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GEOTECHNICAL FEASIBILITY INVESTIGATION

Little Egbert Multi-Benefit Project

SOLANO COUNTY, CA

SHANNON & WILSON

July 27, 2023

Shannon & Wilson No: 110214 / 907.03

Submitted To: Westervelt Ecological Services, LLC
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Sacramento, CA 95864
Attn: Mr. Mark Young

Subject: GEOTECHNICAL FEASIBILITY INVESTIGATION, LITTLE EGBERT MULTI-BENEFIT PROJECT, SOLANO COUNTY, CA

We performed a geotechnical feasibility investigation for the Little Egbert Multi-Benefit Project in Solano County, California. The results of the investigation are presented in the attached report.

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

Sincerely,

SHANNON & WILSON

Gregory Olsen, GE PE
Senior Engineer

R. Kevin Tillis, GE PE
Vice President

GRO:RKT/kxb

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ACRONYMS

CLSM	Controlled Low Strength Material
CPT	Cone Penetration Test
cm/sec	Centimeter per second
CVFPB	Central Valley Flood Protection Board
deg	degrees
DWSE	Design Water Surface Elevation
ft	Feet
GDR	Geotechnical Data Report
H:V	Horizontal to Vertical
HTOL	Hydraulic Top of Levee
LM	Levee Mile
MTL	Mean Tide Level
NAVD88	North American Vertical Datum of 1988
NLD	National Levee Database
NRCS	Natural Resources Conservation Service
NULE	Non-Urban Levee Evaluations
O&M	Operation and Maintenance
pcf	pounds per cubic foot
psf	pounds per square foot
SPT	Standard Penetration Test
TxCU	Consolidated Undrained Triaxial
TxUU	Unconsolidated, Undrained Triaxial
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey

1 INTRODUCTION

This report presents the results of our geotechnical feasibility investigation for the proposed Little Egbert Multi-Benefit Project (Project) in Solano County, California. A vicinity map showing the approximate proposed location of the site is presented on Plate 1. A site plan depicting the proposed project features is presented on Plate 2. The proposed project consists of converting Little Egbert Tract into a variety of habitats. The Little Egbert Tract will be converted into habitat by breaching existing levees and allowing the site to be tidally inundated. The habitat types may include subtidal swales, subtidal flats, tidal wetlands, riparian woodland / scrub, and grassland.

The proposed project is bounded by levees which are included in the National Levee Database (NLD) developed by the United States Army Corps of Engineers (USACE). The NLD includes both USACE Project Levees and levees that are not within the jurisdiction of USACE. The locations of levees listed in the NLD are presented on Plate 3. For conciseness, we will refer to the "RD 0536 – Egbert – Unit 2, South Levee" throughout the report as the "RD 536 Levee". The other levees in the report will be referred to by the names given in the NLD (Mellin Levee, Mellin Levee Extension, Solano County Levee 44, and Solano County Levee 28). The Mellin Levee, Mellin Levee Extension, and Solano County Levee 44 are connected and currently share a continuous stationing alignment.

The project configuration is under development. Numerous alternatives are under consideration for the proposed project. The current, conceptual configuration includes breaching the restricted height levee for RD 2084 (Solano County Levee 28) on the southeast side of Little Egbert Tract to allow water from Cache Slough to flow tidally into the parcel. A degraded section of Solano County Levee 28 near the north end of Little Egbert Tract would allow water to enter the site from the north when water in the adjacent slough is at elevated flood levels, which would improve the flood conveyance of the Yolo Bypass upstream of the project. The proposed project includes rehabilitating levees along the west side of the project to reduce the flood risk to the neighboring parcels under tidal and flood water levels. For all alternatives, the levee along the west side will need to meet current levee design criteria. A new levee is planned to protect a residence (Baldwin residence) adjacent to the southeast corner of the proposed project.

Some alternatives include a smaller tidal opening downstream of the south breach. To create the opening, a bridge or culvert through California State Route 84 will be required to allow water to flow in and out of the proposed project. Another feature of the proposed project includes constructing a dual-purpose water control structure where the Watson

Hollow Diversion Canal (Watson Hollow) crosses the western levee alignment. The new water control structure may include culverts fitted with gates to allow water to flow through Watson Hollow to and from neighboring parcels.

Extensive grading is planned to create habitat berms adjacent to exiting levees, interior channels, and for construction of levee improvements.

We published a draft Geotechnical Data Report (GDR) on December 19, 2022, which included logs of borings, test pits, and Cone Penetration Tests (CPTs) that were conducted for this investigation and previous investigations near the site. We used data from the December 19, 2022, draft GDR to produce this report. This report is intended to support the feasibility level study for the proposed project. It is not intended to support the design. We performed analysis to evaluate the feasibility of geotechnical engineering aspects of the proposed project, including the existing levees. We believe that the results, based on the data collected and analysis performed, demonstrate that the proposed project is feasible and can be constructed.

2 EXISTING DATA, FIELD EXPLORATION AND LABORATORY TESTING

We reviewed logs of previous subsurface explorations within the proposed project footprint and surrounding vicinity. We explored subsurface conditions by drilling borings, excavating test pits, and performing CPTs. The approximate exploration locations are presented on the Exploration Location Map, Plate 4. A description of the data review and field exploration is presented in the December 19, 2022 draft GDR. The logs of borings, CPTs, and test pits are presented in the December 19, 2022 draft GDR along with the laboratory test results. Data from pocket penetrometer, torvane, Atterberg limits, moisture content, and density tests are presented in Appendix D along with $(N_1)_{60}$ Standard Penetration Test (SPT) blow counts.

Elevations referred to in this report are referenced to the North American Vertical Datum of 1988 (NAVD88) unless otherwise stated.

3 SITE CONDITIONS

3.1 Regional Geology

The site is located near the foot of the Montezuma Hills, at the fringe of the Sacramento-San Joaquin Delta. The United States Geological Survey (USGS) has published maps for the Sacramento-San Joaquin Delta (Atwater 1982).

The Atwater geologic map that includes the site and the geologic descriptions of the map units are presented on Plate 5. The map shows the landward margin of tidal wetland at low river stages circa 1850. North of approximately Station 110+00 for the RD 536 Levee, the historic landward margin of the tidal wetland is mapped at least 1,000 feet west of the proposed project, indicating that the RD 536 Levee footprint and parcel interior north of Station 110+00 are within an area that was tidal wetlands before the area was reclaimed in the early 1900s. Between approximately Station 110+00 and the southern end of the RD536 Levee, the mapped landward margin of tidal wetland meanders near the current footprint of the RD 536 Levee. Most of the parcel interior is located within the historic tidal wetland.

The Atwater geologic map indicates that a low ridge crosses the site near the southern boundary of Little Egbert Tract. The ridge is approximately 2,500 feet wide. The footprint of Solano County Levee 44 is mapped within this ridge. The margins of former tidal wetland meander near the current footprint of the Mellin Levee and Mellin Levee Extension. Multiple swales of tidal wetlands pass through the current footprint of the Mellin Levee and Mellin Levee Extension.

The geology map indicates that areas mapped within the margins of tidal wetland are generally covered by peat and mud of tidal wetlands and waterways (Qpm) and flood basin deposits (Qb). The areas outside the margins of the tidal wetland are generally mapped as older alluvium of the Montezuma Hills and vicinity (Qom), and possibly the Montezuma Formation (Qmz).

The present configuration of the Sacramento-San Joaquin River Delta began to form after the last ice age, about 10,000 to 13,000 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 rise in sea level was slow enough to allow for the accretion of marsh vegetation and sediments and formation of a widespread inland delta covered by marsh deposits (mapped as Qpm). Marsh deposits 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 flood basin deposits (Qb) were deposited along the outer edges of the Delta during periods of increased runoff from the streams that feed into the Delta.

The Montezuma Hills are located southwest of the site and predate the present configuration of the Sacramento-San Joaquin River Delta. Storm runoff from the hills formed streams and eroded the soil, carrying it downstream as alluvium. The older alluvial soils (Qom) were present prior to the sea level rise that occurred after the last ice age. The querried portion of the map labeled as Montezuma Formation (Qmz) may be a remnant of a ridgetop of one of the lower-lying Montezuma hills whose lower portions have since been buried by alluvium, flood basin, or marsh deposits.

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) develops soil survey maps of the upper five feet of soil across the United States. The portion of the NRCS soil survey map that includes Little Egbert Tract is presented on Plate 6. The NRCS map shows that most of the site is blanketed by Egbert Clay, a high plasticity clay. The southern and western portions of the site are blanketed by a variety of silt and clay soil with varying plasticity. The boundaries between soil units on the NRCS maps generally agree with the boundaries shown on the Atwater geologic map.

The northern tip of Little Egbert Tract is included in the geomorphic assessment and surficial geologic map of the California Department of Water Resources Non-Urban Levee Evaluations (NULE) Project. The portion of the geologic map that includes Little Egbert Tract and nearby delta islands is presented on Plate 7. The geology map shows that the proposed project area is underlain by Holocene peat and muck (Hpm), Holocene marsh deposits (Hs), Holocene overbank deposits (Hob), and recent and Holocene slough deposits (Rsl and Hsl). The Hpm and Hs soils consist of peat and organic-rich silt and clay which were at one time perennially or seasonally submerged and are mostly now leveed, drained and farmed. The Hob, Rsl, and Hsl deposits consist of sand, silt and clay which are deposited during high-stage, low energy water flow.

3.2 Construction History

According to the NULE reports and the Operations and Maintenance (O&M) Manual for the levee, the RD 536 Levee was constructed in 1943 by USACE. As-built drawings indicate that the levee was constructed from materials excavated from within Little Egbert Tract near the levee. The borrow sites are located in areas mapped as Qpm, peat and mud, and Qb, flood basin deposits on the Atwater Geologic Map. The means and methods used to construct the levee are unknown. As-built drawings for the RD 536 and Mellin Levees are included in Appendix G. According to the O&M Manual, the Mellin Levee was constructed in 1971.

3.3 Levee Performance History

The Egbert Levee has a documented history of seepage, erosion, and cracking at multiple locations. The levee is generally dry, as it is buffered from the Sacramento River and Cache Slough by Solano County Levee 28 to the east. Solano County Levee 28 has overtopped twice since 1968: in February 1986 and January 1997. During the 1997 to 1998 flood season, significant levee safety issues were documented. Seepage in fields and boils were recorded from Levee Mile (LM) 0 to 1.0. Wave wash damage was recorded with 4-foot-high vertical faces from LM 0 to 3.4. The wave wash damage was later repaired. Cracking and burrows were observed along the landward side of the levee slope near LM 1.03. Heavy seepage along the landward side of the levee was documented from LM 2.57 to 3.30. Finally, a boil in the landside irrigation ditch at least 60 feet from the levee was observed, with the bank of the ditch caving at LM 3.4. The approximate locations of these documented seepage areas are presented on Plate 8.

3.4 Surface Conditions

The site is bordered by levees. The western boundary of the site consists of the RD 536 Levee, Solano County Levee 44, Mellin Levee Extension, and Mellin Levee. The eastern boundary of the site is formed by Solano County Levee 28, which is adjacent to Cache Slough and the Sacramento River.

Along the western boundary of Little Egbert Tract, the elevation of the RD 536 Levee crest ranges from 19 to 24.5 feet. The levee crest width is approximately 20 feet. The inclination of the landside slope is between 2H:1V and 3H:1V (horizontal to vertical) and the inclination of the waterside slope is between 2H:1V and 4H:1V. The elevations of the landside and waterside levee toes range from -3 to 10 feet and -3 to 15 feet, respectively. From Stations 4+00 to 40+00, a relatively level bench, approximately 100 feet wide and 7 feet tall, is located near the landside levee toe. A ditch, approximately 40 feet wide and 4 to 8 feet deep, runs along the landside of the levee approximately 80 feet from the landside levee toe.

Watson Hollow is a man-made channel which enters the site on the west side of Little Egbert Tract between the RD 536 Levee and Solano County Levee 44. The channel flows south along the waterside toe of Solano County Levee 44 for approximately 3,000 feet before turning eastward. The channel flows east and southeast and connects to Cache Slough through multiple culvert pipes that flow beneath Highway 84. Watson Hollow forms a gap between the RD 536 Levee and Solano County Levee 44.

Along the western boundary of Little Egbert Tract, the elevation of the Solano County Levee 44 crest ranges from 13 to 25 feet. The inclination of the landside slope is between 3H:1V and 7H:1V and the inclination of the waterside slope is between 3H:1V and 8H:1V. The levee crest width varies from 13 to 18 feet. Watson Hollow flows north-south along the waterside levee toe. An approximately 600-foot wide by 2,300-foot long by 15-foot-deep excavation is located near the landside levee toe.

The elevation of the Mellin Levee and Mellin Levee Extension crests range from 10.5 to 19 feet and 10 to 21 feet, respectively. The inclination of the landside slope is between 2H:1V and 8H:1V and the inclination of the waterside slope is between 2H:1V and 8H:1V for both levees. The levee crest width generally varies from 15 to 30 feet for both levees. A short segment of the Mellin Levee Extension, from approximately Stations 53+00 to 61+00, is narrower, with a crest width of less than 7 feet. The elevation of the waterside toe varies from approximately 5 to 10 feet. The elevation of the landside toe is irregular, as the land west of the levee has been extensively regraded while in use as a soil and rock stockpile and borrow site.

The elevation of the Solano County Levee 28 crest generally ranges from 10 to 15 feet. The levee crest width is generally about 20 feet, with occasional wide sections up to 55 feet wide. The inclination of the landside slope is between 4H:1V and 8H:1V. The elevation of the landside toe ranges from -7 to 11 feet. Starting at the south end of the site, State Route 84 runs northeast along the levee crest before terminating at a ferry which crosses Cache Slough. A home, referred to throughout this report as the Baldwin residence, is located on the levee crest near Station 79+50.

The interior of Little Egbert Tract contains relatively level fields at various elevations ranging from Elevation -8 feet to Elevation +10 feet. Generally, the fields in the south are higher in elevation than the fields in the north. The fields were likely leveled as part of mass grading operations to facilitate irrigation. Throughout the site, there are unpaved roads. Water levels in the proposed project area are currently managed using a series of man-made structures and pumps. A series of man-made channels and ditches traverse the site to supply and drain fields. The ditches vary in depth and are generally 3 to 4 feet in depth below the ground surface.

3.5 Subsurface Conditions

We have grouped the subsurface soils encountered at the proposed project site into five geologic units which include levee fill, hydraulic dredge fill, marsh deposits, flood basin deposits, and older alluvium. The units are described below. The subsurface conditions are represented graphically for the western levee alignments on the idealized subsurface profiles presented in Appendix A and the idealized subsurface cross sections shown in Appendix B. Our interpretations of the surface geology based on our exploration are presented on Plate 9. The main difference between Plate 9 and the Atwater Geologic Map on Plate 5 is the extent of the marsh soils on the southwestern part of the proposed project. Field and laboratory test results, including $(N_1)_{60}$ blow counts, pocket penetrometer and torvane readings, moisture content, unit weight, Atterberg Limits, and percent passing the Number 200 sieve, are summarized in Appendix D.

3.5.1 Soil Units

3.5.1.1 Levee Fill

Fill for the RD 536 Levee consists of high-plasticity fat clay. The fill is generally dry to moist and very stiff to hard.

Fill for the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44 mainly consists of sand with variable fines content, plasticity, and density. The type of fines within the sand ranged from silty to clayey. The density of the sand was generally medium dense to dense with occasional loose zones. Occasional clay layers are present within the fill for the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44. The clay fills are dry to moist, very stiff to hard, and range in plasticity from low to high.

Fill for Solano County Levee 28 consists primarily of high-plasticity fat clay, elastic silt, and organic soil. The fill was generally dry to moist and stiff to very stiff, however, some of the fill was soft to medium stiff near the bottom of the fill layer.

3.5.1.2 Hydraulic Dredge Fill

Hydraulic dredge fill is mapped by Atwater at the ground surface in the property on the landside of Solano County Levee 44 and the Mellin Levee Extension. The hydraulic dredge fill we encountered in test pits near Solano County Levee 44 and the Mellin Levee Extension consisted of poorly graded sand, silty sand, silt, lean clay, and fat clay. Generally, the fine-grained hydraulic dredge fills were dry to moist, medium stiff to stiff, and ranged in plasticity from low to high. The sand hydraulic dredge fills were dry to wet and loose, to medium dense. In some of the test pits, "clay balls" that ranged in size from gravel- to cobble-sized were observed within the silty sand. We did not observe a clear pattern of where the various soil types from the hydraulic dredge fill are located.

3.5.1.3 Marsh Deposits

Marsh deposits were encountered near the ground surface over most of the parcel interior and beneath the levee fill in Solano County Levee 28 and long stretches of the RD 536 Levee, Mellin Levee, and Mellin Levee Extension. The marsh deposits typically consist of peat, organic clay, and organic silt. Marsh deposit soils were deposited in tidal waters and are typically relatively weak and compressible. Near the ground surface, the marsh deposits are generally dry to moist and stiff to very stiff. Generally, the marsh deposits become wet and soft to medium stiff between 3 and 8 feet below the top of the marsh deposit layer.

3.5.1.4 Flood Basin Deposits

Flood basin deposits in our exploration locations closely resemble the marsh deposits described above. The flood basin deposits were deposited when large floods flowed through the Yolo Basin north of the proposed project site. The basin deposits typically consist of organic clay and organic silt with moderate to high plasticity. They are typically stiffer than the marsh deposits.

3.5.1.5 Older Alluvium

The older alluvium soils consist of sand, silt, and clay. Throughout most of the site, the older alluvium is buried below the marsh deposits and basin deposits. Near the southern end of Little Egbert Tract, the older alluvium is present at the ground surface. Fine-grained alluvium (clay and silt) was consistently encountered at the top of the older alluvium deposit and in layers at greater depths. In between the layers of fine-grained alluvium, sand alluvium was encountered.

The fine-grained older alluvium soils generally consist of low to medium plasticity lean clay, with occasional zones of lower plasticity silt or higher plasticity fat clay. The consistency of the fine-grained older alluvium typically ranges from stiff to very stiff, with occasional zones of medium-stiff soil.

The sand alluvium is generally wet, dense to very dense, and of variable fines content. Sieve analysis tests in the sand alluvium resulted in fines contents ranging from 4 to 49 percent. Generally, the fines content decreases with depth. The fines typically consist of silt. The deeper sand layers contain gravel.

3.5.2 RD 536 Levee

The subsurface conditions below the centerline of the RD 536 Levee are depicted in Appendix A on Plates A-2 through A-8. The levee fill ranges in thickness from approximately 13 to 27 feet.

From approximately Stations 0+00 to 100+00, the levee fill is underlain by marsh deposits which are described as organic clays and silts on Plates A-2 through A-8. The marsh deposits range in thickness from 7 to 20 feet. The marsh deposits are underlain by clay alluvium ranging in thickness from 7 to 21 feet. The bottom of the clay alluvium ranges from 16 to 40 feet below the landside levee toe. Sand alluvium underlies the clay alluvium and varies in thickness from 29 to 72 feet. The bottom of the sand alluvium ranges from 52 to 111 feet below the landside levee toe. Another layer of clay alluvium is located beneath the sand alluvium.

South of Station 100+00, the subsurface conditions are more variable. Marsh deposits are present beneath the levee between approximately Stations 120+00 and 130+00, 149+00 and 154+00, and 176+00 and 182+00. The thickness of marsh deposits ranges from 4 to 14 feet. Clay alluvium was typically encountered beneath the marsh deposits within these station ranges. Outside of these station ranges, clay alluvium was generally encountered at the ground surface. The thickness of clay alluvium ranges from 5 to 17 feet. The bottom of the clay alluvium ranges from 8 to 20 feet below the landside levee toe. Sand alluvium underlies the clay alluvium and ranges in thickness from 22 to 54 feet. The bottom of the sand alluvium ranges from 41 to 62 feet below the landside levee toe. The sand alluvium is underlain by clay alluvium.

3.5.3 Mellin Levee, Mellin Levee Extension, and Solano County Levee 44

The subsurface conditions below the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44 are depicted in Appendix A on Plates A-9 through A-13. The fill ranges in depth from approximately 6 to 11 feet, 5 to 13 feet, and 7 to 14 feet in the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44, respectively. The levee fill is underlain by marsh deposits between approximately Stations 13+00 to 37+00 and 49+00 to 53+00, which are up to 30 feet thick. Clay alluvium was typically encountered beneath the marsh deposits within these station ranges. Outside of these station ranges, clay alluvium was generally encountered at the ground surface. The thickness of clay alluvium ranges from 5 to 18 feet. The bottom of the clay alluvium ranges from 6 to 40 feet below the waterside levee toe of the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44. The clay alluvium is underlain by sand alluvium. The bottom of the sand alluvium ranges in depth from 24 to 94 feet below the levee waterside toe. The sand alluvium is underlain by another layer of clay alluvium to the maximum depth encountered in our borings and CPTs, up to 116 feet below the waterside levee toe.

The parcel west of Solano County Levee 44 between roughly Stations 70+00 and 93+13 has been altered by an active borrow operation. The ground has been lowered to about Elevation 0 feet. We anticipate that the large excavation near the landside levee toe in Solano County Levee 44 between approximately Stations 70+00 and 93+13 removed the clay alluvium at the ground surface on the landside of the levee. The width of the borrow operation extends roughly 600 feet west of the levee.

