

**DRAFT
GEOTECHNICAL EVALUATION**

**SHERMAN ISLAND – STATIONS 700 TO 850
RECLAMATION DISTRICT 341
SACRAMENTO COUNTY, CALIFORNIA**

Project No. 789.06
March 10, 2014

Prepared by

Hultgren – Tillis Engineers

Hultgren-Tillis Engineers

March 10, 2014
Project No. 789.06

Reclamation District 341
c/o Wagner & Bonsignore
2151 River Plaza Drive, Suite 100
Sacramento, California 95833-4133

Attention: Mr. Henry Matsunaga

Draft
Geotechnical Evaluation
Sherman Island – Stations 700 to 850
Reclamation District 341
Sacramento County, California

Dear Mr. Matsunaga:

We performed a geotechnical evaluation for levee rehabilitation on Sherman Island in Sacramento County, California between Reclamation District 341 Stations 700 to 850 in accordance with the Service Agreement with Wagner & Bonsignore dated June 25, 2012 and our proposal dated October 9, 2013. The results of the investigation are presented in the attached report.

It was a pleasure working with you on this project. If you have any questions, please call.

Sincerely,

Hultgren – Tillis Engineers

DRAFT

W. Rick Chen
Geotechnical Engineer

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Geotechnical Engineer

WMC:RKT:lm:la

2 copies submitted

cc: Reclamation District 341 (2 copies)

File No. 78906R01 Sherman Island Levee Draft.docx

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I. INTRODUCTION

This report presents the results of our geotechnical evaluation for levee rehabilitation for Reclamation District 341 (District) on Sherman Island in Sacramento County, California. The District plans to improve the erosion protection on the water slope, widen the county road on the levee crest and other slope modifications to meet the PL 84-99 criteria. As part of the modifications the existing county road between District Stations 707 and 733 will be realigned. The limits of levee rehabilitation for this project extend from District Stations 700 to 850, covering approximately 2.8 miles of levee located along the Sacramento River on the northwest side of Sherman Island. This levee reach is a U.S. Army Corps Engineers (USACE) project levee and is part of the State Plan of Flood Control facilities and subject to permitting through the Central Valley Flood Control Board. The existing levee crest serves as a two-lane county road, except the reach between Stations 707 and 733 where the county road is located at the landside slope toe. The California Department of Water Resources (DWR) plans to construct and operate two new salvaged fish release facilities at Stations 707 and 733. The levee between the two fish release sites will be improved as part of the fish release facilities construction. This report addresses levee rehabilitation between Stations 700 to 850. Our geotechnical evaluation for the fish release sites are presented in a separate report.

Sherman Island and the surrounding areas are shown on the Vicinity Map, Plate 1. The project area and District stationing are shown on the Site Plan, Plate 2. The elevations in this report are referenced to the North American Vertical Datum of 1988 (NAVD88). However, some of the published data (Geologic map and previous boring/drill logs) were recorded using the National Geographic Vertical Datum of 1929 (NGVD29). A correction of +2.4 feet may be used to convert from NGVD29 to NAVD88 elevations for this project by the design team.

Our scope of services was outlined in our proposal dated October 9, 2013. Our scope of services consisted of reviewing existing geotechnical data, performing engineering analysis, and developing conclusions and recommendations regarding geotechnical aspects of the project. The results of our geotechnical investigation are presented in this report.

II. EXISTING DATA

We did not explore subsurface conditions and relied on existing data and data recently collected by DWR for our evaluation. As part of our evaluation of the levee, we reviewed data from two sources: The Salinity Control Barrier Investigation by DWR in the 1950's; and the New Salvaged Fish Release Facilities project. DWR collected subsurface data for the Salinity Control Barrier Investigation project between 1955 and 1958 along the perimeter levee of Sherman Island. Data relevant to the project area includes seventeen (17) borings drilled on the levee crest. DWR recently performed subsurface exploration for the planned two fish release sites and presented the subsurface data in the Project Geology Report 80-10-39 dated January 2014. Subsurface data included six (6) soil borings, fifteen (15) cone penetration test soundings (CPT), two (2) field vane shear tests, and associated laboratory testing results. The laboratory testing performed by DWR included sieve analysis, Atterberg limits, moisture and dry density measurements, organic content, specific gravity, consolidated undrained triaxial compression tests, and a consolidation test.

The DWR 1950's data is presented in Appendix A, including the Site Plan, Plate A-1, the Profile of Borings (graphic logs), Plate A-2, the Legend to Borings, Plate A-3, and the boring/drill logs of borings 100 through 116, Plates A-4 through A-53. The Logs of Borings and CPT's from the Project Geology Report are presented in Appendix B. The approximate boring locations are presented on the Site Plans, Plates 1 and 2 and in Appendix B.

III. SITE CONDITIONS

A. Geology

The United States Geological Survey (USGS) has published geologic maps for the Sacramento-San Joaquin Delta (Atwater 1982). The Atwater geologic map that includes Sherman Island and the geologic descriptions of the map units is presented on Plate 3. The geologic map shows that the island is mostly covered by peat and mud (Qpm) except one relatively small area (between approximately Stations 755 and 805) along the Sacramento River where hydraulic fill (Qds) blankets the surface.

The present configuration of the Sacramento-San Joaquin River Delta began to form after the last ice age, about 10,000 years ago. 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 sea level rise slowed. As sea levels rose, the Delta was inundated. The sea level rise was slow enough to allow for the accretion of marsh vegetation and formation of a widespread peat marsh (mapped as Qpm).

The peat 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 reclamation of the Delta allowed the peat materials to dry. The process of drying an organic material such as the peat causes it to oxidize and deplete. The ground surface within Sherman Island 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. History

Based on notes shown on the 1950's DWR drill logs (Appendix A), landside slope instability and seepage were observed at several locations from approximately 200 feet west of Boring 100 (about Station 697) to Boring 104 (about Station 728). The drill logs indicated observations of slope failures and active seepage areas at the levee toes and in the fields (up to 300 yards measured from the levee toe). The existing county road is located at the landside toe between Stations 707 and 733. While we do not have records indicating the reason for moving the road off the levee crest, the location is coincident with the reported instability and seepage.

The existing levee has been widened several times since the 1950's and a 4H:1V (horizontal to vertical) slope has been used by the District. No visual evidence of seepage or instability was noted during our field visit and no seepage or slope failure has been reported recently.

C. Surface Conditions

Sherman Island comprises approximately 10,000 acres of agricultural land and is protected by 19.4 miles of levee. The survey data indicates that the centerline of the levee crest varies from a low of Elevation +12.1 feet at Station 734 to a high of Elevation +17.6 feet at Station 846. The levee crest width varies and generally ranges from 16 feet to 30 feet. A two-lane county road consisting of asphalt concrete pavement covers the levee crest except the reach from Stations 707 to 733. Beside the county road, numerous structures are located along the levee including houses between Stations 765 and 800, an RV park between Stations 755 and 765, a trailer park between Stations 752 and 755, a pump station and associated pipelines at Station 811, trees, brush, and overhead utility lines.

The island interior near the levee reach varies from Elevation -10 feet to +11 feet. The island interior is lower between Stations 700 and 740 and ranges from Elevation -7 feet to -10 feet. The landside slopes are steepest between Stations 700 and 740 and incline at about 2.5H:1V to 3H:1V. The rest of the landside slopes are flatter with typical inclinations near 4H:1V or flatter. In the house and RV park areas, the island interior is relatively high ranging from Elevation -2 feet to +11 feet and the slope inclination is 10H:1V or flatter. In the area to the north of the house area (from Stations 800 to 850), the island interior ranges from Elevation -3 feet to +1 feet. The landside levee slope and toe are covered by vegetation that consists of grass and brush. Trees and dense brush are located on the landside and waterside levee slopes at several locations. Drainage ditches are present beyond the existing levee toe.

The waterside slope generally varies in inclination from 2H:1V to 5H:1V. Between Stations 761 and 765, the lower portion (below Elevation +0 feet) of the waterside slope is steeper with an inclination of approximately 1H:1V to 1.5H:1V. The mudline near the waterside slope is generally between Elevation -14 feet to -30 feet. Two depressions exist near Stations 763 and 847, respectively, with the base of the depression at approximately Elevation -50 feet. The upper portion of most of the waterside slope is not covered by riprap. The riprap has eroded and slumped over portions of the reach. Erosion within the waterside slope has occurred.

The typical daily tidal range at Sherman Island varies from about Elevation +2 feet to +6 feet. Extreme low tides are near Elevation +1 foot and extreme high tides are near Elevation +7 feet. The 100-year base flood level used by the District and the design team is Elevation +9.8 feet.

D. Subsurface Conditions

The levee consists of fill over marsh deposits. The upper portion of fill below the levee crest consists of asphalt concrete pavement over road base (gravel). Beneath the road base is a heterogeneous mixture of fill consisting predominately of silty sand and includes zones of lean clay and clayey sand. The consistency of the silty sand fill ranges from very loose to very dense. The fill thickness generally ranges from 15 to 25 feet at the boring locations.

The fill is underlain by marsh deposits, except between Stations 760 and 845, where zones of sand were encountered beneath the levee fill. No standard penetration tests (SPTs) were performed during the DWR 1950's investigation. The consistency of the sand beneath the levee fill is unknown. The marsh deposits consist predominately of weak and compressible peat and organic silt. The base of the marsh deposits range from Elevation -40 feet to -62 feet. The marsh soil beneath the levee is much thicker than below typical levees in the Delta. Our interpretation of the elevation of the base of marsh deposits beneath the levee is presented on Plate 4.

The material beneath the marsh deposits varies with several locations underlain by sand to the depths explored and with other locations underlain by variable zones of silt and sand. The consistency of the sand is variable and ranges from loose to dense. The loosest sand is typically located directly below the marsh soils.

The island is below sea level and groundwater levels within the island are artificially controlled by evapo-transpiration and pumping. Conditions are expected to vary across the site with time, and depend on several factors including changes in moisture content resulting from seasonal precipitation, irrigation practices, and tides.

IV. DISCUSSION AND CONCLUSIONS

A. General

The significant geotechnical considerations for the levee reach are lack of erosion protection for waterside slopes, the presence of marsh soils below the levee, and on-going settlement of the levee crest.

The District's focus is to improve the erosion protection for the waterside slopes along with evaluating the levee for general conformance with the PL 84-99 design standard.

DWR plans to construct two fish release facilities within this levee reach (Stations 707 and 733). This report includes recommendations for levee rehabilitation for Stations 700 to 850 and includes the levee rehabilitation at the two fish release sites. Specific recommendations for the fish release facilities are presented in a separate report.

The existing county road along the levee toe will need to be relocated to accommodate the levee rehabilitation. We understand that the county road is located along the levee toe from about Stations 707 to 733 due to past concerns with the performance of the levee. The DWR borings from the 1950's described the levee as having landside slope failures and described the presence of numerous active seeps.

The levee has been widened and is not showing evidence of seepage or instability. The exact cause of seepage is not known but the levee is constructed of sand. It is highly likely that seepage occurred through the sand fill and exited the landside slope. The levee likely had a narrow crest and steep landside slopes.

The rehabilitation for the levee reach should include provisions that recognize past concerns. The seepage analysis indicates that the exit gradients at the levee meet the USACE criteria for levees. The use of flatter slopes and a toe berm will provide protection from high seepage through the levee.

The levee on Sherman Island is founded on weak marsh deposits consisting predominately of peat and organic soil. The presence of the marsh deposits has a significant effect on the safety of the levee relative to levees constructed on firm soil. The presence of the

marsh soil requires consideration of principles for design and construction on soft ground. Routine practices include broad landside berms to buttress slopes, construction in stages, and allowing for long-term settlement and deformation. Peat exhibits creep (long-term deformation under sustained loading) that must be considered in design. Levees on marsh deposits continually settle requiring successive episodes of filling to raise and maintain the minimum crest elevation and crest settlement will be an on-going concern for this levee reach.

To buttress the levee between Stations 700 and 745 where the landside slope is steeper and the island interior is lower than the remainder of the levee reach, we conclude that a 150 feet wide toe term measured from the new landside hinge is needed. The landside slope should be inclined at 4H:1V. Typical design configurations are presented on Plates 5 and 6. To fit the existing geometry, some adjustment to the toe berm dimensions may be needed.

B. Erosion

The waterside slope lacks adequate protection from erosion from wind-generated waves or boat wakes. The levee will be vulnerable during high wind events particularly during high tides and flood events. We conclude that the levee reach does not meet USACE criteria for protection of the waterside slope from erosion.

C. Seepage

We performed seepage analysis to evaluate the potential for underseepage and to compare with the USACE guidance criteria for underseepage. The gradients for the existing levee and rehabilitation configuration are at 0.19 or below. The calculated values are below the USACE criteria of 0.5 or lower.

A discussion of the seepage analysis and the results of our seepage analysis are presented in Appendix C. The seepage analysis results from the analysis are also presented in Table 1.

Table 1: Seepage Analysis Summary Results

Station	Design Water Surface Elevation (ft)	Existing Levee		Rehabilitated Levee	
		Exit Y-Gradient (Avg.)	Seepage Flow Rate / Flux (gpm)	Exit Y-Gradient (Avg.)	Seepage Flow Rate / Flux (gpm)
		Slope Toe or Berm Toe		Slope Toe or Berm Toe	
700	9.8	0.18	0.02	0.18	0.02
715	9.8	0.15	0.01	0.16	0.01
724	9.8	0.19	0.01	0.19	0.01
740	9.8	0.19	0.02	0.18	0.01
761	9.8	0.06	0.03	0.06	0.02
839	9.8	0.10	0.02	0.10	0.02

D. Slope Stability

We performed stability analysis to evaluate the safety of the levee for stability and to develop a rehabilitation scheme for the levee. The site is underlain by a thick deposit of marsh soil. The factor of safety for the landside slope is below the minimum criteria of 1.4 for Stations 715 and 724 for the existing levee (effective stress). To increase the factor of safety a toe berm is needed to provide a buttress for the levee. The toe berm was used in the analysis for Stations 715, 724 and 740. The factor of safety is above 1.4 for the rehabilitated levee. The analysis indicated that a toe berm is needed from Stations 700 to 745 and a uniform slope inclined at 4H:1V meets the criteria for the remainder of the reach.

A discussion of the stability analysis and the results are presented in Appendix D. The factors of safety from the analysis are also presented in Tables 2 through 4.

Table 2: Factors of Safety for Landside Slopes

Station	Existing Levee		Rehabilitated Levee		
	Effective Strength	Undrained Strength	End of Construction	Long Term Consolidated	
			Undrained Strength	Effective Strength	Undrained Strength
700	1.85	2.10	1.95	1.99	2.06
715	1.39	1.66	1.63	1.62	1.83
724	1.21	1.48	1.55	1.44	1.68
740	1.60	1.75	1.78	1.83	2.12
761	2.01	2.04	2.52	2.46	2.55
839	2.27	2.57	2.46	2.62	2.52

Table 3: Factors of Safety for Waterside Slopes

Station	Existing Levee		Rehabilitated Levee		
	Effective Strength	Undrained Strength	End of Construction	Long Term Consolidated	
			Undrained Strength	Effective Strength	Undrained Strength
700	1.84	1.58	1.57	1.83	1.57
715	1.59	1.42	1.39	1.58	1.42
724	1.57	1.40	1.40	1.57	1.40
740	2.20	1.89	1.85	2.18	1.87
761	1.68	1.58	1.58	1.68	1.58
839	3.12	2.50	2.50	3.12	2.50

Table 4: Yield Coefficients (K_v) from Pseudo-Static Loading

Station	Landside		Waterside	
	Existing Levee	Rehabilitated Levee	Existing Levee	Rehabilitated Levee
700	0.16	0.15	0.09	0.09
715	0.12	0.12	0.09	0.09
724	0.11	0.11	0.08	0.08
740	0.15	0.16	0.14	0.14
761	0.28	0.28	0.12	0.12
839	0.15	0.15	0.12	0.12

E. Settlement and Lateral Deformation

The levee is underlain by deep marsh deposits. The marsh deposits are highly compressible. We performed analysis to estimate settlement of the levee based on the theory of one-dimensional consolidation. The ground settles from a combination of primary consolidation and secondary compression (creep). 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 hydro-static 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, secondary compression is a significant phenomenon and is a primary cause of long-term settlement of Delta levees and their loss of freeboard. The secondary compression will continue for many years at a diminishing rate with time.

We performed analysis at five stations and our estimate of settlement at each station is presented in Table 5. The estimates are provided for settlement expected within 10 years after fill placement. The settlement estimates are based on raising the crest 12-inches above the minimum crest level.

Table 5: Settlement Estimate – Crest Centerline

Station	Settlement within 10 years (feet)
700	0.6 to 0.9
715	1.4 to 1.7
724	0.5 to 0.7
740	0.8 to 1.1
761	0.5 to 0.7
839	0.3 to 0.5

The toe berm and slopes will also settle under the weight of new fill. We estimate the toe berm will settle 2 to 3 feet under the weight of 5 feet of fill. We estimate that the landside edge of the toe berm will settle about 1.0 to 1.3 feet under the weight of 2 feet of fill.

Deformation of the levee can lead to cracking in the levee crest and slopes. Cracks are prevalent throughout the Delta levee system. The cracking is undesirable and, coupled with an inadequate seepage barrier (core), will be a continuing concern for the levee. Deformation cannot be avoided and cracking should be expected.

F. County Road

The new county road alignment is within the interior of the island and will be founded on the marsh deposits. We conclude that a layer of geogrid should be placed and covered with at least 2 feet of fill prior to placement of the aggregate base. The road will settle under the weight of fill and paving materials. We estimate settlement in the range of 1.5 to 2 feet.

G. Existing Vegetation and Encroachments

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 and dense vegetation should be removed from the footprint of the levee, including the toe berm, and not be allowed in the future.

V. RECOMMENDATIONS

A. Levee Configuration

We recommend that the design generally conform to the configurations and details shown on Plates 5 and 6. We recommend that the levee rehabilitated configuration consist of landside slopes inclined at 4H:1V or flatter. Between Stations 700 to 745, the levee rehabilitated configuration should consist of landside slopes inclined at 4H:1V with a toe berm extending at least 150 feet from the final landside hinge point. The toe berm thickness and inclination may need to vary to account for variation in existing slopes, levee toe elevations, and depth of marsh deposits.

The design of the riprap is not in our scope of work. The slopes need to be covered with riprap to provide protection from wind-generated waves and boat wakes and meet USACE criteria. The toe berms should be constructed before the levee crest is raised or slopes graded.

B. Earthwork

1. Site Preparation

The footprint of the levee and toe berm 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. The existing asphalt concrete and aggregate base should be removed from the crest where new fill is planned for the crest. Where possible, the existing asphalt concrete and aggregate base may be reused on the levee crest to reduce the thickness of new imported aggregate base if allowed by the District and the County. In areas where existing ditches are within the planned toe berm, the ditches should be filled and new ditches should be located with a minimum setback of 20 feet landside of the new toe berm. Soft sediment in the existing ditches should be removed prior to placement of fill.

2. Compaction

Surfaces exposed by stripping or excavation should be scarified to a depth of at least 8-inches except where peat is exposed. Scarification is not required where

peat exists at the ground surface. The scarified soil should be moisture conditioned to at least optimum moisture content and compacted to at least 90 percent relative compaction. ASTM D1557 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. 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 slopes should not exceed 5 feet.

In pavement areas subject to vehicle traffic, the upper 6-inches of subgrade should be compacted to at least 95 percent relative compaction and rolled to provide a smooth, non-yielding surface. Subgrade soils should be proof-rolled before placing aggregate base. Proof-rolling should be performed with the heaviest available rubber-tired construction equipment and should be observed by the geotechnical engineer. Soft or pumping areas should be aerated or excavated and recompacted.

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, non-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 8-inches in loose thickness and in a manner that avoids segregation, moisture conditioned as necessary, and compacted to at least 95 percent relative compaction.

3. Slopes

Fill slopes should be inclined at 4H:1V or flatter except as noted. Fill slopes should be constructed fat and trimmed back to expose well-compacted fill. Finished slopes and toe berms should be trackwalked perpendicular to the slope face with a bulldozer

after completion. The slopes should be hydroseeded to promote vegetation. 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 and toe berms.

4. County Road and Levee Toe

Prior to construction of the county road, new fill 2 feet thick should be placed 5 feet beyond the footprint of the roadway. The fill should be compacted as described in the Earthwork section of this report.

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

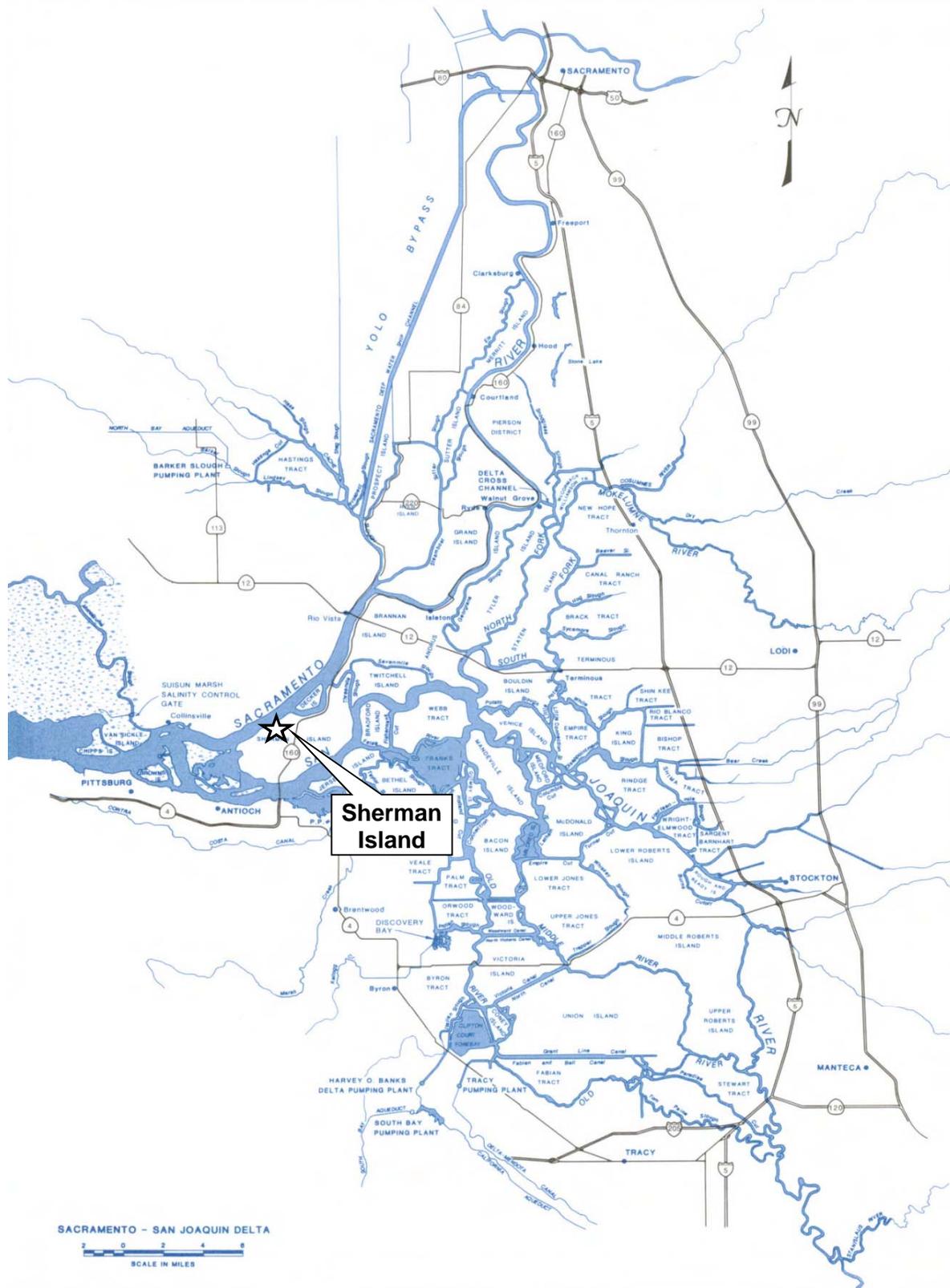
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PLATES



Not to Scale

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Vicinity Map

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. 1




 Approximate Location of Boring
 (DWR 1958 - Salinity Control Barrier Investigation)



Source: Google Earth 2013

0 4000 feet

 SCALE: 1" = 4000'

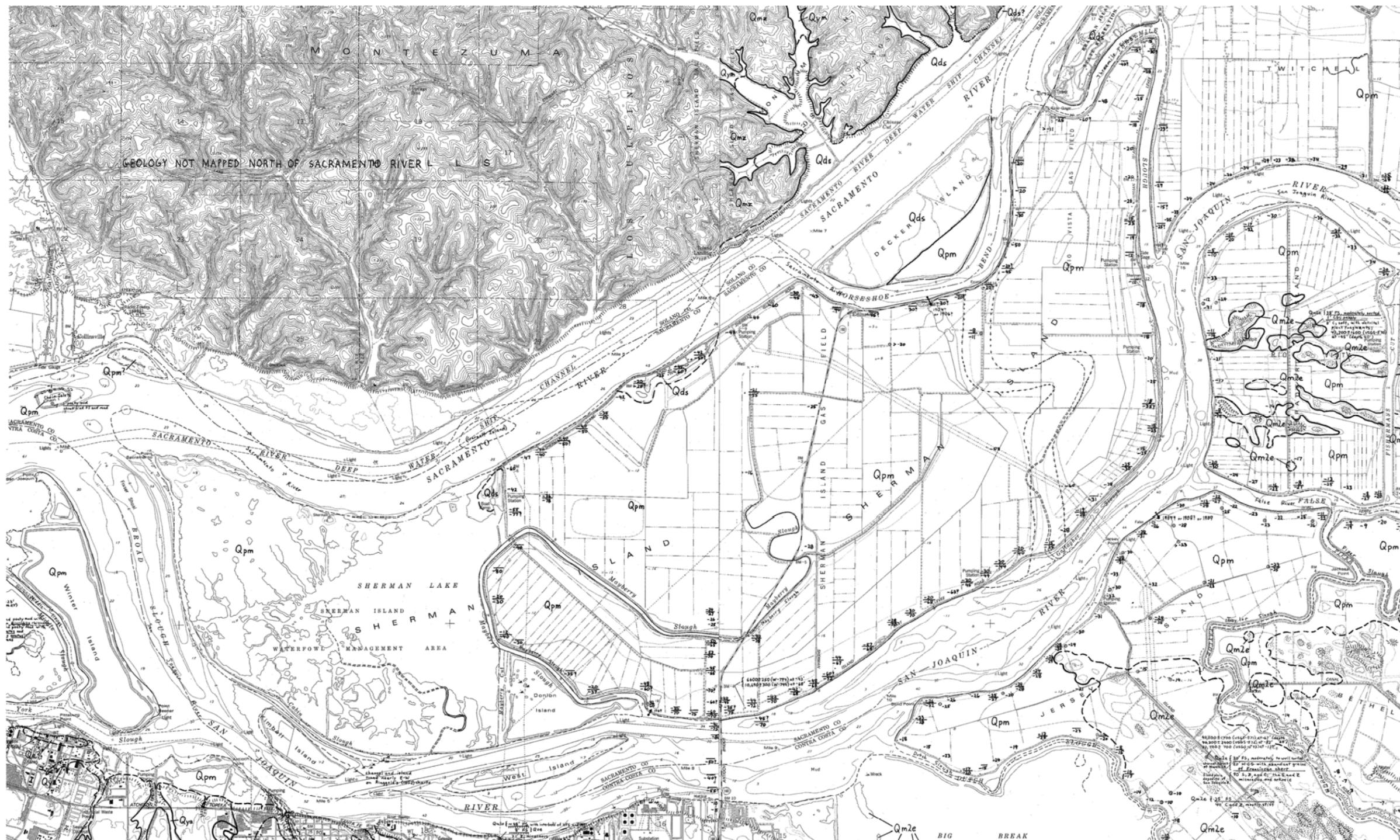
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Site Plan

Hultgren - Tillis Engineers

Project No. 798.06

Plate No. 2



- Qds:** Hydraulic-dredge soils (Holocene; post-1900)
- Qpm:** Peat and mud of tidal wetlands and waterways (Holocene)
- Qm2e:** Eolian deposits of upper member of Modesto Formation (Upper Pleistocene)
- Qym:** Younger alluvium of Montezuma Hills and vicinity (Holocene)
- Qya:** Youngest alluvium of Antioch and vicinity (Holocene)
- Qmz:** Montezuma Formation (Pleistocene)

Source: Map by Brian F. Atwater 1982.

Not to Scale

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

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

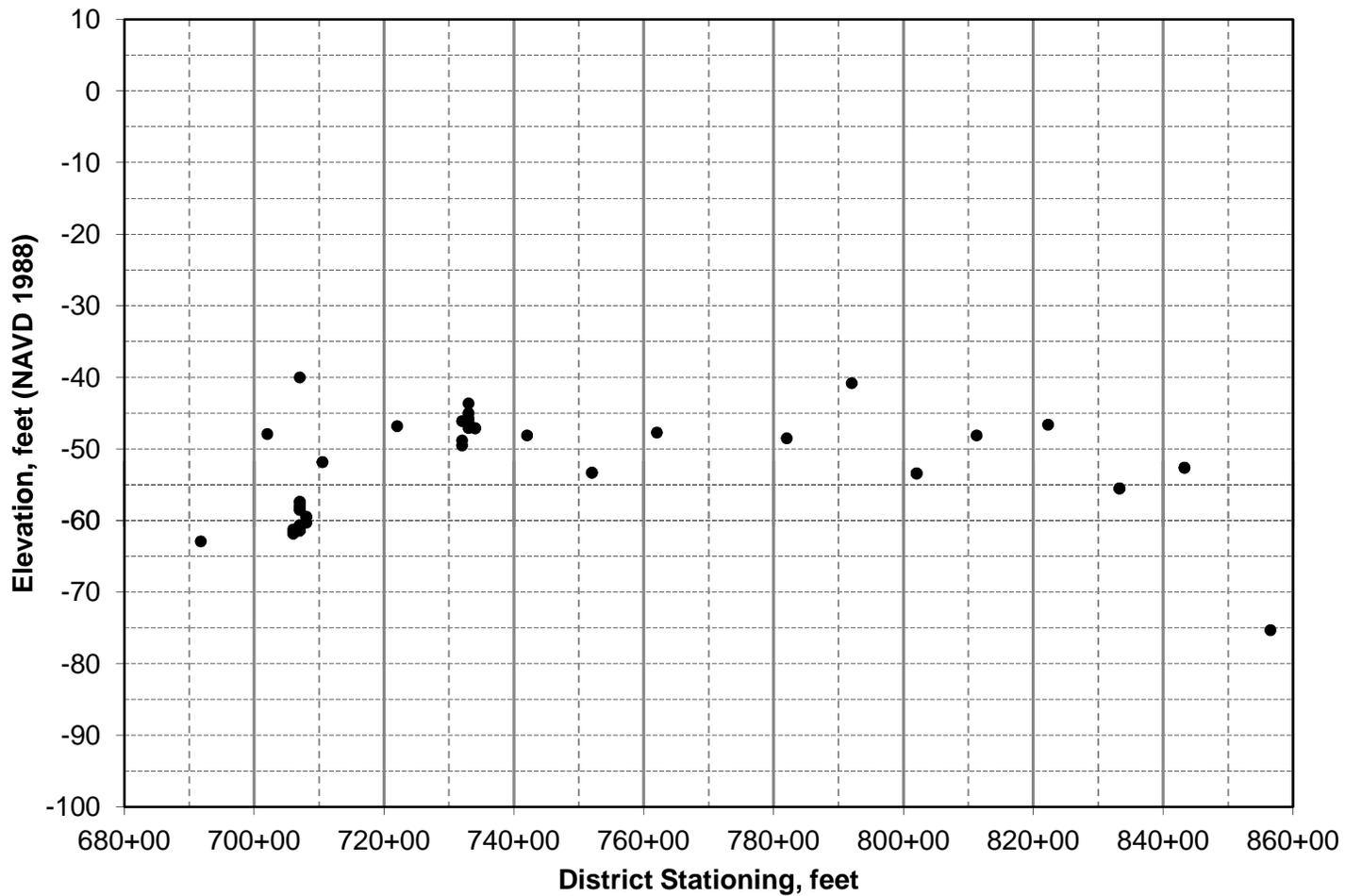
Geologic Map

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. 3

**Sherman Island
Reclamation District 341
Elevation of Base of Marsh Deposits**



● Base of Marsh Deposits

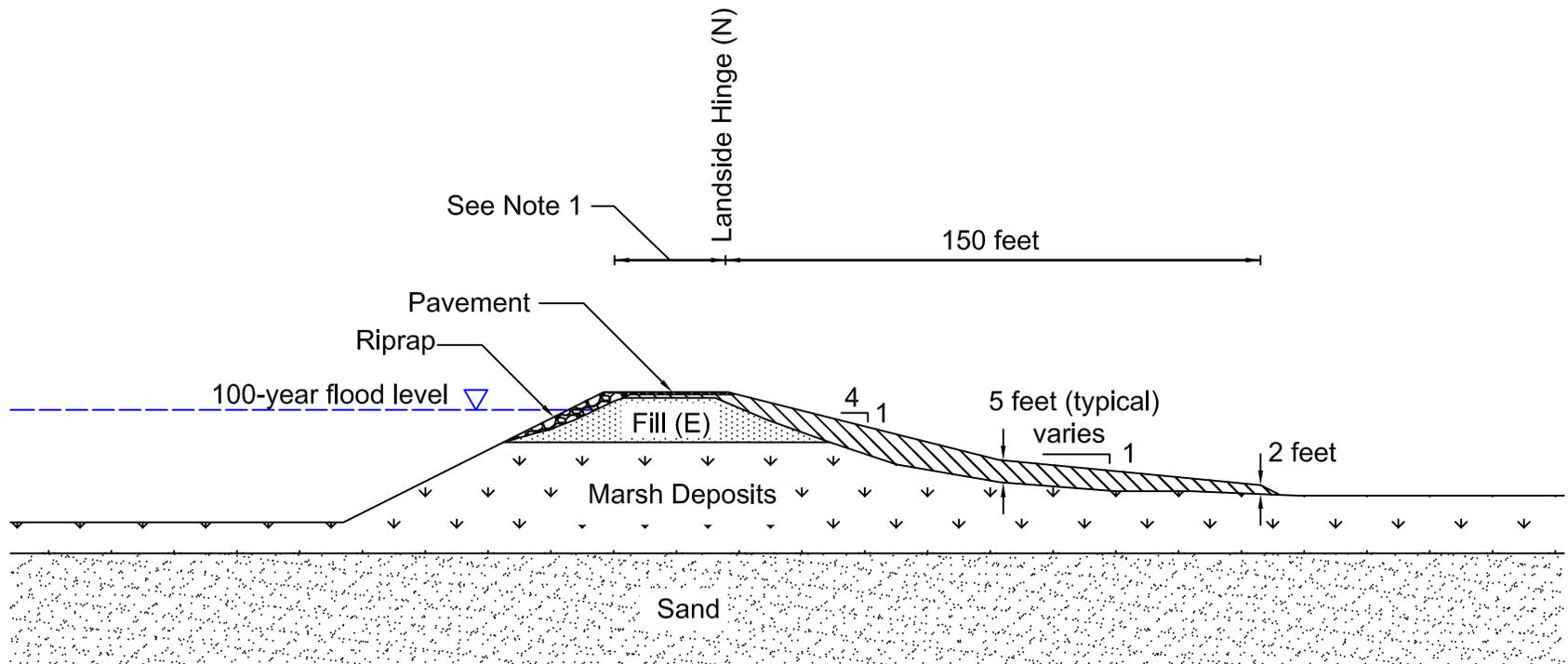
Sherman Island - Stations 700 to 850
Reclamation District 341
Sacramento County, California

Base of Marsh Deposits

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. 4



Note:

- (1) Crest width should conform to County's standard.
- (2) This typical design configuration does not cover the two fish release sites at Stations 707 and 733. Design sections for the two fish release sites are presented in a separate report.
- (3) Crest width of 22 feet (minimum) can be used between Stations 707 and 733. All-weather road should be provided on the levee crest.

NOT TO SCALE

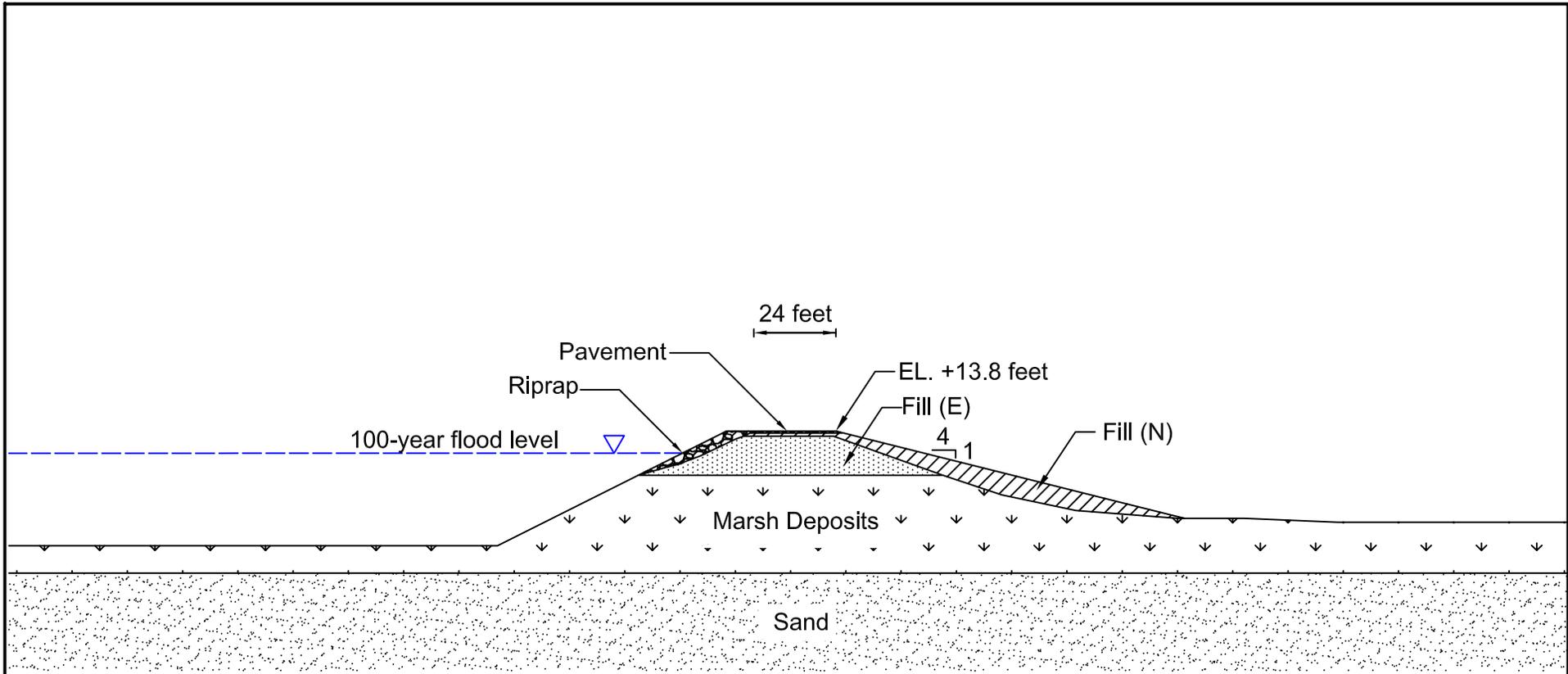
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

**Typical Design Configuration
 Stations 700 to 745**

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. 5



Note: (1) Crest width should conform to County's standard.

NOT TO SCALE	Sherman Island - Stations 700 to 850 Reclamation District 341 Sacramento County, California		Typical Design Configuration Stations 745 to 850	
	Hultgren - Tillis Engineers		Project No. 789.06	Plate No. 6

APPENDIX A
LOGS OF BORINGS
(1958 Salinity Control Barrier Investigation)

DRILL LOG

HOLE NUMBER 100BBs LOCATION Northwest corner of Sherman Island bordering the Sacramento River, approximately 1,100 feet north of 99BBs along the levee. Hole penetrates asphalt road at intersection of north-south and northeast-southwest levee roads, 4 feet northwest of road center line.

GROUND ELEV. 11.7 COUNTY Sacramento T 3N, R 3E, SEC 32E1, M.D.B.&M.

TOTAL DEPTH 135.0' DEPTH TO GROUND WATER _____ DATE DRILLED 3/1/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER
TYPE SAMPLE
DEPTH
TEST RECOMMENDED
LAB. NUMBER

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Asphalt and aggregate			↑ 4" fishtail with water
			Tan medium-grained sand with streaks of brown silt and black peat		Water return flow o.k.	
10	9		Dark brown, highly organic and plastic clay			↑
	10				Lost all water at this depth	
					4" casing to 14 feet	
20			Dark brown peat, generally nonfibrous however streaks of fibrous peat are present		Water returning but losing small amounts	
					Wash water colored dark brown	
	25		Soft slate-gray, somewhat organic, sandy silt with layers of very soft nonfibrous brown peat		Wash water becoming gray	
30						

Driller Hogate Logged by Thronson
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

155

HOLE NUMBER 1COBBs

SAMPLE DATA

SAMPLE NUMBER			
TYPE SAMPLE			
DEPTH			
TEST RECOMMENDED			
LAB. NUMBER			

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	30						Very soft to drop of rods
						Tiny fibers of peat in return water	
						Water return colored dark brown	
40						Very soft	
		41					
				Brown fibrous peat with thin streaks of gray clayey silt interspersed throughout		Return water tinted grey	
		46				Peat fibers still coming up	
							4" fishtail with water
50						Wash water is dark brown	
						Water still returning	
						Tiny brown peat fibers in return water	
				Dark brown nonfibrous peat-very soft			
60						Lumps of very soft decomposed peat coming up	
		68					
70							

156 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

(1) and (2)	
Drive	
86.5-87.5	
M.A., M.C. Unit Wt.	
Triaxial comp.	

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
				Very soft, gray, clayey silt and brown nonfibrous peat		Wash water tinted grey Very soft. Lumps of soft brown peat returning	4" fishtail with water
		75				Pressure fluctuates	
		77		Streaks of soft gray silt and fine-grained sand.		Very hard to rods dropping	
				Hard blue, silty sand (partially cemented with CaCO ₃)			
						No core obtained	NXM core barrel
					(1)&(2)	Blow count 7/6", 15/6", 26/6"	Drive 86.0-87.5
				Layers of dark blue to pale-grey clayey silt, silty clay and fine-grained sand. This material is very firmly packed and contains thin layers and nodules cemented with calcareous matter		No water return	
						Using mud below here-water returning	
						Pressure increases and decreases	4" fishtail with mud
						Full return	
						Hard layers are difficult and slow to drill through	

157 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 101BBs LOCATION Southwest side of Sherman Island bordering the Sacramento River. Hole penetrates asphalt road on levee crest, 4' southeast of center line. This levee is a potential failure section. It is 200 feet northeast of small failure area and active seep areas are noticed at landward toe of levee.
 GROUND ELEV. 13.7 COUNTY Sacramento T 3N, R 2E, SEC 32E1, M.D.B.&M.
 TOTAL DEPTH 81.0 DEPTH TO GROUND WATER _____ DATE DRILLED 3/2/56 9:28 A PST

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER _____
 TYPE SAMPLE _____
 DEPTH _____
 TEST RECOMMENDED _____
 LAB. NUMBER _____

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Road aggregate and asphalt			↑ 6" augers
	17				Forms 1" lumps	
	18		Tan silt			
20			Brown sand		Dry	
	24		Layers of gray sand and organic silt		Wet, curls loosely around augers	

Driller Hogate Logged by Thronson
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

159

HOLE NUMBER 101BBa

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
30	31		Brown, organic silty clay with thin thin streaks of brown fibrous peat		1" diameter lumps	
	34					6" augers
40			Firm brown fibrous peat		Augers push at 38' and 41 feet	
50					Spongy to drop of rods slow washing down No return flow	
	59					Wash drive barrel
60	59		Soft silt		Very soft to drop of rods-washes easily	
	64		Layers of soft silt and firm sand		Alternately soft and hard to drop of rods	
70						

160 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

HOLE NUMBER 101BBs

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

(1)		
Drive		
80.0-81.0		
M.A., Unit Wt.		

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	70		74				
				Slate-gray, medium-grained, silty sand		Firm to drop of rods	↓
80		81.0		Bottom of hole	(1)	Blow count 7/6", 12/6", 17/6"	Drive 79.5-81.0
90							

- 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 102BBs LOCATION Northwest side of Sherman Island bordering the Sacramento River, approximately 850 feet northeast of 101BBs along levee crest. Hole is 5' landward of center line of newly filled dirt road atop levee. This levee has failed previously and has numerous seeps at toe of levee and in field 2 to 300 yds southeast of levee toe.
 GROUND ELEV. 12.8 COUNTY Sacramento T 3N, R 2E, SEC 32C1, M.D.B.&M.
 TOTAL DEPTH 81.0 DEPTH TO GROUND WATER _____ DATE DRILLED 3/2/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER _____
 TYPE SAMPLE _____
 DEPTH _____
 TEST RECOMMENDED _____
 LAB. NUMBER _____

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0			Black silty peat		Dry and forms 1" lumps	↑ 6" augers
	5					
	6		Gravel old road surface			
			Brown medium-grained sand with streaks of black peat and gray clayey silt		Granular with 1" lumps	
10	10					
			Dark brownish-gray clayey, organic silt-tan oxidized layer at top.		Forms lumps and 1" diameter balls	
20						
	27					
30						

Driller Hogate Logged by Thronson
 1/ Drive sample - BFF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

162

HOLE NUMBER 102BB4

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	30						Silt curls loosely around augers
						Augers will push at 34.0'	
				Dark brown fibrous and nonfibrous peat with layers of soft gray-green organic silt		Peat curls tightly around augers	6"
40							
						Spongy to drop of rods	
50						No return	
		51					
				Soft silt		Very soft to drop of rods washes down easily	Wash drive barrel
60						No return flow	
		67					
				Soft silt with layers of firm sand-becomes firmer with depth		Alternately hard and soft to drop of rods	
70							

1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

HOLE NUMBER 102BBS

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
70						
	76				Becoming firmer	Wash drive barrel
			Gray, medium-grained sand		Hard to drop of rods	
80					Blow count	
	81			No sample obtained	10/6", 15/6", 21/6"	Drive 79.5-81.0
			Bottom of hole			
90						

164 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 103BBs LOCATION Northwest side of Sherman Island bordering the Sacramento River approximately 1,150 feet northeast of 102BBs along levee. Hole is in southeast side of gravel road atop levee, 4 feet southeast of center line. This area is between two badly failed levee sections. Seeps are present at landward toe of levee and
 GROUND ELEV. 13.8 COUNTY Sacramento T 3N, R 2E, SEC 32E1, M.D.B.&M. in field up to 100 yds distance southeast of levee toe.
 TOTAL DEPTH 72.0 DEPTH TO GROUND WATER _____ DATE DRILLED 3/6/56 10:53 A PST

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER	(1)
TYPE SAMPLE	Undisturbed (Shelby)
DEPTH	21.0-21.5
TEST RECOMMENDED	Consol., Unconfined Comp.
LAB. NUMBER	M.C., Unit Wt. Atterberg Limits, sensitivity.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Road aggregate			↑
	2		Dark brown medium-grained sand with streaks of dry black peat.		Forms 2" lumps	
	3		Dark grey clayey silt		Binds augers	
	4		Gravel (another road surface)			
			Brown medium-grained sand		Granular	6" augers
10	13		Tan organic silt with thin streaks of peat and medium-grained sand	Sample not kept	Forms 1" lumps in granular sand	Push Shelby 13.5-15.5
	18		Dark gray, highly organic to peaty sandy silt and clayey silt	(1)	Curls loosely around augers	6" augers Push Shelby 20.5-22.5
20	28					6" augers
30						↓

Driller Horate Logged by Thronson
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

165

SAMPLE DATA

SAMPLE NUMBER	(2)	(3)	(4)
TYPE SAMPLE	Undisturbed (Shelby)	Undisturbed (Shelby)	Undisturbed (Shelby)
DEPTH	30.C-31.5 (Use 30.5-31.5)	45.5-47.0	55.C-56.5 (Use 55.5-56.5)
TEST RECOMMENDED	Consol., Unconfined Comp. (Same as for (2))		Consol., Unconfined Comp.
LAB. NUMBER	M.C., Unit Wt., Sensitivity, Atterberg Limits		M.C., Unit Wt., Sensitivity Atterberg Limits

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	30					(2)	Hole caved to 15 feet when augers returned to hole
				Brown fibrous peat with layers and streaks of gray clayey silt and gray-green organic silt		Tight on augers	6" augers
40					(3)	Spongy to drop of rods	Push Shelby 45.C-47.0
		53				No return flow	Wash Shelby
50				Soft gray organic and clayey silt-highly plastic	(4)	Fairly firm to drop of rods	Push Shelby 55.C-56.5
		63				No return flow	Wash Shelby
60				Soft gray silt with streaks of firm sand	(5)	Alternately hard and soft to drop of rods	Push Shelby 65.C-67.0
		69				Hard to drop of rods	Wash drive barrel
70				Slate-gray, medium-grained sand			

166 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 104BBs LOCATION Northwest side of Sherman Island bordering the Sacramento River, approximately 1,000 feet northeast of 103BBs along levee. Hole penetrates center line of dirt road on levee crest. This hole is inside of border of failure zone of levee. There are numerous active seeps at toe of levee at this area.
 GROUND ELEV. 12.8 COUNTY Sacramento T 3N, R 2E, SEC 32A1, M.D.B.&M.

TOTAL DEPTH 71.0 DEPTH TO GROUND WATER _____ DATE DRILLED 3/6/56 1:31P PST

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Road gravel			↑ 6" augers
	5		Black peat with streaks of tan silt and sand		Forms 2" lumps	
10	18		Brown coarse-grained sand with streaks of dark gray peaty silt (old levee included?)		Granular with 1" lumps	
20	22		Tan organic silt-soft and plastic		Curly loosely around augers	
			Brown fibrous peat with streaks of gray-green organic and clayey silt		Curly around augers	
30						

Down dropped 2'

Driller Hogate Logged by Thronson
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

168

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMENDED
 LAB. NUMBER

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	0						
40							6" augers
50		52				Spongy to drop of rods	
60				Soft organic silt		Very soft to drop of rods, washes down easily No return flow	Wash drive barrel
		64					
70				Fine to medium-grained, well sorted blue-gray sand		Hard to drop of rods	

169 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

HOLE NUMBER 105BBs LOCATION Northwest edge of Sherman Island, bordering the Sacramento River, approximately 1,000 feet northeast of 104BBs. Hole penetrates landward side of asphalt road on levee crest 4' southeast of center line. Levee appears in good condition.

GROUND ELEV. 13.5 COUNTY Sacramento T 3N, R 2E, SEC 28N1, M.D.B.&M.

