stiff, fibrous texture, (fill)		1.3	17	97	-200=56
				CL		Sandy Lean Clay (CL), brown, moist, very loose, (fill)					
				SM		Silty Sand (SM), yellowish brown, moist, very dense, (fill)					
10	M	7		ML		Sandy Silt (ML), brown, very stiff, low plasticity		2.3	24	75	LL=42 PI=11
15	M	9		CL		Lean Clay (CL), olive brown, moist, stiff, low plasticity		1.5			
20	M	3		Pt		Peat (Pt), black, moist, very stiff		2.3	64	60	

Bottom of boring at 21.5 feet
No groundwater encountered

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Aggregate base (3-inches), (fill)					
				CL		Sandy Lean Clay (CL), brown, moist, stiff, (fill)					
5	M	7		CL		Lean Clay (CL), brown, moist, stiff, low plasticity, (fill)		1.5			LL=27 PI=13 -200=61
				ML		Silt with Sand (ML), brown, fine grained sand, moist, stiff, no plasticity, (fill)					
10	M	4		CH		Fat Clay (CH), dark brown, moist, firm, high plasticity, peat seams		1.5 0.8			
15	M	2		Pt		Peat (Pt), black, wet, very soft		<0.3	44	77	
				CH		Fat Clay (CH), olive gray, moist, stiff, medium plasticity		1.8			
20	M	10		Pt		Peat (Pt), black, moist, stiff, fibrous texture		1.9	140	35	

Date: 9/13/2019
Drilling Method: Hollow-Stem Auger
Elevation (Feet): 14.5
Latitude: 38.20111
Longitude: -121.47543

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 13
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Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-16

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
					Date : 9/11/2019 Drilling Method : Hollow-Stem Auger Elevation (Feet) : -2.6 Latitude : 38.20036 Longitude : -121.47485					
			CL		Lean Clay (CL), dark brown, moist, hard, low plasticity					
	T	P					4.5+			
5	T	P		▽	Sandy Lean Clay (CL), blue gray, wet, very soft, medium plasticity		0.3			(D) LL=40 PI=23 (W) LL=35 PI=17 TxCU LL=47 PI=20
	T	P								
10	M	8			Firm		0.5	28	96	
					Stiff		1.5			
			CL							
15	M	11			Firm		0.5	27	98	
20	M	8			Soft		0.3	25	100	-200=49
					Clayey Sand (SC), olive gray, wet, loose					
25	M	13	SC							
					Medium dense					
30	M	9						35	86	LL=30 PI=10
					Lean Clay with Sand (CL), blue gray, wet, stiff, low plasticity		2.0			
			CL							
35	M	17					0.3	35	87	-200=75
			SC		Clayey Sand (SC), gray, moist, medium dense					
			CL		Lean Clay with Sand (CL), blue gray, wet, firm, low plasticity					
40	M	15					0.5	31	92	-200=39
					Clayey Sand (SC), brown, wet, medium dense					
			SC							

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 14
(Page 1 of 2)

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 9/11/2019 Drilling Method : Hollow-Stem Auger Elevation (Feet) : -2.6 Latitude : 38.20036 Longitude : -121.47485 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	M	29		CL		Lean Clay with Sand (CL), gray, moist, hard, low plasticity		4.5+	23	104	LL=44 PI=25 -200=84
50	M	22				Blue gray, very stiff		2.5			
55	M	34						3.0			
60	M	23						3.0	29	93	
				SP-SC		Poorly-Graded Sand with Clay (SP-SC), gray, wet, medium dense					

Bottom of boring at 61.5 feet
Groundwater encountered at 5 feet during drilling

Date : 9/12/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 15
Latitude : 38.19988
Longitude : -121.47576

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Lean Clay with Sand (CL), brown, moist, stiff, low plasticity, (fill)					
5	M	4		CL				1.3 1.5	27	97	LL=41 PI=21 -200=74
10	M	4				Firm		0.8	23	102	
				SC		Clayey Sand (SC), yellowish brown, moist, very loose, (fill)					
15	M	3				Peat (Pt), black, moist, firm, fibrous texture		0.8	110	39	
				Pt							
20	M	10				Stiff		1.8	107	40	

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 15
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-19

Date	: 9/13/2019
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: 17.7
Latitude	: 38.19881
Longitude	: -121.47670

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Aggregate base (3-inches), (fill)					
				CL		Lean Clay (CL), brown, moist, low plasticity, (fill)					
						Silty Sand (SM), brown with red brown mottling, moist, loose, (fill)					
5	M	7							7	98	-200=15 LL=NP PI=NP
				SM							
10	M	4				Few gravel			27	89	
15	M	2							25	97	LL=47 PI=19
						Sandy Silt (ML), brown, moist, stiff, medium plasticity		1.3			
				ML							
20	M	5				Gray, moist, soft, low plasticity		0.3	78	53	
				Pt		Peat (Pt), black, moist, firm, fibrous texture		0.9			

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 16
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-20

Date	: 9/11/2019
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: -1.5
Latitude	: 38.19818
Longitude	: -121.47616

Depth in Feet	Samples Type/ Recovery	Blow Count	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
			CL		Lean Clay with Gravel (CL), brown, dry to moist, stiff, low plasticity, (gravel size approx, 1.2-inch to 1 1/2-inch), (fill)					
	T	P	SP	▽	Poorly-Graded Sand (SP), brown, moist, very loose, little gravel (approx. 1/2-inch), (fill)					
5	T	P								
								26	96	Consol (D) LL=27 PI=11 (W) LL=23 PI=9 TxCU LL=44 PI=21
	T	P	CL		Lean Clay (CL), dark brown, moist, hard, medium plasticity		4.5+			
10	M	3	SP-SM		Poorly-Graded Sand with Silt (SP-SM), gray, wet, very loose		2.0	30	93	
			CL		Sandy Lean Clay (CL), gray, wet, stiff, medium plasticity					
15	M	7			Firm		0.5			
20	M	3			Soft		0.3	28	97	
			SM		Silty Sand (SM), yellowish brown, moist, medium dense					
25	M	11						26	99	-200=35
30	M	25	SP-SM		Poorly-Graded Sand with Silt (SP-SM), yellowish brown, moist, medium dense					
					Few gravel					
35	M	21								
40	M	11								

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 17
(Page 1 of 2)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-21

Date	: 9/11/2019
Drilling Method	: Hollow-Stem Auger
Elevation (Feet)	: -1.5
Latitude	: 38.19818
Longitude	: -121.47616

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	M	19		CH		Fat Clay with Sand (CH), gray, wet, hard, high plasticity		4.0	22	107	
50	M	17						3.0			
55	M	26		ML		Sandy Silt (ML), bluish gray, moist, very stiff, low plasticity			29	94	LL=44 PI=16
				SC		Clayey Sand (SC), gray, moist, medium dense					
60	M	17							21	106	-200=22

Bottom of boring at 61.5 feet
Groundwater encountered at 4 feet

Date : 9/12/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : -1.5
Latitude : 38.19814
Longitude : -121.47607

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				CL		Lean Clay with Gravel (CL), brown, moist, firm, low plasticity, (fill)					
	M	2		Pt		Peat (Pt), black, moist, very stiff, fibrous texture		0.5 3.0	100	42	
5	M	0		CL		Sandy Lean Clay (CL), gray, moist, soft, medium plasticity		0.3	22	105	(D) LL=27 PI=12
	M	8				Blue gray, very stiff		2.0			(W) LL=26 PI=11

Bottom of boring at 8.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 17 - 10ft offset
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-23

Date : 9/12/2019
Drilling Method : Hollow-Stem Auger
Elevation (Feet) : 16.2
Latitude : 38.19747
Longitude : -121.47643

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				SM		Silty Sand (SM), brown, moist, loose, (fill)					
5	M	4						1.8	17	80	-200=49 LL=30 PI=5
				ML		Sandy Silt (ML), yellowish brown, moist, firm, low plasticity					
10	M	4							30	81	
15	M	3				Soft		0.3	37	85	LL=37 PI=10
20	M	5		CH		Fat Clay (CH), dark brown, moist, firm, medium plasticity, with organic material		0.8			

Bottom of boring at 21.5 feet
No groundwater encountered

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 9/12/2019 Drilling Method : Hollow-Stem Auger Elevation (Feet) : 16.3 Latitude : 38.19658 Longitude : -121.47766 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				CL		Lean Clay with Sand (CL), brown, dry to moist, low plasticity, (fill)					
5	M	6							21	94	-200=85
				CL		Sandy Lean Clay (CL), brown, dry to moist, stiff, low plasticity, (fill)					-200=54 LL=32 PI=17
10	M	5							31	85	LL=35 PI=15
				CL		Lean Clay (CL), olive gray, moist, stiff, low plasticity		1.5			
15	M	5							38	83	LL=43 PI=15
				ML		Silt with Sand (ML), olive brown, moist, firm, low plasticity		0.8			
20	M	5		Pt		Peat (Pt), black, moist, very stiff, fibrous texture			117	37	

Bottom of boring at 21.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Boring 19
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-25

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : 0 Latitude : 38.22400 Longitude : -121.49090 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Organic Silt (OH), dark brown, wet, very soft, high plasticity					
	B										
1					▽				69		LL=63 PI=27
	B										
				OH		Medium stiff					
2											
									65		
	B										
3											

Bottom of hand auger at 3 feet
Groundwater was encountered at 1 feet during hand augering

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 20
(Page 1 of 1)

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. B-26

Date : 6/12/2020
Drilling Method : Hand Auger
Elevation (Feet) : 0
Latitude : 38.22300
Longitude : -121.49140

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Organic Silt (OH), dark brown, wet, very soft					
	B			OH							
1						Medium stiff					
									38		
	B					Lean Clay (CL), olive brown, wet, medium stiff, trace silt and sand					
2				CL	▽						
									45		
	B			OH		Organic Clay (OH), dark gray, wet, medium stiff					
3											

Bottom of hand auger at 3 feet
Groundwater was encountered at 2 feet during hand augering

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 21
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-27

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : -2.5 Latitude : 38.20930 Longitude : -121.48770 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B			CL		Lean Clay (CL), dark brown, dry to moist, stiff to very stiff			29		
	B								36		
	B			OH		Organic Silt (OH), dark brown, moist to wet, medium stiff to stiff, high plasticity			74		LL=107 PI=36
	B										
5	B					Peat seams					
	B			MH		Elastic Silt (MH), olive brown, wet, medium stiff					

Bottom of hand auger at 5.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 22
(Page 1 of 1)

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. B-28

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : -2 Latitude : 38.21010 Longitude : -121.48850 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B					Lean Clay (CL), dark brown to dark gray, dry to moist, stiff			31		
	B			CL							
	B					With yellowish red mottling Seam of organic silt			52		
	B					Lean Clay (CL), olive brown with yellowish red mottling, wet, medium stiff to stiff Stiff					
5	B			CL							

Bottom of hand auger at 5 feet
No groundwater encountered

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 23
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-29

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : -0.5 Latitude : 38.20750 Longitude : -121.48180 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
				CL		Lean Clay (CL), grayish brown, dry, stiff					
	B								20		
	B										
	B					Wet			44		
	B			OH		Organic Clay (OH), dark brown, wet, soft, with black peat seams					
5	B			CL		Lean Clay (CL), dark gray, wet, medium stiff					

Bottom of hand auger at 5.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 24
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Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-30

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : -2 Latitude : 38.20710 Longitude : -121.48130 Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B			CL		Lean Clay (CL), dark brown, dry to moist, stiff			20		
	B			OH		Organic Silt (OH), brown, moist to wet, medium stiff, high plasticity, with peat seams			50		LL=69 PI=25
	B			CL		Lean Clay (CL), olive brown with orange mottling, wet, stiff			41		
	B					Peat (Pt), dark gray, wet, soft to medium stiff, with lean clay seams					
	B			Pt		Fibrous					
5	B										

Bottom of hand auger at 5.5 feet
No groundwater encountered

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 25
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-31

Date : 6/12/2020
Drilling Method : Hand Auger
Elevation (Feet) : -3
Latitude : 38.20120
Longitude : -121.47510

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B					Organic Silt (OH), dark gray, wet, soft to medium stiff, with peat					
	B			OH							
	B					Dark gray to black with peat					
	B								83		
						Lean Clay with Sand (CL), dark gray, wet, soft					
	B			CL							
5	B				▽						

Bottom of hand auger at 5 feet
Groundwater was encountered at 5 feet during hand augering

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 26
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-32

Date : 6/12/2020
Drilling Method : Hand Auger
Elevation (Feet) : -4
Latitude :
Longitude :

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B			OH		Organic Silt (OH), dark gray, dry to moist, stiff			31		
	B			Pt		Peat (Pt), black, wet, medium stiff to soft					
	B								210		
	B			CL	▽	Lean Clay with Sand (CL), gray, wet, soft to medium stiff, medium plasticity			43		LL=41 PI=21
	B					Stiffer					
5	B										

Bottom of hand auger at 5.5 feet
Groundwater was encountered at 4 feet during hand augering

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : -4 Latitude : Longitude : Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B			OH		Organic Silt (OH), brown, dry to moist, stiff, high plasticity			44		LL=68 PI=25
	B			Pt		Peat (Pt), black, wet, soft, fibrous			501		
	B					Lean Clay (CL), light gray, wet, soft to medium stiff, trace sand			27		
	B			CL							
5	B				▽	Stiffer					

Bottom of hand auger at 5 feet
Groundwater was encountered at 5 feet during hand augering

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 28
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-34

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : Latitude : Longitude : Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B			OH		Organic Silt (OH), dark gray, dry to moist, stiff			31		
	B					Organic Clay (OL), very dark brown to black, moist to wet, medium stiff, medium plasticity, with peat					
	B			OL					162		LL=42 PI=18
	B				▽	Lean Clay with Sand (CL), dark gray to gray, wet, medium stiff					
5	B			CL							

Bottom of hand auger at 5 feet
Groundwater was encountered at 4 feet during hand augering

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 29
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-35

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : -3 Latitude : Longitude : Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
	B			OH		Organic Silt (OH), dark gray, moist to wet, medium stiff			59		
	B								93		
	B			Pt		Peat (Pt), black, wet, soft to medium stiff			208		
	B			CL	▽	Lean Clay with Sand (CL), bluish gray, wet, soft to medium stiff, trace fine sand					
5	B										

Bottom of hand auger at 5 feet
Groundwater was encountered at 4 feet during hand augering

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 30
(Page 1 of 1)

Depth in Feet	Samples Type/ Recovery	Blow Count	Graphic	USCS	Water Levels	Material Description	Torvane (tsf)	Pocket Pen (tsf)	Moisture Content (%)	Dry Density (pcf)	Other Laboratory Tests
						Date : 6/12/2020 Drilling Method : Hand Auger Elevation (Feet) : -2 Latitude : Longitude :					
				OH		Organic Silt (OH), dark gray, moist to wet, medium stiff to stiff					
	B								46		
	B					Increasing peat					
	B								87		
					∇						
	B										
5	B										

Bottom of hand auger at 6 feet
Groundwater was encountered at 3 feet during hand augering

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Log of Hand Auger 31
(Page 1 of 1)

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-37

MAJOR DIVISIONS					GROUP NAMES
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	**GRAVELS** MORE THAN 50% OF COARSE FRACTION IS RETAINED ON NO. 4 SIEVE	**CLEAN GRAVELS** WITH LESS THAN 5% FINES	GW		WELL GRADED GRAVEL
			GP		POORLY GRADED GRAVEL
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVEL
			GC		CLAYEY GRAVEL
	SANDS 50% OR MORE OF COARSE FRACTION PASSES NO. 4 SIEVE	**CLEAN SANDS** WITH LESS THAN 5% FINES	SW		WELL GRADED SAND
			SP		POORLY GRADED SAND
		SANDS WITH OVER 12% FINES	SM		SILTY SAND
			SC		CLAYEY SAND
FINE GRAINED SOILS 50% OR MORE PASSES NO. 200 SIEVE	**SILTS AND CLAYS** LIQUID LIMIT LESS THAN 50		ML		SILT
			CL		LEAN CLAY
			OL		ORGANIC CLAY, ORGANIC SILT
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE		MH		ELASTIC SILT
			CH		FAT CLAY
			OH		ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			Pt		PEAT

UNIFIED SOIL CLASSIFICATION SYSTEM- ASTM D 2487

S	- SPT	▽	- Water Level at Time of Drilling	P	- Push
		▼	- Water Level after Drilling (with date measured)	Perm	- Permeability
M	- 2.5 inch	Consol	- Consolidation	Sieve	- Particle Size Analysis
		Gs	- Specific Gravity	VS	- Laboratory Vane Shear (psf)
C	- 3.0 inch	LL	- Liquid Limit (%)	-200	- % Passing No. 200 Sieve
		PI	- Plasticity Index (%)		
T	- Shelby Tube	TxUU	- Shear Strength (psf) - Unconsolidated Undrained Triaxial Shear		
		TxCU	- Shear Strength (psf) - Consolidated Undrained Triaxial Shear		
B	- Bag	UC	- Compressive Strength (psf) - Unconfined Compression		

KEY TO TEST DATA

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Soil Classification Chart

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. B-38

NEW HOPE 18 — CLINE / BAKER / KINCHELOE

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 25' 37" LATITUDE 38° 11' 43"
DESCRIPTION DRILLED AT TOE OF LEVEE CONFLUENCE OF BEAVER SLOUGH AND NEW HOPE ISLAND

BORING NO. NH-1
SHEET NO. 1 OF 1
DATE DRILLED 1-9-57
GROUND ELEVATION -3.8

DIST. FROM SURF. FEET	ELEVATION	FIELD TUBE NO.		SOILS LAB NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS./FT.³	UNCONF. COMP. STRENGTH TEST NO.	KG/CM²	LOG OF MATERIAL
1		CASED									
2					PUSHED						
3		1	A, B, C			76%		57.2			PEAT FIBROUS WITH ORGANIC OOZE AND SLIME. 60% ORGANIC STRUCTURES (TWIGS, FIBER, LEAF STALK) YELLOW BROWN TO DARK RUST. DAMP.
4			D, E				193.5	59.[illegible]			
5			F				150.0 144.0	59.5 56.0	1		
6		CASED									
7											
8		2	A, B, C		PUSHED	81%	217.5	127.0			PEAT AT TOP OF BORE BUT CHANGES TO BLUE GRAY SAND AND CLAY IN BASE OF "B" TUBE THROUGH "F" TUBE. SLIGHTLY TACKY, MICACEOUS, WET FOR CLAY
9			D, E				217.7	127.4	2		
10			F				215.4	125.0			
11		CASED			4						
12					12						
13		3	A, B		28	93%	98.8 174.1	109.0 105.0			CLAY BLUE GRAY SLIGHT GRIT SOME MICA TACKY TRACES OF DENSE SAND TOUGH AND RUBBERY IN SOME PORTIONS OTHERS RATHER FRIABLE. ERATIC VISUAL CHARACTERISTICS, BUT CERTAINLY SOLID DELTA FOUNDATION
14			C, D		14						
15			E, F		22						
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

REMARKS HOLE COMPLETED AT -15'
ELEVATION 1540 HR 9 JAN 57 HOLE -6' LEVEE: +12.1

LEVEE ELEV +14.3 MSL

PRIMARY SAMPLER DRILLING LOG FORM NO D.W.R. 103 - AUGUST 29, 1956

NEW HOPE

CLINE
BAKER
KINCHELOE

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 28 ' 30 ' LATITUDE 38 ° 11 ' 55 '
DESCRIPTION DRILLED 1500' ± NORTH OF THE CONFLUENCE OF BEAVER SLOUGH AND THE SOUTH FORK OF THE MOKELUMNE RIVER TOE OF LEVEE IN EXISTING FARM ROAD.

BORING NO. NH 2
SHEET NO. 1 OF 1
DATE DRILLED 9 JAN 57
GROUND ELEVATION -2.4

DIST. FROM SURF. FEET	ELEVATION	FIELD TUBE NO		SOILS LAB NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS./FT.^{3}	UNCONF. COMP. STRENGTH TEST NO.	UNCONF. COMP. STRENGTH KG/CM^2	LOG OF MATERIAL
		CLOSED			7						
1					8						
2		1	A, B		4						TOP SOIL AND AT -5 TRACES OF PEAT IN CLAY SILT AND ORGANIC GREASE MATRIX
3			C, D		7	68%					
4			E, F		8		-	-			
5		CLOSED			6						
6					5						
7		2	A, B		12		-	-			NO TRACES OF ANY MATERIAL WHEN SAMPLER WAS OPENED THERE WAS NO GRIT. ?
8			C, D		17	00%					
9			E, F		20						
10		CLOSED			9						
11					24						
12		3	A, B		47						CLAY BLUE GRAY MICACEOUS, FRIABLE & RUBBERY TOUGH DRY, DRILL RESISTANT.
13			C, D		46	80%	205.5 206.9	115.7 115.1			
14			E, F		47		207.1 209.4	117.0 115.8			
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

REMARKS HOLE GROUTED AT -5' HOLE: -4' LEVEE: -14.4
ELEVATION AT 1500 HR 9 JAN 57

LEVEE ELEV +16.0 MSL

PRIMARY SAMPLER DRILLING LOG FORM NO. D.W.R. 103 - AUGUST 29, 1956

2

NEW HOPE 15.

CLINE
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KINCHE

STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 28' 32" LATITUDE 38° 12' 08"
DESCRIPTION DRILLED IN ¢ FARM ROAD 200' SOUTH OF SMALL CAMP (2 HOUSES BARN - GREEN CORRUGATED) 1800' SOUTH OF MAIN PUMPING PLANT SOUTH NEW H. TRACT

BORING NO. N H 3
SHEET NO. 1 OF 1
DATE DRILLED 9 JAN 57
GROUND ELEVATION

DIST. FROM SURF FEET	ELEVATION	FIELD TUBE NO.		SOILS LAB. NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS/FT.³	UNCONF COMP STRENGTH TEST NO	KG/CM²	LOG OF MATERIAL
0–1		CLOSED			6						
1–2		CLOSED			14						
2–3		1	A, B		24						TOP SOIL ORGANIC DECOMPOSIT[illegible] AND CLAY, SAND & SILT DARK BR[illegible] BLACK GRAY BROWN.
3–4		1	C, D		29						
4–5		1	E, F		19		149.8	62.1			
5–6		CLOSED			PUSH						
6–7		CLOSED			↓						
7–8		2	A, B								SILT ORGANIC GREASE STREAKS OF CLAY DARK GRAY BROWN GRADES TO BLUE GRAY GRITTY CLAY IN D TUBE. MICACEOUS SOME LENTILS OF CLAY REVEAL TOTAL PRESENCE OF MOISTURE MORE POWDERY THAN TACKY?
8–9		2	C, D				178.8	86.[illegible]			
9–10		2	E, F		↓		205.5	115.7			
10–11		CLOSED			6						
11–12		CLOSED			14						
12–13		3	A, B		17						CLAY AND SAND AT TOP OF DRIVE GRADING TO VERY COARSE SAND* MEDIUM SORTED QTZ RICH SOME BIOTITE FELSPAR AT TIP OF DRIVE.
13–14		3	C, D		20		214.2	123.[illegible]			
14–15		3	E, F		23		227.0	135.[illegible]			
15–25											

Left margin notes: TOP SOIL (approx. 2–5 ft); ORG. SILT (approx. 7–9 ft); CLAY & SAND (approx. 9–10 ft)

REMARKS HOLE GROUTED AT -15 ELEVATION AT 1630 9 JAN 57 HOLE: 1'2? TAKEN LEVEE: NOT TAKEN

* COARSE FOR THIS PART OF THE DELTA.

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PRIMARY SAMPLER DRILLING LOG FORM NO. D.W.R. 103 - AUGUST 29, 1956

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DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 28' 31" LATITUDE 38° 12' 16"
DESCRIPTION DRILLED 100' SOUTH EAST OF MAIN PUMPING PLANT SOUTH WEST CORNER NEW HOPE TRACT.

BORING NO. NH 4
SHEET NO. 1 OF 1
DATE DRILLED 10 JAN 57
GROUND ELEVATION -3.7

DIST. FROM SURF. FEET	ELEVATION	FIELD TUBE NO.		SOILS LAB NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS/FT.³	UNCONF COMP STRENGTH TEST NO	KG/CM²	LOG OF MATERIAL
		CLOSED			7						TOP SOIL
1					14						
2			A		14						ORGANIC SILT BROWNISH GRAY
			B								HEAVILY MICACEOUS, SLIGHTLY
3			C		12						TACKY, LIGHT GRIT POOR
			D								RECOVERY, SLIGHTLY SANDY AT
4		1	E		9	29%	-	-			TIP OF BORE
			F								
5		CLOSED			PUSH						
6											
7			A		15						CLAY VERY TACKY NON
			B								MICACEOUS DENSE BLUE GRAY
8			C		12	60%					NON GRITTY
		2	D				183.2	94.6	1		
9			E		15		180.5	92.3			
			F								
10		CLOSED			27						
11					26						
12			A		27						CLAY DRY TACKY NON MICACEOUS
			B								NON GRITTY BLUE GRAY CLAY.
13			C		26	43%					VISUALLY APPEARS TO BE GOOD
			D								FOUNDATION MATERIAL.
14		3	E		30		199.8	110.2			
			F				204.1	114.4			
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

REMARKS HOLE GROUTED AT -15'
ELEVATION AT 1120 HR 10 JAN 57 HOLE: -6.3' LEVEE: + 11.1'
ELEV OF LEVEE +13.7 MSL

PRIMARY SAMPLER DRILLING LOG FORM NO D.W.R 103-AUGUST 29, 1956

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STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 28 ' 52 " LATITUDE 38° 12 ' 29 "
DESCRIPTION DRILLED 1600' NORTH WEST OF MAIN PUMP STATION SOUTH WEST NEW HOPE ISLAND AT TOE OF MOKELUMNE RIVER ISLAND SIDE OF THE DITCH

BORING NO. N H 5
SHEET NO. 1 OF 1
DATE DRILLED 10 JAN 57
GROUND ELEVATION -1.7

DIST. FROM SURF. FEET	ELEVATION	FIELD TUBE NO.		SOILS LAB NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS./FT.³	UNCONF. COMP. STRENGTH TEST NO.	KG/CM²	LOG OF MATERIAL
0–2		CLOSED			4						TOP SOIL SUPPORTING CLOVER. GRAY ORGANIC & CLASTIC DETRITAL MATERIAL. HAS SOME COMPACTION OR CEMENTING QUALITIES. NOT AS
					8						EASILY DEFLATED AS SOILS
2		1	A		4						FURTHER SOUTH I.E. EMPIRE IS. OR
			B				171.8	84.0			MEDFORD, WHERE THE OVERBURDEN IS
3			C				164.1	80.5			STRICTLY POWDER. E TUBE OF
			D		7	88%	153.6	66.8			DRIVE CONTAINED DARK BROWN
4			E				153.6	66.8	1		ORGANIC SILTS AND 30% FIBROUS
			F		6		15.0	64.5			MAT'L SOME TRACES OF CLAY
5–7		CLOSED			PUSH						
7		2	A								NO RECOVERIES
8			B								
			C								
9			D				–	–			
			E								
10			F								
10–12		CLOSED									
12		3	A								SAND, MEDIUM GRAINED MEDIUM SORTED
13			B								SUB ANGULAR TO SUB ROUNDED. SOME
			C								PORTIONS APPEAR TO HAVE MORE
14			D								CLAY MATRIX THAN OTHERS. MUST BE
			E		14		2241				DUE TO WASHING DURING EXTRACTION
15			F				2241	133.0			DELTA BASEMENT SEDS.
16–25											

TOP SOIL ? CLAY AND SAND — SAND

REMARKS HOLE COMPLETED 10 JAN 57 AT -15'
ELEVATION AT 1310 HR 10 JAN 57 HOLE: -4.8 LEVEE: +10.6

LEVEE ELEV +13.7 MSL

PRIMARY SAMPLER DRILLING LOG FORM NO D.W.R. 103 - AUGUST 29, 1956

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NEW HOPE TR.

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STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 29' 11" LATITUDE 38° 12' 33"
DESCRIPTION DRILLED AT TOE OF LEVEE 600' SOUTHEAST OF SIPHON CURVE NORTH OF MAIN PUMP STA WEST N HOPE. SIPHON IS ON STATEN ISLAND AT POINT WHERE RIVER TAKES SHARP EAST [illegible] [illegible] STATEN ISLAND.