3.5.4 Solano County Levee 28

The subsurface conditions below Solano County Levee 28 generally consist of 3 to 23 feet of levee fill underlain by marsh deposits. Between Stations 0+00 and 65+00, the marsh deposits are of varying thickness from less than 4 feet thick to about 30 feet thick. The areas with thicker marsh deposits tend to align with the areas mapped by Atwater (1982) as within the margins of tidal wetland at low river stages circa 1850. The marsh deposits are underlain by older alluvium with relatively variable sand, silt, and clay.

North of approximately Station 65+00, the marsh deposits increase in thickness and range from 15 to 40 feet thick. The marsh deposits are typically underlain by older alluvium consisting of clay and silt to the maximum depth explored.

3.5.5 Parcel Interior

The near-surface soil conditions are depicted on Plate 9. In the areas denoted with marsh deposits and flood basin deposits within Little Egbert Tract, high plasticity and often organic-rich soil was encountered near the ground surface. The thickness of the marsh deposits generally increases from approximately 10 to 15 feet on the west side of the parcel interior to 35 to 40 feet near the east side. The marsh deposits are generally underlain by older alluvium that consists predominantly of clay and silt. The older alluvium is at least 10 feet thick. The clay alluvium is underlain by dense sand alluvium.

At the southern end of Little Egbert Tract, older alluvium is present near the ground surface along an approximately 2,500-foot-wide ridge. Marsh soils were largely absent along this ridge.

3.5.6 Levee Fill Borrow Area

Portions of the parcel interior near the south end of Little Egbert Tract and near the waterside toe of the Mellin Levee Extension had little to no marsh deposit soils at the ground surface. Older alluvium was present at the ground surface and continued to the maximum depth explored. The area of the parcel interior with minimal marsh deposits will be referred to throughout the remainder of this report as the Levee Fill Borrow Area because this area contains soils at relatively shallow depths which meet USACE requirements for levee fill. The USACE requirements are discussed in the Discussion and Conclusions section of this report. The location of the Levee Fill Borrow Area is divided into three zones, which are mapped on Plates C-1 through C-4 in Appendix C.

The soil in the Levee Fill Borrow Area generally consists of fat clay, underlain by lean clay, underlain by sand. The top layer of the older alluvium was generally high plasticity fat clay which was dry to moist and stiff to very stiff. The top layer typically ranged in thickness from 1 to 3 feet, with some test pits containing about 8 feet of surface fat clay and others containing no fat clay. The depth to the bottom of the fat clay is indicated at various exploration locations next to the exploration number on Plates C-1 through C-4 as the first number in parenthesis. The liquid limits of the fat clay soils ranged from 50 to 58 and the plasticity indices ranged from 30 to 41.

The second layer of the older alluvium was generally moist, medium stiff to very stiff, low to medium plasticity lean clay and silt. Generally, the lean clay soils were encountered below the fat clay soils described above, but in some locations, the lean clay soils were encountered at the ground surface. The lean clay soils typically ranged in thickness from 5 to 8 feet. Not all test pits encountered the bottom of the lean clay soils while others encountered no lean clay. The depth to the bottom of the lean clay is indicated on Plates C-1 through C-4 at various locations by the second number in parenthesis. The thickness of lean clay can be calculated by subtracting the first number in parenthesis from the second. The liquid limits of the lean clay soils ranged from 32 to 47 and the plasticity indices ranged from 12 to 33.

The third layer of the older alluvium was generally moist, medium dense poorly graded sand with silt and silty sand or stiff to very stiff non-plastic silt. The fines content in the sands tested within this layer ranged from 8 to 41 percent.

3.6 Groundwater

Groundwater measurements were obtained during exploration for some of the borings and test pits. Most of the borings were drilled using rotary wash methods that obscured the groundwater level. Groundwater measurements from the borings and test pits are listed in Exhibit 3-1 below. The borings and test pits were backfilled immediately after drilling and stabilized water levels were not obtained.

Boring or Test Pit #	Depth to Groundwater Table (GWT) (ft)	Surface Elevation (ft)	GWT Elevation (ft)	Date
18TP-1	4.2	-5.5	-9.7	11/13/2018
18TP-2	4	-8	-12	11/13/2018
18TP-3	4	-6	-10	11/13/2018
18TP-4	4	-6	-10	11/13/2018
18TP-6	3.5	-0.5	-4	11/13/2018
18TP-7	3.8	-6	-9.8	11/13/2018
18TP-8	6	-5	-11	11/13/2018

Boring or Test Pit #	Depth to Groundwater Table (GWT) (ft)	Surface Elevation (ft)	GWT Elevation (ft)	Date
18TP-9	4	-4	-8	11/14/2018
18TP-10	5	-3	-8	11/14/2018
18TP-11	4.5	-4	-8.5	11/14/2018
18TP-12	5.5	-3	-8.5	11/14/2018
18TP-13	4	-5	-9	11/14/2018
18TP-14	5	-5.5	-10.5	11/14/2018
18TP-15	4	-6	-10	11/14/2018
19TP-16	4	2.5	-1.5	11/14/2018
19TP-17	7	3.5	-3.5	7/11/2019
19TP-20	9	9.5	0.5	7/11/2019
19TP-22	6.5	5.8	-0.7	7/11/2019
19TP-23	5	-0.2	-5.2	7/11/2019
19TP-24	7.5	5.7	-1.8	7/12/2019
19TP-25	7	7.5	0.5	7/12/2019
19TP-26	7	6.6	-0.4	7/12/2019
19TP-27	10	6.8	-3.2	7/12/2019
19TP-28	6	6.3	0.3	7/12/2019
19TP-29	5	5.7	0.7	7/12/2019
19TP-31	7	6.5	-0.5	7/12/2019
19B-1	8	3	-5	5/8/2019
19B-2	11	3	-8	5/9/2019
19B-3	5	0	-5	5/9/2019
21TP-1	11	4	-7	10/12/2021
21TP-2	10	5	-5	10/12/2021
21TP-4	8	6	-2	10/12/2021
21TP-7	10	7.5	-2.5	10/12/2021
21TP-8	6.5	6	-0.5	10/12/2021
21TP-9	11	6	-5	10/12/2021
21TP-10	9	10	1	10/12/2021
21TP-11	9	8	-1	10/13/2021
21TP-12	11	-5	-16	10/13/2021
21TP-13	4	-1	-5	10/13/2021
21TP-14	9	8	-1	10/13/2021
21TP-16	8	5	-3	10/13/2021

Boring or Test Pit #	Depth to Groundwater Table (GWT) (ft)	Surface Elevation (ft)	GWT Elevation (ft)	Date
21TP-18	8	4	-4	10/13/2021
21TP-19	6	5	-1	10/13/2021
21TP-20	11	4	-7	10/13/2021
21TP-21	9	7	-2	10/13/2021
21TP-22	11	6	-5	10/13/2021
21TP-23	5	-0.2	-5.2	10/13/2021
21B-6	7.5	13	5.5	9/24/2021
21B-7	10.2	3	-7.2	9/27/2021
21B-11	9	6	-3	10/1/2021
21B-12	12.5	-1	-13.5	10/4/2021
21B-19	21	23	2	10/14/2021
21B-20	24	22	-2	10/15/2021
22B-5	25	21	-4	6/3/2022
22B-9	15	10	-5	6/8/2022
22B-13	6	-4.5	-10.5	7/26/2022

Exhibit 3-1: Groundwater Elevations from Borings and Test Pits

Pore pressure dissipation tests were performed during select CPTs. Exhibit 3-2 below summarizes the interpreted groundwater levels from the pore pressure dissipation tests. The interpreted water levels are based on the assumption that hydrostatic water levels are present and that aquifers are unconfined.

CPT #	Interpreted Depth to GWT (ft)	Surface Elevation (ft)	GWT Elevation (ft)	Date
21C-1	1.4	-3	-4.4	10/04/2021
21C-2	0.5	-2	-2.5	10/04/2021
21C-3	4.9	1.5	-3.4	10/04/2021
21C-4	5.8	1.5	-4.3	10/05/2021
21C-5	7.6	4	-3.6	10/05/2021
21C-6	9.6	0	-9.6	10/05/2021
21C-8	8.5	12	3.5	10/06/2021
21C-9	5.9	7	1.1	10/06/2021
21C-10	3.7	-1.5	-5.2	10/07/2021

CPT #	Interpreted Depth to GWT (ft)	Surface Elevation (ft)	GWT Elevation (ft)	Date
21C-11	3.2	-2	-5.2	10/07/2021
21C-12	5.9	-0.5	-6.4	10/07/2021
21C-13	2.8	0.5	-2.3	10/07/2021
21C-15	8	5	-3	10/08/2021
21C-16	3.5	4	0.5	10/08/2021
21C-17	12.7	8.5	-4.2	10/08/2021
21C-18	0.8	-6	-6.8	10/11/2021
21C-19	2.9	-2	-4.9	10/11/2021
21C-20	1.4	-3	-4.4	10/11/2021
21C-21	0.3	-6	-6.3	10/11/2021
21C-22	0.8	5	-5.8	10/11/2021
21C-23	11.3	8	-3.3	10/11/2021
22C-1	26.2	22	-4.2	05/16/2022
22C-2	25.1	20.5	-4.6	05/16/2022
22C-3	27.7	21	--6.7	05/16/2022
22C-4	27.8	24	-3.8	05/17/2022
22C-5	27.2	22	-5.2	05/17/2022
22C-6	28.4	23	-5.4	05/17/2022
22C-7	27.9	22	-5.9	05/17/2022
22C-8	29	24	-5	05/18/2022
22C-9	28.5	23	-5.5	05/18/2022
22C-10	27.1	21	-6.1	05/18/2022
22C-11	25.7	21.5	-4.2	05/18/2022
22C-12	25.6	21	-4.6	05/19/2022
22C-13	8.7	6	-2.7	05/19/2022
22C-14	9.4	7	-2.4	05/19/2022
22C-15	8.3	4.5	-3.8	05/20/2022
22C-16	2.8	-2	-4.8	05/20/2022
22C-17	1.9	-3	-4.9	05/20/2022
22C-18	17.1	15	-2.1	05/23/2022
22C-19	16.9	14.5	-2.4	05/23/2022
22C-20	18.3	15	-3.3	05/23/2022
22C-21	19.2	18	-1.2	08/17/2022
22C-22	15.2	15	-0.2	08/17/2022

CPT #	Interpreted Depth to GWT (ft)	Surface Elevation (ft)	GWT Elevation (ft)	Date
22C-23	13.3	15	1.7	08/17/2022
22C-24	8.7	10	1.3	08/17/2022
22C-25	12.1	14.5	2.4	08/18/2022
22C-26	5.2	6	0.8	08/18/2022

Exhibit 3-2: CPT Groundwater Elevation Interpretations

Westervelt Ecological Services installed 16 piezometers to measure groundwater levels in the parcel interior and 8 data loggers in ditches on-site and sloughs adjacent to the property to measure surface water levels. The instrumentation was installed in January and February of 2020. The data from the piezometers and surface water level loggers are presented in Appendix H.

The above descriptions of soil and groundwater conditions summarize observations at the time of the investigations. Conditions are expected to vary across the site, with time, and depend on several factors including changes in moisture content resulting from seasonal precipitation and land use changes.

4 BASIS OF DESIGN

The following basis of design is specific to the RD 536 Levee, Mellin Levee, Mellin Levee Extension, and Solano County Levee 44. The levees will be designed to meet current USACE and CVFPB guidelines. The design standards and criteria are described below.

4.1 Design Documents

The USACE has a number of documents that pertain to design and analysis of levees. The main documents used for our analysis include but are not limited to:

- Guidance Document for Geotechnical Analyses (DWR, 2015)
- EM 1110-2-1913 Design and Construction of Levees (USACE, 2000).

The Guidance Document for Geotechnical Analyses (Guidance Document (2015)) differentiates levees between intermittently-loaded and frequently-loaded. Frequently-loaded levees are defined as levees that experience a water surface elevation of 1 foot or higher above the elevation of the landside levee toe at least once per day for more than 36 days per year on average. We assumed for this study that after the proposed project is constructed, the levees will meet the frequently-loaded definition.

4.2 Freeboard

The design standard is 6 feet of freeboard above the design water surface elevation (DWSE). The standard is consistent with levees within the Yolo Bypass.

In addition, the levee standard includes 1 foot of additional levee height to account for uncertainty related to sea level rise and climate change.

The minimum height of the levee crest is 7 feet above the DWSE.

4.3 Settlement Allowance

To account for settlement of the levee, an allowance has been included in the levee. The allowance ranges from 0.5 feet to 2.0 feet. The allowance will be height in addition to the 7 feet of freeboard.

The levees were designed with a settlement allowance (overbuild) which varied by station according to Exhibit 4-1 and 4-2 below. The settlement allowance was based on preliminary settlement analysis which analyzed a range of fill thicknesses, compressible layer thicknesses, and organic soil compressiblities.

Levee	Station	Settlement Allowance (feet)
RD 536 Levee	35+00	2
RD 536 Levee	65+00	1
RD 536 Levee	95+00	1
RD 536 Levee	135+00	0.5
RD 536 Levee	175+00	0.5

Exhibit 4-1: Settlement Allowance for RD 536 Levee

Levee	Station	Settlement Allowance (feet)
Mellin Levee	6+00	0.5
Mellin Levee	21+00	2
Mellin Levee Extension	41+00	0.5
Solano County Levee 44	66+00	1
Solano County Levee 44	83+00	0.5

Exhibit 4-2: Settlement Allowance for Mellin Levee, Mellin Levee Extension, and Solano County Levee 44

4.4 Analysis Criteria

4.4.1 Seepage

The primary analysis criteria for underseepage is the average vertical gradient across a landside blanket (surface clay layer) where a blanket exists. The average vertical gradient is the total head drop across the blanket in the vertical direction divided by the thickness of the blanket. The average vertical gradient criteria published in the Guidance Document (2015) and used for this study is presented in Exhibit 4-3.

Location on Levee	Water Surface Elevation	Maximum Average Vertical Gradient
Landside Toe	DWSE	0.5
150 feet from Landside Toe*	DWSE	0.8
Landside Toe	HTOL	0.6
150 feet from Landside Toe*	HTOL	0.9

* For locations between the landside toe and 150 feet from the landside toe, use linear interpolation to determine maximum average vertical gradient criteria.

Exhibit 4-3: Average Exit Gradient Criteria

4.4.2 Slope Stability

The Guidance Document (2015) provides minimum factors of safety for different loading conditions on the land- and waterside levee slopes. The minimum factors of safety for frequently-loaded levees used for this study are presented in Exhibit 4-4.

Loading Condition	Levee Slope	Water Surface Elevation	Minimum Factor of Safety
Steady State Seepage	Landside	DWSE	1.5
	Landside	HTOL	1.3
	Waterside	Mean Tide Level (MTL)	1.5
Rapid Drawdown	Waterside	DWSE	1.2
End-of-Construction	Landside and Waterside	5-feet below existing free-field ground surface*	1.3

* 5 feet below the existing free-field ground surface was selected as a reasonable estimate for the water level after levee construction and before the site is breached.

Exhibit 4-4: Allowable Factors of Safety for Slope Stability Analysis for Frequently Loaded Levees

4.4.3 Analysis Cross Sections

4.4.3.1 Analysis Cross Sections For Feasibility Level Design

We selected ten cross sections (five for RD 536, two for Mellin Levee, one for Mellin Levee Extension, and two for Solano County Levee 44) to represent the range of existing levee geometry and geologic conditions for the feasibility study. The stations we selected are presented in Exhibit 4-5. The idealized subsurface cross sections at each station are presented in Appendix B.

Levee	Station
RD 536 Levee	35+00
	65+00
	95+00
	135+00
	175+00
Mellin Levee	6+00
	21+00
Mellin Levee Extension	41+00
Solano County Levee 44	66+00
	83+00

Exhibit 4-5: Analysis Sections

4.4.3.2 Design Water Surface Elevations

The DWSE is defined in a technical memorandum prepared by MBK Engineers titled "Little Egbert Multi-Benefit Project – Flood Hydrology & Hydraulics Analysis" and dated April 7, 2022. The DWSE is different for the RD 536 Levee and the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44. The DWSE for the RD 536 Levee is the DWSE specified in the 1957 USACE "Levee and Channel Profiles, File Number 50-10-334" (1957 DWSE). For the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44, the DWSE is the 100-year flood level. MBK Engineers provided both the 1957 DWSE and the 100-year flood DWSE. Both are shown specifically on Plates 10 and 11.

We analyzed two water levels per analysis cross section, the DWSE and hydraulic top of levee (HTOL). The HTOL is defined as the lower of the actual top of levee and 3 feet above the DWSE.

The DWSE and HTOL elevations at each station are presented in Exhibit 4-6.

Design Section	Design Water Surface	DWSE (feet, NAVD 88)	HTOL (feet, NAVD 88)
RD 536 Levee– 35+00	1957 DWSE	18.6	21.6
RD 536 Levee– 65+00	1957 DWSE	18.4	21.4
RD 536 Levee– 95+00	1957 DWSE	18.0	21.0
RD 536 Levee– 135+00	1957 DWSE	17.6	20.6
RD 536 Levee– 175+00	1957 DWSE	17.1	20.1
Mellin Levee– 6+00	100-year flood	15.2	18.2*
Mellin Levee– 21+00	100-year flood	15.6*	18.6*
Mellin Levee Extension– 41+00	100-year flood	15.7	18.7*
Solano County Levee 44 – 66+00	100-year flood	16.2	19.2
Solano County Levee 44 – 83+00	100-year flood	16.4	19.4

*The existing levee is lower than this elevation. For runs modeling the existing conditions, the water surface was run at the top of the existing levee.

Exhibit 4-6: Water Surface Elevations for Analysis

4.4.3.3 Design Levee Geometry

The levee design geometry is a 20-foot-wide crest and 3H:1V slopes for new levee construction. For raising existing levees, the design geometry is 2.5H:1V landside slopes and 3H:1V waterside slopes.

4.4.4 Seismic

The Guidance Document (2015) includes criteria for analyzing the seismic vulnerability of levees. Levees must be evaluated for seismic deformation and liquefaction.

4.4.4.1 Liquefaction

We evaluated liquefaction consistent with the Guidance Document (2015). We used the computer program LiqSVs by GEOLOGISMIKI to perform an SPT-based liquefaction evaluation. We used a peak ground acceleration (PGA) of 0.23g and an earthquake magnitude of 6.57 based on the 200-year return period mapped for the proposed project site.

4.4.4.2 Seismic Deformation

The Guidance Document (2015) specifies that frequently-loaded levees meet the criteria for seismic deformation if the amount of total displacement is less than 3 feet, the amount of vertical displacement is less than 1 foot, and the amount of displacement would not cause significant damage to internal structures.

5 DISCUSSION AND CONCLUSIONS

5.1 General Geotechnical Considerations

The intent of this report is to support the feasibility level design and help develop feasibility level project cost estimates. The analysis for the proposed project is not sufficient to support design but we consider it appropriate for evaluating the feasibilitity of project elements related to geotechnical engineering. The considerations discussed in this section will be analyzed in greater detail in subsequent design phases. The proposed project has several geotechnical considerations which apply to mutliple facilities across the site. These considerations are discussed below.

5.1.1 Seepage

Breaching Solano County Levee 28 and allowing tidal water inundation will create a large body of water. Levees on the west side of the site (RD 536 Levee, Solano County Levee 44, Mellin Levee Extension, and Mellin Levee) will experience more frequent and sustained wetting than under current conditions.

Many of the remedial measures of the west levees are focussed on seepage concerns. The Mellin Levee, Mellin Levee Extension, and Solano County Levee 44 were constructed predominantly with poorly-compacted sand. Seepage through the sand is a high risk for the levees. We have concluded that the sand fill should be removed. Most of Solano County Levee 44 is adjacent to a soil borrow operation. The borrow operation has created a depression adjacent to the levee and has exposed the alluvial sand. For this reach (Station 62+00 to 93+13) we are recomending installation of a cutoff wall.

For the RD 536 Levee, underseepage is a concern where the older alluvium is located at shallow depths below the levee. Some of the reach from approximately Station 80+00 to Station 185+44 of the RD 536 Levee is underlain by this alluvium. Where the alluvium is present at shallow depths, the levee does not meet the underseepage criteria. For this reach (Station 80+00 to 185+44), we conclude that both seepage berms and cutoff walls are acceptable remedial measures.

A landside ditch is located typically between 100 to 150 feet from the landside levee toe of the RD 536 levee. The seepage gradients into the ditch are relatively high for existing conditions. The cutoff wall reduces the gradients to values that meet the criteria. For the seepage berm alternative, some modifications or relocation of the ditch may be needed.

A concern for the project is the potential for seepage water flowing toward neighboring properties. Raising the water level in the parcel interior may cause water to flow towards neighboring parcels. The amount of flow to adjoining parcels is difficult to quantify and will depend on several factors including subsurface conditions, distance to the parcels, existing water levels, and alternatives that are selected to improve levee safety.

We have not performed calculations to evaluate seepage impacts to neighboring parcels as part of our current report. The specific risks and mitigation measures should be considered in future phases of the project.

5.1.2 Erosion

Erosion can occur from a variety of factors. Levees and berms are subject to erosion from rainwater running down their slopes. Channels and breaches are subject to erosion from the flow of tidal water through the openings and around bends. Embankments and sills will be subject to erosion from overtopping when floods pass through the site. Wind generated waves are another cause of erosion. For the waterside face of levees and berms, waterside faces derived from clay will be moderately erodible. Erosion protection features, such as armoring, sacrificial fill, planting, and slope flattening may be needed to reduce the negative impacts of erosion. Depending on the method of erosion protection selected, maintenance may be required to restore areas which are damaged by erosion.