TOTAL DEPTH 78.5 DEPTH TO GROUND WATER _____ DATE DRILLED 3/6/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER		
TYPE SAMPLE		
DEPTH		
TEST RECOMMENDED		
LAB. NUMBER		

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Asphalt and aggregate			↑ 6" augers
			Coarse-grained brown sand		Granular	
10	12		Brown sand, streaks of dark gray organic silt (old levee)		Granular with 2" lumps	
	18	OG	Tan organic silt		1" balls formed	
20	21		Brownish-gray organic, silty sand. Small black oxidized particles of vegetation present		Augers will push at 24'	
30						

Driller Hogate Logged by Thronson

- 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

171

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	33						
40				Brown fibrous peat with layers of soft gray organic silt and fine-grained sand		Curls tightly around augers	6" augers
48						Spongy to drop of rods	
50				Soft clayey silt and organic silt		Very soft to drop of rods - washes down easily	
60						No return flow	Wash drive barrel
64				Layers of soft silt and firm sand		Alternately soft and firm to drop of rods	
69							

172 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

HOLE NUMBER 105BBa

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
70					Hard to drop of rods	
			Fine to medium-grained, blue-gray, well sorted sand			
				No sample obtained	Blow Count 2/6", 15/6", 22/6"	Drive 77.0-78.5
	78.5		Bottom of hole			
80						

173 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 106BBs LOCATION Northwestern side of Sherman Island bordering the Sacramento River approximately 1,000 feet northeast of 105BBs along the crest of the levee. Hole penetrates the southeast shoulder of asphalt road on levee crest. Levee appears stable here (no seeps, etc).

GROUND ELEV. 13.3 COUNTY Sacramento T 3N, R 2E, SEC 28N2, M.D.B.&M.

TOTAL DEPTH 75.5 DEPTH TO GROUND WATER _____ DATE DRILLED 3/7/56 9:44 A PST

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER
TYPE SAMPLE
DEPTH
TEST RECOMMENDED
LAB. NUMBER

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Gravel			↑ 6" augers
			Brown coarse-grained sand		Granular moist	
	5					
			Brown coarse-grained sand with thin streaks of dark gray silty peat		Granular with peat forming 1" lumps Moist	
10	9				Dry	
			Tan medium-grained sand with streaks of brown silt and black, dry peat <i>OG near Sea Level</i>		Generally granular with silt and peat forming 1" lumps	
	19		↓			
20			Dark grey-green, sandy organic silt-thin brown oxidized layer is present at the top.		Curls loosely around augers and forms thick puddles Augers will push at 24'	
	26					
30			Slate gray, very soft, highly organic silt with thin streaks of brown fibrous peat and gray, fine-grained sand		Curls loosely around augers	

Driller Wagner Logged by Thronson

- 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
2/ Auger - Continuous flight auger, unless otherwise indicated

174

HOLE NUMBER 106BEs

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
30						
	35					6" augers
40			Layers of brown fibrous peat and fibrous peat interspersed with pale gray clayey silt		Curls tightly around augers	
					Spongy to drop of rods	
50					No return flow	
	56				Very soft to drop of rods and washes down very easily	Wash drive barrel
60			Soft silt and clayey silt			
	69					Water returning
70						

175 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

HOLE NUMBER 106BBg

SAMPLE DATA

SAMPLE NUMBER	(1)	(2)
TYPE SAMPLE	Drive (2")	Drive (2")
DEPTH	74.5-75.0	75.0-75.5
TEST RECOMMENDED	M.C., Unit Wt., Atterberg	Unconfined comp. sensitivity
LAB. NUMBER	Limits	

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
70						
	73		Soft silt with streaks of firm sand		Alternately and soft to drop of rods	hard wash drive barrel
	75.5		Dark gray to slate-gray, firmly packed clay and calcareous silty clay.	(1)&(2)	Firm-won't wash high pressure Blow count 6/6", 11/6", 20/6"	Chopped dr. Drive 74.0-75.5
			Bottom of hole			
80						

176 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

HOLE NUMBER 107BBs LOCATION Northwest side of Sherman Island, bordering the Sacramento River, approximately 1,000 feet northeast of 106BBs along the levee. Hole penetrates the asphalt road on the crest of the levee 3 feet southeast at the center line. (Levee appears to be on hydraulic fill area).
 GROUND ELEV. 13.9 COUNTY Sacramento T 3N, R 2E, SEC 28L1, M.D.B.&M.
 TOTAL DEPTH 76.5' DEPTH TO GROUND WATER _____ DATE DRILLED 3/7/56 10:03 A PST

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER _____
 TYPE SAMPLE _____
 DEPTH _____
 TEST RECOMMENDED _____
 LAB. NUMBER _____

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Asphalt and aggregate			↑ 6" augers
			Brown coarse-grained sand with thin streaks of silt		Generally granular but silt forms 1" lumps	
10	9		Brown sand with thin streaks of silty black peat and brown silt		Granular and forms 1" balls	
	14		OG		Augers will push slightly	
20			Brown medium-grained, micaceous sand		Granular	
					Augers will not push at 24'	
30						

Driller Hogate Logged by Thronson
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

177

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	30		31				Augers will push at 31 feet
				Brown fibrous peat with layers of slate-gray sand and silt		The peat curls tightly around augers the sand and silt curls loosely around augers	
40		41				Granular	Wash drive barrel
				Slate-gray, micaceous, medium-grained sand-loosely packed		No return flow-sand binds rods	
50		55					Wash drive barrel
				Soft silt		Very soft to drop of rods -washes down easily.	
60		64				No return flow	Wash drive barrel
				Soft silt with streaks of firm sand		A ternately hard and soft to drop of rods water returning	
70							

178 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 108BBs LOCATION Northwest side of Sherman Island, bordering the Sacramento River, approximately 1,000 feet northeast of 107BBs along levee. Hole penetrates the southeastern side of the asphalt road on crest of levee 6 feet southeast of center line. (Levee on hydraulic fill?)
 GROUND ELEV. 14.7 COUNTY Sacramento T 3N, R 2E, SEC 28E2, M.D.B.&M.
 TOTAL DEPTH 52.0 DEPTH TO GROUND WATER _____ DATE DRILLED 3/7/56 1:40 P PST

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER		
TYPE SAMPLE		
DEPTH		
TEST RECOMMENDED		
LAB. NUMBER		

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Asphalt and aggregate			↑
			Brown coarse-grained sand		Granular	
	5					
			Tan, loosely packed medium-grained sand with gravel to 1" in diameter in very minor quantities			
10	10					
					Augers can be pushed at 10'	6"
			Brown medium-grained sand with thin streaks of silt		Difficult to augers push augers at 17' - very wet below 17'	
20						
	24					↓
			Gray-green to slate-grey, medium-grained micaceous sand. Some organic matter included. Gravel to 1/2" in diameter included in minor quantities		Curls loosely around augers and forms puddles	
30						

Driller Wagner Logged by Thronson

1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

180

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
30					Augers can be pushed but with difficulty	6" augers
40					Sloppy puddles formed	
50					Firm to drop of rods - no return flow	Wash drive barrel
	52.0		Bottom of hole	No sample obtained	Flow Count 3/6", 4/6", 5/6"	Drive 50.5-52.0
60						

- 181 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 109BBs LOCATION Northwest side of Sherman Island, bordering the Sacramento River, approximately 1,000 feet northeast of 108BBs along levee. Hole penetrates asphalt road on levee crest 5 feet southeast of center line. (Levee on hydraulic fill?)

GROUND ELEV. 14.1 COUNTY Sacramento T 3N, R 2E, SEC 28K1, M.D.B.&M.

TOTAL DEPTH 75.0 DEPTH TO GROUND WATER _____ DATE DRILLED 3/7/56 3:42 P PST

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER	
TYPE SAMPLE	
DEPTH	
TEST RECOMMENDED	
LAB. NUMBER	

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Asphalt and aggregate			↑ 6" augers
			Brown coarse-grained sand		Granular Moist	
	7					
10			Brown coarse-grained sand with streaks of black peat and tan silt		Granular with silt and peat forming 1" lumps	
	11					
	14		Tan, medium-grained sand O-S.		Dry-granular	
			Brownish-gray sandy silt, somewhat organic			
20					Curls loosely around augers	
	22					
			Soft, slate-gray, organic silt-very plastic			
30					Curls loosely around augers	

Driller Hogate Logged by Thronson

- 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
- 2/ Auger - Continuous flight auger, unless otherwise indicated

182

HOLE NUMBER 109BBs

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
30						
	34					6" augers
					Curls tightly around augers	
40			Brown fibrous peat			Push augers
					Spongy to drop of rods	
50					No return flow	Wash Shelby tube
	59			No sample obtained	Very soft to drop of rods	Push Shelby 59.0-60.5
60			Soft silt		Washes down easily	
	65				Alternately hard and soft to drop of rods	Wash Shelby tube
			Soft silt, streaks of firm sand			
70						

1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 110BBs LOCATION Northwest side of Sherman Island, bordering the Sacramento River, approximately 1,000 feet northeast of 109BBs along the levee. Hole located 10 feet southeast of landward toe of levee (hydraulic fill area).

GROUND ELEV. 8.8 COUNTY Sacramento T 3N, R 2E, SEC 28H1, M.D.B.&M.

TOTAL DEPTH 69.5 DEPTH TO GROUND WATER _____ DATE DRILLED 3/8/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER
TYPE SAMPLE
DEPTH
TEST RECOMMENDED
LAB. NUMBER

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0			Tan, medium-grained sand		Granular, dry	↑ 6" augers
	4				Granular, moist	
			Brown medium-grained, micaceous sand			
	14		▼ Slate-gray coarse-grained, micaceous sand		Met, curls loosely around augers	
20					Augers can't be pushed at 20½ feet	
30						

Driller Hogate Logged by Thronson
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

185

SAMPLE DATA

SAMPLE NUMBER	(1)
TYPE SAMPLE	Push (2" drive barrel)
DEPTH	68.C-69.5
TEST RECOMMENDED	Unconfined comp., M.C.
LAB. NUMBER	Unit wt. sensitivity

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
30							
		34				Water at 34'	6" augers
40				Layers of dark brown nonfibrous peat and slate-gray, medium-grained, micaceous sand-minor quantities of fibrous peat present		Augers can be pushed at 41-44' depth	
50						Spongy to drop of rods	
		52					Wash drive barrel
				Soft silt with streaks of firm sand		Alternately hard and soft to drop of rods	
60		60				No return flow	
				Slate-gray silty sand		Firmer to drop of rods	
		68				No sample obtained	Drive 65.C-66.5
						Flow Count 2/6" 1/6", 3/6"	
		69.5		Slate-gray silt and silty clay-fine filaments of brown stain (iron) interspersed	(1)	Water returning	Wash drive bpl
70				Bottom of hole		Difficult push	Push Drive bpl 68.C-69.5

- 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 111BBs LOCATION Northwest side of Sherman Island, bordering the Sacramento River, approximately 1,000 feet northeast of 110BBs along the levee. Hole is 3 feet southeast at shoulder of asphalt road on levee crest.

GROUND ELEV. 12.2 COUNTY Sacramento T 3N, R 2E, SEC 28N2, M.D.B.&M.

TOTAL DEPTH 31.5 DEPTH TO GROUND WATER _____ DATE DRILLED 3/8/56 2:40 P PST

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER
TYPE SAMPLE
DEPTH
TEST RECOMMENDED
LAB. NUMBER

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0			Tan silt		1/2" lumps	↑ 6" augers
	3		Brown medium-grained sand with streaks of dry black peat		Granular	
	5					
			Brown medium-grained sand		Granular and moist	
10						
20	21				Can't push augers at 20'	
			Medium to coarse-grained, micaceous sand		Curls loosely around augers	
30						

Driller Wagner Logged by Thronson
 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

187

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

(1)	(2)
Undisturbed (Shelby)	Undisturbed (Shelby)
52.0-53.5	60.5-62.0
Consolidation, Unconfined comp.	Consol., Triaxial comp.
M.C., Unit Wt.	M.C., Unit Wt., M.A.

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
		36				Can't push augers at 34'	
				Brown fibrous peat		Curls tightly around augers	6" augers
40		42				Augers can be pushed at 41'	Wash Shelby tube
				Gray medium-grained sand, micaceous			
		46				Spongy to drop of rods	
50				Brown fibrous peat with streaks of sand and clayey silt	(1)	Easy push	Push Shelby tube 50.5-53.5
						No return flow	Wash Shelby Tube
		57				Very soft to drop of rods	
60				Soft gray silt	(2)	Water returning	Push Shelby tube 60.0-62.0
							4" fishtail
		68				Firm to drop of rods	
70							

- 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

189

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	73		Soft silt with sand streaks		Water returning	4" fishtail ↓
			Slate-grey firmly packed silty sand with sand streaks		Fairly hard to drop of rods	
80	81.5		Bottom of hole	No sample obtained	Hard to drop of rods. Blow Count 11/6", 27/6"	Drive 80.5-81.5

189
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 112BBs LOCATION Northwest side of Sherman Island bordering the Sacramento River, approximately 1,000 feet northeast of 111BBs along the levee. Hole penetrates asphalt road on levee crest 4 feet southeast of road center line.

GROUND ELEV. 13.5 COUNTY Sacramento T 3N, R 2E, SEC 27D1, M.D.B.&M.

TOTAL DEPTH 73.5 DEPTH TO GROUND WATER _____ DATE DRILLED 3/9/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER		
TYPE SAMPLE		
DEPTH		
TEST RECOMMENDED		
LAB. NUMBER		

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Asphalt and aggregate			↑ 6" augers
			Brown medium-grained silty sand		Moist Generally granular silt forms 1/2" lumps	
	3				Granular	
	4		Gray medium-grained sand		Dry - Forms 1/2" lumps	
			Brownish-gray peaty silt			
10	12				Difficult to push augers	
			Tan, medium-grained sand		Dry-granular	
20	21		✓ OG		Can't push augers 20 1/2'	
			Slate-gray medium-grained micaceous sand		Curls loosely around augers	
30						

Driller Lee Logged by Thronson
 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

190

SAMPLE DATA

SAMPLE NUMBER	
TYPE SAMPLE	
DEPTH	
TEST RECOMMENDED	
LAB. NUMBER	

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	30		31		Brown fibrous and nonfibrous peat		Augers can be pushed at 31'
40		40				Forms sloppy puddles with augers	
50				Brown fibrous and nonfibrous peat interbedded with layers of medium-grained sand		Augers can be pushed at 41'	Wash drive barrel
						No return flow-spongy to drop of rods-soft at sand layers	
60		57		Soft silt		Water returning	Wash drive barrel
						Very soft to drop of rods	
70		64		Soft silt with streaks of firmer sand		Alternately soft and hard to drop of rods	

1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

191

SAMPLE DATA

SAMPLE NUMBER	(1)
TYPE SAMPLE	Drive (2")
DEPTH	73.0-73.5
TEST RECOMMENDED	M.C., Unit Wt., Unconfined
LAB. NUMBER	COMP.

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	70	70					
		73.5		Dark blue very firmly packed silt and silty clay	(1)	Firm to drop of rods Blow Count 5/8", 1 1/8"	Chop down drive barrel Drive 72.0-73.5
				Bottom of hole		18/6"	
80							

192 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

DRILL LOG

HOLE NUMBER 113BBs LOCATION Northwest side of Sherman Island bordering the Sacramento River approximately 1,000 feet northeast of 112BBs along the levee. Hole is one foot northwest of shoulder of asphalt road on levee crest

GROUND ELEV. 13.0 COUNTY Sacramento T 3N, R 2E, SEC 27C1, M.D.B.&M.

TOTAL DEPTH 77.0 DEPTH TO GROUND WATER _____ DATE DRILLED 3/9/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER
TYPE SAMPLE
DEPTH
TEST RECOMMENDED
LAB. NUMBER

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0			Tan to dark brown silt and peaty silt		Forms 1/2" lumps	↑ 6" augers
	3		Brown medium-grained sand with streaks of tan silt and black peat		Moist granular with silt and peat forming 1/2" lumps	
	9		Brown medium-grained micaceous sand. Streaks of black peat		Moist generally granular with peat forming 1/2" lumps	
10						
	22		Blue-gray medium-grained, micaceous sand		Wet - curls loosely around augers	
					Augers can't be pushed at 27'	
20						
30						

Driller Hogate Logged by Thronson
 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

193

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
30					Augers can't be pushed at 31'	
34 1/2					Augers can be pushed at 34 1/2' but difficult	6" augers
40			Brown fibrous and nonfibrous peat layers of blue-gray medium-grained micaceous sand		Peat curls tightly around augers Difficult push at 41'	
50					No return flow spongy to drop of rods	
53					Water returning	
60			Soft silt		Soft to drop of rods -washing down easily	Wash drive barrel
62					Water returning	
68			Soft silt with streaks of firm sand		Alternately firm and soft to drop of rods	
70			Sand		Firm to drop of rods	

1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

194

DRILL LOG

HOLE NUMBER 114BBs LOCATION Northwest side of Sherman Island, bordering the Sacramento River approximately 1,200 feet northeast of 113BBs along the levee. Hole penetrates riverward shoulder of asphalt road on levee crest.

GROUND ELEV. 14.1 COUNTY Sacramento T 3N, R 2E, SEC 27C2, M.D.B.&M.
(Artesian)

TOTAL DEPTH 101.0 DEPTH TO GROUND WATER 2.1 DATE DRILLED 3/12/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER
TYPE SAMPLE
DEPTH
TEST RECOMMENDED
LAB. NUMBER

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0						
	6		Tan fine to medium-grained sand with streaks of brown silt and dry black peat		4" casing to 4 feet	↑ 4" fishtail using mud
10			Grayish-brown fine to medium-grained micaceous sand		Losing some water	
	16					
20			Brown fine-grained, micaceous sand.			
	24					
30			Slate-gray fine to medium-grained, micaceous sand		Firm to drop of rods	

Driller Wagner Logged by Thronson
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

196

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	0				<i>Sand</i>		Losing some water Firm to drop of rods
40		43		Twigs, small leaves, and tiny bits of wood coming up with sand in water return			
						Return water stained dark brown	4" fishtail
50				Brown, nonfibrous peat		Spongy and soft to drop of rods	
60		60				Lost water at 58'	
				Brown nonfibrous peat interbedded with layers of soft silt		Loosing large amounts of water	
70							

197 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

HOLE NUMBER 117888

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
70	72		Firmly packed blue-gray silt, layers of sandy silt and sand.		Very firm to drop of rods Losing water in sand layers	
80					Artesian flow 4" below here	fishtail
90	92		Layers of yellowish brown silt and brown sand			
100	101.0		Bottom of hole		Water flowed out of drill rods for 5 min after hole completed	
110						

1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

198

DRILL LOG

HOLE NUMBER 115BRs LOCATION Northwest side of Sherman Island, bordering the Sacramento River, approximately 1,000 feet northeast of 114BRs along the levee. Hole 15 located 10 feet northwest of the riverward shoulder of asphalt road on levee crest.

GROUND ELEV. 13.0 COUNTY Sacramento T 3N, R 2E, SEC 22Q1, M.D.B.&M.

TOTAL DEPTH 75.5 DEPTH TO GROUND WATER _____ DATE DRILLED 3/13/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER
TYPE SAMPLE
DEPTH
TEST RECOMMENDED
LAB. NUMBER

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0			Reddish brown to dark brown or black silt and peaty silt		Dry and powdery	↑ 6" augers
	7					
10			Black silty peat			
	11					
			Tan, medium-grained, micaceous sand		Granular Augers can't be pushed at 17'	
20						
	22					
			Blue-gray coarse-grained, micaceous sand		Wet Augers can't be pushed at 24' Curls loosely around augers	
30						

Driller Lee Logged by Thronson

- 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
- 2/ Auger - Continuous flight auger, unless otherwise indicated

199

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

(1)	(2)
Undisturbed (Shelby)	Undisturbed (Shelby)
50.5-52.0	60.0-61.5
Unconfined comp., Consol.	Consol. unconfined comp. or
M.C., Unit Wt., Sensitivity	Triaxial comp., M.C., Unit Wt., Sensitivity

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
30	31				Augers can be pushed with difficulty at 31' and 34' depths	6" augers
40			Layers of dark brown nonfibrous peat and soft brownish-green organic clayey silt. Thin streaks of blue-gray medium-grained, micaceous sand interspersed throughout		Peat and silt curl tightly around augers sand forms thick puddles	
	45				Augers can be pushed easily at 41'	
50			Thin streaks of gray clayey silt and brown fibrous peat interlaminated. (Fissile characteristics from compaction due to weight of overlying material of artificial levee)	(1)	Fairly firm to drop of rods No return flow	Wash Shelby Tube Push Shelby Tube 50.0-52.0
	57				Water returning at this depth	Wash Shelby Tube
60			Soft, slate-gray silt with streaks of dark brown peat	(2)	Very soft to drop of rods washing down easily	Push Shelby Tube 60.0-61.5 Wash Drive Barrel
	68					
70			Soft silt and firm sand		Alternately soft and hard to drop of rods	

1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

200

ROLL NUMBER 115Bba

SAMPLE DATA

SAMPLE NUMBER
 TYPE SAMPLE
 DEPTH
 TEST RECOMMENDED
 LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
70						Wash drive barrel
	73		Gray, silty, coarse-grained sand	No sample obtained	Blow Count 6/6", 8/6", 6/6"	Drive 74.C-75.5
	75.5					
80						

1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

201

DRILL LOG

HOLE NUMBER 116BBs LOCATION Northwest side of Sherman Island bordering Horseshoe Bend, approximately 1,000 feet southeast of the bend in the levee road that flanks the Sacramento River. Hole penetrates asphalt road on levee crest 10 feet southwest of landward shoulder
 GROUND ELEV. 13.3 COUNTY Sacramento T 3N, R 2E, SEC 22R1, M.D.B.&M.
 TOTAL DEPTH 102.0 DEPTH TO GROUND WATER _____ DATE DRILLED 3/13/56

SOILS LAB. NOS.

SAMPLE DATA

SAMPLE NUMBER _____
 TYPE SAMPLE _____
 DEPTH _____
 TEST RECOMMENDED _____
 LAB. NUMBER _____

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
0	1		Asphalt and aggregate			↑
			Layers of brown, silty, coarse-grained sand and gray to brown silt		Granular-silt forms 1" balls	
10	10		Brownish-green organic silt with streaks of brown medium-grained sand		Augers can be 6" pushed at 13" augers	↑
					Forms 1" balls	
20	26		Gray silty clay-very plastic		Curled around augers	
	27		Dark brown nonfibrous peat		Sudden flow of water	
30						

Driller Wagner Logged by Thronson
 1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 2/ Auger - Continuous flight auger, unless otherwise indicated

HOLE NUMBER 116BBg

SAMPLE DATA

SAMPLE NUMBER
TYPE SAMPLE
DEPTH
TEST RECOMMENDED
LAB. NUMBER

SOILS LAB. NOS.

ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
30					Augers can be pushed at 31'	
	37					6" augers
40			Dark brown nonfibrous peat with layers and streaks of blue-gray medium-grained, micaceous sand		Difficult to push augers Peat curls tightly around augers	
50					No return flow spongy to drop of rods	Wash drive barrel
	57					
60			Soft silt		Very soft to drop of rods No return flow	
	68					
70			Soft silt with streaks of firm sand		Alternately hard and soft to drop of rods	

1/ Drive sample - BPF for 2½" or 4½" O.D. sampler driven with 350 lb. hammer, 1.2' drop
2/ Auger - Continuous flight auger, unless otherwise indicated

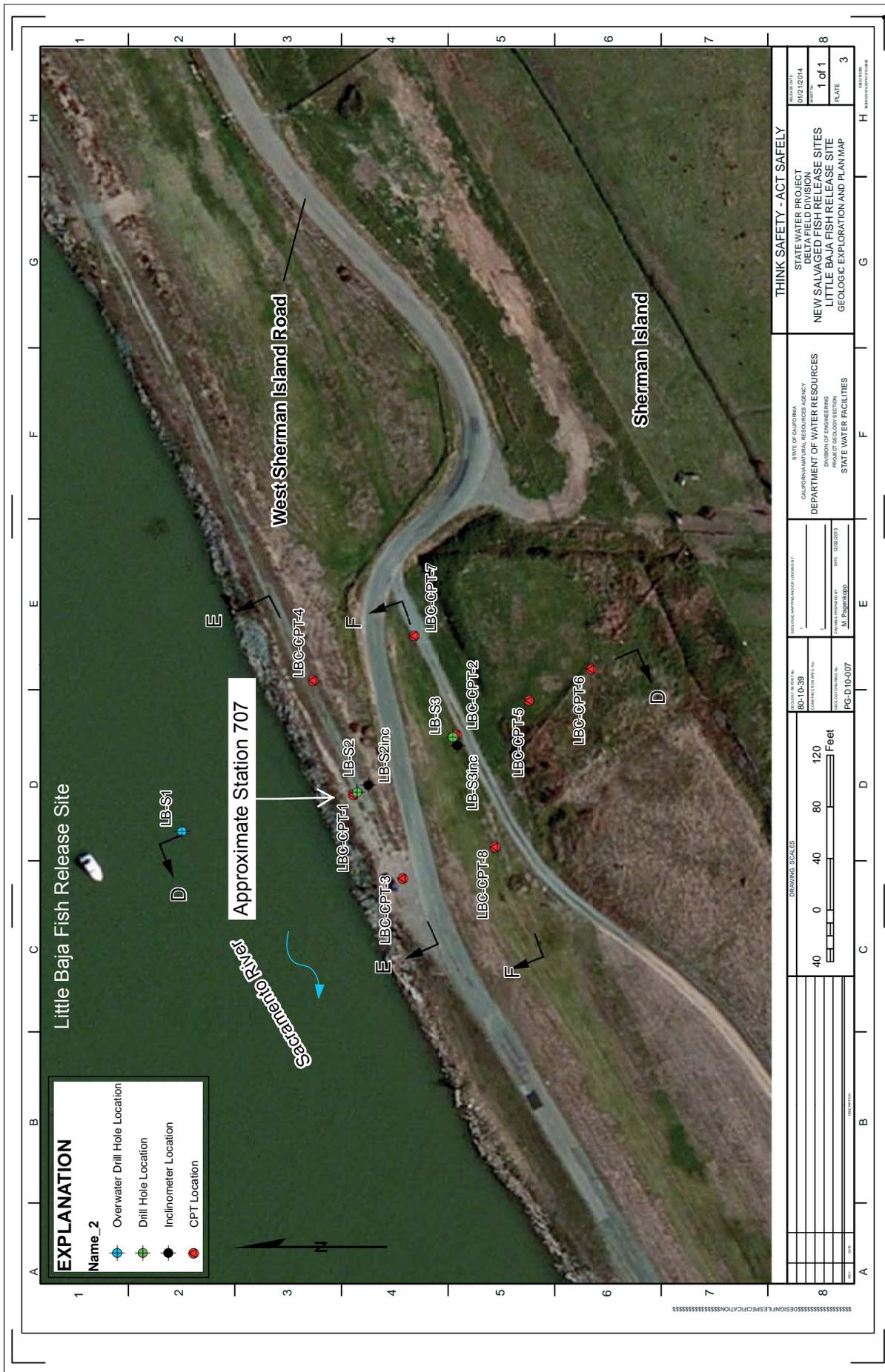
SAMPLE DATA

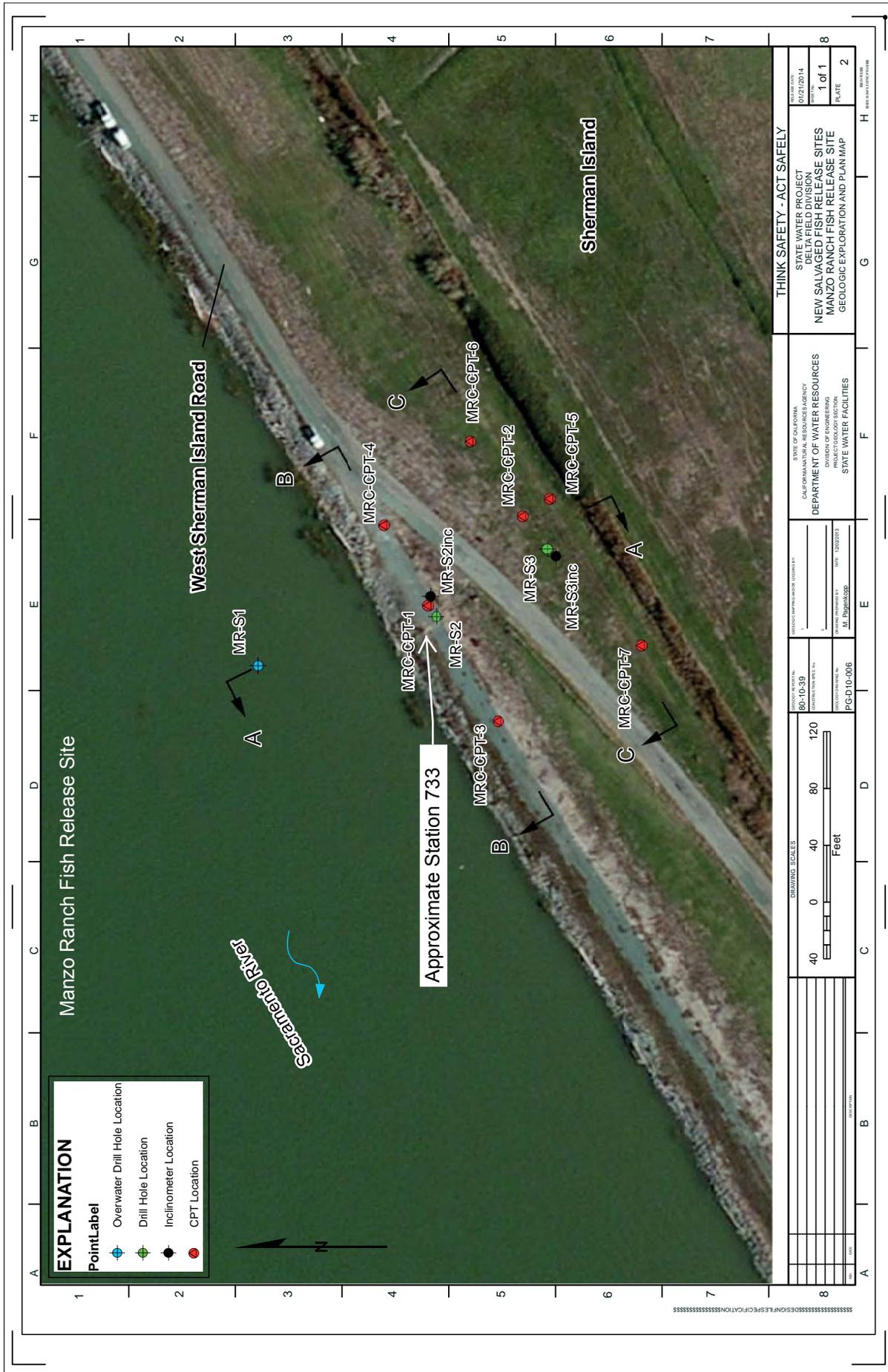
SAMPLE NUMBER	(1)
TYPE SAMPLE	Drive
DEPTH	101.0-102.0
TEST RECOMMENDED	M.A., Unit Wt.,
LAB. NUMBER	Carbon 14?

SOILS LAB. NOS.	ELEV.	DEPTH	GRAPHIC LOG	CLASSIFICATION AND DESCRIPTION	SAMPLE NUMBER	DRILLING INFORMATION	METHOD OF DRILLING
	70		71				Pressure increase Very soft to drop of rods washes down easily
80				Soft clayey silt		No return flow	Wash drive barrel
90		91					
		94		Soft clayey silt and firm sand		Alternately hard and soft to drop of rods	
100				Light brown, poorly sorted silty sand and gravel. Sand varies and is from fine to medium-grained; the gravel consists of well rounded particles up to 1/4" in diameter		Hard to drop of rods No return flow	
		102.0		Bottom of hole	(1)	Blow Count 22/6", 29/6" (Too difficult to drive further)	Drive 101.0-102.0
110							

- 3
- 1/ Drive sample - BPF for 2 1/2" or 4 1/2" O.D. sampler driven with 350 lb. hammer, 1.2' drop
 - 2/ Auger - Continuous flight auger, unless otherwise indicated

APPENDIX B
LOGS OF BORINGS AND CPT'S
(2014 Project Geology Report 80-10-39)







Project: NEW SALVAGED FISH RELEASE SITES
Feature: / Sacramento River
 Coordinates: North 2,213,514.06 East 6,195,485.69
 Survey Method: Ground Survey Datum: NAD83
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DATE STARTED 8/12/13	DATE COMPLETED 8/14/13	GROUND ELEVATION 8.00 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 113.5 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.		DRILLER'S NAME Chris St. Pierre	HELPER'S NAME Jose Sagrero	TOTAL DEPTH OF FILL
DRILLING METHOD 0 - 113.5 ft: RD		DRILL RIG MAKE AND MODEL Mobile B-80		DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 5 3/4" drag bit		DRILLING ROD TYPE AND DIAMETER 4.5" O.D. HWT		FIELD LOGGER Hightower
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		CASING TYPE, DIAMETER, INSTALLATION DEPTH 8.625" O.D. threaded steel to 45'		FIELD LOG REVIEWER
SAMPLER TYPE(S) 2" SPT, 3" Shelby Tube, 134 mm Punch Core, 3" Pitcher		HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP Marl, automatic, 140 lbs / 30-inch drop		HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with 95% cement, 5% bentonite by wt.		GROUNDWATER READING: DURING DRILLING AFTER DRILLING (DATE-TIME)		

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS		
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests	
0			0.0 to 1.5' Deck of Quin Delta.	(RD)														
1			1.5 to 20.1' Water-Sacramento River.	(RD)														
2				(RD)														
3				(RD)														
4				(RD)														
5				(RD)														
6				(RD)														
7				(RD)														
8				(RD)														
9				(RD)														
10				(RD)														
11				(RD)														
12				(RD)														
13				(RD)														
14				(RD)														
15				(RD)														
16				(RD)														
17				(RD)														
18				(RD)														
19			(RD)															
20			(RD)															

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PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14



Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	LABORATORY DATA							REMARKS							
					Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample Water Content %		Liquid Limit	Plasticity Index	Fines% < #200	Other Lab Tests			
20			<u>Quaternary, (Qal)</u> 20.1 to 113.5'																
21			20.1 to 30.0' <u>ORGANIC SILT with Sand, o(ML)s</u> : About 50% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 35% organics, non-decomposed organic fibers, thick root-like fibers and large wood chunks > 1.5" diameter and +3" length; about 15% fine sand; very soft, very dark gray, wet; organic odor; no reaction with HCl.																
22																			
23																			
24																			
25		o(ML)s																	
26																			
27																			
28				SPT	100	0	0	0	0				41	28	47	OC		S01A-027.0-028.5	
29																			
30			30.0 to 42.5' <u>ORGANIC LEAN CLAY, (OL)</u> : About 60% medium plasticity, medium dry strength, no dilatancy, low toughness fines; about 40% organics, slightly decomposed organics, leaf and root-like material; very soft, very dark brown, wet; organic odor; no reaction with HCl; organic content varies, could be peat.																
31																			
32																			
33				SPT	100	0	1	2	3	<0.25P 0.2T		7							S02A-032.0-033.5
34																			
35																			
36		OL																	
37																			
38				SHELBY		82													T01A-037.0-038.8
39																			
40			At 39.2' 0.3' thick spongy peat layer, non-altered leaf material. From 39.5' alternating layers of dark gray clay and slightly decomposed organic material, spongy feel. At 41.2' 0.3' peat layer, black slightly altered organic leaf and root material.																
41				SPT	100	0	1	1	1										S03A-039.5-041.0
42																			
43			42.5 to 48.2' <u>SANDY ELASTIC SILT, s(MH)</u> : About 70% low plasticity, medium dry strength, slow dilatancy, low toughness fines; about 30% fine sand; very soft, dark greenish gray, wet; no reaction with HCl; trace organic fibers.																
44																			
45		s(MH)		POORE		37													P01A-041.5-042.0
				SPT	93	0	1	3	4										S04A-044.0-045.4

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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				REMARKS	
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
45			42.5 to 48.2' SANDY ELASTIC SILT, s(MH) : About 70% low plasticity, medium dry strength, slow dilatancy, low toughness fines; about 30% fine sand; very soft, dark greenish gray, wet; no reaction with HCl; trace organic fibers. (Continued)	SPT	93	2	3	4									
46		s(MH)		PCORE	0												
47			From 47.0' About 60% low plasticity fines; about 40% fine sand.	SPT	100	0	0	0									S05A-047.0-048.5
48			48.2 to 53.0' SANDY LEAN CLAY, s(CL) : About 70% medium plasticity, high dry strength, no dilatancy, medium toughness fines; about 30% fine sand; very soft, dark greenish gray, wet; no reaction with HCl.	PCORE	9												
49		s(CL)															
50																	
51																	
52																	
53			53.0 to 56.8' CLAYEY SAND, (SC/CL) : About 50% fine to medium sand; about 50% low to medium plasticity, slow dilatancy, low to medium toughness fines; loose, dark greenish gray, moist; no reaction with HCl.	SHELBY	0												
54																	
55		SC/CL		SPT	0	3	4	6	8								Shelby pushed with 50 psi downpressure
56																	
57			56.8 to 59.3' SILTY SAND, (SM) : About 80% fine to medium sand; about 20% nonplastic fines; loose, dark greenish gray, wet; no reaction with HCl; trace mica.	RD	100												P04A-056.0-056.5
58		SM		SPT	100	1	3	8	10								S07A-057.0-058.5
59																	
60			59.3 to 69.2' Poorly Graded SAND with Silt, (SP-SM) : About 90% fine to medium sand; about 10% nonplastic fines; medium dense, dark gray, wet; no reaction with HCl; abundant mica.	PCORE	80												
61																	P05A-058.5-059.0
62																	
63				SPT	87	5	7	17	22						13		S08A-062.0-063.2 Lab. Classification: SILTY SAND (SM)
64		SP-SM															
65				PCORE	74												
66			From 65.0' trace coarse sand, trace fine subrounded gravel. Max sieve size is about 3/8".														
67																	
68				SPT	73	3	10	29	38								
69																	
70		(CH)s	Description on next page.	PCORE	100												

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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS		
											Retained Sample	Water Content %	Liquidity Limit	Plasticity Index	Fines% < #200		Other Lab Tests	
70			69.2 to 72.8' FAT CLAY with Sand, (CH)s : About 80% high plasticity, very high dry strength, no dilatancy, high toughness fines; about 20% fine sand; hard, greenish gray, moist; strong reaction with HCl; calcium carbonate nodules. (Continued)	POCORE		100												
71		(CH)s									2.0T							P07A-070.5-071.0
72			At 72.2' 0.2' layer of cemented carbonate with a strong HCL reaction.								>4.5P							
73	-65	SC	72.8 to 74.2' CLAYEY SAND, (SC) : About 70% fine sand; about 30% medium plasticity fines; dense, greenish gray, moist; no reaction with HCl.	SPT		100	5	11	26	34								S10A-072.0-072.8
74			From 73.8' About 60% fine sand; about 40% medium plasticity fines.															S10B-072.8-073.5
75			74.2 to 88.9' FAT CLAY, (CH) : About 90% high plasticity, very high dry strength, no dilatancy, high toughness fines; about 10% fine sand; hard, greenish gray, moist; strong reaction with HCl; abundant calcium carbonate nodules, slightly indurated.	POCORE		74												P08A-074.5-075.0
76																		P08B-075.5-076.0
77																		
78	-70		From 74.4' olive brown.								>4.5P							T03A-077.0-078.1
79			From 77.0' About 95% high plasticity fines; about 5% fine sand.	PITCHER		44					1.8T							
80			From 79.6' yellowish brown.															
81				SPT		100	7	12	27	35								S11A-079.5-078.1
82		CH									>4.5P							P09A-081.0-081.5
83	-75			PITCHER		40					>4.5P							T04A-082.0-083.0
84																		
85				SPT		93	5	10	22	28								S12A-084.5-085.9
86																		
87																		P10A-086.0-086.5
88	-80			SPT		100	4	8	18	23		3.0P						S13A-087.0-088.5
89											3.75P							
90			88.9 to 106.0' FAT CLAY with Sand, (CH)s : About 85% high plasticity, very high dry strength, no dilatancy, high toughness fines; about 15% sand; hard, reddish brown, moist; strong reaction with HCl; trace fine to coarse rounded gravel, max size about 1"; slightly indurated.	POCORE		100					>4.5P							
91											1.8T							P11A-090.0-090.5
92		(CH)s									>4.5P							
93	-85			SPT		100	6	10	24	31								S14A-092.0-093.5
94																		
95			From 94.0' strong reaction with HCl; no gravel; abundant calcium carbonate stringers.								>4.5P							P12A-094.5-095.0

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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS		
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests	
95			88.9 to 106.0' FAT CLAY with Sand, (CH)s : About 85% high plasticity, very high dry strength, no dilatancy, high toughness fines; about 15% sand; hard, reddish brown, moist; strong reaction with HCl; trace fine to coarse rounded gravel, max size about 1"; slightly indurated. <i>(Continued)</i>	PITCHER	56												T05A-094.5-095.9	
96																		
97																		
-90	98			From 97.8' moderately indurated. From 97.9' greenish gray mottling to 99.5'.	SPT	67	12	15	34	44								S15A-097.0-098.0
99																		
100				At 99.3' 0.2' layer with about 5% fine rounded gravel up to 1/2" diameter.														P13A-098.5-099.0
101				101.0' sandy fat clay layer 0.1' thick.	PCOIRE	91						>4.5P						P13B-100.0-100.5
102																		
-95	103			From 102.0' fine sand sized green nodules, same bright green as mottling above.	SPT	100	10	16	38	49								S16A-102.0-103.5
104																		
105				At 104.0' 1.4' thick layer of 25% fine sand, trace fine rounded gravel up to 3/8", abundant calcium carbonate masses and nodules.	PCOIRE	77												P14A-104.0-104.5
106																		
107				From 105.6' greenish gray, strong reaction with HCl; mottled with dark greenish gray;; about 20 fine sand, no gravel, abundant calcium carbonate nodules.														
-100	108		106.0 to 113.5' SILTY SAND, (SM/ML) : About 50% fine to medium sand; about 50% low plasticity, rapid dilatancy fines; dense, dark greenish gray, moist; strong reaction with HCl; abundant calcium carbonate stringers.	SPT	100	9	16	56	73									S17A-107.0-108.5
109																		
110			At 108.1' strong reaction with HCl; 0.2' layer cemented with calcium carbonate.															
111			At 109.5' 0.5' gravel layer with 1-1/4" rounded gravel.	PCOIRE	11													
112																		
-105	113			SPT	100	9	14	37	48									S18A-1120.-113.5
114			Boring terminated at 113.5' below ship deck.															
115																		
116																		
117																		
-110	118																	
119																		
120																		

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

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Project: NEW SALVAGED FISH RELEASE SITES
Feature: / Sherman Island
 Coordinates: North 2,213,388.55 East 6,195,520.24
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

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DATE STARTED 7/17/13	DATE COMPLETED 7/19/13	GROUND ELEVATION 13.37 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 99.0 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	DRILLER'S NAME Luis Torres	HELPER'S NAME James McIntyre	TOTAL DEPTH OF FILL 23.1 ft	
DRILLING METHOD 0 - 5 ft: HA, 5 - 32 ft: HSA, 32 - 99 ft: RD		DRILL RIG MAKE AND MODEL Mobile B-53		DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6.5" O.D. HSA bit/ 5-3/4" O.D. punch core bit		DRILLING ROD TYPE AND DIAMETER 4.5" O.D. HWT		FIELD LOGGER Perry
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		CASING TYPE, DIAMETER, INSTALLATION DEPTH 6.625" O.D. threaded steel to 30'		FIELD LOG REVIEWER
SAMPLER TYPE(S) 2" SPT, 3" Shelby Tube, 134 mm Punch Core, 3" Pitcher		HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP Marl, automatic, 140 lbs / 30-inch drop		HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with 95% cement, 5% bentonite by wt.		GROUNDWATER READING: DURING DRILLING		AFTER DRILLING (DATE-TIME)

PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200	
0	0	(GP)s	LEVEE FILL. (Qaf) 0.0 to 23.1'	Hand Auger												B01A-000.0-005.0
1	0.0 to 0.5'		0.0 to 0.5' Poorly Graded GRAVEL with Sand. (GP)s: About 85% fine, angular to subangular gravel, maximum size 3/4" in.; about 15% fine sand; greenish gray, dry; road base.													
2	0.5 to 4.5'	s(ML)	0.5 to 4.5' SANDY SILT. s(ML): About 60% nonplastic, slow dilatancy fines; about 40% fine sand; light reddish brown, moist; no reaction with HCl.													
3	4.5 to 10.7'		4.5 to 10.7' SILTY SAND. (SM): About 60% fine to medium sand; about 40% nonplastic fines; medium dense, light reddish brown, moist; no reaction with HCl.													
4	10.7 to 15.8'		10.7 to 15.8' SANDY LEAN CLAY. s(CL): About 70% medium plasticity, low dry strength, slow dilatancy, low toughness fines; about 30% fine sand; stiff, black, wet; organic odor; no reaction with HCl.													
5	15.8 to 19.5'		15.8 to 19.5' CLAYEY SAND. (SC): About 55% fine sand; about 45% low plasticity fines; loose, dark gray, wet; no reaction with HCl.													
6	19.5 to 20'		Description on next page.													
7	0	s(CL)		Auger												
8	0															
9	0															
10	0															
11	0															
12	0															
13	0															
14	0															
15	0															
16	0															
17	0															
18	0															
19	0															
20	0															

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Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Project No. 789.06

Plate No. B-8



Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
 Coordinates: North 2,213,388.55 East 6,195,520.24
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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS	
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
45	44.5 to 46.5'	PT	PEAT. (PT): About 80% hemic organics, fibrous, leaves and twigs. Slightly decomposed; about 20% no to low plasticity fines; black, wet; organic odor; no reaction with HCl. (Continued)	POCORE	0												
46																	
47	46.5 to 52.0'	OL	ORGANIC SILT with Sand. (OL): About 50% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 35% organics, leaf material and decomposed organics, very spongy; about 15% sand; stiff, black, wet; organic odor; no reaction with HCl.	SHELBY	100							77	26	47	HD OC	T06A-047.0-049.0 Lab. Classification: SILTY SAND (SM) Shelby pushed with 50 psi downpressure	
48																	
49	50.0'		From 50.0' alternating layers of gray and black silt and organics.	SPT	100		0	0	0								S07A-050.0-050.7
50																	
51	52.0 to 57.0'	CL	LEAN CLAY. (CL): About 90% medium plasticity, low dry strength, slow dilatancy, low toughness fines; about 10% fine sand; very soft, gray, wet; no reaction with HCl.	SHELBY	100							37	15	96	HD OC	T07A-052.5-054.5 Lab. Classification: LEAN CLAY (CL)	
52												36	15	89	HD OC		
53												34	12	85	HD OC	Lab. Classification: LEAN CLAY (CL)	
54																	
55																	
56																	
57	57.0 to 81.5'	SM	SILTY SAND. (SM): About 85% fine to medium sand; about 15% nonplastic fines; medium dense, dark gray, wet; no reaction with HCl.	SPT	100		5	9	24	31							
58																	
59																	
60																	
61																	
62																	
63																	
64																	
65																	
66																	
67			From 67.0' dense.														
68																	
69																	
70																	

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 Coordinates: North 2,213,388.55 East 6,195,520.24
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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS											
											Retained Sample Water Content %	Liquid Limit	Plasticity Index	Fines% < #200	Other Lab Tests												
70			57.0 to 81.5' SILTY SAND, (SM) ; About 85% fine to medium sand; about 15% nonplastic fines; medium dense, dark gray, wet; no reaction with HCl. <i>(Continued)</i>																								
71																											
72																											
73																											S11A-072.0-073.0
-60																											
74																											
75																											
76																											
77																											
-65																											
78																											
79																											
80																											
81																											
82			81.5 to 99.0' FAT CLAY, (CH) ; About 90% high plasticity, high dry strength, no dilatancy, high toughness fines; about 10% fine sand; hard, light greenish gray, moist; weak reaction with HCl. From 83.5' light brown, greenish gray mottling, calcite stringers react strong to HCL. At 92.7' .04' thick layer of greenish gray clay.																								
83																											
-70																											
84																											
85																											
86																											
87																											
88																											
-75																											
89																											
90																											
91																											
92																											
93																											
-80																											
94																											
95																											

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Final Report Version 8/20/2013



Project: NEW SALVAGED FISH RELEASE SITES
Feature:
 Coordinates: North 2,213,388.55 East 6,195,520.24
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude Longitude
 County: Sacramento

DRILL HOLE LOG
MR-S2
Sheet 5 of 5
 State of California
 California Natural Resources Agency
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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				REMARKS		
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests	
95		 CH	81.5 to 99.0' FAT CLAY, (CH) ; About 90% high plasticity, high dry strength, no dilatancy, high toughness fines; about 10% fine sand; hard, light greenish gray, moist; weak reaction with HCl. <i>(Continued)</i>	 RD						4.0P						P14A-094.5-095.0		
96																		
97																		
98																		
-85																		
99			Boring terminated 99' below levee crown.															
100																		
101																		
102																		
103																		
-90																		
104																		
105																		
106																		
107																		
108																		
-95																		
109																		
110																		
111																		
112																		
113																		
-100																		
114																		
115																		
116																		
117																		
118																		
-105																		
119																		
120																		

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

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Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: / **Sherman Island**
 Coordinates: North 2,213,393.00 East 6,195,534.45
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: _____

DRILL HOLE LOG
MR-S2inc
 Sheet 1 of 1
 State of California
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 DEPARTMENT OF WATER RESOURCES

DATE STARTED 8/6/13	DATE COMPLETED 8/5/13	GROUND ELEVATION 13.10 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 70.0 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	DRILLER'S NAME Vince Pokrywka	HELPER'S NAME James McIntyre		TOTAL DEPTH OF FILL
DRILLING METHOD 0 - 5 ft: HA, 5 - 70 ft: RD	DRILL RIG MAKE AND MODEL Mobile B-53			DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6.5" O.D. HSA bit/ 5-3/4"	DRILLING ROD TYPE AND DIAMETER			FIELD LOGGER Perry
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED	CASING TYPE, DIAMETER, INSTALLATION DEPTH 6.625" O.D. threaded steel to 30'			FIELD LOG REVIEWER
SAMPLER TYPE(S) Vane shear testing	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP			HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with a lean cement mix	GROUNDWATER READING: DURING DRILLING		AFTER DRILLING (DATE-TIME)	

PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				Other Lab Tests	Inclinometer Installation Schematic	REMARKS
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200			
0	0			Hand Auger														0' to 70' Lean Cement 0' to 70' Inclinometer Casing 0' to 2' Flush Monument
10	10																	
5	15																	
0	20																	
-5	25																	
-10	30																	
-15	35																	
-20	40																	
-25	45																	
-30	50																	
-35	55																	
-40	60																	
-45	65																	
-50	70																	
-55	75																	

9/11/2013



Project: NEW SALVAGED FISH RELEASE SITES
Feature: / Sherman Island
 Coordinates: North 2,213,310.45 East 6,195,567.80
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
MR-S3
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 DEPARTMENT OF WATER RESOURCES

DATE STARTED 7/23/13	DATE COMPLETED 7/22/13	GROUND ELEVATION -5.56 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 79.0 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	DRILLER'S NAME Vince Pokrywka	HELPER'S NAME James McIntyre	TOTAL DEPTH OF FILL	
DRILLING METHOD 0 - 5 ft: HA, 5 - 31.5 ft: HSA, 31.5 - 79 ft: RD	DRILL RIG MAKE AND MODEL Mobile B-53		DWR/CONSULTANT COMPANY	
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6.5" O.D. HSA bit/ 5-3/4" O.D. punch core bit	DRILLING ROD TYPE AND DIAMETER 4.5" O.D. HWT		FIELD LOGGER Perry	
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED	CASING TYPE, DIAMETER, INSTALLATION DEPTH 6.625" O.D. threaded steel to 30'		FIELD LOG REVIEWER	
SAMPLER TYPE(S) 2" SPT, 3" Shelby Tube, 134 mm Punch Core, 3" Pitcher	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP Marl, automatic, 140 lbs / 30-inch drop		HAMMER EFFICIENCY 77.7%	
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with 95% cement, 5% bentonite by wt.	GROUNDWATER READING: DURING DRILLING		AFTER DRILLING (DATE-TIME)	

PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS	
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
0	0		<u>QUATERNARY ALLUVIUM, (Qal)</u> 0.0 to 79.0'	Hand Auger												B01A-000.0-005.0	
1	1		0.0 to 4.5' <u>SANDY SILT, s(ML)</u> : About 70% no to low plasticity fines; about 30% fine sand; light brown, moist; no reaction with HCl.														
2	2	s(ML)															
3	3																
4	4																
-10	5		4.5 to 6.0' <u>SANDY LEAN CLAY, s(CL)</u> : About 70% low plasticity, low toughness fines; about 30% fine sand; dark gray to black, moist; no reaction with HCl.														T01A-005.0-007.0
5	5	s(CL)															
6	6		6.0 to 9.5' <u>LEAN CLAY with Organics, (CL)</u> : About 85% low plasticity, medium dry strength, slow dilatancy, low toughness fines; about 10% organics; about 5% fine sand; soft, black, moist; organic odor; no reaction with HCl.														
7	7																
8	8	(CL)															
9	9																
-15	10		9.5 to 34.0' <u>PEAT, (PT)</u> : About 50% low to medium plasticity, low dry strength, slow dilatancy, low toughness fines; about 50% organics, fibers and decomposed material; very soft, moist; organic odor; no reaction with HCl.														
10	10																
11	11																
12	12																
13	13																
14	14																
-20	15																
15	15	PT															
16	16																
17	17																
18	18																
19	19																
-25	20																
20	20																

Final Report Version 8/20/2013



Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
 Coordinates: North 2,213,310.45 East 6,195,567.80
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
MR-S3
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DEPARTMENT OF WATER RESOURCES

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS	
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
45	46	SM	41.5 to 46.5' SILTY SAND, (SM) : About 85% fine to medium sand; about 15% nonplastic fines; medium dense, light gray, moist; no reaction with HCl. <i>(Continued)</i>	POORE		86											P04A-044.5-045.0
47	48	SW-SM	46.5 to 47.5' Poorly Graded SAND with Silt, (SW-SM) : About 90% fine sand; about 10% nonplastic fines; light gray, moist; no reaction with HCl.	SPT			10 21 28	49	63								S10A-047.5-078.5
49	50		47.5 to 60.2' SILTY SAND, (SM) : About 85% fine sand; about 15% nonplastic fines; dense, gray, moist; no reaction with HCl; Fine to medium sand below 49ft.	POORE		0											
53	54	SM		SPT			12 18 33	51	66								S11A-052.5-054.0
58	59			SPT			10 21 30	51	66								S12A-057.5-059.0
61	62		60.2 to 79.0' FAT CLAY, (CH) : About 95% high plasticity, high dry strength, no dilatancy, high toughness fines; about 5% fine sand; light brown with bluish grey mottling, moist; strong reaction with HCl; Calcite inclusions throughout, possible pumice inclusions below 70.5ft.	POORE		63											
63	64			SPT			7 11 12	23	30								S13A-062.5-064.0
68	69	CH		POORE		0											
68	69			SPT			5 11 15	26	34								S14A-067.5-069.0
70	70			POORE		60											P09A-069.0-069.5

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Project: NEW SALVAGED FISH RELEASE SITES
Feature: / Sherman Island
 Coordinates: North 2,213,304.58 East 6,195,562.60
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: _____

DRILL HOLE LOG
MR-S3inc
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DATE STARTED 8/2/13	DATE COMPLETED 8/1/13	GROUND ELEVATION -5.27 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 50.0 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.		DRILLER'S NAME Vince Pokrywka	HELPER'S NAME James McIntyre	TOTAL DEPTH OF FILL
DRILLING METHOD 0 - 5 ft: HA, 5 - 50 ft: RD		DRILL RIG MAKE AND MODEL Mobile B-53		DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6.5" O.D. HSA bit/ 5-3/4"		DRILLING ROD TYPE AND DIAMETER		FIELD LOGGER Perry
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED SAMPLER TYPE(S)		CASING TYPE, DIAMETER, INSTALLATION DEPTH 6.625" O.D. threaded steel to 30'		FIELD LOG REVIEWER
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with a lean cement mix		HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP		HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION		GROUNDWATER READING: DURING DRILLING		AFTER DRILLING (DATE-TIME)

PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				Other Lab Tests	Inclinometer Installation Schematic	REMARKS	
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200				
0				Hand Auger															0' to 60' Lean Cement 0' to 60' Inclinometer Casing 0' to 3' Monument Monument starts 2.5' above ground surface. Inclinometer Starts 2.0' above ground surface.
-10				Rotary															
-15																			
-20																			
-25	20																		
-30																			
-35																			
-40																			
-45	40																		
-50																			
-55																			
-60																			
-65	60																		
9/11/2013																			



Project: NEW SALVAGED FISH RELEASE SITES
Feature: / Sacramento River
 Coordinates: North 2,212,304.62 East 6,193,252.41
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
LB-S1
Sheet 1 of 6
 State of California
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DEPARTMENT OF WATER RESOURCES

DATE STARTED 8/14/13	DATE COMPLETED 8/16/13	GROUND ELEVATION 9.00 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 127.2 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.		DRILLER'S NAME Chris St. Pierre	HELPER'S NAME Jose Sagrero	TOTAL DEPTH OF FILL
DRILLING METHOD 0 - 113.5 ft: RD		DRILL RIG MAKE AND MODEL Mobile B-80		DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 5 3/4" drag bit		DRILLING ROD TYPE AND DIAMETER 4.5" O.D. HWT		FIELD LOGGER Perry
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		CASING TYPE, DIAMETER, INSTALLATION DEPTH 8.625" O.D. threaded steel to 45'		FIELD LOG REVIEWER
SAMPLER TYPE(S) 2" SPT, 3" Shelby Tube, 134 mm Punch Core, 3" Pitcher		HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP Marl, automatic, 140 lbs / 30-inch drop		HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with 95% cement, 5% bentonite by wt.		GROUNDWATER READING: DURING DRILLING AFTER DRILLING (DATE-TIME)		

PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS	
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
0			0.0 to 1.5' Deck of Quin Delta.	(RD)													
1			1.5 to 27.0' Water-Sacramento River.	(RD)													
2																	
3																	
5																	
4																	
5																	
6																	
7																	
8																	
0																	
9																	
10																	
11																	
12																	
13																	
-5																	
14																	
15																	
16																	
17																	
18																	
-10																	
19																	
20																	

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Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
 Coordinates: North 2,212,304.62 East 6,193,252.41
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
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PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				REMARKS	
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
20			1.5 to 27.0' Water-Sacramento River. (Continued)														
21																	
22																	
23																	
-15	24																
25																	
26																	
27			<u>Quaternary. (Qal)</u> 27.0 to 127.2'														
28			27.0 to 38.5' <u>ORGANIC LEAN CLAY. (OL)</u> : About 65% low plasticity, no to low dry strength, no dilatancy, low toughness fines; about 35% organics, highly decomposed organic muck, some reddish brown leaf material; very soft, dark brown to black, wet; organic odor; no reaction with HCl.														
-20	29																
30																	
31																	
32																	
33		OL															
-25	34																
35																	
36																	
37																	
38																	
39			38.5 to 41.7' <u>PEAT. (PT)</u> : About 65% organics, leaf and decomposed material; about 35% low plasticity, medium dry strength fines; black mottled with reddish brown, wet; no reaction with HCl.														
-30	40																
41																	
42			41.7 to 45.2' <u>ORGANIC LEAN CLAY. o(CL)</u> : About 70% medium plasticity, low dry strength, no dilatancy, medium toughness fines; about 30% organics, leaf material; very soft, light gray, wet; no reaction with HCl.														
43																	
-35	44																
45																	

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Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
 Coordinates: North 2,212,304.62 East 6,193,252.41
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
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PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200	
45	46	CL	45.2 to 49.2' LEAN CLAY, (CL) : About 90% medium to high plasticity, low dry strength, no dilatancy, low toughness fines; about 10% fine sand; medium stiff, gray, moist; no reaction with HCl.	POORE	100					5P						P02A-046.0-046.5
47	48															
49	50	s(CL)	49.2 to 51.3' SANDY LEAN CLAY, s(CL) : About 65% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 35% fine sand; medium stiff, light gray, moist; no reaction with HCl.	SHELBY	88					<2P						Shelby tube pushed with 50 psi downpressure
51	52															
52	53	SM	51.3 to 54.8' SILTY SAND, (SM) : About 80% fine sand; about 20% nonplastic fines; medium dense, gray, wet; no reaction with HCl.	POORE	100					5P						
53	54															
54	55	(CL)s	54.8 to 57.5' LEAN CLAY with Sand, (CL)s : About 75% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 25% fine sand; stiff, gray, moist; no reaction with HCl.	SPT	100	3	4	11	14							
55	56															
56	57	SM	57.5 to 69.9' SILTY SAND, (SM) : About 85% fine sand; about 15% no plasticity fines; gray, moist; no reaction with HCl.	POORE	71					1.0P						
57	58															
58	59	SM	57.5 to 69.9' SILTY SAND, (SM) : About 85% fine sand; about 15% no plasticity fines; gray, moist; no reaction with HCl.	POORE	54											
59	60															
60	61	SM	From 67.0' About 65% fine sand; about 35% nonplastic fines.	SPT	0	3	6	14	18							
61	62															
62	63	SM	From 67.0' About 65% fine sand; about 35% nonplastic fines.	POORE	0											
63	64															
64	65	SM	From 68.0' strong reaction with HCl; calcite concretions.	SPT	80	4	6	13	17						29	
65	66															
66	67	SM	From 68.0' strong reaction with HCl; calcite concretions.	POORE	86											
67	68															
68	69	SM	From 68.0' strong reaction with HCl; calcite concretions.	SPT	86											
69	70															

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Project: NEW SALVAGED FISH RELEASE SITES
Feature:
 Coordinates: North 2,212,304.62 East 6,193,252.41
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude Longitude
 County: Sacramento

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LB-S1
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PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines % < #200	
70			69.9 to 73.0' SILT with Sand. (ML)s: About 75% no plasticity, low dry strength, rapid dilatancy fines; about 25% fine sand; greenish gray, moist; no reaction with HCl. (Continued)	POORE		86										P07A-071.0-071.5
71		(ML)s														T02A-072.0-072.6
72						60										
73			73.0 to 75.0' SANDY SILT, s(ML): About 65% no plasticity, rapid dilatancy fines; about 35% fine sand; dense, greenish gray, moist; no reaction with HCl.	SPT		100										
-65	74	s(ML)					9	18	48	62						S06A-073.5-075.0
75			75.0 to 76.5' LEAN CLAY. (CL): About 90% low plasticity, low to medium dry strength, no dilatancy, medium toughness fines; about 10% fine sand; very stiff, greenish gray, moist; no reaction with HCl.	POORE		60				2.5P						
76		CL														
77			76.5 to 80.2' SILTY SAND. (SM): About 55% fine sand; about 45% low plasticity fines; dense, dark greenish gray, moist; weak cementation; no reaction with HCl.	SPT		100	9	17	48	62						
78		SM														S09A-077.0-078.5
-70	79															
80			80.2 to 86.3' LEAN CLAY. (CL): About 90% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 10% fine sand; very stiff, greenish gray, moist; weak cementation; no reaction with HCl; Borderline ML.	POORE		83				3.5P						
81																P10A-080.5-081.0
82																
83				PITCHER												T03A-082.0-083.1
-75	84	CL				44				>4.5P						
85																
86			86.3 to 109.1' SILTY SAND. (SM): About 60% fine sand; about 40% no plasticity fines; greenish gray, moist; weak cementation; no reaction with HCl.	POORE		80										
87							0	17	50							S08A-087.0-087.75
88			From 88.0' strong reaction with HCl; calcite inclusions.													
-80	89															
90						29										
91		SM														
92			From 92.0' no reaction with HCl.													
93				SPT		93	14	28	69	89						S09A-092.0-093.4
-85	94															
95				POORE		86										

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Project: NEW SALVAGED FISH RELEASE SITES
Feature: _____
 Coordinates: North 2,212,304.62 East 6,193,252.41
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
LB-S1
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 California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS		
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines % < #200		Other Lab Tests	
95			86.3 to 109.1' SILTY SAND, (SM) ; About 60% fine sand; about 40% no plasticity fines; greenish gray, moist; weak cementation; no reaction with HCl. <i>(Continued)</i>	PCOORE	86												P13A-095.0-095.5	
96																		
97			From 97.0' About 85% fine sand; about 15% nonplastic fines; dark greenish gray.	SPT	100	19	25	59	76									S10A-097.0-098.5
98																		
-90	99		From 99.0' well indurated.															
100				PCOORE	100													
101																		
102		SM																
103				SPT	100	36	27	64	83									S11A-102.0-103.5
104																		
-95	104			PCOORE	100													
105																		
106																		
107																		
108																		
109																		
-100	109			PCOORE	100													
110		(SW)g	109.1 to 111.0' Well-Graded SAND with Gravel, (SW)g ; About 80% fine to coarse sand; about 15% fine, rounded gravel; about 5% no plasticity fines; very dense, dark greenish gray, wet; weak cementation; no reaction with HCl.															
111			111.0 to 127.2' SILTY SAND, (SM) ; About 85% fine sand; about 15% nonplastic fines; greenish gray, moist; weak cementation; no reaction with HCl.	PCOORE	88													P16A-109.5-110.0
112																		
113			From 113.0' well indurated.															
-105	114																	
115		SM																
116																		
117																		
118				SPT	80	32	32	82	106									
119			From 118.0' fine to medium sand; no reaction with HCl; well indurated.															
-110	119			PCOORE	100													
120																		

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Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
 Coordinates: North 2,212,304.62 East 6,193,252.41
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
LB-S1
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 State of California
 California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				REMARKS														
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests													
120		SM	111.0 to 127.2' SILTY SAND, (SM) ; About 85% fine sand; about 15% nonplastic fines; greenish gray, moist; weak cementation; no reaction with HCl. (Continued)	POORE	100	100	50				☑					P18A-119.5-120.0														
121																S15A-120.0-120.25														
122																														
123																														
124																														
125																														
126																														
127																														
127																														P19A-124.0-124.5
																	Boring terminated at 127.2' below ship deck.													
128																														
129																														
130																														
131																														
132																														
133																														
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145																														

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

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Project: NEW SALVAGED FISH RELEASE SITES
Feature: / Sherman Island
 Coordinates: North 2,212,168.63 East 6,193,282.63
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude Longitude
 County: Sacramento

DRILL HOLE LOG
LB-S2
Sheet 1 of 5
 State of California
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DATE STARTED 7/23/13	DATE COMPLETED 7/26/13	GROUND ELEVATION 13.63 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 100.0 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.		DRILLER'S NAME Vince Pokrywka	HELPER'S NAME James McIntyre	TOTAL DEPTH OF FILL 20 ft
DRILLING METHOD 0 - 5 ft: HA, 5 - 31.5 ft: HSA, 31.5 - 100 ft: RD		DRILL RIG MAKE AND MODEL Mobile B-53		DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6.5" O.D. HSA bit/ 5-3/4" O.D. punch core bit		DRILLING ROD TYPE AND DIAMETER 4.5" O.D. HWT		FIELD LOGGER Perry
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		CASING TYPE, DIAMETER, INSTALLATION DEPTH 6.625" O.D. threaded steel to 30'		FIELD LOG REVIEWER
SAMPLER TYPE(S) 2" SPT, 3" Shelby Tube, 134 mm Punch Core, 3" Pitcher		HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP Marl, automatic, 140 lbs / 30-inch drop		HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with 95% cement, 5% bentonite by wt.		GROUNDWATER READING: DURING DRILLING AFTER DRILLING (DATE-TIME)		

PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200	
0	0	(GP)s	LEVEE FILL. (Qaf) 0.0 to 20.0'	Hand Auger												B01A-001.0-005.0
0	0.5		Poorly Graded GRAVEL with Sand. (GP)s: About 85% fine, angular to subangular gravel, maximum size 3/4" in.; about 15% fine sand; greenish gray, dry; road base.													
0	0.5		0.5 to 14.5' SILTY SAND. (SM): About 70% fine to medium sand; about 30% nonplastic fines; very loose, brown, dry; no reaction with HCl.													
5	5.2		At 5.2' 0.2 foot thick layer of organic silt.		SPT	53	0 1 1	2 3								
5	8	SM			SPT	80	0 1 2	3 4				1		8		S02A-007.5-008.7 Lab. Classification: POORLY GRADED SAND with SILT (SP-SM)
10	10.0		From 10.0' loose.		SPT	80	1 3 4	7 9								
13	12.6		At 12.6' About 70% low plasticity, low toughness fines; about 30% fine sand; 0.7 foot thick layer.		SPT	93	0 2 2	4 5								S04A-012.6-013.3
15	14.5	CL	14.5 to 15.2' SANDY LEAN CLAY. (CL): About 95% low plasticity, low toughness fines; about 5% fine sand; black, moist.		SPT	100	2 2 2	4 5								
16	15.2	SM	15.2 to 16.2' SILTY SAND. (SM): About 70% fine to medium sand; about 30% nonplastic fines; very loose, brown, dry; no reaction with HCl.													S05A-016.2-016.5
17	16.2	(CL) _o	16.2 to 17.2' LEAN CLAY with Organics. (CL) _o : About 90% low plasticity, slow dilatancy, low toughness fines; about 10% organics, highly decomposed; black, moist; organic odor; no reaction with HCl.													T01A-017.5-018.5
18	17.2	SM	17.2 to 20.0' SILTY SAND. (SM): About 70% fine to medium sand; about 30% nonplastic fines.		SHELBY	50										Shelby pushed with 250 psi

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Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature:
 Coordinates: North 2,212,168.63 East 6,193,282.63
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
LB-S2
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PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS	
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
20			<u>QUATERNARY, (Qal)</u> 20.0 to 100.0'													downpressure	
21			20.0 to 32.3' <u>ORGANIC ELASTIC SILT with Sand, o(MH)s</u> ; About 60% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 25% organics, leaf material; about 15% fine sand; black, moist; organic odor; no reaction with HCl.	SPT	100	0	0	0								S03A-020.5-022.0	
22																	
23					SHELBY	95							70	31	72	HD OC	T02A-022.5-024.4
24	-10		From 24.0' medium stiff.									75	23	57	HD OC	Lab. Classification: ELASTIC SILT with SAND (MH)	
25										0.75P		108	39	59	HD OC	Lab. Classification: SANDY ELASTIC SILT (MH)	
26				SPT	100	0	1	4	5							Lab. Classification: SANDY ELASTIC SILT (MH)	
27																Shelby pushed with 0 psi downpressure	
28				SHELBY	85											S04A-025.0-026.5	
29	-15		From 29.0' very stiff.													T03A-027.5-029.2	
30																Shelby pushed with 0 psi downpressure from 29.5' to 29.0' and 150 psi downpressure from 29.0' to 29.5'	
31			At 30.2' 0.6 foot thick layer of gray with no leafy organics just sticks.	SPT	100	0	0	0	0	1.5P						S05A-030.0-031.5	
32																	
33	-20		<u>32.3 to 42.2' SANDY ORGANIC ELASTIC SILT, s(MH)</u> ; About 40% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 30% fine sand; about 30% organics, sticks, leaves and decomposed material; very soft, gray, wet; organic odor; no reaction with HCl.	SPT	67	0	1	2	3							S06A-032.5-033.5	
34																	
35																	
36				POORE	86											BOX1-035.0-037.5	
37																	
38	-25			SHELBY	85							86	37	68	HD OC	T04A-037.5-039.3	
39												140	55	28	HD OC	Lab. Classification: SANDY ELASTIC SILT (MH)	
40												138	56	21	HD OC	Lab. Classification: SILTY SAND (SM)	
41																	
42				POORE	57					1.5P .5T						Lab. Classification: SILTY SAND (SM)	
43																Shelby pushed with 0 psi downpressure	
44	-30		<u>42.2 to 54.5' ORGANIC LEAN CLAY, o(CL)</u> ; About 70% low plasticity, slow dilatancy, low toughness fines; about 25% organics, horizontal layers of leaf material; about 5% fine sand; dark gray to black, wet; organic odor; no reaction with HCl.	SPT	100	0	0	0	0							S07A-042.5-044.0	
45				POORE	100											BOX1-044.0-046.0	

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Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
 Coordinates: North 2,212,168.63 East 6,193,282.63
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

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LB-S2
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PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS	
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
45			42.2 to 54.5' ORGANIC LEAN CLAY, o(CL) : About 70% low plasticity, slow dilatancy, low toughness fines; about 25% organics, horizontal layers of leaf material; about 5% fine sand; dark gray to black, wet; organic odor; no reaction with HCl. (Continued)	PCOORE	100						5P						
46																	
47																	
48				SPT	100		0	0									S08A-047.5-049.0
49			From 49.0' About 55% low plasticity, low toughness fines; about 40% organics; about 5% fine sand.														
50		o(CL)															P05A-049.0-049.5
51				PCOORE	91						5P						BOX1-049.5-051.5
52																	
53				SPT	100		0	0									S09A-052.5-054.0
54																	
55			54.5 to 58.7' LEAN CLAY, (CL) : About 90% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 10% fine sand; gray, moist; no reaction with HCl.														
56		CL		SHELBY	100												T05A-055.0-057.0
57											<.2P						Shelby pushed with 50 psi downpressure
58																	
59			58.7 to 60.7' SANDY LEAN CLAY, s(CL) : About 60% low plasticity fines; about 40% fine sand; gray, moist.														
60		s(CL)		PCOORE	100												
61			60.7 to 62.8' CLAYEY SAND, (SC) : About 70% fine sand; about 30% low plasticity fines; very loose, gray, wet; no reaction with HCl.														
62		SC															
63			62.8 to 64.5' SANDY LEAN CLAY, s(CL) : About 60% low plasticity fines; about 40% fine sand; gray, moist.				0	0	0								
64		s(CL)		SPT	100		0	0	0								P06A-062.0-062.5 S10A-062.5-064.0
65			64.5 to 67.0' CLAYEY SAND, (SC) : About 70% fine sand; about 30% low plasticity fines; gray, wet; no reaction with HCl.														
66		SC		PCOORE	100												
67			67.0 to 72.2' LEAN CLAY with Sand, (CL)s : About 85% high plasticity, slow dilatancy, low to medium toughness fines; about 15% fine sand; very soft, gray, wet; no reaction with HCl.														
68		(CL)s		SPT	100		0	0	0				3	35	12		S11A-067.5-069.0
69				PCOORE	60						<.2P						
70																	

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Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
 Coordinates: North 2,212,168.63 East 6,193,282.63
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
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PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS	
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
70			67.0 to 72.2' LEAN CLAY with Sand, (CL)s : About 85% high plasticity, slow dilatancy, low to medium toughness fines; about 15% fine sand; very soft, gray, wet; no reaction with HCl. (Continued)	POORE		60				1.5P							
71		(CL)s															
72			From 71.0' stiff.														
73			72.2 to 75.3' SANDY LEAN CLAY, s(CL) : About 55% low plasticity, slow dilatancy, low toughness fines; about 45% fine sand; gray, wet; no reaction with HCl.	SPT			0	8	10								S12A-072.5-074.0
74		s(CL)					1										
75							7										
76		ML	75.3 to 76.4' SILT, (ML) : About 90% no to low plasticity, slow dilatancy, low toughness fines; about 10% fine sand; weak cementation; strong reaction with HCl.	POORE		80											
77		SM	76.4 to 77.4' SILTY SAND, (SM) : About 75% fine sand; about 25% nonplastic fines; gray, wet; no reaction with HCl.														
78			77.4 to 80.3' Poorly Graded SAND, (SP) : About 95% fine to medium sand; about 5% nonplastic fines; dense, gray to dark gray, wet; no reaction with HCl.	SPT			9	36	47								S13A-077.5-078.8
79		SP					16										
80							20										
81		s(CL)	80.3 to 81.6' SANDY LEAN CLAY, s(CL) : About 65% low plasticity, low toughness fines; about 35% fine sand; light greenish gray.	POORE		100											
82			81.6 to 83.8' SILTY SAND, (SM) : About 95% fine sand; about 5% nonplastic fines; dark greenish gray, wet; no reaction with HCl.														
83		SM															
84			83.8 to 88.2' SILT with Sand, (ML)s : About 85% no to low plasticity, rapid dilatancy, low toughness fines; about 15% fine sand; very dense, light greenish gray, moist; weak cementation; weak reaction with HCl.	SPT			8	36	47								S14A-082.5-083.8
85							18										
86		(ML)s					18										P11A-085.0-085.5
87																	
88			88.2 to 95.1' SILTY SAND, (SM) : About 75% fine sand; about 25% nonplastic fines; very dense, light greenish gray, moist; no reaction with HCl.	SPT			13	103	133								S15A-088.2-089.0
89							43										
90							60										
91		SM	From 91.0' About 85% fine sand; about 15% nonplastic fines.														
92																	
93			From 93.2' About 55% fine sand; about 45% nonplastic fines.	SPT			10	81	105								S16A-092.5-093.2
94							31										S16B-093.2-093.9
95							50										

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Project: NEW SALVAGED FISH RELEASE SITES
Feature:
 Coordinates: North 2,212,168.63 East 6,193,282.63
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
LB-S2
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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				REMARKS							
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests						
95		 (ML)s	95.1 to 98.7' SILT with Sand, (ML)s: About 80% nonplastic, rapid dilatancy, low toughness fines; about 20% fine sand; moist; no reaction with HCl.	 PCORE RD PCORE	89											P13A-095.5-096.0							
96																							
97																							
98		 SM	98.7 to 100.0' SILTY SAND, (SM): About 75% fine sand; about 25% nonplastic fines; light greenish gray, moist; weak reaction with HCl.		90	12	50									S17A-097.5-098.4							
99																							
-85					100											P14A-099.0-100.0							
100		Boring terminated at 100' levee crown.																					
101																							
102																							
103																							
-90																							
104																							
105																							
106																							
107																							
108																							
-95																							
109																							
110																							
111																							
112																							
113																							
-100																							
114																							
115																							
116																							
117																							
118																							
-105																							
119																							
120																							

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

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Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: / **Sherman Island**
 Coordinates: North 2,212,160.43 East 6,193,288.08
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: _____

DRILL HOLE LOG
LB-S2inc
 Sheet 1 of 1
 State of California
 California Natural Resources Agency
 DEPARTMENT OF WATER RESOURCES

DATE STARTED 8/6/13	DATE COMPLETED 8/6/13	GROUND ELEVATION 13.05 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 51.5 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	DRILLER'S NAME Vince Pokrywka	HELPER'S NAME James McIntyre		TOTAL DEPTH OF FILL 20 ft
DRILLING METHOD 0 - 5 ft: HA, 5 - 50 ft: RD	DRILL RIG MAKE AND MODEL Mobile B-53			DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6.5" O.D. HSA bit/ 5-3/4"	DRILLING ROD TYPE AND DIAMETER 4.5" O.D. HWT			FIELD LOGGER Perry
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED	CASING TYPE, DIAMETER, INSTALLATION DEPTH 6.625" O.D. threaded steel to 30'			FIELD LOG REVIEWER
SAMPLER TYPE(S) Vane shear testing	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP			HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with a lean cement mix	GROUNDWATER READING: DURING DRILLING		AFTER DRILLING (DATE-TIME)	

PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				Other Lab Tests	Inclinometer Installation Schematic	REMARKS
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200			
0	0			Hand Auger														0' to 51.5' Lean Cement 0' to 51.5' Inclinometer Casing 0' to 2' Flush Monument
10	10																	
5	5																	
0	0																	
-5	5																	
-10	10																	
-15	15																	
-20	20																	
-25	25																	
-30	30																	
-35	35																	
-40	40																	
-45	45																	
60	60																	

9/11/2013



Project: NEW SALVAGED FISH RELEASE SITES
Feature: / Sherman Island
 Coordinates: North 2,212,094.40 East 6,193,325.28
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
LB-S3
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 State of California
 California Natural Resources Agency
 DEPARTMENT OF WATER RESOURCES

DATE STARTED 7/29/13	DATE COMPLETED 7/31/13	GROUND ELEVATION -6.49 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 89.0 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.		DRILLER'S NAME Vince Pokrywka	HELPER'S NAME James McIntyre	TOTAL DEPTH OF FILL
DRILLING METHOD 0 - 5 ft: HA, 5 - 30 ft: HSA, 30 - 89 ft: RD		DRILL RIG MAKE AND MODEL Mobile B-53		DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6.5" O.D. HSA bit/ 5-3/4" O.D. punch core bit		DRILLING ROD TYPE AND DIAMETER 4.5" O.D. HWT		FIELD LOGGER Perry
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED		CASING TYPE, DIAMETER, INSTALLATION DEPTH 6.625" O.D. threaded steel to 30'		FIELD LOG REVIEWER
SAMPLER TYPE(S) 2" SPT, 3" Shelby Tube, 134 mm Punch Core, 3" Pitcher		HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP Marl, automatic, 140 lbs / 30-inch drop		HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with 95% cement, 5% bentonite by wt.		GROUNDWATER READING: DURING DRILLING		AFTER DRILLING (DATE-TIME)

PROJECT GEOLOGY DRILL HOLE LOG: NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS															
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests														
0	0	SM	0.0 to 4.5' SILTY SAND, (SM) : About 80% fine sand; about 20% nonplastic fines; light brown, dry; no reaction with HCl.	Hand Auger	bulk	100										B01A-000.0-003.0															
1	1																														
2	2																														
3	3																														
-10	4	o(CL)	4.5 to 12.0' ORGANIC LEAN CLAY, o(CL) : About 55% low plasticity, slow dilatancy, low toughness fines; about 45% organics, leafy and decomposed material; medium stiff, dark brown to black, moist; organic odor; no reaction with HCl.	Auger	SPT	100	0	4	8	10						S01A-005.0-006.5															
5	5																														
6	6																														
7	7																														
8	8																														
-15	9																.7P													T01A-007.5-008.8	
8	8																														
9	9																10														Lab. Classification: WELL-GRADED SAND with SILT (SW-SM)
10	10																														
11	11																s(OL)	12.0 to 33.3' SANDY ORGANIC SILT, s(OL) : About 35% nonplastic, low dry strength, no dilatancy, low toughness fines; about 35% organics, leafy decomposed material; about 30% fine sand; dark brown, moist. From 14.5' very soft.	Auger	SPT	20	0	0	0	0						
12	12																														
13	13	.2P													T02A-012.5-014.5 Lab. Classification: SILTY SAND (SM)																
13	13																														
14	14	10														Lab. Classification: SILTY SAND (SM)															
14	14																														
15	15	10														Lab. Classification: SILTY SAND (SM)															
15	15																														
16	16	10														Lab. Classification: SILTY SAND (SM)															
16	16																														
17	17	10														S03A-015.0-016.5															
17	17																														
18	18	10														S04A-017.5-019.0 Lab. Classification: SILTY SAND (SM)															
18	18																														
19	19	10																													
19	19																														
20	20																														

Final Report Version 8/20/2013



Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature: _____
 Coordinates: North 2,212,094.40 East 6,193,325.28
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
LB-S3
Sheet 2 of 4
 State of California
 California Natural Resources Agency
 DEPARTMENT OF WATER RESOURCES

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS		
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests	
20			12.0 to 33.3' <u>SANDY ORGANIC SILT, s(OL)</u> : About 35% nonplastic, low dry strength, no dilatancy, low toughness fines; about 35% organics, leafy decomposed material; about 30% fine sand; dark brown, moist. (Continued)	SPT	100	0	0	0										
21				SPT	100	0	0	0										
22																		
23				SPT	100	0	0	0									S06A-022.5-024.0	
24																		
25				SHELBY	85												T03A-025.0-026.7	
26		s(OL)																
27																		
28				SPT	100	0	0	0									S07A-028.0-029.5	
29																		
30				SPT	100	0	0	0									S08A-030.0-030.5	
31																	Lab. Classification: SANDY SILT (ML)	
32				PCORE	100													
33																		
34			33.3 to 37.0' <u>ELASTIC SILT with Organics, (MH)o</u> : About 80% medium plasticity, low dry strength, slow dilatancy, low toughness fines; about 15% organics, leaves and decomposed material; about 5% fine sand; very soft, gray, moist; no reaction with HCl.	SHELBY	85													P01A-033.5-034.0
35		(MH)o																T04A-035.0-036.7
36																		
37			37.0 to 44.3' <u>LEAN CLAY, (CL)</u> : About 95% low plasticity, low dry strength, slow dilatancy, low toughness fines; about 5% fine sand; medium dense, gray, moist; no reaction with HCl.	SPT	100	0	0	0										S09A-037.5-039.0
38																		
39																		
40				PCORE	86													P03A-040.0-040.5
41		CL																
42																		
43				SHELBY	100													T05A-042.5-044.5
44																		
45		s(CL)	Description on next page.															

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Final Report Version 8/20/2013



Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature:
 Coordinates: North 2,212,094.40 East 6,193,325.28
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude _____ Longitude _____
 County: Sacramento

DRILL HOLE LOG
LB-S3
Sheet 3 of 4
 State of California
 California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES

PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS	
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200		Other Lab Tests
45	46	s(CL)	44.3 to 56.2' SANDY LEAN CLAY, s(CL) : About 65% low plasticity, slow dilatancy, low toughness fines; about 35% fine sand; medium stiff, gray, moist; no reaction with HCl. (Continued)	POORE	100					7P							
47	48				SPT	100	0	0	0								S10A-047.5-049.5
-55	49		From 49.0' About 25% fine sand.	POORE	100												
50	51			POORE	100												
52	53		From 52.0' About 40% fine sand.	SPT	100	0	4	9	12								S11A-052.5-054.0
-60	54			POORE	77												
56	57	SM	56.2 to 83.0' SILTY SAND, (SM) : About 85% fine sand; about 15% nonplastic fines; dense, dark gray, moist; no reaction with HCl.	RD													
58	59				SPT	100	10	15	35	45				8			S12A-057.5-059.0 Lab. Classification: POORLY GRADED SAND with SILT (SP-SM)
-65	60			POORE	100												
61	62		At 61.5' 1 foot thick layer with trace subrounded fine gravel. No gravel below 62.5 feet	POORE													
63	64		From 62.5' weak reaction with HCl; thin 0.01 foot layers of greenish gray silty sand cemented w/in calcite.	SPT	38	12	28	78	101								P07A-061.5-062.0 S13A-062.5-063.8
-70	65			POORE	84												
66	67			POORE													
68	69			SPT	40	13	30	80	104								S14A-067.5-068.1
-75	70			POORE	66												

Final Report Version 8/20/2013



Project: **NEW SALVAGED FISH RELEASE SITES**
 Feature:
 Coordinates: North 2,212,094.40 East 6,193,325.28
 Survey Method: Ground Survey Datum: NAD83
 GPS: Latitude Longitude
 County: Sacramento

DRILL HOLE LOG
LB-S3
Sheet 4 of 4
 State of California
 California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES

Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	LABORATORY DATA					REMARKS
											Retained Sample	Water Content %	Liquid Limit	Plasticity Index	Fines% < #200	
70			56.2 to 83.0' SILTY SAND, (SM) : About 85% fine sand; about 15% nonplastic fines; dense, dark gray, moist; no reaction with HCl. (Continued) At 75.5' 0.2 foot layer of greenish gray hard clay. 83.0 to 89.0' LEAN CLAY, (CL) : About 90% low plasticity, low toughness fines; about 10% fine sand; very stiff, light greenish gray, moist; weak cementation; no reaction with HCl. From 88.0' several thin (0.1') sand layers. Boring terminated at 89' below ground.		66 100 91 0 11 100	66 70 46 50 50	4P		P09A-071.0-071.5 S15A-072.5-073.0 P10A-076.5-077.0 S16A-077.5-078.0 P12A-083.0-083.5 S18A-087.5-089.0							
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PROJECT GEOLOGY DRILL HOLE LOG; NEW FISH RELEASE SITES 12062013.GPJ; DWR PROJECT GEOLOGY LIBRARY 10292013.GLB; 01/07/14

Final Report Version 8/20/2013



Project: **NEW SALVAGED FISH RELEASE SITES**
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 GPS: Latitude _____ Longitude _____
 County: _____

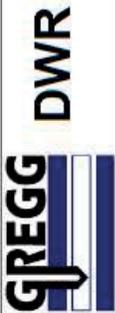
DRILL HOLE LOG
LB-S3inc
Sheet 1 of 1
 State of California
 California Natural Resources Agency
DEPARTMENT OF WATER RESOURCES

DATE STARTED 8/1/13	DATE COMPLETED 7/31/13	GROUND ELEVATION -6.48 ft	ELEVATION BASIS Ground Survey	TOTAL DEPTH OF BORING 60.0 ft
DRILLING CONTRACTOR Gregg Drilling & Testing, Inc.	DRILLER'S NAME Vince Pokrywka	HELPER'S NAME James McIntyre		TOTAL DEPTH OF FILL
DRILLING METHOD 0 - 5 ft: HA, 5 - 60 ft: RD	DRILL RIG MAKE AND MODEL Mobile B-53			DWR/CONSULTANT COMPANY
DRILL BIT SIZE AND TYPE (HOLE DIAMETER) 6.5" O.D. HSA bit/ 5-3/4"	DRILLING ROD TYPE AND DIAMETER			FIELD LOGGER Perry
<input checked="" type="checkbox"/> VERTICAL <input type="checkbox"/> INCLINED	CASING TYPE, DIAMETER, INSTALLATION DEPTH			FIELD LOG REVIEWER
SAMPLER TYPE(S)	HAMMER TYPE, MAKE/MODEL, WEIGHT/DROP			HAMMER EFFICIENCY 77.7%
BOREHOLE BACKFILL OR COMPLETION Tremie backfilled with a lean cement mix	GROUNDWATER READING: DURING DRILLING		AFTER DRILLING (DATE-TIME)	

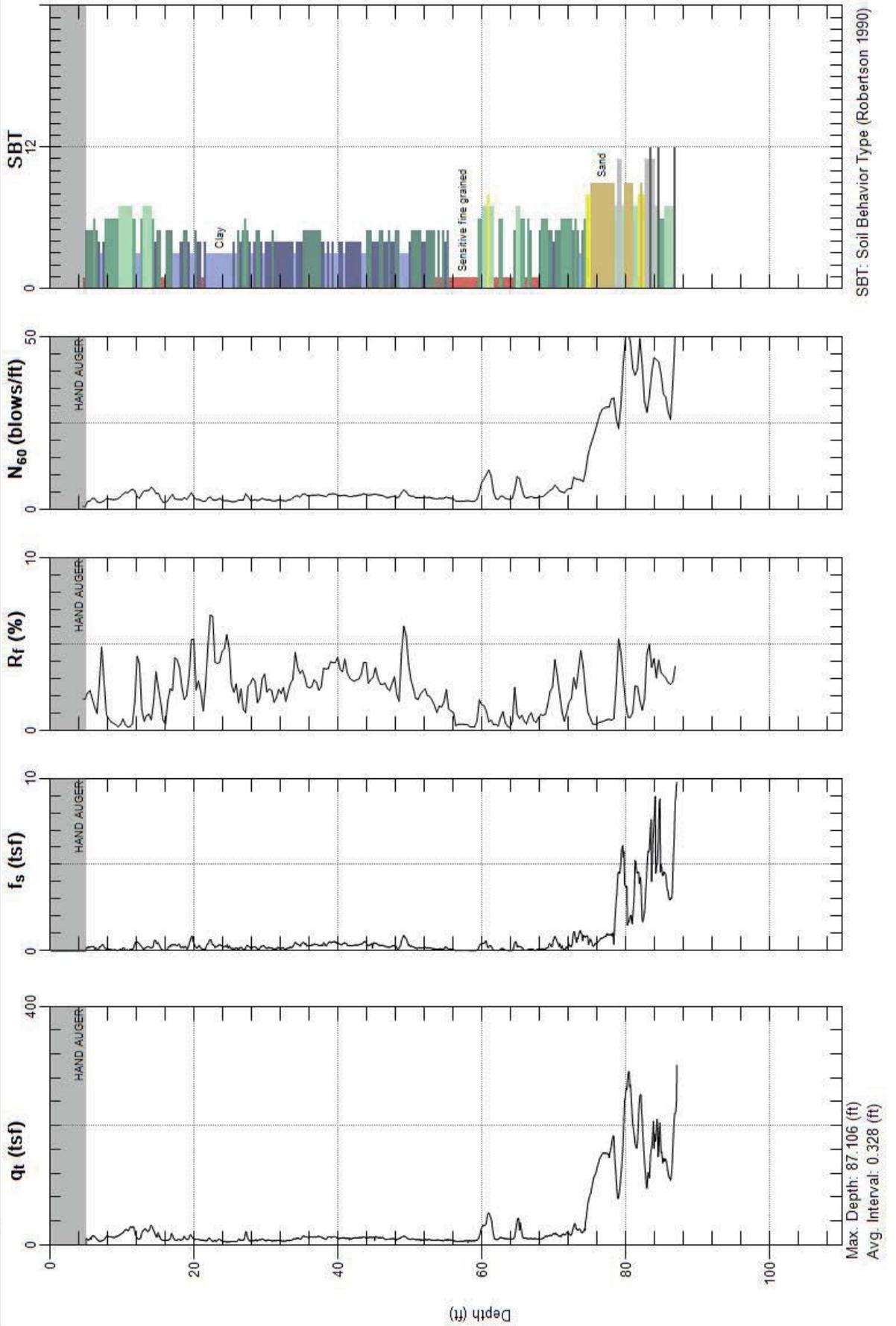
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Elevation, feet	Depth, feet	Graphic Log	FIELD CLASSIFICATION AND DESCRIPTION	Drilling Method	Sampled Interval	Recovery %	Blows per 6 in.	SPT N Value	N ₆₀ (ASTM)	PP or TV, tsf	Retained Sample	LABORATORY DATA				Other Lab Tests	Inclinometer Installation Schematic	REMARKS
												Water Content %	Liquid Limit	Plasticity Index	Fines% < #200			
0	0			Hand Auger														0' to 60' Lean Cement 0' to 3' Monument 0' to 60' Inclinometer Casing Monument starts 2.5' above ground surface. Inclinometer Starts 2.0' above ground surface.
-10																		
-15																		
-20																		
-25																		
-30																		
-35																		
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-50																		
-55																		
-60																		
-65																		
60																		

9/11/2013



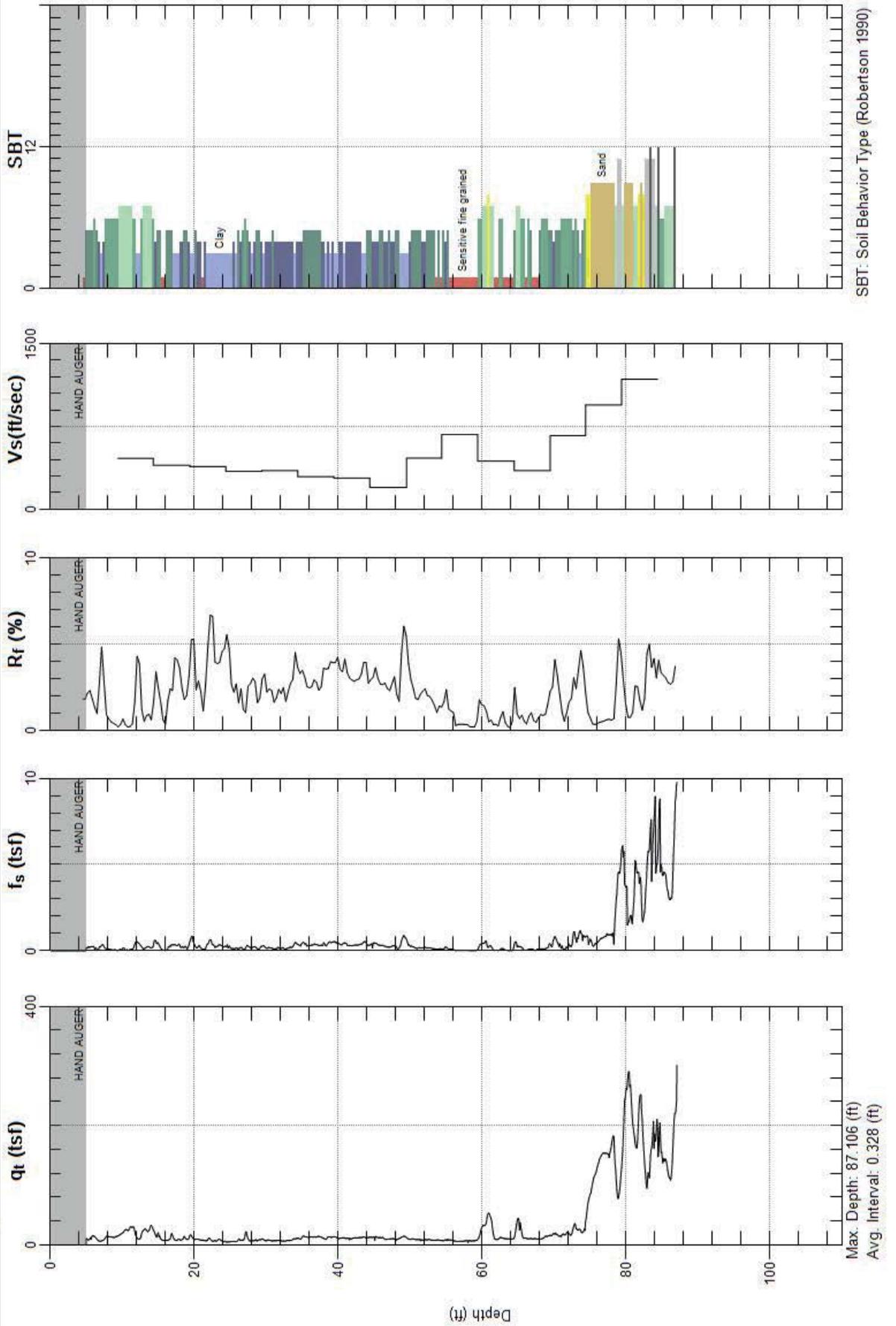
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Sounding: LBC1