BORING NO. NH8
SHEET NO. 1 OF 1
DATE DRILLED 10 JAN 57
GROUND ELEVATION -2.2

DIST. FROM SURF FEET	ELEVATION	FIELD TUBE NO		SOILS LAB NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS/FT.³	UNCONF COMP STRENGTH TEST NO	KG/CM²	LOG OF MATERIAL
0		CLOSED			6						TOP SOIL, BLUE GRAY
1					10						
2		1	A		PUSH						
			B		3						
3			C		8	08%					
			D								
4			E		10						TOP SOIL TO HERE
			F								
5		CLOSED			PUSH						CLAY TRACES HERE
6											
7		2	A								CLAY, BLUE GRAY, RUBBERY AND FRIABLE, TOUGH DENSE MATERIAL EXTREMELY FINE PCS OF MICA. FAINT KAOLIN ODOR. SLIGHT GRIT.
			B								
8			C				216.0	116.0			
			D		11	80%	201.6	115.8	1		
9			E		20		202.1	112.5			
			F				200.2	110.6			
10		CLOSED			28						
11					38						
12	D	3	A		65	33%	214.2	124.1			CLAY, BLUE GRAY, AS ABOVE BUT VERY DRY FOR DELTA SUB-SURFACE. SLIGHT GRIT, BUT WHETHER THE IS SAND OR JUST CONCRETIONS OF CLAY IS SPECULATIVE.
13	E		B		65		213.3	123.0	2		
	F		C								
14			D								
15											

REFUSAL AT 13'6"
60 BLOWS WITH 140 LB HAMMER AT 18" DROP DROVE THE PIPE 0.5' CONSIDERED TO BE REFUSAL

(Left margin: TOP SOIL ↓ — CLAY)

REMARKS HOLE GROUTED AT -13.5' ELEVATION AT 1430 10 JAN 57 HOLE: -4.6 LEVEE: +12.00

LEVEE ELEV +14.4 MSL

PRIMARY SAMPLER DRILLING LOG FORM NO D.W.R. 103 - AUGUST 29, 1956

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STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 24' 26" LATITUDE 38° 12' 37"	BORING NO. NH 7
DESCRIPTION DRILLED AT TOE OF LEVEE ON PT PRECEDING	SHEET NO. 1 OF 1
SIPHON CURVE, (SEE N.H. 6) NEW HOPE, WEST.	DATE DRILLED 10 JAN 57
	GROUND ELEVATION -0.9

DIST FROM SURF FEET	ELEVATION	FIELD TUBE NO		SOILS LAB. NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS./FT.³	UNCONF. COMP. STRENGTH TEST NO	KG/CM²	LOG OF MATERIAL
0–1		CLOSED			4						
1–2					6						
2–3		1	A, B		4						
3–4			C, D		5		20%				
4–5			E, F		6	–		–			TOP SOIL
5–6		CLOSED			14						
6–7					16						
7–8		2	A, B		15						CLAY BLUE GRAY DENSE TOUGH RUBBERY, DRY SOME FIBRES OLD
8–9			C, D		14	214.9	64%	123.6	1		
9–10			E, F		13	213.5 206.4		124.5 116.6			
10–11		CLOSED			18						
11–12					16						
12–13		3	A, B		30		70%				CLAY AT TOP OF DRIVE GRADES TO DARK GRAY BLUE SAND, DENSE
13–14			C, D		40	202.4 212.1		113.0 122.5	2		AND SLIGHTLY TACKY VISUALLY CONSIDERED TO BE STABLE
14–15			E, F		45	209.5 213.4		118.6 123.0			FOUNDATION MATERIAL.
15–25											

REMARKS HOLE COMPLETED AT -15'
ELEVATION AT 1600 HR 10 JAN 57 HOLE: -2.5 LEVEE: +12.5

LEVEE ELEV +14.2 MSL

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PRIMARY SAMPLER DRILLING LOG FORM NO. D.W.R. 105 - AUGUST 29, 1956

NEW HOPE

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DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 29' 37" LATITUDE 38° 12' 59"
DESCRIPTION DRILLED AT TOE OF MOKELUMNE LEVEE
1500' SOUTH EAST OF GRAIN ELEVATOR MEANDER
2000 NORTH WEST OF SIPHON CURVE (1/2 NH 6) NEW HOPE WEST

BORING NO. NH 5
SHEET NO. 1 OF 1
DATE DRILLED 11 JAN 57
GROUND ELEVATION -2.2

DIST. FROM SURF FEET	ELEVATION	FIELD TUBE NO		SOILS LAB NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS/FT.³	UNCONF COMP STRENGTH TEST NO	UNCONF COMP STRENGTH KG/CM²	LOG OF MATERIAL
0		CLOSED			2						TOP SOIL
1					4						
2		1	A		PUSH	10%					TOP SOIL WITH CLAY BASE.
			B		9'						
3			C								
			D		4						
4			E		8						
			F								
5		CLOSED			6						
6					4						
7		2	A		6						CLAY, BLUE GRAY DRY TACKY
			B								NON GRITTY, UNDERLYING ORGANIC
8			C		7						SILT WITH CLAY STREAKS. TRACES
			D			41%					OF ORGANICS LESS THAN 5%
9			E		8						
			F				204.5	115.0			
10		CLOSED			8		197.0	101.9			
11					10						
12		3	A		22						CLAY BLUE GRAY VERY DRY
			B								FRIABLE, BRITTLE, STREAKS OF
13			C		20						LIGHT BLU GRAY POWDER
			D								HARD, TOUGH MAT'L, HARD TO
14			E		32		202.1	112.5			CUT.
			F				209.9	115.2			
15											
16											
17											
18											
19											
20											
21											
22											
23											
24											
25											

REMARKS HOLE COMPLETED AT -15'
ELEVATION AT 10:20 HR 11 JAN 57 HOLE: -4.4 LEVEE +13.4

LEVEE ELEV +15.1 MSL

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PRIMARY SAMPLER DRILLING LOG FORM NO D.W.R 103-AUGUST 29, 1956

NEW HOPE

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STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 29' 43" LATITUDE 38° 3' 22"
DESCRIPTION DRILLED OPPOSITE GRAIN ELEVATOR, STATEN ISLAND AT TOE OF LEVEE, NEW HOPE ISLAND

BORING NO. NH-9
SHEET NO. 1 OF 1
DATE DRILLED 11 JAN 57
GROUND ELEVATION -1.5

DIST. FROM SURF. FEET	ELEVATION	FIELD TUBE NO.		SOILS LAB. NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS./FT.³	UNCONF. COMP. STRENGTH TEST NO.	UNCONF. COMP. STRENGTH KG/CM²	LOG OF MATERIAL
0–1		CLOSED			4						TOP SOIL
1–2					4						
2–3			A, B		6						TOP SOIL, BASE OF TUBE CONTAINS BRIGHT ORANGE LIMONITE STAINED CLAY AND ORGANIC SILT
3–4			C, D		7						
4–5		1	E, F		6	[illegible]					
5–7		CLOSED			PUSH						
7–8			A, B		4						CLAY, BLUE GRAY, ATYPICAL OF THIS ELEVATION NORTH OF BRACK TRACT, DRY, TOUGH, OCCASIONAL FIBER IN TUBE
8		2	C			[illegible]	216	129.0			
9			D		10		216.3	127.7	1		
9.5			E		25		218.6	121.5			
10			F				207.4	117.6			
10–11		CLOSED			26						
11–12					22						
12		3	C		27		222.2	131.0			SAND, TOP SAMPLES CONTAIN FINE GRAINED WELL SORTED SANDS AND LOWER SAMPLES ARE COARSER WITH MEDIUM SORTING AND SUB ANGULAR FRAGMENTS. DELTA BASEMENT SAND
13			D			100%	219.3	128.6			
13.5			E				225.5	132.7			
14			F		77						
14–15					REFUSAL 27 BLOWS 140 LB HAMMER DROP 18" MOVED PIPE 1"						

TOP SOIL — CLAY — SAND

REMARKS HOLE COMPLETED AT - 14' ELEVATION AT 10:00 HR 11 JAN 57 HOLE: -4.1 LEVEE: +14.2

LEVEE ELEV +16.8 MSL

PRIMARY SAMPLER DRILLING LOG FORM NO. D.W.R. 105 - AUGUST 29, 1956

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STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 32 ° 36 ' LATITUDE 38 ° 3 ° 5 '
DESCRIPTION DRILLED AT TOE OF LEVEE 1500' NORTH EAST GRAIN ELEVATOR BEND WEST NEW HOPE TRACT

BORING NO. NH 10
SHEET NO. 1 OF 1
DATE DRILLED 11 JAN 57
GROUND ELEVATION +0.8

DIST. FROM SURF. FEET	ELEVATION	FIELD TUBE NO		SOILS LAB NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS./FT.³	UNCONF COMP STRENGTH TEST NO	KG/CM²	LOG OF MATERIAL
0–1		CASED			3						
1–2		CASED			3						
2–3		1	A, B		4						TOP SOIL DRY GRAY BROWN ORGANIC AND SILT LOOSELY COMPACTED
3–4		1	C, D		4						TIP SHOWS WEATHERED STAINED CLAY WITH STREAKS
4–5		1	E, F		6		186.0	97.2			
5–6		CASED			10						
6–7		CASED			13						
7–8		2	A, B		30						CLAY AND SAND VERY DENSE SAND PARTICLES, TYPICAL BLUE-GRAY-GREEN CASTE OF DELTA BASEMENT
8–9		2	C, D		65		210.0 220.0	120.0 124.2			MATERIAL, BUT DRY. CLAY ACTS AS BINDER FOR THIS TOUGH FRIABLE
9–10		2	E, F		90		211.5 -	121.5 -	1		DRILL RESISTANT MATERIAL.
10–11					REFUSAL						
11–12				LAST 1 FOOT DRIVE TOOK 90 BLOWS							
12				140 LB HAMMER DROP 18"							
13–25											

REMARKS HOLE GROUTED AT -10'
ELEVATION AT 1130 HR 11 JAN 57 HOLE: -2' LEVEE: +14.2

LEVEE ELEV +17.0 MSL

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PRIMARY SAMPLER DRILLING LOG FORM NO D.W.R. 103 - AUGUST 29, 1956

NEW HOPE

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STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
SALINITY CONTROL BARRIER INVESTIGATION

LOCATION LONGITUDE 121° 3[illegible]° 24' LATITUDE 3[illegible]° [illegible]° 26'
DESCRIPTION DRILLED 1000' SOUTH OF NEW HOPE LANDING AT TOE OF MOKELUMNE LEVEE WEST NEW HOPE TRACT

BORING NO. [illegible] 11
SHEET NO. 1 OF 1
DATE DRILLED 11 JAN 57
GROUND ELEVATION -0.9

DIST. FROM SURF. FEET	ELEVATION	FIELD TUBE NO.		SOILS LAB. NO.	BLOWS PER FOOT	PER CENT RECOVERY	WEIGHT PER TUBE GRAMS	WET DENSITY LBS./FT.³	UNCONF. COMP. STRENGTH TEST NO.	KG/CM²	LOG OF MATERIAL
0–1		CLOSED			4						
1–2		CLOSED			8						
2–3		1	A, B		13						TOP SOIL AND ORGANIC AND CLASTIC SILT SLIGHTLY TACKY, DARK BROWN TO GRAY BROWN COLOR SOME MICA
3–4		1	C, D		15	25%					
4–5		1	E, F		17						
5–6		CLOSED			7						
6–7		CLOSED			7						
7–8		2	A, B		7						CLAY BLUE GRAY, TACKY, DAMP NOT AS BRITTLE AS PREVIOUS SAMPLES SAME WITH THIS ISLAND OCCASIONAL FIBRE LESS THAN 01%
8–9		2	C, D		14	74%	210.0 210.4	120.0 120.5			
9–10		2	E, F		23		210.0 224.0	120.0 115.0			
10–11		CLOSED			18						
11–12		CLOSED			28						
12–13		3	A, B		31	100%	217.9	122.0			SAND FINE GRAINED MEDIUM SORTED BLUE GRAY AT TOP OF BORE GRADES TO COARSE GRAINED SAND AT BASE OF HOLE, GOOD CLEAN WASHED DELTA SAND AT TIP. SOME CLAY IN A AND B TUBES
13–14		3	C, D		37						
14–15		3	E, F		45		218.3 N.A.	- [illegible]			
15–25											

REMARKS HOLE GROUTED AT -15' 1320 HR 11 JAN 57 HOLE +15 LEVEE : +15.8 ELEVATION

LEVEE ELEV +19.4 MSL

PRIMARY SAMPLER DRILLING LOG FORM NO D.W.R 103 - AUGUST 29, 1956

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DEPARTMENT OF WATER RESOURCES

DRILL HOLE LOG

SHEET 1 of 1
HOLE NO. ND-21A
ELEV. FEET
DEPTH 35.0 FEET

PROJECT	1992 North Delta Seepage Monitoring	DATE DRILLED	11/16/92-11/16/92
FEATURE	New Hope Tract	ATTITUDE	Vertical
LOCATION	Top of levee, land side of road, about 15' above island floor.	LOGGED BY	G. Newmarch
CONTR.	PC Exploration; DRILL RIG Mobile Drill B-61	DEPTH TO WATER	Not Determined

AD = Hole drilled with 8" hollow-stem auger

ELEV DEPTH	LOG	WELL CONS	FIELD CLASSIFICATION AND DESCRIPTION	MODE	REMARKS
0	GM, SM		**0.0 - 19.0' LEVEE FILL:** 0 - 1.0' Gravel, Dry. 1.0 - 16.0' Sand. Silty. Dry. 16.0 - 19.0' Sand. Silty. Moist.	AD	
11					Firm materials 11 - 21 feet.
19	CL		**19.0 - 21.0' CLAY:** Dark yellowish brown (10YR 4/2). Very silty. Low plasticity. Moist.		
21	OL		**21.0 - 24.0' ORGANIC CLAY:** Grayish brown (5YR 3/2). Silty. Low plasticity. Soft. Moist.		Softer materials 21 - 30 feet.
24	OL		**24.0 - 30.0' ORGANIC CLAY:** Grayish black (N 2). Silty. Low to medium plasticity. Soft. Saturated.		
30	OL		**30.0 - 35.0' ORGANIC CLAY:** Dark greenish gray (5G 4/1). Silty. Low to medium plasticity. Stiff. Saturated.		Firm materials 30 - 35 feet.
35					Total Depth = 35 feet

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DRILL HOLE LOG

SHEET 1 of 1

HOLE NO. **ND-21B**

ELEV. ____ FEET

DEPTH 35.0 FEET

PROJECT **1992 North Delta Seepage Monitoring**

FEATURE **New Hope Tract**

LOCATION **Top of levee, land side of road, about 15' above tract floor.**

CONTR. **PC Exploration** DRILL RIG **CME All Terrain**

DATE DRILLED **11/13/92-11/13/92**

ATTITUDE **Vertical**

LOGGED BY **G. Newmarch**

DEPTH TO WATER ∇ **Not Determined**

AD = Hole drilled with 8" hollow-stem auger

ELEV DEPTH	LOG	WELL CONS	FIELD CLASSIFICATION AND DESCRIPTION	MODE	REMARKS
0	GM CL		<u>0.0 - 16.0' LEVEE FILL:</u> 0 - 1.0' Gravel. Dry 1.0 - 16.0' Clay. Moderate brown (5YR 3/4). Silty. Low plasticity. Dry.	AD	
8.5			The clay becomes slightly moist at 8.5 feet.		
11			The clay becomes dark yellowish brown (10YR 4/2) and moderately moist at 11 feet. The clay becomes moderate brown (5YR 3/4), has low to medium plasticity, and is saturated at 13 feet.		
16	OL		<u>16.0 - 25.0' ORGANIC SILT:</u> Brownish black (5YR 2/1). Clayey. Slight plasticity. Soft. Saturated.		Soft materials, rapid drilling rate 16 - 25 feet.
25	ML		<u>25.0 - 35.0' SILT:</u> Greenish gray (5G 6/1). Clayey. Slight plasticity. Moderately soft. Saturated.		Slightly firmer materials, slower drilling rate 25 - 35 feet.
35					Total Depth = 35 feet

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

DRILL HOLE LOG

SHEET 1 of 1
HOLE NO. ND-22
ELEV. ______ FEET
DEPTH 20.0 FEET

PROJECT 1992 North Delta Seepage Monitoring
FEATURE New Hope Tract
LOCATION Levee toe
CONTR. PC Exploration DRILL RIG Mobile Drill B-61

DATE DRILLED 11/16/92-11/16/92
ATTITUDE Vertical
LOGGED BY G. Newmarch
DEPTH TO WATER ⊻ Not Determined

AD = Hole drilled with 8" hollow-stem auger

ELEV DEPTH	LOG	WELL CONS	FIELD CLASSIFICATION AND DESCRIPTION	MODE	REMARKS
0	OL		0.0 - 8.0' ORGANIC CLAY: Moderate brown (5YR 3/4). Silty. No recognizable organic fibers. Low plasticity. Slightly moist.	AD	Soft materials, rapid drilling 0 to 12 feet.
8	OL		8.0 - 10.0' ORGANIC SILT: Dark yellowish brown (10YR 4/2). Low plasticity. Soft. Saturated.		
10	OL		10.0 - 12.0' ORGANIC SILT: Medium dark gran (N 4). Clayey. Slight plasticity. Very soft. Saturated.		
12	CL		12.0 - 18.0' CLAY: Dark greenish gray (5G 4/1). Ranges from a lean to a fat clay. Medium to high plasticity. Moderately stiff. Saturated.		Firm materials, slower drilling 12 to 18 feet.
18	ML		18.0 - 20.0' SILT: Dark greenish gray (5G 4/1). Clayey. No plasticity. Very soft. Saturated.		Soft materials, rapid drilling 18 to 20 feet.
20					Total Depth = 20 feet

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

DRILL HOLE LOG

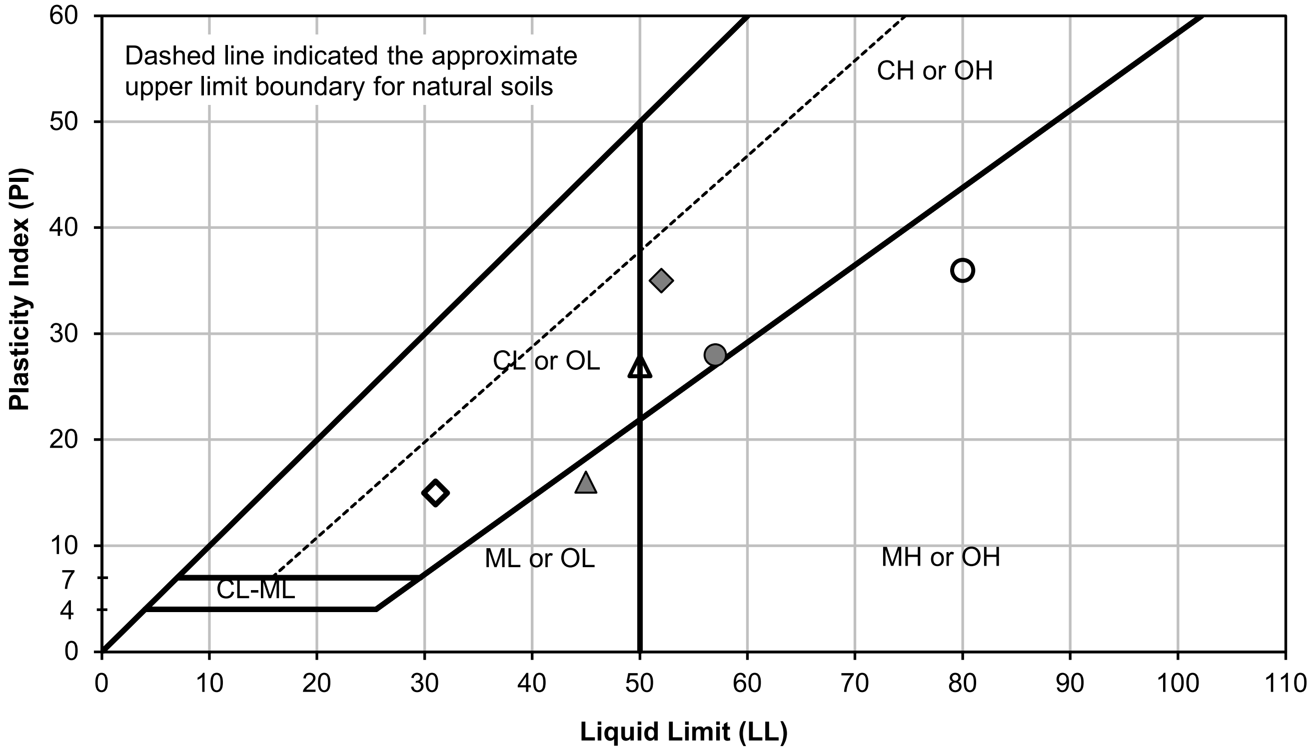
SHEET	1 of 1
HOLE NO.	ND-25
ELEV.	FEET
DEPTH	35.0 FEET
DATE DRILLED	11/16/92-11/16/92
ATTITUDE	Vertical
LOGGED BY	G. Newmarch
DEPTH TO WATER	☿ Not Determined

PROJECT 1992 North Delta Seepage Monitoring
FEATURE New Hope Tract
LOCATION Top of levee, land side of road, about 15' above tract floor.
CONTR. PC Exploration DRILL RIG Mobile Drill B-61
AD = Hole drilled with 8" hollow-stem auger

ELEV DEPTH	LOG	WELL CONS	FIELD CLASSIFICATION AND DESCRIPTION	MODE	REMARKS
0	GM, SM		**0.0 - 10.0' LEVEE FILL:** 0 - 1.0' Gravel. Sandy. Silty. Dry. 1.0 - 6.0' Sand. Moderate brown (5YR 3/4). Fine-grained. Silty. Poorly graded. Dry. 6.0 - 10.0 Sand. Dark Yellowish Brown (10YR 4/2). Fine-grained. Silty. Poorly graded. Moist.	AD	Soft materials, rapid drilling rate 0 to 10 feet.
5	SM				
10	OL		**10.0 - 14.0' ORGANIC SILT:** Moderate yellowish brown (5YR 3/4). Very clayey. Low plasticity. Soft. Saturated.		Firm materials, slow drilling rate 10 to 14 feet.
15	OL		**14.0 - 20.0' ORGANIC CLAY:** Moderate yellowish brown (5YR 3/4). Silty. Low to medium plasticity. Soft. Saturated.		Very firm materials, very slow drilling rate 14 to 15 feet. Soft materials, rapid drilling rate 15 to 32 feet.
20	OL		**20.0 - 28.0' ORGANIC CLAY:** Olive gray (5Y 3/2). Silty. Low to medium plasticity. Soft. Saturated.		
25					
30	CL		**28.0 - 35.0' CLAY:** Dark greenish gray. Silty. Low to medium plasticity. Stiff. Saturated.		Firm materials, slow drilling rate 32 to 35 feet. Local observers would probably call this "Blue Clay."
35					Total Depth = 35 feet

APPENDIX C

Laboratory Testing



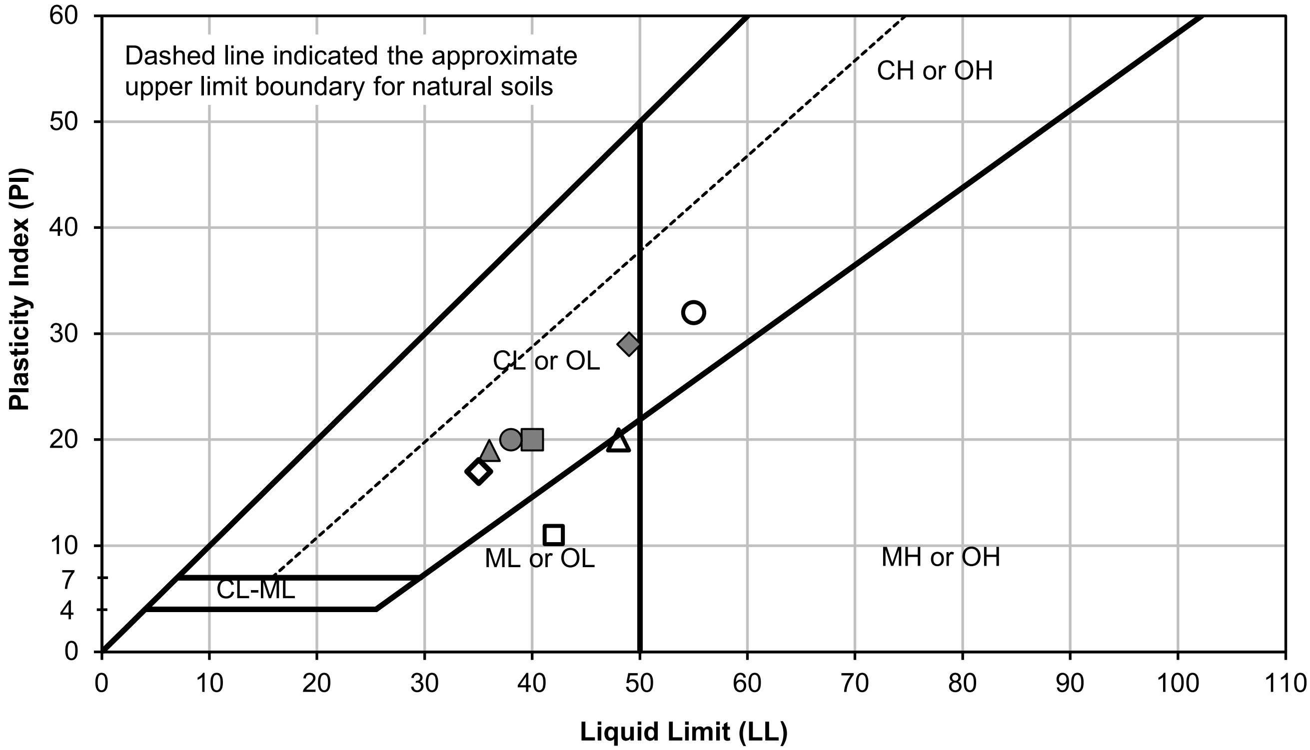
Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
●	2	31-31.5	Blue Gray Fat Clay	57	29	28	37
▲	3	15.4-15.9	Brown with Dark Gray Silt	45	29	16	12
■	5	15.7-16.2	Light Reddish Brown Silty Sand	NP	NP	NP	16
◆	6	10.5-11	Gray Fat Clay	52	17	35	21
○	6	15.5-16	Brown Silty Sand	80	44	36	22
△	7	10.5-11	Bluish Gray and Olive Brown Fat Clay	50	23	27	28
□	7	40.5-41	Light Yellowish Brown Poorly-Graded Sand	NP	NP	NP	28
◇	9	10.5-11	Brown with Red Mottling Lean Clay with Sand	31	16	15	20

Testing performed by Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Atterberg Limits