Wind generated waves can cause erosion from the repeated pounding of waves on embankment slopes. The magnitude of the erosion depends on the wave height and frequency. Wave height and frequency depend on water depth, wave fetch, wind direction, and wind velocity. Exposing the parcel interior to daily tidal inundation will subject levees and berms to frequent wind generated waves. The project interior is over one mile wide and four miles long, which will provide long fetch for waves to develop. Intermediate berms in the parcel interior could potentially shorten the wave fetch, provided they are designed to withstand wind generated waves themselves. Openings in the Solano County Levee 28 could increase the potential for wind generated waves that develop within the project interior to impact neighboring islands. The design of the erosion protection is not within our scope of work but we should review the design relative to levee reliability.

5.1.3 Seismic Considerations

The predominant seismic hazard for this site is strong ground shaking resulting from earthquakes. Structures for the proposed project should be designed to accommodate such ground shaking in accordance with existing codes. No known active faults pass through the site and we conclude that the risk of fault rupture is low. We can provide seismic design criteria for structures based on the California Building Code, Caltrans Acceleration Response Spectrum, or other tools once the locations of the structures are better established.

Soil liquefaction is a phenomenon in which a loose to medium dense saturated granular soil undergoes reduction of internal strength as a result of increased pore water pressure generated by shear strains within the soil mass. This behavior is most commonly induced by strong ground shaking associated with earthquakes. The alluvium soils are older deposits and generally dense to very dense. Both older deposits and dense deposits have low risk of liquefaction. The soil conditions at the site generally consist of materials that do not require an in-depth SPT- or CPT-based liquefaction triggering analysis according to the Guidance Document (2015). We plotted the blow counts from the borings (Appendix D). The blow counts indicate relatively dense materials. We do not expect that remedial measures will be needed related to soil liquefaction.

Another consideration for embankments is the seismic deformation of the slope due to earthquake loading. We analyzed seismic deformation of the levees using the simplified procedure presented in the Guidance Document (2015). We describe our analysis procedure in Appendix F. The Ky values range from 0.19 to 0.52. The results of our analysis indicate that the deformation of the levee is not expected to damage the levee.

5.2 West Levees (RD 536 Levee, Mellin Levee, Mellin Levee Extension, Solano County Levee 44)

The west levees were evaluated relative to the criteria previously noted. The levees require remediation to meet freeboard requirements and for through and underseepage. The recommend rehabilitation by station is presented in Exhibit 5-1, below. The rehabilitation scheme, by stationing, is presented graphically in Plate 17.

Levee	Station	Rehabilitation	Cutoff Tip Elevation, feet (NAVD 88)	Approximate Depth of Cutoff below Existing Grade, feet	Berm Width (feet)
RD 536 Levee	0+00 to 80+00	Levee Raising Only	NA	NA	NA
RD 536 Levee	80+00 to 185+44	Levee Raising and Cutoff/Berm	-65	90	80
Mellin Levee	0+00 to 32+78	Rebuild Levee	NA	NA	NA
Mellin Levee Extension	32+78 to 61+02	Rebuild Levee	NA	NA	NA
Solano County Levee 44	61+02 to 62+00	Rebuild Levee	NA	NA	NA
Solano County Levee 44	62+00 to 93+13	Rebuild Levee and Cutoff	-70	90 to 95	80

Exhibit 5-1: Recommended Rehabilitation by Station

Ditches excavated near the west levees reduce the thickness of clay on the waterside of the levees, making them more susceptible to underseepage. We conclude that ditches on the waterside of the levee, including Watson Hollow, should be filled with clay soils where they are located within 400 feet of the levee. The functionality of Watson Hollow can be maintained by rerouting the outlet of Watson Hollow to the parcel interior, which will be tidally connected to the delta when the project is constructed.

The levee geometries and layout described above do not include the planned habitat berms. The configuration of the habitat berms is being developed by others. We understand that the habitat berms are anticipated to be relatively flat slopes located near the lower half of the waterside of the levee. The habitat berms are expected to provide benefits for seepage and stability of the levees but are not included in the evaluation of levee performance.

5.2.1 Levee Rehabilitation – RD 536

The existing RD 536 Levee is composed of clay and will not require a complete rebuild. The RD 536 Levee has settled since it was originally constructed and will need to be raised to restore freeboard, meet the uncertainty criteria and allow for future settlement. Approximately 8,000 feet of levee rehabilitation will include levee raising only as the remedial measure. The remainder will need additional remedial measures to mitigate concerns with underseepage. A typical detail for the levee raising is presented on Plate 12. The configuration includes raising the levee with a 2.5H:1V landside slope and 3H:1V waterside slope. The intent is to raise the levee toward the waterside of the existing levee (toward Little Egbert Tract). The new fill should be benched into the existing fill. For simplicity, the benching into the levee is not shown. The remainder of the RD 536 Levee south of Station 80+00 to Watson Hollow requires a rehabilitation plan for underseepage.

Both a cutoff wall and seepage berm are technically feasible. The cutoff wall has the added benefit of reducing the potential for seepage developing into the landside fields relative to the seepage berm. A typical detail for cutoff walls in the RD 536 Levee is presented on Plate 14. A typical detail for seepage berms is presented on Plate 16.

5.2.2 Levee Rehabilitation – Mellin Levee, Mellin Extension, and Solano County Levee 44

The existing Mellin Levee, Mellin Levee Extension, and Solano County Levee 44 are constructed primarily with sand. The sand appears to be poorly compacted and poses risks for through seepage and seismic deformation. The rehabilitation plan for the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44 includes removing the existing fill, constructing new levees with fill obtained from onsite borrow sites, and installing a cutoff wall from Station 62+00 to Watson Hollow. A typical detail for the levee replacement is presented on Plate 13. The configuration includes replacing the existing sand fill with clay fill with 3H:1V landside and waterside slopes.

From Station 0+00 to Station 62+00, additional rehabilitation is not needed. From Station 62+00 to Station 93+13, a rehabilitation plan for underseepage is needed. Both cutoff wall and seepage berm are technically feasible. We conclude that the cutoff wall is the preferred solution. While a seepage berm can be designed to meet the underseepage levee design criteria, the adjacent ground is below the tide levels. We anticipate that water will flow into this area with the potential for sand boils developing, unless a cutoff wall is installed. We recommend the use of a cutoff wall for this reach. A typical detail for cutoff walls in Solano County Levee 44 is presented on Plate 15.

5.2.3 Levee Analysis

5.2.3.1 Seepage and Slope Stability

We performed analysis to evaluate seepage and slope stability through and below the levee. We analyzed ten (10) cross sections. A discussion of the analysis and the results are presented in Appendix E for seepage and Appendix F for slope stability.

5.2.3.1.1 Slope Stability

Our slope stability analysis indicates that the rehabilitation schemes outlined in this report will meet the criteria for slope stability. Portions of the levees are underlain by marsh deposits. Rapid loading on softer marsh deposits can overstress the soil and cause deformation of the marsh deposits and the levees. To reduce risk, it may be prudent to place fill in stages, with time between stages, to limit the stress to the ground and provide time for consolidation. The duration of each waiting period between stages will be developed during design. The waiting period will likely be about three months.

We anticipate that the construction period for the proposed project is long enough to allow for multiple stages of fill placement with a waiting period between stages, without impacting the overall project schedule.

5.2.3.1.2 Seepage

5.2.3.1.2.1 Underseepage

Our analysis indicates seepage below the levees is a significant concern when the alluvial material is located at shallow depths below the levee and where the adjacent borrow operation created a depression adjacent the levee. Two remediation methods to mitigate the risks of underseepage include constructing seepage berms or soil-bentonite cutoff walls. A cutoff wall is highly effective in reducing the volume of water flowing through and below the levee and reducing the water pressure at and beyond the landside toe. A seepage berm is effective within the limits of the berm at reducing the exit gradient but does not reduce the quantity of flow through and beneath the levee. Seepage berms may include drains. We analyzed berms that did not include drains and conclude that undrained berms are sufficient.

5.2.3.1.2.2 Cutoff Wall

The cutoff wall will extend to the cutoff tip elevations provided in Exhibit 5-1. The cutoff wall should extend at least 5 feet into the clay layer located at depth. The tip elevations are our estimate of this depth. We have a limited number of exploration points and some variation in these depths are likely. A typical detail for a cutoff wall is presented on Plate 14 for the RD 536 Levee and on Plate 15 for Solano County Levee 44.

For the RD 536 Levee, the existing levee should be degraded to minimize the potential to hydraulically fracture the levee and to provide room to construct the cutoff. The wall should be at least 3 feet thick. The detail shows the wall capped with an 8-foot wide clay layer. The wall should be capped with compacted clay.

5.2.3.1.3 Seepage Berm

This alternative consists of an undrained berm placed at the base of the landside levee slope and extending beyond the levee toe. The intent is to provide resistance to underseepage uplift forces near the levee toe. Plate 16 shows a typical detail of the seepage berm alternative. The berm should extend 80 feet landward of the levee toe and should be at least 5 feet thick at the levee toe and at least 3 feet thick at the landward extent of the berm.

5.2.4 Levee Settlement

Fill is needed to raise existing levees, create habitat berms, and for other non-structural features. The marsh deposits will consolidate from the weight of new fills or structures, resulting in settlement of fills, levees, and structures placed over the marsh soils. We performed analysis to estimate settlement based on the theory of consolidation. Primary consolidation occurs from compression of the marsh soils, beginning when weight is placed on the soil. The initial weight is transferred to the water within the soil. The water builds up pressure, causing flow to occur. As the water flows out of the soil, the soil structure compresses and continues to compress until the water flow is complete and the water pressure returns to hydrostatic levels.

We performed settlement analysis using Terzaghi's theory of one-dimensional consolidation to estimate the magnitude of settlement due to the weight of new fill. We used the data observed from the borings, test pits, and CPTs to develop material properties. To estimate the magnitude of settlement, we used the parameters in Exhibit 5-2, below.

New Fill Unit Weight	125 pcf*
Existing Fill Unit Weight	95 pcf
Marsh Soils Unit Weight	95 pcf
Marsh Soils Compression Ratio, $C_c / (1+ e_0)$	0.25 to 0.45
Groundwater Elevation	-3 feet

*pcf is pounds per cubic foot

Exhibit 5-2: Soil Properties Used for Settlement Analyses

The settlement analysis assumes that the new levee will be overbuilt to accommodate settlement. The amount of settlement will depend on where the new fill is placed in relation to existing levees, the thickness of the new fill, and the thickness of the compressible soil layer.

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

For feasibility planning and cost estimating purposes, we have provided a recommended allowance for levee settlement by station in Exhibit 5-3. For planning, it should be assumed that the levee crest finished grade will be the required freeboard, plus the uncertainty allowance, plus the settlement allowance. During the design phase, we will perform additional analysis to support and refine the settlement allowances.

Levee	Station	Settlement Allowance (feet)
RD 536 Levee	0+00 to 50+00	2.0
RD 536 Levee	50+00 to 130+00	1.0
RD 536 Levee	130+00 to 185+44	0.5
Mellin Levee	0+00 to 12+00	0.5
Mellin Levee	12+00 to 28+00	2.0
Mellin Levee	28+00 to 32+78	0.5
Mellin Levee Extension	32+78 to 50+00	0.5
Mellin Levee Extension	50+00 to 61+02	1.0
Solano County Levee 44	61+02 to 70+00	1.0
Solano County Levee 44	70+00 to 93+13	0.5

Exhibit 5-3: Recommended Settlement Allowance by Station

5.3 Interior Grading

5.3.1 General Grading

The proposed project requires extensive cuts and fills to create the various marsh levels and channels within the parcels and to construct habitat berms. Interior channels should have side slopes that are 2H:1V or flatter. Much of the grading will create shallow, nonstructural berms and wetlands. Fill for habitat berms and other non-structural fills may consist of the marsh deposit, flood basin, and older alluvium soils.

Some of the material excavated from the site will be significantly wet of optimum moisture content depending on the depth of excavation. The excavated soil may require drying prior to placement, shaping, and compaction. Drying could occur at or near the borrow site or at the fill site during construction provided there is time allowed for drying between lifts of fill. A disk should be considered for use in breaking up and drying the wet materials.

The grading contractor should have experience with moving soft, saturated soils. The bottom of the channel excavations will likely be below the groundwater level. The contractor should be prepared to manage water that collects in the channel excavations and process wet soil.

Our experience with similar soils near the proposed project site indicates that even with disking, the soil could take multiple days or longer to dry before reaching a moisture content that will allow for compaction and placement of additional lifts. Drying time will depend heavily on tide, weather conditions during construction, and the talent and efficiency of the contractor. The soils will dry fastest in the summer months.

5.3.2 Levee Fill Materials

Levees and other structural fills require inorganic, low to moderate plasticity, fine-grained soils to function as designed. Organic marsh deposit soils are not suitable for structural fills. We evaluated areas within the site that might have material suitable for constructing levees. We identified three areas with suitable materials: two on the Little Egbert property and a third on the adjacent property. The locations of the site where suitable borrow materials for levees and other structural fills are present near the ground surface are depicted on the maps in Appendix C.

Levee fill for portions of the proposed project will be required to meet the requirements of the USACE and Central Valley Flood Protection Board (CVFPB). The USACE typically specifies that levee material should have a liquid limit less than 45, plasticity index between 8 and 40, and at least 30 percent fines (material passing the No. 200 sieve). The CVFPB typically requires that levee material should have a liquid limit less than 50, a plasticity index greater than 8, and at least 20 percent fines. The lean clay soils indicated within the depth ranges shown in parenthesis on the maps in Appendix C will generally meet USACE and CVFPB requirements.

Most of the area within the borrow zones will require some removal of surface soil to obtain the lean clay soil which meets USACE and CVFPB requirements. Stripped material that does not meet USACE and CVFPB requirements could be used for habitat berms, shoals, undrained seepage berms, and other non-structural fills for the proposed project.

Within the three zones depicted in red on Plates C-1 through C-4, we have identified preferred borrow limits which minimize the amount of surface soil stripping required above the lean clay. The approximate acreage of these preferred areas and estimated quantities of surface soil and lean clay are presented in Exhibit 5-4 below. The quantity estimates are rough and should be refined by others using existing survey data.

Zone	Limits of Preferred Borrow (acres)	Estimated Average Stripping Depth (feet)	Approximate Quantity of Stripping (cubic yards)	Estimated Average Thickness of Borrow Material (feet)	Approximate Quantity of Borrow Material (cubic yards)
1	81	1	100,000 to 150,000	5	600,000 to 700,000
2	24	3	100,000 to 150,000	8	250,000 to 350,000
3	42	2	100,000 to 150,000	5	300,000 to 400,000

Exhibit 5-4: Estimated Borrow Area Quantities

The depths and quantities shown in Exhibit 5-5 and Plates C-1 through C-4 are based on relatively widely spaced test pits. As the fill quantities and interior finish grade elevations become better defined, additional test pits and laboratory testing will help to more accurately define the limits and depths of interior borrow areas.

5.4 Solano County Levee 28

After the proposed project is constructed, Solano County Levee 28 will no longer function as a levee because tidal water will be present on both sides of the embankment. We understand that the proposed project plans to keep the embankment intact, with the exception of degrading select segments for the inlet and outlet sills and some possible smaller breaches. The embankment will function as a habitat area above the tidal range and also as a wave break to protect neighboring islands east of the proposed project from wind generated waves. Two concerns for the Solano County Levee 28 are erosion and settlement.

5.4.1 Erosion

The embankment will be subjected to erosion due to wind generated waves and overtopping in floods. The embankment slopes will require some form of erosion protection to withstand wind generated waves. Erosion protection measures could include a combination of armoring, sacrificial berms, and planting. The levee currently overtops during significant flood events. The project should consider raising the levees above the flood level to eliminate future overtopping during flood events and the maintenance associated with repairing the embankment after it overtops.

5.4.2 Settlement

Placement of fill on or adjacent to the Solano County Levee 28 embankment will cause settlement of the embankment due to consolidation of the marsh deposit soils beneath the embankment. The settlement should be considered when evaluating the elevation of the crest.

5.5 Inlet Sills and Outlet Sills

The inlet sills and outlet sills will be subjected to erosion from water flowing over and through the openings. We understand that the dimensions of the sills, including the width and bottom elevation may be required to remain fixed. To maintain the fixed dimensions of the sills, erosion protection such as pavement or armoring should be considered. The side slopes should be inclined at 2H:1V or flatter.

5.6 Watson Hollow

In the existing configuration, Watson Hollow flows through the gap between the RD 536 Levee and Solano County Levee 44. Watson Hollow currently provides drainage and water supply for parcels upstream of Little Egbert Tract. For many of the alternatives, the RD 536 Levee and Solano County Levee 44 will be connected by a new levee across Watson Hollow that closes the gap between the RD 536 Levee and Solano County Levee 44 and provides a continuous levee along the western side of the proposed project. A new water control structure will be needed to maintain the current functionality of Watson Hollow. The water control structure will serve a dual purpose or dual function. To maintain drainage flow through Watson Hollow, the new levee could include culverts with gate structures to allow the flow of water through the levee. The second function is to take water from Little Egbert Tract for irrigation. An intake, likely screened, will be needed to meet this function. The culverts and penetrations should be designed using USACE criteria. A typical detail for Controlled Low Strength Material (CLSM) backfill and drainage around the pipe penetrations is presented in Plate 18.

The base of the existing canal likely contains soft materials. Before placement of fill for the crossing, the soft material will need to be removed until a firm base is encountered.

5.7 State Route 84 Crossing

A bridge or culverts for State Route 84 will be required for the alternatives that include a tidal connection to Cache Slough near the current outlet of Watson Hollow into Cache Slough. The exact location and dimension of the crossing has not been developed.

We conclude that if a bridge is used, the bridge should be supported on deep foundations. Practical foundation types include driven prestressed, precast concrete piles; driven steel pipe piles; and drilled auger cast-in-place piles. For estimating purposes, the pile foundations should be assumed to be 60 feet long. We can provide estimates of axial and lateral capacity of the pile foundations during design.

If culverts are used, temporary cofferdams will need to be constructed on the Cache Slough side of the culvert to isolate the area and provide dewatering. Depending on the location and configuration of the culvert, a cofferdam may also need to be constructed on the project interior. The culvert should include vertical keyway structure(s) to provide lateral support for the culvert at both ends. It should be founded on a 24-inch thick layer of gravel soil to provide a firm base during construction.

5.8 Baldwin Residence

Additional levees will be required to protect the property around the Baldwin residence from flooding after the proposed project is converted to tidal conditions. The configuration of the levees around the Baldwin residence has not been established.

6 RECOMMENDATIONS

6.1 Levee Configuration

We recommend that the initial levee layout for the RD 536 Levee generally conform to the details shown on Plate 12. We recommend that the levee layout for the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44 generally conform to the details shown on Plate 13. All levee crests should be covered with 6-inches of aggregate base. We recommend that in addition to the typical details shown in Plates 12 and 13, cutoff walls or seepage berms should be added to the levees at the station ranges indicated in Plate 17 and Exhibit 5-1.

Cutoff walls should conform to the details shown on Plates 14 and 15. Cutoff walls should extend at least 5 feet into the clay layers below the sand and should be 3 feet wide. The cutoff wall material and construction method will be selected during design. The levee crest should be lowered before installing the cutoff wall for RD 536. For the Mellin Levee, Mellin Levee Extension, and Solano County Levee 44, the entire levee should be completely removed. After the levee is degraded, a clay cap should be installed (minimum 3 feet thick). The slurry trench should be constructed through the clay cap. After installation of the cutoff wall, the clay cap should be extended to above the flood level for the RD 536 levee. The clay cap should meet the requirements for levee fill stated below.

Seepage berms should conform to the details shown on Plate 16. The berm should be at least 5 feet thick at the levee toe and at least 3 feet thick at the landward extent of the berm.

6.2 Earthwork

6.2.1 Site Preparation

The footprint of fill areas, including levees and seepage berms, should be cleared and grubbed of surface and subsurface deleterious matter including trees, grasses, other vegetation and debris designated for removal. Levee and seepage berm footprints 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.

If loose or soft materials are encountered, they should be excavated to expose firm soil and placed in accordance with the recommendations presented below. Debris and deleterious material encountered during grading should be removed from the site.

A keyway should be placed below the center of new levees and should be constructed from levee fill meeting the requirements below. The keyway should be at least 3 feet deep and 10 feet wide at the base. The keyway slopes should extend up to the ground surface at 2H:1V or flatter.

For planning, we recommend assuming a shrinkage factor of 15 percent.

6.2.2 Fill Material

Levees should be constructed of materials with low permeability and moderate plasticity. The levee fill material should have at least 30 percent fines passing the No. 200 sieve and 100 percent passing the 2-inch sieve. The plasticity index of the fill should be between 8 and 40 and have a maximum liquid limit of 45. Fill meeting the above criteria may be obtained from the borrow areas shown in Appendix C. Removal of surface soil may be required to obtain fill meeting the criteria above.

The gradation for filter material for culverts will be specified in the next design phase after additional subsurface data is collected.

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

Controlled Low-Strength Material (CLSM) should conform to Section 19-3.02G of the Caltrans 2015 Standard Specifications. The 28-day compressive strength should be in the range of 50 to 100 psi.