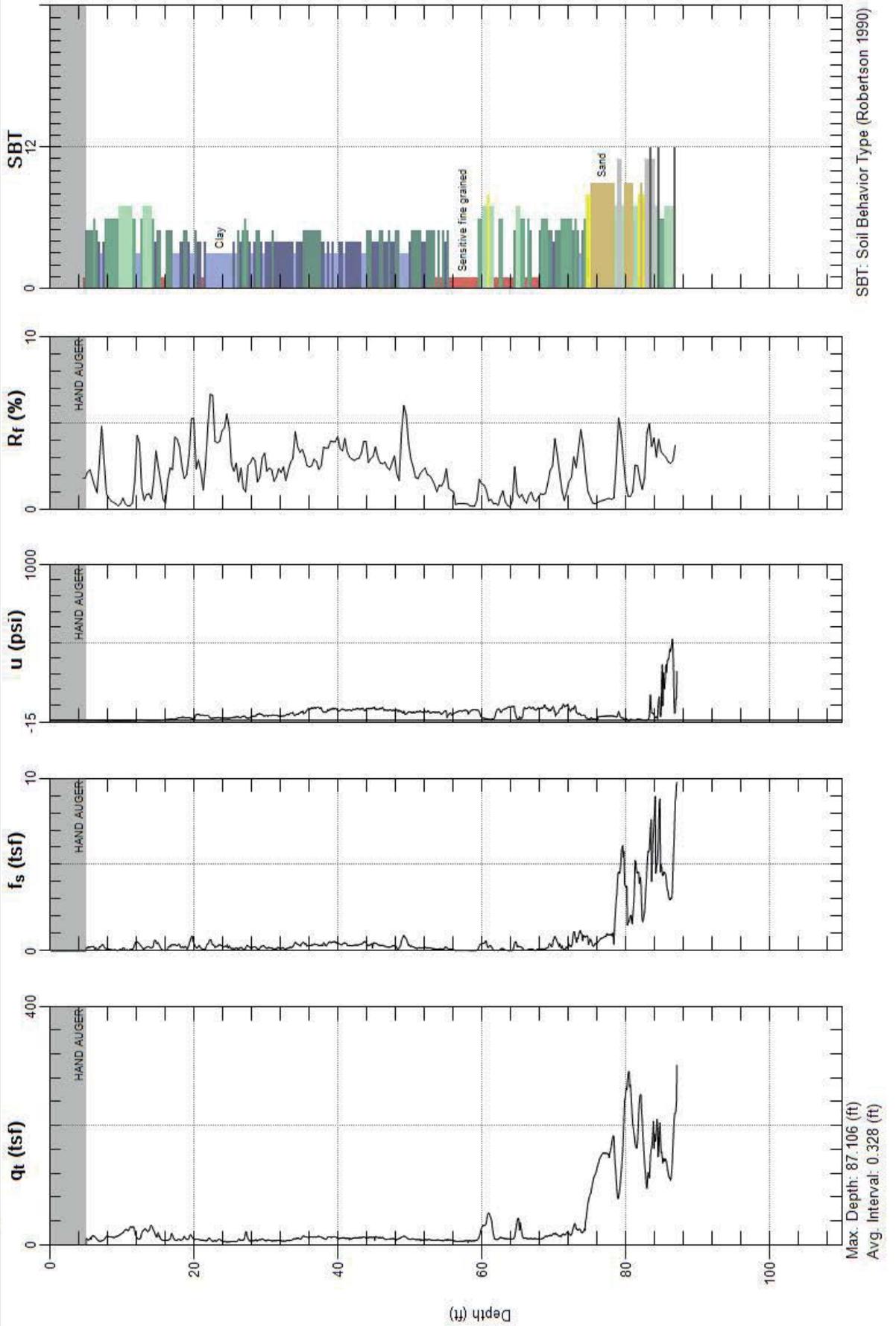
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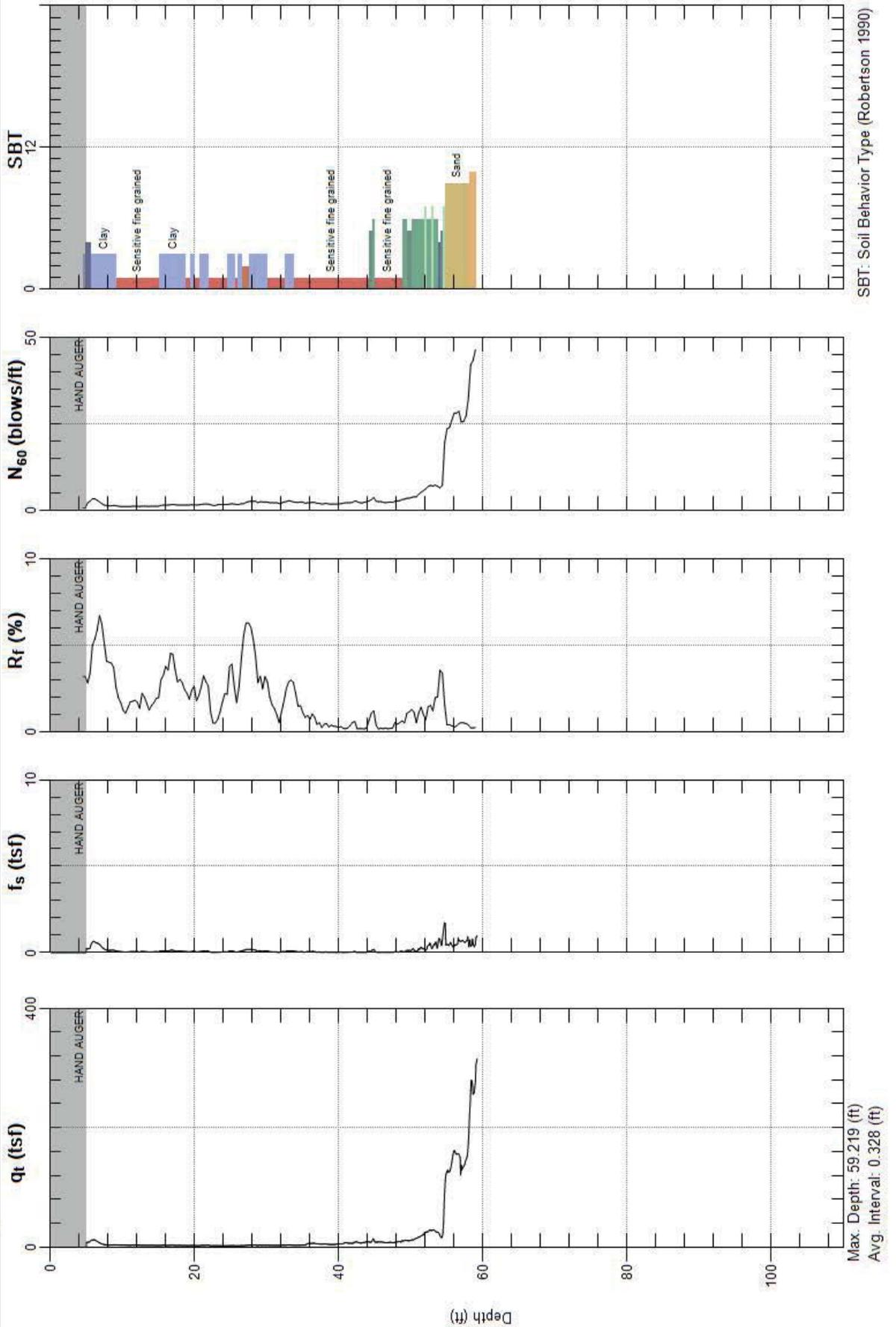
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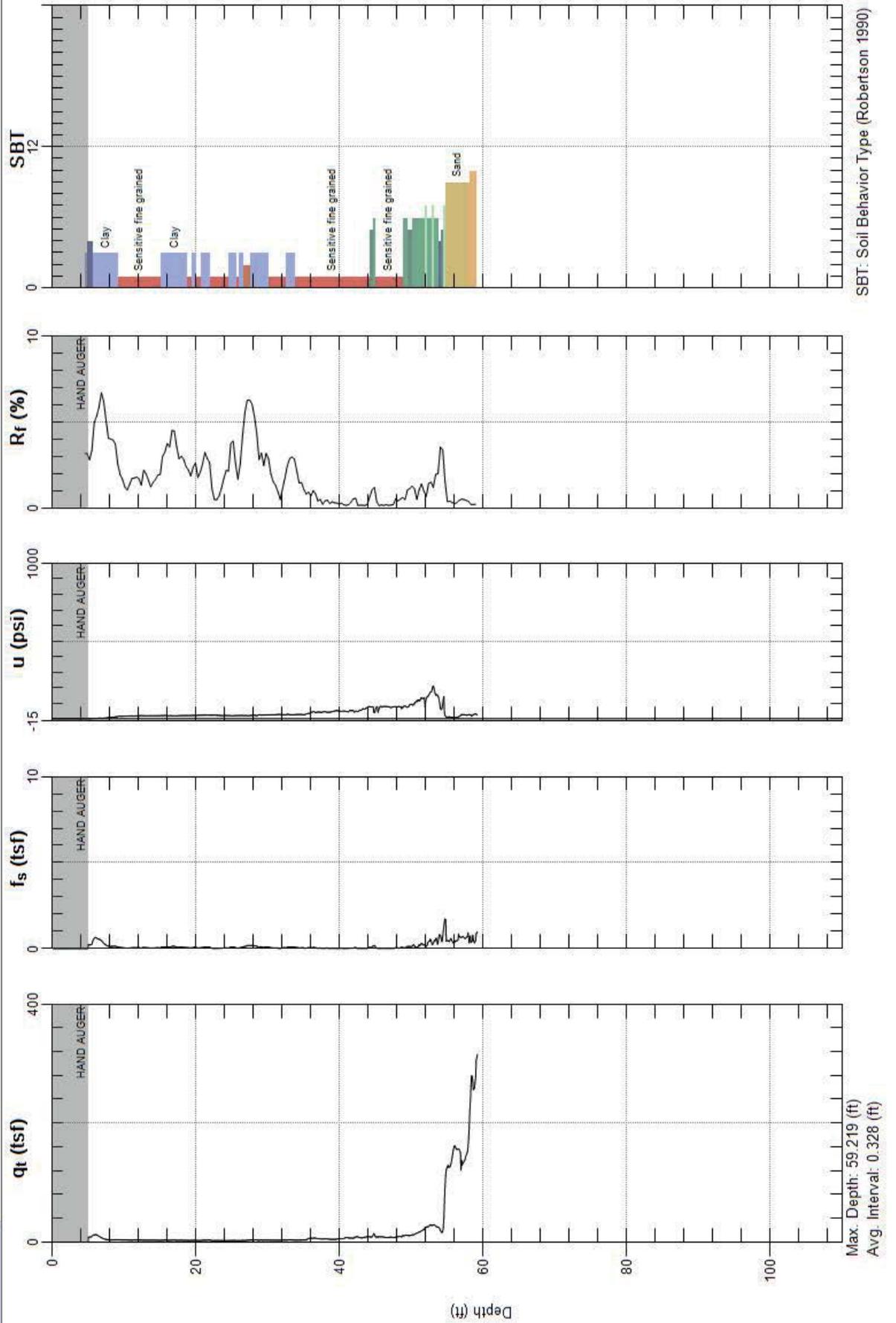
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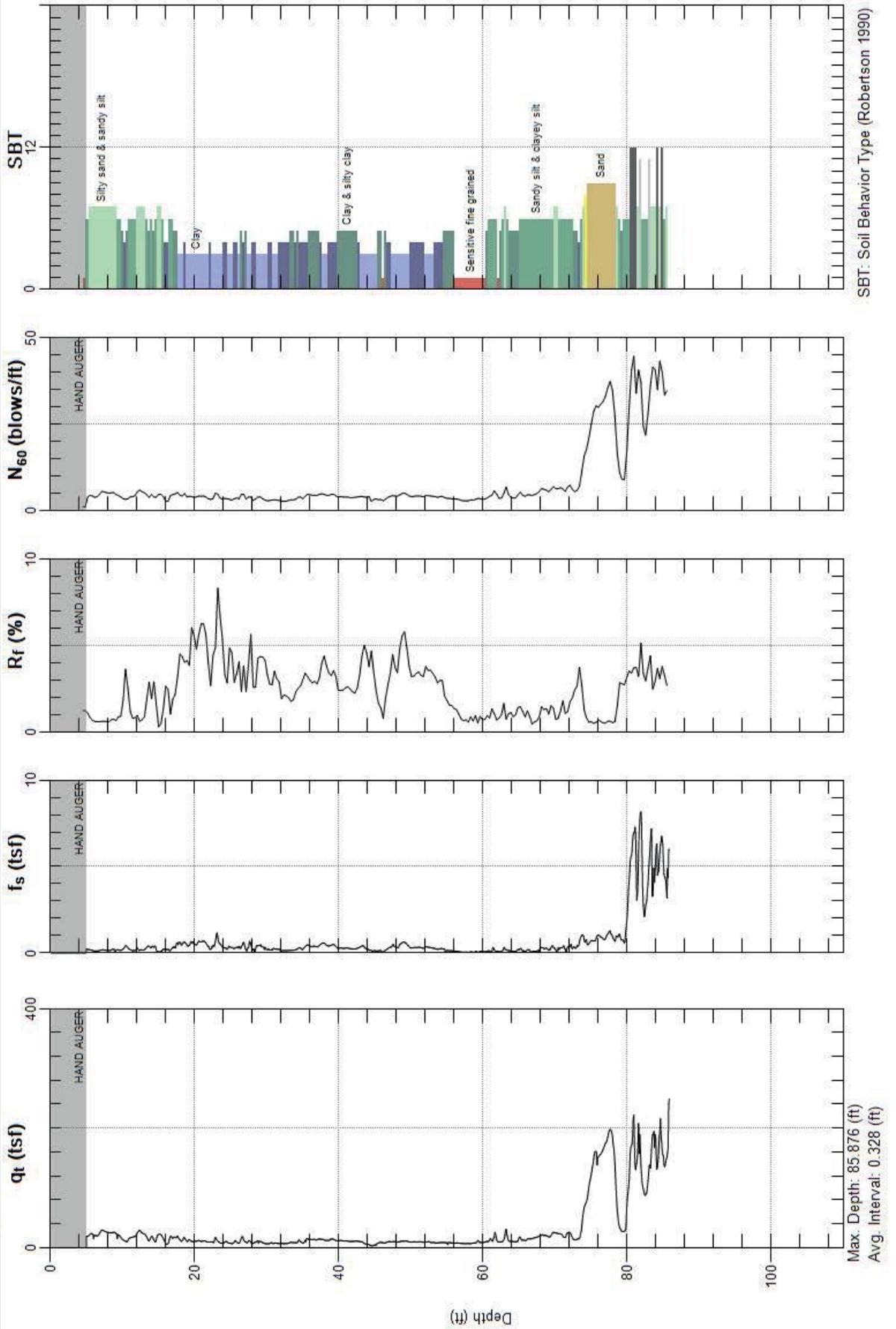
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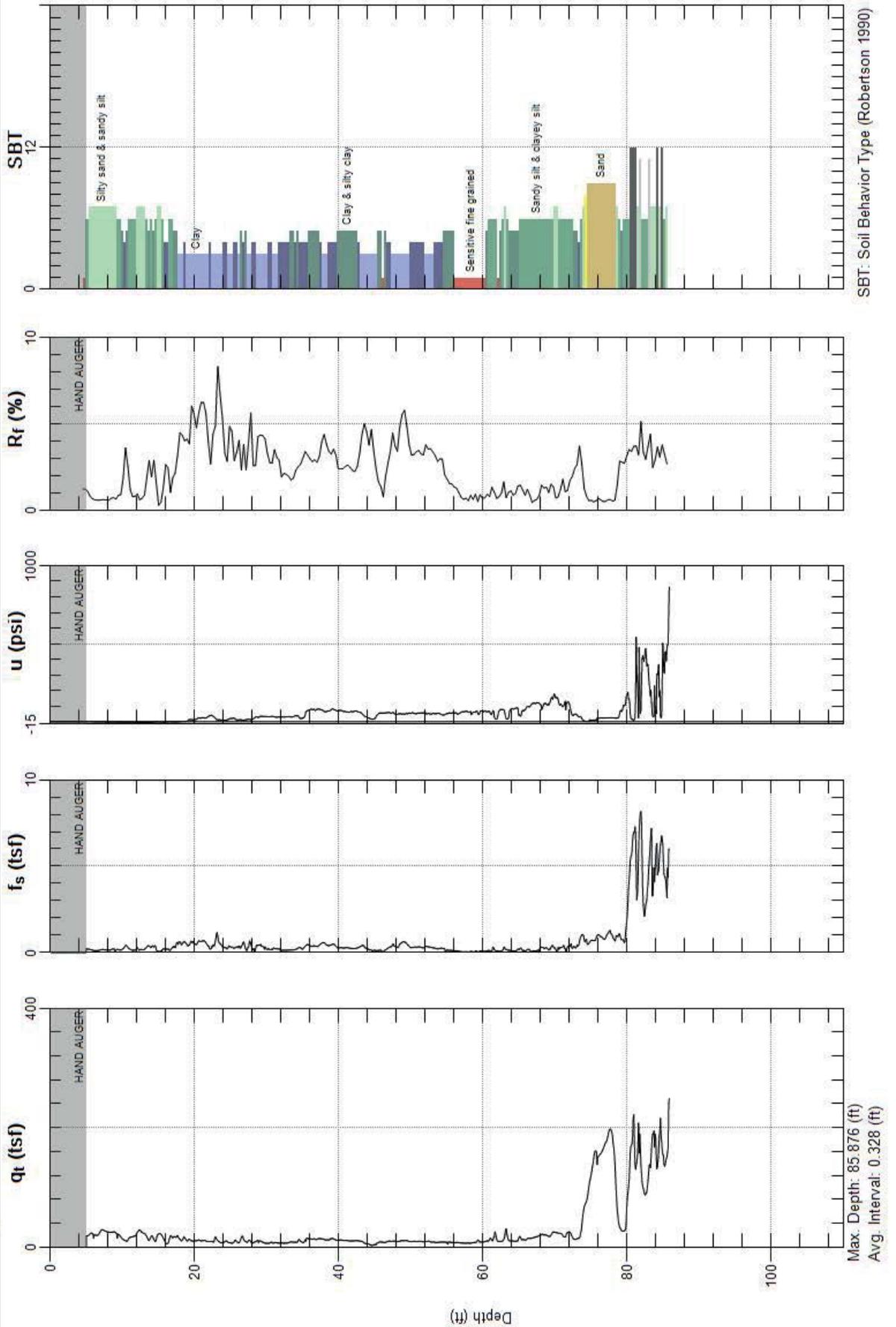
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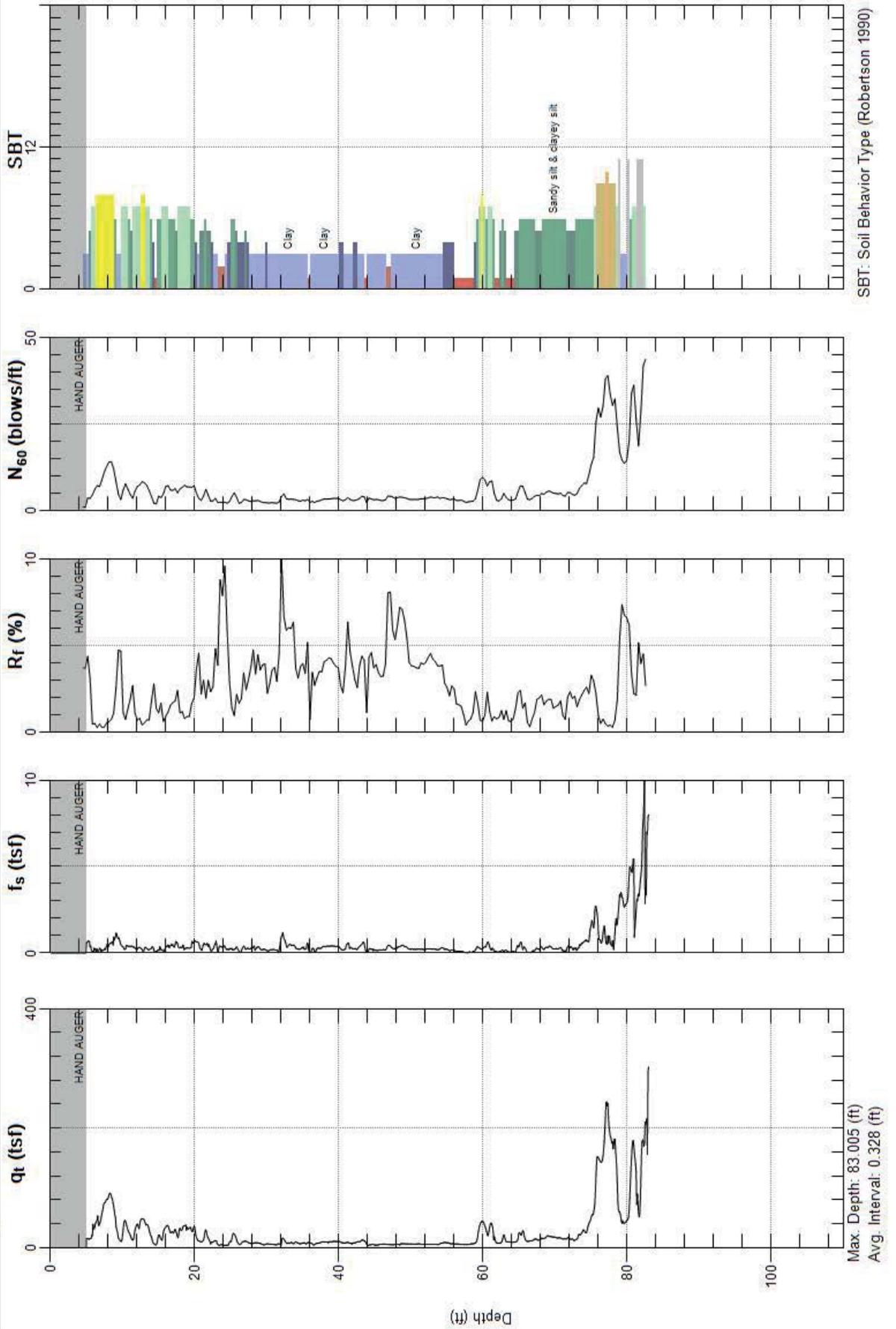
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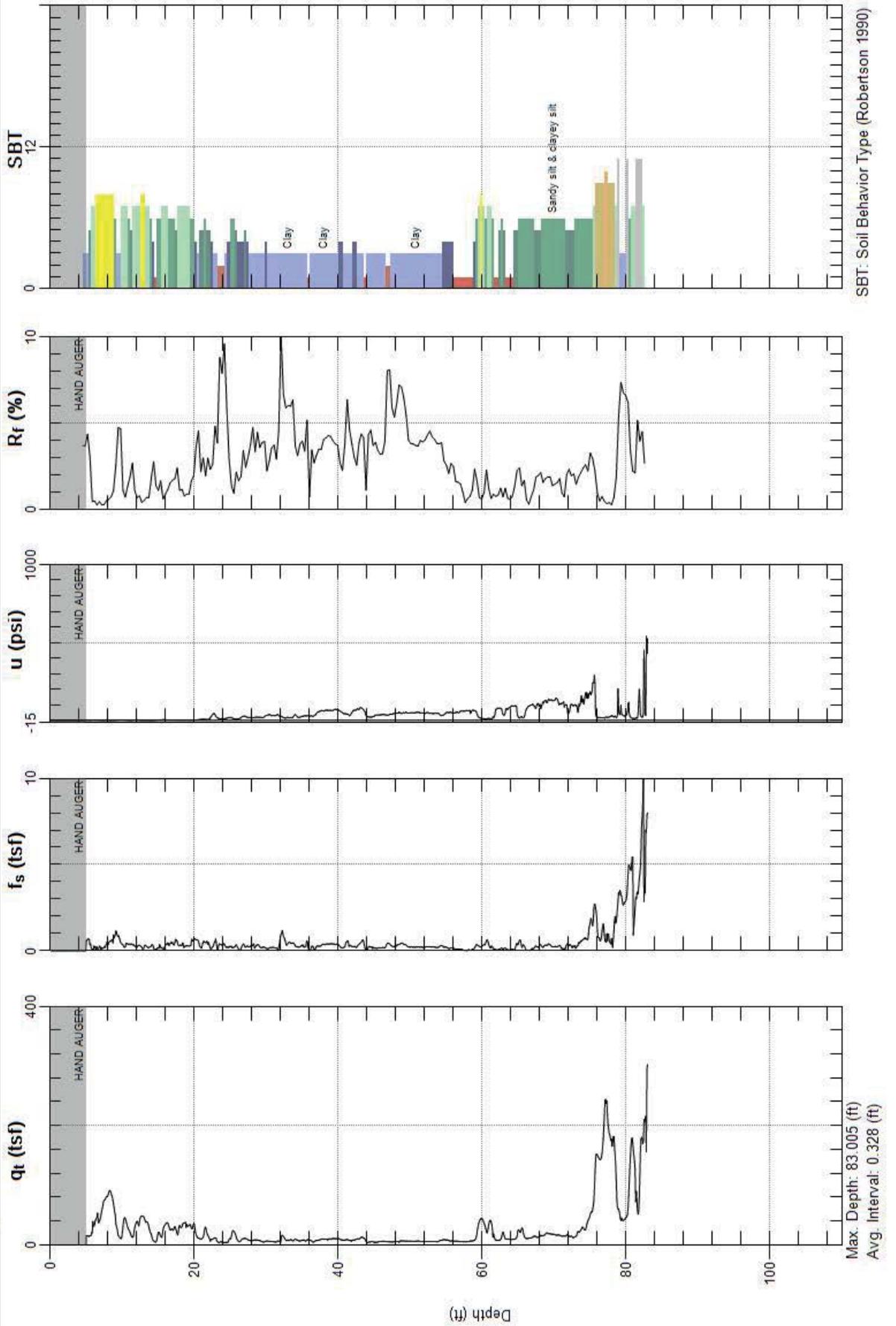
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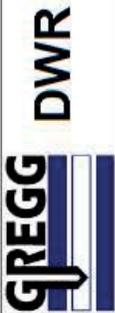




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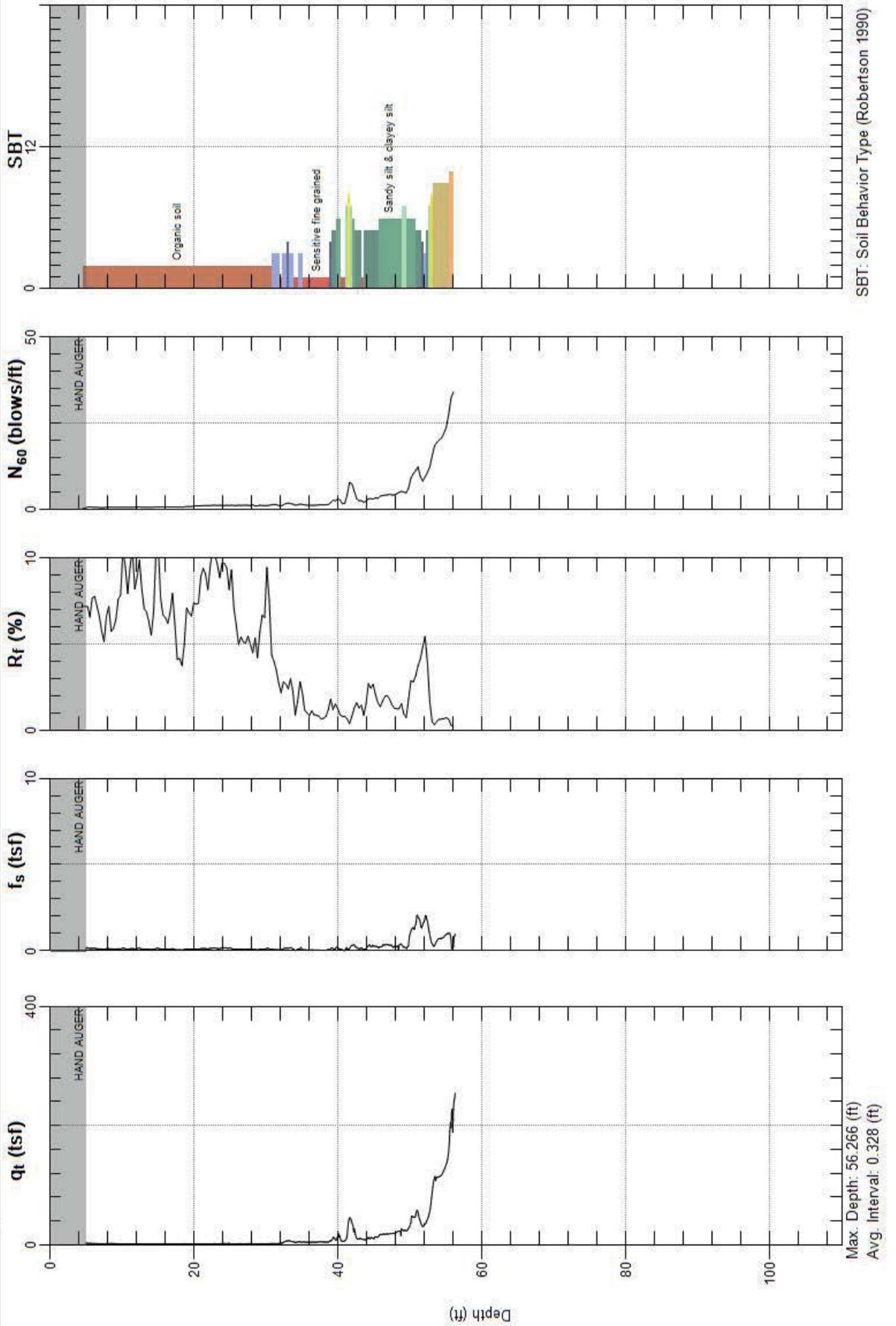
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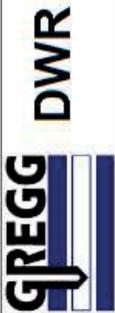




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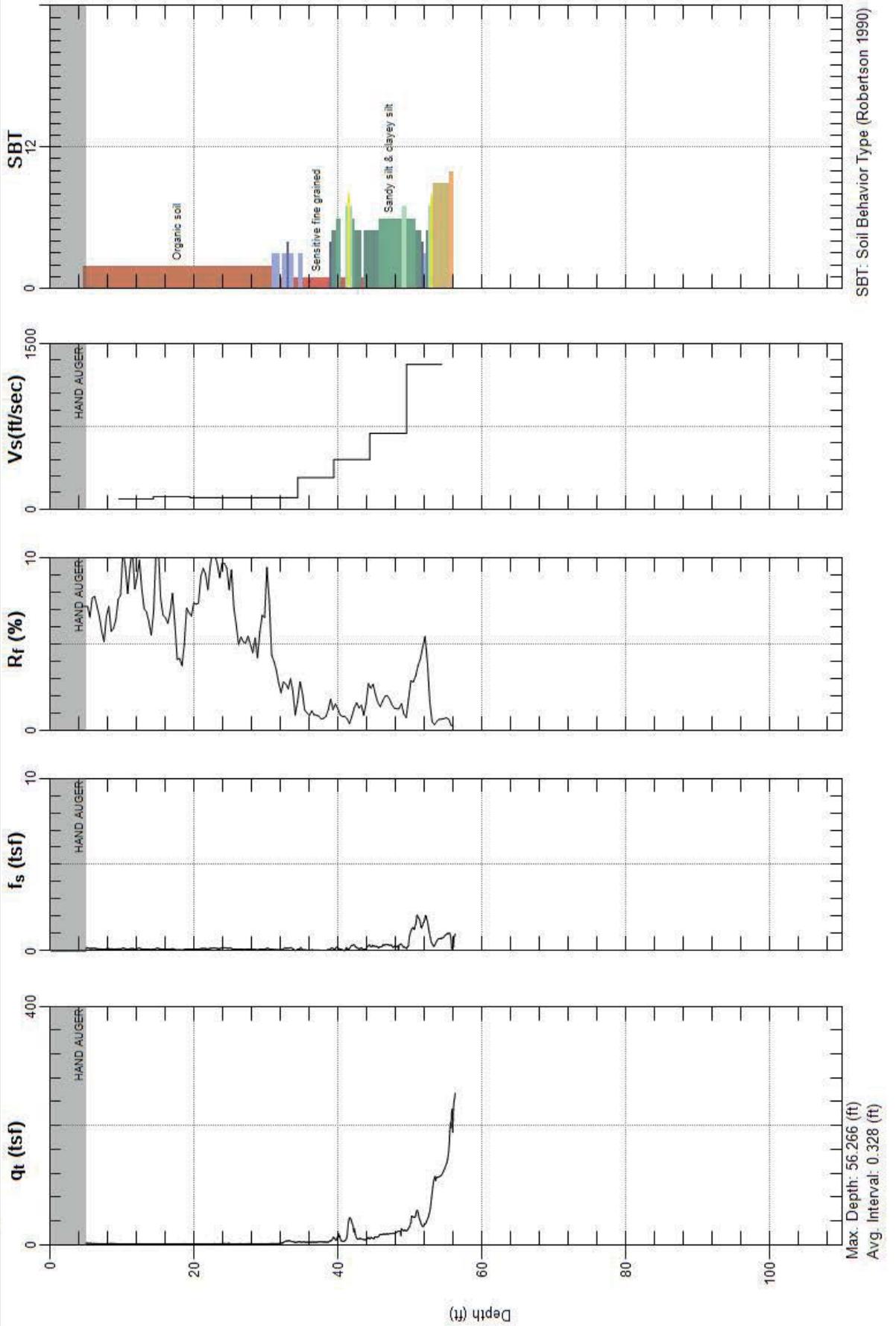
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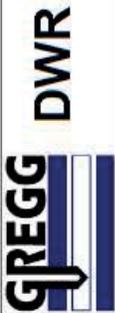




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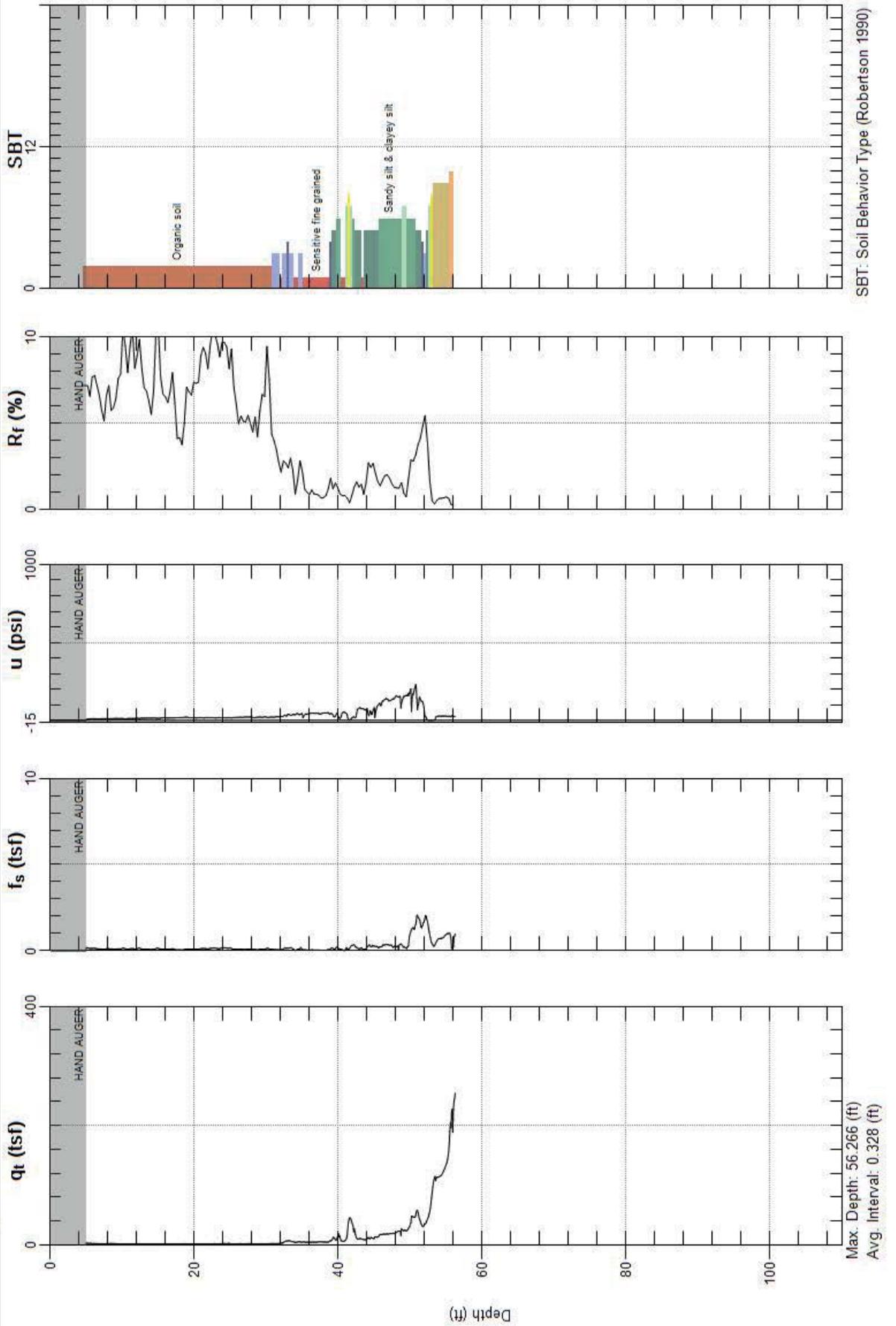
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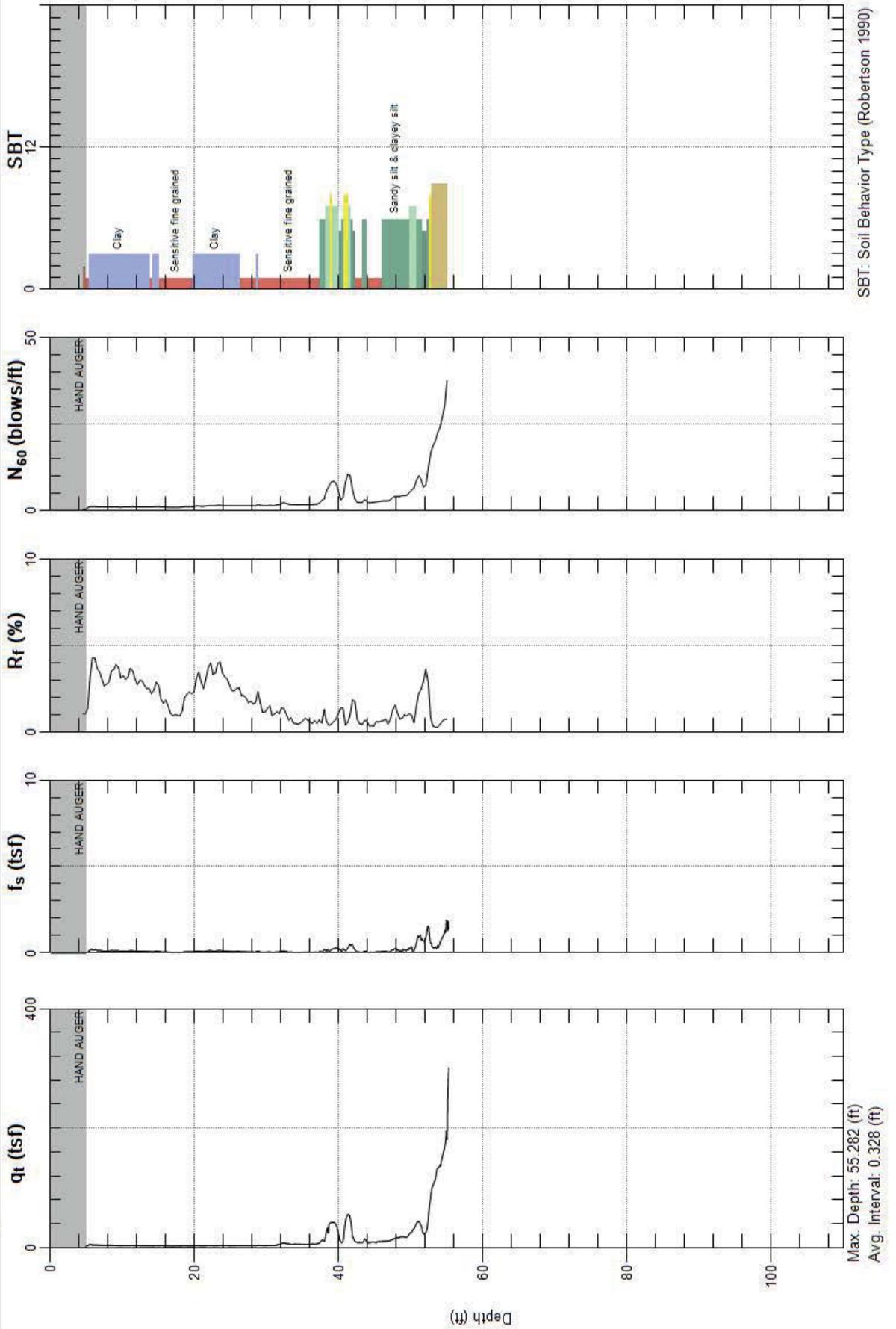
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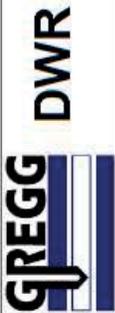