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-1



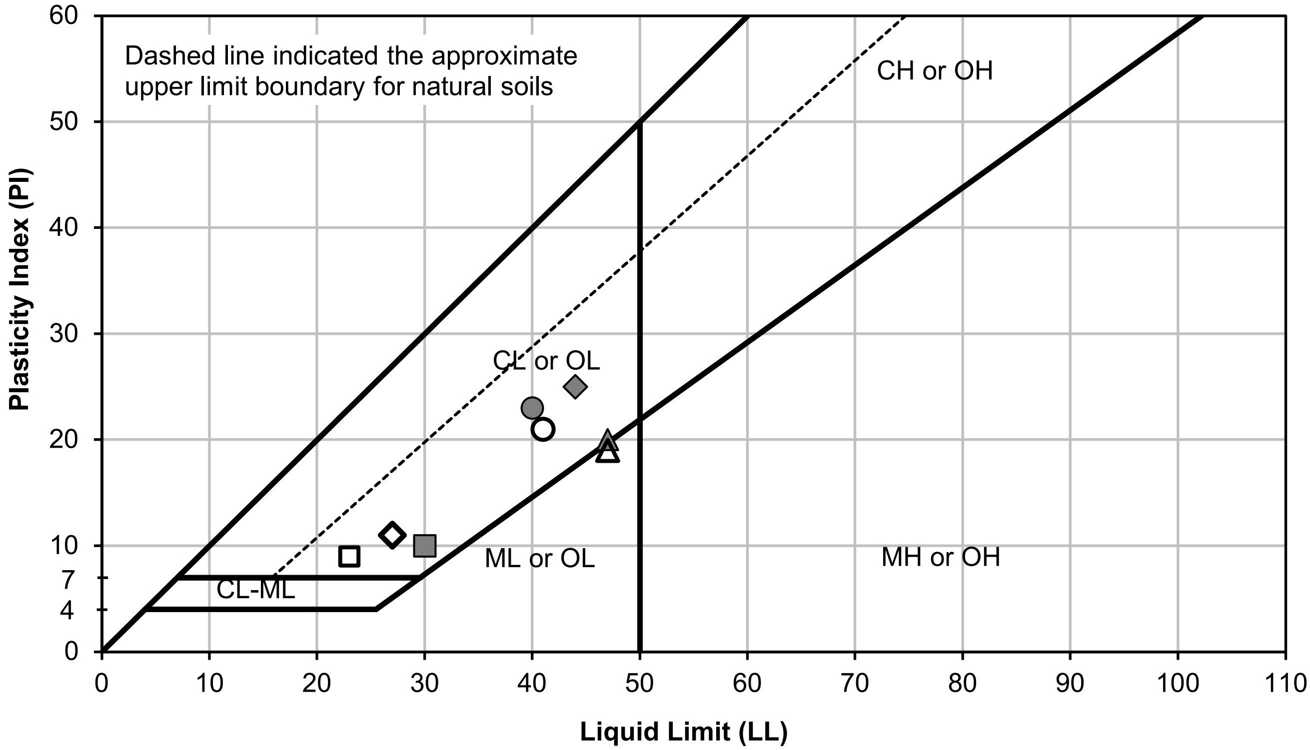
Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
● (gray circle)	10*	6-7.7	Gray Sandy Lean Clay	38	18	20	
▲ (gray triangle)	10	6-7.7	Gray Sandy Lean Clay	36	17	19	
■ (gray square)	10	10.2-10.7	Gray Sandy Lean Clay	40	20	20	24
◆ (gray diamond)	10*	30.3-30.8	Yellowish Gray Fat Clay with Sand	49	20	29	38
○	10	30.3-30.8	Yellowish Gray Fat Clay with Sand	55	23	32	38
△	10	45.5-46	Gray Sandy Silt	48	28	20	49
□	12	10.5-11	Brown Sandy Silt	42	31	11	24
◇	14*	5-6.6	Blue Gray Sandy Lean Clay	35	18	17	

*Atterberg limit was performed using the wet prep method
Testing performed by Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Atterberg Limits

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-2



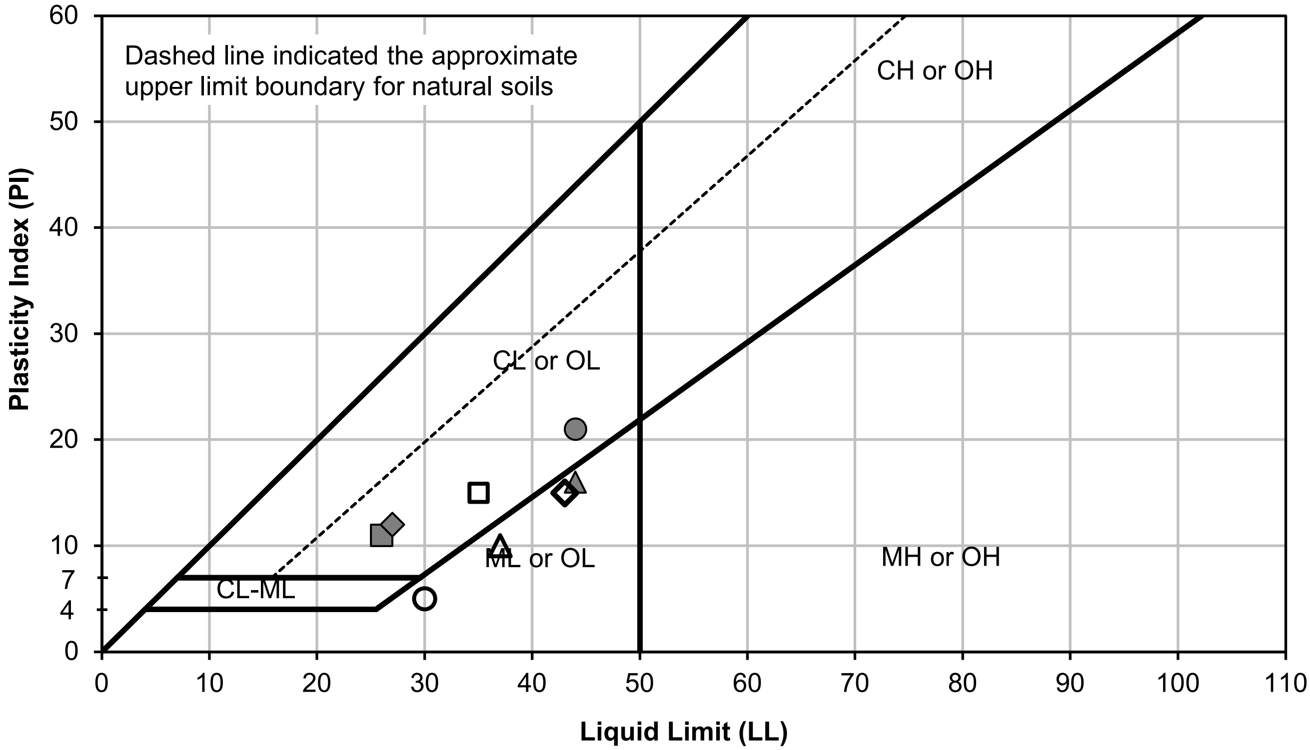
Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
● (gray circle)	14	5-6.6	Blue Gray Sandy Lean Clay	40	17	23	
▲ (gray triangle)	14	10.2-10.7	Blue Gray Sandy Lean Clay	47	27	20	28
■ (gray square)	14	30.3-30.8	Blue Gray Lean Clay with Sand	30	20	10	35
◆ (gray diamond)	14	45.5-46	Gray Lean Clay with Sand	44	19	25	23
○	15	5.2-5.7	Brown Lean Clay with Sand	41	20	21	27
△	16	15.3-15.8	Brown Sandy Silt	47	28	19	25
□	17*	7.5-9	Dark Brown Lean Clay	23	14	9	
◇	17	7.5-9	Dark Brown Lean Clay	27	16	11	

*Atterberg limit was performed using the wet prep method
Testing performed by Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Atterberg Limits

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-3



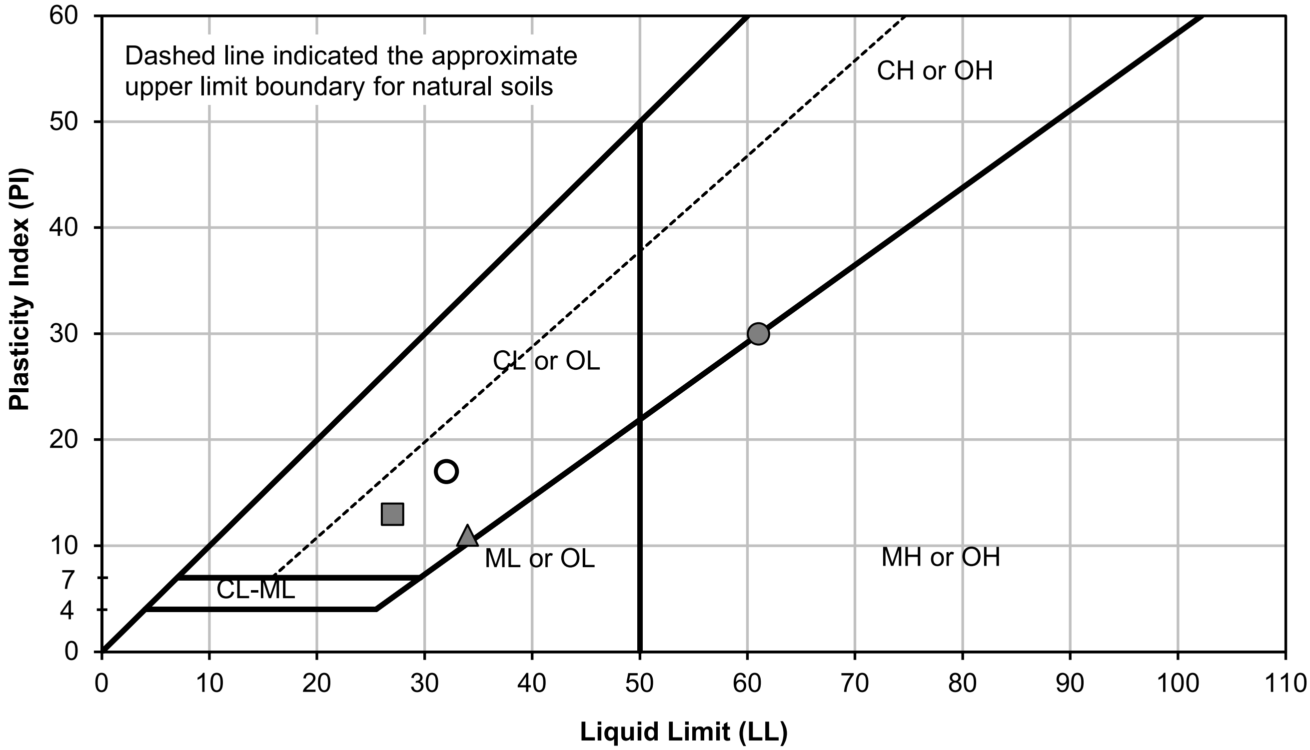
Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
● (gray circle)	17	10.5-11	Gray Sandy Lean Clay	44	23	21	30
▲ (gray triangle)	17	55.5-56	Bluish Gray Sandy Silt	44	28	16	29
■ (gray square)	17 offset*	5.5-6	Gray Sandy Lean Clay	26	15	11	22
◆ (gray diamond)	17 offset	5.5-6	Gray Sandy Lean Clay	27	15	12	22
○	18	5.5-6	Brown Silty Sand	30	25	5	17
△	18	15.5-16	Yellowish Brown Sandy Silt	37	27	10	37
□	19	10.5-11	Olive Gray Lean Clay	35	20	15	31
◇	19	15.3-15.8	Olive Brown Silt with Sand	43	28	15	38

*Atterberg limit was performed using the wet prep method
Testing performed by Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Atterberg Limits

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. C-4



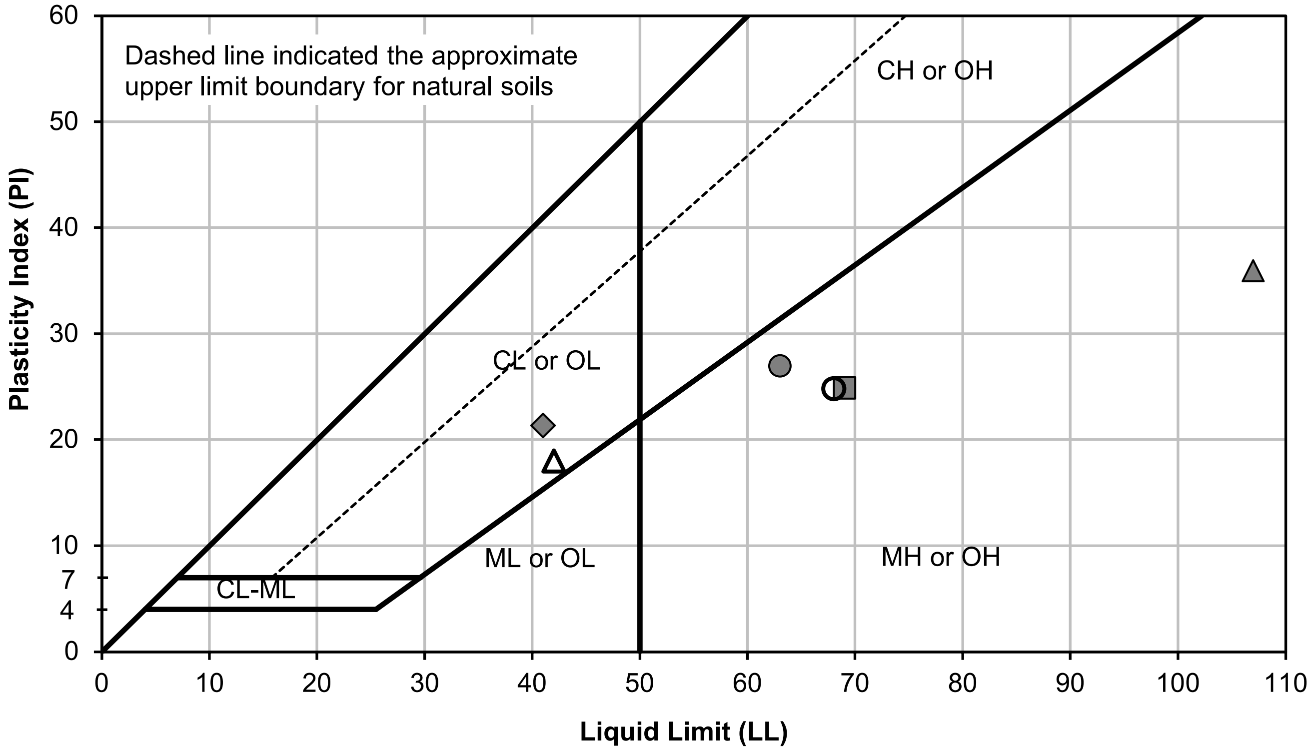
Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
●	7**	4-4.6	Dark Brown Fat Clay	61	31	30	32
▲	8	5.7-6.2	Brown Sandy Lean Clay	34	23	11	
■	13	5.2-5.5	Brown Lean Clay	27	14	13	
◆	16	5.8-6.3	Brown with Red Brown Mottling Silty Sand	NP	NP	NP	
○	19	5.7-6.2	Brown Sandy Lean Clay	32	15	17	
△							
□							
◇							

**Testing performed by B. Hillebrandt Soils Testing, Inc.
Testing performed by Hultgren - Tillis Engineers

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Atterberg Limits

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. C-5

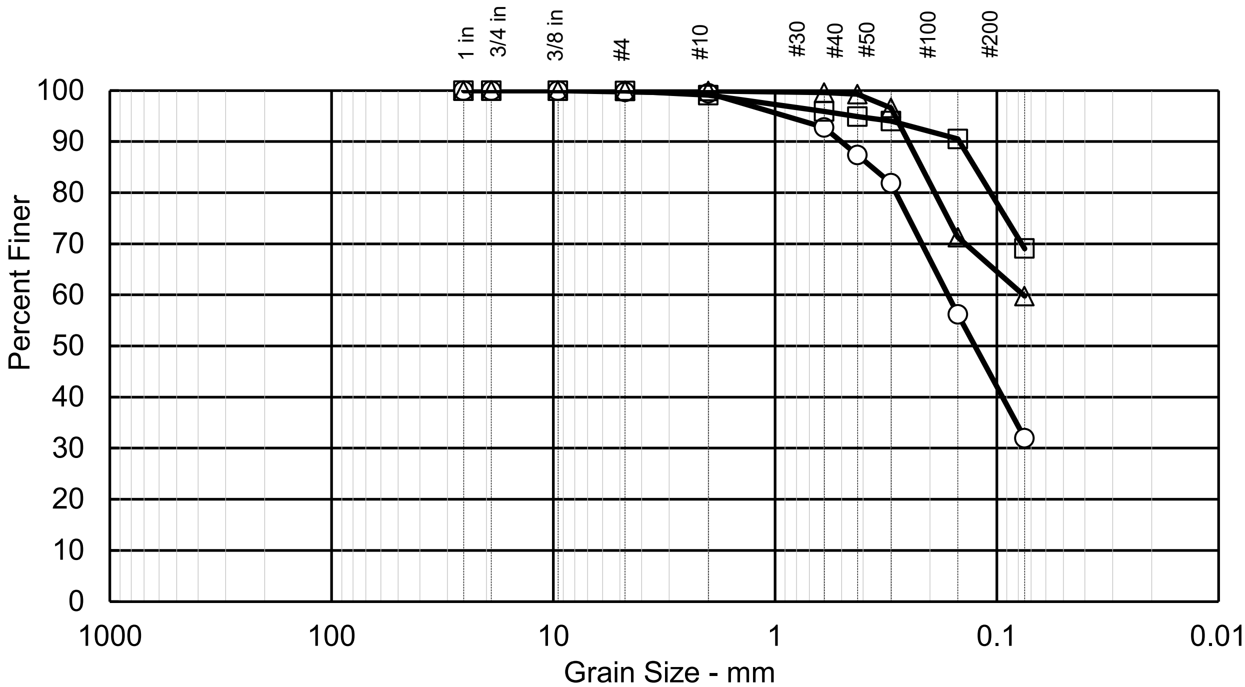


Symbol	Boring Number	Depth (feet)	Soil Description	LL (%)	PL (%)	PI (%)	Moisture Content (%)
●	HA20	1	Dark Brown Organic Silt	63	36	27	69
▲	HA22	2.5	Dark Brown Organic Silt	107	71	36	74
■	HA25	1.5	Brown Organic Silt	69	44	25	50
◆	HA27	3.5	Gray Lean Clay with Sand	41	20	21	43
○	HA28	0.5	Brown Organic Silt	68	43	25	44
△	HA29	2.5	Very Dark Brown to Black Organic Clay	42	24	18	162
□							
◇							

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Atterberg Limits

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-6



Sieve Size	○	□	△
	Percent Finer		
1 in	100.0	100.0	100.0
3/4 in	100.0	100.0	100.0
3/8 in	100.0	100.0	100.0
#4	99.7	99.9	100.0
#10	99.5	99.1	99.9
#30	92.8	95.9	99.6
#40	87.4	94.9	99.3
#50	81.9	94.0	96.6
#100	56.2	90.5	71.3
#200	32.0	69.1	59.8
	Grain Size		
D60	0.165	-	0.077
D30	-	-	-
D10	-	-	-
	Coefficients		
Cc	-	-	-
Cu	-	-	-

Soil Description	
○	Brown Silty Sand (SM)
□	Yellowish Brown Sandy Lean Clay (CL)
△	Olive Sandy Lean Clay (CL)

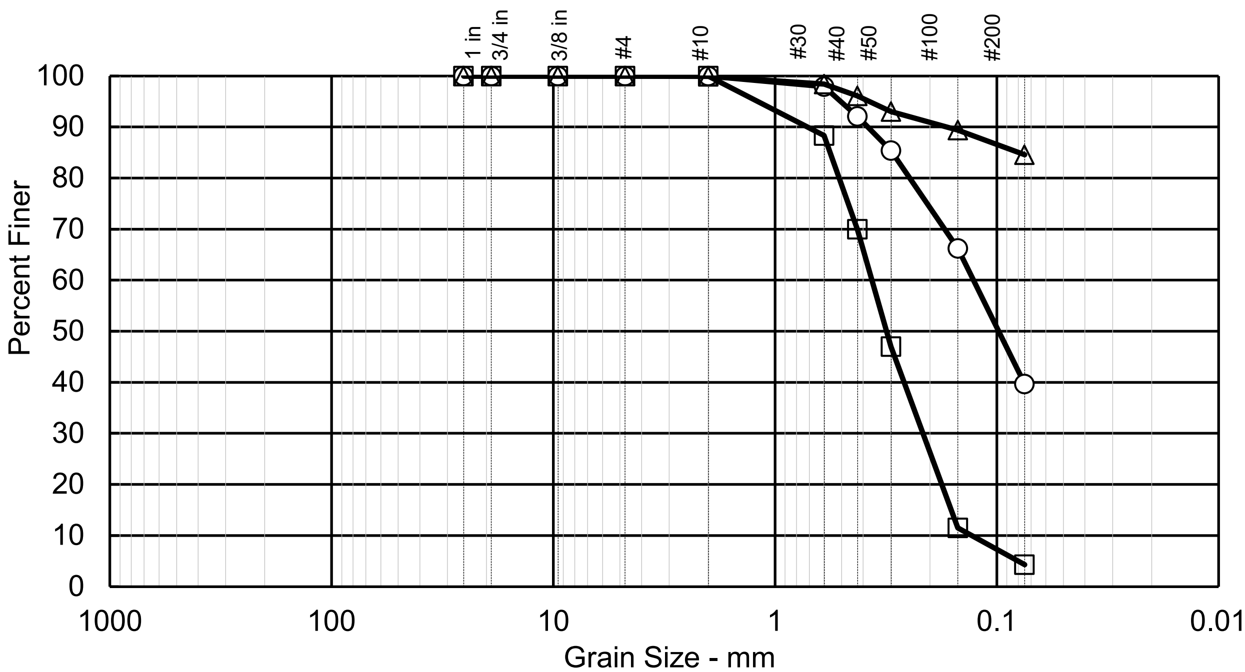
Sample Key	
○	Boring 1 @ 5.4-5.9 feet
□	Boring 2 @ 10.4-10.9 feet
△	Boring 2 @ 40.5-41 feet

Testing performed by
Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. C-7



Sieve Size	○	□	△
	Percent Finer		
1 in	100.0	100.0	100.0
3/4 in	100.0	100.0	100.0
3/8 in	100.0	100.0	100.0
#4	100.0	100.0	100.0
#10	100.0	100.0	99.9
#30	97.9	88.3	98.4
#40	92.1	70.0	96.1
#50	85.4	47.0	93.0
#100	66.2	11.5	89.4
#200	39.7	4.3	84.6
	Grain Size		
D60	0.126	0.364	-
D30	-	0.228	-
D10	-	0.142	-
	Coefficients		
Cc	-	1.01	-
Cu	-	2.56	-

Soil Description	
○	Reddish Brown Silty Sand (SM)
□	Light Yellowish Brown Poorly-Graded Sand (SP)
△	Brown with Red Brown Mottling Lean Clay with Sand (CL)

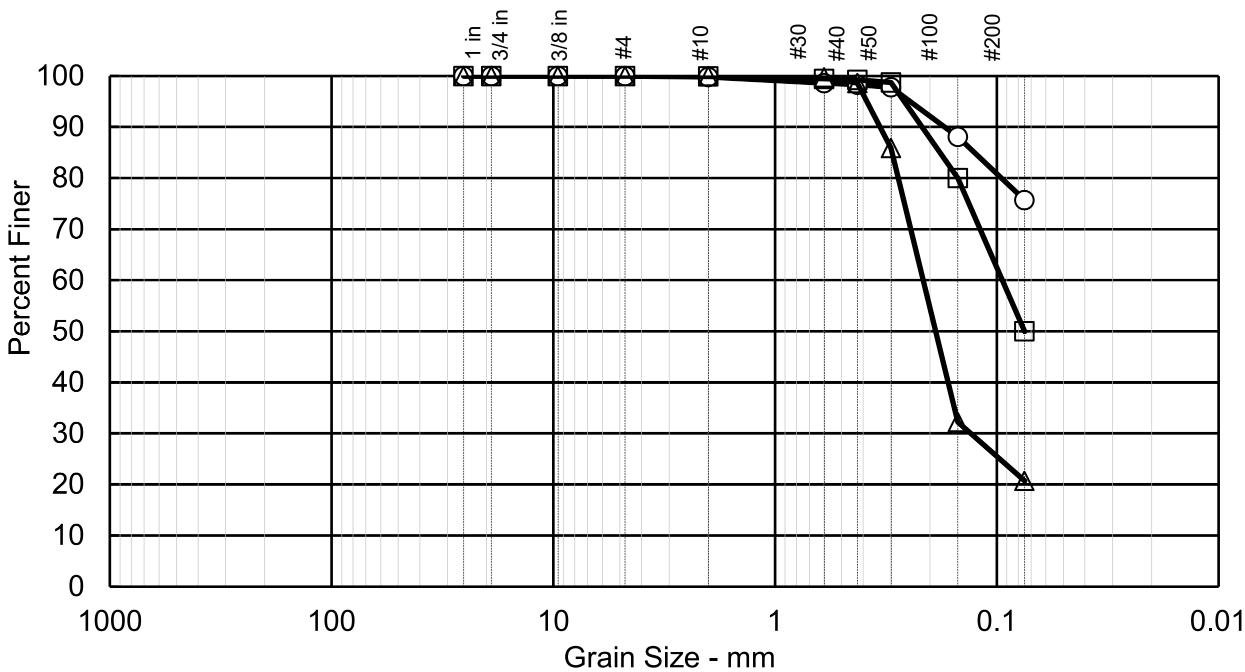
Sample Key	
○	Boring 4 @ 15.3-15.8 feet
□	Boring 7 @ 30.2-30.7 feet
△	Boring 9 @ 10.5-11 feet

Testing performed by
Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-8



Sieve Size	○	□	△
	Percent Finer		
1 in	100.0	100.0	100.0
3/4 in	100.0	100.0	100.0
3/8 in	100.0	100.0	100.0
#4	100.0	100.0	100.0
#10	99.8	99.9	100.0
#30	98.6	99.4	99.7
#40	98.3	99.2	98.6
#50	97.8	98.7	85.9
#100	88.1	80.0	32.2
#200	75.7	50.0	20.7
	Grain Size		
D60	-	0.093	0.214
D30	-	-	0.131
D10	-	-	-
	Coefficients		
Cc	-	-	-
Cu	-	-	-

Soil Description	
○	Gray Sandy Lean Clay (CL)
□	Gray Sandy Lean Clay (CL)
△	Dark Greenish Gray Clayey Sand (SC)

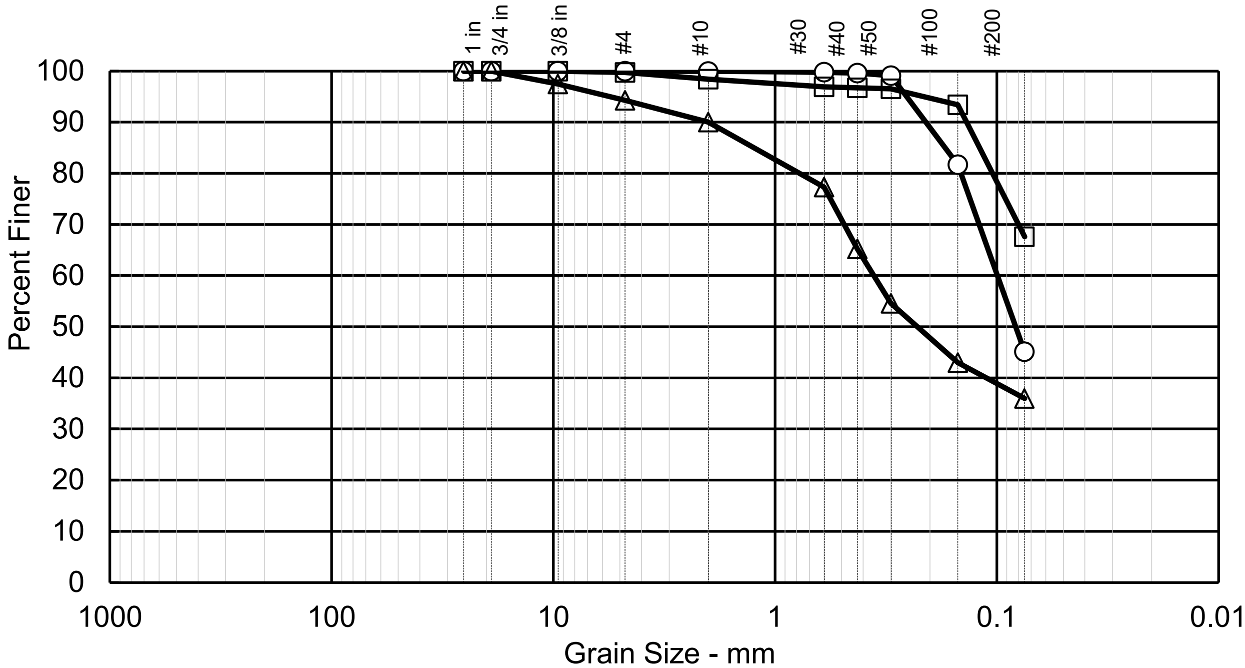
Sample Key	
○	Boring 10 @ 15.5-16 feet
□	Boring 10 @ 20.3-20.8 feet
△	Boring 10 @ 25.6-26.1 feet