6.2.3 Compaction

Surfaces within the footprint of the levees and berms should be scarified to a depth of at least 8-inches. The scarified soil should be moisture conditioned to at least optimum moisture content and compacted to at least 90 percent relative compaction. ASTM test method D-1557 should be used to establish the reference values for computing optimum moisture content and relative compaction.

Fill should be placed in lifts 8-inches or less in loose thickness and moisture conditioned to at least optimum moisture content. Moisture conditioning should be performed prior to compaction. Each lift should be methodically compacted to at least 90 percent relative compaction. 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. At connections with adjoining slopes, the fill should be benched into the existing 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 areas where traffic is anticipated, including the levee crest and ramps, the upper 6-inches of subgrade should be compacted to at least 95 percent relative compaction and rolled to provide a smooth, firm-yielding surface. Subgrade soils should be proof-rolled prior to placing aggregate base. Soft or pumping areas should be aerated or excavated and recompacted.

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

6.2.4 Slopes

Fill slopes should be constructed fat and trimmed back to expose well-compacted fill. Finished slopes should be trackwalked perpendicular to the slope face with a bulldozer after completion. The slopes should be hydroseeded to promote vegetation. Vegetation should be limited to grasses or other vegetation that can be mowed or disked to allow inspection of the landside levee slope. Trees, bushes, and brush should not be allowed within the footprint of the levee slopes.

6.3 Levee Penetration

Gravity drainage culverts or pipe penetrating the new levee embankment should follow the backfill criteria presented in USACE EM 1110-2-1913. The backfill around the culverts should generally conform to the configuration shown on Plate 18. The culverts through the levee should be encased in CLSM to avoid the difficulty with placing bedding below the pipe and compacting soil around and above the pipe. The downstream third of the culvert should be surrounded by a layer of filter drainage material at least 18-inches thick. We can provide recommendations for the gradation of the filter drainage material during design.

6.4 Culverts

The culvert should be underlain by 24-inches of imported material. A fabric should be placed below the import. The import should consist of clean crushed ¾-inch aggregate placed over fabric. Cutoffs should be provided at both ends of the culvert. The cutoff should be at least 5 feet deep. Concrete cutoffs should be at least 2 feet wide.

The cutoff should be tied into the base of the culvert. A temporary cofferdam will likely be required. For planning purposes, sheet piles for the cofferdam should extend 50 feet below grade.

6.5 Bridge Foundations

If a bridge is used to span a channel crossing beneath State Route 84, the bridge should be supported by deep foundations. Steel pipe piles, prestressed concrete piles, and drilled auger-cast piles are practical foundations that have been installed for similar structures in the project region. In general, piles should be spaced at least 3 pile widths apart, center-to-center.

For steel pipe piles, we recommend a minimum pile width of 16-inches. For prestressed concrete piles, we recommend a minimum pile width of 14-inches. Vibration and noise issues should be considered for driven piles. For auger-cast piles, typical diameters are 16- to 24-inches, and the installers typically use “non-displacement” equipment that produces significant drilling spoils to be removed from the site. For estimating purposes, we recommend assuming the piles will be 60 feet long. We will provide axial and lateral capacities for the piles during design.

Corrosion protection measures should be provided for piles, especially steel pipe piles. For concrete piles, including prestressed concrete and auger cast piles, concrete mix design details should be specified by the designer to address corrosion.

7 REFERENCES

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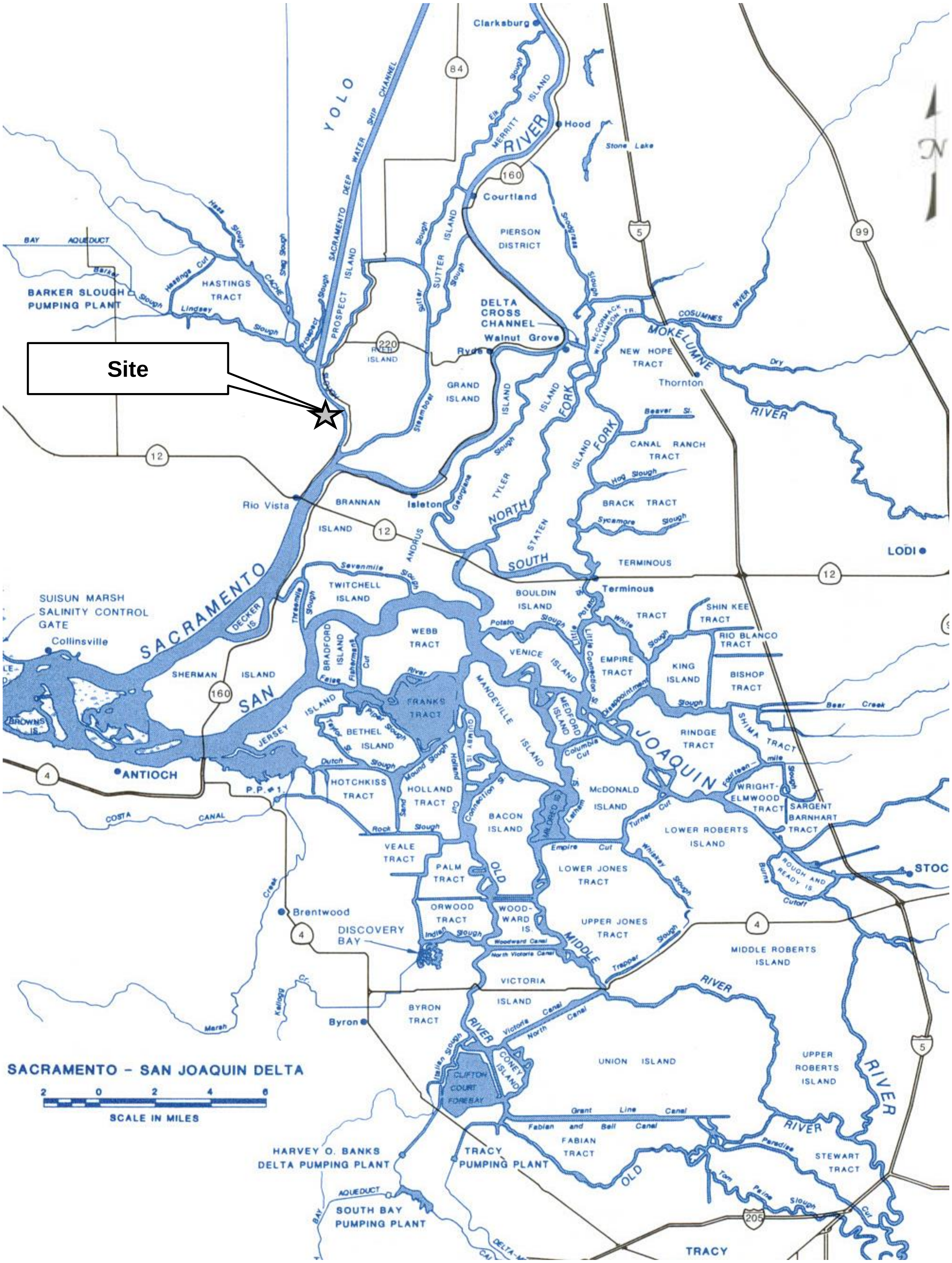


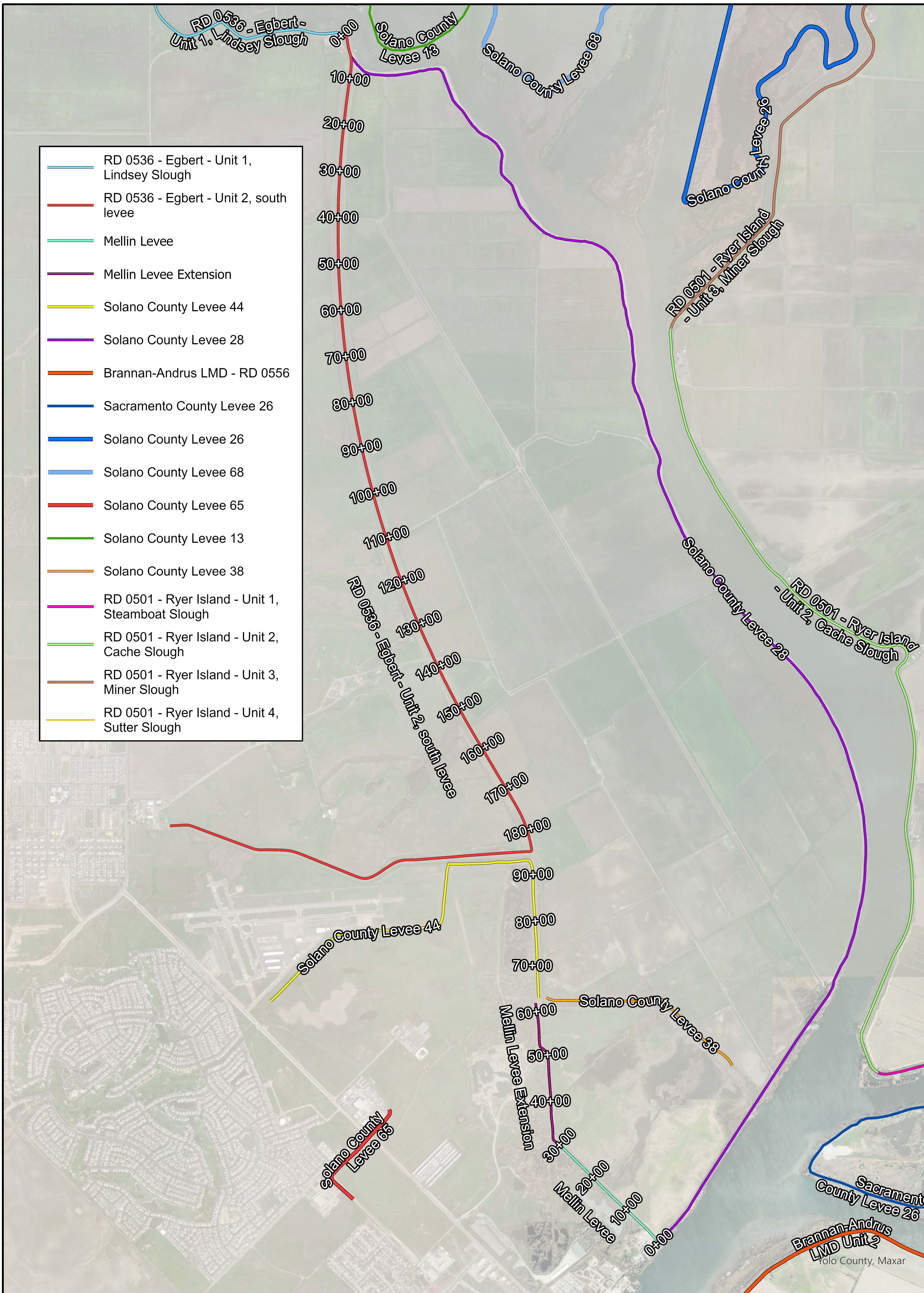
Source: Sacramento-San Joaquin Delta Atlas by Department of Water Resources (1995)

Little Egbert Multi-Benefit Project
Solano County, California

Vicinity Map

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 1

Little Egbert Multi-Benefit Project Solano County, California	**Site Plan**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 2



0 2,000 Feet

1 inch = 2,000 feet

Little Egbert Multi-Benefit Project
Solano County, California

National Levee Database Map

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. 3

##B-## Approximate Location of Boring

##P-## Approximate Location of Test Pits

##C-## Approximate Location of CPT

Approximate Location of Boring by others

Approximate Location of Test Pit by others

Approximate Location of CPT by others

Approximate Location of RD 536 Levee Centerline

Approximate Location of Solano County Levee 28 Centerline

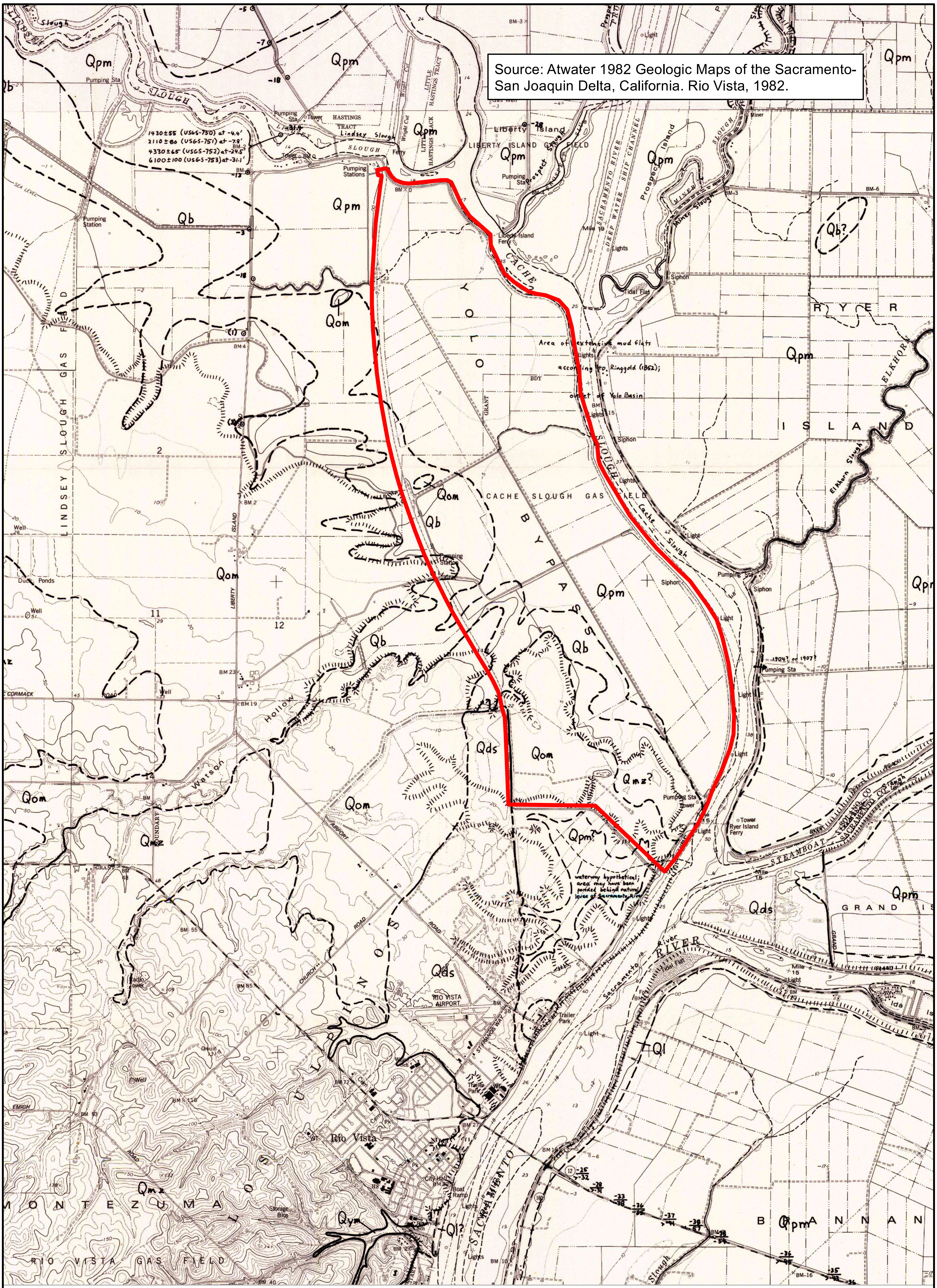
Approximate Location of Mellin Levee, Mellin Levee Extension, Solano County Levee 44 Centerline

N

0 1,000 feet

1 inch = 1,000 feet

Little Egbert Multi-Benefit Project Solano County, California	Exploration Location Map	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 4



"""" - Approximate Landward Margin of Tidal Wetland at Low River Stages circa 1850