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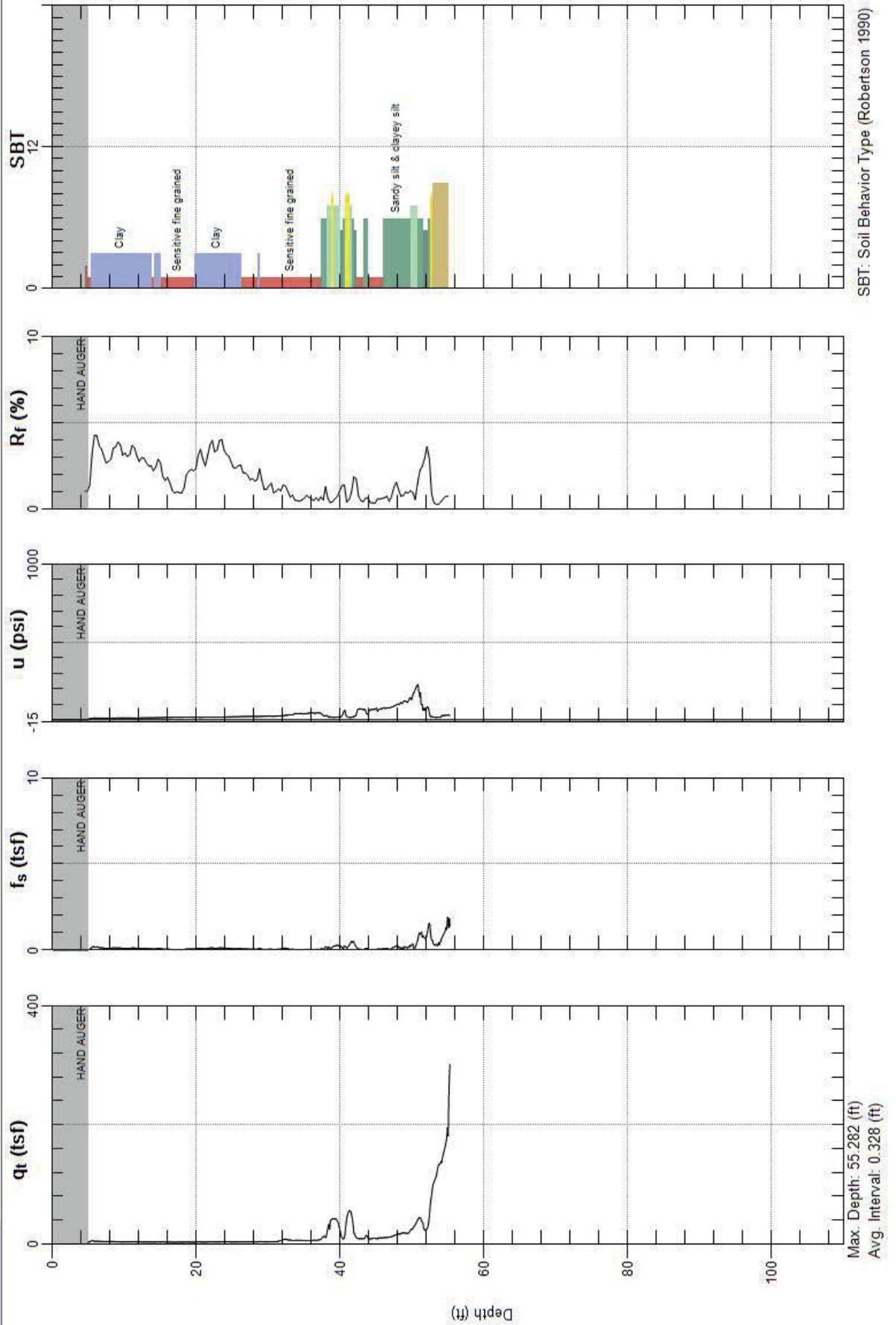
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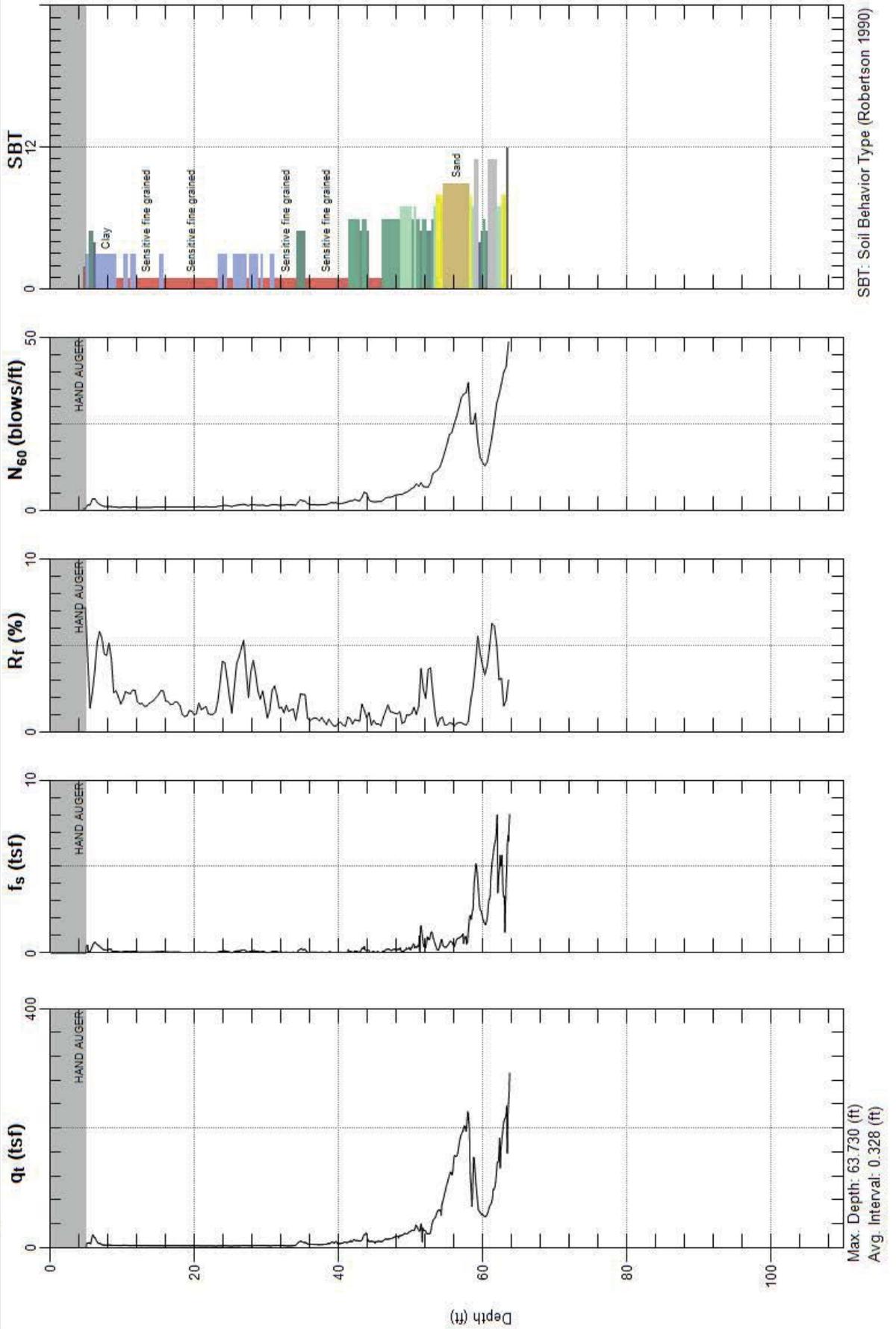
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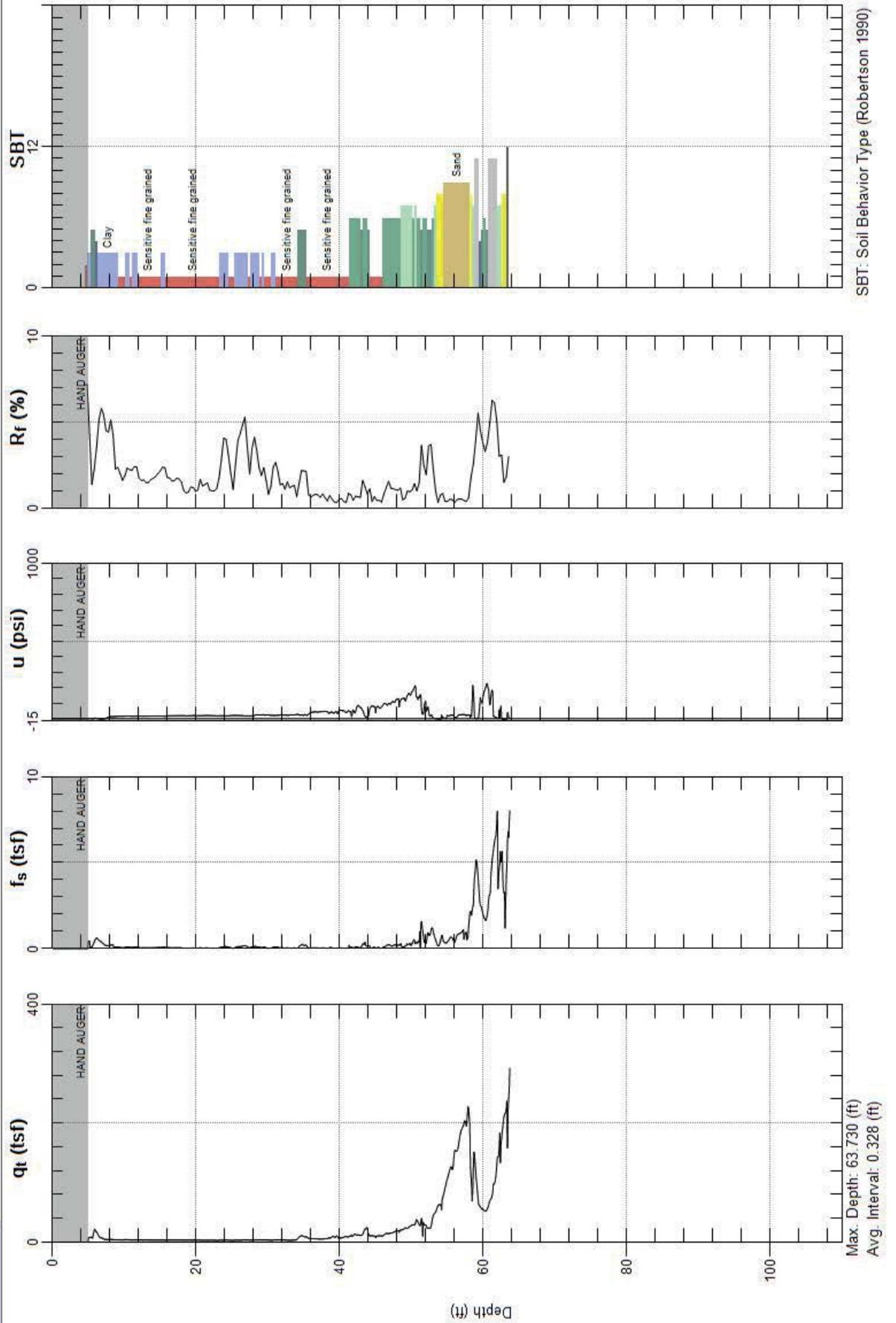
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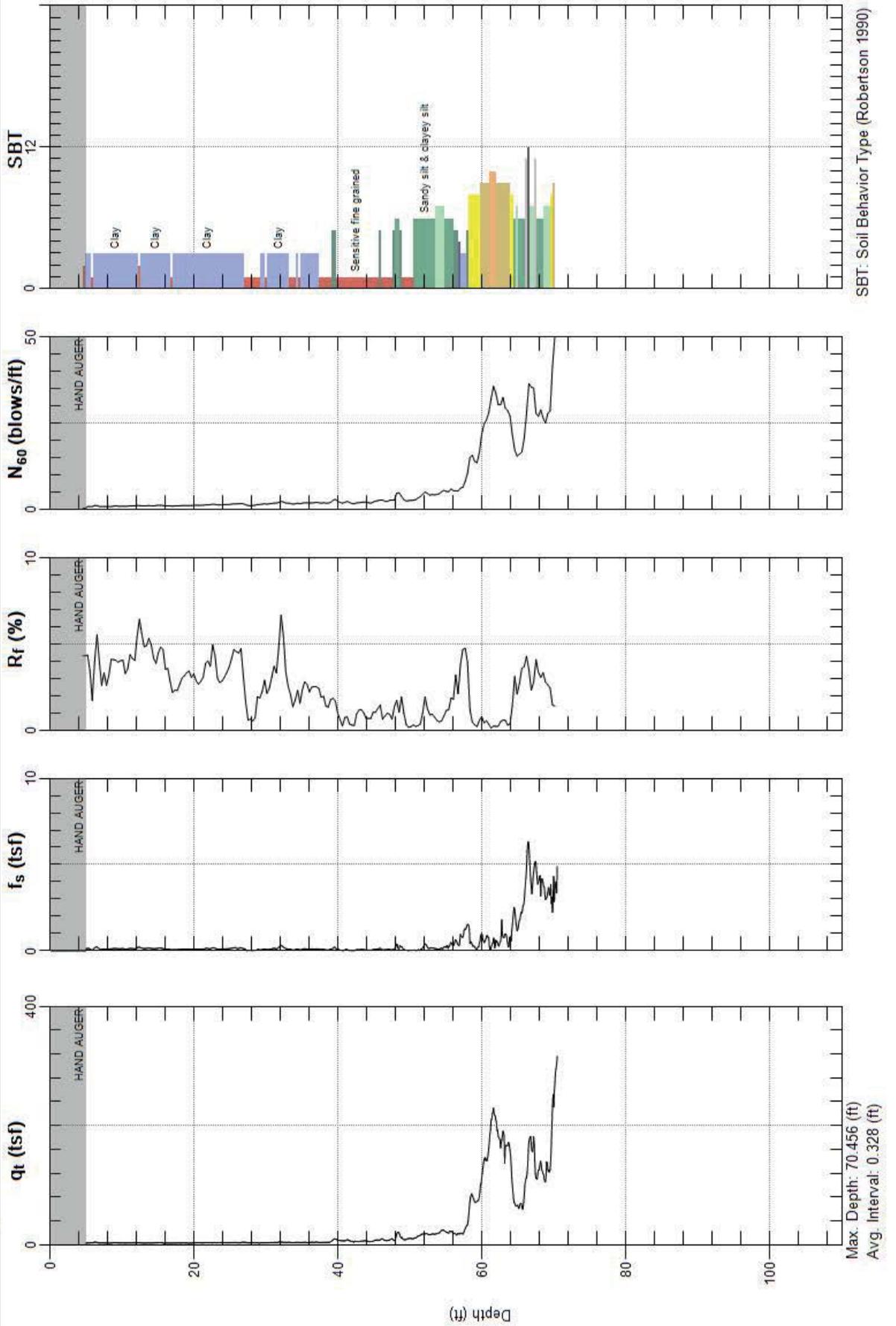
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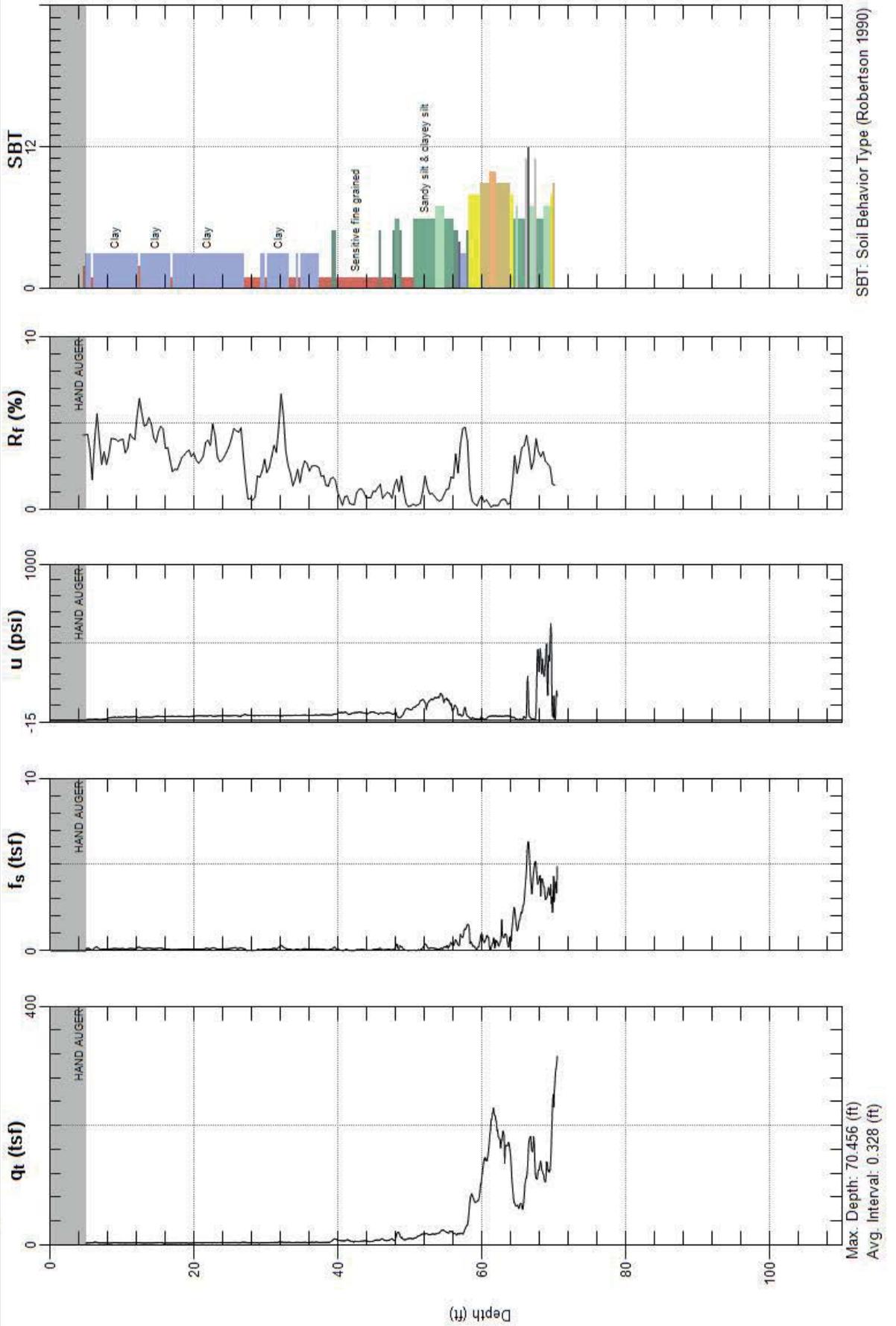
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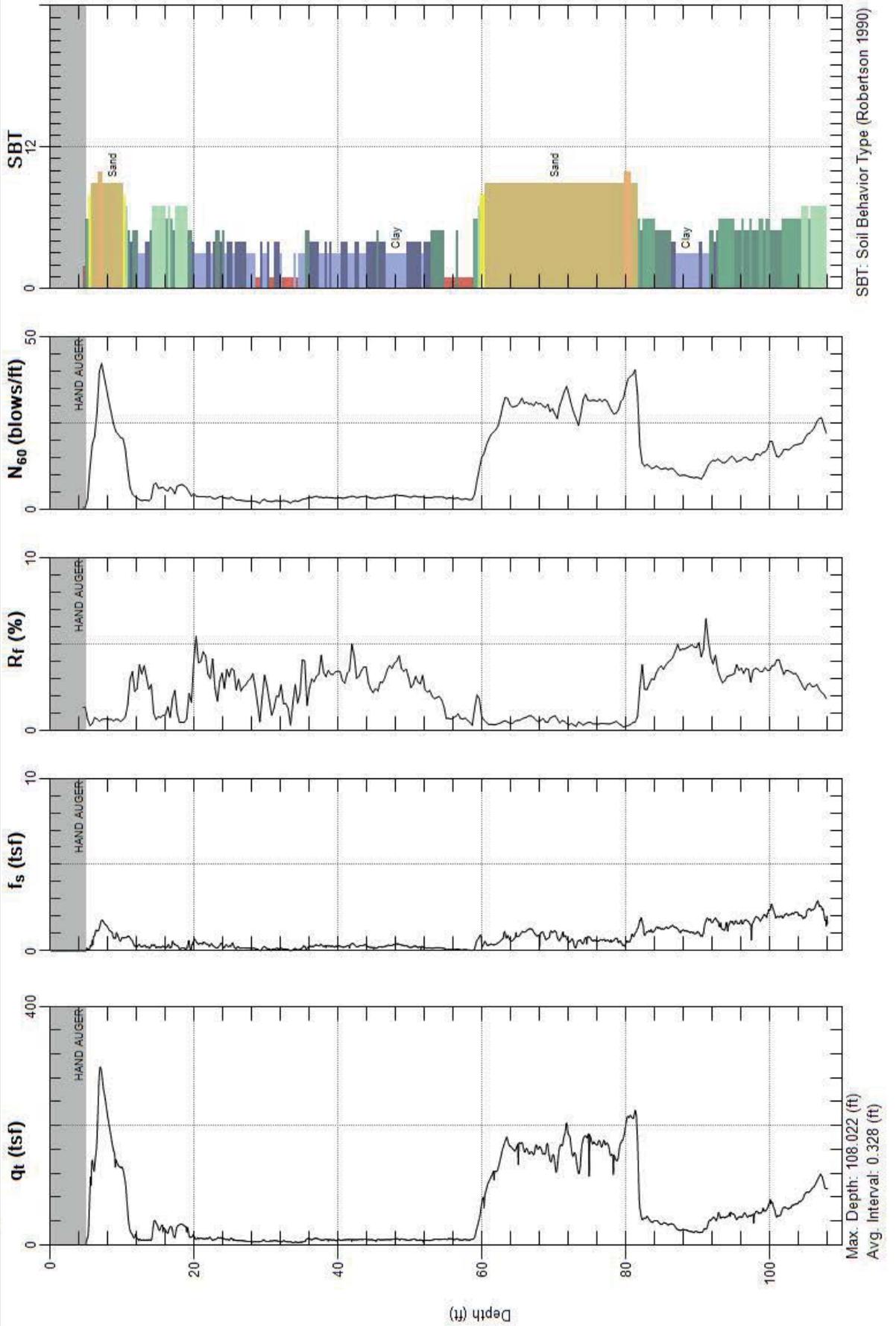
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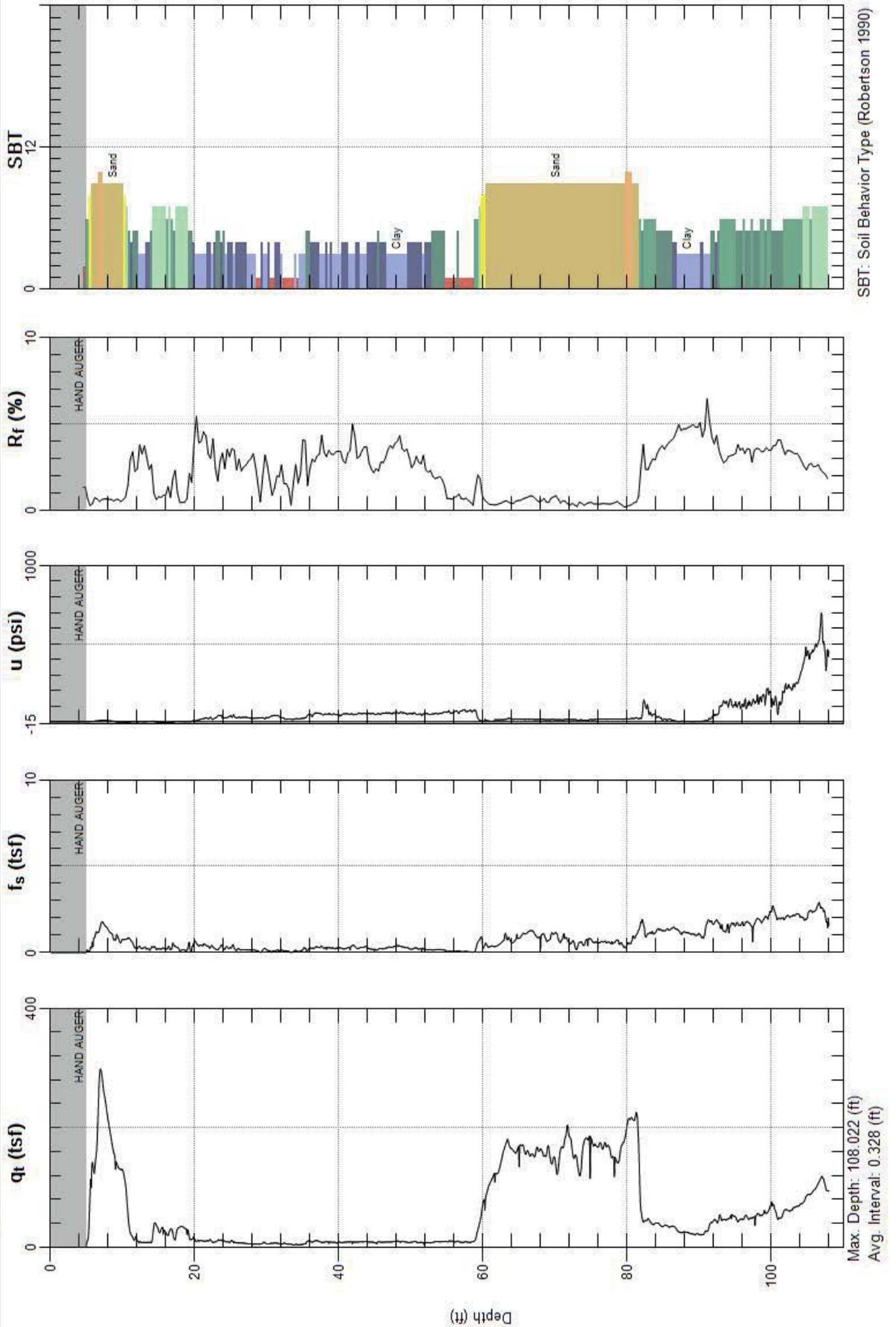
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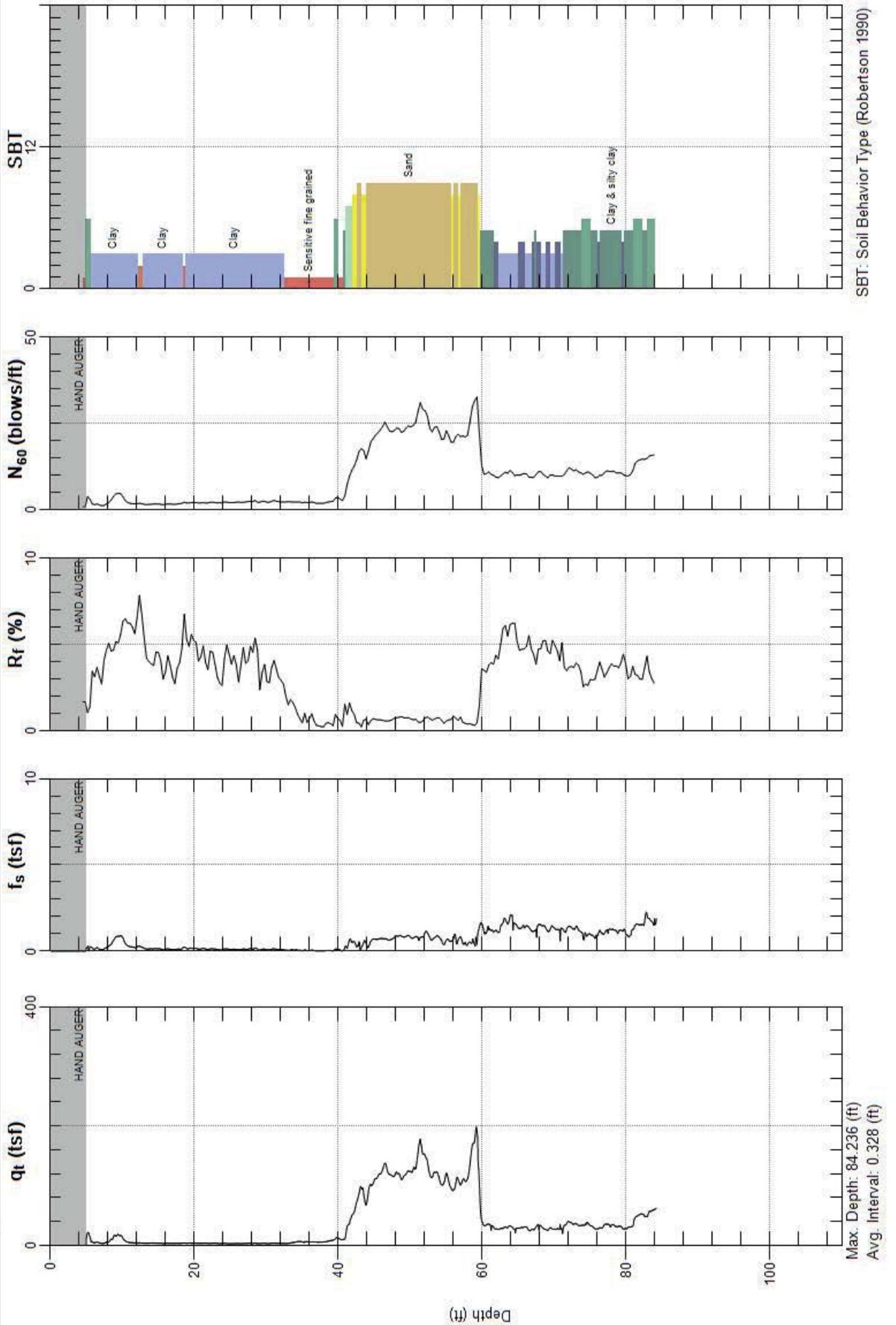
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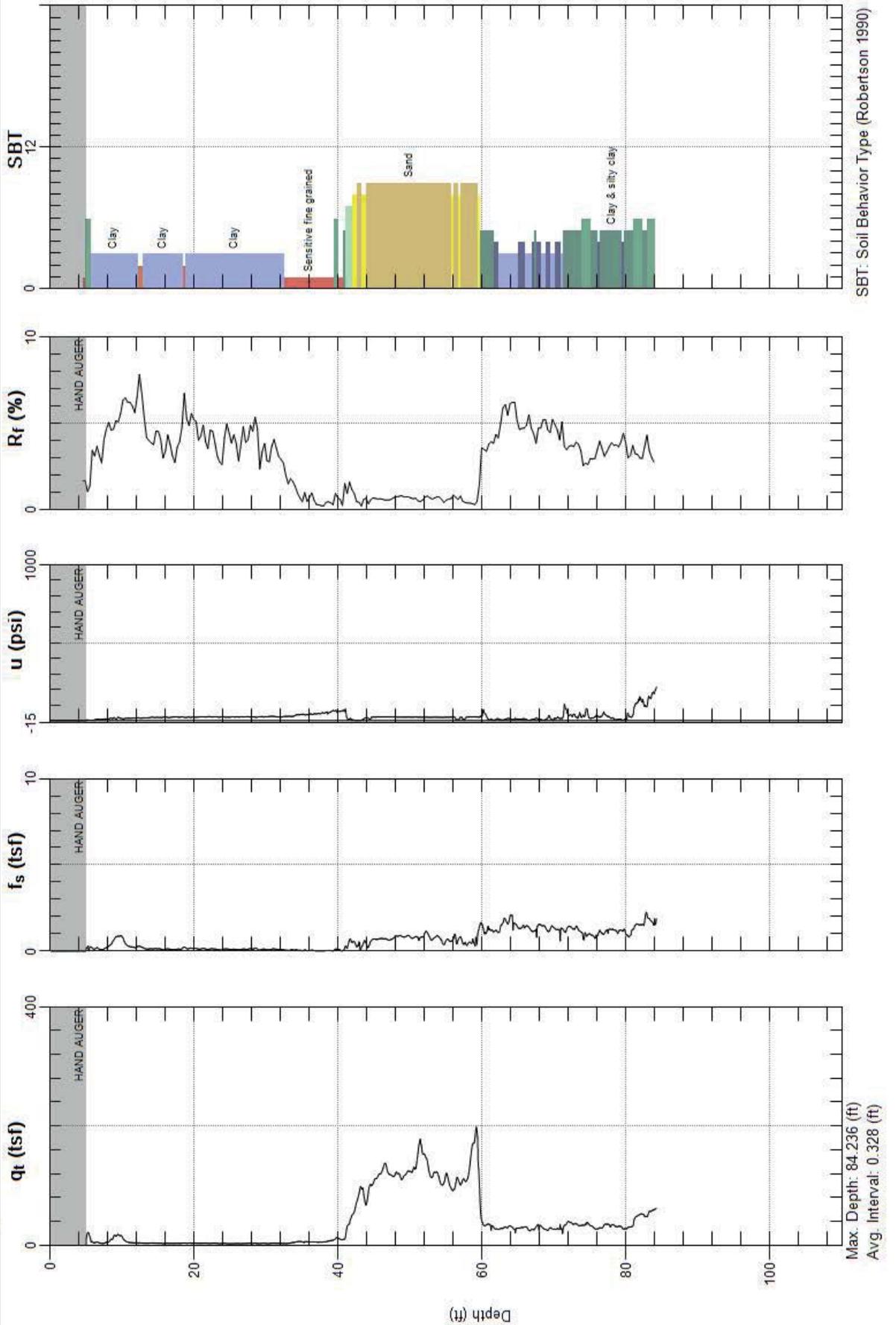
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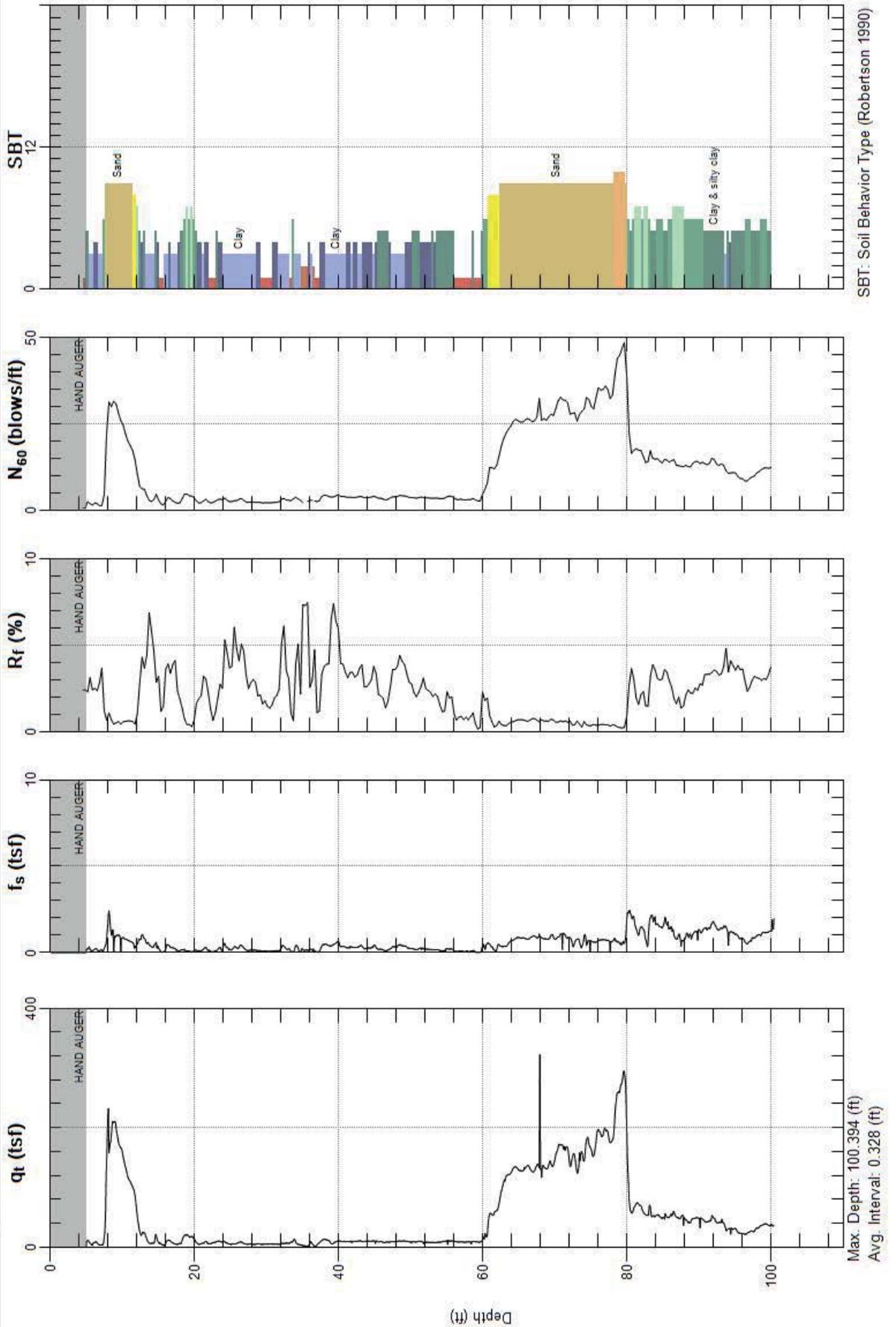
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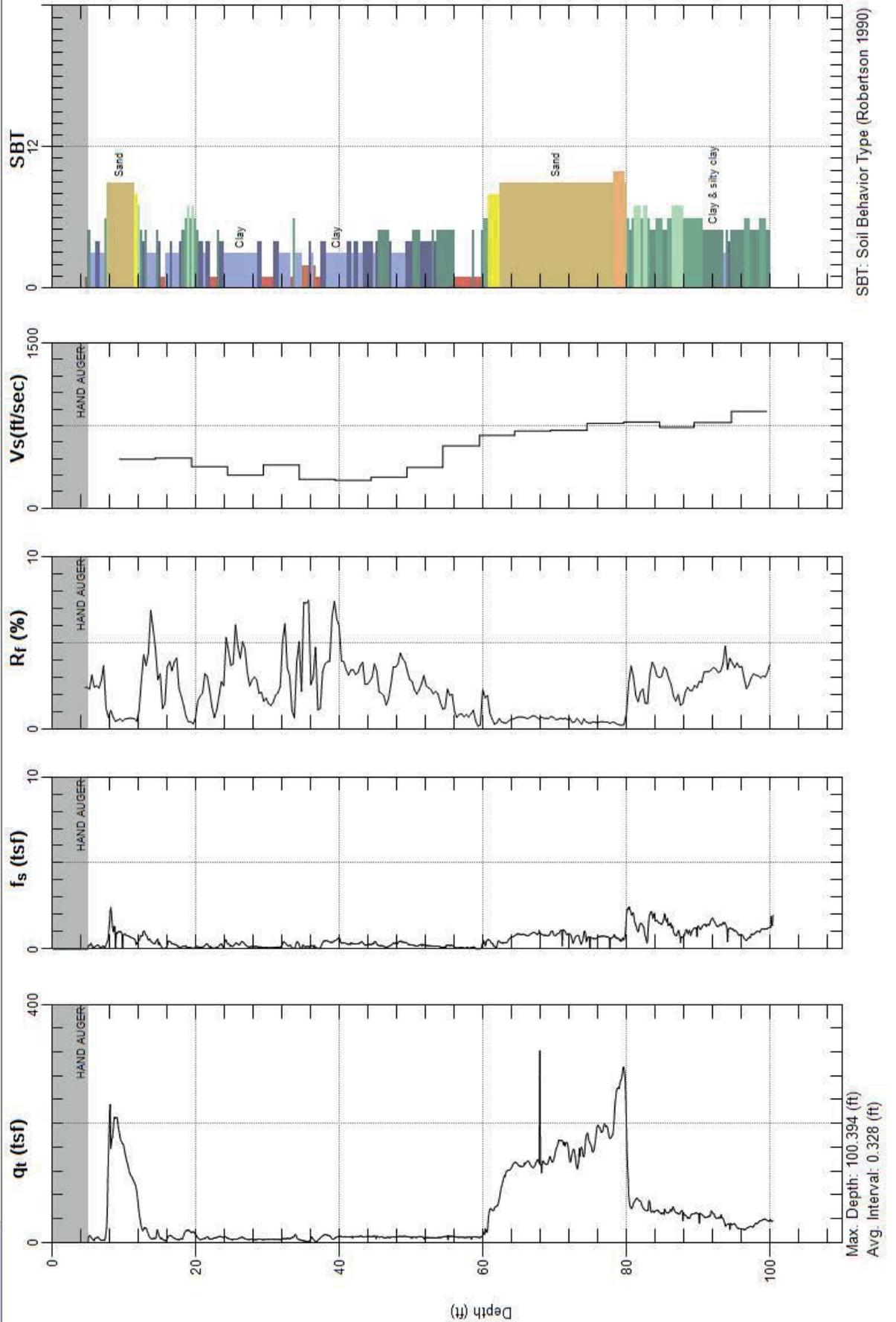
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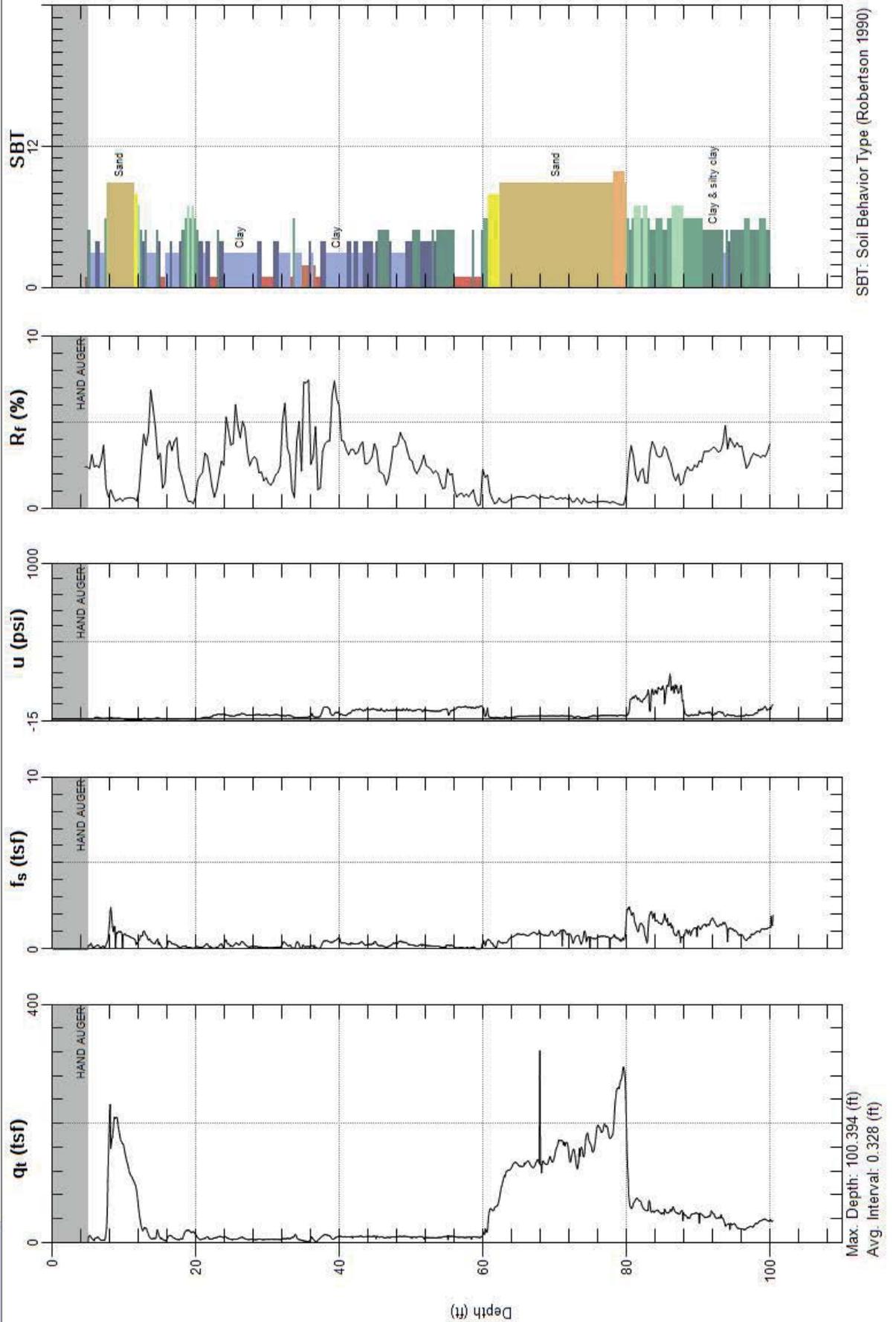
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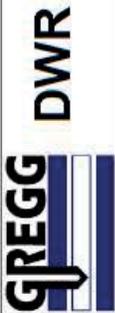




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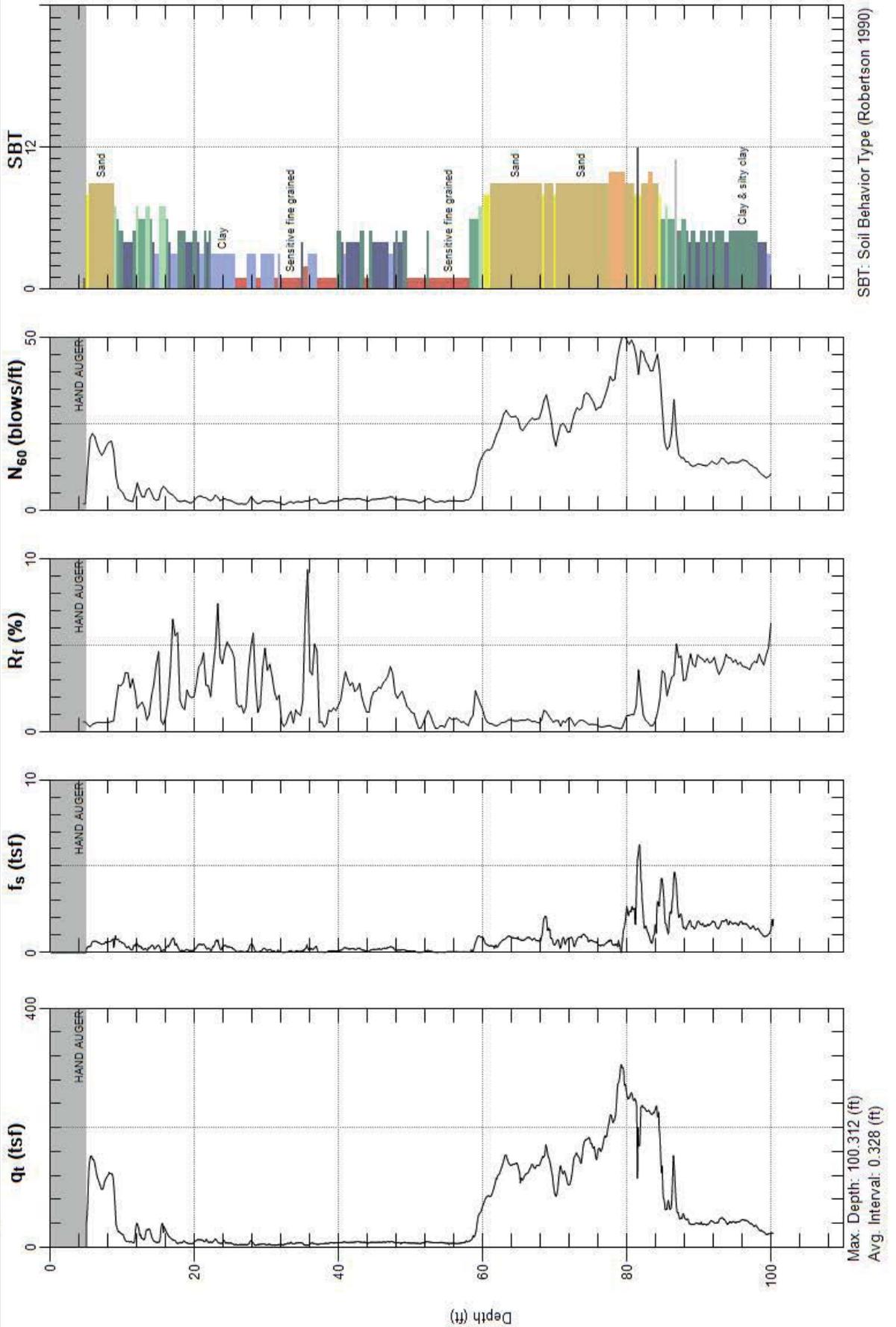
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Site: SHERMAN ISLAND
Sounding: MRC4

Engineer: D.PERRY
Date: 7/8/2013 02:33

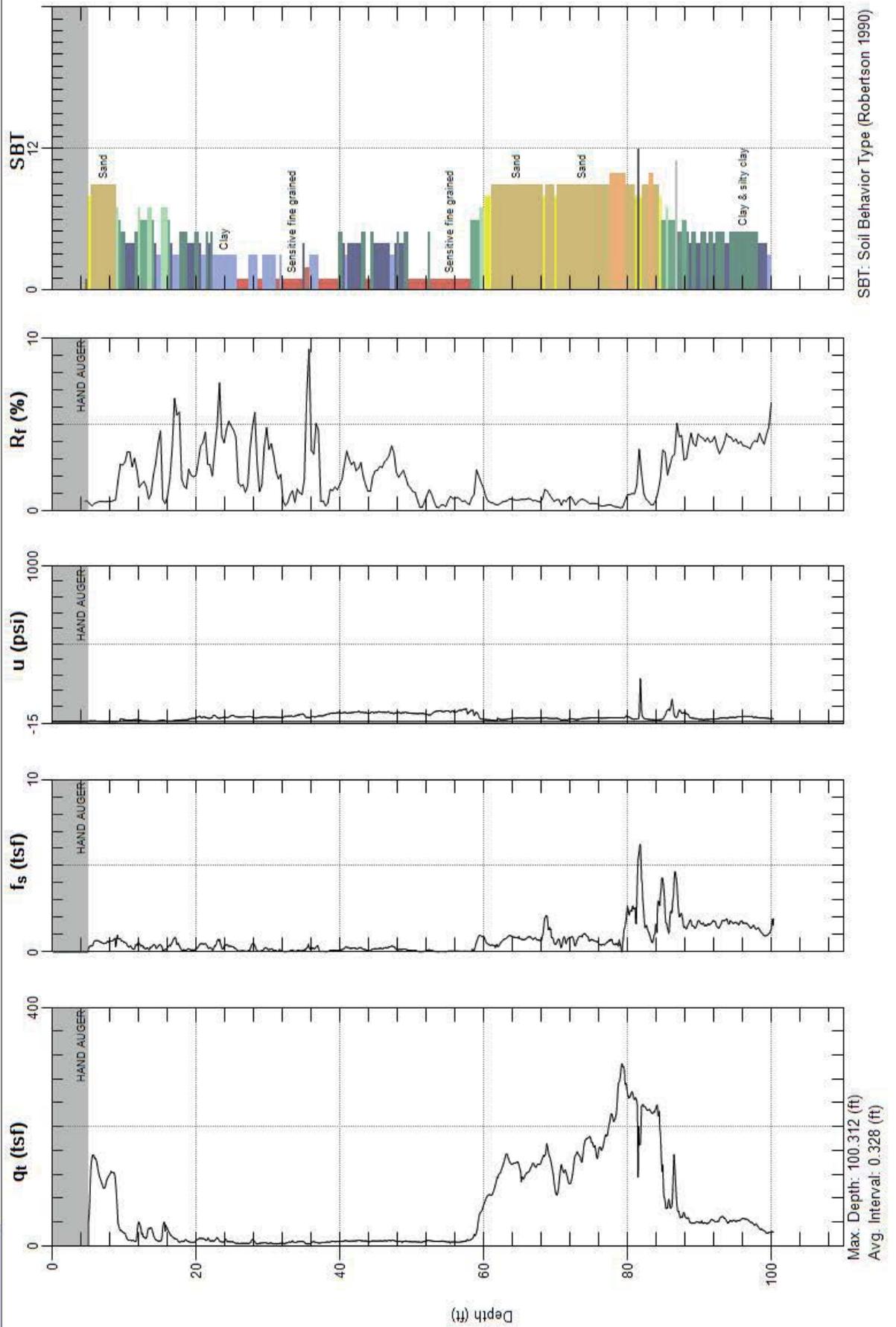


SBT: Soil Behavior Type (Robertson 1990)



Site: SHERMAN ISLAND
Sounding: MRC4

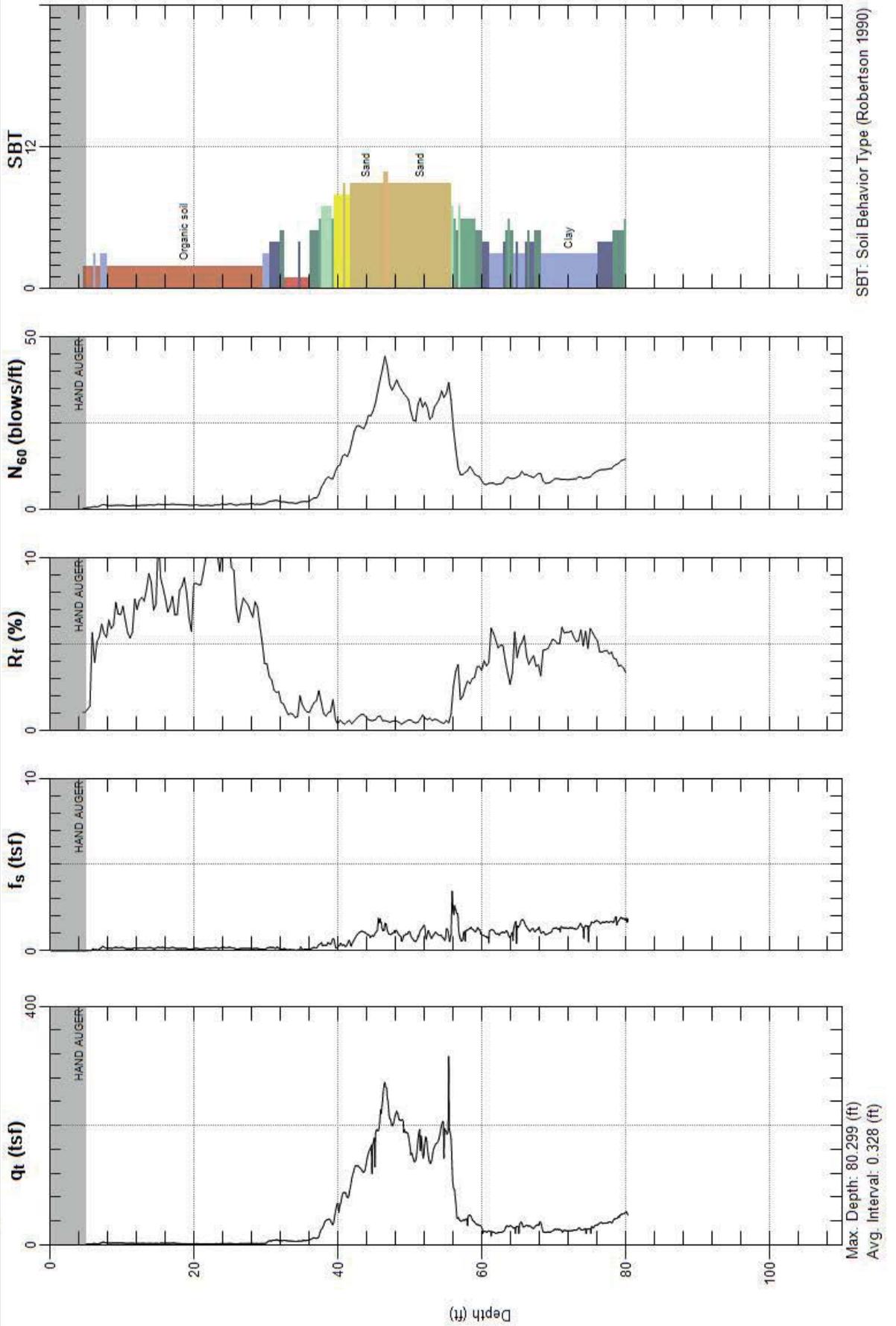
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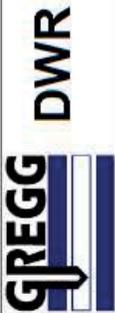




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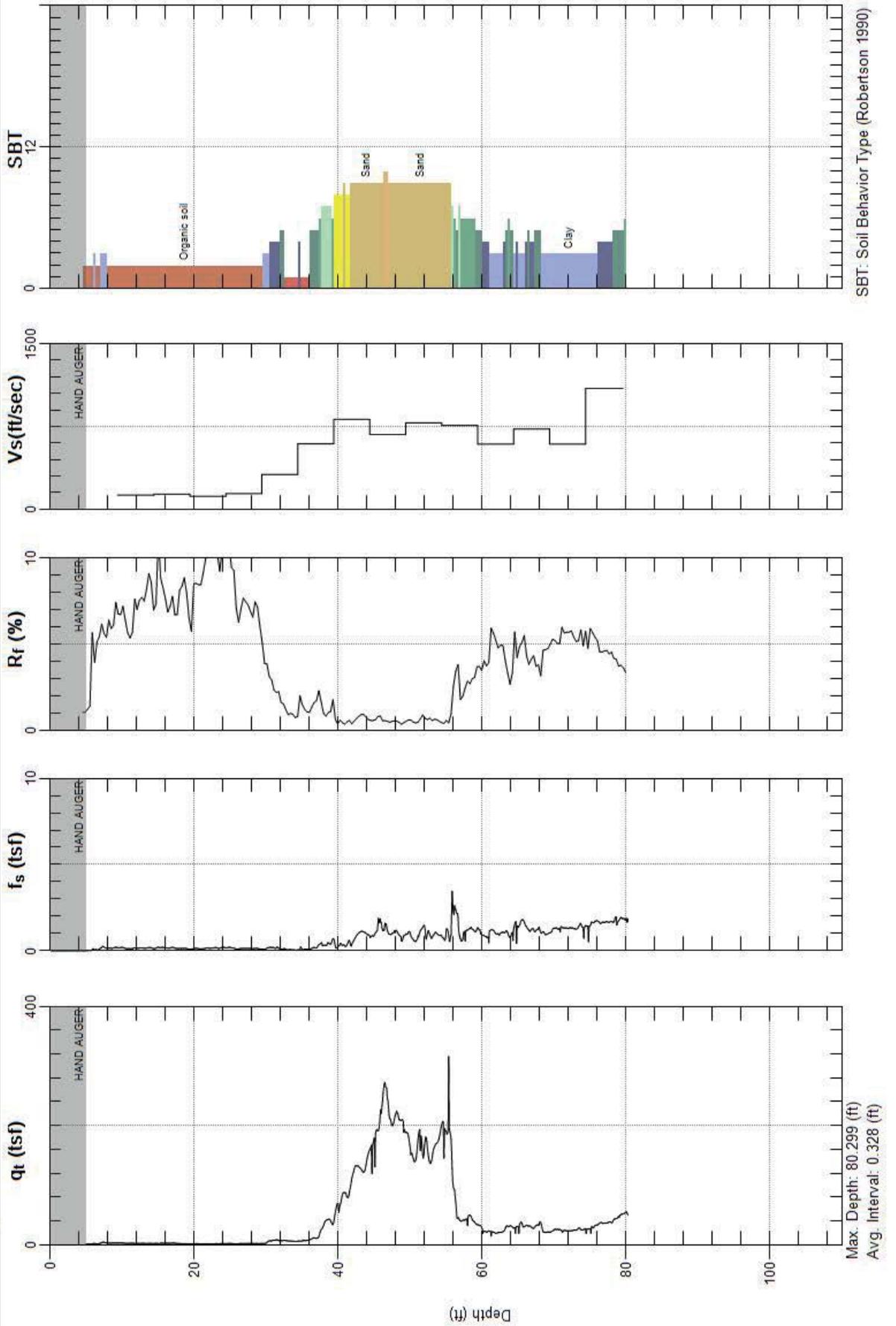
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Site: SHERMAN ISLAND
Sounding: MRC5

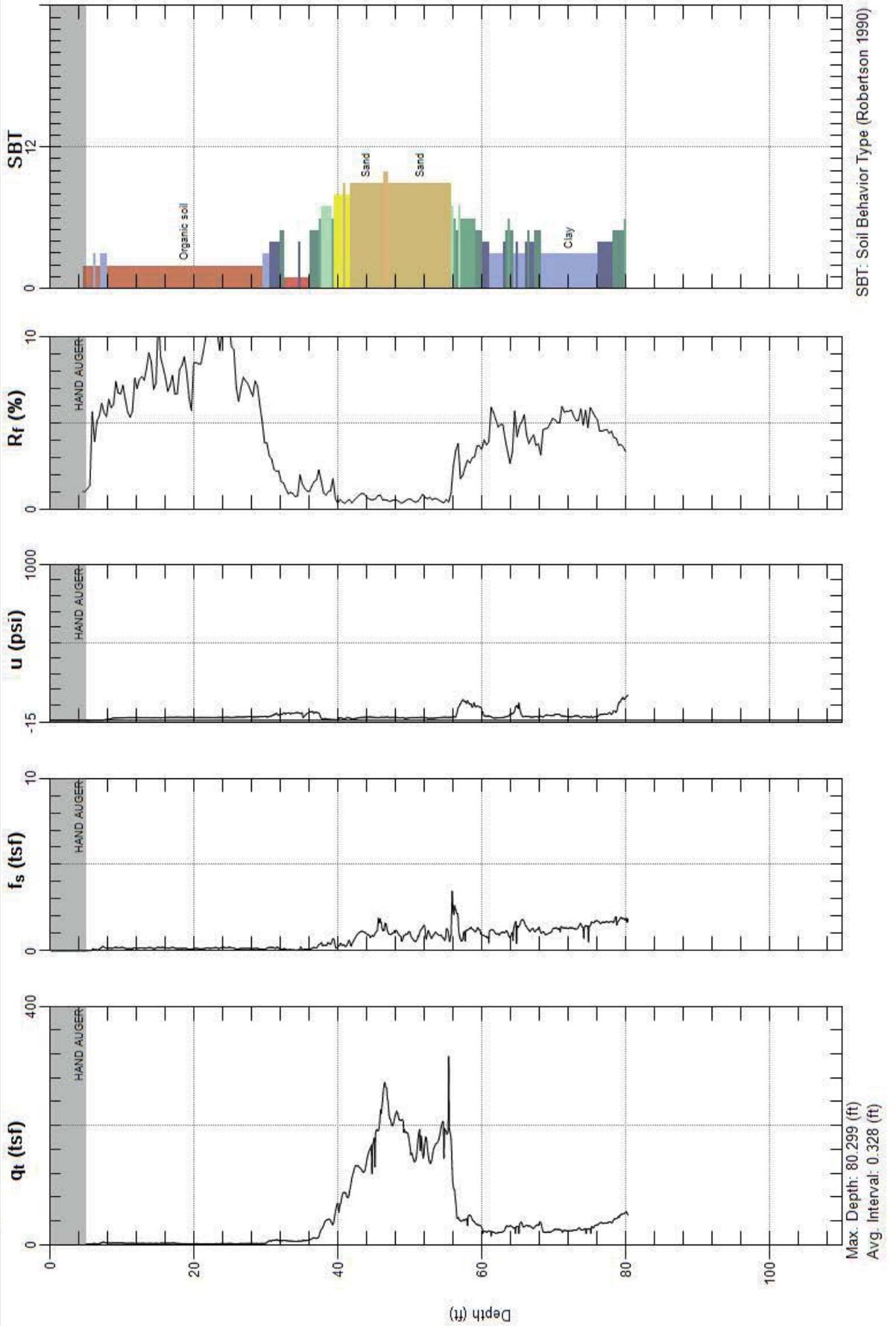
Engineer: D.PERRY
Date: 7/9/2013 07:04





Site: SHERMAN ISLAND
Sounding: MRC5

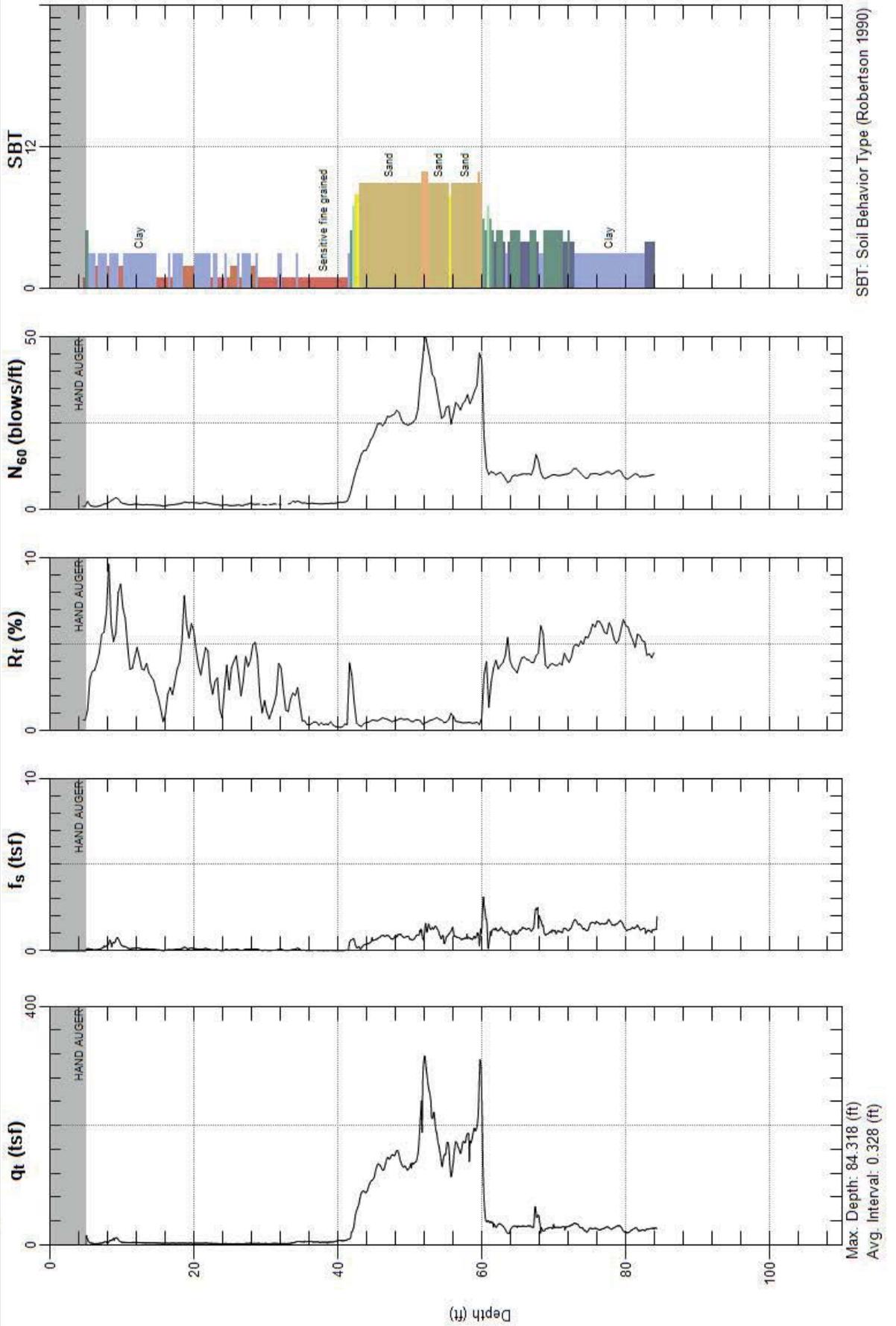
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Date: 7/9/2013 07:04