Testing performed by
Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-9



Sieve Size	○	□	△
	Percent Finer		
1 in	100.0	100.0	100.0
3/4 in	100.0	100.0	100.0
3/8 in	100.0	100.0	97.5
#4	100.0	99.7	94.3
#10	99.9	98.4	90.0
#30	99.8	96.9	77.3
#40	99.6	96.7	65.2
#50	99.1	96.5	54.6
#100	81.7	93.4	43.0
#200	45.1	67.6	36.0
	Grain Size		
D60	0.097	-	0.363
D30	-	-	-
D10	-	-	-
	Coefficients		
Cc	-	-	-
Cu	-	-	-

Soil Description	
○	Yellowish Gray Clayey Sand (SC)
□	Gray Sandy Silt (ML)
△	Brown Clayey Sand (SC)

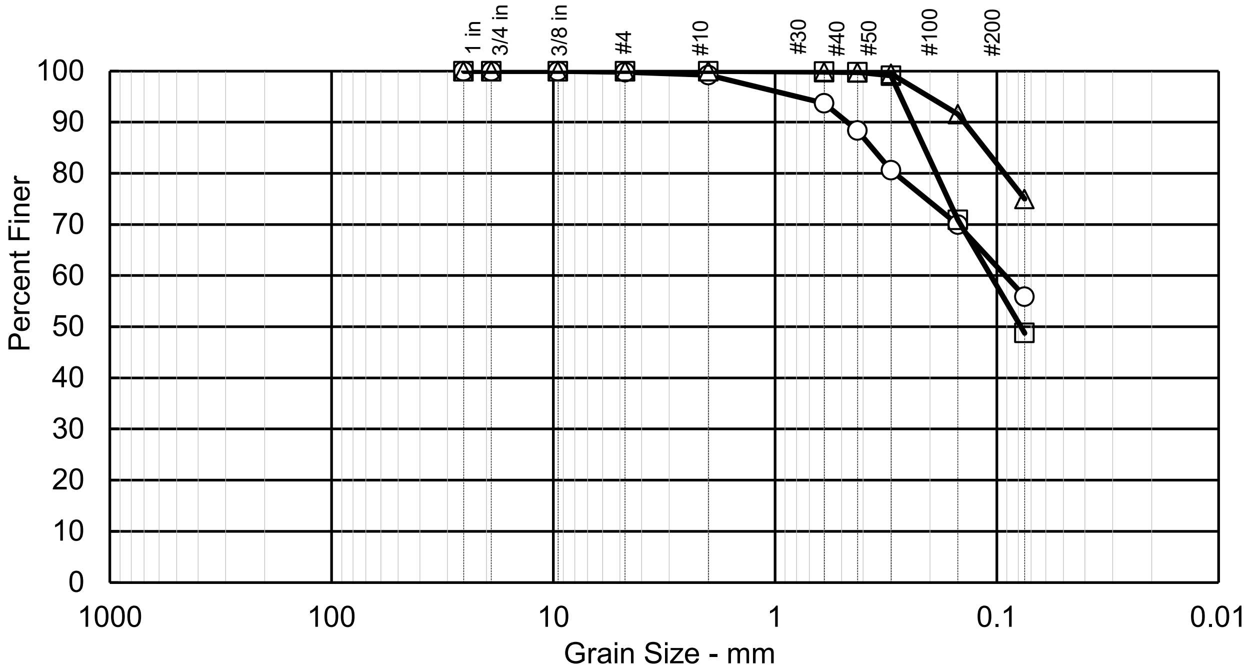
Sample Key	
○	Boring 10 @ 35.1-35.6 feet
□	Boring 10 @ 53.3-55.8 feet
△	Boring 11 @ 5.5-6 feet

Testing performed by
Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-10



Sieve Size	○	□	△
	Percent Finer		
1 in	100.0	100.0	100.0
3/4 in	100.0	100.0	100.0
3/8 in	100.0	100.0	100.0
#4	99.8	100.0	100.0
#10	99.2	100.0	100.0
#30	93.7	99.9	99.8
#40	88.4	99.8	99.7
#50	80.6	99.1	99.5
#100	70.0	70.9	91.6
#200	55.9	48.8	75.0
	Grain Size		
D60	0.090	0.109	-
D30	-	-	-
D10	-	-	-
	Coefficients		
Cc	-	-	-
Cu	-	-	-

Soil Description	
○	Brown Sandy Lean Clay (CL)
□	Olive Gray Clayey Sand (SC)
△	Blue Gray Lean Clay with Sand (CL)

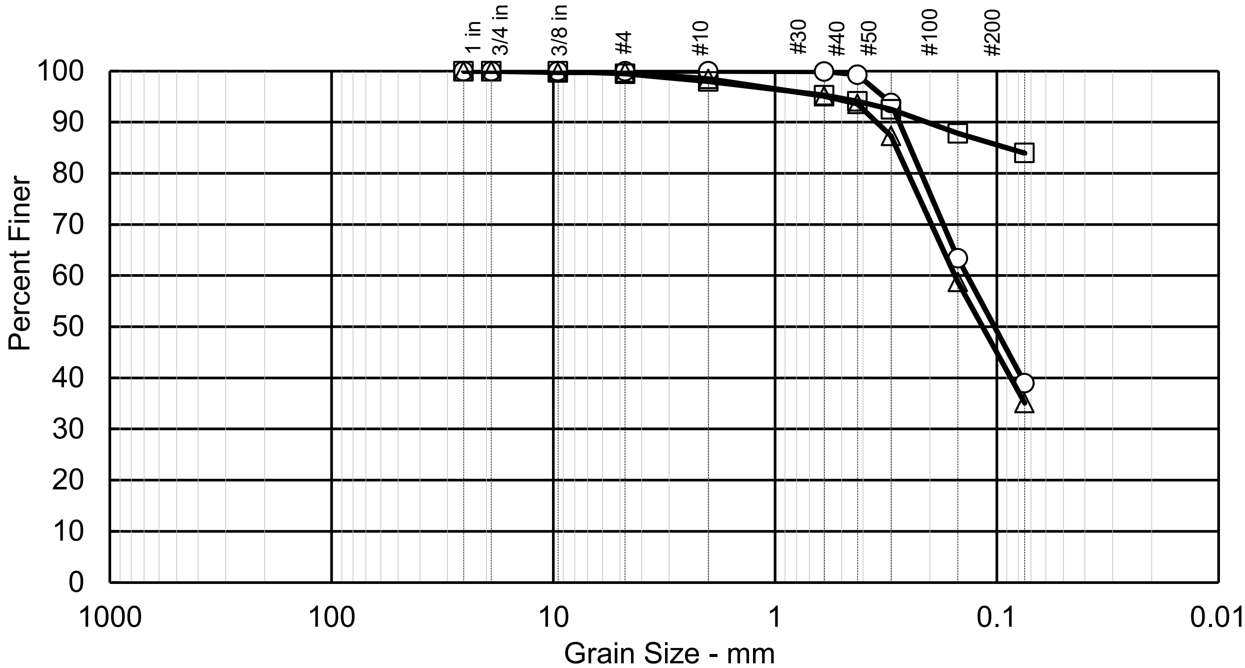
Sample Key	
○	Boring 12 @ 5.5-6 feet
□	Boring 14 @ 20.3-20.8 feet
△	Boring 14 @ 35.3-35.8 feet

Testing performed by
Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-11



Sieve Size	○	□	△
	Percent Finer		
1 in	100.0	100.0	100.0
3/4 in	100.0	100.0	100.0
3/8 in	100.0	100.0	99.7
#4	100.0	99.5	99.7
#10	100.0	98.0	98.5
#30	99.9	95.3	95.1
#40	99.3	94.1	93.6
#50	93.8	92.5	87.3
#100	63.4	87.8	58.8
#200	39.0	84.0	35.1
	Grain Size		
D60	0.139	-	0.154
D30	-	-	-
D10	-	-	-
	Coefficients		
Cc	-	-	-
Cu	-	-	-

Soil Description	
○	Brown Clayey Sand (SC)
□	Gray Lean Clay with Sand (CL)
△	Gray Lean Clay with Sand (CL)

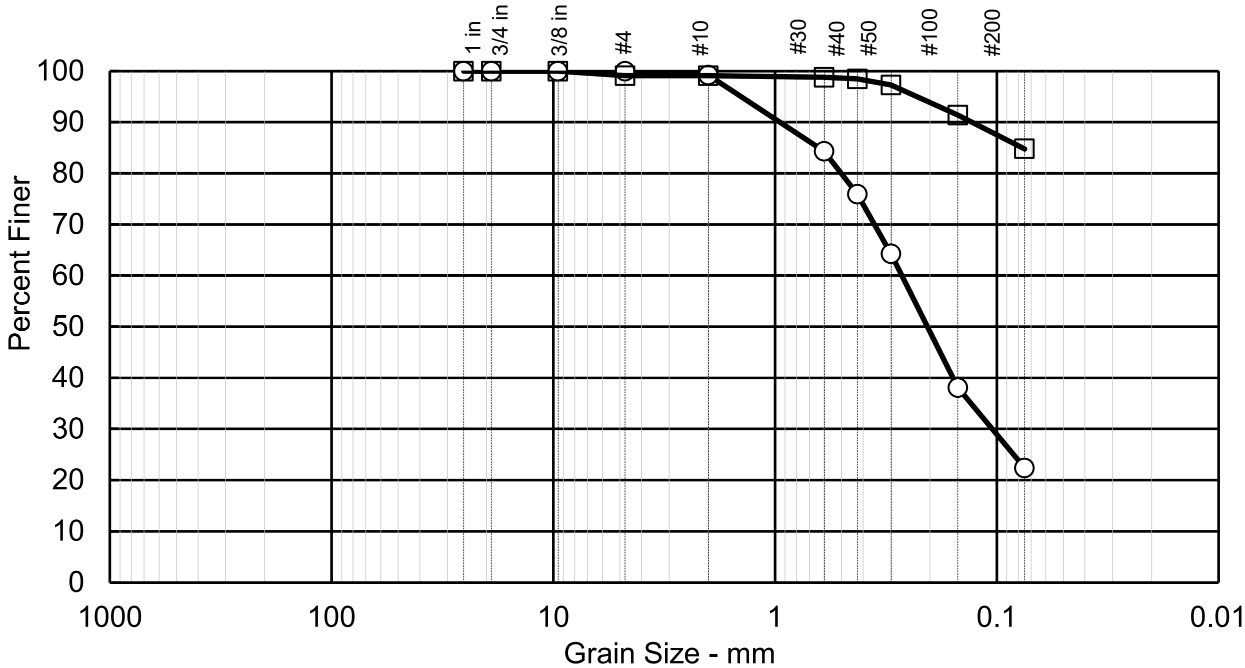
Sample Key	
○	Boring 14 @ 40.4-40.9 feet
□	Boring 14 @ 45.5-46 feet
△	Boring 17 @ 25.5-26 feet

Testing performed by
Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. C-12



Sieve Size	○	□	△
	Percent Finer		
1 in	100.0	100.0	
3/4 in	100.0	100.0	
3/8 in	100.0	100.0	
#4	100.0	99.1	
#10	99.2	99.1	
#30	84.3	98.8	
#40	75.9	98.5	
#50	64.3	97.3	
#100	38.1	91.4	
#200	22.4	84.8	
	Grain Size		
D60	0.268	-	-
D30	0.110	-	-
D10	-	-	-
	Coefficients		
Cc	-	-	-
Cu	-	-	-

Soil Description	
○	Gray Clayey Sand (SC)
□	Brown Lean Clay with Sand (CL)
△	

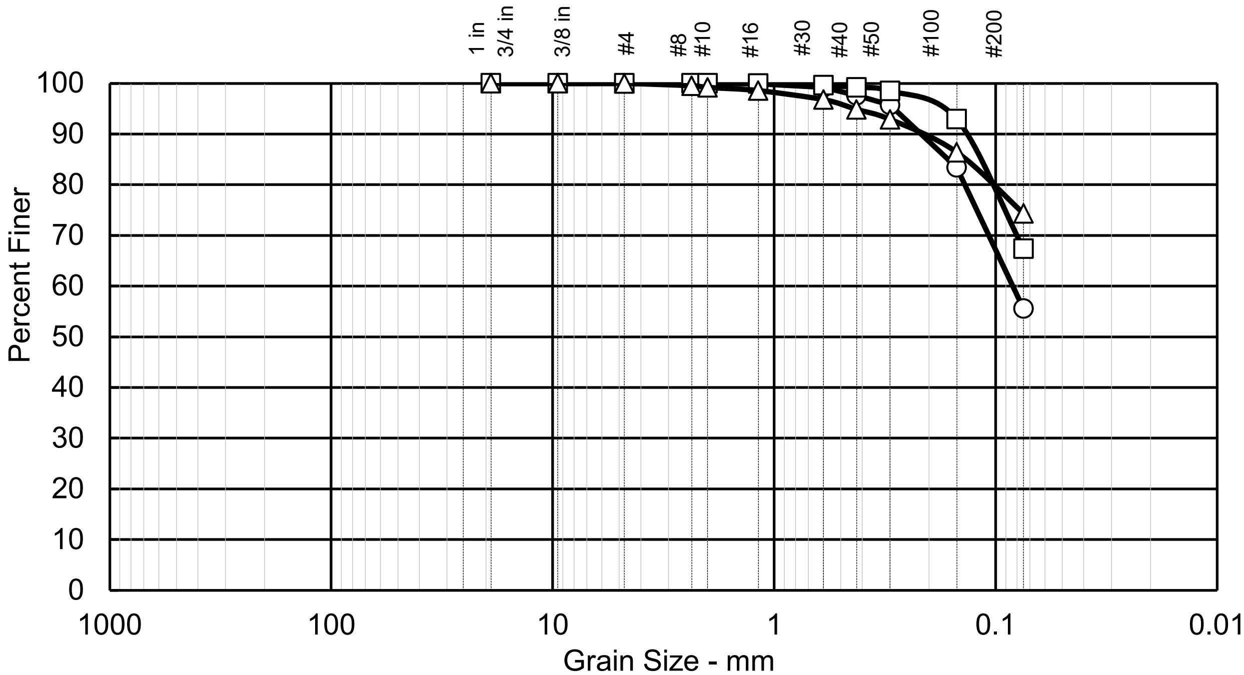
Sample Key	
○	Boring 17 @ 60.2-60.7 feet
□	Boring 19 @ 5.2-5.7 feet
△	

Testing performed by
Cooper Testing Laboratory

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-13



Sieve Size	○	□	△
	Percent Finer		
3/4 in	100.0	100.0	100.0
3/8 in	100.0	100.0	100.0
#4	100.0	100.0	100.0
#8	100.0	100.0	99.5
#10	100.0	100.0	99.2
#16	99.9	100.0	98.6
#30	99.2	99.6	96.8
#40	97.6	99.2	94.8
#50	95.7	98.5	92.9
#100	83.4	92.9	86.4
#200	55.6	67.4	74.4
	Grain Size		
D60	0.08	-	-
D30	-	-	-
D10	-	-	-
	Coefficients		
Cc	-	-	-
Cu	-	-	-

Soil Description	
○	Brown Sandy Silt (ML)
□	Brown Sandy Lean Clay (CL)
△	Brown Lean Clay with Sand (CL)

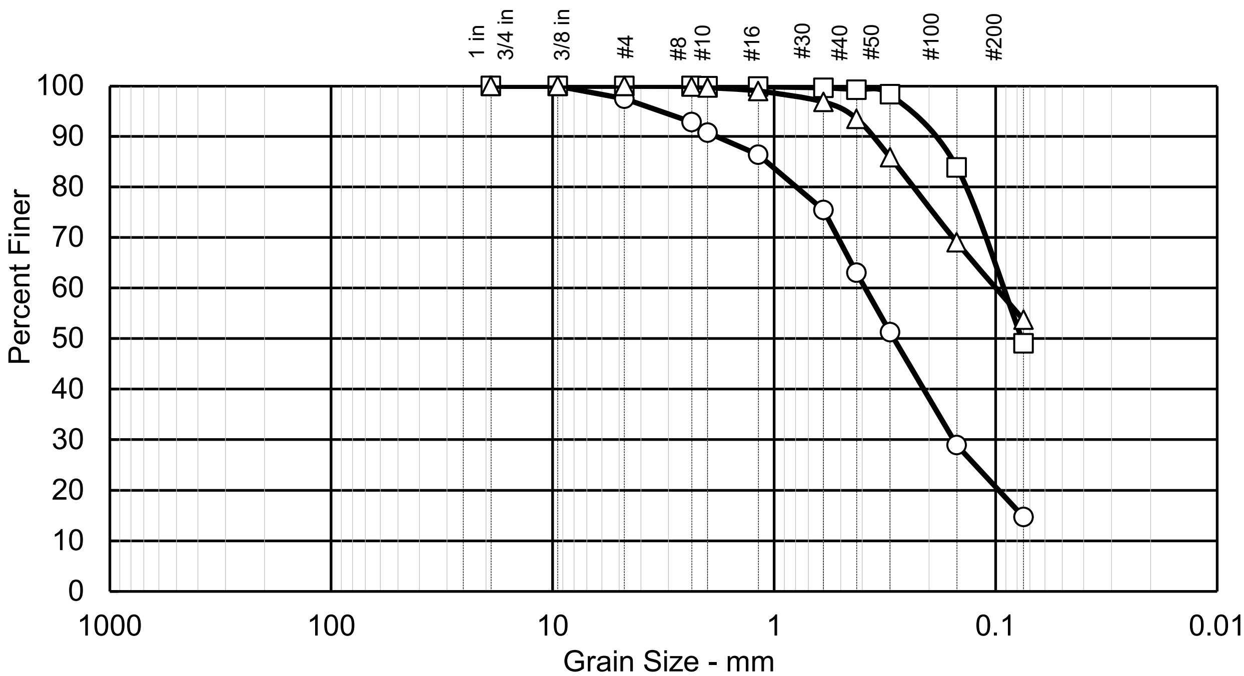
Sample Key	
○	Boring 3 at 15.0-15.4 feet
□	Boring 8 at 5.8-6.3 feet
△	Boring 15 at 5.7-6.2 feet

Testing performed by
Hultgren - Tillis Engineers

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-14



Sieve Size	○	□	△
	Percent Finer		
3/4 in	100.0	100.0	100.0
3/8 in	100.0	100.0	100.0
#4	97.5	100.0	100.0
#8	92.9	100.0	99.9
#10	90.8	99.9	99.7
#16	86.4	99.9	99.0
#30	75.5	99.6	96.9
#40	63.0	99.3	93.5
#50	51.3	98.3	85.9
#100	29.0	83.9	69.1
#200	14.7	49.1	53.7
	Grain Size		
D60	0.39	0.09	0.10
D30	0.15	-	-
D10	-	-	-
	Coefficients		
Cc	-	-	-
Cu	-	-	-

Soil Description	
○	Brown with Red Brown Mottling Silty Sand (SM)
□	Brown Silty Sand (SM)
△	Brown Sandy Lean Clay (CL)

Sample Key	
○	Boring 16 at 5.8-6.3 feet
□	Boring 18 at 5.0-5.5 feet
△	Boring 19 at 5.7-6.2 feet

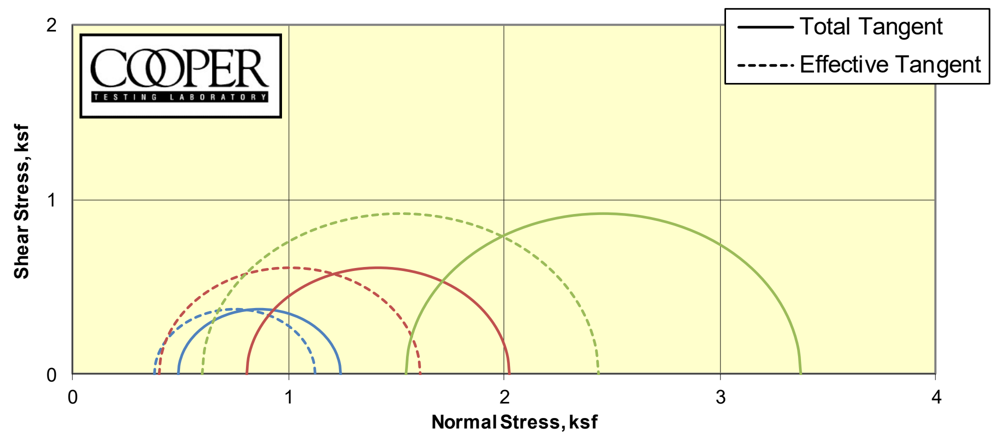
Testing performed by
Hultgren - Tillis Engineers

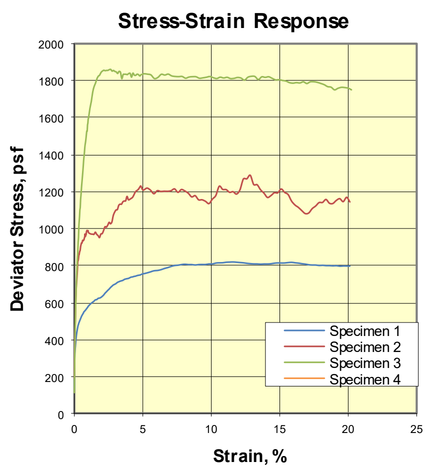
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Sieve Analysis Results

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. C-15

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767





CTL Number:	212-179
Client Name:	Hultgren-Tillis Engineers
Project Name:	New Hope Tract
Project Number:	921.01
Date:	10/7/2019 By: MD/DC
Total C	#DIV/0! ksf
Total phi	#DIV/0! degrees
Eff. C	#DIV/0! ksf
Eff. Phi	#DIV/0! degrees

©

Remarks: Engineering judgement is required to determine phi and cohesion, no phi or cohesion is reported. To add phi and cohesion to the report go to the "phi" tab and in cells M18, M19, N18, and N19 enter end points for a line through the 3 data points. The points plotted can be changed on the "Shear Values" tab using cells B3, F3, and J3.

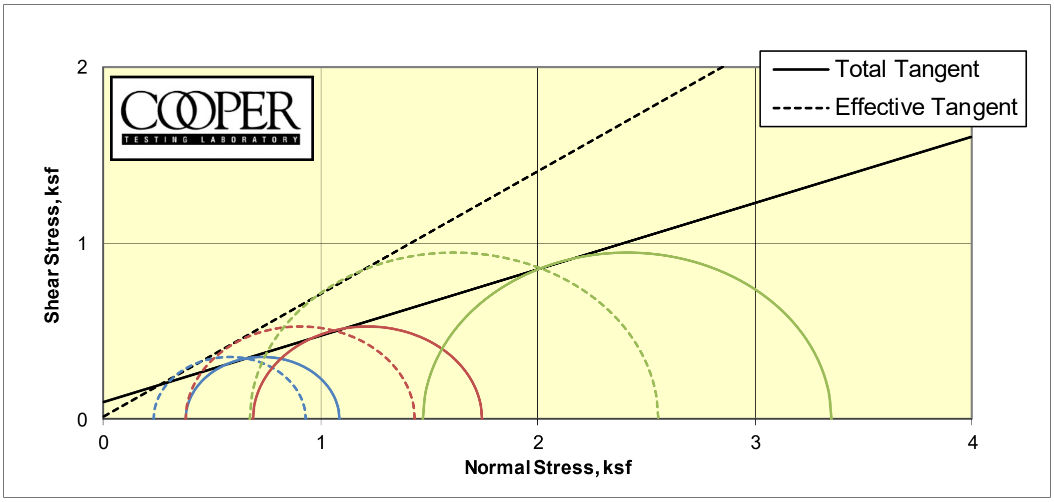
Specimen	1	2	3	4
Boring	14	14	10	
Sample	Shelby	Shelby	Shelby	
Depth	5-6.6(Tip-6.5")	5-6.6(Tip-1/2")	6-7.5(Tip-5)	
Visual Description	Greenish Gray Lean CLAY	Greenish Gray Lean CLAY	Greenish Gray Lean CLAY w/ Sand/ Sandy Lean CLAY	
MC (%)	28.9	25.7	21.7	
Dry Density (pcf)	93.3	98.2	103.5	
Saturation (%)	99.2	92.3	88.5	
Void Ratio	0.773	0.780	0.688	
Diameter (in)	2.86	2.86	2.86	
Height (in)	5.91	5.82	6.08	
Final				
MC (%)	27.4	27.3	22.7	
Dry Density (pcf)	95.8	99.1	106.9	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	0.726	0.764	0.636	
Diameter (in)	2.83	2.86	2.84	
Height (in)	5.87	5.78	6.00	
Cell Pressure (psi)	73.1	75.0	81.3	
Back Pressure (psi)	69.7	69.4	70.6	
Effective Stresses At:				
Strain (%)	5.0	5.0	5.0	
Deviator (ksf)	0.751	1.212	1.834	
Excess PP (psi)	0.8	2.8	6.5	
Sigma 1 (ksf)	1.128	1.615	2.438	
Sigma 3 (ksf)	0.377	0.402	0.604	
P (ksf)	0.752	1.008	1.521	
Q (ksf)	0.376	0.606	0.917	
Stress Ratio	2.993	4.014	4.037	
Rate (in/min)	0.0003	0.0003	0.0003	

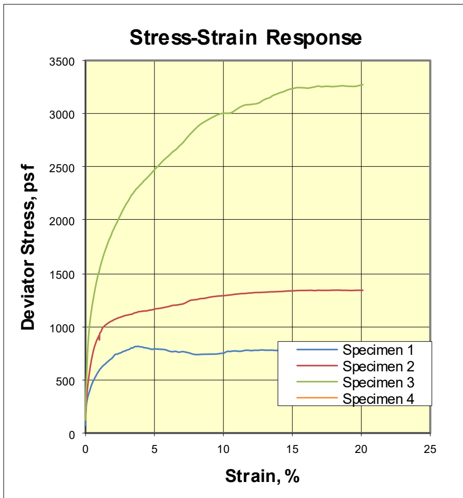
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

TxCU Test Results

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. C-16

Consolidated Undrained Triaxial Compression with Pore Pressure
ASTM D4767





Specimen	1	2	3	4
Boring	17	17	17	
Sample				
Depth	7.5-9(Tip-17.5")	7.5-9(Tip-11.5")	7.5-9(Tip-5")	
Visual Description	Greenish Gray Lean CLAY	Greenish Gray Lean CLAY	Greenish Gray Lean CLAY	
MC (%)	23.5	22.6	22.6	
Dry Density (pcf)	101.8	104.3	104.7	
Saturation (%)	94.2	96.1	97.3	
Void Ratio	0.687	0.646	0.639	
Diameter (in)	2.86	2.86	2.86	
Height (in)	6.01	6.00	6.06	
Final				
MC (%)	23.0	22.6	22.2	
Dry Density (pcf)	105.2	105.9	106.6	
Saturation (%)	100.0	100.0	100.0	
Void Ratio	0.632	0.622	0.611	
Diameter (in)	2.82	2.84	2.84	
Height (in)	5.99	5.98	6.01	
Cell Pressure (psi)	62.6	65.0	70.1	
Back Pressure (psi)	59.9	60.2	59.9	
Effective Stresses At:				
Strain (%)	2.0	2.0	2.0	
Deviator (ksf)	0.703	1.057	1.884	
Excess PP (psi)	1.0	2.2	5.6	
Sigma 1 (ksf)	0.934	1.434	2.555	
Sigma 3 (ksf)	0.230	0.376	0.671	
P (ksf)	0.582	0.905	1.613	
Q (ksf)	0.352	0.529	0.942	
Stress Ratio	4.051	3.811	3.807	
Rate (in/min)	0.0003	0.0003	0.0003	

CTL Number:	212-179		
Client Name:	Hultgren-Tillis Engineers		
Project Name:	New Hope Tract		
Project Number:	921.01		
Date:	10/2/2019	By:	MD/DC
Total C		ksf	
Total phi		degrees	
Eff. C		ksf	
Eff. Phi		degrees	©