Project Boundary

Qds - Hydraulic-Dredge Soils

Qpm - Peat & Mud

Qmz - Montezuma Formation

Ql - Natural-levee deposits

Qym - Younger Alluvium of Montezuma Hills

Qom - Older Alluvium of Montezuma Hills

Qb - Flood-basin deposits

N

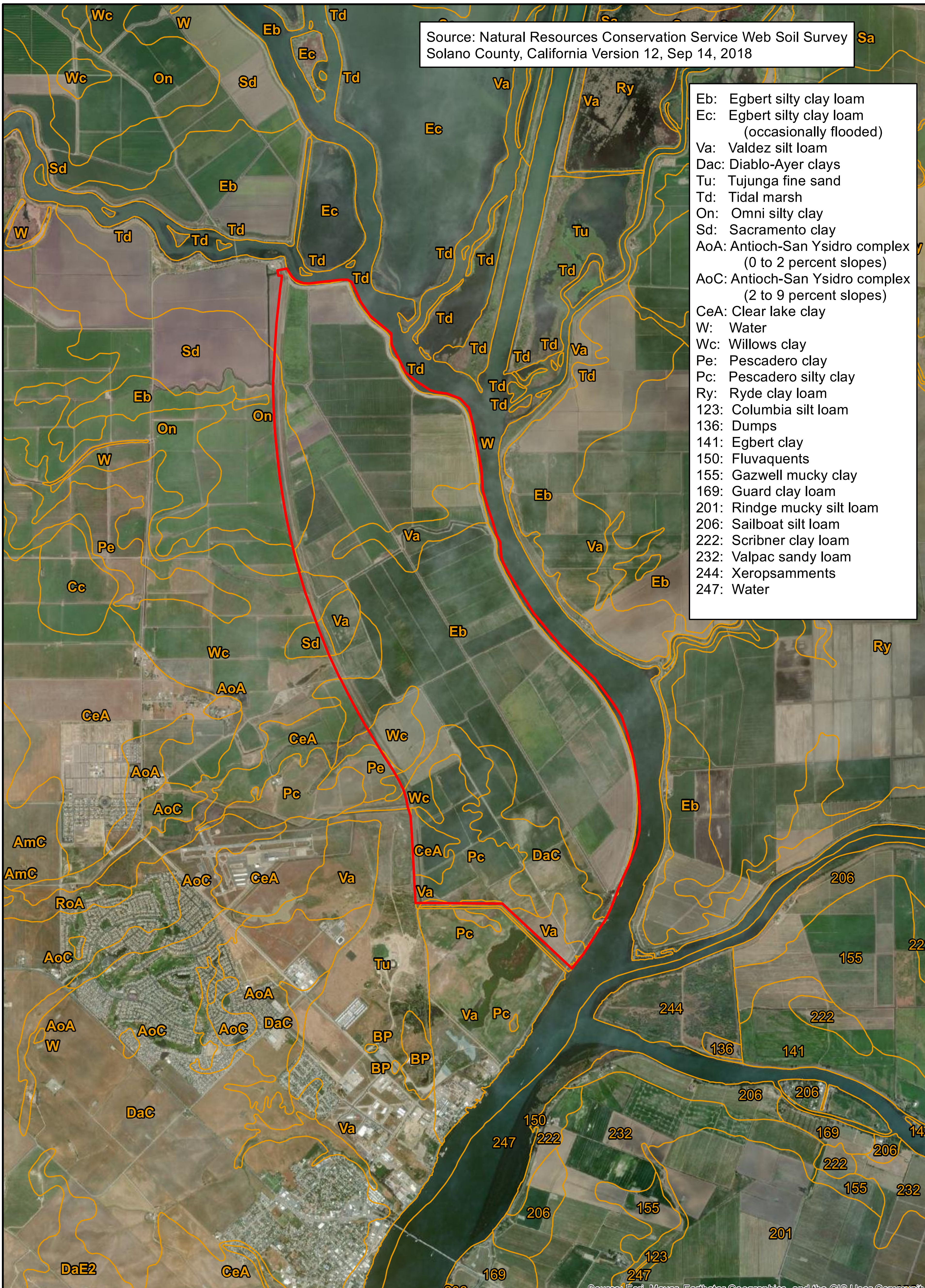
0 3,000 Feet

1 inch = 3,000 feet

Little Egbert Multi-Benefit Project
Solano County, California

Atwater Geology Map

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. 5



Project Boundary

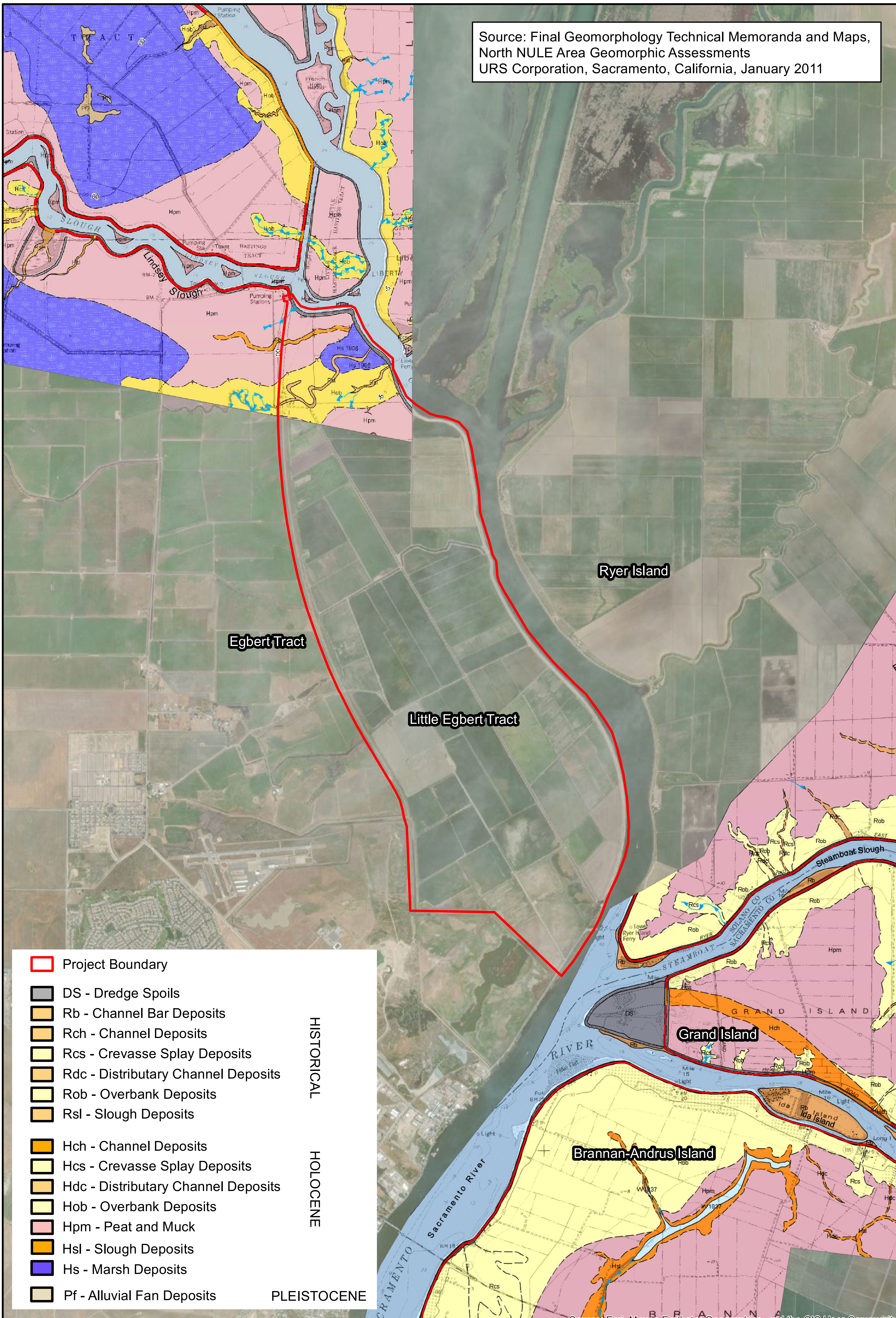
N

0 3,000 feet
1 inch = 3,000 feet

Little Egbert Multi-Benefit Project
Solano County, California

Soil Conservation Map

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. 6



N

0 3,000 feet

1 inch = 3,000 feet

Little Egbert Multi-Benefit Project
Solano County, California

NULE Geomorphology Map

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 7

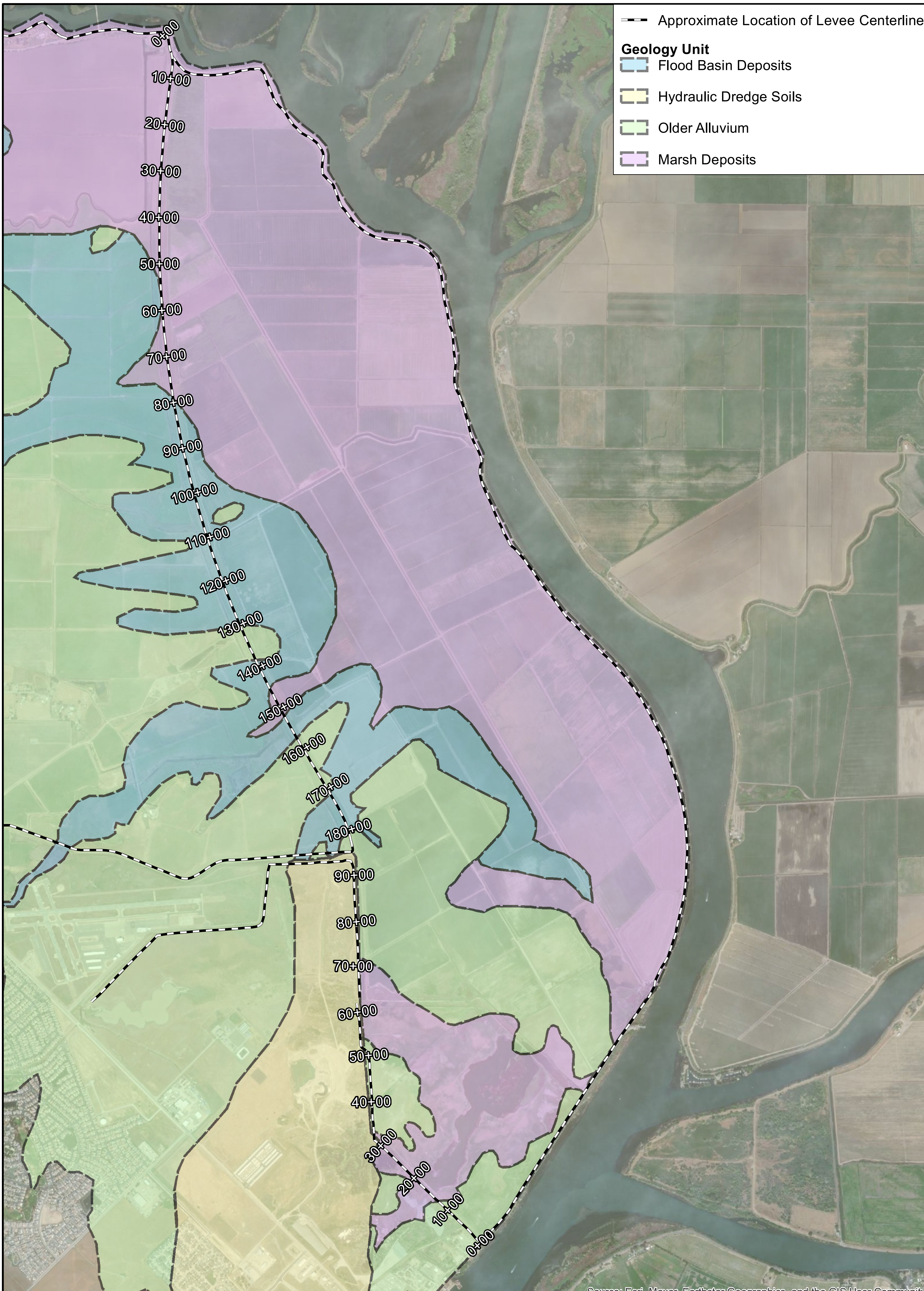
0 2,000 Feet

1 inch = 2,000 feet

Little Egbert Multi-Benefit Project
Solano County, California

Seepage Location Map

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 8



0 2,000 Feet

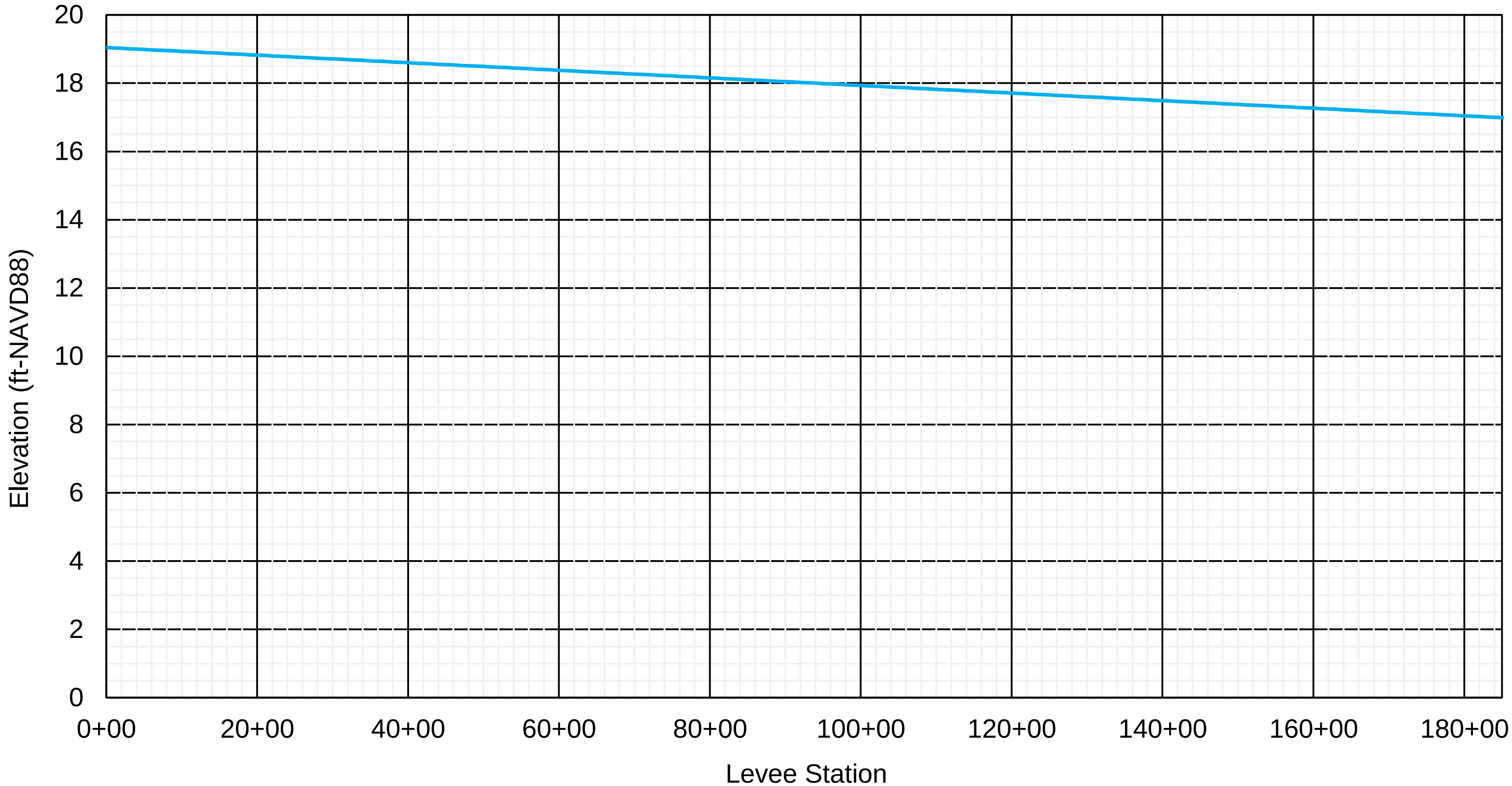
1 inch = 2,000 feet

Little Egbert Multi-Benefit Project
Solano County, California

Preliminary Site Geology

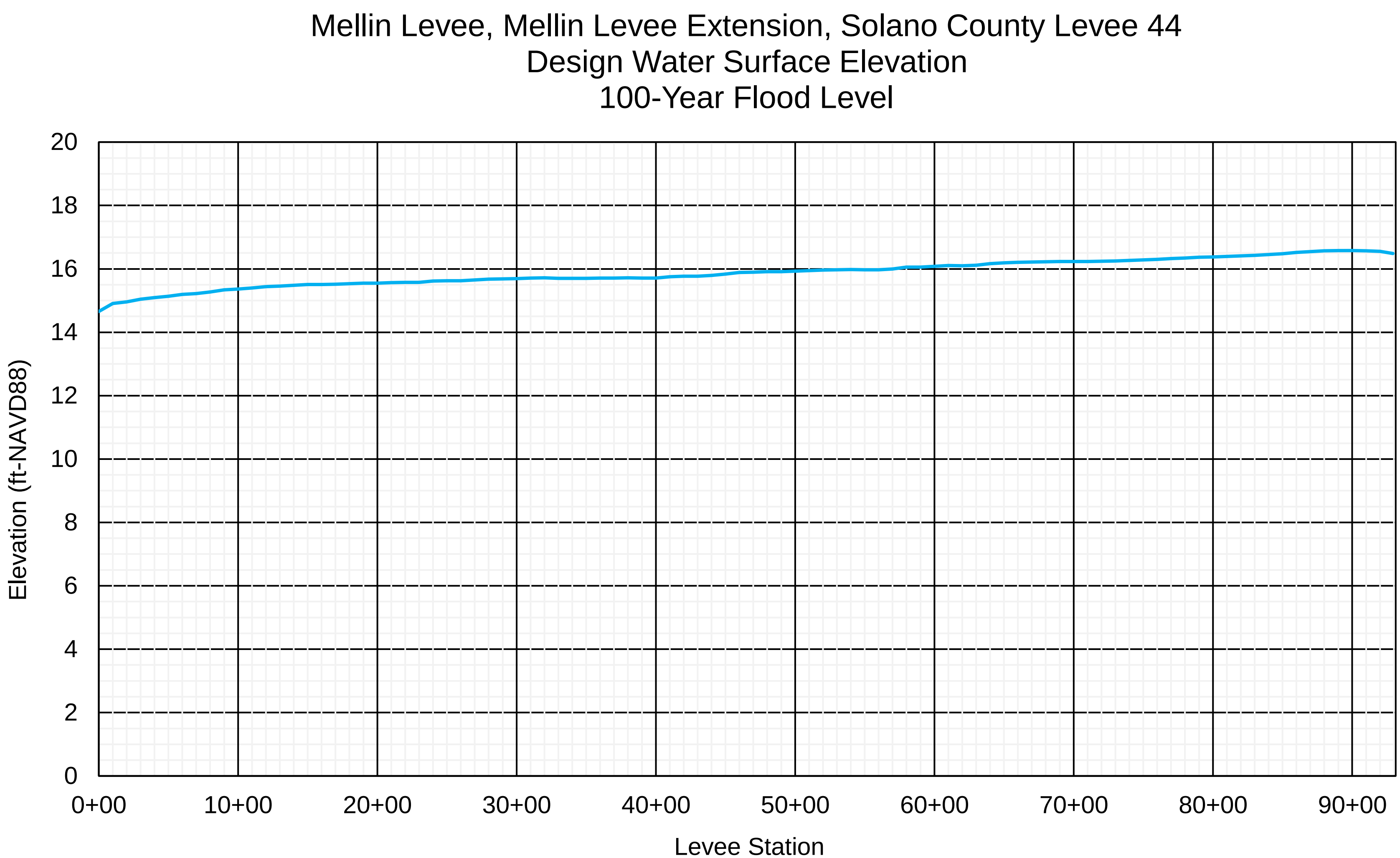
Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. 9

RD536 Unit 2 - Yolo Bypass
Design Water Surface Elevation
1957 Flood Level



Source: MBK Engineers

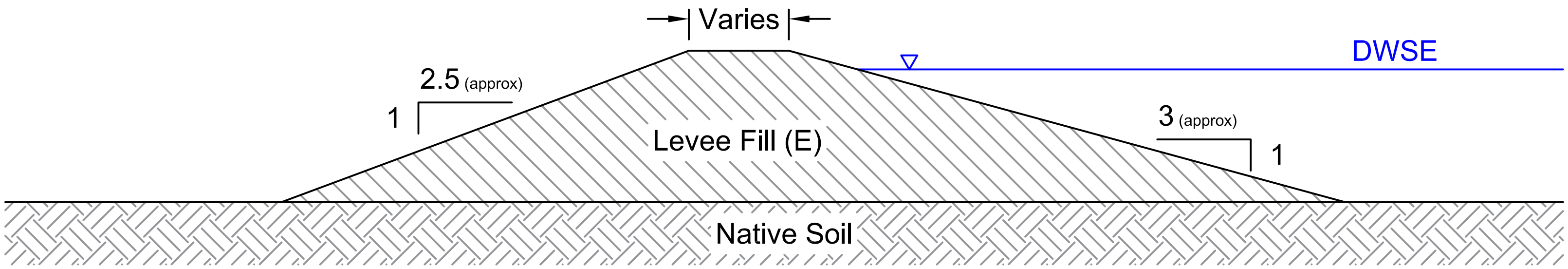
Little Egbert Multi-Benefit Project Solano County, California	**Design Water Surface Elevation Profile RD 536 Levee**	
Hultgren - Tillis Engineers	Project No. 907.03	Plate No. 10



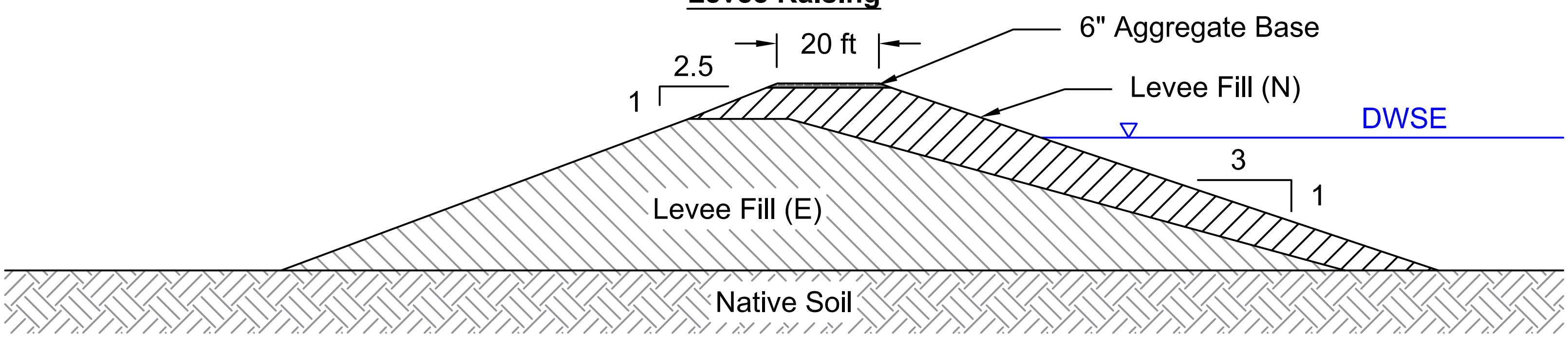
Source: MBK Engineers

Little Egbert Multi-Benefit Project Solano County, California	**Design Water Surface Elevation Profile** **Mellin Levees**	
Hultgren - Tillis Engineers	Project No. 907.03	Plate No. 11

Existing Levee



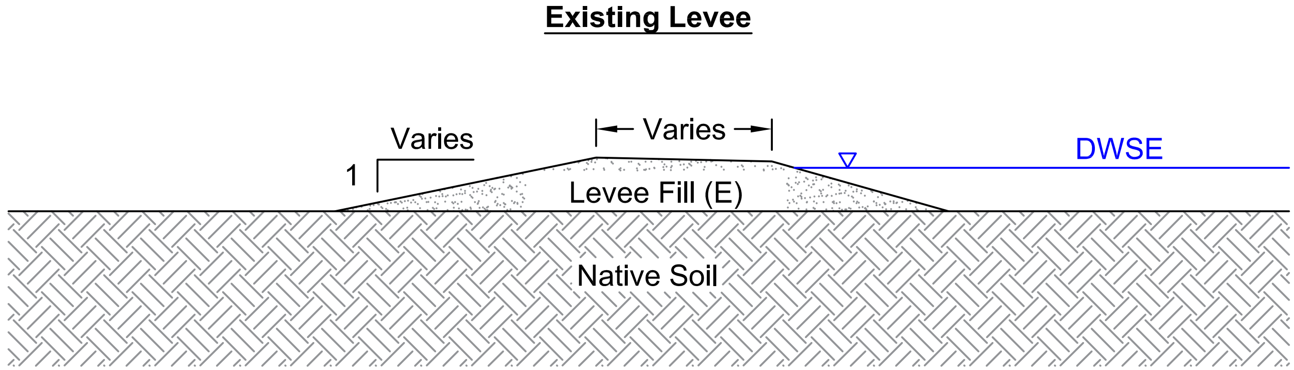
Levee Raising

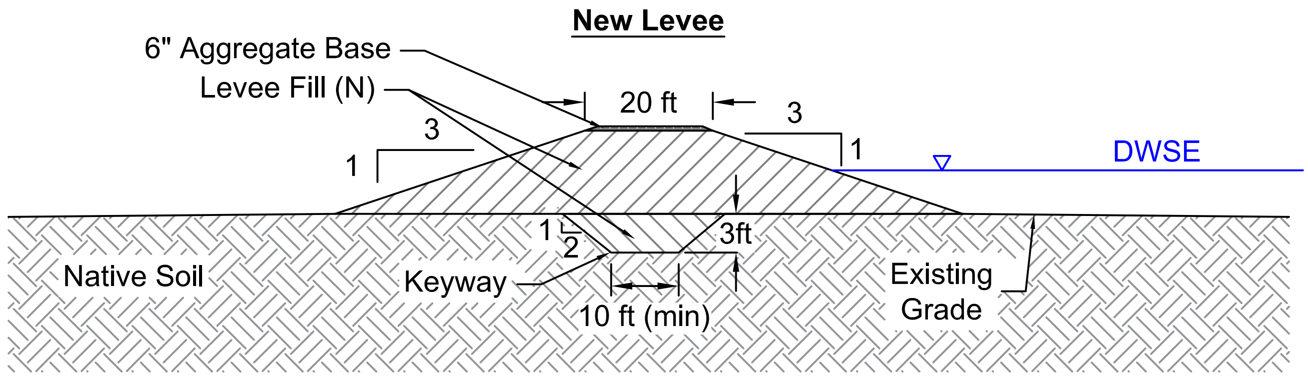


Notes:

1. Clear and grub vegetation prior to fill placement.
2. Fill should consist of levee fill from designated borrow areas.
3. The configuration shown above does not show the cutoff wall, seepage berms or habitat berms.
4. The new fill will be benched into the existing fill. Benching is not shown.