Site: SHERMAN ISLAND
Sounding: MRC6

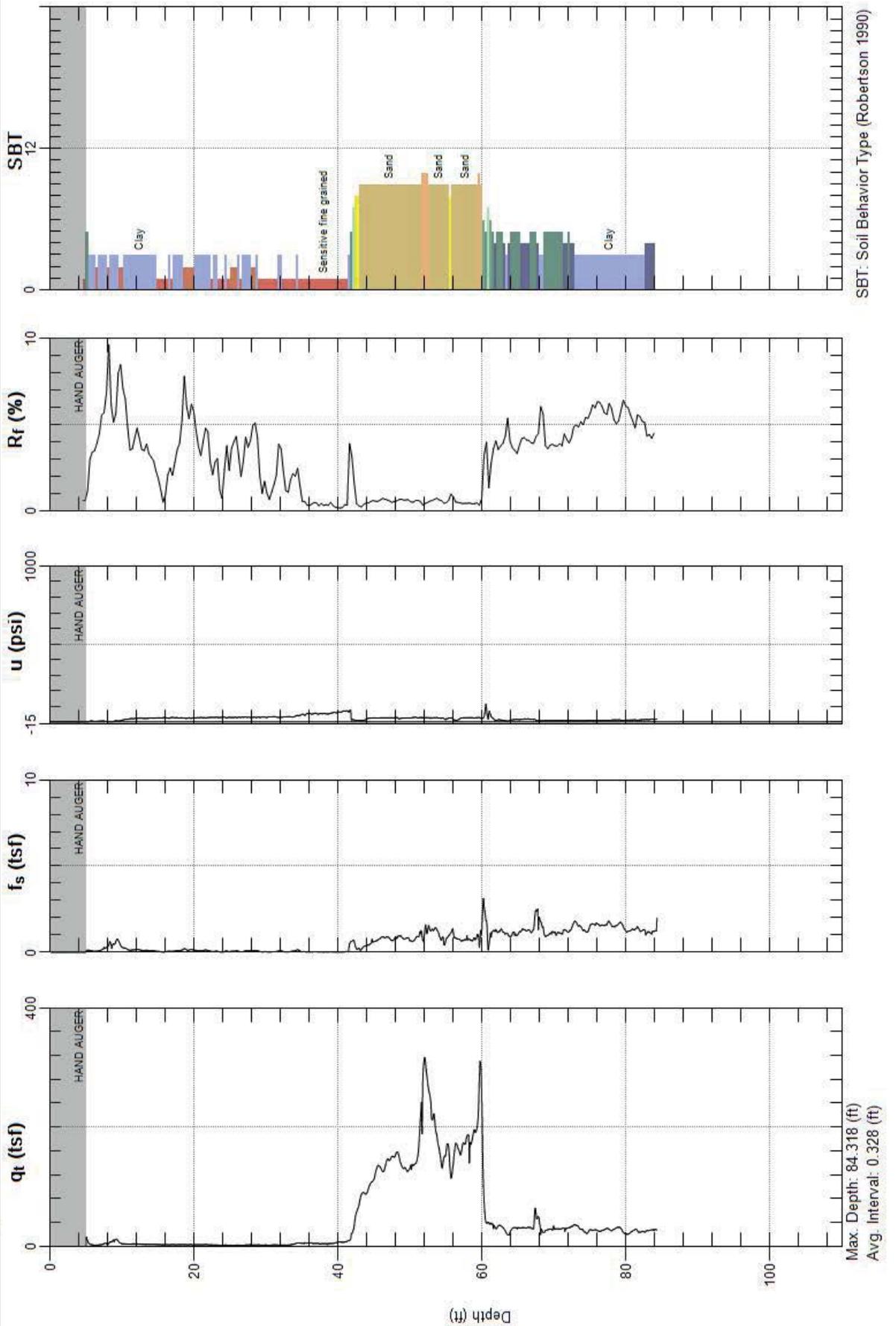
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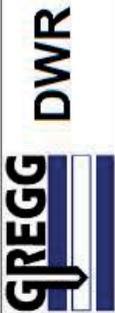




Site: SHERMAN ISLAND
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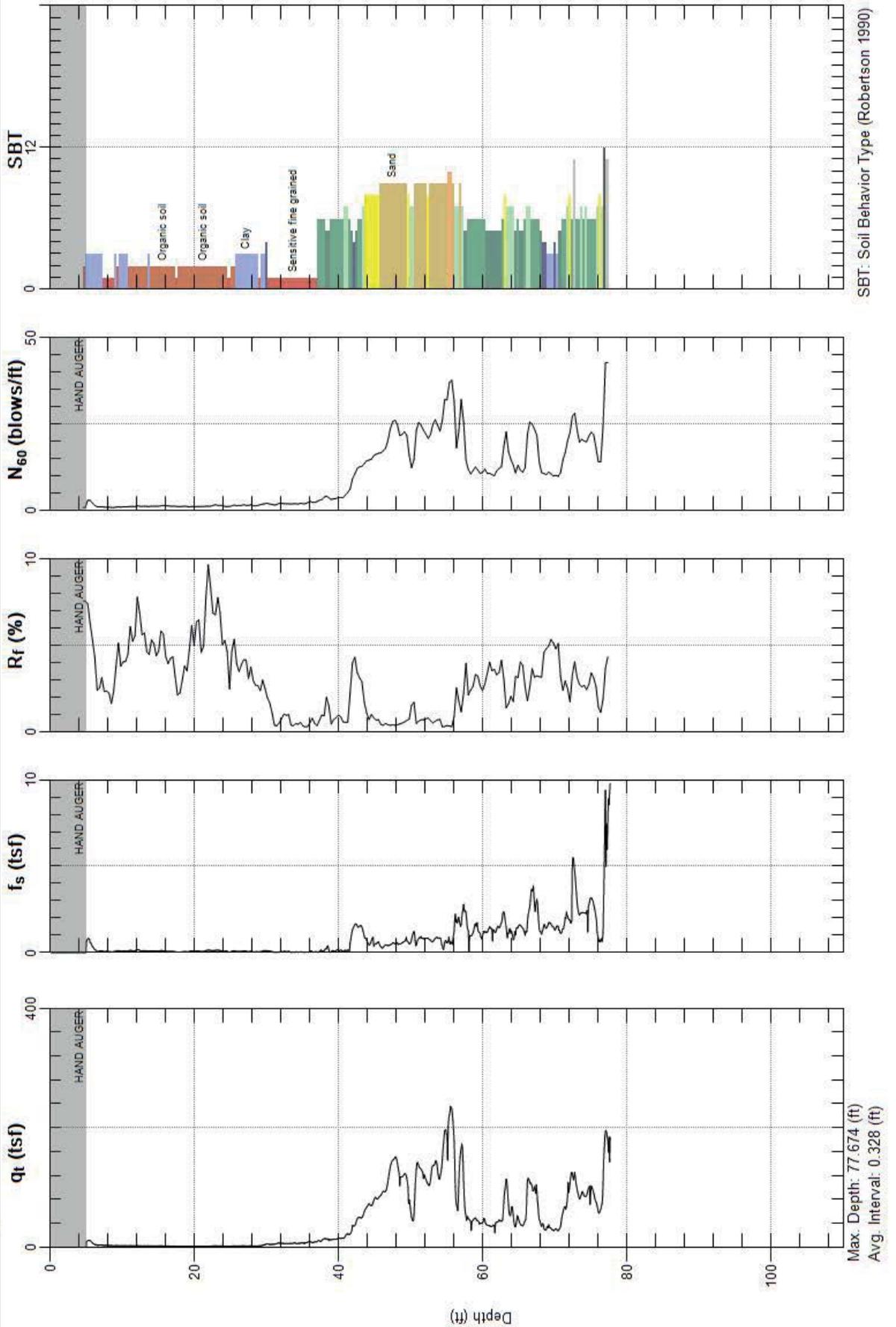
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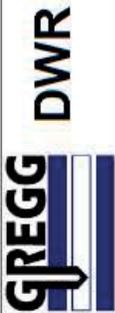




Site: SHERMAN ISLAND
Sounding: MRC7

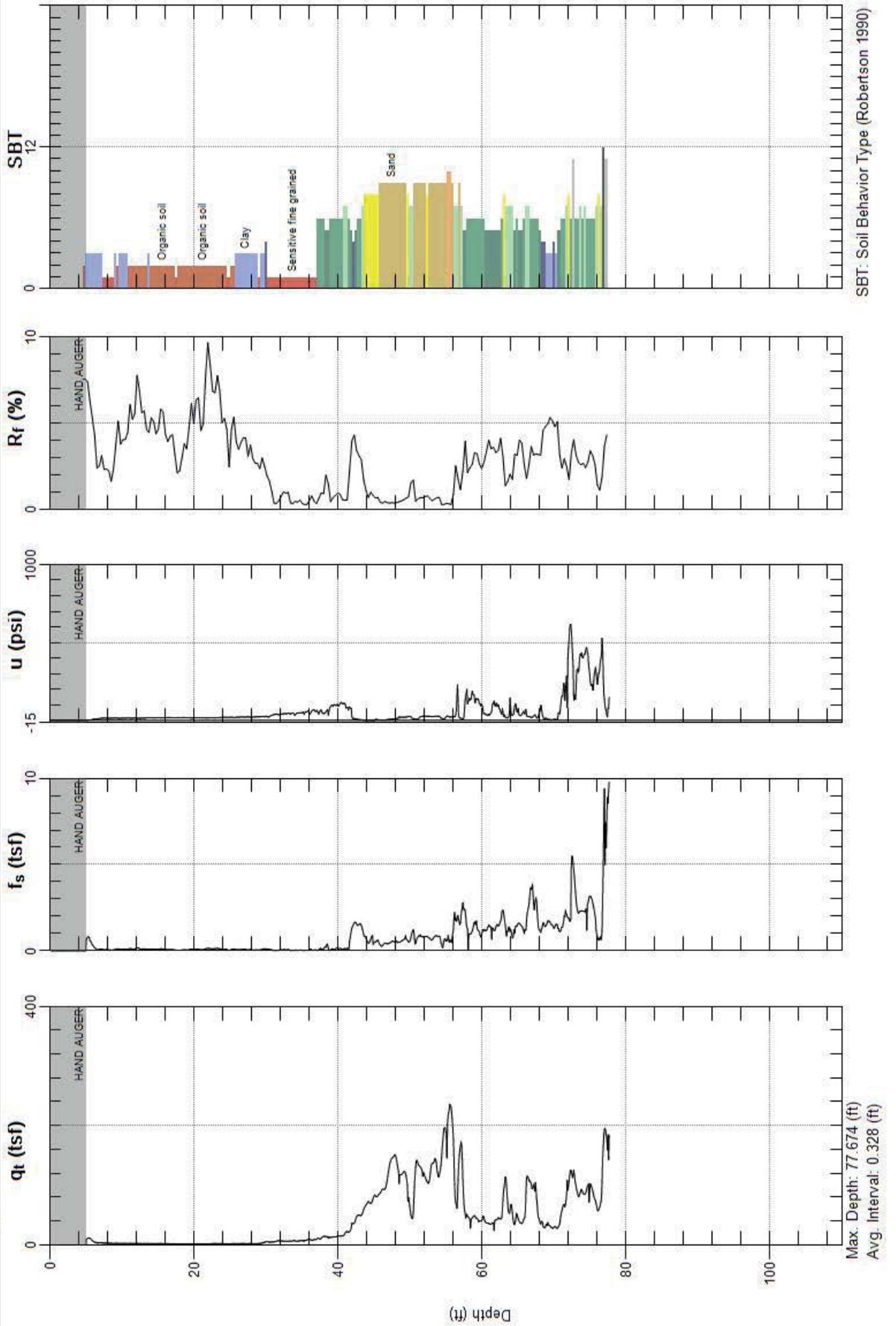
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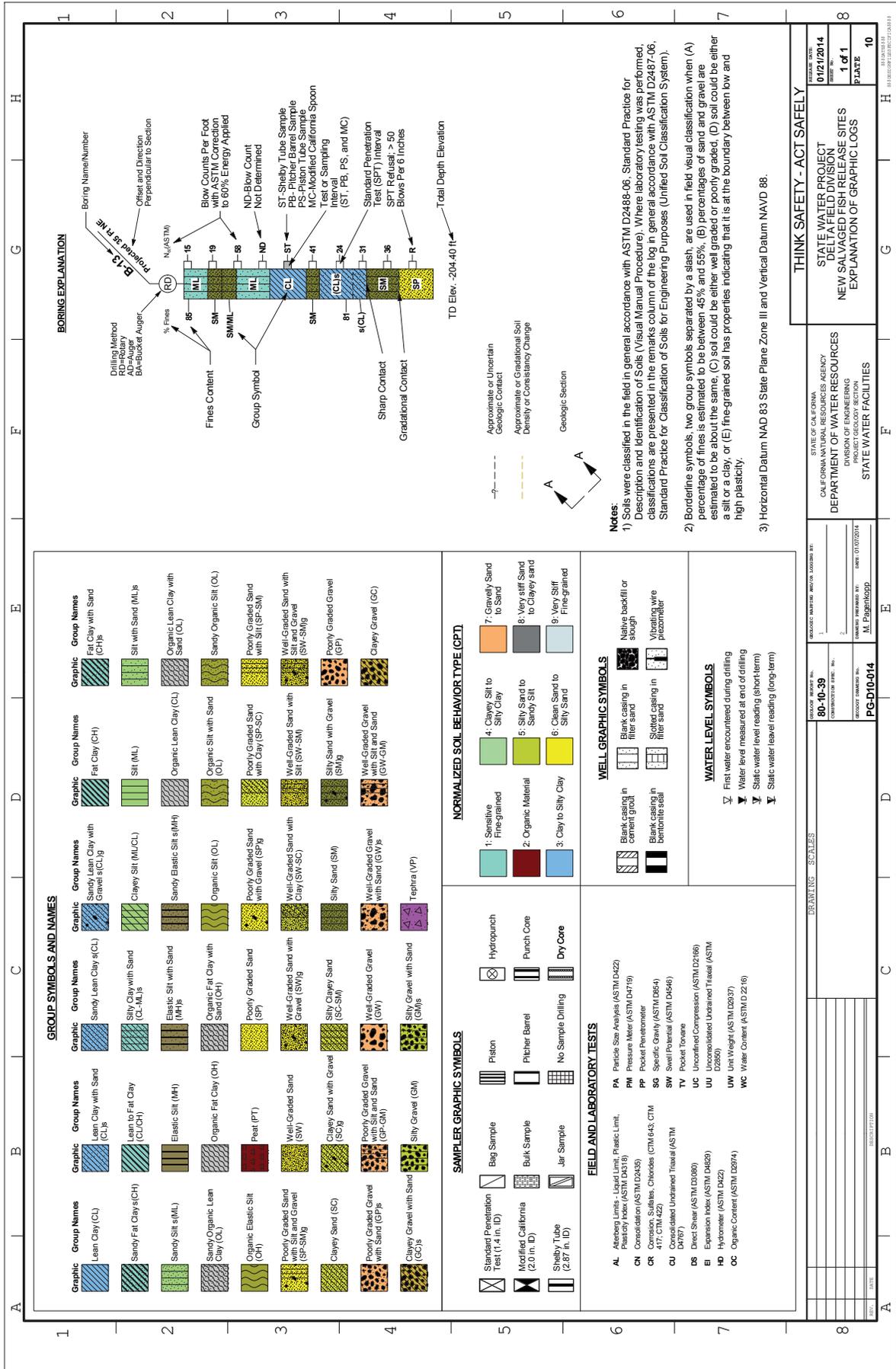




Site: SHERMAN ISLAND
Sounding: MRC7

Engineer: D.PERRY
Date: 7/10/2013 07:43





THINK SAFETY - ACT SAFELY

STATE OF CALIFORNIA
 CALIFORNIA NATURAL RESOURCES AGENCY
 DEPARTMENT OF WATER RESOURCES
 DIVISION OF ENGINEERING
 PROJECT GEOLOGY SECTION
 STATE WATER FACILITIES

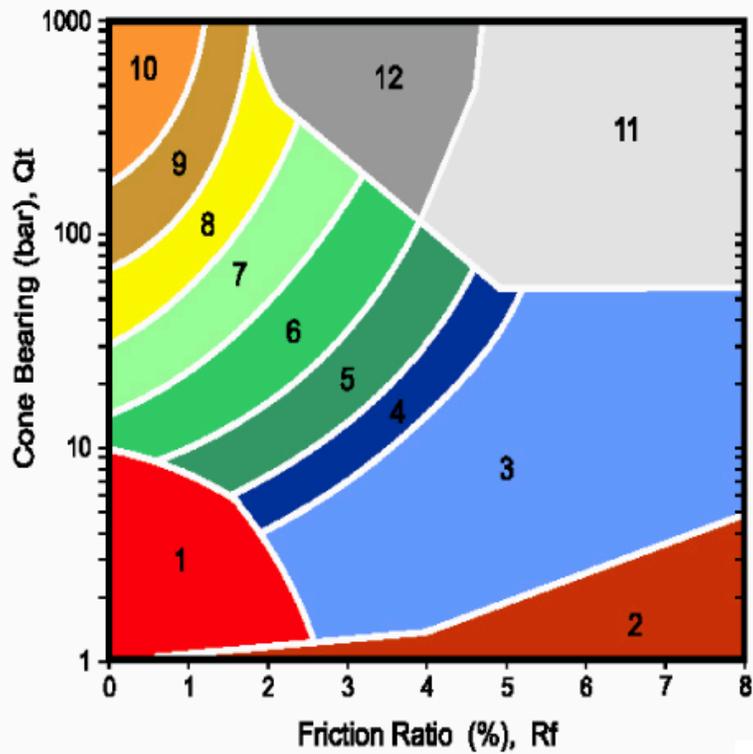
DATE: 01/07/2014
 DRAWN BY: M. Paganikopp
 CHECKED BY: M. Paganikopp
 PROJECT NUMBER: PG-D10-014

DATE: 01/21/2014
 SHEET NO.: 1 of 1
 PLATE NO.: 10

STATE WATER PROJECT
 DELTA FIELD DIVISION
 NEW SALVAGED FISH RELEASE SITES
 EXPLANATION OF GRAPHIC LOGS

DRAWING SCALES

80-10-39
 11-07-13
 120913 PG KEY TO GRAPHIC LOGS 11-07-13 NEW FISH RELEASE SITES 1206213 GPJ NEW SALVAGED FISH RELEASE SITES



ZONE	Qt/N		SBT
1	2	■	Sensitive, fine grained
2	1	■	Organic materials
3	1	■	Clay
4	1.5	■	Silty clay to clay
5	2	■	Clayey silt to silty clay
6	2.5	■	Sandy silt to clayey silt
7	3	■	Silty sand to sandy silt
8	4	■	Sand to silty sand
9	5	■	Sand
10	6	■	Gravelly sand to sand
11	1	■	Very stiff fine grained*
12	2	■	Sand to clayey sand*

*over consolidated or cemented

Note: Interpretation of Soil Behavior Type is based on the charts described by Robertson et al (1986).

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

CPT Soil Behavior Type Legend

Hultgren - Tillis Engineers

Project No. 789.03

Plate No. B-71

APPENDIX C
SEEPAGE ANALYSIS

C – 1. SEEPAGE ANALYSIS

A. General

Six locations along the levee reach were chosen for seepage analysis, including Stations 700, 715, 724, 740, 761 and 839. Those locations were chosen based on the surface and subsurface conditions encountered and are intended to represent the range of conditions along the reach.

We used computer program SEEP/W and the parameters in Table C-1 in the seepage analysis. The model is a two-dimension model considering only horizontal and vertical seepage in the model plane. Three dimensional effects were not analyzed. The permeability values were estimated based on our available data with similar soil conditions and the presumptive values presented in the Guidance Document for DWR Geotechnical Analyses (Revision 9, 2011).

We analyzed seepage using a water level at Elevation +9.8 feet (the 100-year flood level) for the design water surface elevation (DWSE). The seepage analysis assumes steady state flow conditions. The model extends 2,000 feet landward and 1,000 feet on the waterside from the levee centerline. A high mesh density (1 foot by 1 foot to 2 feet by 2 feet) was used within approximately 250 feet from the levee centerline. A lower mesh density (4 feet by 4 feet) was used in the rest of the model.

For boundary conditions at the perimeter of the model, the water level upstream of the levee was modeled as a total head boundary condition which was applied below the water surface on the mudline and on the waterside levee slope. A no-flow boundary condition was applied along the vertical face of the waterside boundary and the bottom of the model. Along the levee crest, landside slope, and landside ground surface a no-flow boundary condition was applied with the “potential seepage face review” option in SEEP/W. A total head boundary condition was applied along the vertical face of the landside boundary. No other flows into or out of the system were modeled in the analysis, such as infiltration and evapotranspiration.

Table C-1: Seepage Model Material Properties

Material	Horizontal Permeability (cm/sec)	Permeability Ratio (kv/kh)
Levee Fill (Cohesionless)	1×10^{-3}	0.25
Levee Fill (Cohesive)	1×10^{-4}	0.25
Silt	1×10^{-5}	0.25
Peat	1×10^{-5}	0.25
Sand	1×10^{-3}	0.11
New Levee Fill	1×10^{-4}	0.25

B. Analysis Results

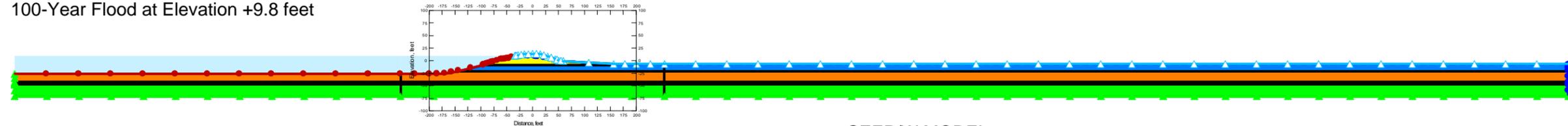
The seepage analysis results are presented in Table C-2 and on Plates C-1 through C-12. The average vertical gradients (y-gradients) across the marsh deposits (blanket) and seepage flow rates are presented in the table. The plates present additional data and graphical output of the program SEEP/W, including the total head contours, average y-gradients, local y-gradients, local x-y gradients, local flux and the phreatic surface. The average y-gradients for the existing levee configurations and the rehabilitated levee configuration vary from 0.06 to 0.19. The average y-gradients meet the USACE criteria for underseepage (0.5 or lower). The calculated rates of seepage range from about 0.01 to 0.03 gallons per minute (gpm) per linear foot of the levee. These rates of seepage are relatively low.

The analysis results indicate that phreatic surface exists on the face of the landside slopes may be expected during design flood levels. The embankment was assumed to continuously retain design water levels during flooded events, even though high water levels are tidally influenced and remain high only a few hours each day while a flood passes through the Delta. Water exiting on the levee face is undesirable. Internal erosion of soil particles from within the levee embankment that seeps through the levee could further cause levee instability. Flood fighting may be required during sustained high water.

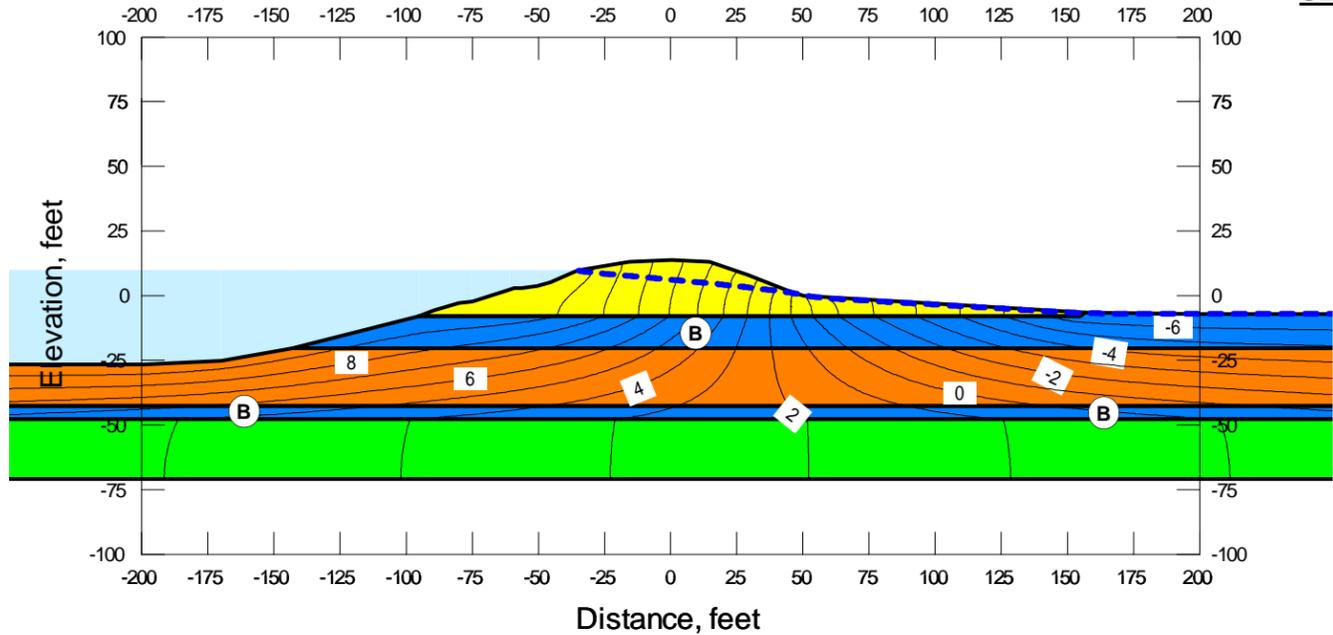
Table C-2: Seepage Analysis Summary Results

Station	Design Water Surface Elevation (ft)	Existing Levee		Rehabilitated Levee	
		Exit Y-Gradient (Avg.)	Seepage Flow Rate / Flux (gpm)	Exit Y-Gradient (Avg.)	Seepage Flow Rate / Flux (gpm)
		Slope Toe or Berm Toe		Slope Toe or Berm Toe	
700	9.8	0.18	0.02	0.18	0.02
715	9.8	0.15	0.01	0.16	0.01
724	9.8	0.19	0.01	0.19	0.01
740	9.8	0.19	0.02	0.18	0.01
761	9.8	0.06	0.03	0.06	0.02
839	9.8	0.10	0.02	0.10	0.02

100-Year Flood at Elevation +9.8 feet

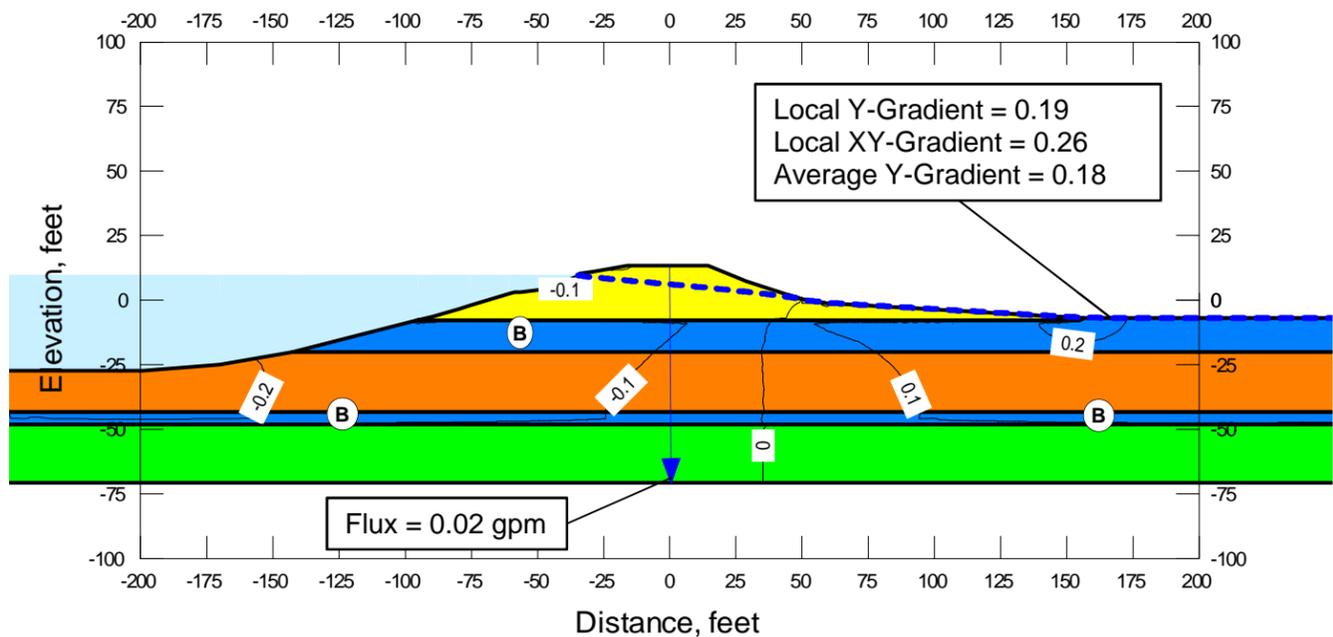


SEEP/W MODEL



TOTAL HEAD CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
LAYER DESIGNATION	LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_h (cm/sec)	VERT./HORZ. CONDUCTIVITY RATIO, k_v/k_h
	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25



VERTICAL GRADIENT CONTOURS

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

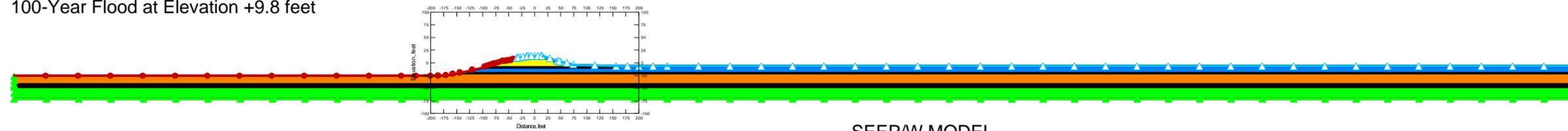
Seepage Analysis Results
Existing Configuration
Station 700+00

Hultgren - Tillis Engineers

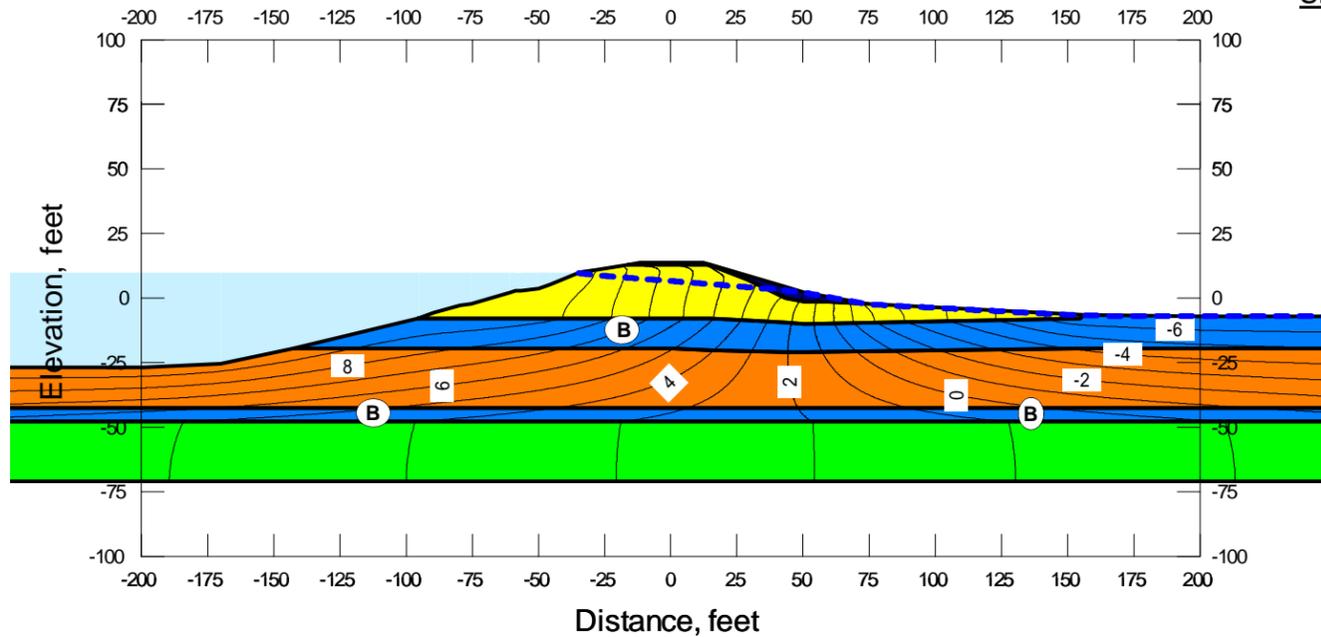
Project No. 789.06

Plate No. C-1

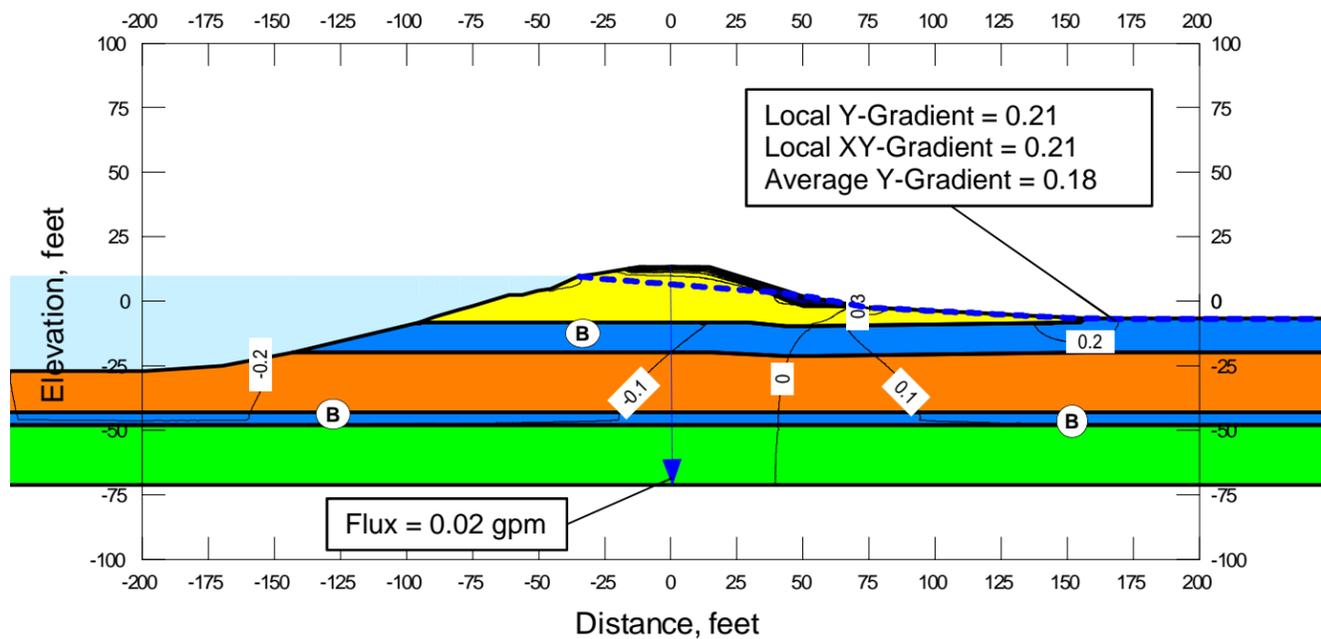
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
LAYER DESIGNATION	LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_h (cm/sec)	VERT./HORZ. CONDUCTIVITY RATIO, k_v/k_h
	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

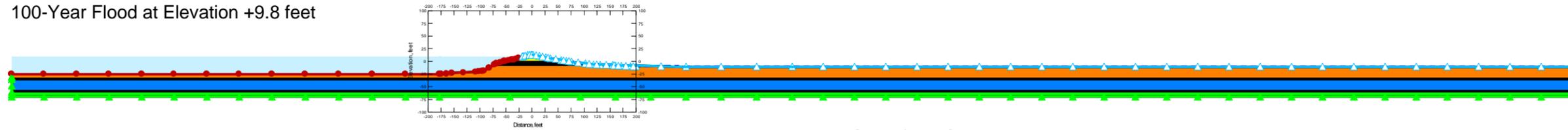
Seepage Analysis Results
Long Term Consolidated Configuration
Station 700+00

Hultgren - Tillis Engineers

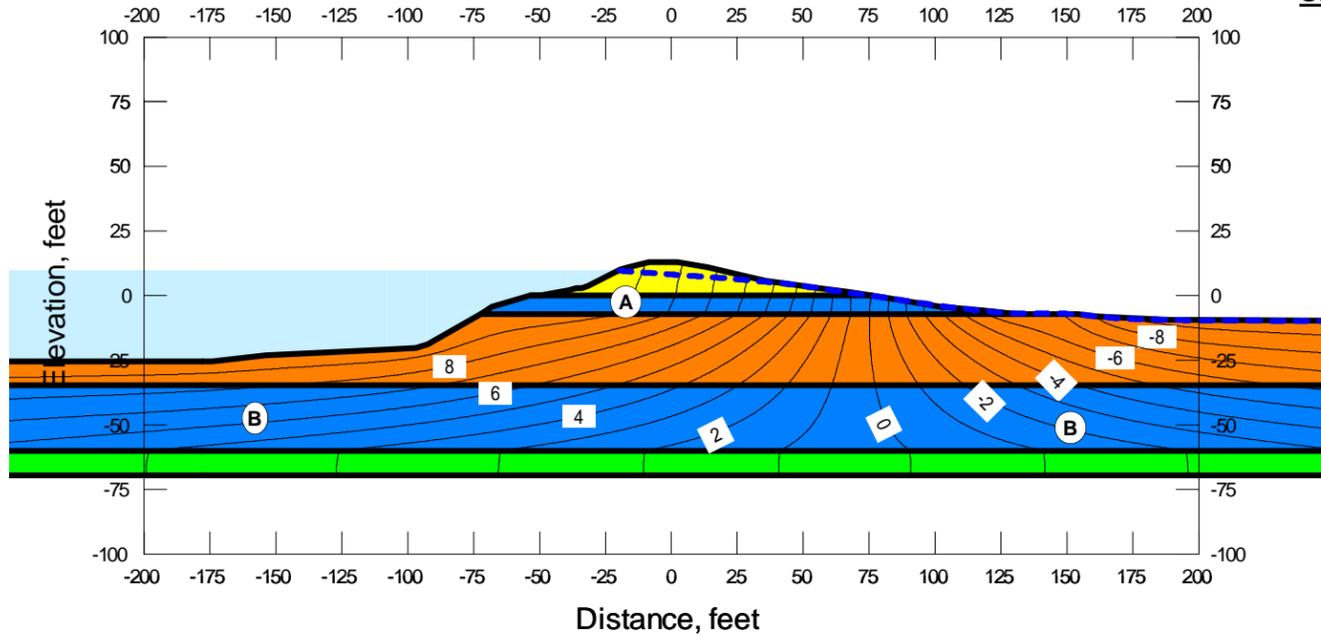
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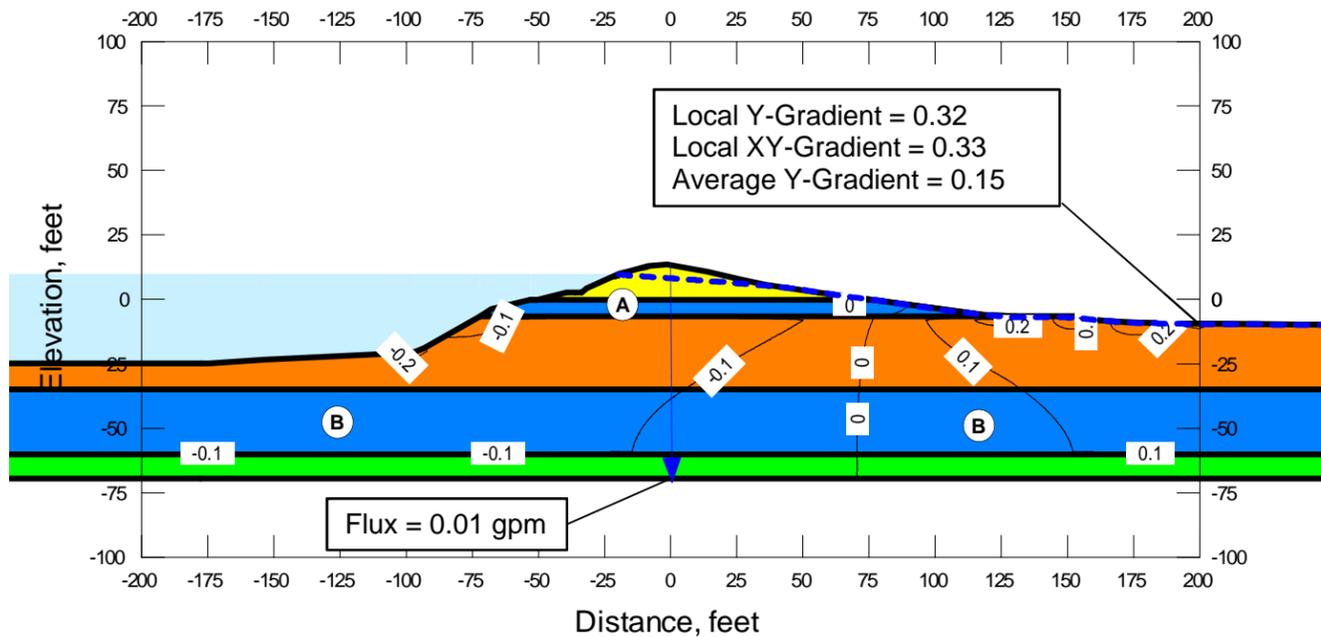
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
LAYER DESIGNATION	LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_h (cm/sec)	VERT./HORZ. CONDUCTIVITY RATIO, k_v/k_h
	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

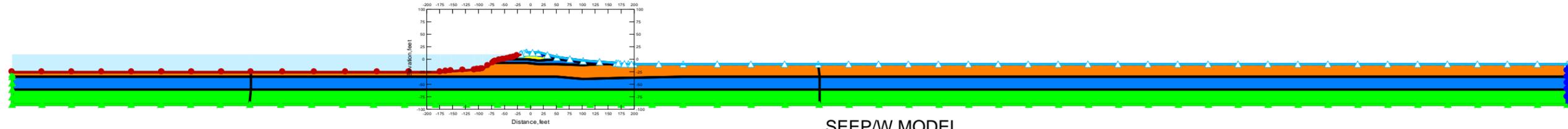
Seepage Analysis Results
Existing Conditions
Station 715+00

Hultgren - Tillis Engineers

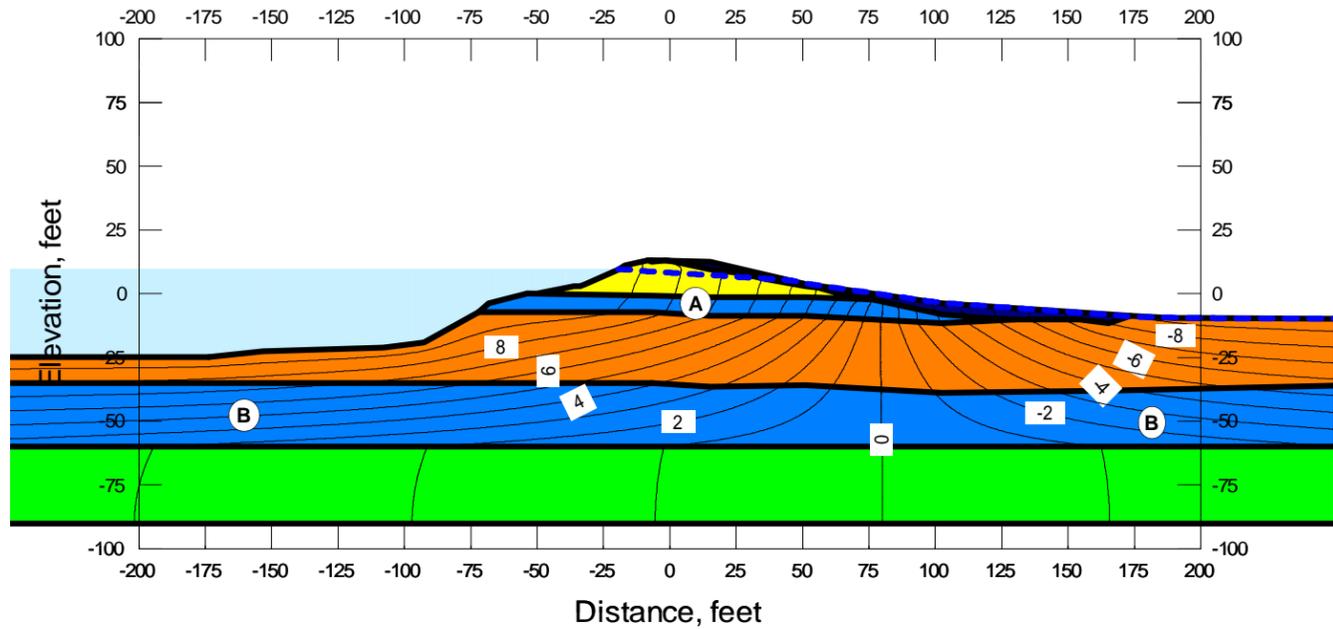
Project No. 789.06

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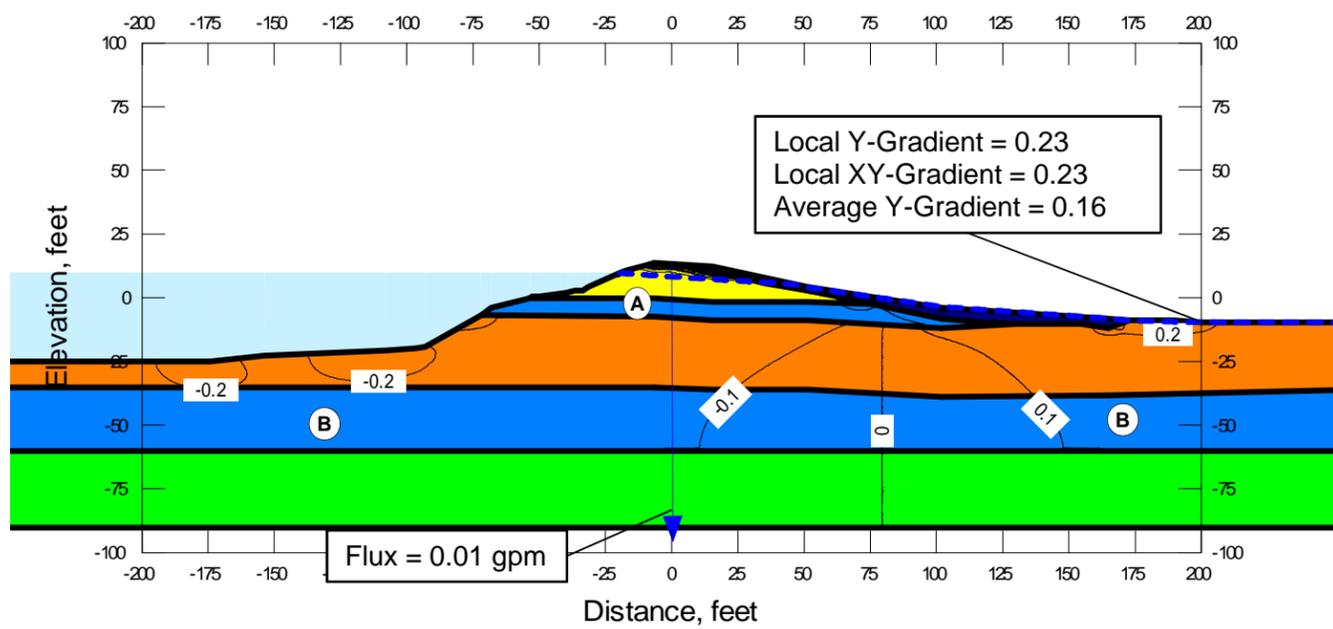
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

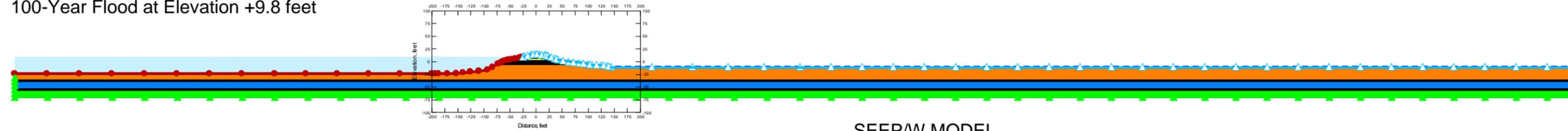


VERTICAL GRADIENT CONTOURS

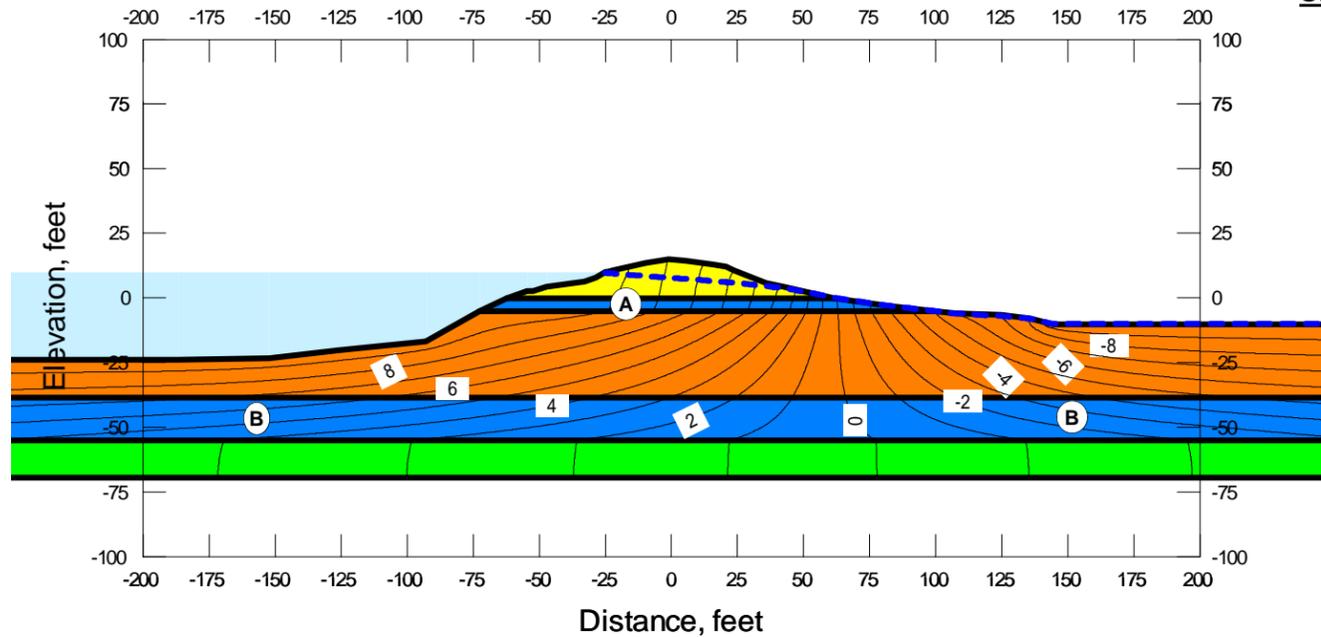
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	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850 Reclamation District 341 Sacramento County, California	Seepage Analysis Results Long Term Consolidated Configuration Station 715+00	
	Hultgren - Tillis Engineers	Project No. 789.06