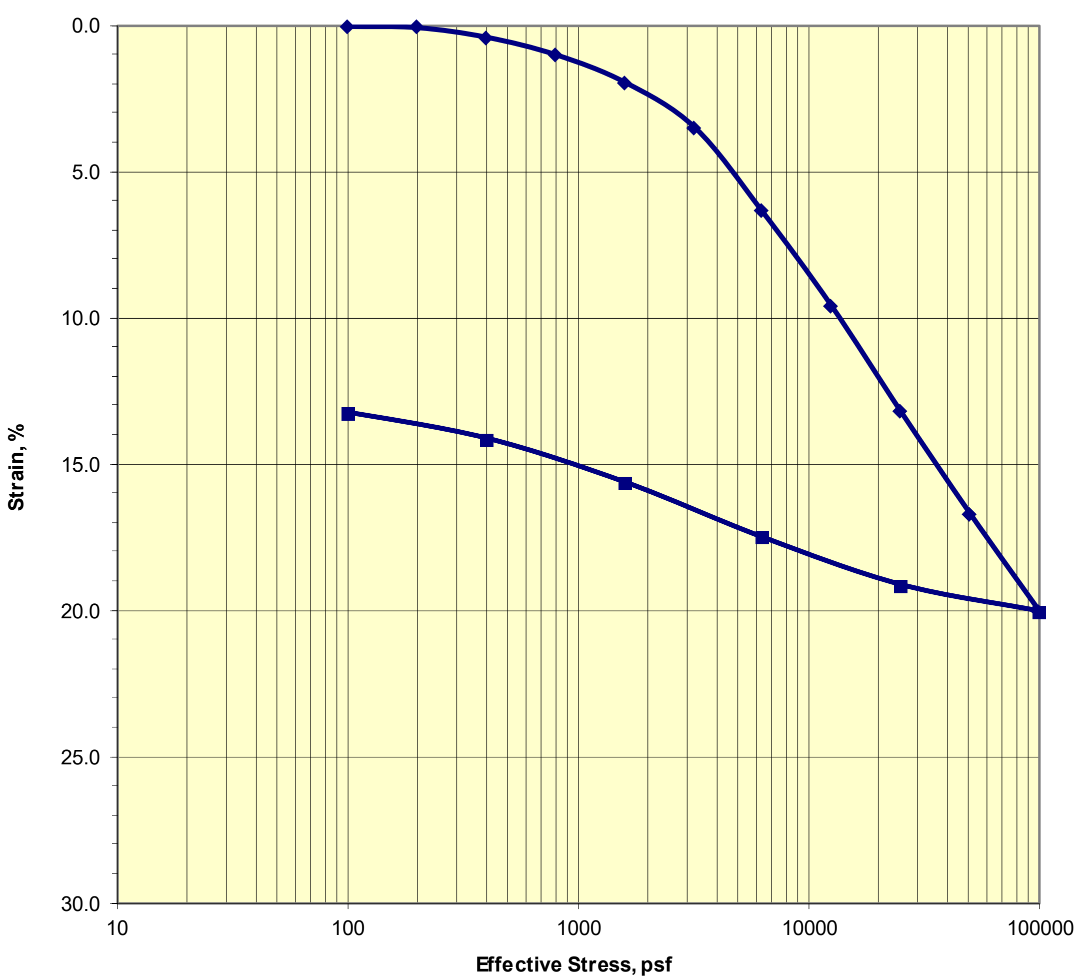
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

TxCU Test Results

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. C-17

Consolidation Test
ASTM D2435

Job No.:	212-179	**Boring:**	B-10	**Run By:**	MD
Client:	Hultgren-Tillis Engineers	**Sample:**		**Reduced:**	PJ
Project:	921.01	**Depth, ft.:**	6-7.7(Tip-3")	**Checked:**	PJ/DC
Soil Type:	Greenish Gray Sandy Lean CLAY/ Lean CLAY w/ Sand			**Date:**	10/9/2019



Assumed Gs 2.7	Initial	Final
Moisture %:	22.0	16.7
Dry Density, pcf:	101.0	116.1
Void Ratio:	0.668	0.452
% Saturation:	88.8	100.0

Remarks:

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

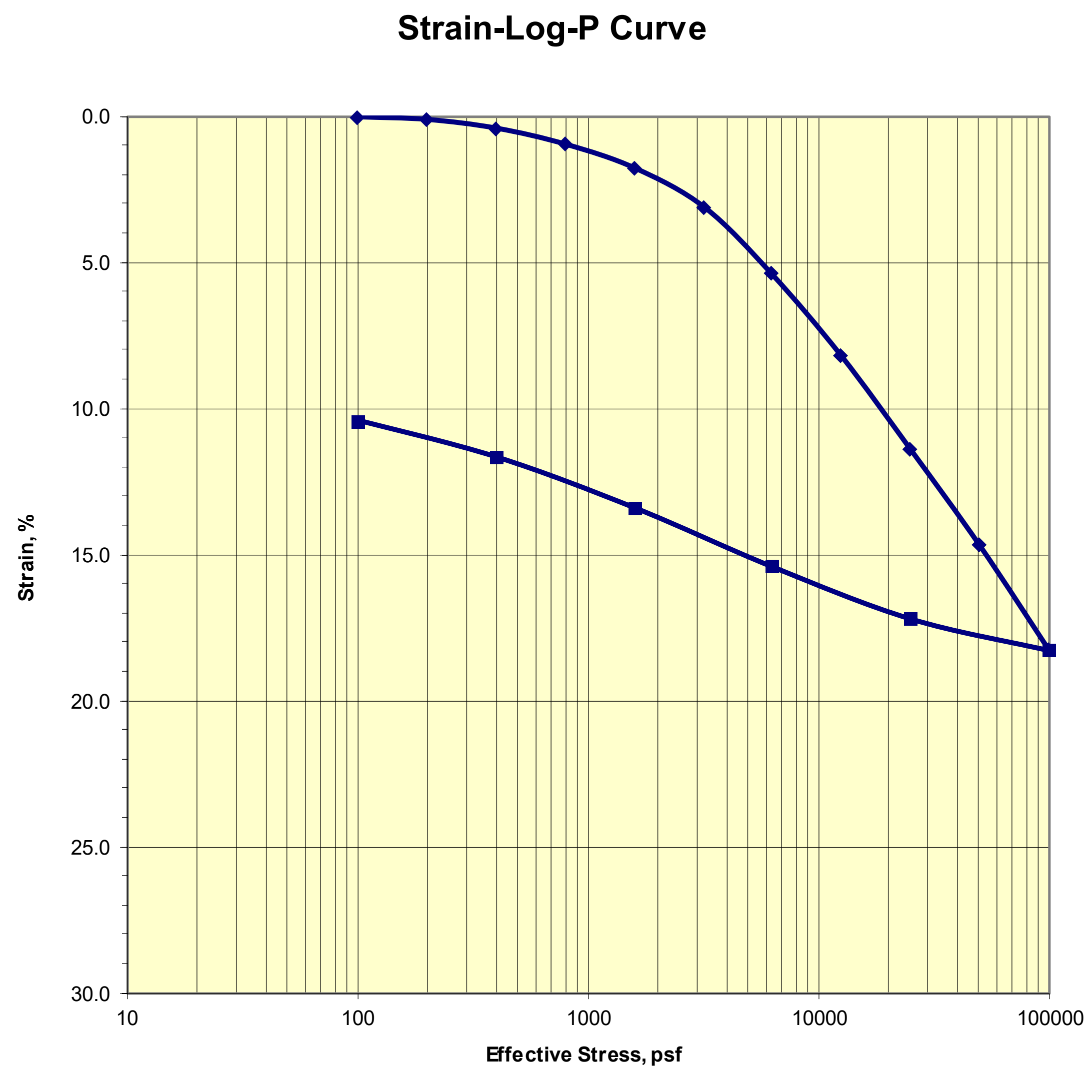
Consolidation Test Results

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. C-18

Consolidation Test
ASTM D2435

COOPER TESTING LABORATORY

Job No.:	212-179	**Boring:**	17	**Run By:**	MD
Client:	Hultgren-Tillis Engineers	**Sample:**		**Reduced:**	PJ
Project:	921.01	**Depth, ft.:**	7-9.5(Tip-3")	**Checked:**	PJ/DC
Soil Type:	Greenish Gray Lean CLAY			**Date:**	10/7/2019



Assumed Gs 2.75	Initial	Final
Moisture %:	26.3	22.4
Dry Density, pcf:	95.6	106.3
Void Ratio:	0.796	0.615
% Saturation:	90.7	100.0

Remarks:

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Consolidation Test Results

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. C-19

APPENDIX D

Seepage Analysis

D-I. SEEPAGE ANALYSIS

A. General

We performed analysis to evaluate seepage at five locations (Stations 245+00, 260+00, 294+00, 317+00 and 396+00). The details of subsurface conditions at these locations are presented in the main text. The details of the analysis and results are presented below.

B. Analysis and Results

We performed seepage analysis using computer program SEEP/W. We analyzed seepage for the 100-year flood using Elevations +13.9, +14.5, +14.9, and +16.4 feet for Areas 1, 2, 3, and 4, respectively. The seepage analyses assume steady state flow conditions. The seepage models and results are shown for each section on Plates D-1 through D-5.

We used permeability values recommended in the "Guidance Document for Geotechnical Analyses' prepared by URS Corporation for the Department of Water Resources. The parameters used in the analysis are presented in Table D-1.

Table D-1: Soil Parameters for Seepage Analysis

Material	Vertical Permeability (cm/sec)	Anisotropic Ratio (k_h/k_y)
Existing Levee Fill (sand)	2×10^{-3}	9
Clay	5×10^{-6}	4
Sand	1×10^{-4}	9
New Levee Fill	2.5×10^{-6}	4

The model extends 2,000 feet landward and to the center of Mokelumne River on the waterside. The model includes a high mesh density (2 foot by 2 foot) in and around the levee embankment within the waterside end of the model and 150 feet landward from the levee centerline, and a lower mesh density (4 feet by 4 feet) between 150 feet landward from the levee centerline and the landside end of the model.

The model includes a no-flow boundary condition along the vertical face of the waterside boundary and the bottom of each model; the 100-year flood water level as a total head boundary condition applied to the surface of the waterside of the levee slope; and, a total head boundary condition along the vertical face of the landside boundary which matched the landside ground surface elevation. Along the levee crown, landside slope and landside ground surface, a no-flow boundary condition, the model includes the "potential seepage face review" option in SEEP/W. No other flows into or out of the system were modeled in the analysis, such as infiltration and evapo-transpiration.

A design consideration for underseepage is the average vertical gradient across the landside blanket where a blanket exists. The average vertical gradient is the total head drop in the vertical direction across the landside blanket. The critical gradient is calculated as the difference between the unit weight of soil and the unit weight of water divided by the unit weight of water.

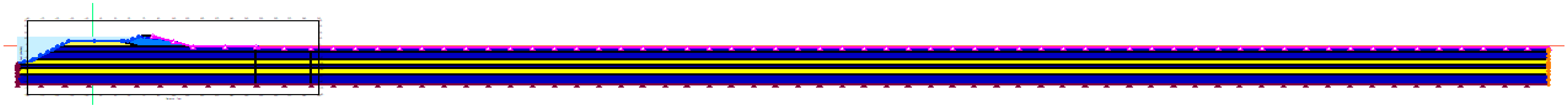
The clayey soils at Mokelumne River waterside weigh approximately 125 pounds per cubic foot (pcf). The minimum factors of safety for underseepage are 1.6 at the landside levee toe using USACE criteria. For an average weight of 112 pcf or greater, the average vertical gradient for a factor of safety of 1.6 is about 0.5.

We calculated the average vertical exit gradient through the clay foundation. Table D-2 presents the average vertical gradients (y-gradients) at the levee slope toe. The plates present additional data and the graphical output of the program SEEP/W, including total head contours, localized gradients (xy-and y-gradients), flux and the resulting phreatic surface.

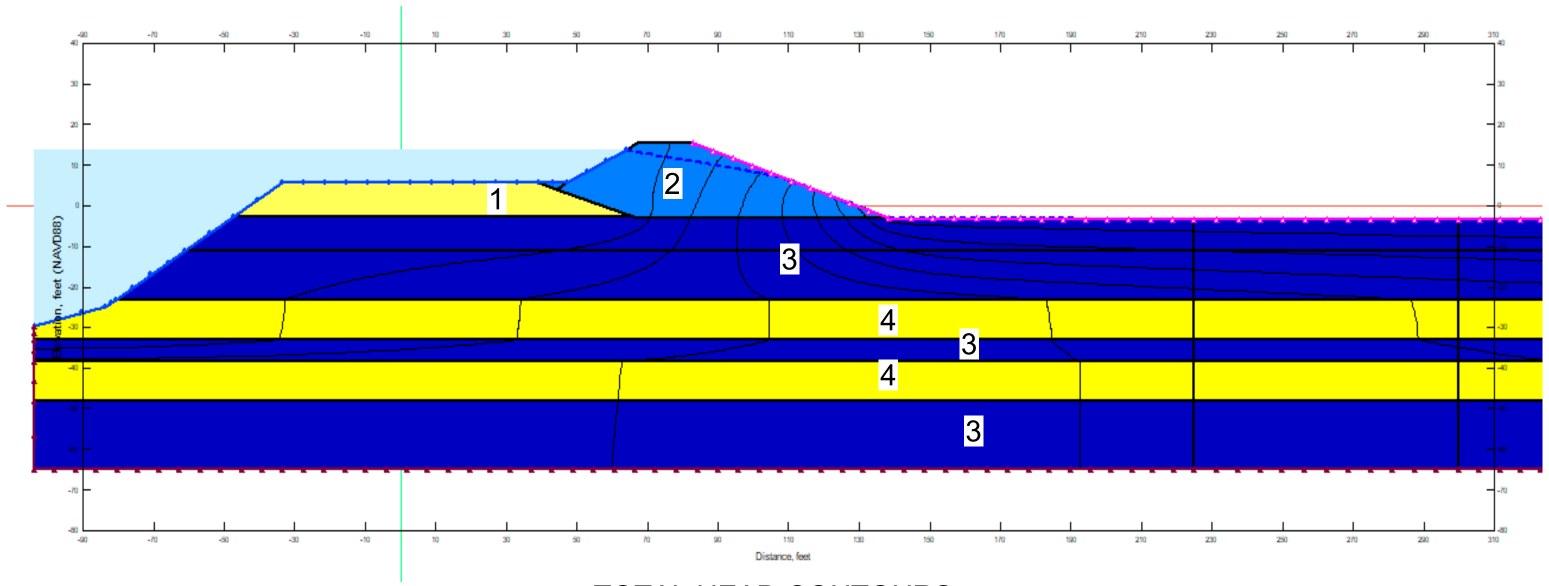
Our analysis shows that the vertical exit gradients meet the USACE criteria.

Table D-2: Summary of Seepage Analysis Results			
Location	**Station**	**Average Y-Exit Gradient**	**Seepage Flow Rate / Flux (gpm)**
Area 1 South	245+00	0.32	0.0072
Area 1 North	260+00	0.41	0.010
Area 2	294+00	0.39	0.0084
Area 3	317+00	0.18	0.0054
Area 4	396+00	0.43	0.0100

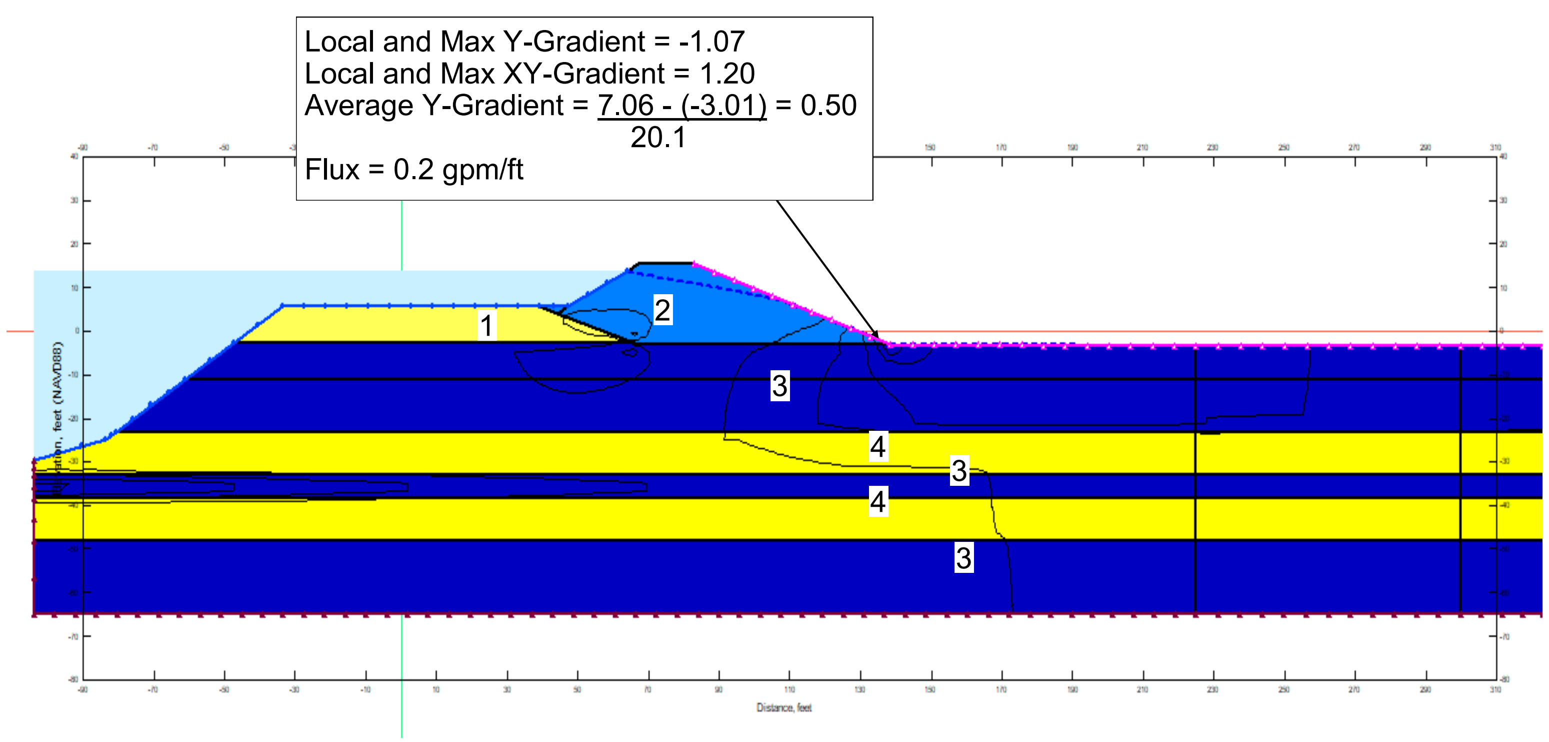
Water Surface Elevation (NAVD88): 13.9 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

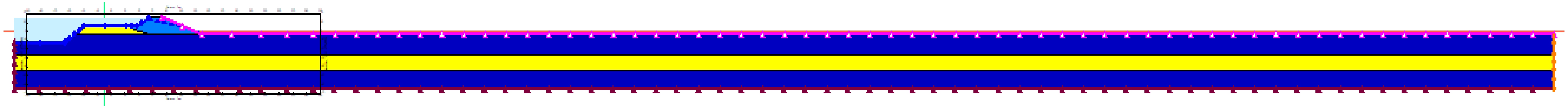
SEEPAGE MODEL MATERIAL PROPERTIES				
UNIT NO.	LAYER COLOR	MATERIAL TYPE	VERTICAL CONDUCTIVITY, k_V (cm/s)	PERMEABILITY RATIO, k_H/k_V
1	(yellow)	Existing Levee Fill	2.0×10^{-3}	9
2	(light blue)	New Levee Fill	2.5×10^{-6}	4
3	(yellow)	Sand	1.0×10^{-4}	9
4	(dark blue)	Clay	5×10^{-6}	4

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

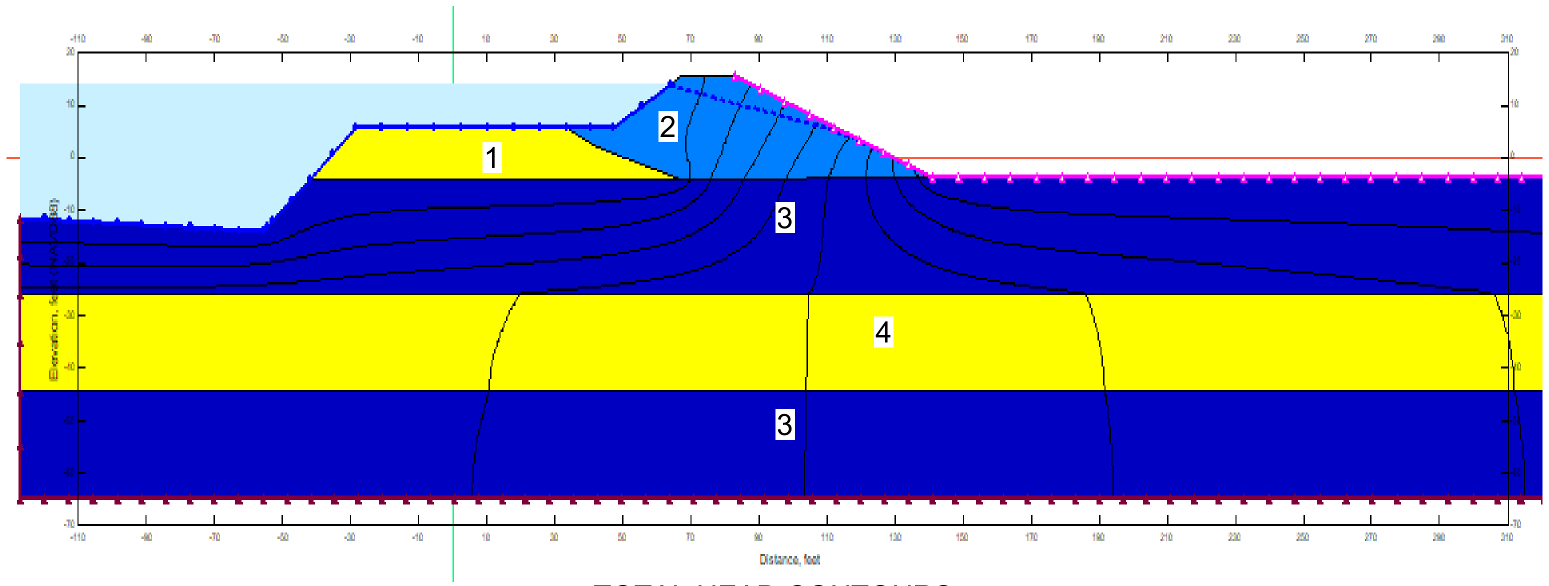
Seepage Results
Area 1 North
Long-Term Configuration - DWSE

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. D-1

Water Surface Elevation (NAVD88): 13.9 feet

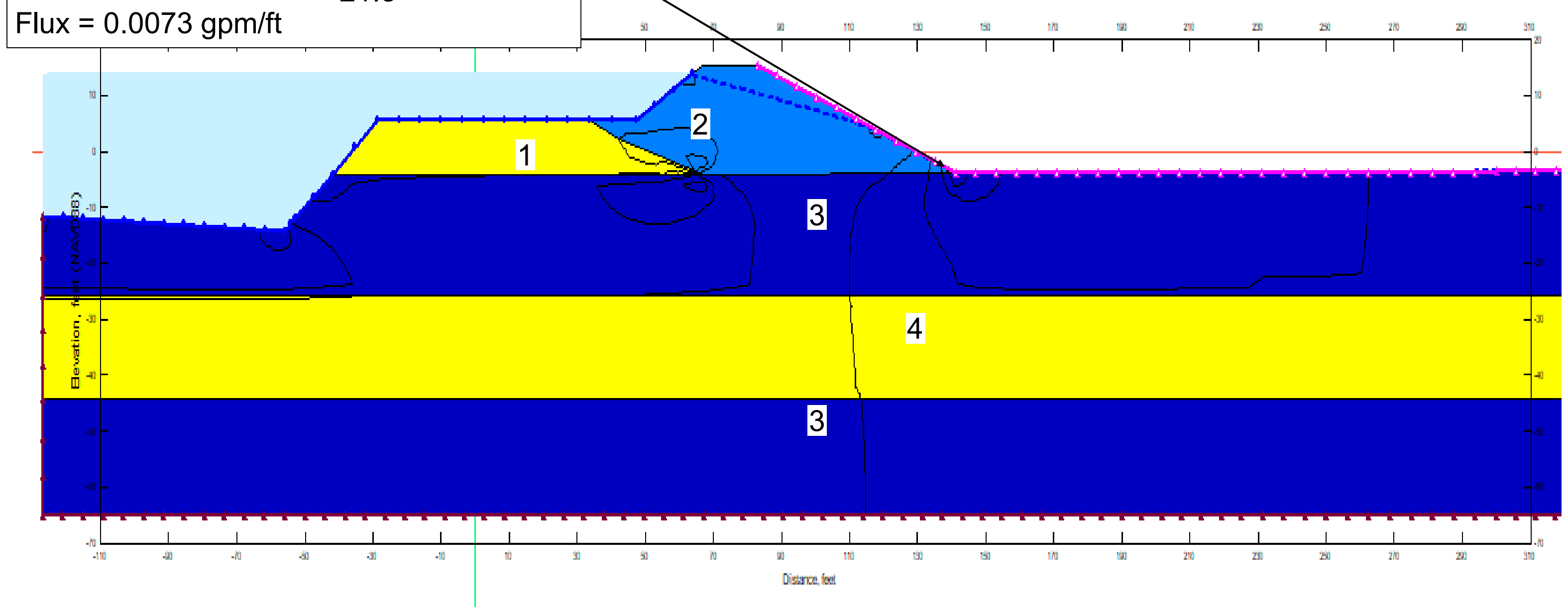


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local and Max Y-Gradient = -0.81
Local and Max XY-Gradient = 0.93
Average Y-Gradient = $\frac{3.04 - (-4.0)}{21.8}$ = 0.32
Flux = 0.0073 gpm/ft



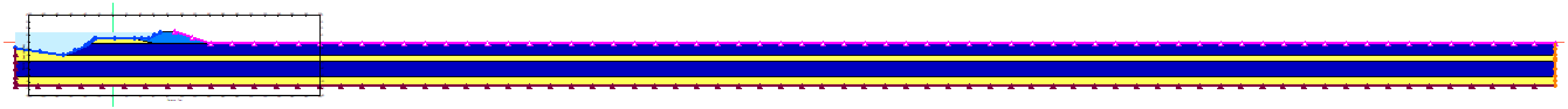
VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
UNIT NO.	LAYER COLOR	MATERIAL TYPE	VERTICAL CONDUCTIVITY, k_V (cm/s)	PERMEABILITY RATIO, k_H/k_V
1	(yellow)	Existing Levee Fill	2.0×10^{-3}	9
2	(light blue)	New Levee Fill	2.5×10^{-6}	4
3	(yellow)	Sand	1.0×10^{-4}	9
4	(blue)	Clay	5×10^{-6}	4

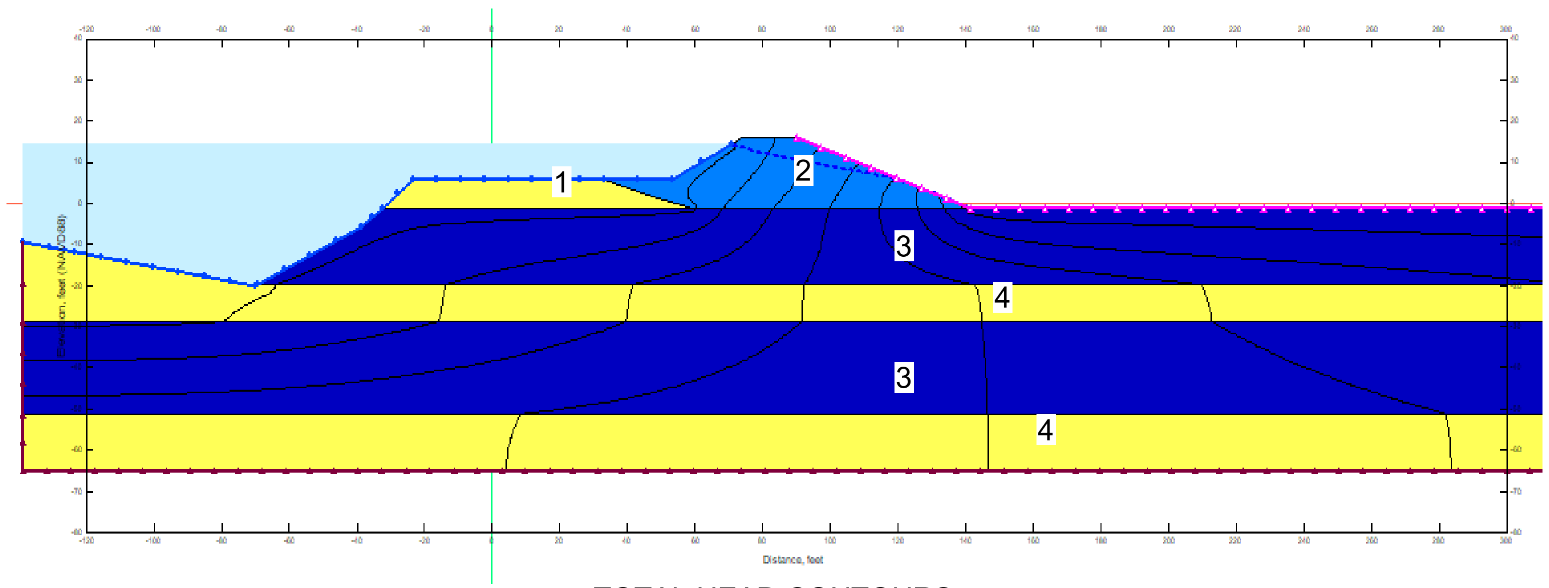
Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California	**Seepage Results** **Area 1 South** **Long-Term Configuration - DWSE**