NOT TO SCALE	Little Egbert Multi-Benefit Project Solano County, California	**Typical Detail** **Levee Raising** **RD 536 Levee**
	Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. 12

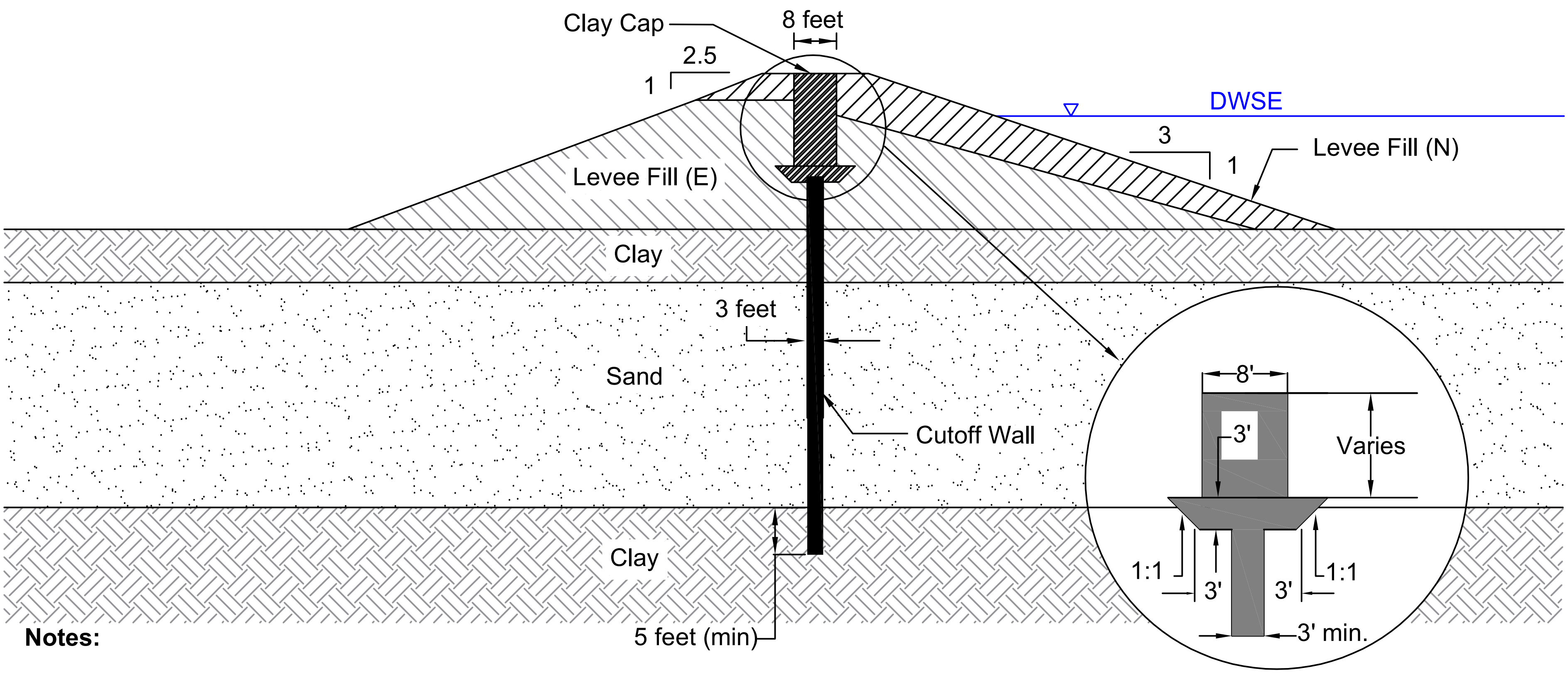




Notes:

1. Remove existing levee fill.
2. Excavate keyway at least 3 feet deep and 10 feet wide.
3. Fill should consist of levee fill from designated borrow areas.
4. The configuration shown above does not show cutoff wall, seepage berms, or habitat berms.

NOT TO SCALE	Little Egbert Multi-Benefit Project Solano County, California	**Typical Detail - Levee Reconstruction Mellin Levee, Mellin Levee Extension, Solano County Levee 44**	
	Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 13

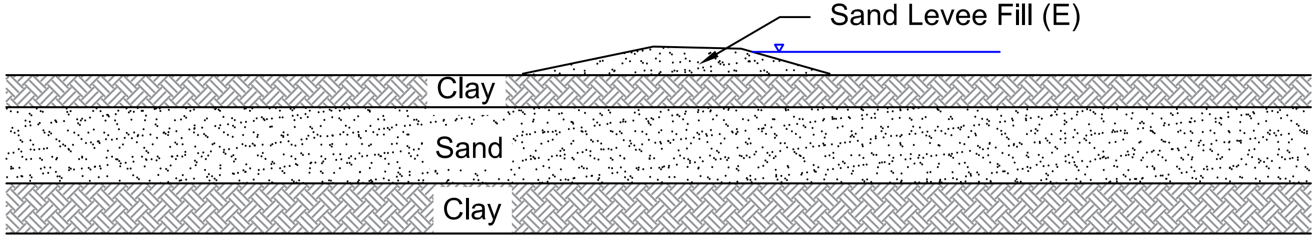


Notes:

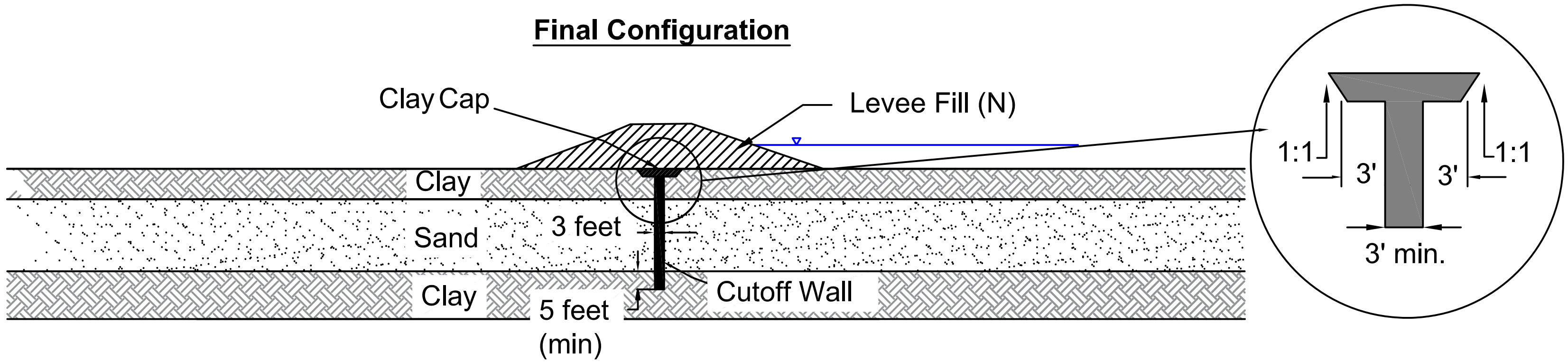
1. Degrade levee before installing cutoff wall.
2. Install lower portion of clay cap. (3-foot minimum thickness)
3. Construct slurry trench through clay cap.
4. Clay cap should be at least 3 feet wide and extend at least 5 feet into clay layer.
5. After installation of slurry trench, install remainder of clay cap and levee fill. (8-foot minimum width)
6. Fill and clay cap should consist of levee fill from designated borrow areas.

NOT TO SCALE	Little Egbert Multi-Benefit Project Solano County, California	**Typical Detail** **Soil Bentonite Cutoff Wall** **Zoned Embankment**	
	Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 14

Existing Levee



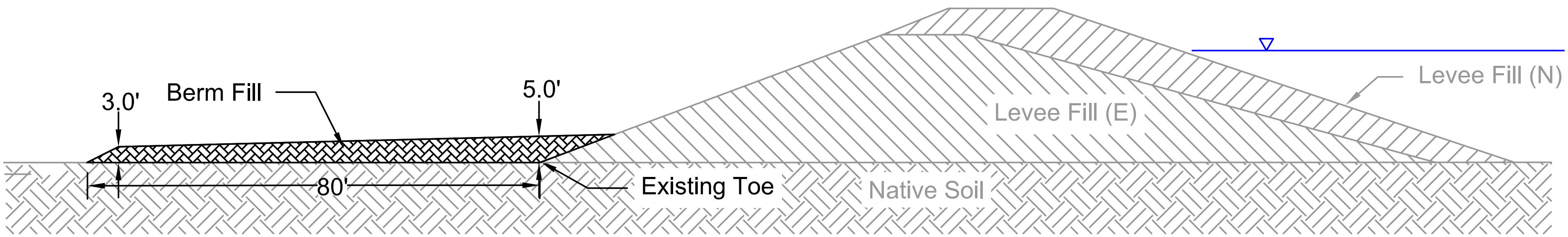
Final Configuration



Notes:

1. Remove existing levee.
2. Install clay cap. (3-foot minimum thickness)
3. Construct slurry trench through clay cap.
4. Cutoff wall should be at least 3 feet wide and extend at least 5 feet into clay layer.
5. Construct levee and levee fill from designated borrow areas.

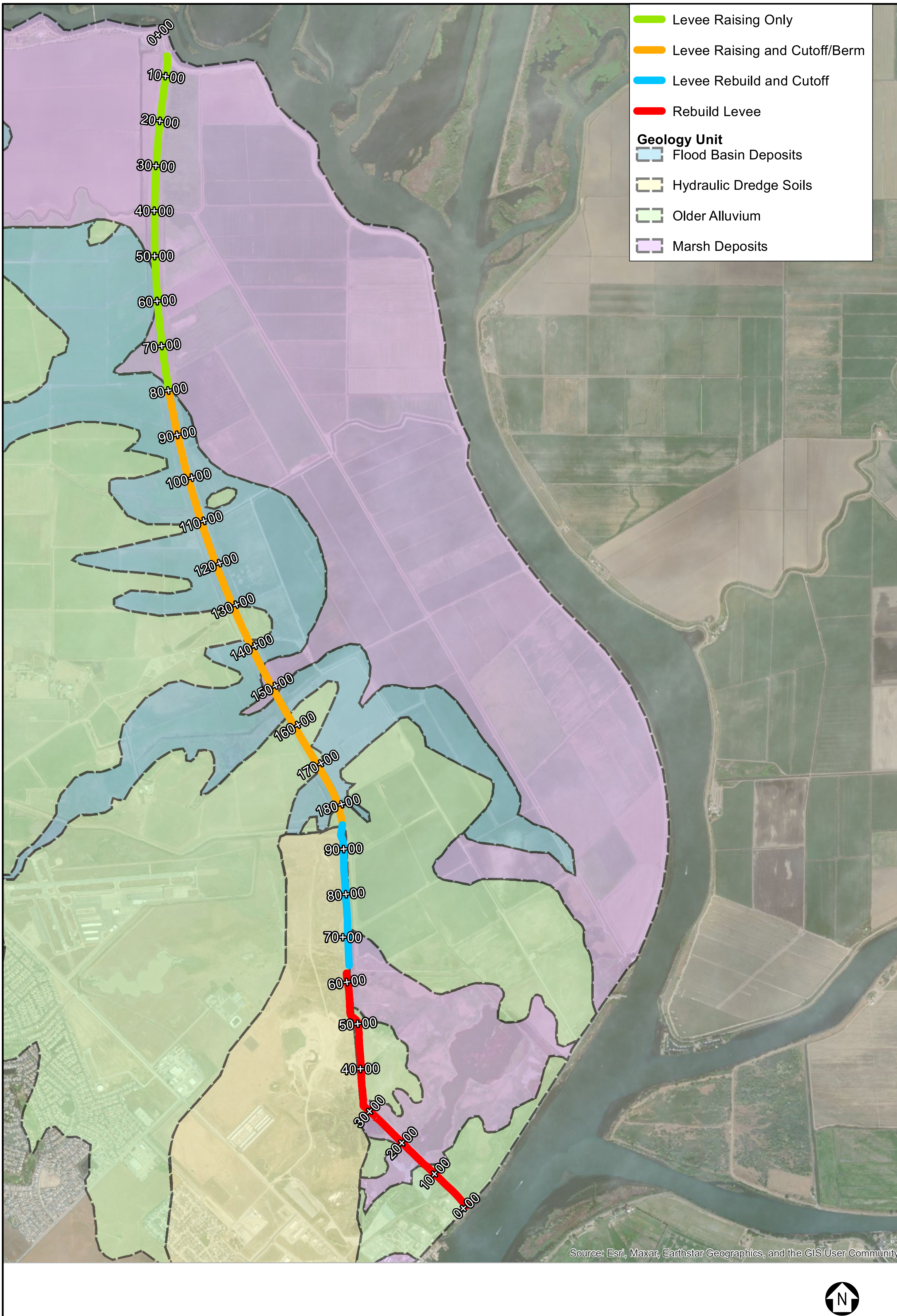
NOT TO SCALE	Little Egbert Multi-Benefit Project Solano County, California	**Typical Detail** **Soil Bentonite Cutoff Wall** **Homogenous Embankment**	
	Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 15



Notes:

1. Prior to placing fill, grade existing ground below seepage berm to a constant slope.
2. Berm fill should be obtained from designated borrow areas.

NOT TO SCALE	Little Egbert Multi-Benefit Project Solano County, California		**Typical Detail** **Seepage Berm**
	Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 16



0 2,000 Feet

1 inch = 2,000 feet

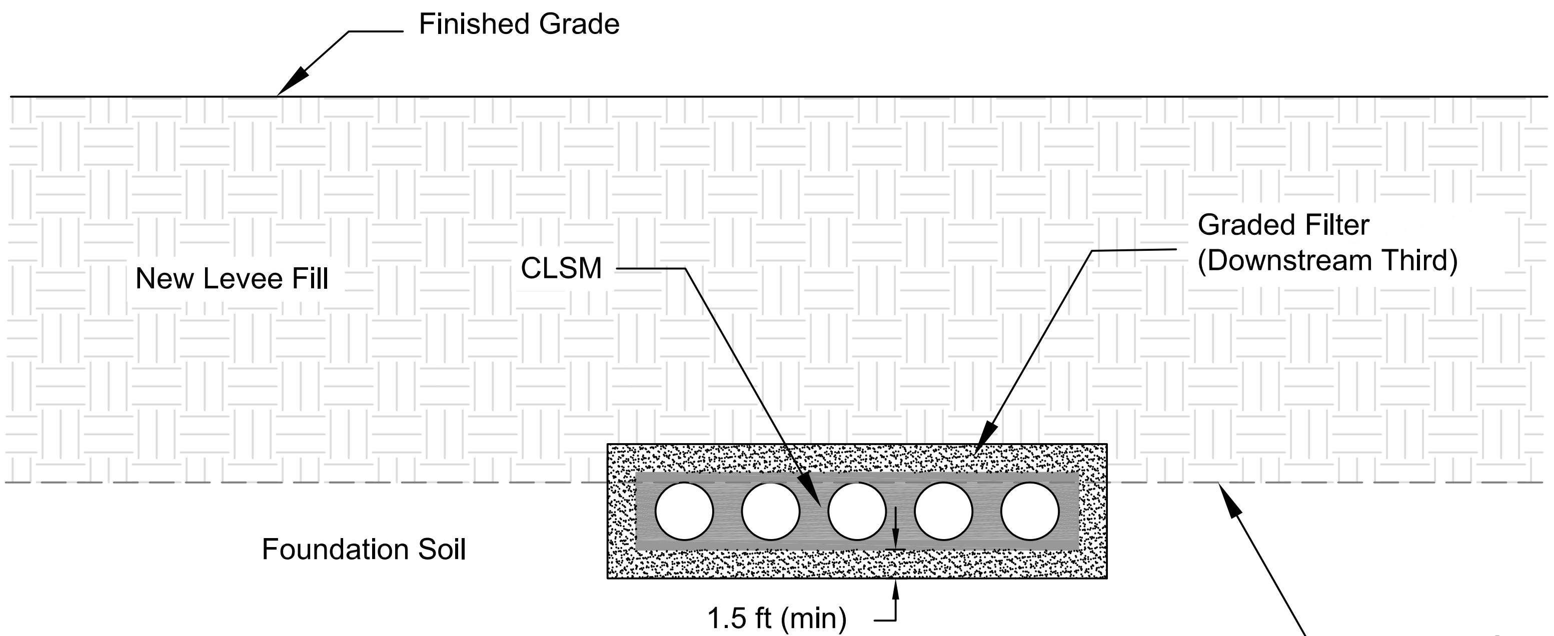
Little Egbert Multi-Benefit Project
Solano County, California

Levee Remediation Map

Shannon & Wilson, Inc.

Project No. 907.03

Plate No. 17



Notes:

1. Pipe should be encased in CLSM.
2. CLSM should be encased by 1.5-foot annular thickness graded filter in downstream (landside) third of the culvert.
3. Filter Gradation to be specified during design.

NOT TO SCALE	Little Egbert Multi-Benefit Project Solano County, California	**Typical Detail for** **CLSM and Drainage around Pipe Penetrations**	
	Shannon & Wilson, Inc.	Project No. 907.03	Plate No. 18