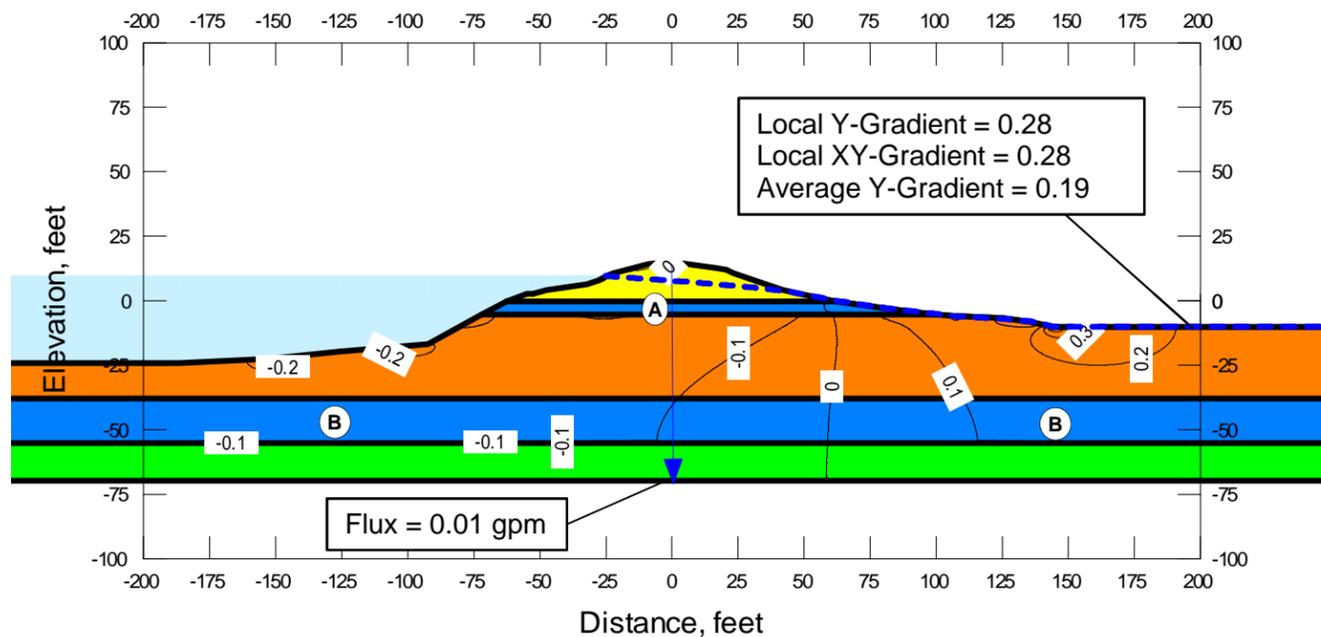
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
LAYER DESIGNATION	LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_h (cm/sec)	VERT./HORZ. CONDUCTIVITY RATIO, k_v/k_h
	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

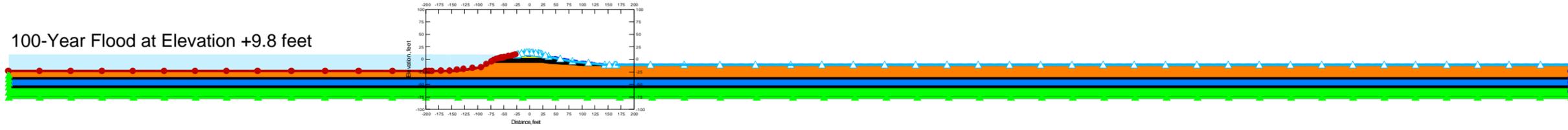
Seepage Analysis Results
 Existing Conditions
 Station 724+00

Hultgren - Tillis Engineers

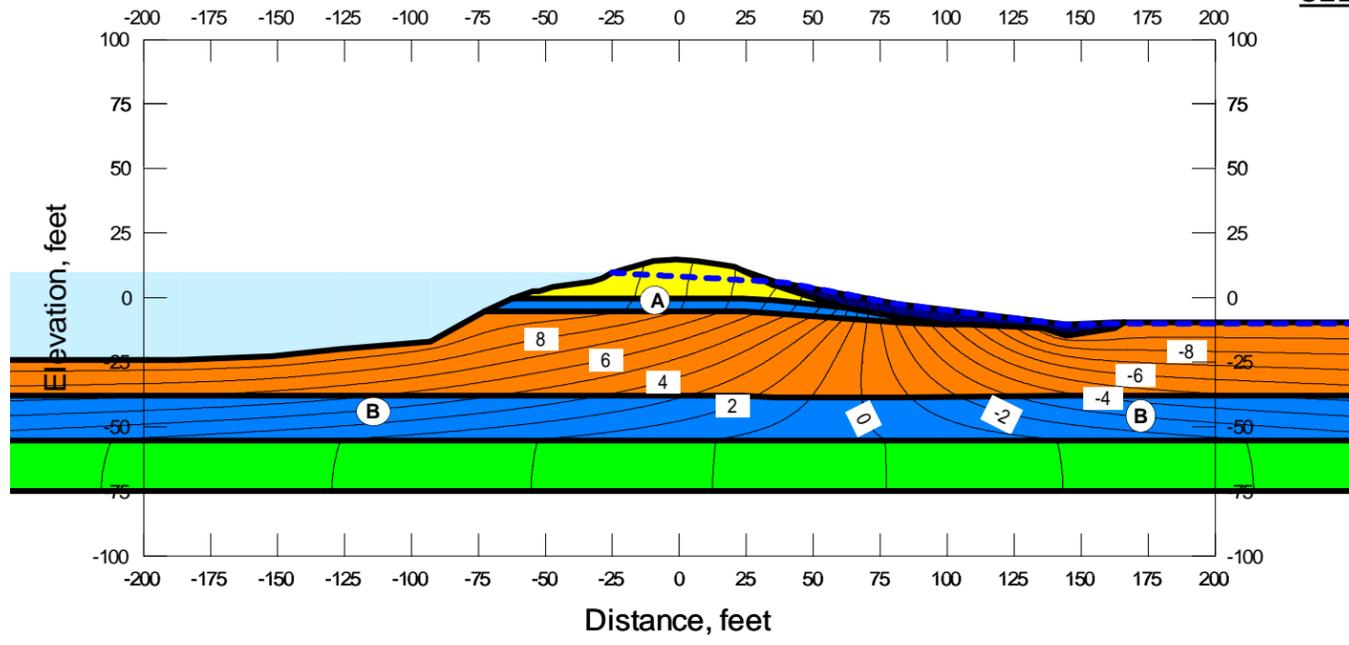
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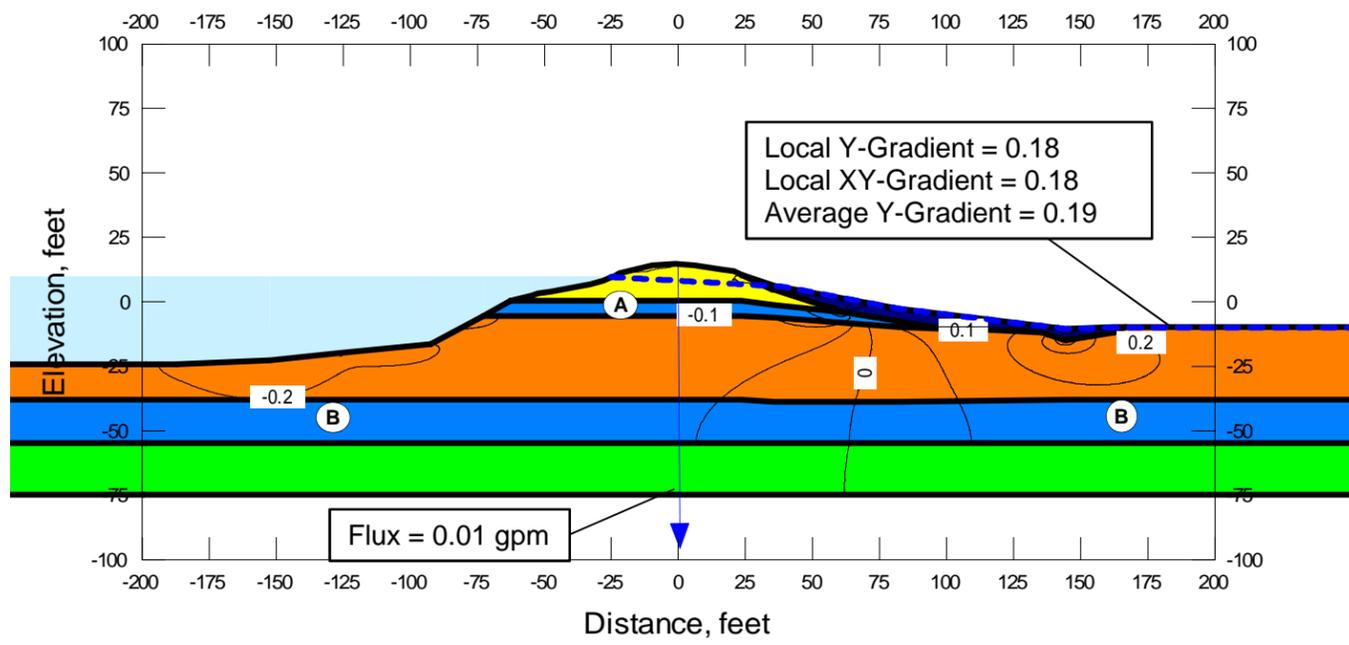
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES

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	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

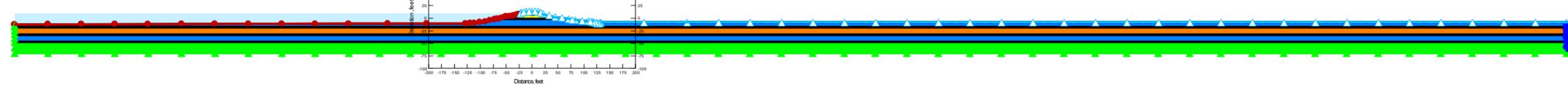
Seepage Analysis Results
Long Term Consolidated Configuration
Station 724+00

Hultgren - Tillis Engineers

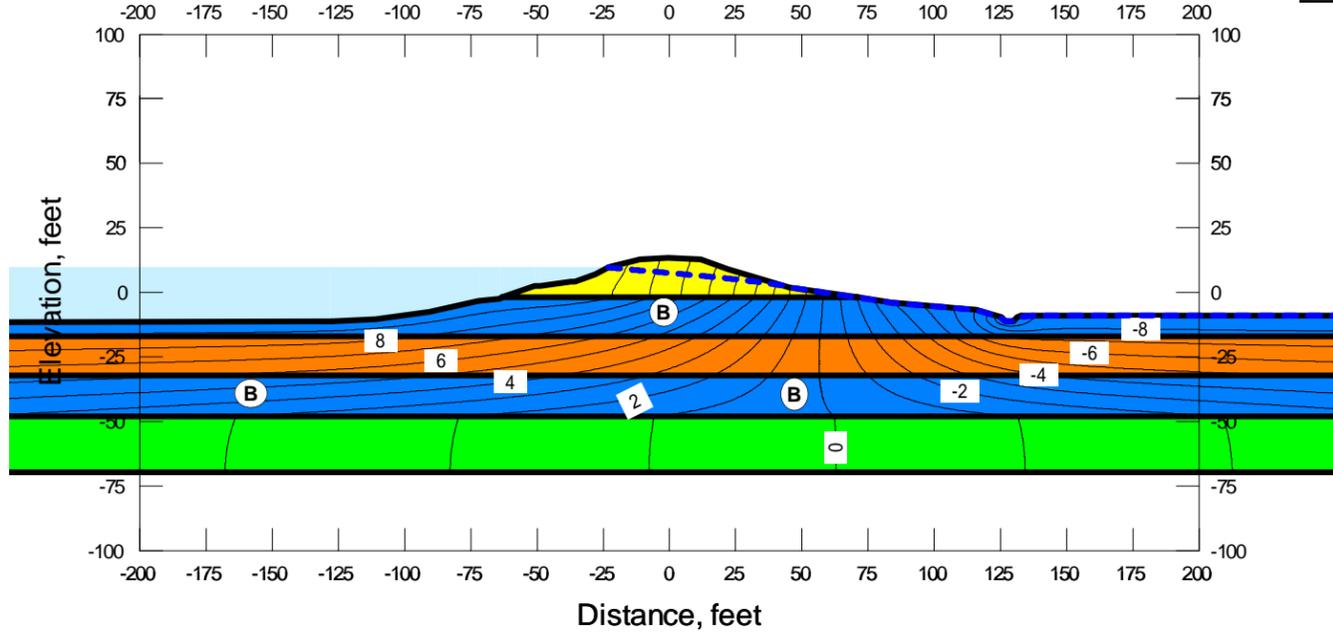
Project No. 789.06

Plate No. C-6

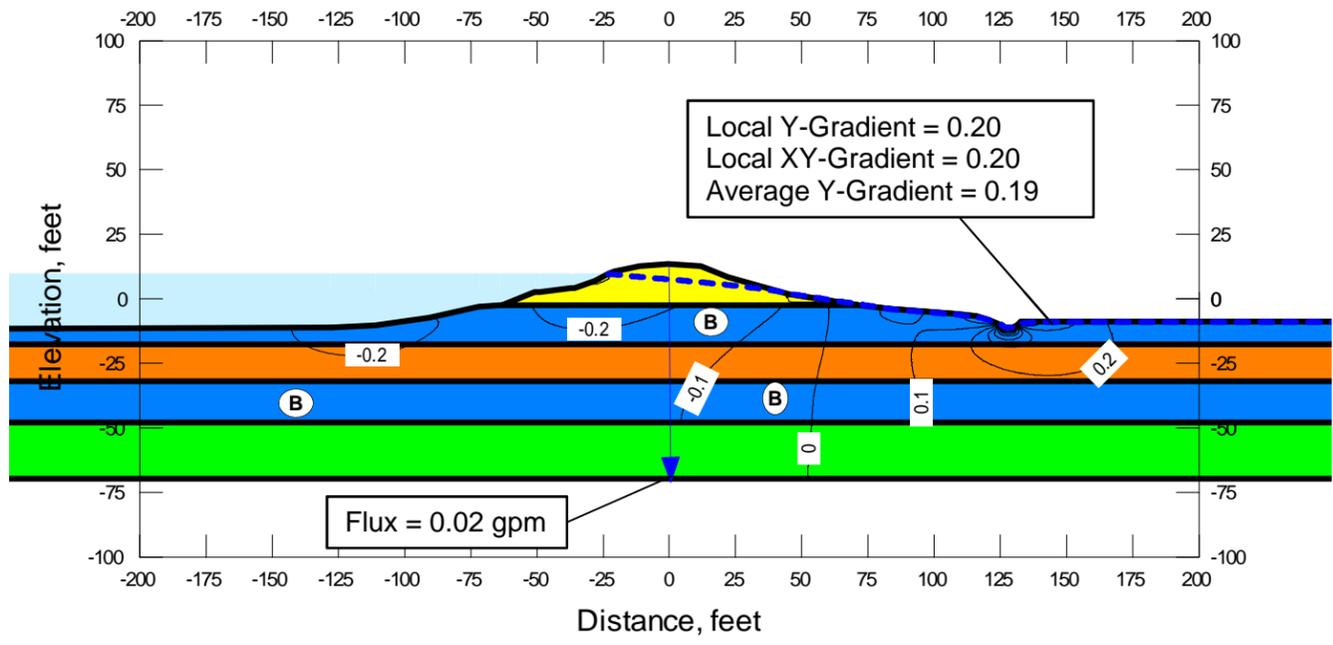
100- Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

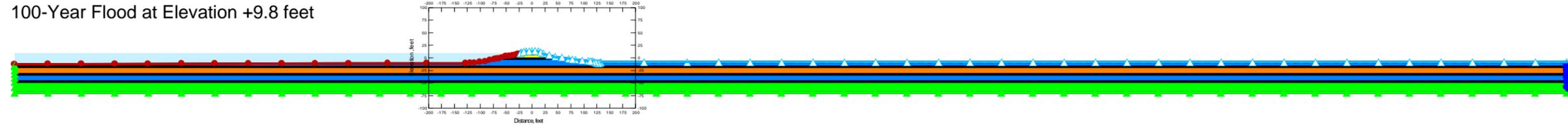


VERTICAL GRADIENT CONTOURS

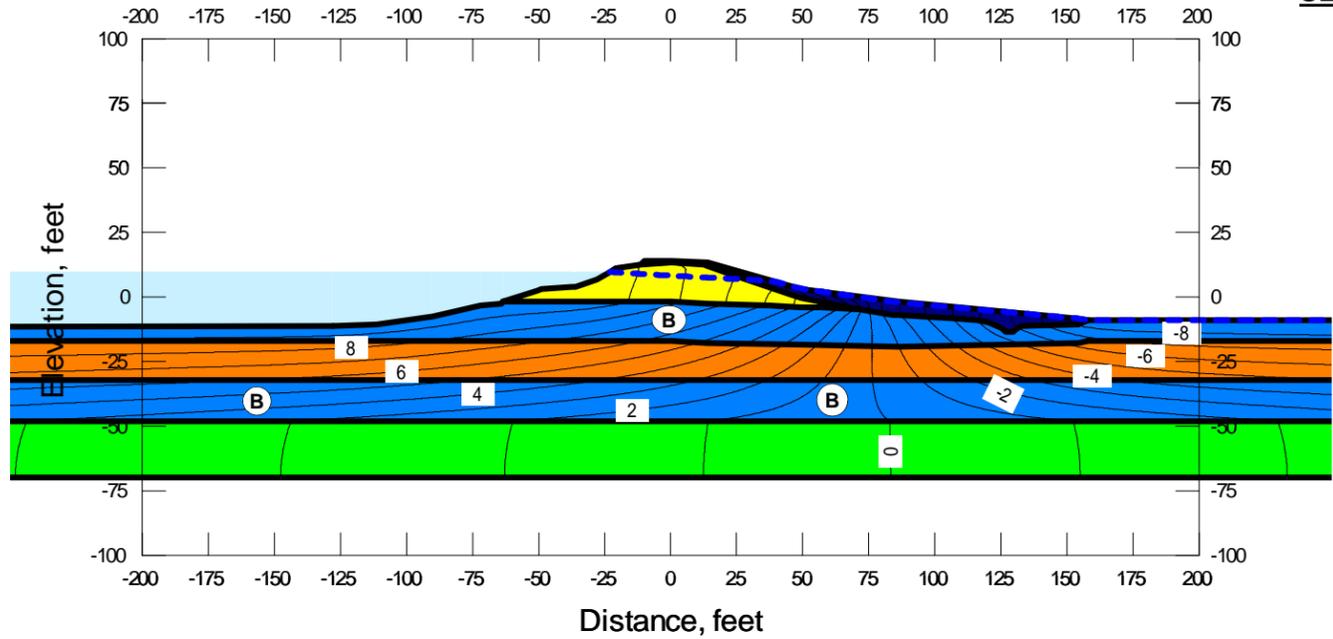
SEEPAGE MODEL MATERIAL PROPERTIES				
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	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850 Reclamation District 341 Sacramento County, California		Seepage Analysis Results Existing Configuration Station 740+00	
Hultgren - Tillis Engineers		Project No. 789.06	Plate No. C-7

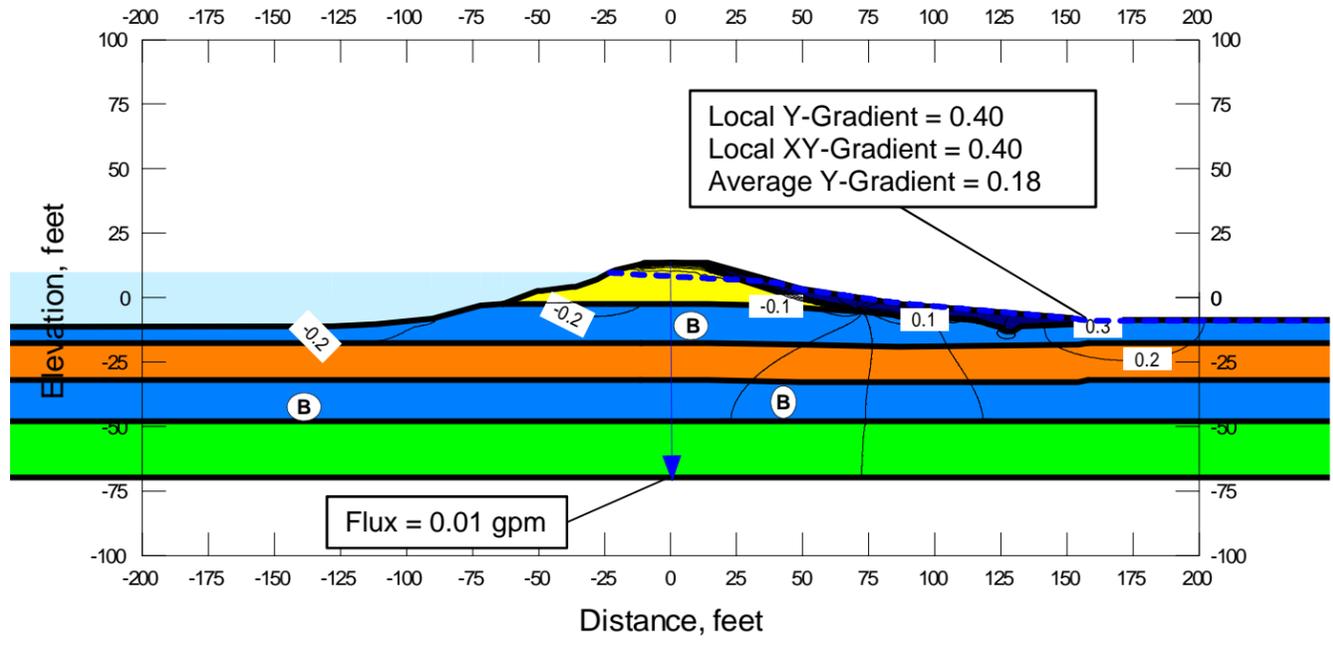
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

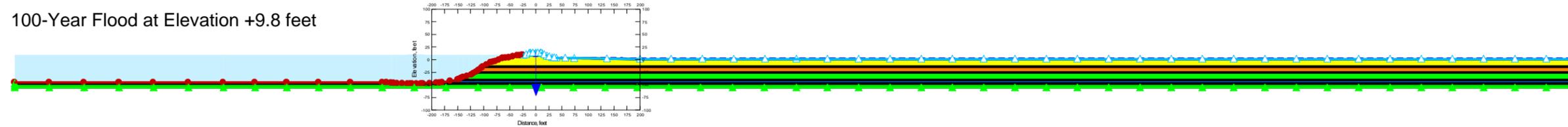


VERTICAL GRADIENT CONTOURS

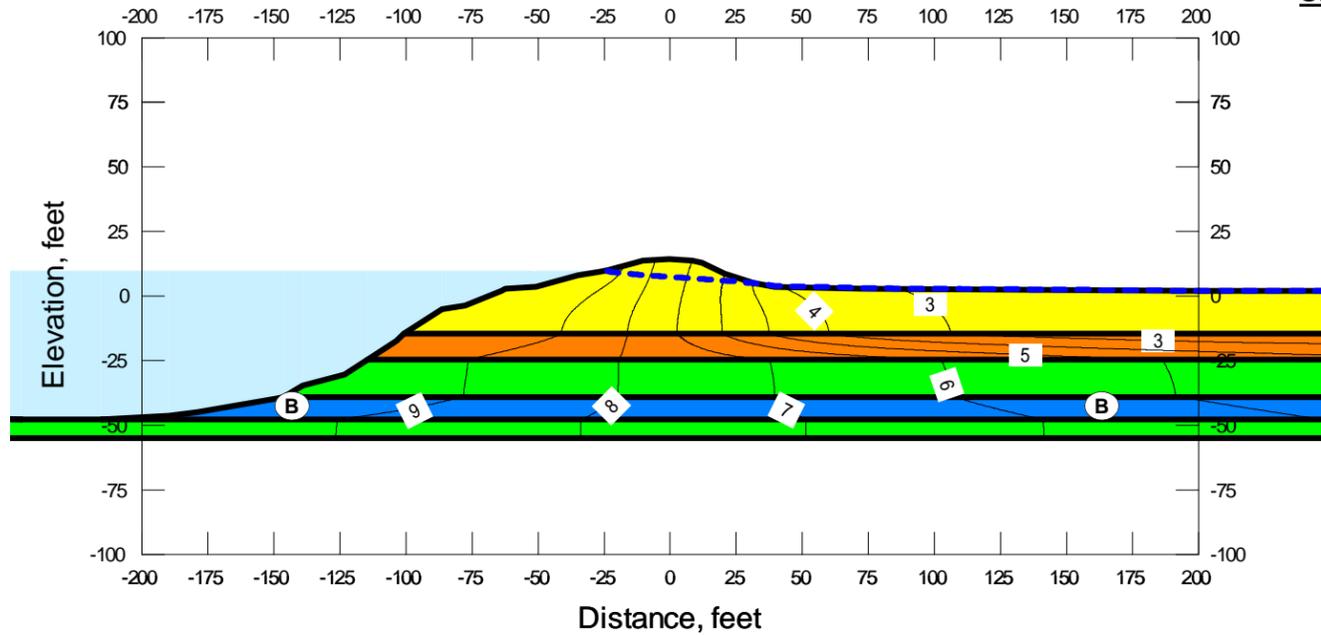
SEEPAGE MODEL MATERIAL PROPERTIES				
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	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850 Reclamation District 341 Sacramento County, California	Seepage Analysis Results Long Term Consolidated Configuration Station 740+00	
	Hultgren - Tillis Engineers	Project No. 789.06

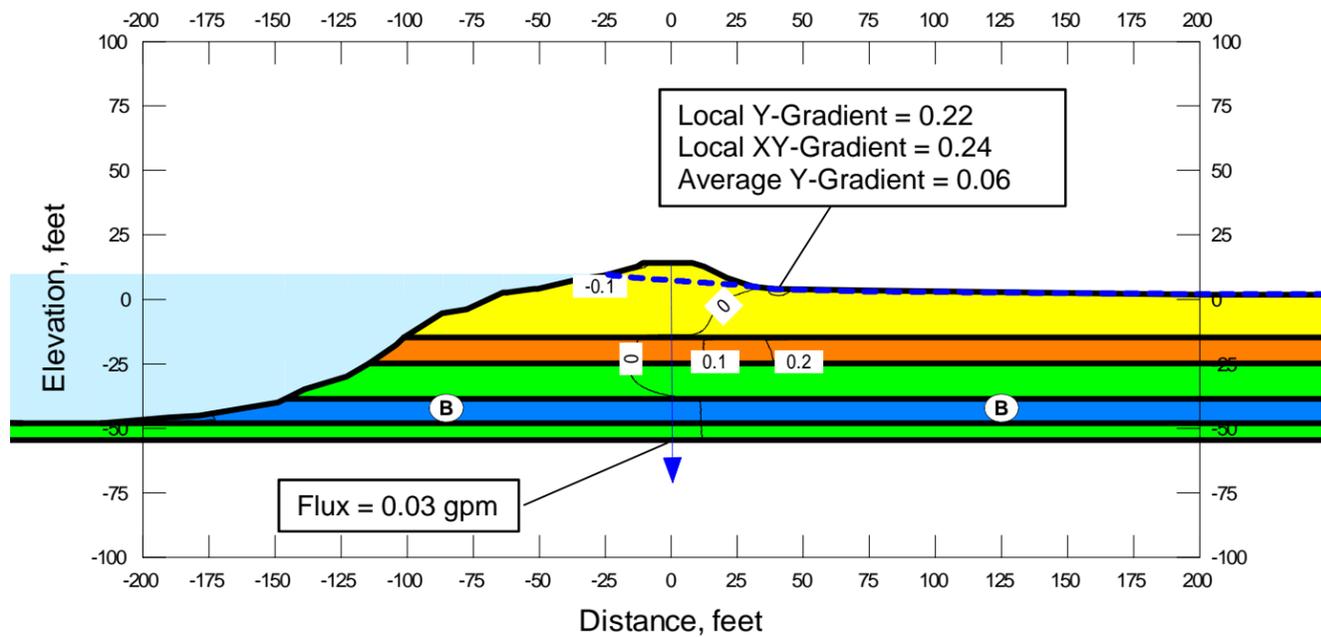
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
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	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

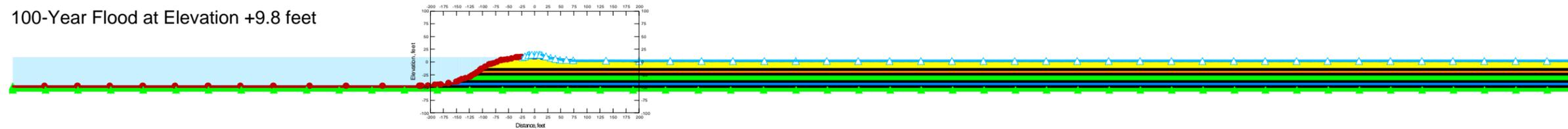
Seepage Analysis Results
Existing Configuration
Station 761+00

Hultgren - Tillis Engineers

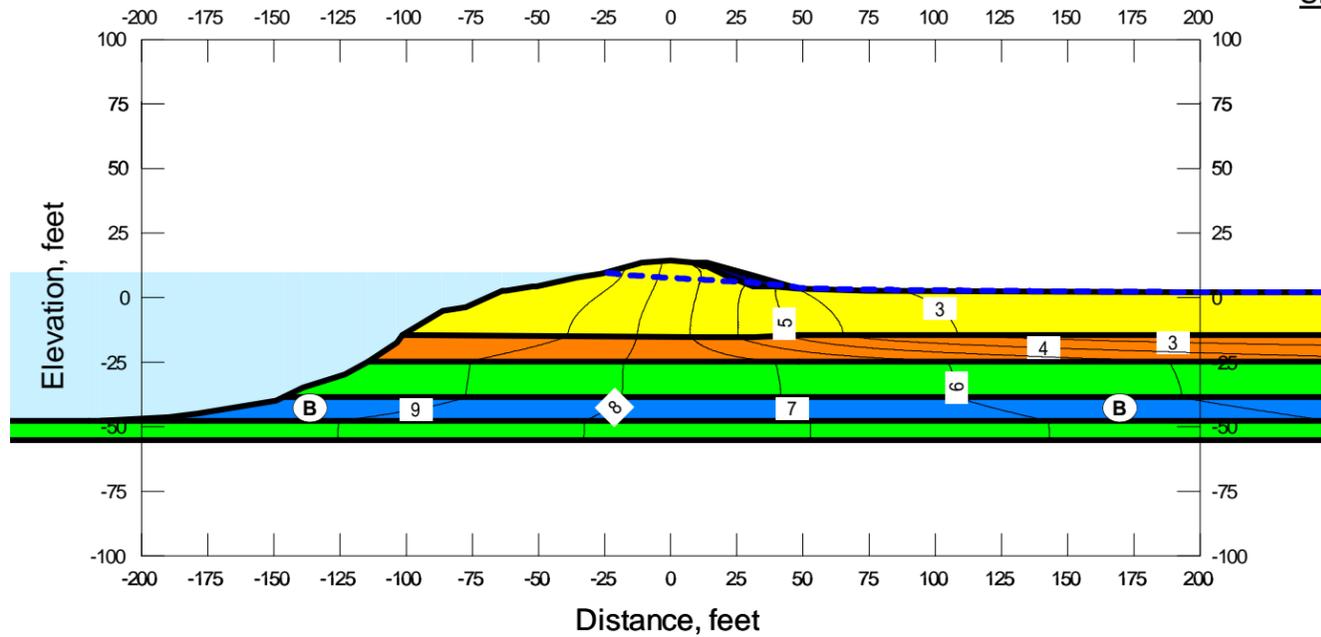
Project No. 789.06

Plate No. C-9

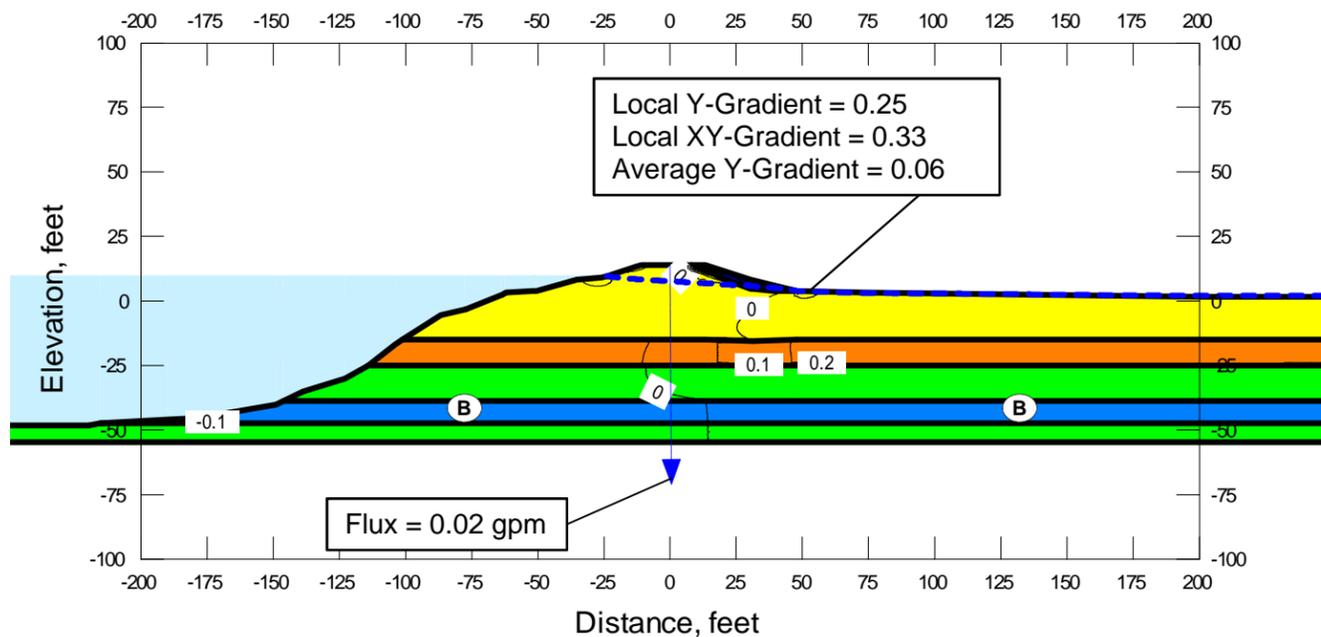
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
LAYER DESIGNATION	LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_h (cm/sec)	VERT./HORZ. CONDUCTIVITY RATIO, k_v/k_h
	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

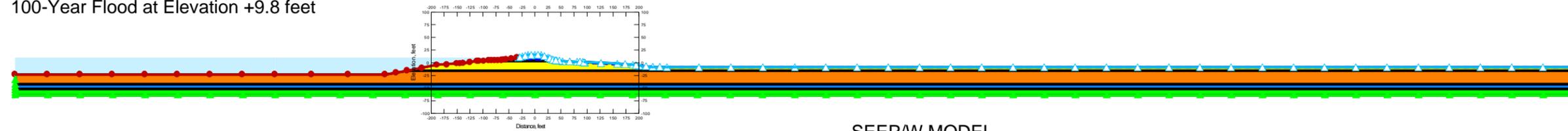
Seepage Analysis Results
Long Term Consolidated Configuration
Station 761+00

Hultgren - Tillis Engineers

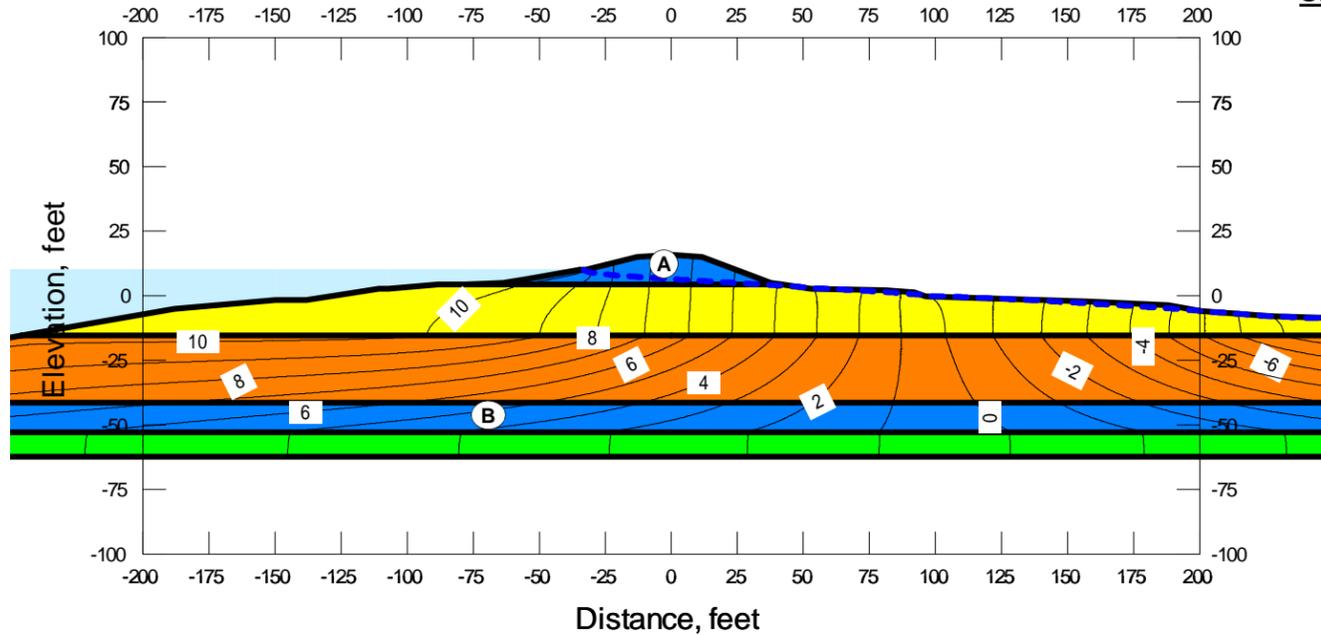
Project No. 789.06

Plate No. C-10

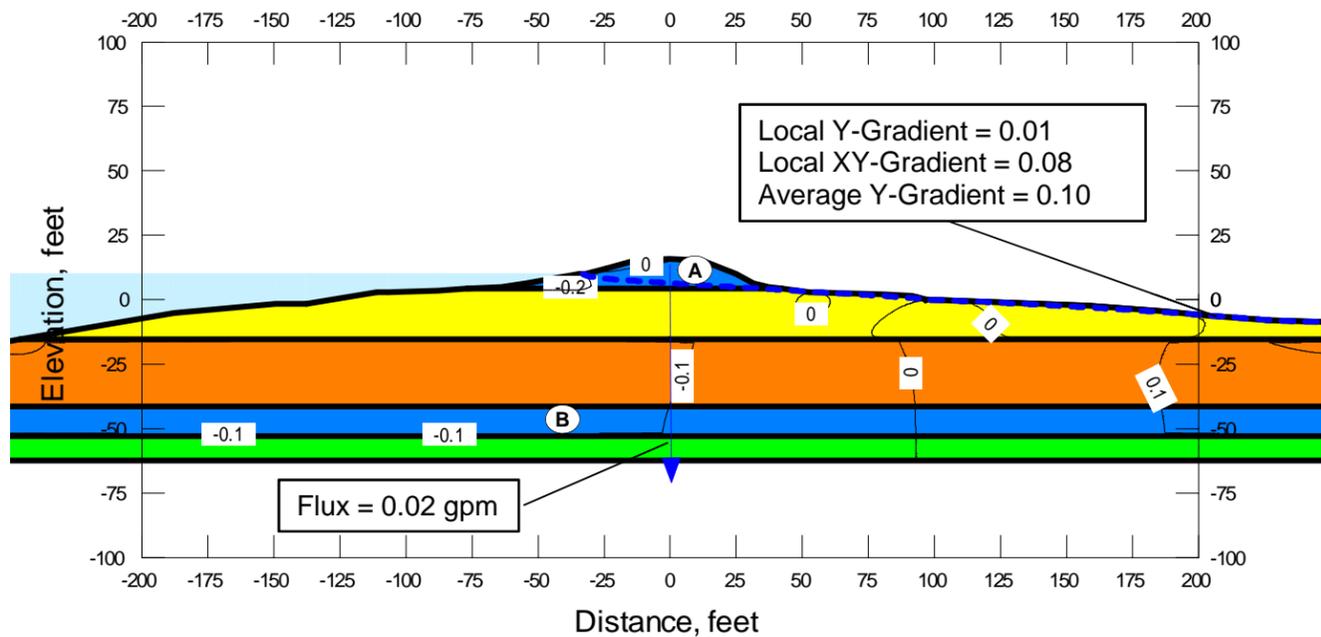
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
LAYER DESIGNATION	LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_h (cm/sec)	VERT./HORZ. CONDUCTIVITY RATIO, k_v/k_h
	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Light Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

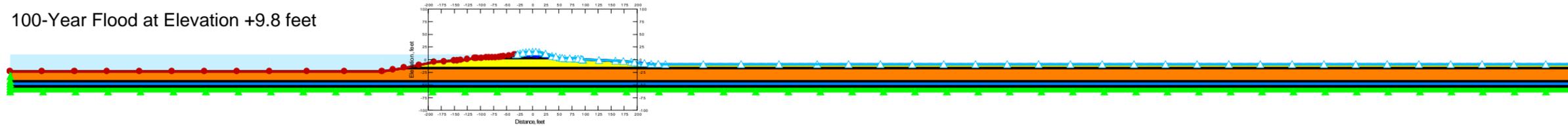
Seepage Analysis Results
 Existing Configuration
 Station 839+00

Hultgren - Tillis Engineers

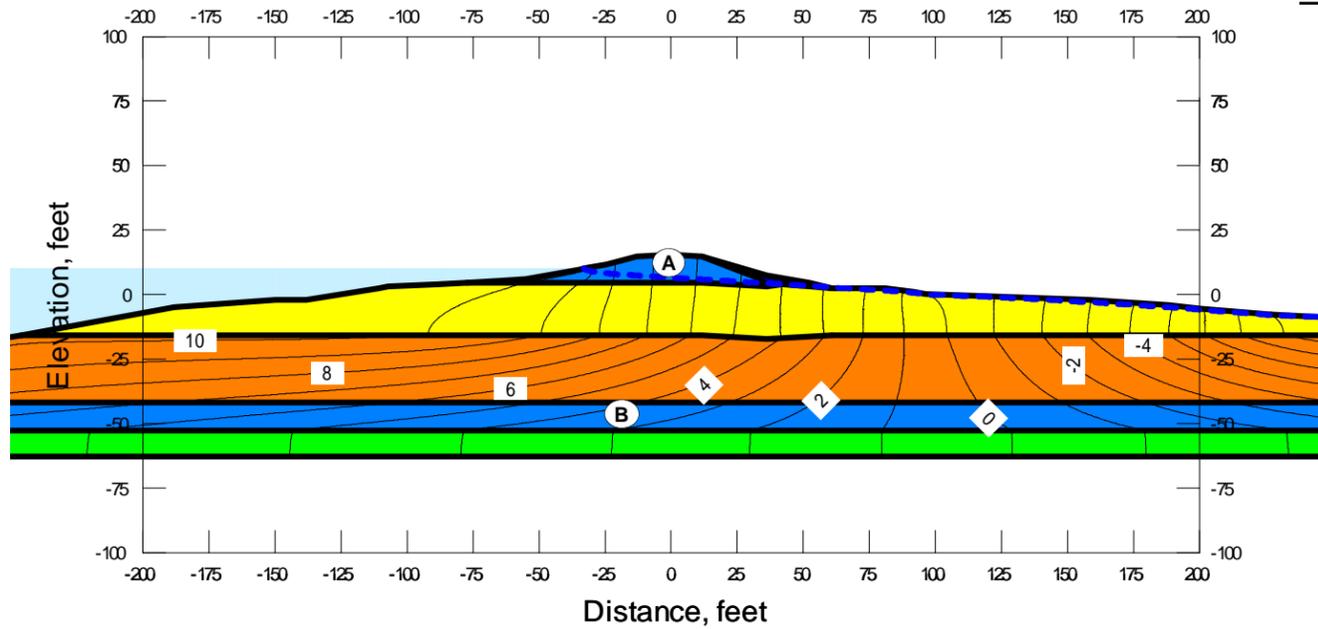
Project No. 789.06

Plate No. C-11

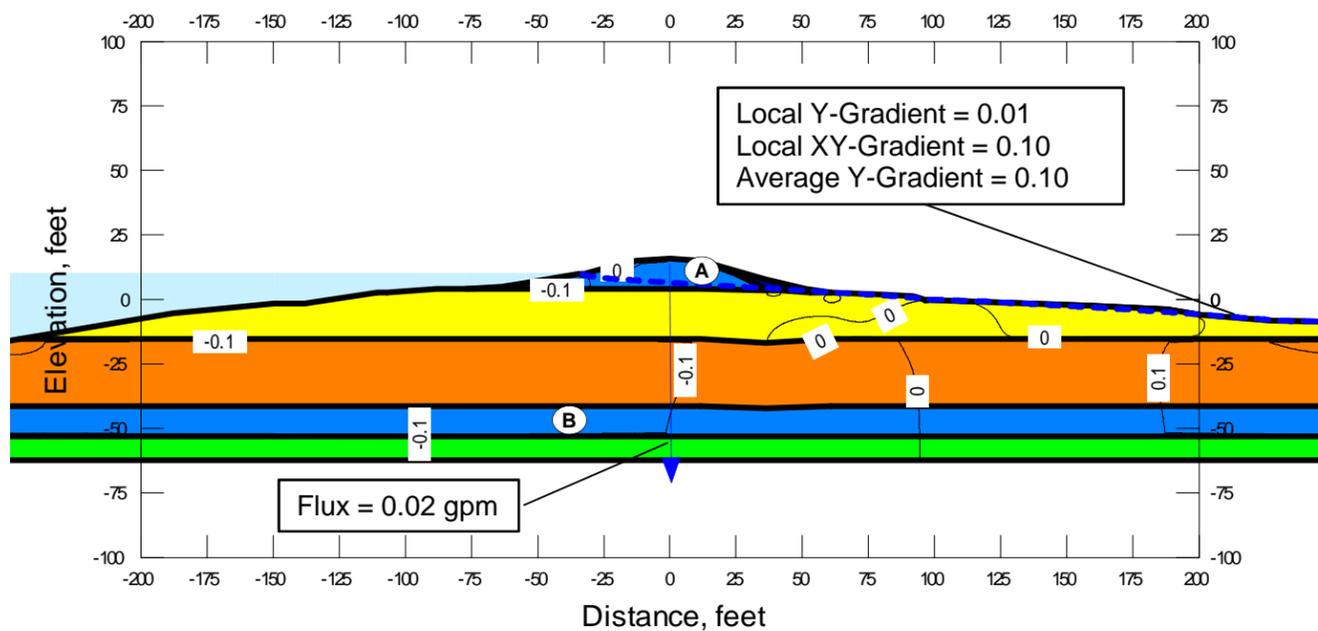
100-Year Flood at Elevation +9.8 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES				
LAYER DESIGNATION	LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_h (cm/sec)	VERT./HORZ. CONDUCTIVITY RATIO, k_v/k_h
	Yellow	Existing Fill (Cohesionless)	1×10^{-3}	0.25
(A)	Light Blue	Existing Fill (Cohesive)	1×10^{-4}	0.25
(B)	Blue	Silt	1×10^{-5}	0.25
	Orange	Peat	1×10^{-5}	0.25
	Green	Sand	1×10^{-3}	0.11
	Dark Blue	New Levee Fill	1×10^{-4}	0.25

Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Seepage Analysis Results
Long Term Consolidated Configuration
Station 839+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. C-12

APPENDIX D
SLOPE STABILITY ANALYSIS

D – 1. SLOPE STABILITY

A. General

We performed analyses to check the factor of safety for the existing levee, the factor of safety for after placement of fill (end of construction), and the factor of safety after rehabilitation and consolidation of the marsh deposits. We used Spencer's method of analysis and computer programs SLOPE/W and/or UTEXAS4. We used data obtained from the borings along with our assessment of average undrained shear strengths for Delta marsh deposits, including peat and silt. Shear strength design values for the remaining materials are based on laboratory test results, our existing project data with similar soil conditions and the presumptive values obtained from the Guidance Document for Geotechnical Analyses (Guidance Document, Revision 9, 2011). Typically, fill placement occurs over a period of time that is relatively short compared to the time required for marsh soils to gain strength. We assumed that the marsh soils will not gain shear strength prior to the end of construction. The long-term consolidated case accounts for strength gain and settlement due to consolidation of the marsh soils. The soil properties used in our analysis are presented on the plates.

We reviewed the topography and cross-sections and selected six sections (Stations 700, 715, 724, 740, 761, and 839) to represent the levee between Stations 700 to 850. The cross-sections were selected to represent varying landside and waterside slope angles, levee heights, crest widths, and depths of marsh soils. For the landside slopes, we used the 100-year flood surface for the analysis of the existing levee, end of construction, and long-term consolidated configuration. For the seismic loading case, we used an average tide level at Elevation +3.9 feet for the analysis. For the waterside slopes, we used a low water level at Elevation +2.4 feet for the analyses.

We analyzed the existing levee using both effective stress and undrained strength parameters. We analyzed the rehabilitated levee using undrained strengths for end of construction, and both effective stress and undrained strengths for long-term consolidated conditions. For pseudo-static or seismic loading conditions, both existing and rehabilitated levees were analyzed using undrained strengths. The analyses included:

Static Loading

- Existing Levee – Effective Strength

- Existing Levee –Undrained Strength
- Rehabilitated Levee – End of Construction – Undrained Strength
- Rehabilitated Levee – Long-Term Consolidated – Effective Strength
- Rehabilitated Levee – Long-Term Consolidated – Undrained Strength

Pseudo-Static Loading

- Existing Levee – Undrained Strength
- Rehabilitated Levee – Long-Term Consolidated – Undrained Strength

The rehabilitated levee cross-section used for analysis consists of a 24-foot wide levee crest at Elevation +13.8 feet with a 4H:1V landside slope except for Stations 715, 724, and 740. At Stations 715, 724, and 740 a cross-section that includes a 4H:1V landside slope and a toe berm was analyzed. For the marsh soil depths along this reach, we analyzed a toe berm that extends 140 feet (Station 740) and 150 feet (Stations 715 and 724) from the landside hinge point. The maximum fill thickness for the toe berm is 5 feet, reduced to 2 feet at the landside edge of the berm. The levee crest elevation was analyzed as four (4) feet above the 100-year flood, including a freeboard of 3 feet and a 1 foot overbuild.