Hultgren - Tillis Engineers	Project No. 921.01	Plate No. D-2

Water Surface Elevation (NAVD88): 14.5 feet

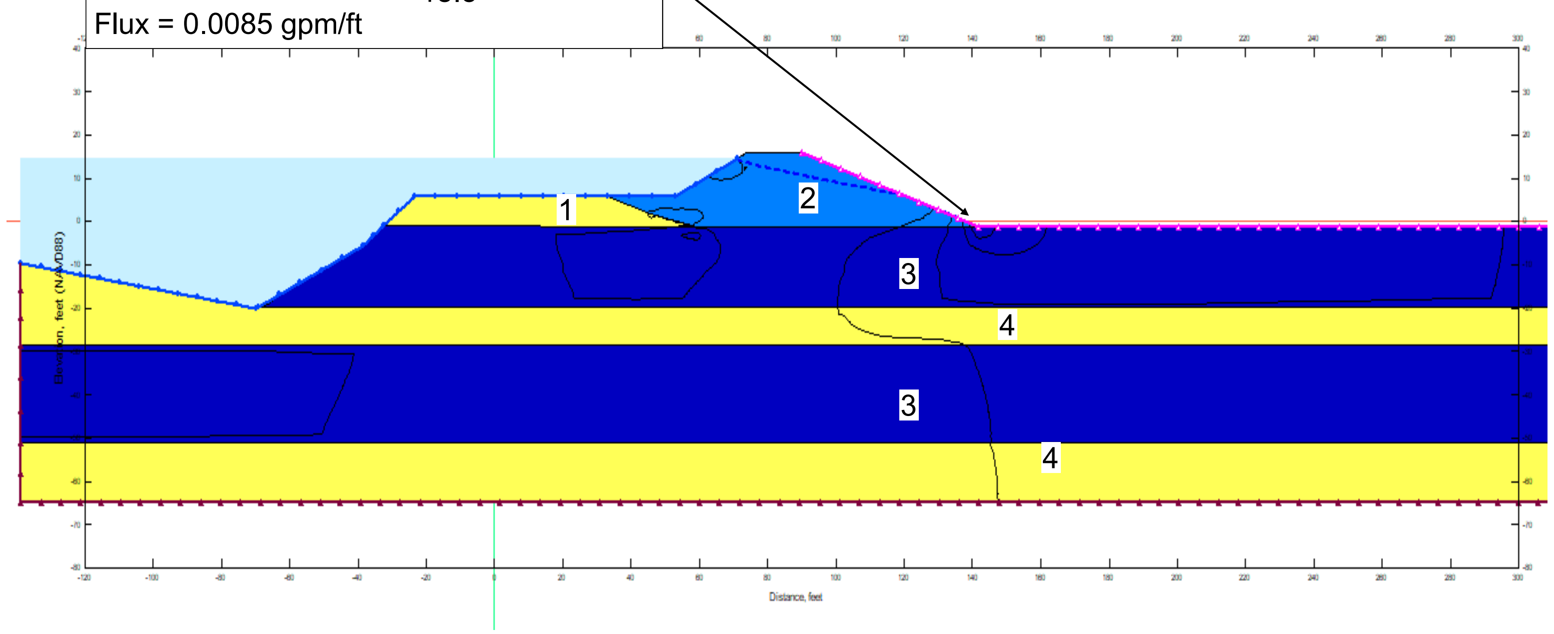


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local and Max Y-Gradient = -0.86
Local and Max XY-Gradient = 0.99
Average Y-Gradient = $\frac{6.02 - (-1.23)}{18.5}$ = 0.39
Flux = 0.0085 gpm/ft

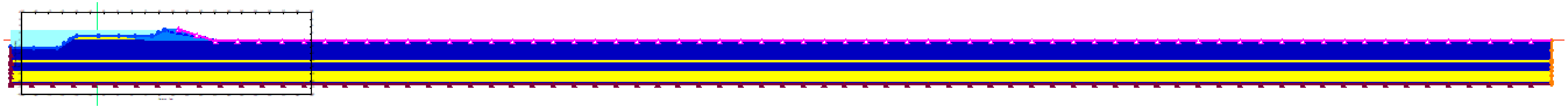


VERTICAL GRADIENT CONTOURS

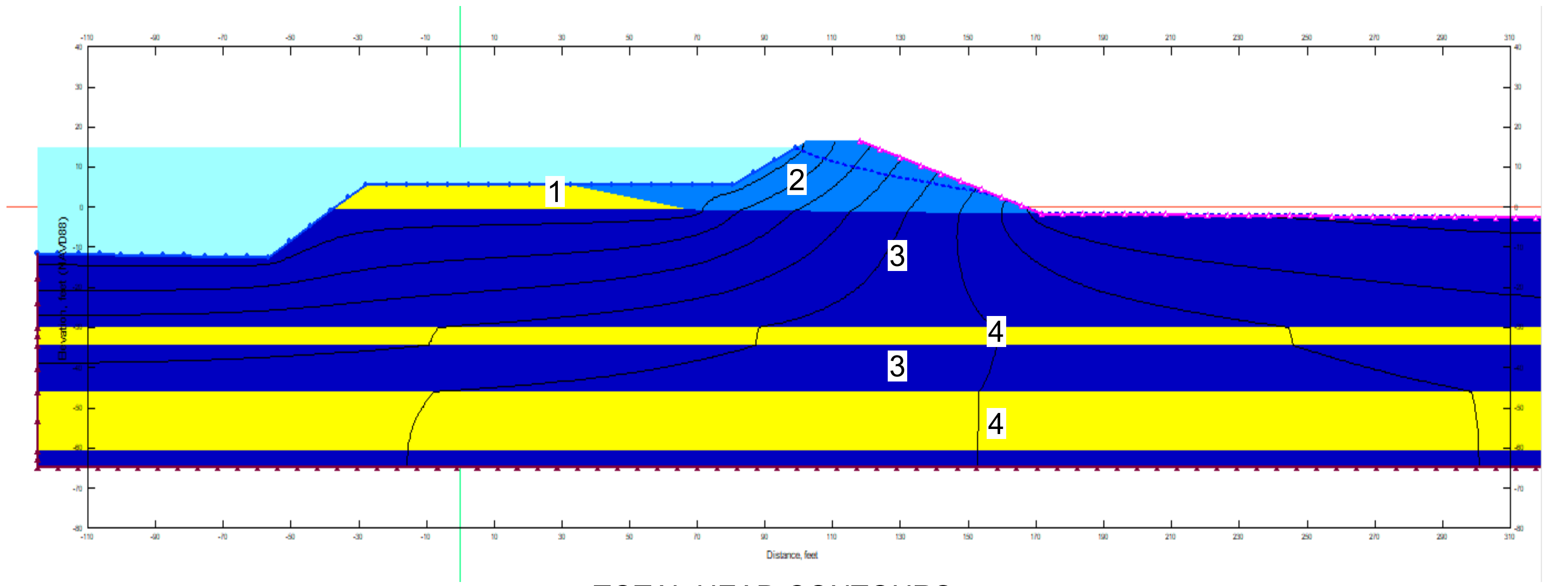
SEEPAGE MODEL MATERIAL PROPERTIES				
UNIT NO.	LAYER COLOR	MATERIAL TYPE	VERTICAL CONDUCTIVITY, k_V (cm/s)	PERMEABILITY RATIO, k_H/k_V
1	(yellow)	Existing Levee Fill	2.0×10^{-3}	9
2	(light blue)	New Levee Fill	2.5×10^{-6}	4
3	(yellow)	Sand	1.0×10^{-4}	9
4	(blue)	Clay	5×10^{-6}	4

Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California	**Seepage Results** **Area 2** **Long-Term Configuration - DWSE**
Hultgren - Tillis Engineers	Project No. 921.01 | Plate No. D-3

Water Surface Elevation (NAVD88): 14.9 feet

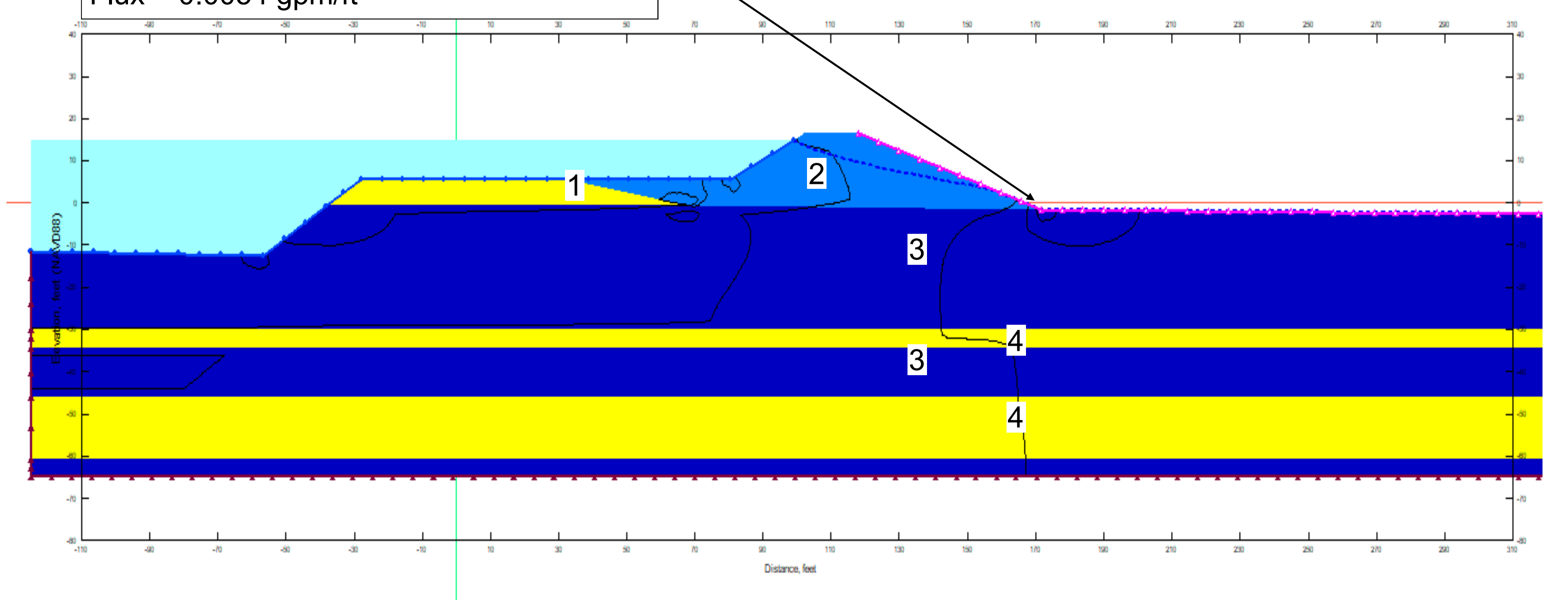


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local and Max Y-Gradient = -0.58
Local and Max XY-Gradient = 0.70
Average Y-Gradient = $\frac{3.57 - (-1.55)}{28.4} = 0.18$
Flux = 0.0054 gpm/ft



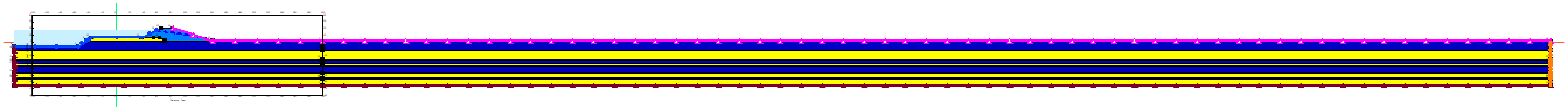
VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES

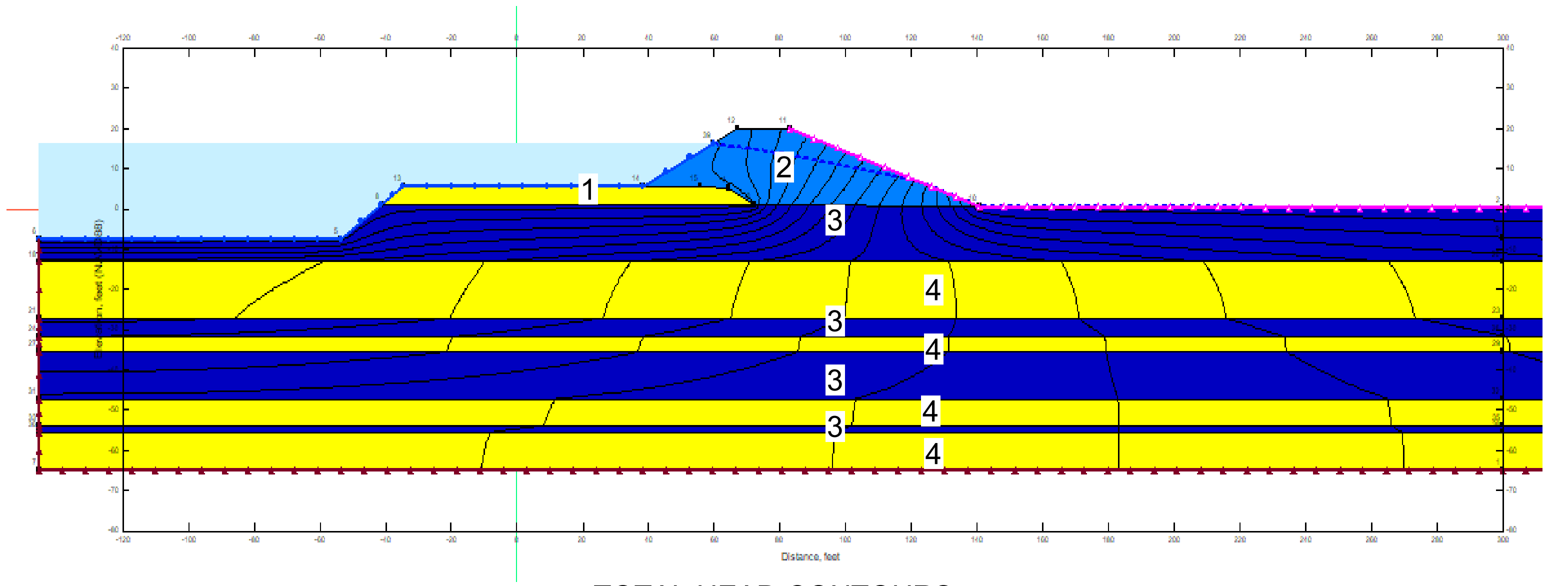
UNIT NO.	LAYER COLOR	MATERIAL TYPE	VERTICAL CONDUCTIVITY, k_V (cm/s)	PERMEABILITY RATIO, k_H/k_V
1	Yellow	Existing Levee Fill	$2.0x10^{-3}$	9
2	Light blue	New Levee Fill	$2.5x10^{-6}$	4
3	Yellow	Sand	$1.0x10^{-4}$	9
4	Dark blue	Clay	$5x10^{-6}$	4

Mokelumne River Waterside Habitat Enhancement and Levee Repair New Hope Tract, California	**Seepage Results** **Area 3** **Long-Term Configuration - DWSE**
Hultgren - Tillis Engineers	Project No. 921.01 — Plate No. D-4

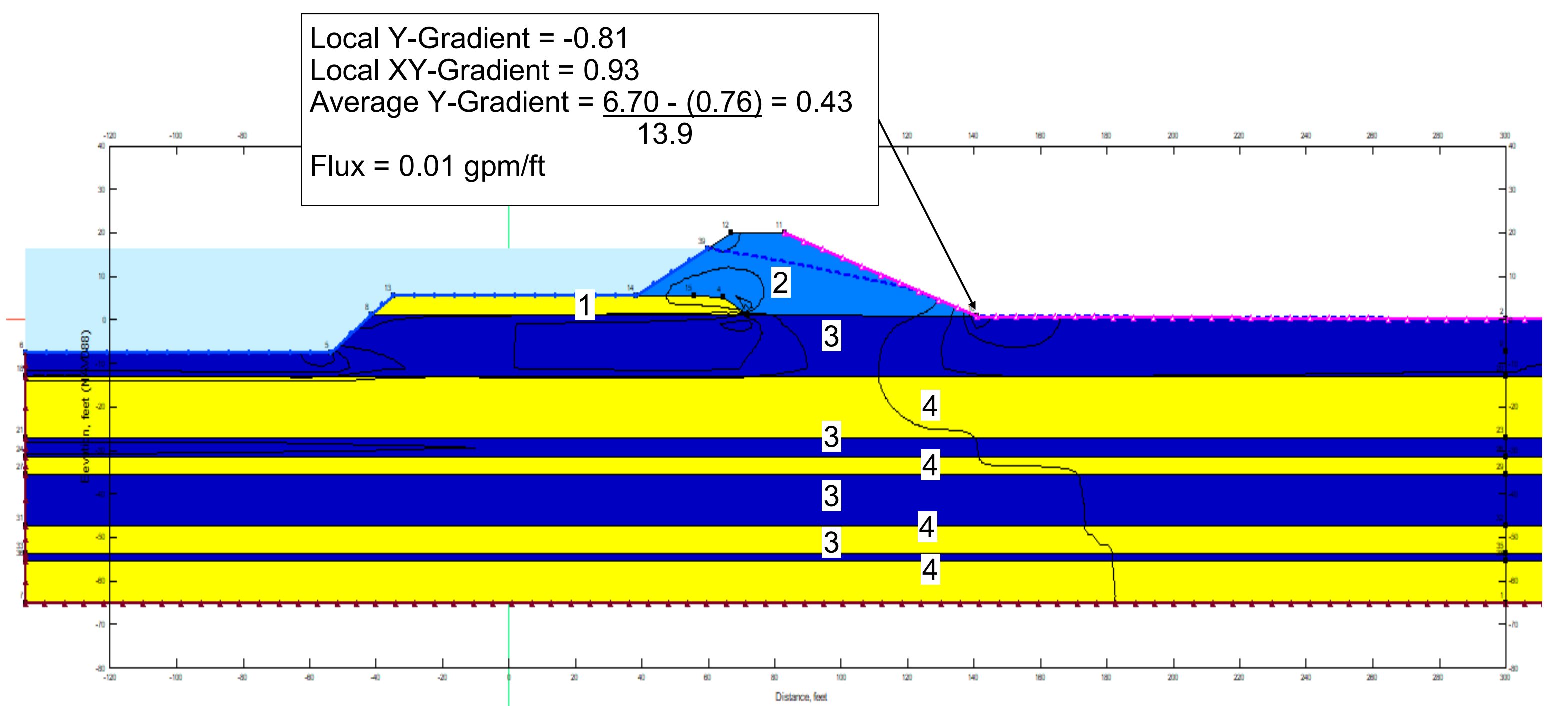
Water Surface Elevation (NAVD88): 16.4 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
UNIT NO.	LAYER COLOR	MATERIAL TYPE	VERTICAL CONDUCTIVITY, k_V (cm/s)	PERMEABILITY RATIO, k_H/k_V
1	(yellow)	Existing Levee Fill	$2.0x10^{-3}$	9
2	(light blue)	New Levee Fill	$2.5x10^{-6}$	4
3	(yellow)	Sand	$1.0x10^{-4}$	9
4	(blue)	Clay	$5x10^{-6}$	4

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Seepage Results
Area 4
Long-Term Configuration - DWSE

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. D-5

APPENDIX E

Slope Stability Results

E-1. SLOPE STABILITY RESULTS

A. General

We performed analysis to check the factors of safety at the end of construction and for the long-term levee of the landside and waterside slopes for static, pseudo-static, and rapid drawdown loading conditions. We used the computer program SLOPE/W and Spencer's method of analysis. We used data obtained from the borings along with our assessment of average effective stress and undrained shear strengths for clayey deposits. Typically, fill placement occurs over a period of time that is relatively short compared to the time required for clayey soils to gain strength. We assumed that the clayey soils will not gain shear strength prior to the end of construction. The long-term levee case accounts for strength gain. The soil parameters used in our analysis are presented on Plates E-1 through E-20.

We reviewed the topography and cross sections, and selected Station 294+00, 317+00 and 396+00 to represent the levee in Areas 2, 3 and 4, and Stations 245+00 and 260+00 to represent the levee in Area 1. The cross sections were selected to represent varying levee heights, depths of clayey soils, and design configurations. Slope stability was analyzed for three different water levels. For the end of construction and seismic cases, we used an average tide level at Elevation 4.8 feet for the landside slopes and low tide at Elevation 3.3 feet for the waterside slopes. For the long-term case, we used the 100-year flood for the landside slopes and low tide at Elevation 3.3 feet for the waterside slopes. For the rapid drawdown cases, we used the 100-year flood for stage 1 and low tide at Elevation 3.3 feet for stage 2.

We analyzed the new levee using undrained strengths for end of construction, and both effective stress and undrained strengths for the long-term configuration. For pseudo-static loading conditions and rapid drawdown conditions, the new levee was analyzed using undrained strengths. For existing fills and the underlying foundation of dense sand / stiff clay, effective stress strength parameters were used in the analysis, while both undrained strength and effective stress parameters were used for new fills and the clay deposits directly below the levees. The analyses included:

Static Loading

- End of Construction – Undrained Strength
- Long-Term Consolidated – Effective Stresses
- Long-Term Consolidated – Undrained Strength

Pseudo-Static Loading

- Long-Term Consolidated – Undrained Strength

Rapid Drawdown

- Long-Term Consolidated – Undrained Strength

The results of our analysis for landside and waterside slopes are presented in Tables E-1 through E-4. We performed two separate analyses for each of the waterside slope cases. We evaluated a shallow failure through the new fill only and a deep failure extending to the river channel.

Table E-1 – Factors of Safety for Landside Slopes

Location	Station	Landside		
		End of Construction	Long-Term Consolidated	
		Undrained Strength	Effective Strength	Undrained Strength
Area 1 South	245+00	1.4	1.9	1.8
Area 1 North	260+00	1.5	2.0	1.8
Area 2	294+00	1.5	2.0	1.9
Area 3	317+00	1.5	2.0	1.9
Area 4	396+00	1.4	2.0	1.9

Table E-2 – Factors of Safety for Waterside Slopes

Location	Station	Waterside					
		End of Construction		Long-Term Consolidated			
		Undrained Strength		Effective Strength		Undrained Strength	
		Shallow Failure	Deep Failure	Shallow Failure	Deep Failure	Shallow Failure	Deep Failure
Area 1 South	245+00	2.1	3.7	1.9	3.4	2.2	3.5
Area 1 North	260+00	2.2	3.8	1.9	3.6	2.2	3.9
Area 2	294+00	1.9	4.3	1.9	3.6	2.3	3.9
Area 3	317+00	1.3	7.1	2.0	4.7	2.3	5.5
Area 4	396+00	2.1	3.5	1.8	3.4	1.9	3.5

The results indicate the factors of safety for the end of construction conditions are as low as 1.3 assuming the levee is constructed in one sequence. The surface materials include relatively weak materials. To minimize the risk of ground movement during fill placement, we conclude that the fill should be placed in stages.

The results indicate the factors of safety for the landside slopes for the long-term condition are higher than those obtained for the end of construction condition. The results indicate that the factors of safety for the levees are above the minimum factors of safety required by the USACE.

B. Seismic Deformation and Soil Liquefaction

Our scope did not include performing a detailed evaluation of the seismic safety of the levee. The data collected during the investigation did provide sufficient information to perform a preliminary evaluation of seismic concerns for the levee. The following discussion is intended to provide a preliminary basis for evaluating the effect of improvements on seismic performance. Within the Delta, two significant concerns for seismic performance of the levees are permanent deformation from earthquake shaking and soil liquefaction of levee fill and the sand underlying the marsh deposits.

1. Pseudo-Static

We performed a pseudo-static slope stability analysis for the proposed levee for both landside and waterside slopes. The pseudo-static analysis applies a horizontal force at the center of gravity to model an earthquake force. The yield coefficient is the value of the force resulting in a factor of safety of 1.0. The analysis assumes that materials do not lose strength during earthquake shaking. Table E-3 presents the yield coefficients (K_y).

Table E-3 – Yield Coefficients (K_y) from Pseudo-Static Loading

Location	**Station**	**Long-Term Consolidated Undrained Strength**		
		Landside	**Waterside**	
			Shallow Failure	Deep Failure
Area 1 South	245+00	0.27	0.34	0.26
Area 1 North	260+00	0.28	0.35	0.28
Area 2	294+00	0.30	0.35	0.29
Area 3	317+00	0.29	0.31	0.31
Area 4	396+00	0.29	0.33	0.32

We determined a maximum horizontal equivalent acceleration, K_{max}, following the procedure outlined in the "Guidance Document for Geotechnical Analyses' prepared by URS Corporation for the Department of Water Resources. K_{max} = 0.21 based on site location and levee geometry, which yields a K_y / K_{max} value above 0.5 for each area of the project. This result indicates the levee should not experience significant displacements due to seismic motion. The analysis assumes that liquefaction and strength loss does not occur.

2. Soil Liquefaction

For Delta levees, the two soil zones most susceptible to liquefaction are the levee fill (where the fill consists of sand) and the upper portion of the foundation sand below the marsh deposits. Previous studies have indicated that the largest risk to the levee is liquefaction of the fill. The proposed levee will consist of fine-grained material resistant to liquefaction. The existing levee will be flattened at Elevation 5.6 feet. We assume the remains of the existing levee will stay saturated during the life of the project because mean tide is at Elevation 4.8 feet. At the project site, the bottom of the existing levee fill is located between Elevation -4.1 feet and Elevation 1.0 feet. Our borings indicate that some of the existing levee fill consists of loose saturated sandy soil. If the fill liquefies, significant deformation of the habitat bench could occur.

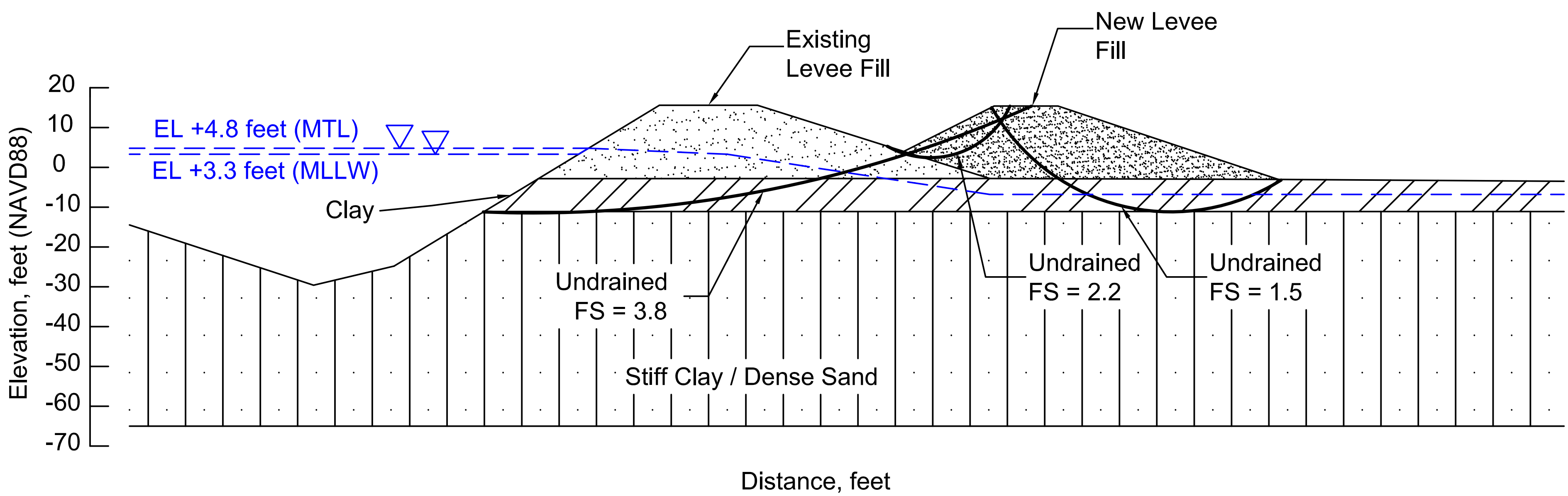
Sand exists within the foundation soil beneath the marsh deposits and, where loose, the foundation sand could liquefy due to earthquake shaking. Analysis from other Delta projects suggests that the slopes may not experience large deformations from liquefaction of the foundation sand. The data is limited in extent and not sufficient for a complete analysis or a definitive conclusion on the levee's performance should liquefaction occur in the foundation soil.