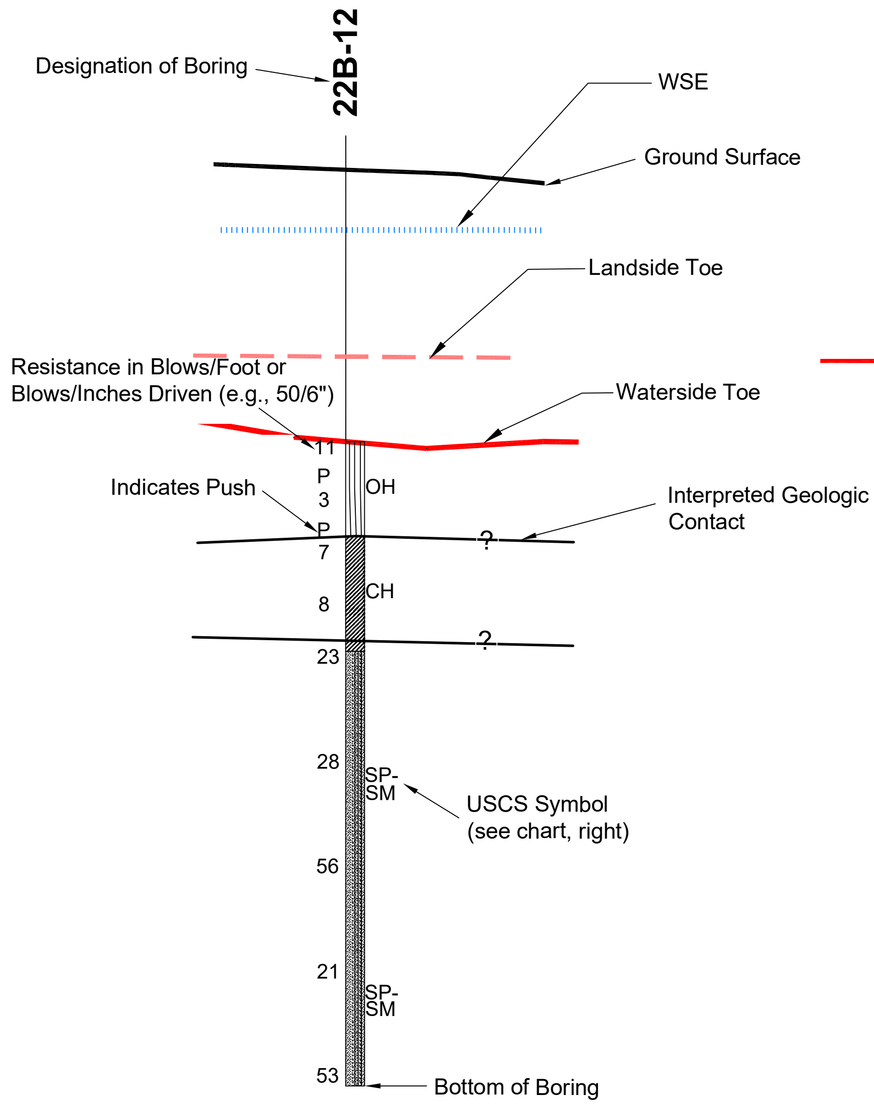
APPENDIX A: IDEALIZED GEOLOGIC PROFILES

Appendix A

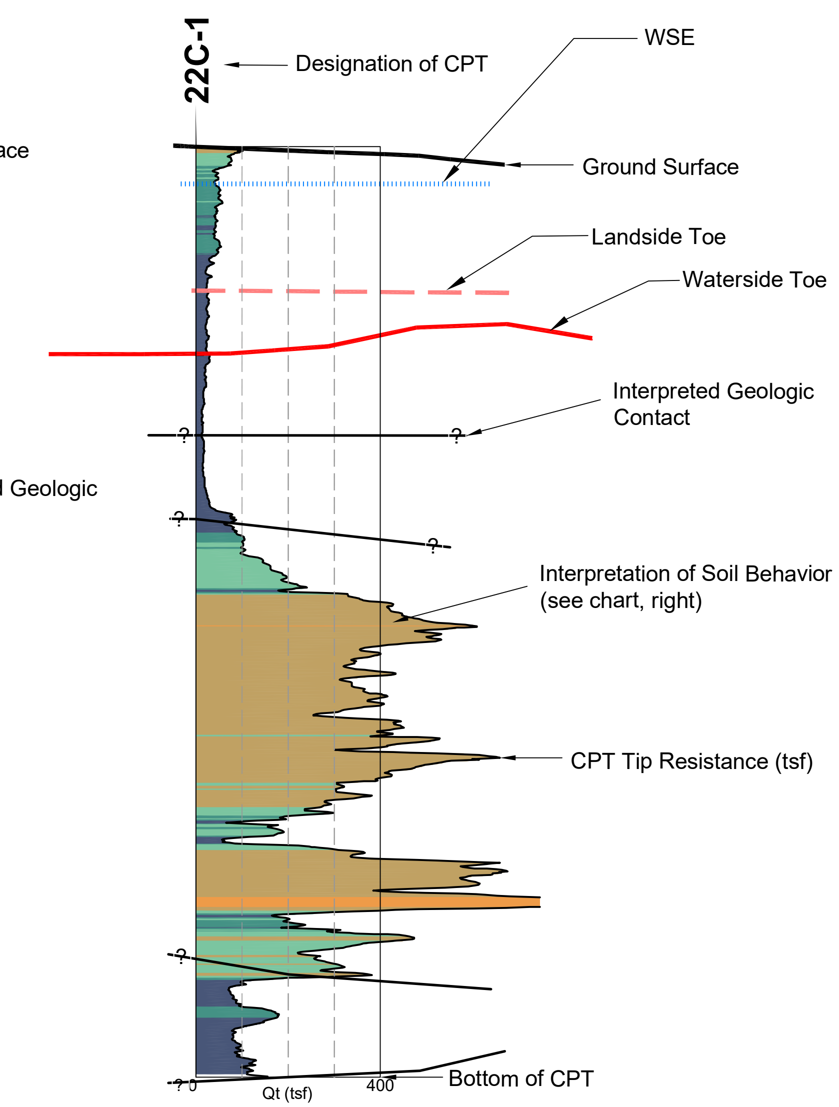
Idealized Geologic Profiles

PLATES

BORING LOG LEGEND



CONE PENETRATION TEST (CPT) LEGEND



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

UNIFIED SOIL CLASSIFICATION SYSTEM- ASTM D 2487

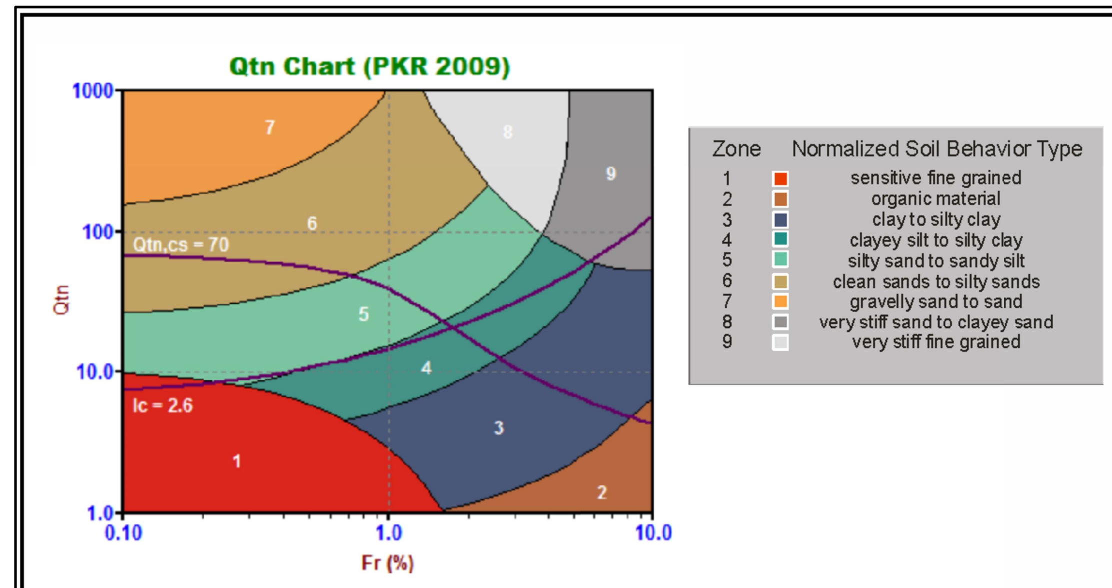


Figure 4. Normalized Soil Behavior Type Chart using Q_{tn} (SBT Qtn)

Note: Interpretation of Soil Behavior Type is based on the charts described by Robertson et al (2009).

DRAFT

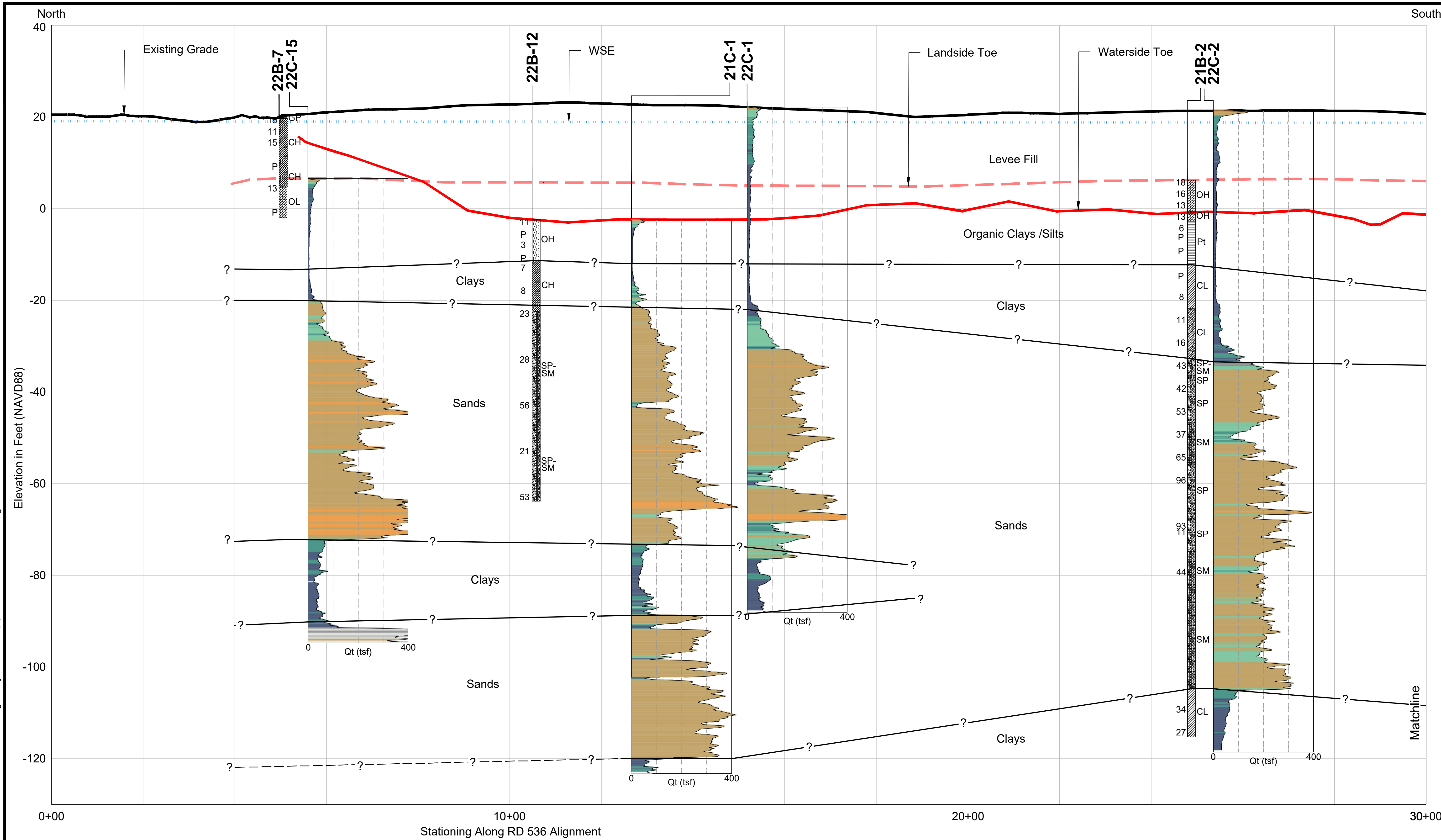
NOTES

1. The profiles are constructed from surface elevations based on the North American Vertical Datum 1988 (NAVD88). The geology shown is derived from borings conducted by Shannon & Wilson, Inc. for this study and from borings conducted by Shannon & Wilson and others for previous studies. Elevations and geologic contacts should be considered approximate. Contacts between borings are based on local geologic experience; however, variations between the profile and actual conditions are likely to exist.
2. Detailed logs of the current project explorations are presented in the data report.

SOURCES

1. This figure is based on surveys in the field and on the sources listed below.
3. Project alignment and grades were adapted from CAD files LE_PRofiles-Sections_2022,09.30 and LE-M-Ext-44-Prf-Sect.dwg, provided by MBK, received 9-30-2022 and 11-07-2022 respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Geologic Profile Legend**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. A-1



NOTE

See Plate No. A-1 for profile legend and notes.

0 20 40

Vertical Scale in Feet

0 200 400

Horizontal Scale in Feet

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

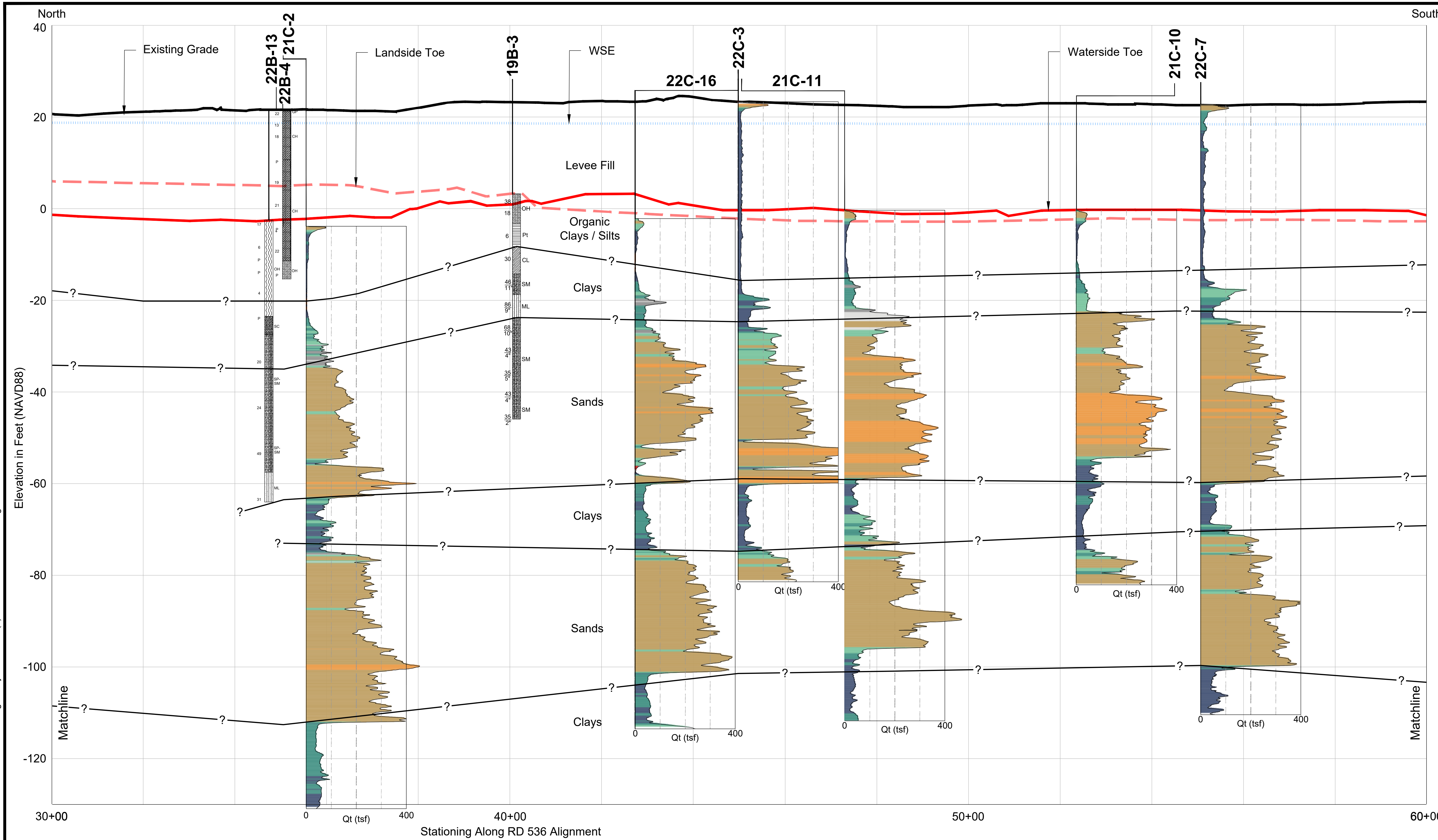
Idealized Geologic Profile
RD 536 Egbert Tract - Unit 2
Station 0+00 to 30+00

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-2

Filename: E:\J_SEA\110214\006\110214-006 Profiles.dwg Layout: RD536 (1) Date: 01-31-2023 Login: SAC



0 20 40

Vertical Scale in Feet

Vertical Exaggeration = 10X

0 200 400

Horizontal Scale in Feet

NOTE

See Plate No. A-1 for profile legend and notes.

Little Egbert Multi-Benefit Project
Solano County, California

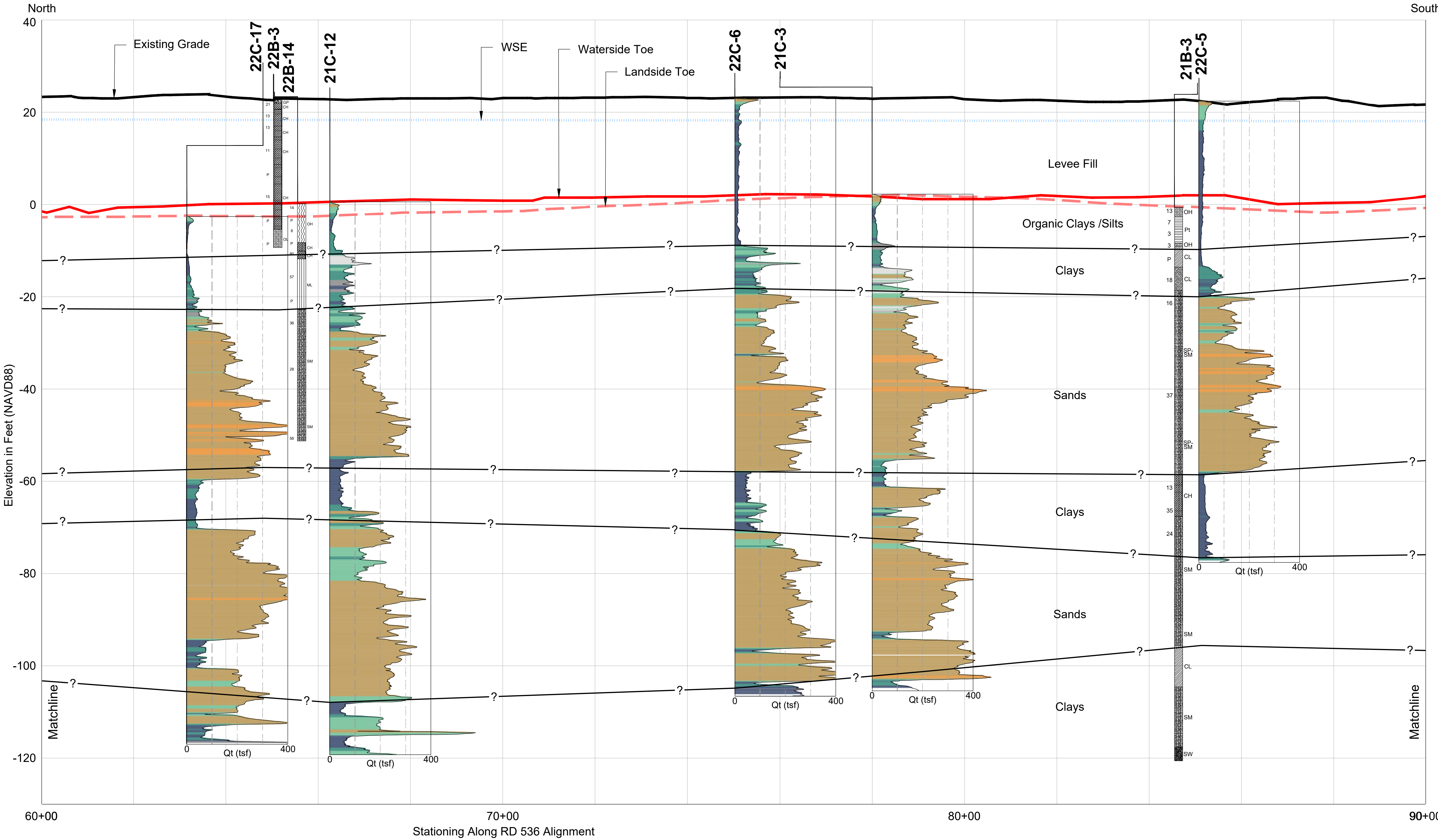
Idealized Geologic Profile
RD 536 Egbert Tract - Unit 2
Station 30+00 to 60+00

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-3

Filename: E:\J_SEA\110214\006\110214-006 Profiles.dwg Layout: RD536 (2) Date: 01-31-2023 Login: SAC



NOTE

See Plate No. A-1 for profile legend and notes.

0 20 40

Vertical Scale in Feet

0 200 400

Horizontal Scale in Feet

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

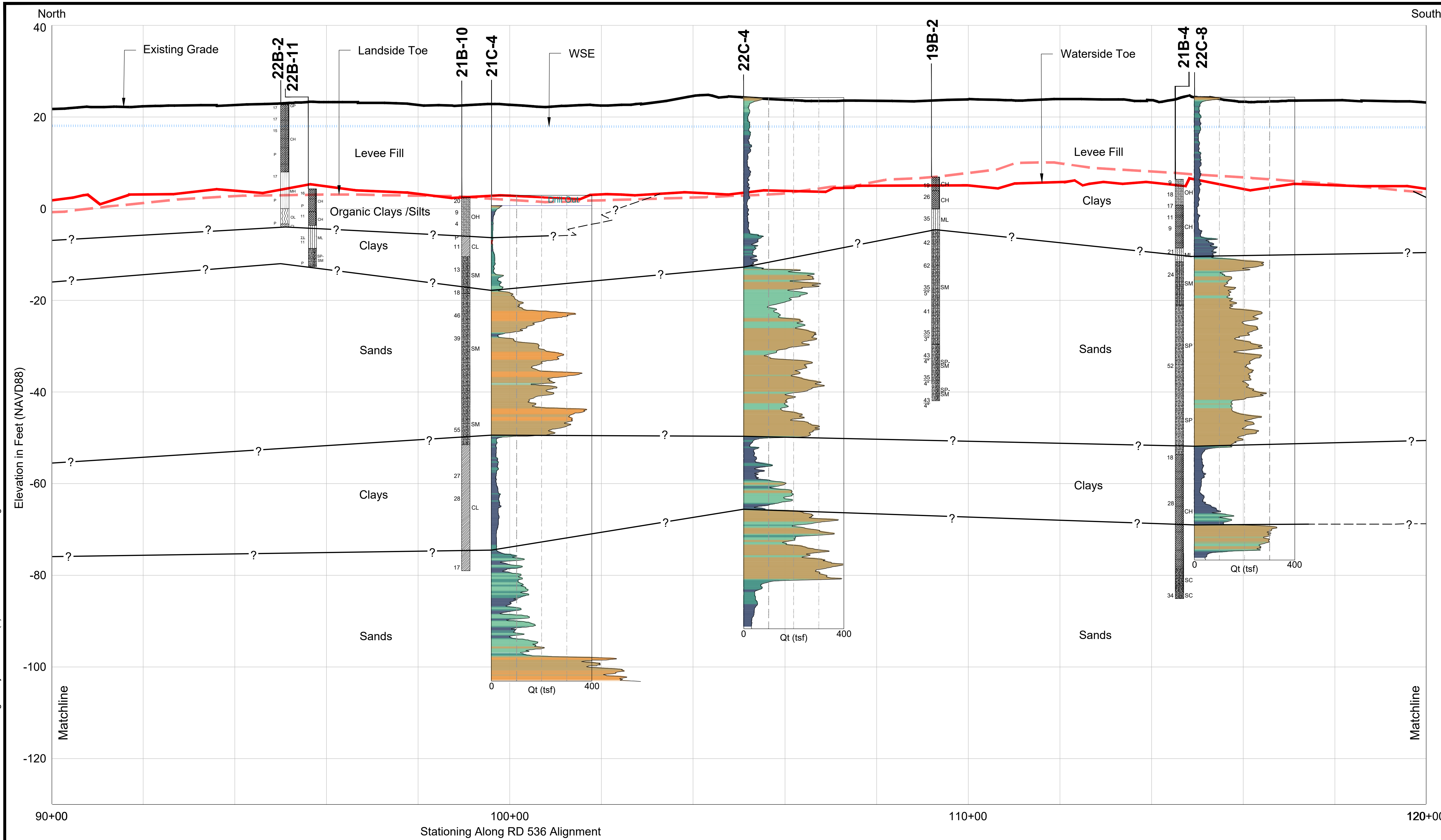
Idealized Geologic Profile
RD 536 Egbert Tract - Unit 2
Station 60+00 to 90+00

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-4

Filename: E:\JI_SEA\110214\006\110214-006 Profiles.dwg Layout: RD536 (3) Date: 01-31-2023 Login: SAC



NOTE

See Plate No. A-1 for profile legend and notes.