B. Slope Stability

The results of our analysis for landside slopes are presented in Table D-1 and D-2.

Table D-1: Factors of Safety for Landside Slopes

Station	Existing Levee		Rehabilitated Levee		
	Effective Strength	Undrained Strength	End of Construction	Long Term Consolidated	
			Undrained Strength	Effective Strength	Undrained Strength
700	1.85	2.10	1.95	1.99	2.06
715	1.39	1.66	1.63	1.62	1.83
724	1.21	1.48	1.55	1.44	1.68
740	1.60	1.75	1.78	1.83	2.12
761	2.01	2.04	2.52	2.46	2.55
839	2.27	2.57	2.46	2.62	2.52

Table D-2: Factors of Safety for Waterside Slopes

Station	Existing Levee		Rehabilitated Levee		
	Effective Strength	Undrained Strength	End of Construction	Long Term Consolidated	
			Undrained Strength	Effective Strength	Undrained Strength
700	1.84	1.58	1.57	1.83	1.57
715	1.59	1.42	1.39	1.58	1.42
724	1.57	1.40	1.40	1.57	1.40
740	2.20	1.89	1.85	2.18	1.87
761	1.68	1.58	1.58	1.68	1.58
839	3.12	2.50	2.50	3.12	2.50

We performed a pseudo-static stability analysis for the existing levee and the rehabilitating levee for the landside and waterside slopes. The pseudo-static analysis applies a horizontal force at the center of gravity of the slip area mass to model an earthquake force. The yield coefficient is the value of this force resulting in a factor of safety of 1.0. Table D-3 presents the yield coefficients (K_y). The analysis assumes that materials do not lose strength during earthquake shaking and no liquefaction occurs in the fill sand and/or foundation sand.

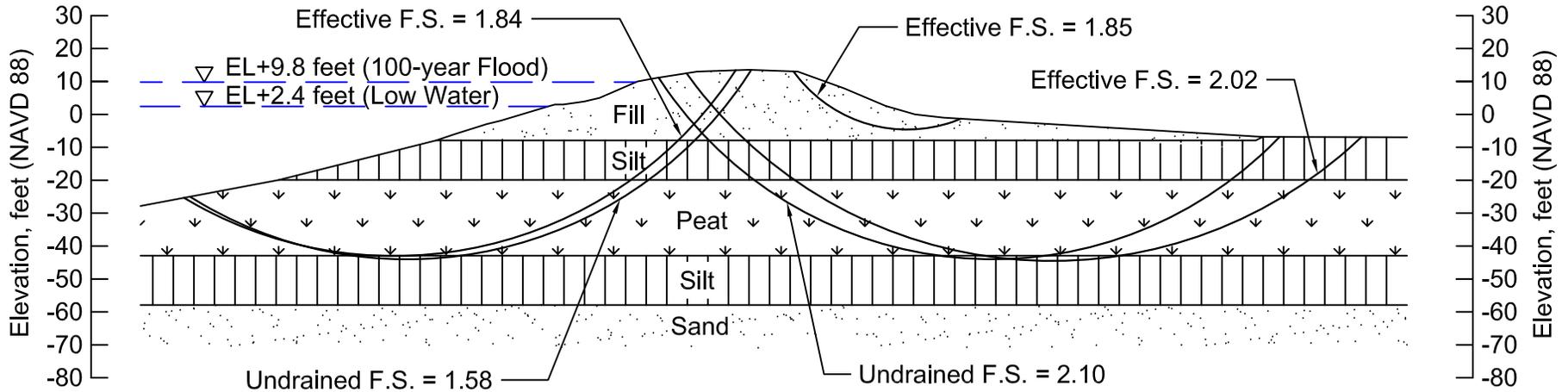
Table D-3: Yield Coefficients (K_y) from Pseudo-Static Loading

Station	Landside		Waterside	
	Existing Levee	Rehabilitated Levee	Existing Levee	Rehabilitated Levee
700	0.16	0.15	0.09	0.09
715	0.12	0.12	0.09	0.09
724	0.11	0.11	0.08	0.08
740	0.15	0.16	0.14	0.14
761	0.28	0.28	0.12	0.12
839	0.15	0.15	0.12	0.12

The results indicate the yield coefficients remain the same for the landside and waterside slopes after the levee is rehabilitated.

C. Soil Liquefaction

The existing 1950's DWR data does not have blow counts that can be used to perform a liquefaction evaluation except the data from the recent exploration at two fish release sites (Stations 707 and 733). 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. Generally, the levee fill on Sherman Island contains sand. Between Stations 760 and 845, zones of sand were encountered beneath the levee fill. We analyzed the liquefaction potential using the method described in Idriss and Boulanger (2008 and 2010) which includes procedures for liquefaction triggering. The analysis was performed using the data collected at the two fish release sites. A design earthquake magnitude of 6.6 and a peak ground acceleration of 0.27g for Sherman Island, based on the Guidance Document, were selected to represent a risk of recurrence interval of 200 years. The preliminary analysis indicates that the levee fill will liquefy and that liquefaction will occur within the upper five feet (or less) of the foundation sand. Other Delta studies have concluded that large deformation may occur if the levee fill liquefies.



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 1 inch = 50 feet

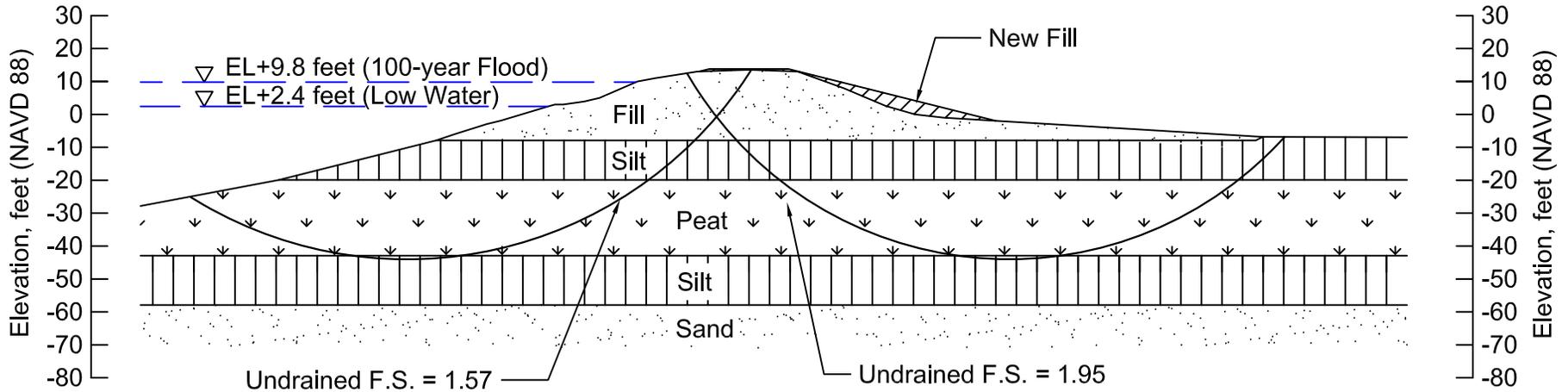
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
Existing Levee
Station 700+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-1



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 1 inch = 50 feet

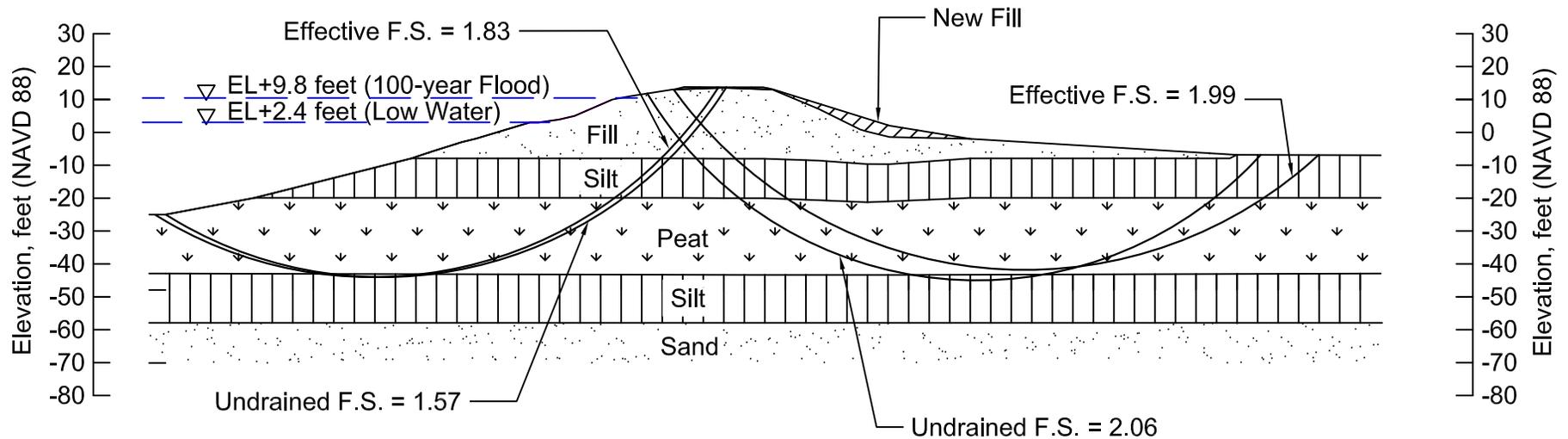
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
End of Construction
Station 700+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-2



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
0 50 feet
1 inch = 50 feet

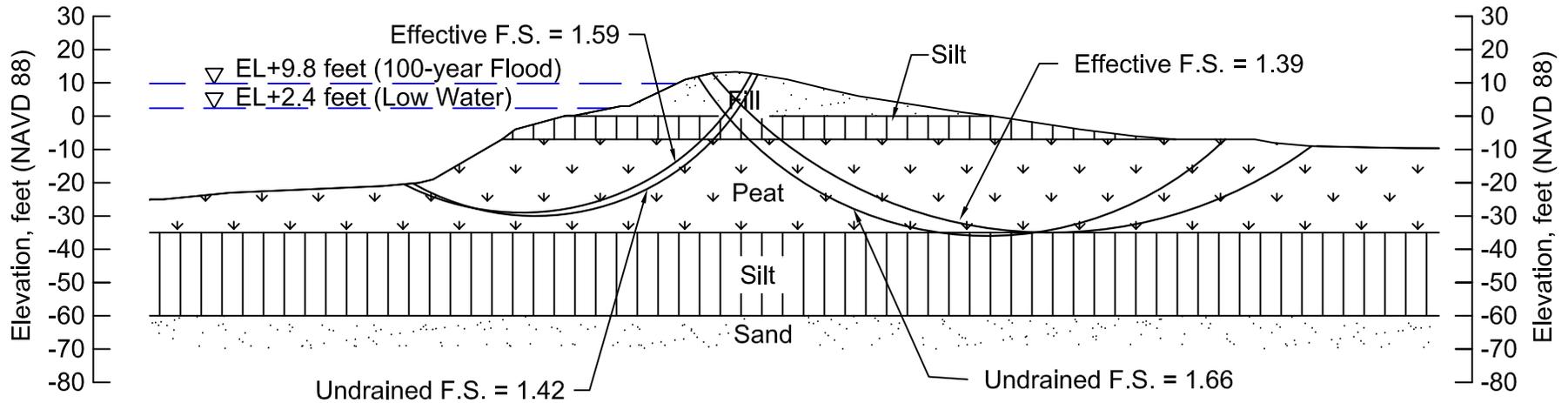
Sherman Island - Stations 700 to 850
Reclamation District 341
Sacramento County, California

Slope Stability Results
Long Term Consolidated Levee
Station 700+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-3



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
0 50 feet
1 inch = 50 feet

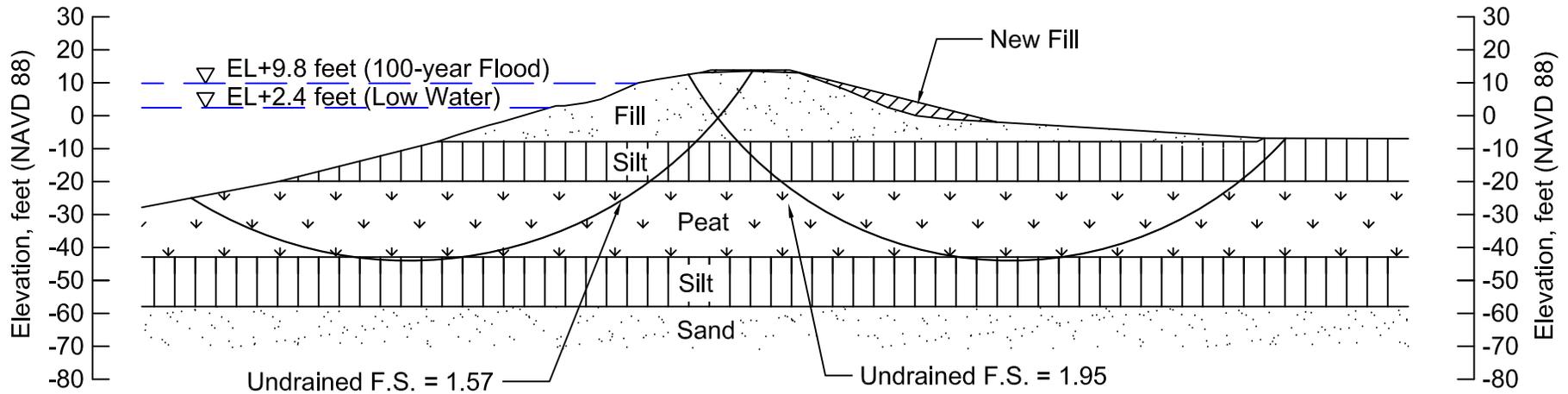
Sherman Island - Station 700 to 850
Reclamation District 341
Sacramento County, California

Slope Stability Results
Existing Levee
Station 715+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-4



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
0 50 feet
1 inch = 50 feet

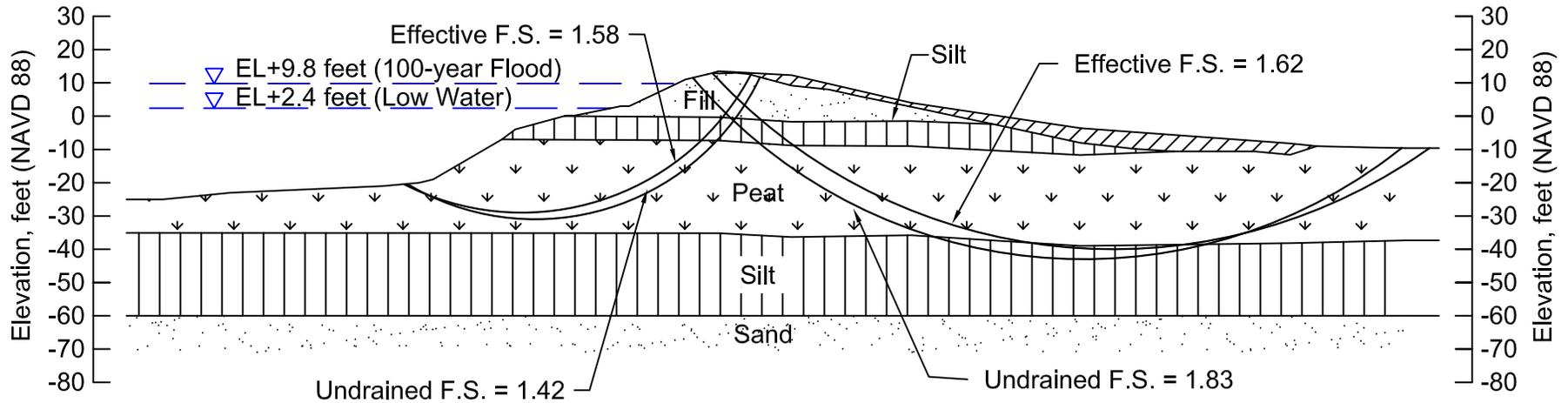
Sherman Island - Station 700 to 850
Reclamation District 341
Sacramento County, California

Slope Stability Results
End of Construction
Station 715+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-5



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 1 inch = 50 feet

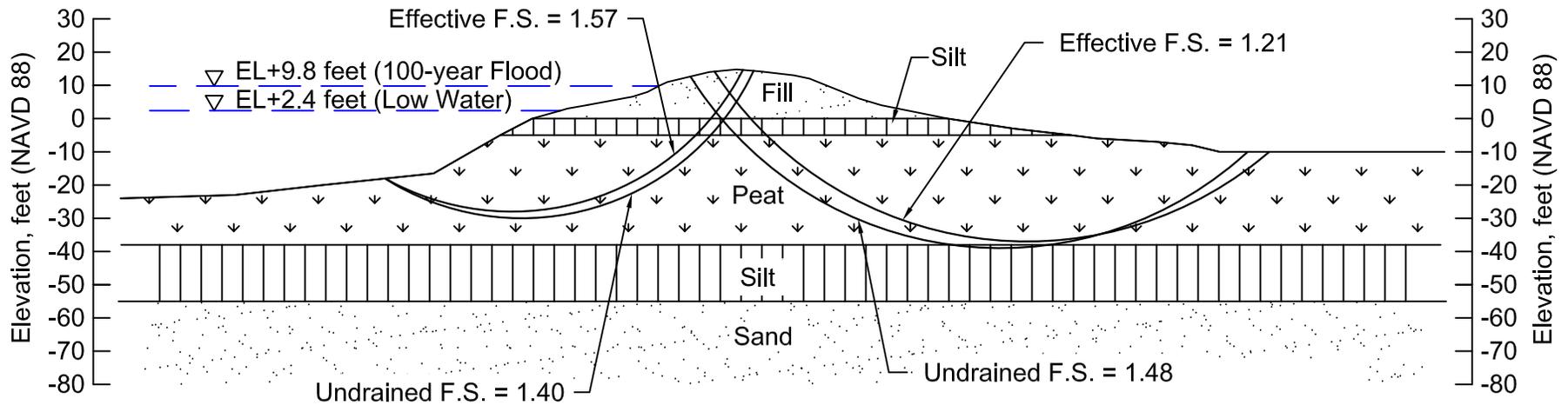
Sherman Island - Station 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
Long Term Consolidated Levee
Station 715+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-6



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
0 50 feet
1 inch = 50 feet

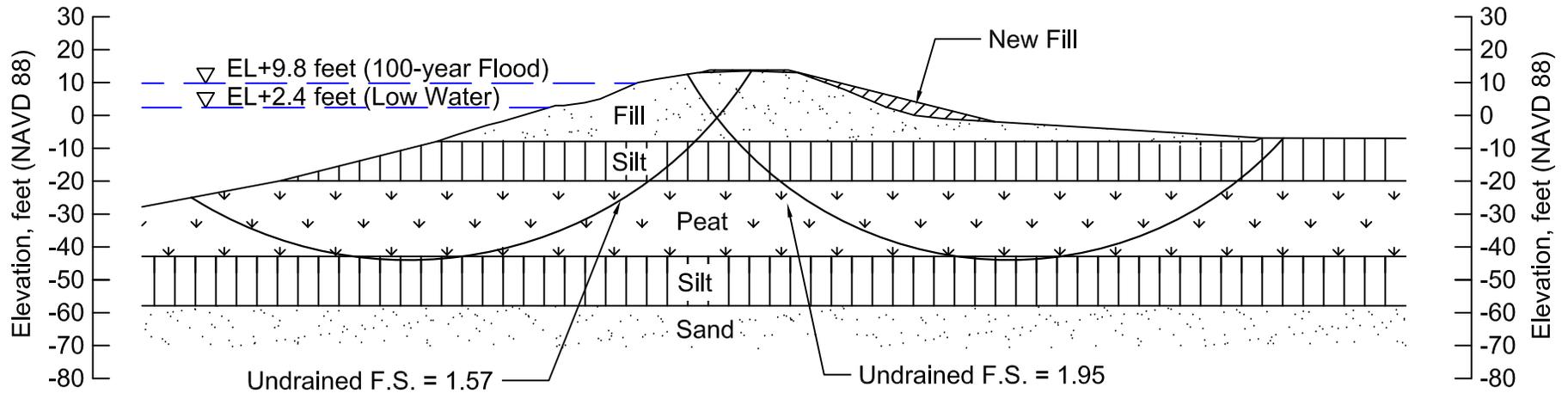
Sherman Island - Station 700 to 850
Reclamation District 341
Sacramento County, California

Slope Stability Results
Existing Levee
Station 724+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-7



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 1 inch = 50 feet

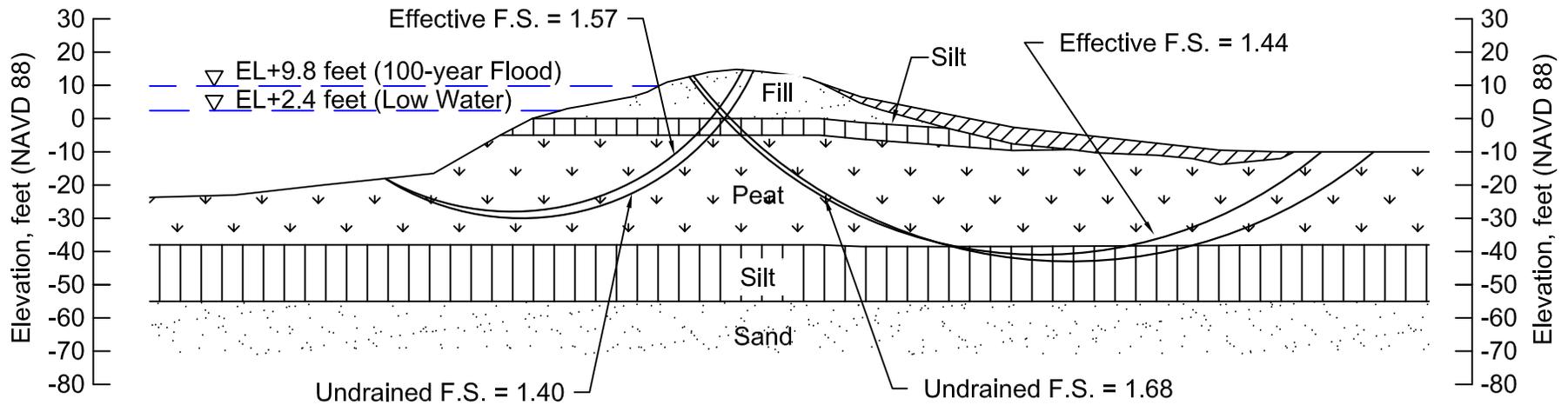
Sherman Island - Station 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
End of Construction
Station 724+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-8



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 1 inch = 50 feet

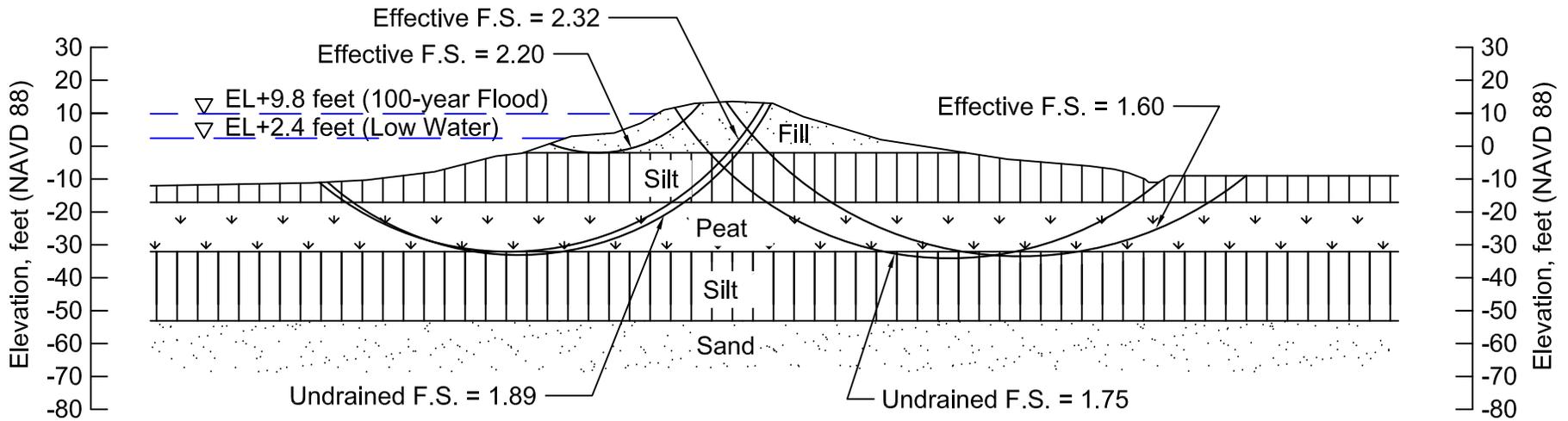
Sherman Island - Station 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
Long Term Consolidated Levee
Station 724+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-9



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 1 inch = 50 feet

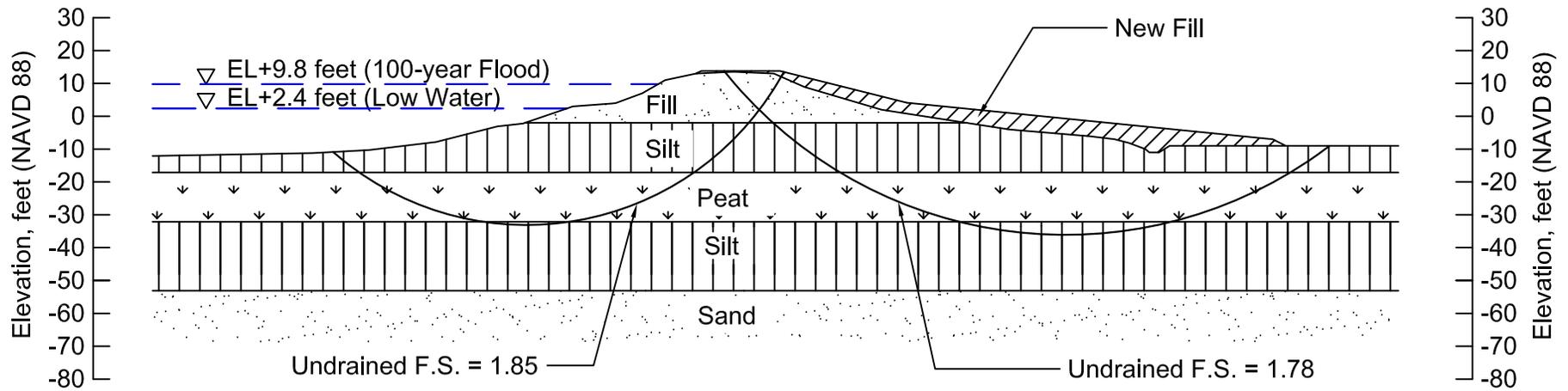
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
Existing Levee
Station 740+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-10



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 |-----|
 1 inch = 50 feet

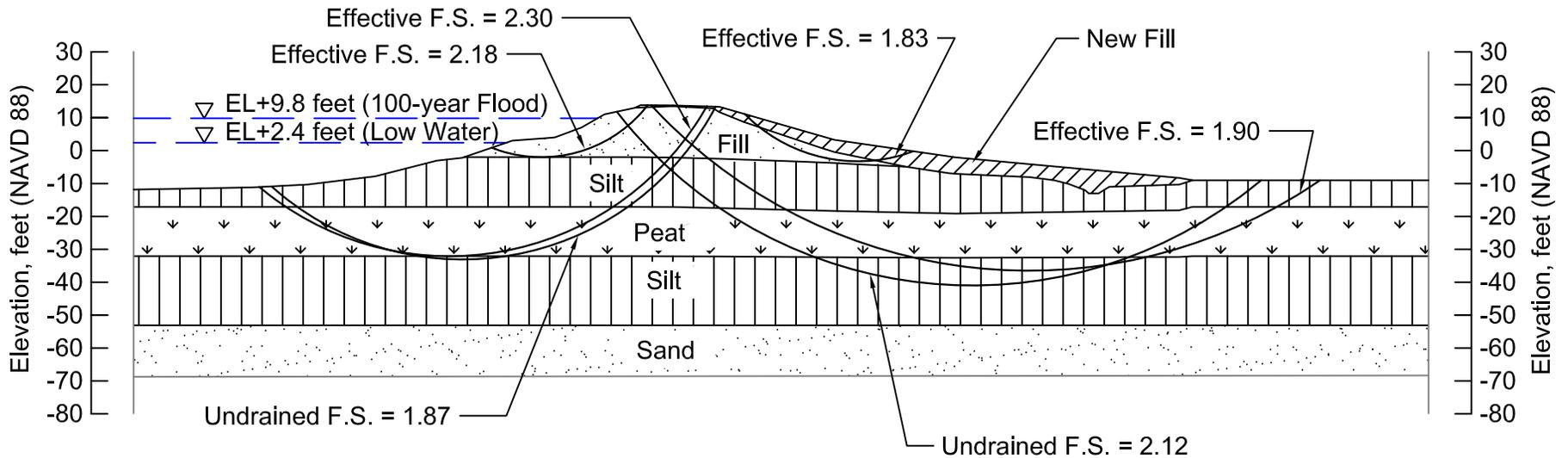
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
End of Construction
Station 740+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-11



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 1 inch = 50 feet

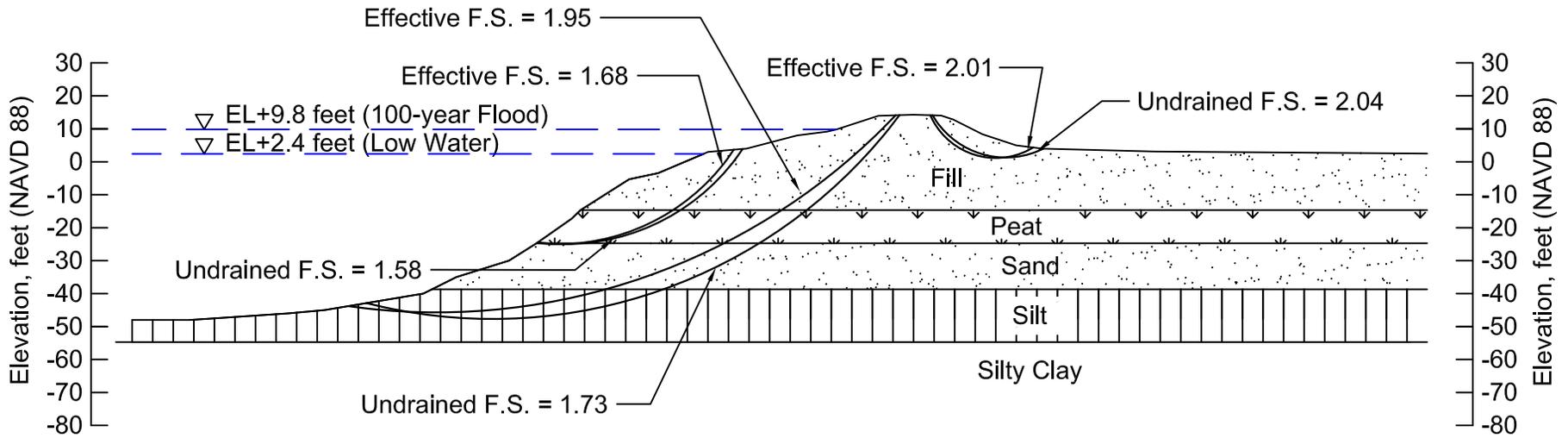
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
Long Term Consolidated Levee
Station 740+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-12



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
0 50 feet
1 inch = 50 feet

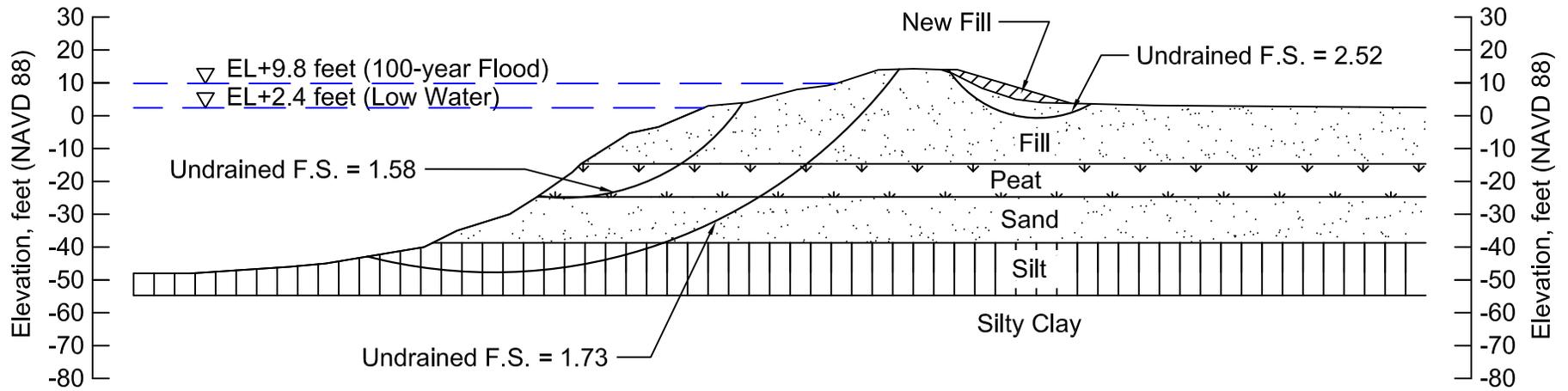
Sherman Island - Stations 700 to 850
Reclamation District 341
Sacramento County, California

Slope Stability Results
Existing Levee
Station 761+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-13



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 |-----|
 1 inch = 50 feet

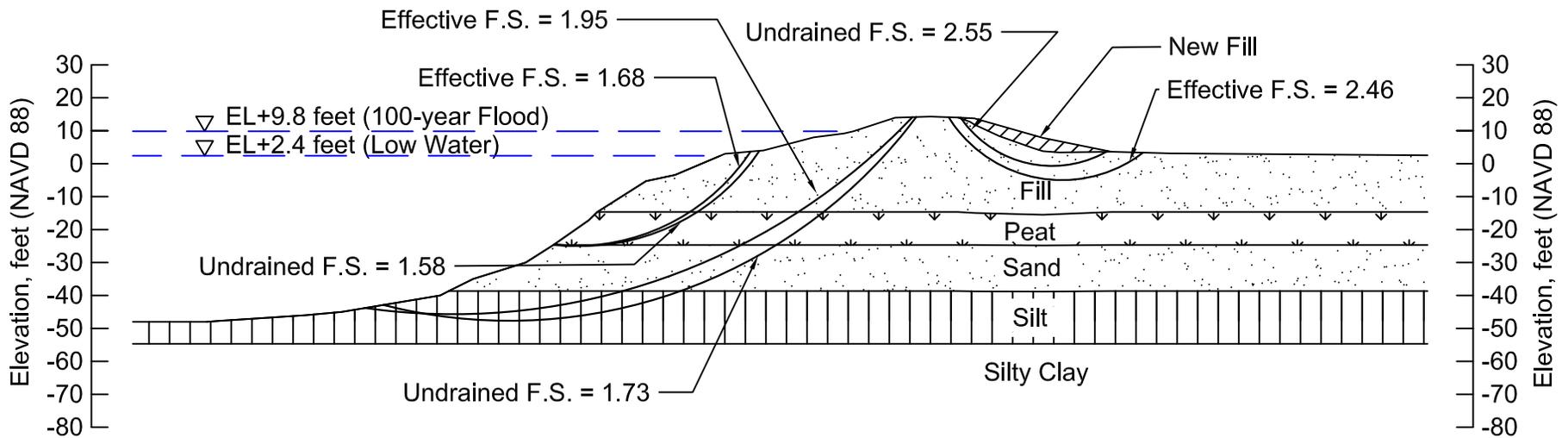
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
End of Construction
Station 761+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-14



SOIL PARAMETERS

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

Note: River stages at 9.8 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

SCALE
 0 50 feet
 1 inch = 50 feet

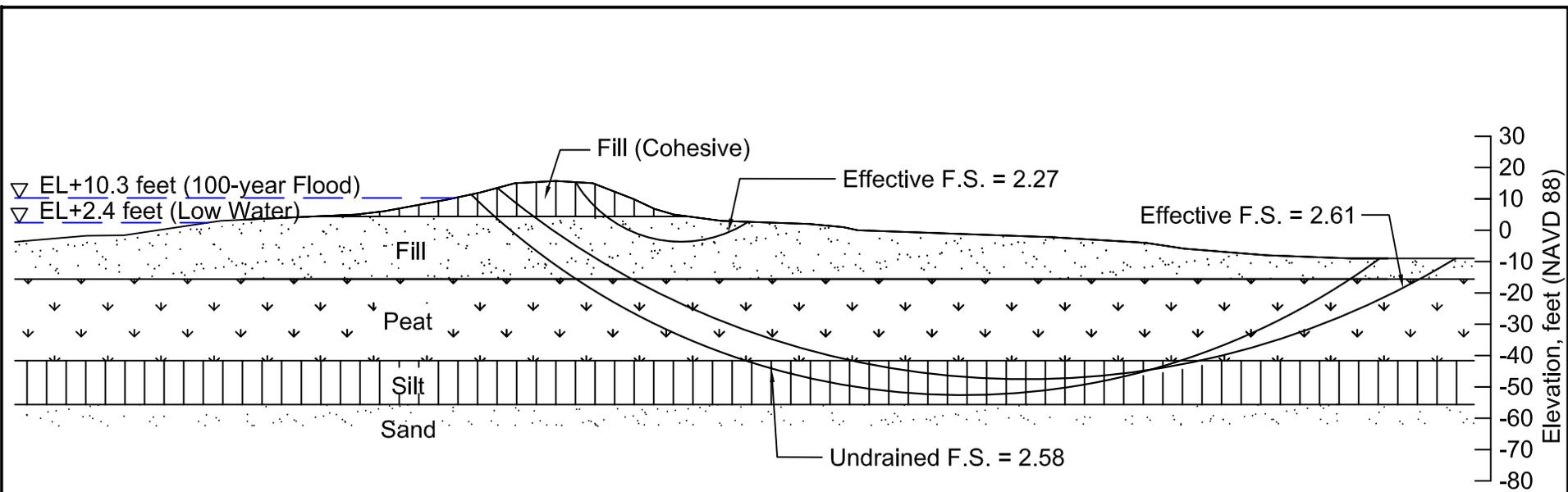
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
Long Term Consolidation Levee
Station 761+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-15



SOIL PARAMETERS

Note: 1. Soil parameters of Fill (Cohesive) are the same as Silt in the slope stability analysis.

2. River stages at 10.3 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

SCALE
 0 50 feet
 1 inch = 50 feet

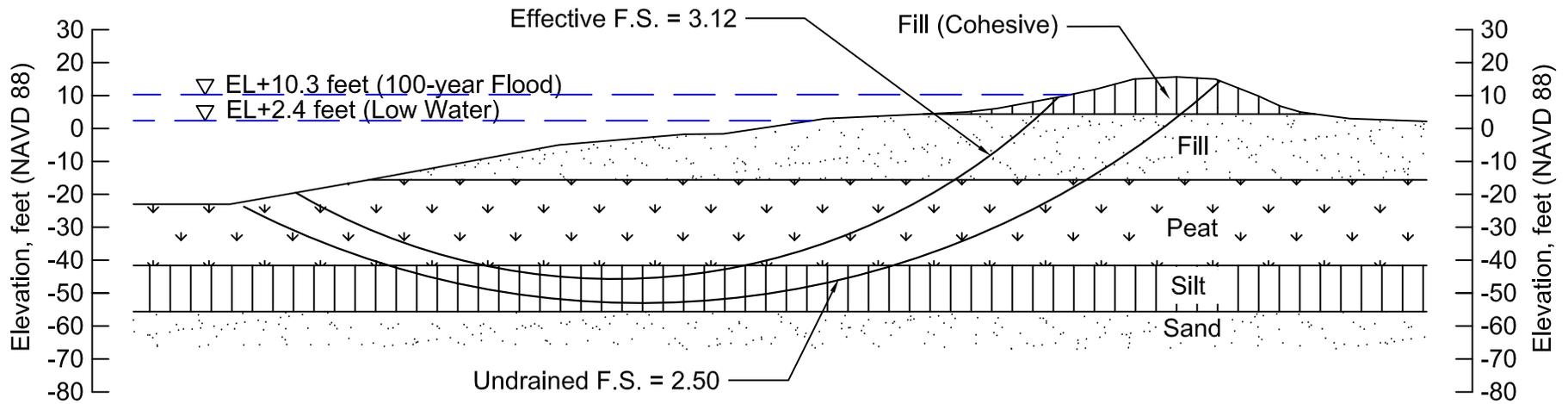
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
Existing Levee
Station 839+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-16



SOIL PARAMETERS

- Note: 1. Soil parameters of Fill (Cohesive) are the same as Silt in the slope stability analysis.
2. River stages at 10.3 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

SCALE
0 50 feet
1 inch = 50 feet

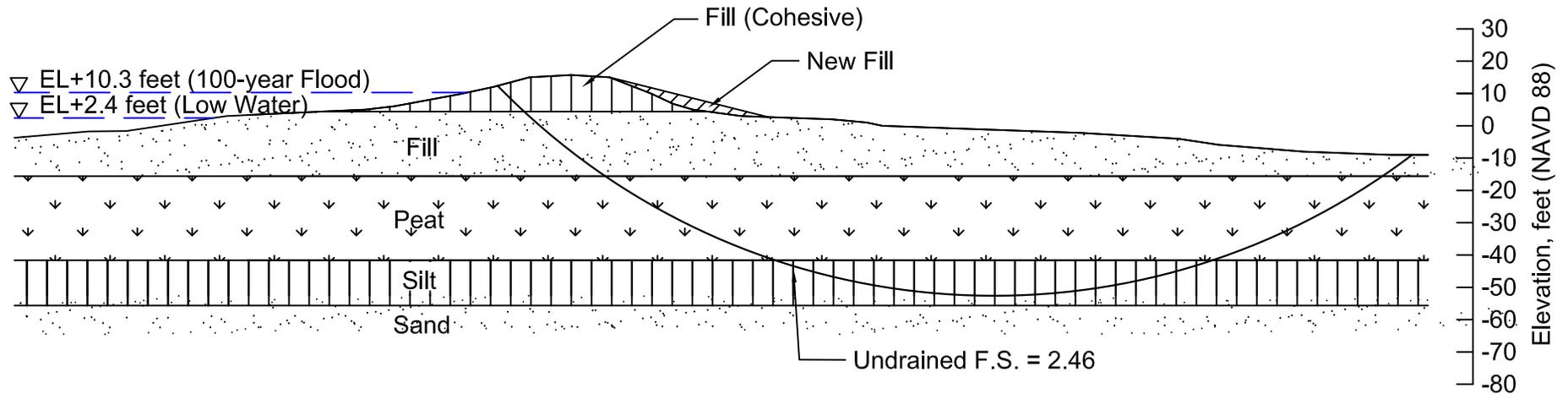
Sherman Island - Stations 700 to 850
Reclamation District 341
Sacramento County, California

Slope Stability Results
Existing Levee
Station 839+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-17



SOIL PARAMETERS

Note: 1. Soil parameters of Fill (Cohesive) are the same as Silt in the slope stability analysis.

2. River stages at 10.3 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

SCALE
 0 50 feet
 |-----|
 1 inch = 50 feet

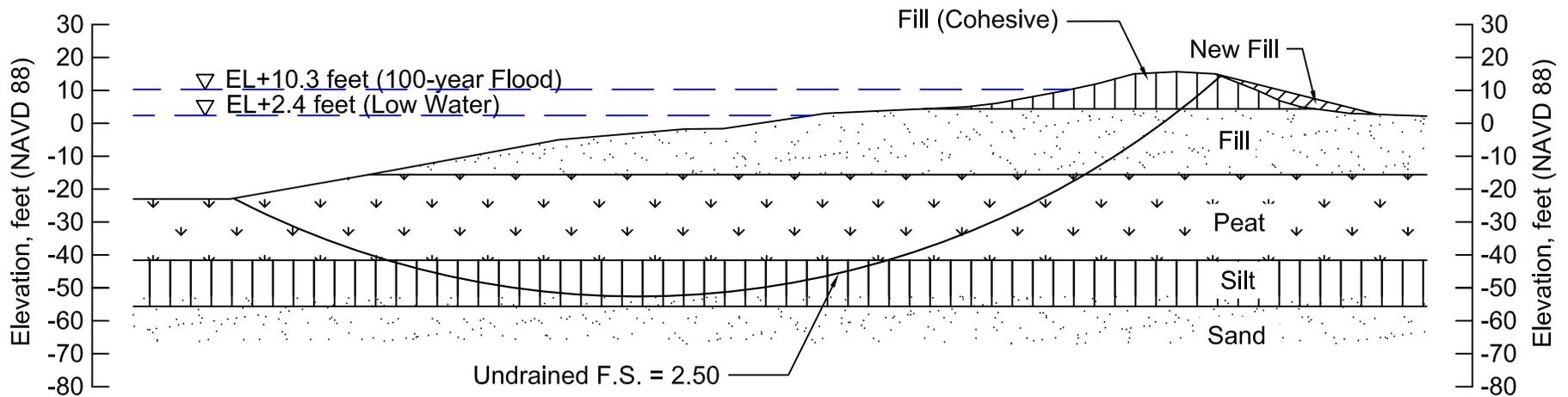
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
End of Construction
Station 839+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-18



SOIL PARAMETERS

Note: 1. Soil parameters of Fill (Cohesive) are the same as Silt in the slope stability analysis.
 2. River stages at 10.3 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

SCALE
 0 50 feet
 1 inch = 50 feet

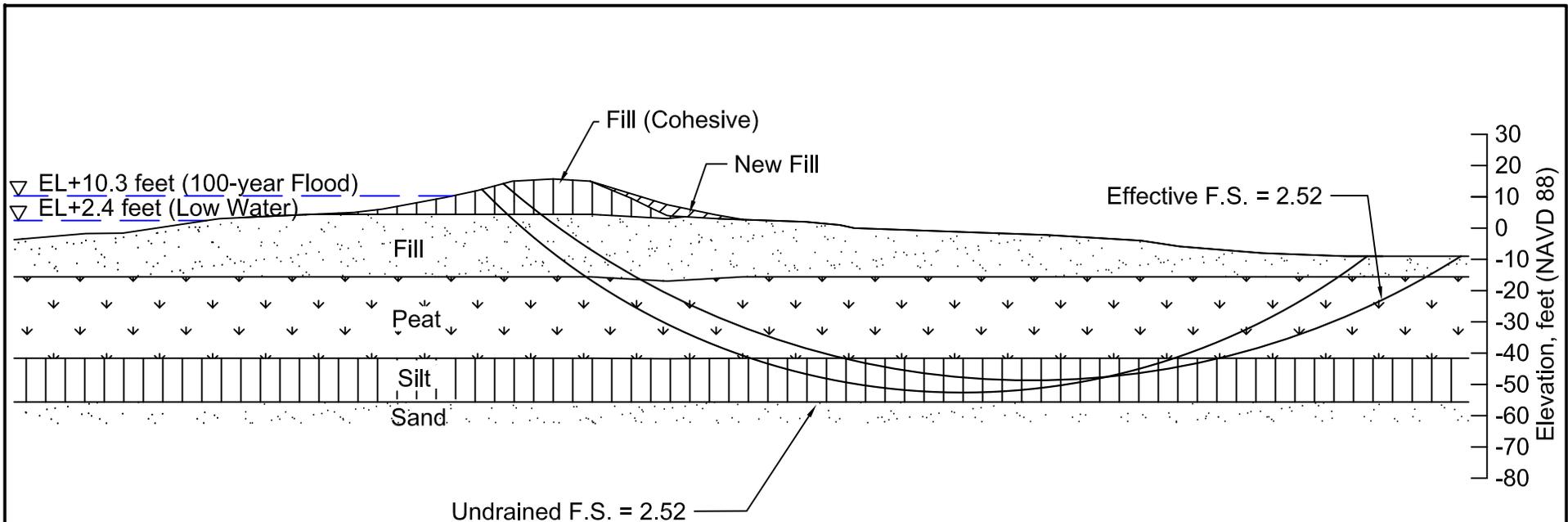
Sherman Island - Stations 700 to 850
 Reclamation District 341
 Sacramento County, California

Slope Stability Results
End of Construction
Station 839+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-19



SOIL PARAMETERS

Note: 1. Soil parameters of Fill (Cohesive) are the same as Silt in the slope stability analysis.

2. River stages at 10.3 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

SCALE
0 50 feet
1 inch = 50 feet

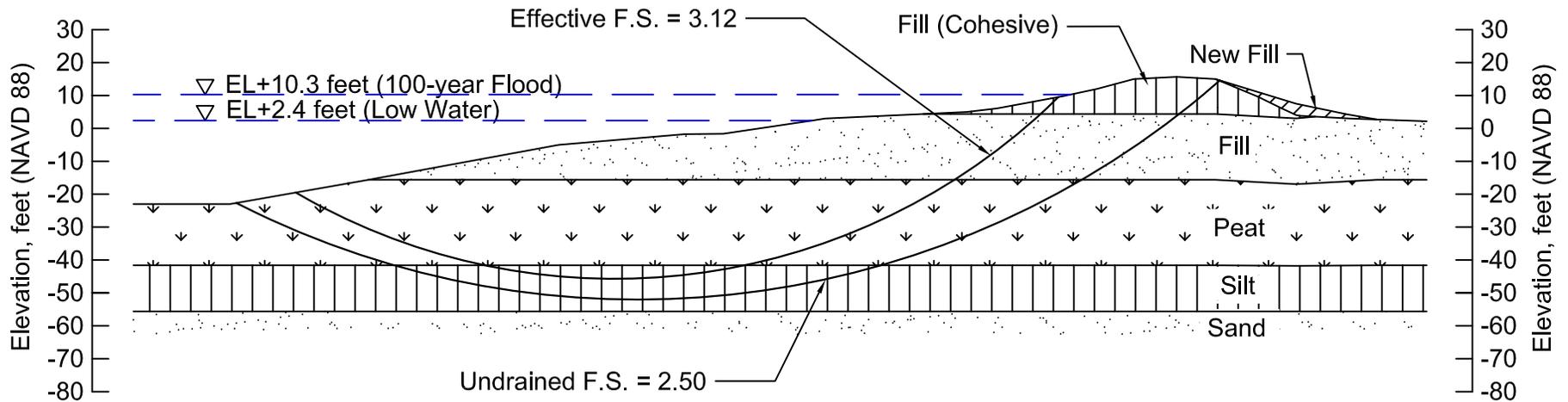
Sherman Island - Stations 700 to 850
Reclamation District 341
Sacramento County, California

Slope Stability Results (Landside)
Long Term Consolidated Levee
Station 839+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-20



SOIL PARAMETERS

Note: 1. Soil parameters of Fill (Cohesive) are the same as Silt in the slope stability analysis.

2. River stages at 10.3 ft flood level and at 2.4 ft low water level were used in the slope stability analysis for the landside and waterside, respectively.

Soil Type	Unit Weight (pcf)	Undrained Strength		Effective Strength	
		Cohesion (psf)	Friction Angle (°)	Cohesion (psf)	Friction Angle (°)
Fill	115	-	-	50	32
Peat	70	140	20	100	32
Silt	100	150	19	100	32
Sand	125	-	-	50	38
New Fill	115	-	-	50	32

SCALE
0 50 feet
1 inch = 50 feet

Sherman Island - Stations 700 to 850
Reclamation District 341
Sacramento County, California

Slope Stability Results (Waterside)
Long Term Consolidated Levee
Station 839+00

Hultgren - Tillis Engineers

Project No. 789.06

Plate No. D-21