C. Rapid Drawdown Conditions

We conducted one rapid drawdown analysis case for each area of the site. The analyses are from the 100-year flood elevation to the mean low tide elevation. Table E-4 presents the factors of safety for rapid drawdown loading conditions. The factors of safety are above the minimum factors of safety required by the USACE.

Table E-4 – Factors of Safety for Rapid Drawdown

Location	Station	Long-Term Consolidated – Undrained Strength	
		Waterside	
		Shallow Failure	Deep Failure
Area 1 South	245+00	1.8	3.3
Area 1 North	260+00	1.8	3.6
Area 2	294+00	1.7	3.5
Area 3	317+00	1.8	4.7
Area 4	396+00	1.6	3.2



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE

0 40 feet

1 inch = 40 feet

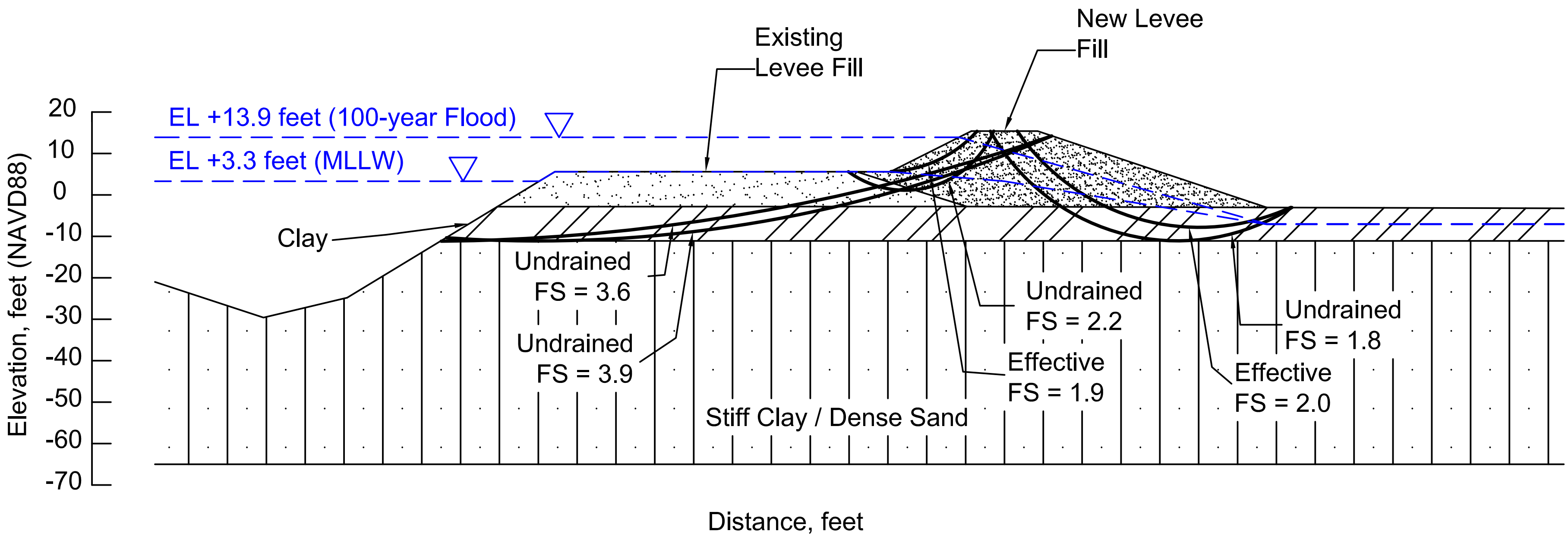
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 1 North
After Construction Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-1



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at 100-year flood level and at MLLW level were used in slope stability analysis for stages 1 and 2, respectively.

SCALE
0 40 feet
1 inch = 40 feet

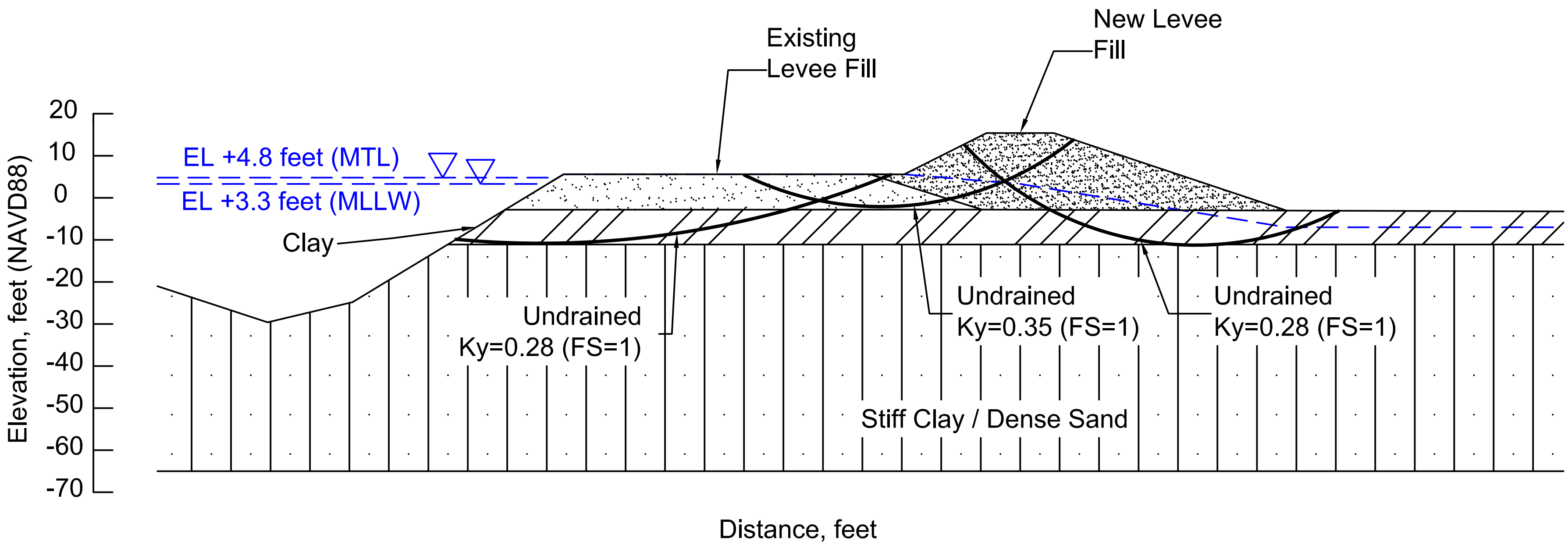
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 1 North
Long-Term Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-2



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

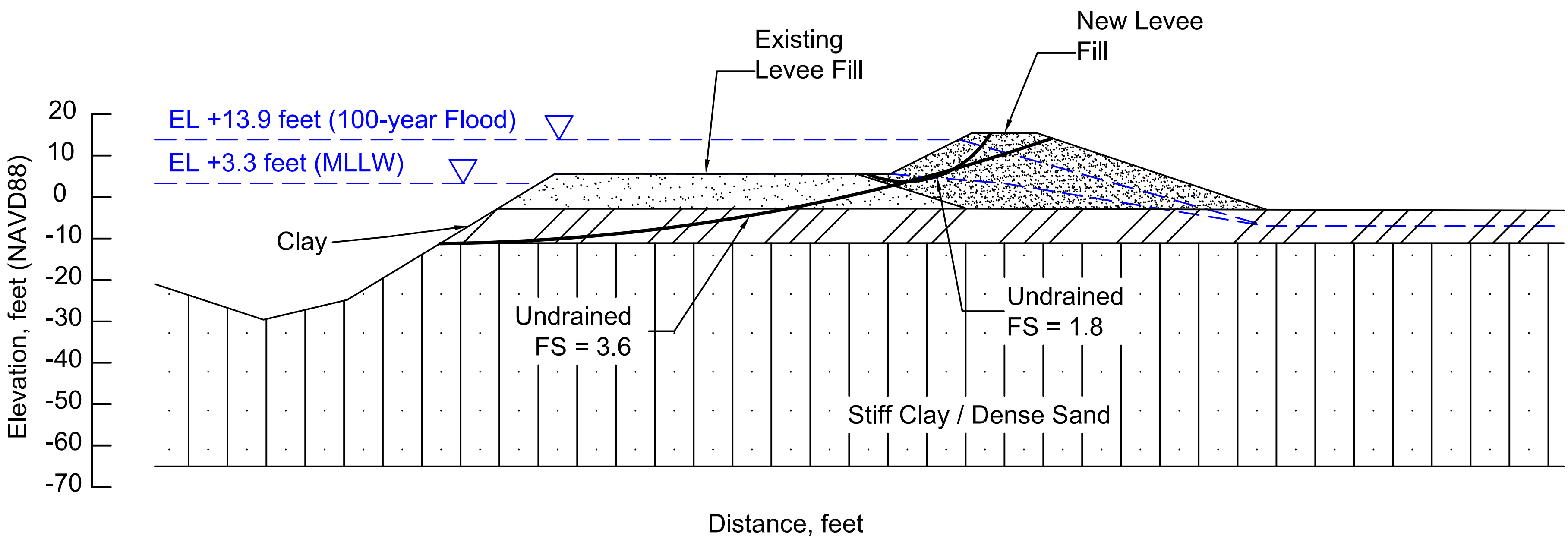
Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 1 North
Pseudo-Static Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-3



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at 100-year flood level and at MLLW level were used in slope stability analysis for stages 1 and 2, respectively.

SCALE

0 40 feet

1 inch = 40 feet

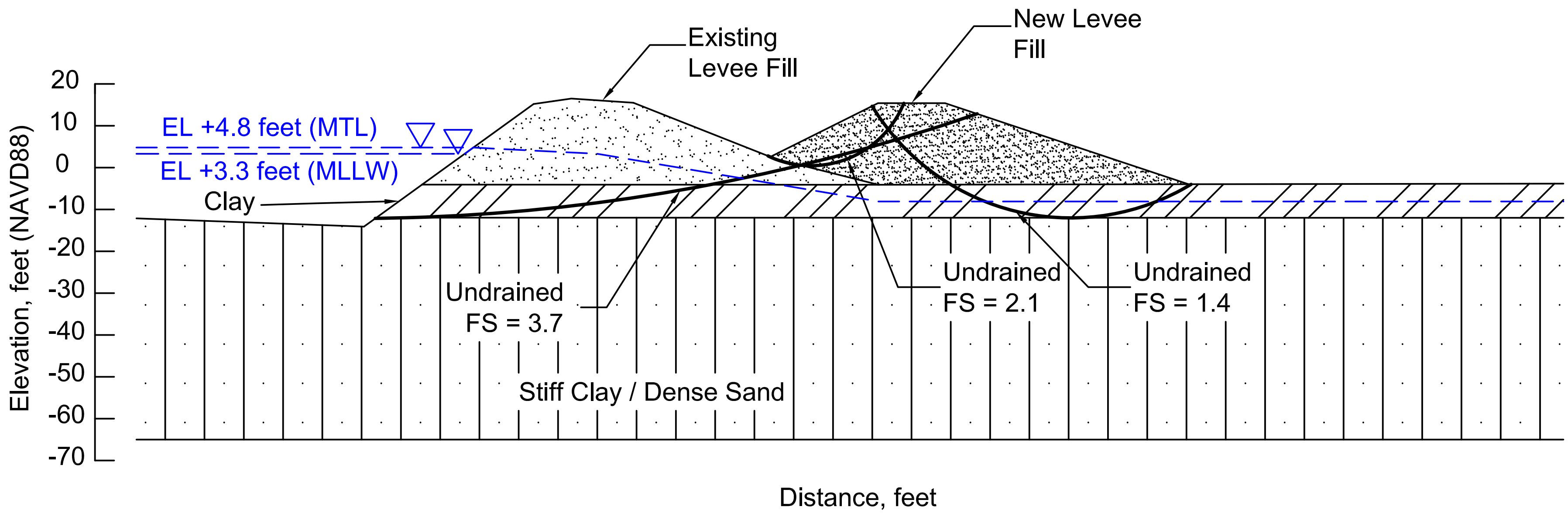
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 1 North
Rapid Drawdown Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-4



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

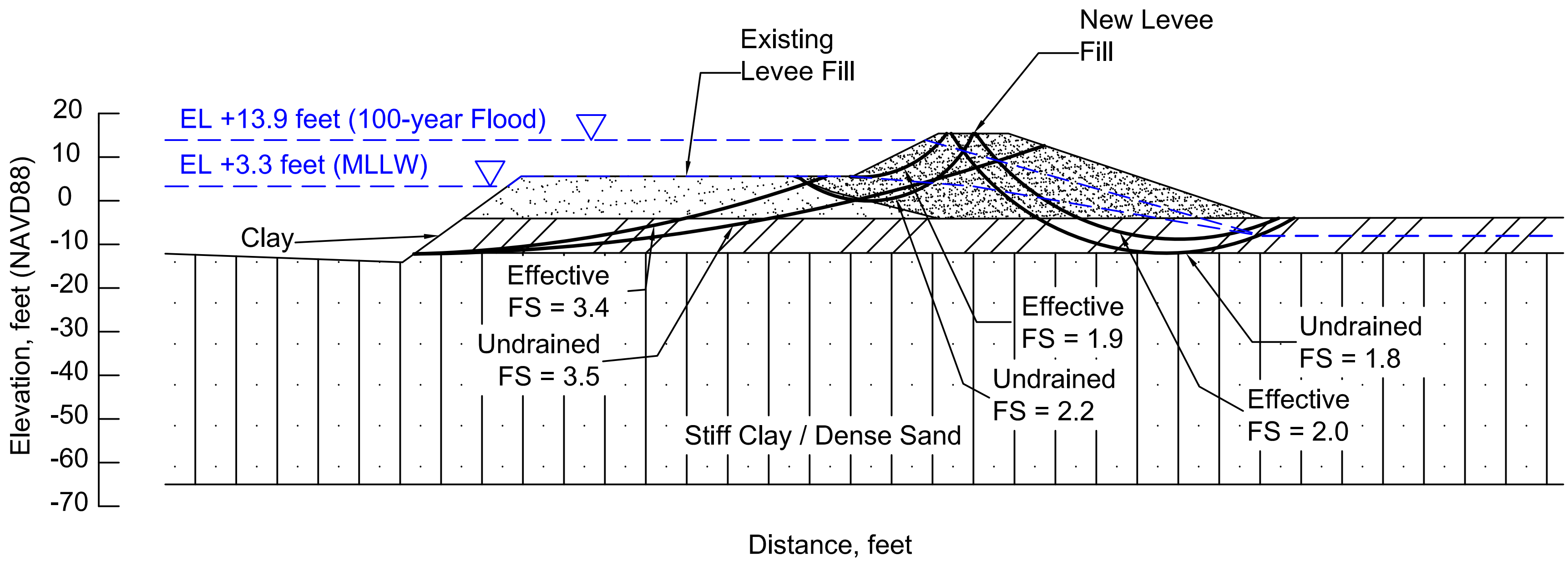
Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 1 South
After Construction Configuration

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. E-5



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at 100 year flood level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

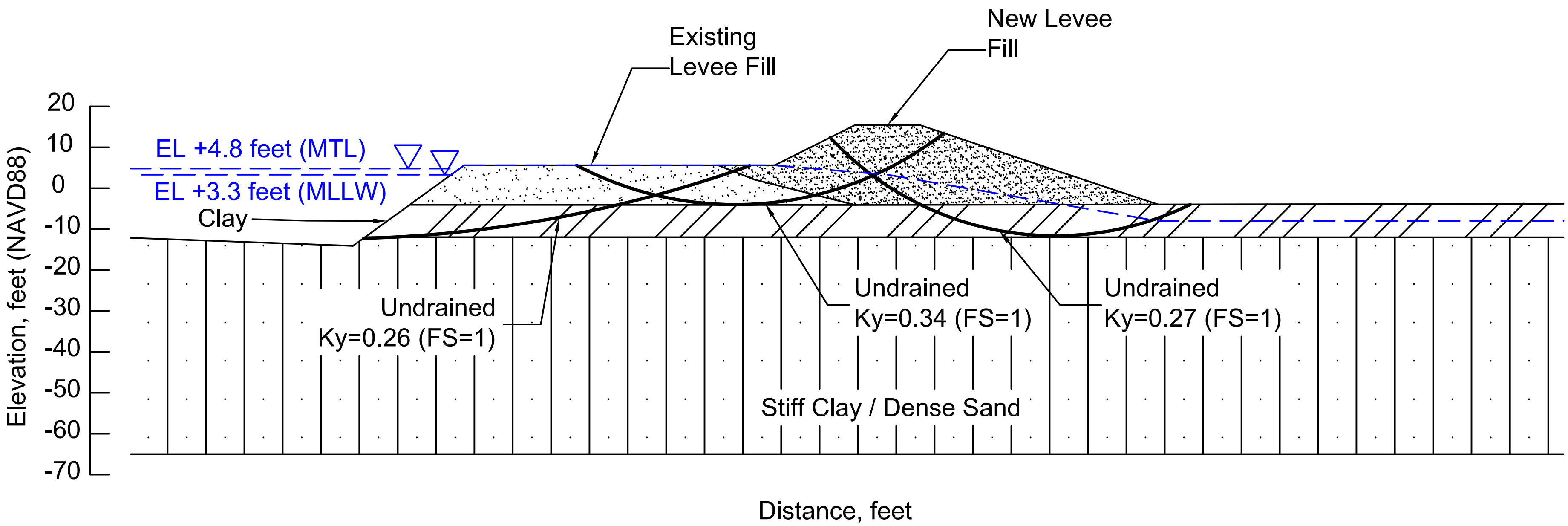
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 1 South
Long-Term Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-6



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE

0 40 feet

1 inch = 40 feet

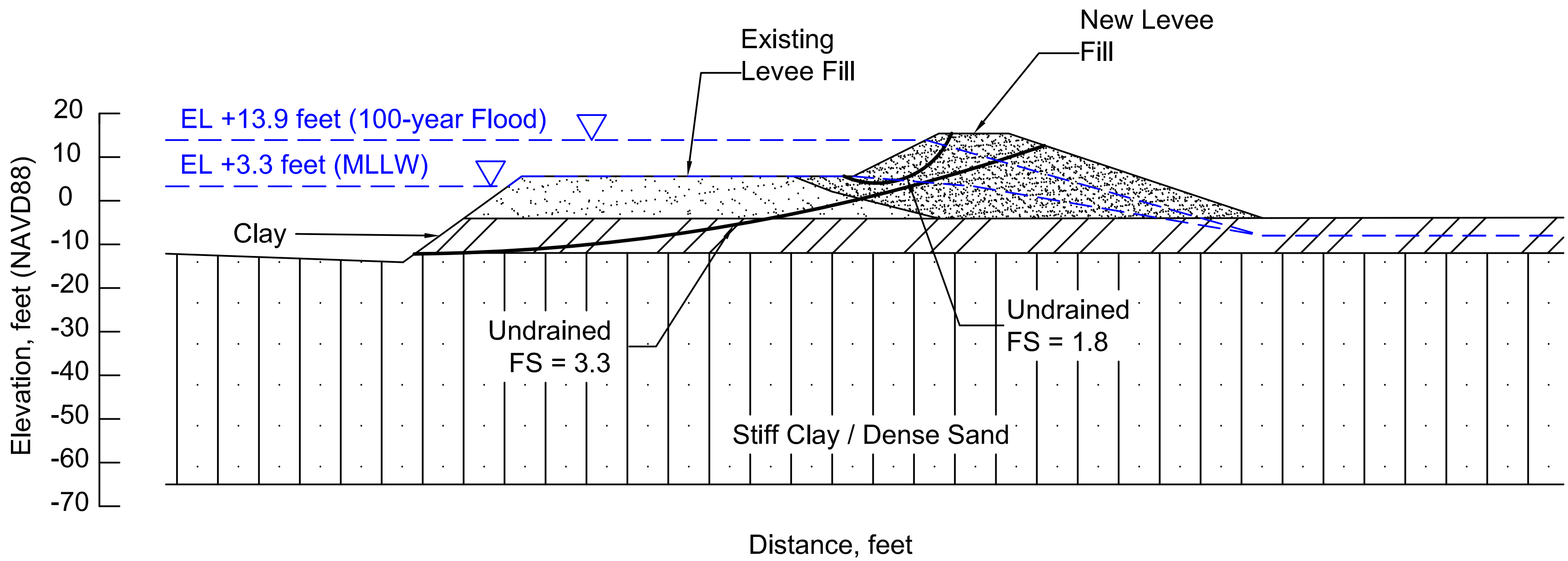
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 1 South
Pseudo-Static Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-7



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

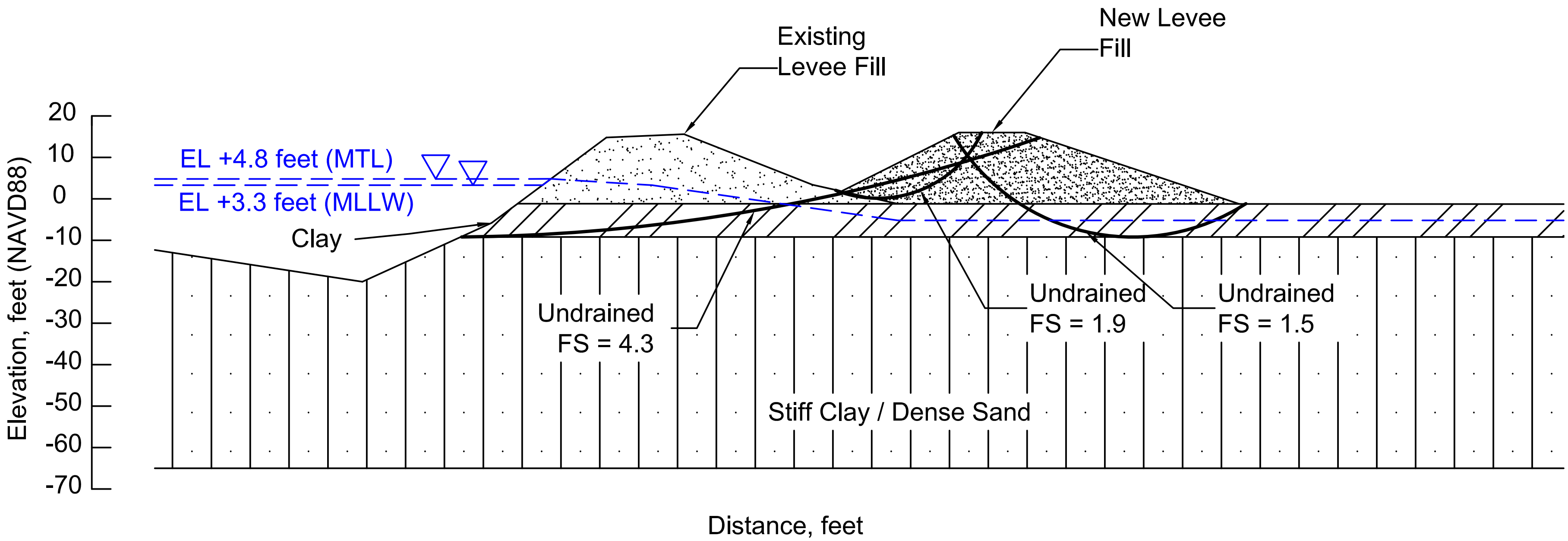
Note: River stages at 100-year flood level and at MLLW level were used in slope stability analysis for stages 1 and 2, respectively.

SCALE
0 40 feet
1 inch = 40 feet

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 1 South
Rapid Drawdown Configuration

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. E-8



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

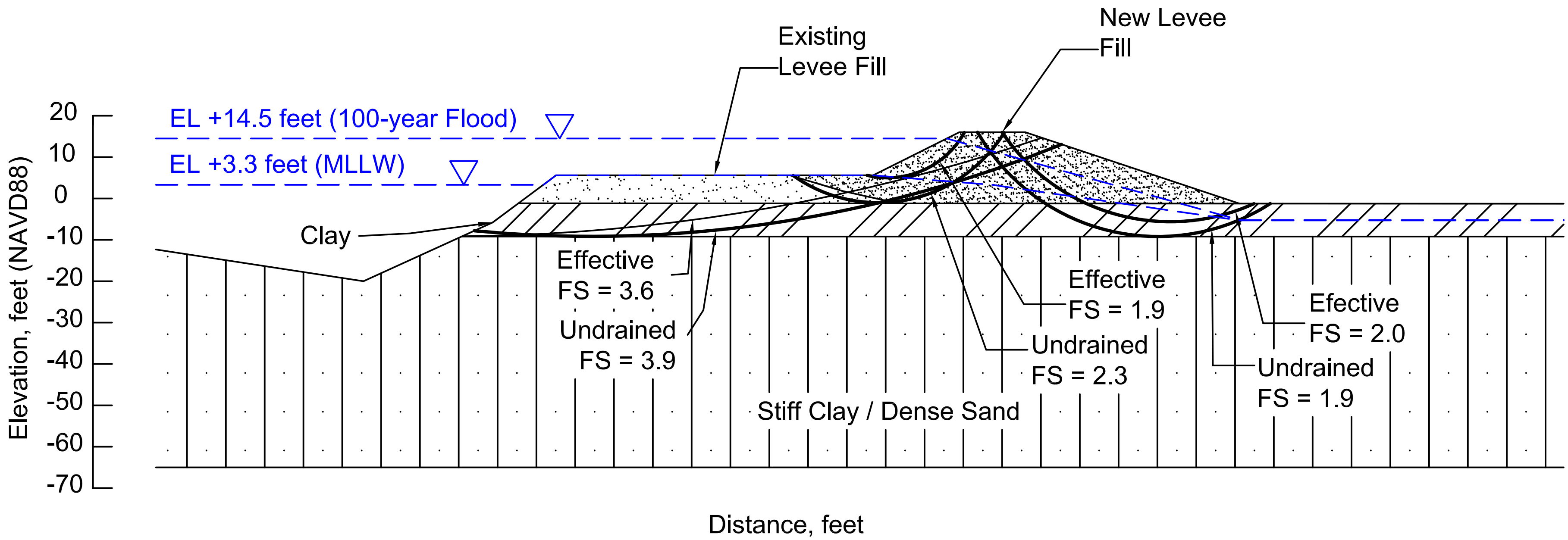
Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 2
After Construction Configuration

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. E-9



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

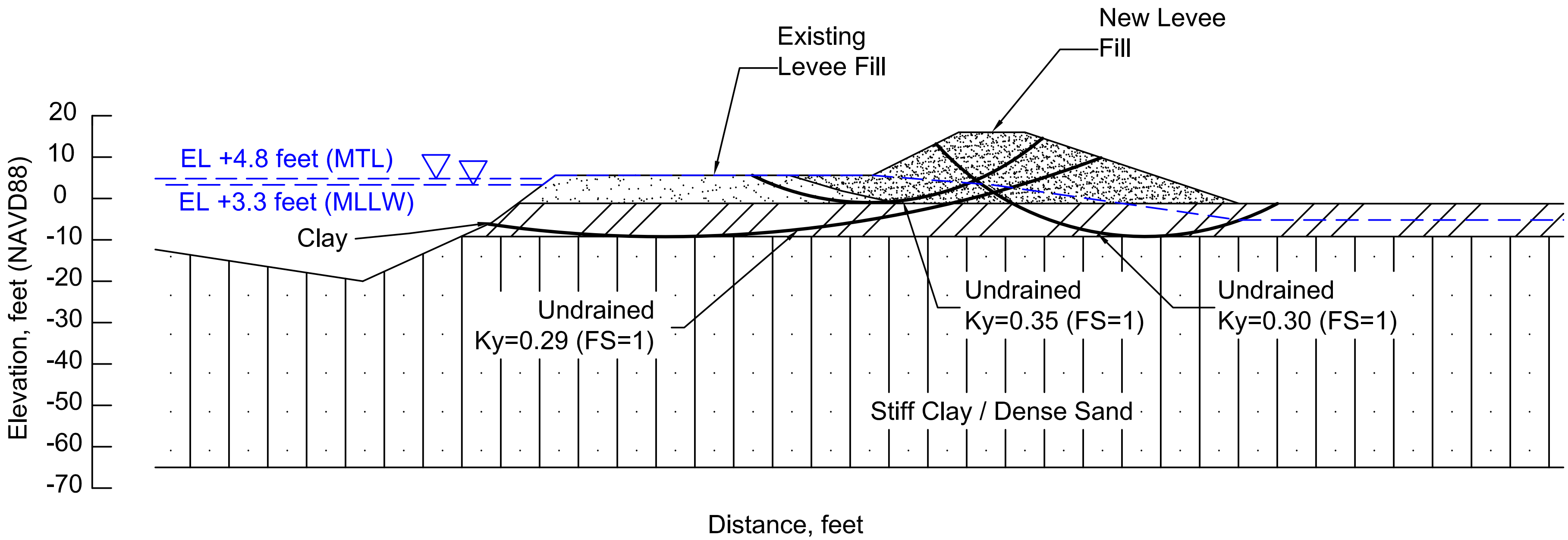
Note: River stages at 100 year flood level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 2
Long-Term Configuration

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. E-10



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE

0 40 feet

1 inch = 40 feet

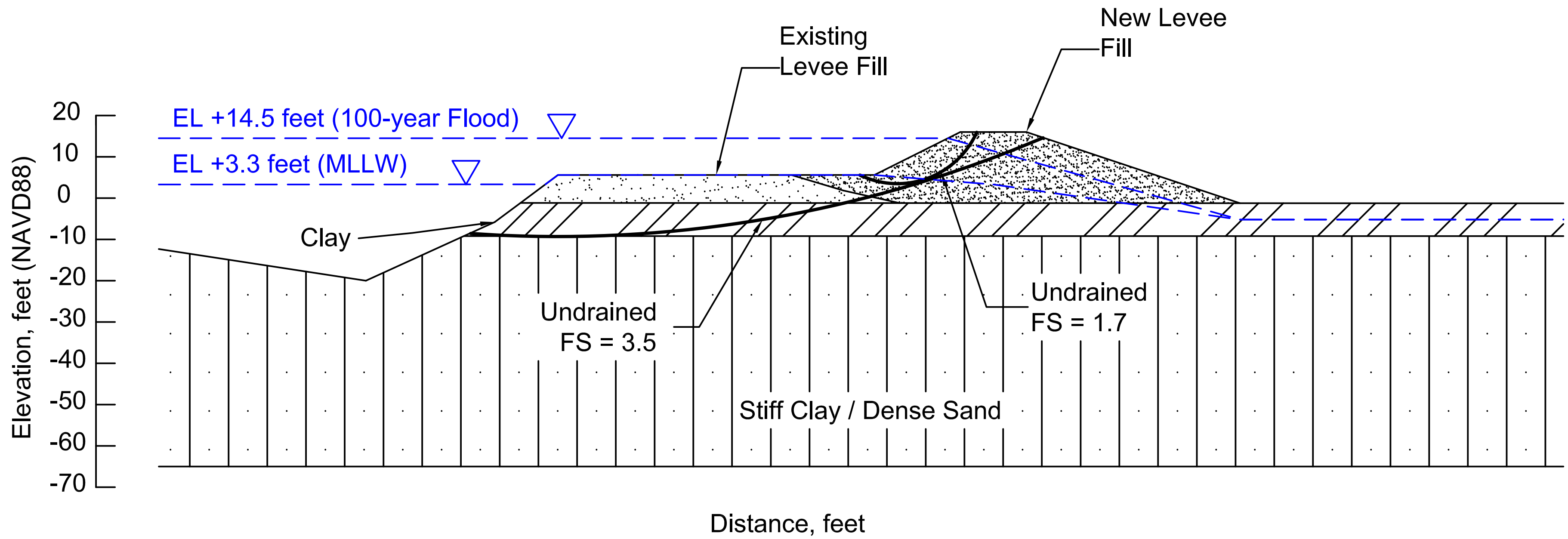
Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 2
Pseudo-Static Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-11



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at 100-year flood level and at MLLW level were used in slope stability analysis for stages 1 and 2, respectively.

SCALE
0 40 feet
1 inch = 40 feet

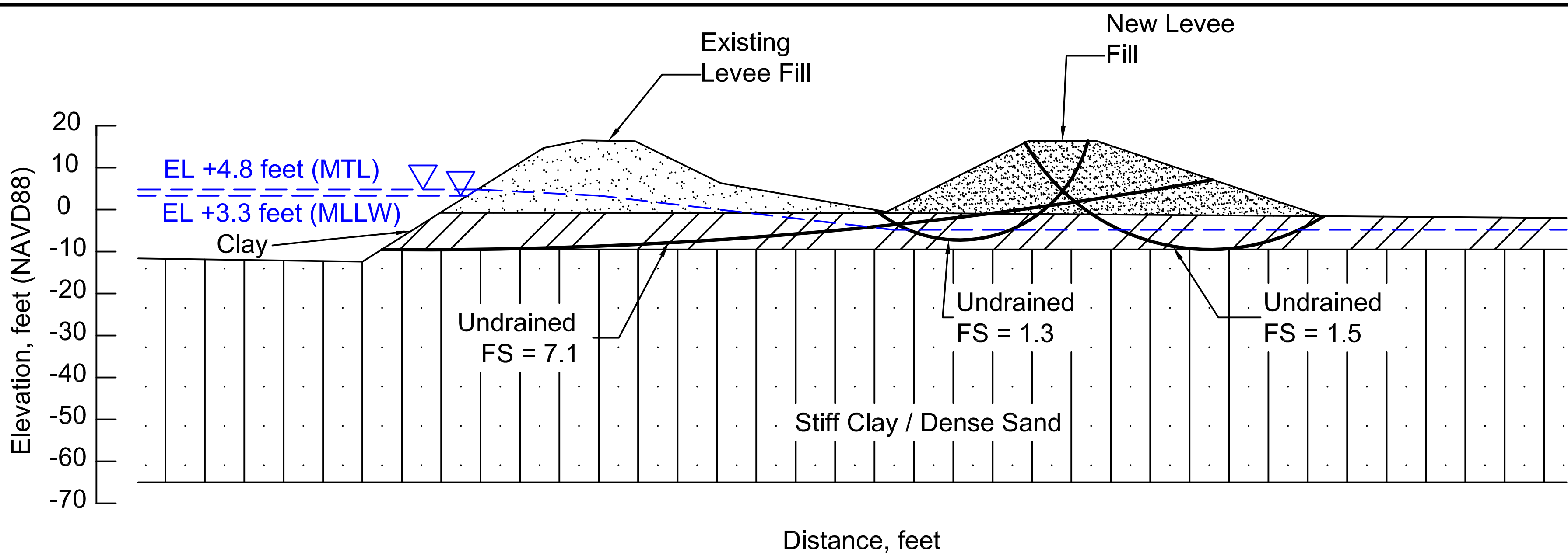
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 2
Rapid Drawdown Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-12



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

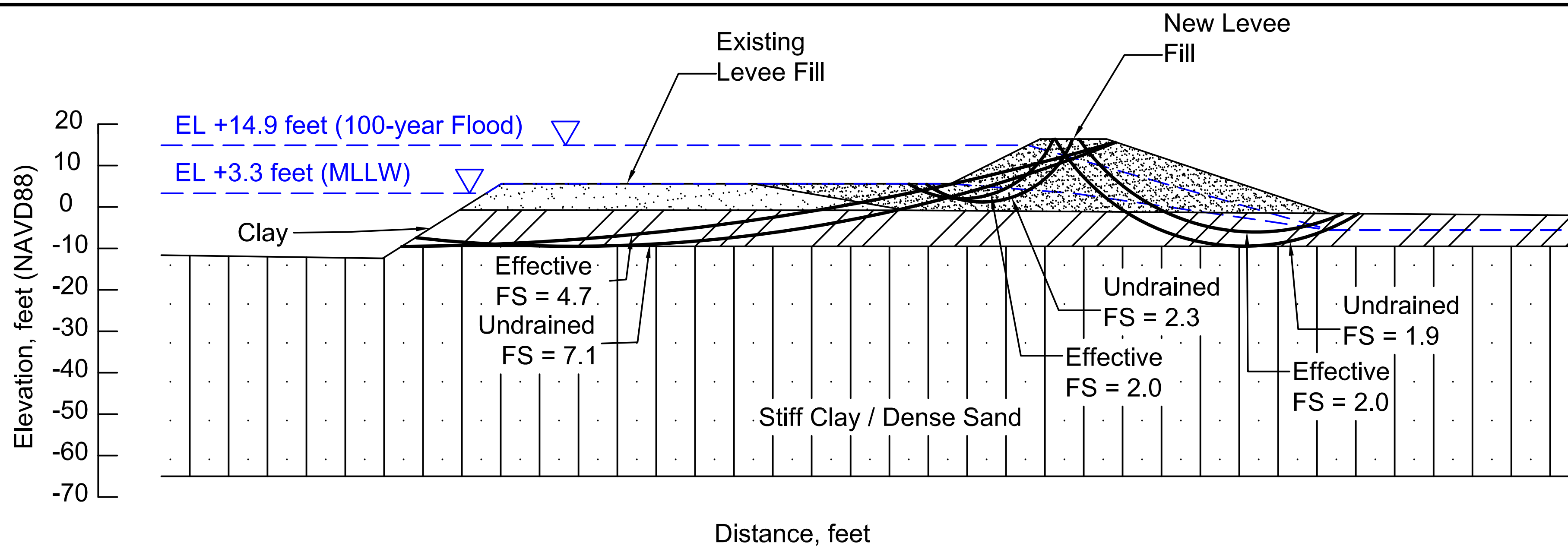
Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 3
After Construction Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-13



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength Cohesion (psf)	Undrained Strength Friction Angle (°)	Effective Strength Cohesion (psf)	Effective Strength Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

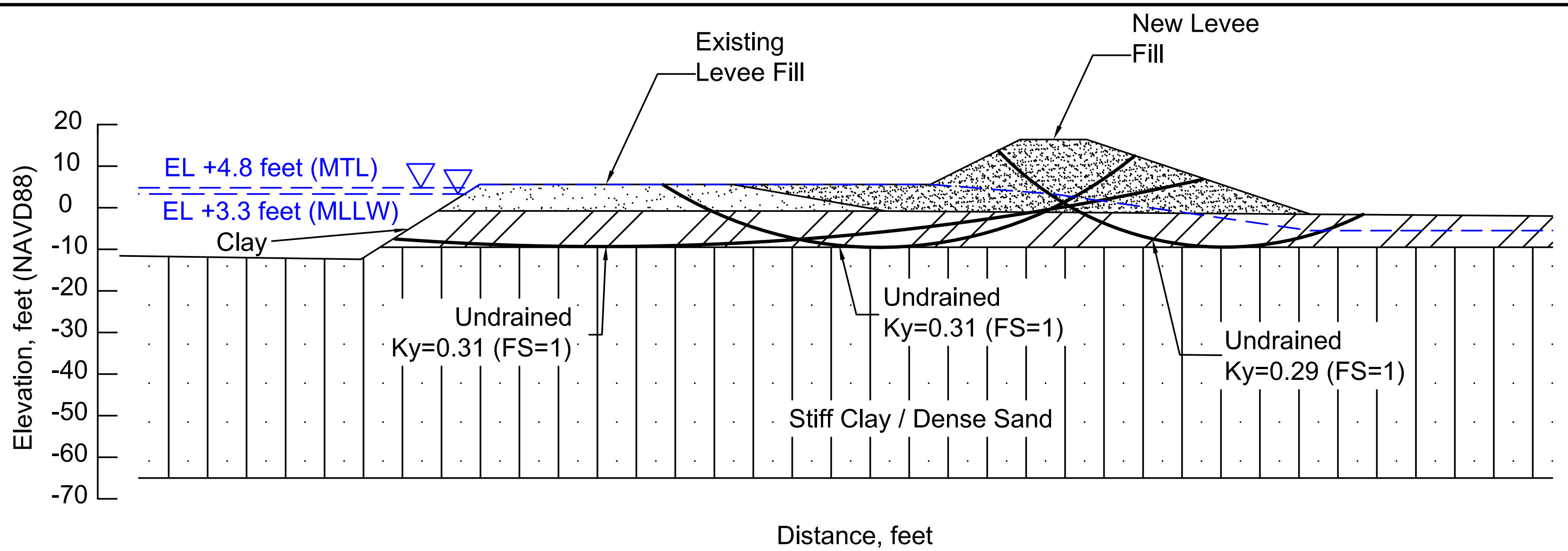
Note: River stages at 100 year flood level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 3
Long-Term Configuration

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. E-14



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

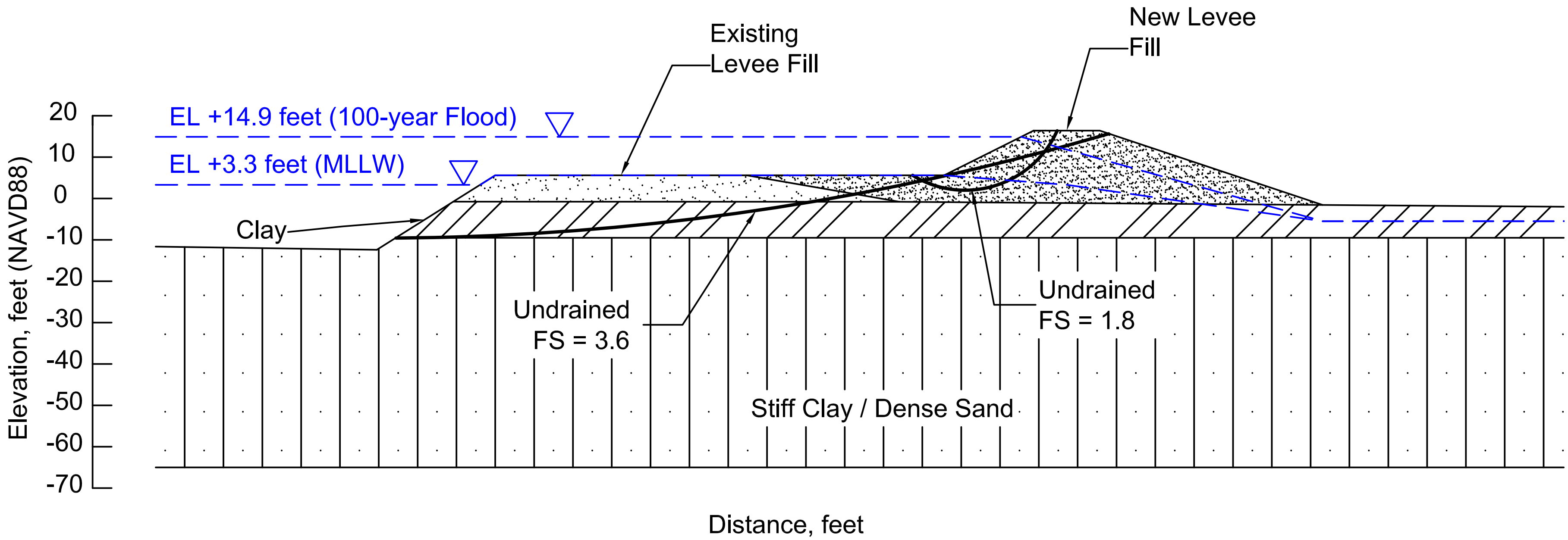
Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 3
Pseudo-Static Configuration

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. E-15



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

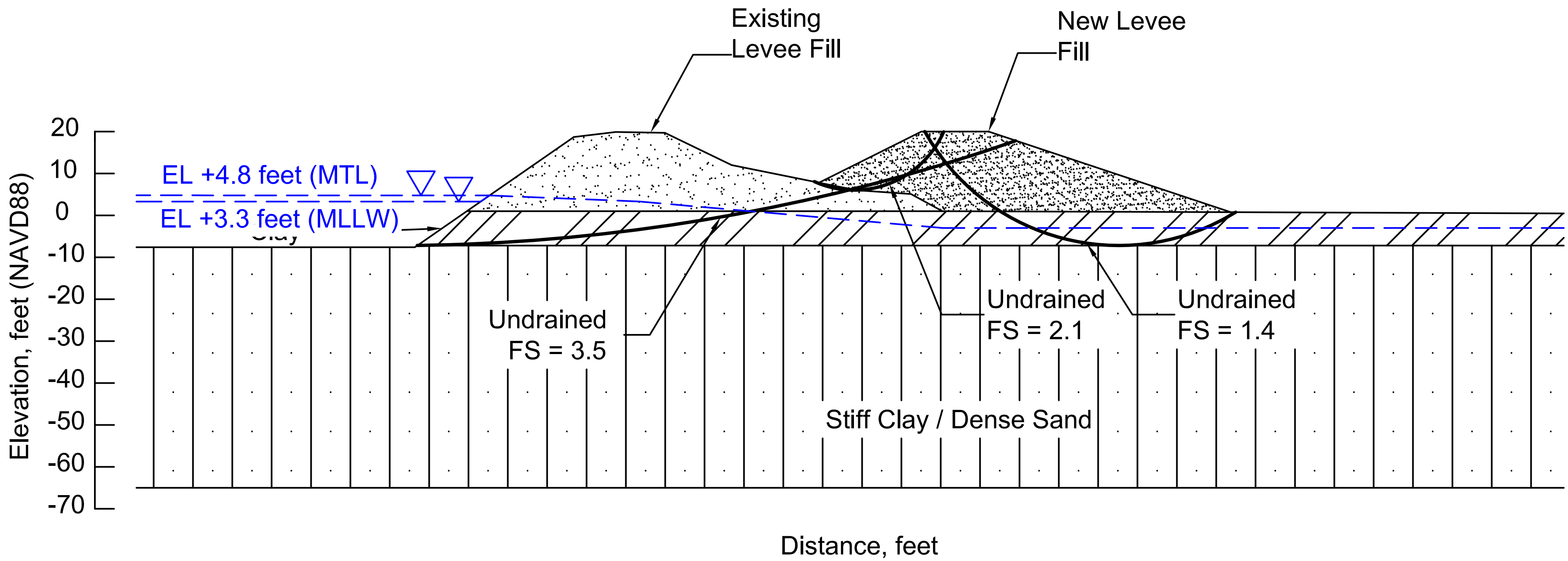
Note: River stages at 100-year flood level and at MLLW level were used in slope stability analysis for stages 1 and 2, respectively.

SCALE
0 40 feet
1 inch = 40 feet

Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 3
Rapid Drawdown Configuration

Hultgren - Tillis Engineers | Project No. 921.01 | Plate No. E-16



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE

0 40 feet

1 inch = 40 feet

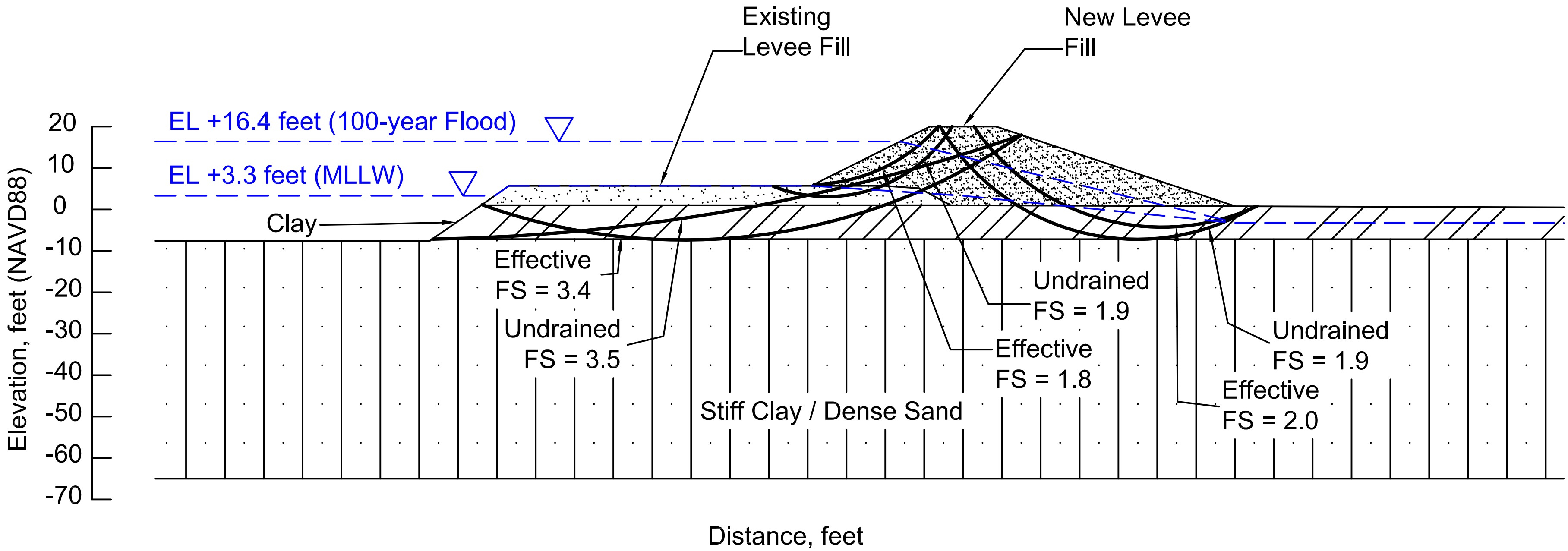
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 4
After Construction Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-17



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at 100 year flood level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

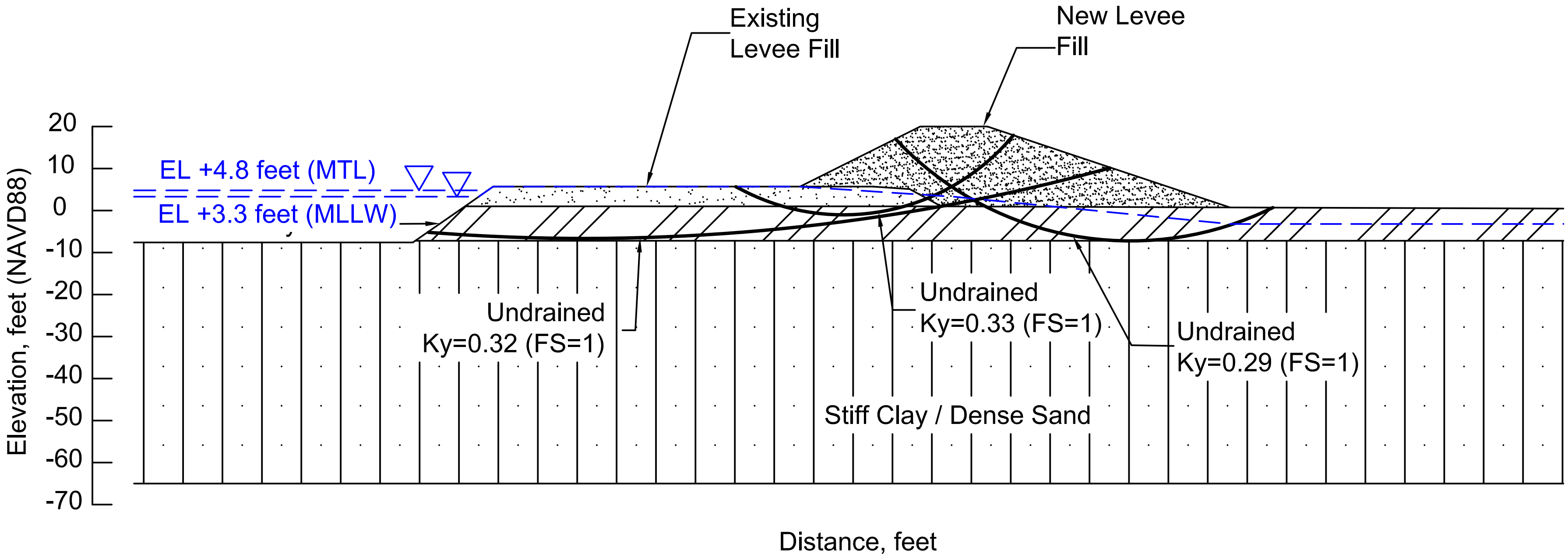
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 4
Long-Term Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-18



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at MTL level and at MLLW level were used in slope stability analysis landside and waterside, respectively.

SCALE
0 40 feet
1 inch = 40 feet

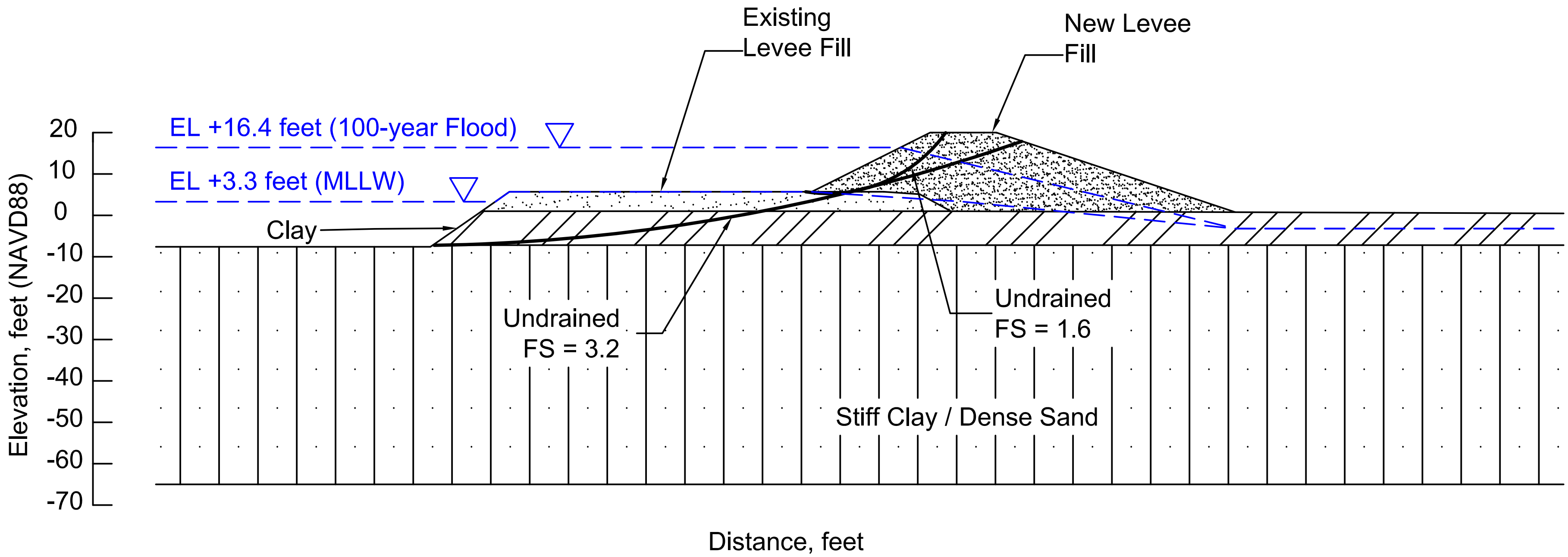
Mokelumne River Waterside Habitat
Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 4
Pseudo-Static Configuration

Hultgren - Tillis Engineers

Project No. 921.01

Plate No. E-19



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Existing Levee Fill	115	-	-	50	32
New Levee Fill	125	250	18	50	32
Clay	125	250	18	50	30
Stiff Clay / Dense Sand	125	-	-	50	38

Note: River stages at 100-year flood level and at MLLW level were used in slope stability analysis for stages 1 and 2, respectively.

SCALE
0 40 feet
1 inch = 40 feet

Mokelumne River Waterside Habitat Enhancement and Levee Repair
New Hope Tract, California

Slope Stability Results
Area 4
Rapid Drawdown Configuration

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