0 20 40

Vertical Scale in Feet

0 200 400

Horizontal Scale in Feet

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

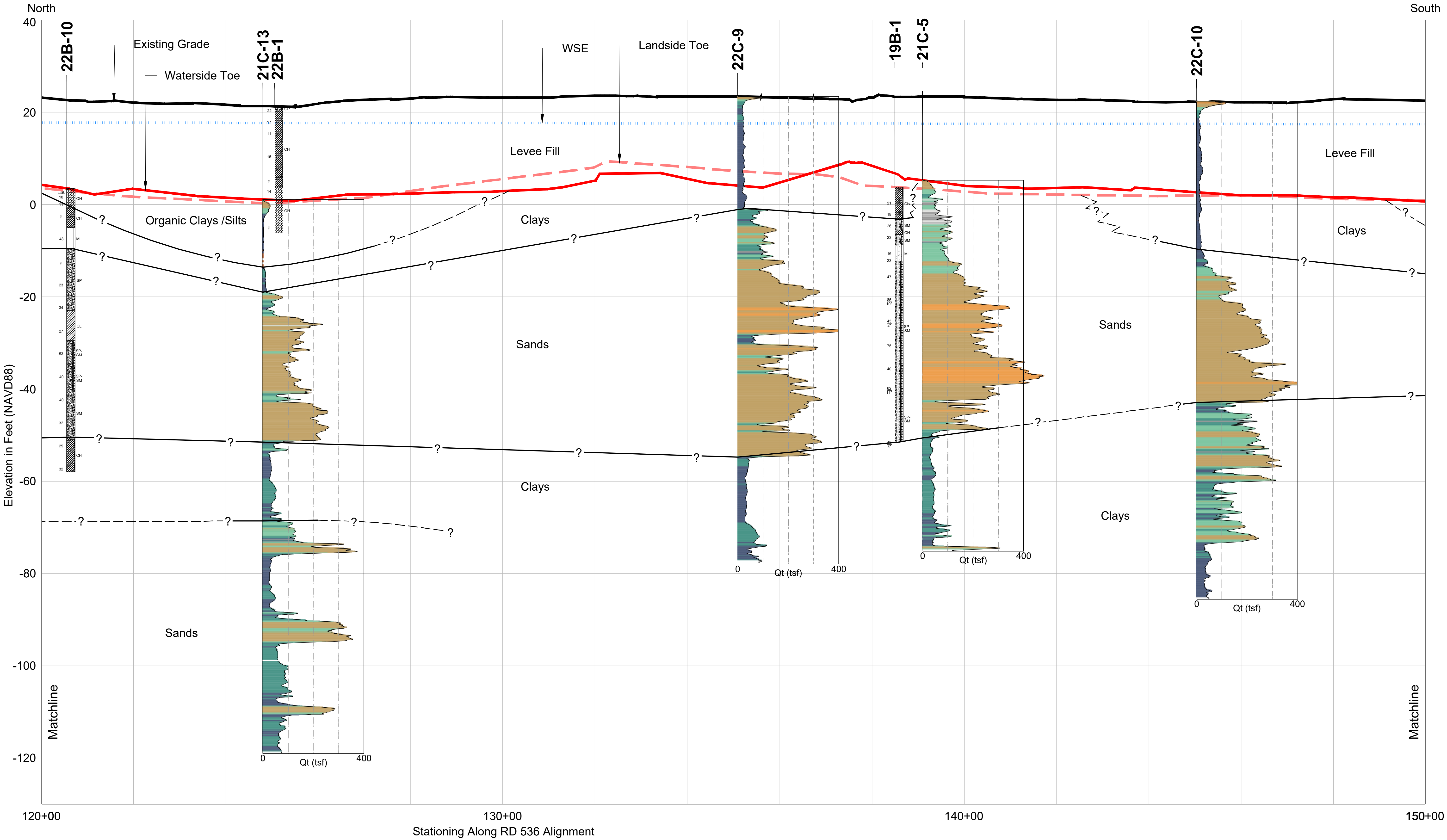
Idealized Geologic Profile
RD 536 Egbert Tract - Unit 2
Station 90+00 to 120+00

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-5

Filename: E:\J_SEA\110214\006\110214-006 Profiles.dwg Layout: RD536 (4) Date: 01-31-2023 Login: SAC



NOTE

See Plate No. A-1 for profile legend and notes.

0 20 40
Vertical Scale in Feet

0 200 400
Horizontal Scale in Feet

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

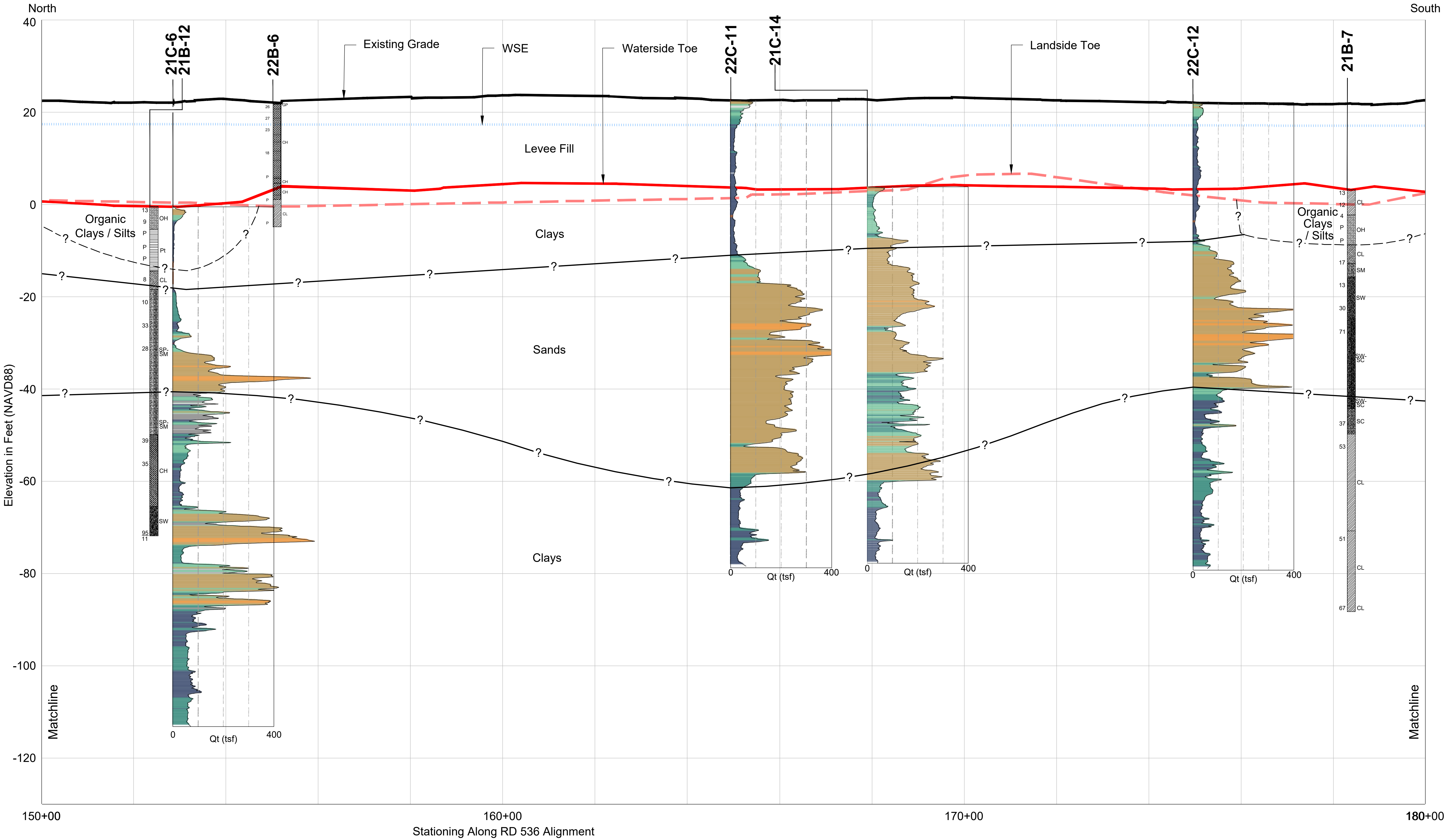
Idealized Geologic Profile
RD 536 Egbert Tract - Unit 2
Station 120+00 to 150+00

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-6

Filename: E:\J_SEA\110214\006\110214-006 Profiles.dwg Layout: RD536 (5) Date: 01-31-2023 Login: SAC



NOTE

See Plate No. A-1 for profile legend and notes.

Vertical Scale in Feet: 0, 20, 40

Horizontal Scale in Feet: 0, 200, 400

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

Idealized Geologic Profile
RD 536 Egbert Tract - Unit 2
Station 150+00 to 180+00

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-7

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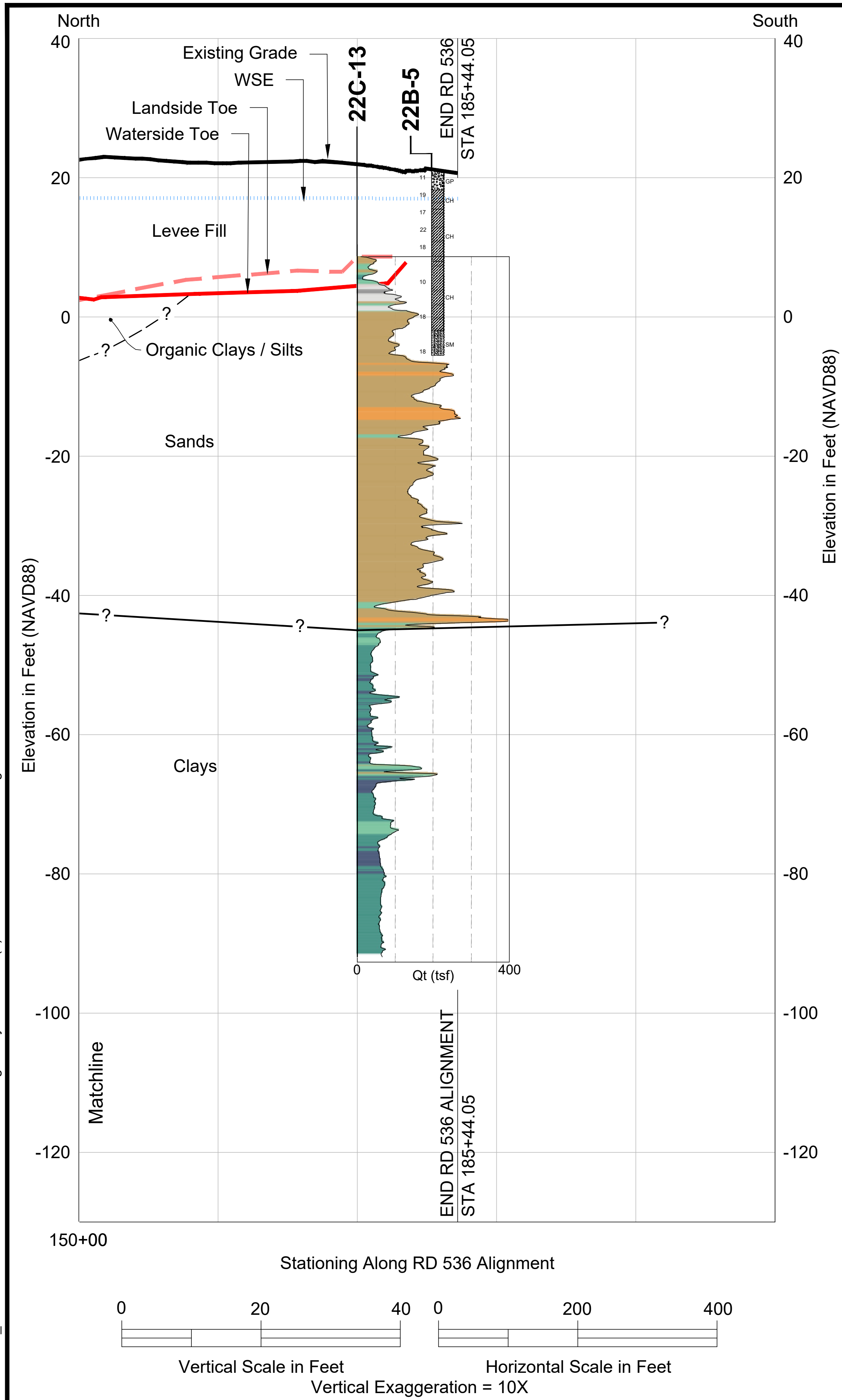
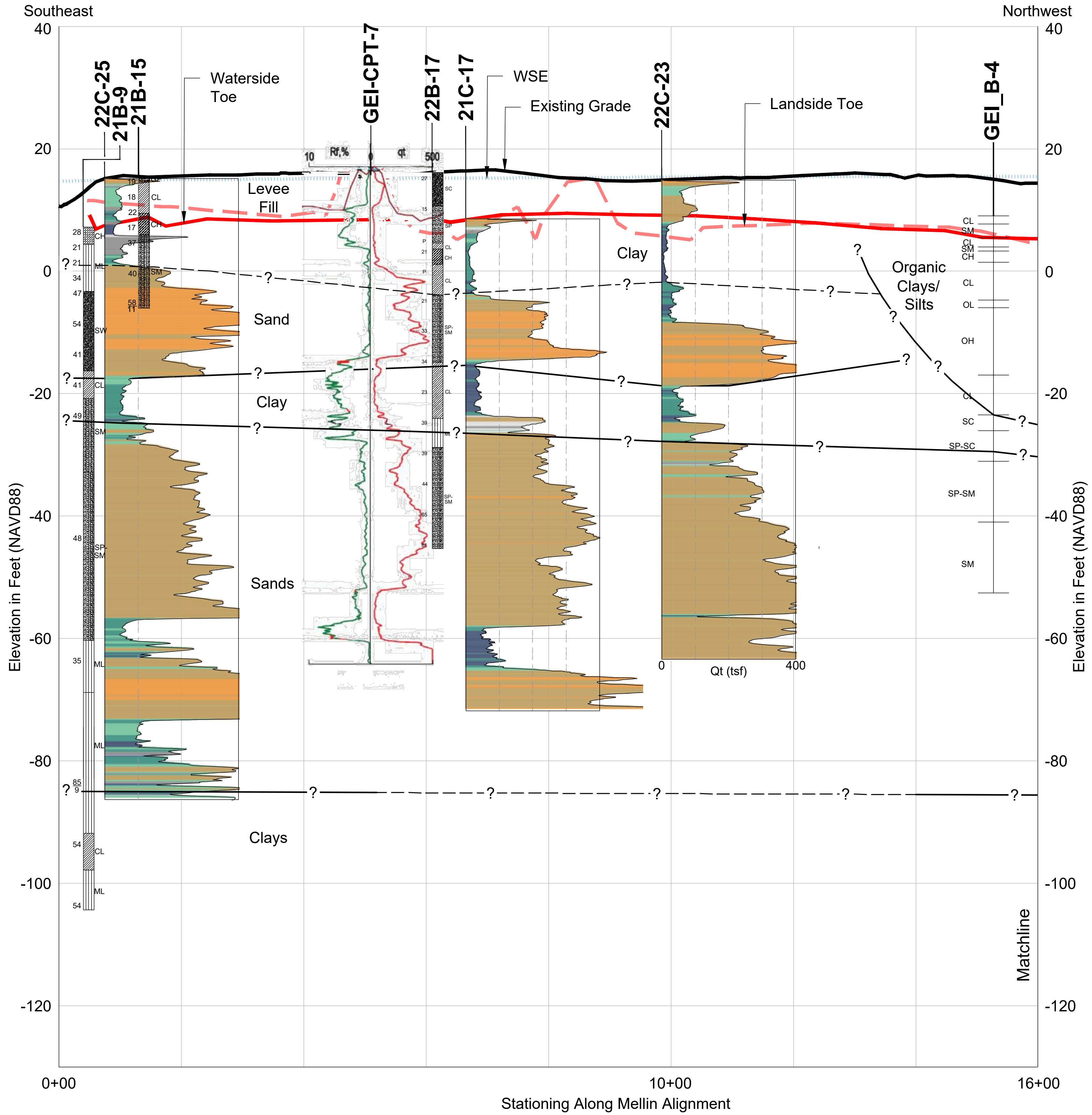


Filename: E:\J_SEA\110214\006\110214-006 Profiles.dwg Layout: RD536 (7) Date: 01-31-2023 Login: SAC

Little Egbert Multi-Benefit Project Solano County, California	**Idealized Geologic Profile RD 536 Egbert Tract - Unit 2 Station 180+00 to 185+44.05**	
SHANNON & WILSON GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS	Project No. 907.03	Plate No. A-8



NOTE

See Plate No. A-1 for profile legend and notes.

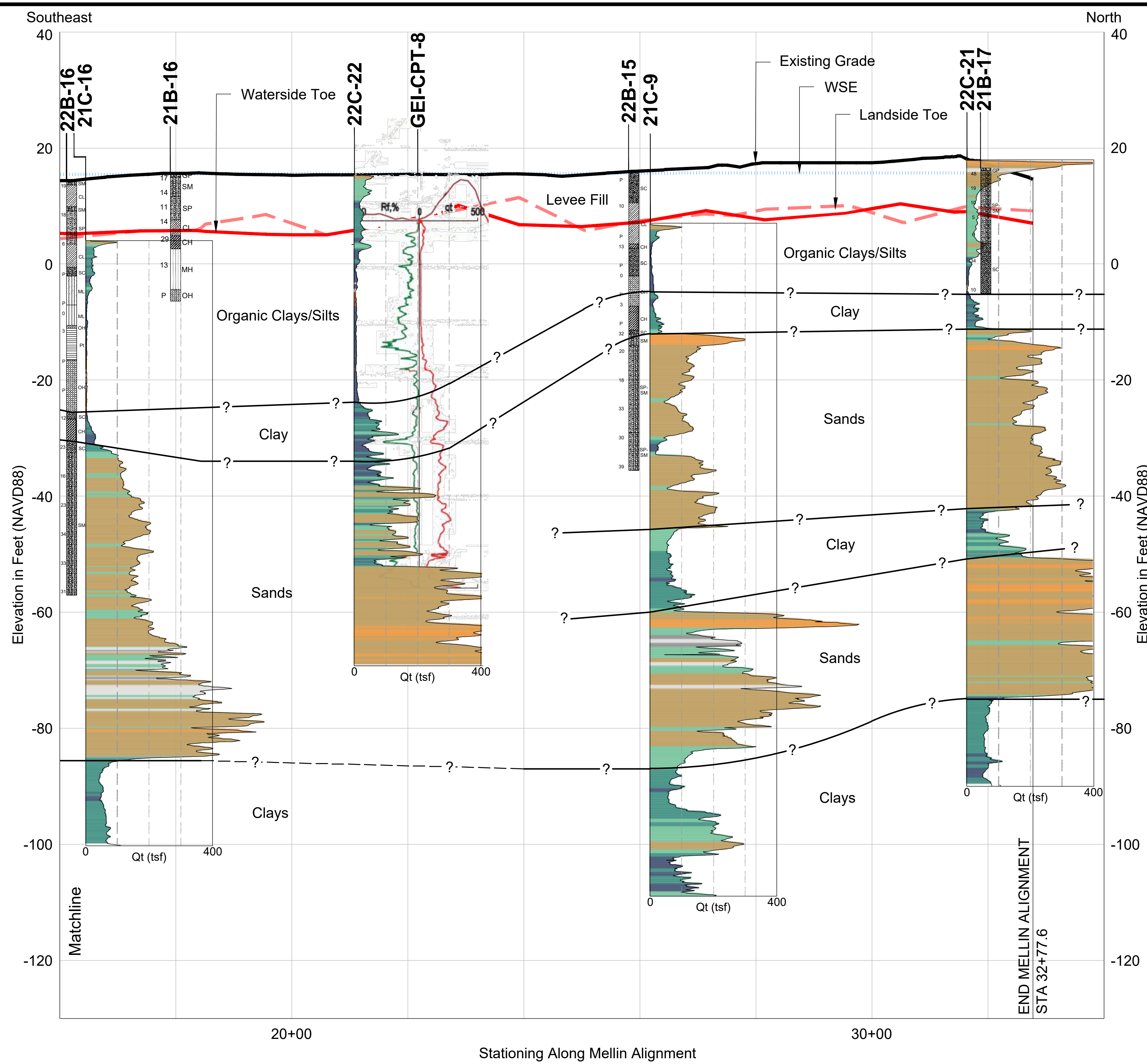
Vertical Scale in Feet (0, 20, 40)

Horizontal Scale in Feet (0, 200, 400)

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project Solano County, California	Idealized Geologic Profile Mellin Levee Station 0+00 to 16+00	
SHANNON & WILSON GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS	Project No. 907.03	Plate No. A-9

Filename: E:\JI_SEA\110214\006\110214-006 Profiles.dwg Layout: Mellin (1) Date: 01-27-2023 Login: SAC



NOTE

See Plate No. A-1 for profile legend and notes.

0 20 40

Vertical Scale in Feet

0 200 400

Horizontal Scale in Feet

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

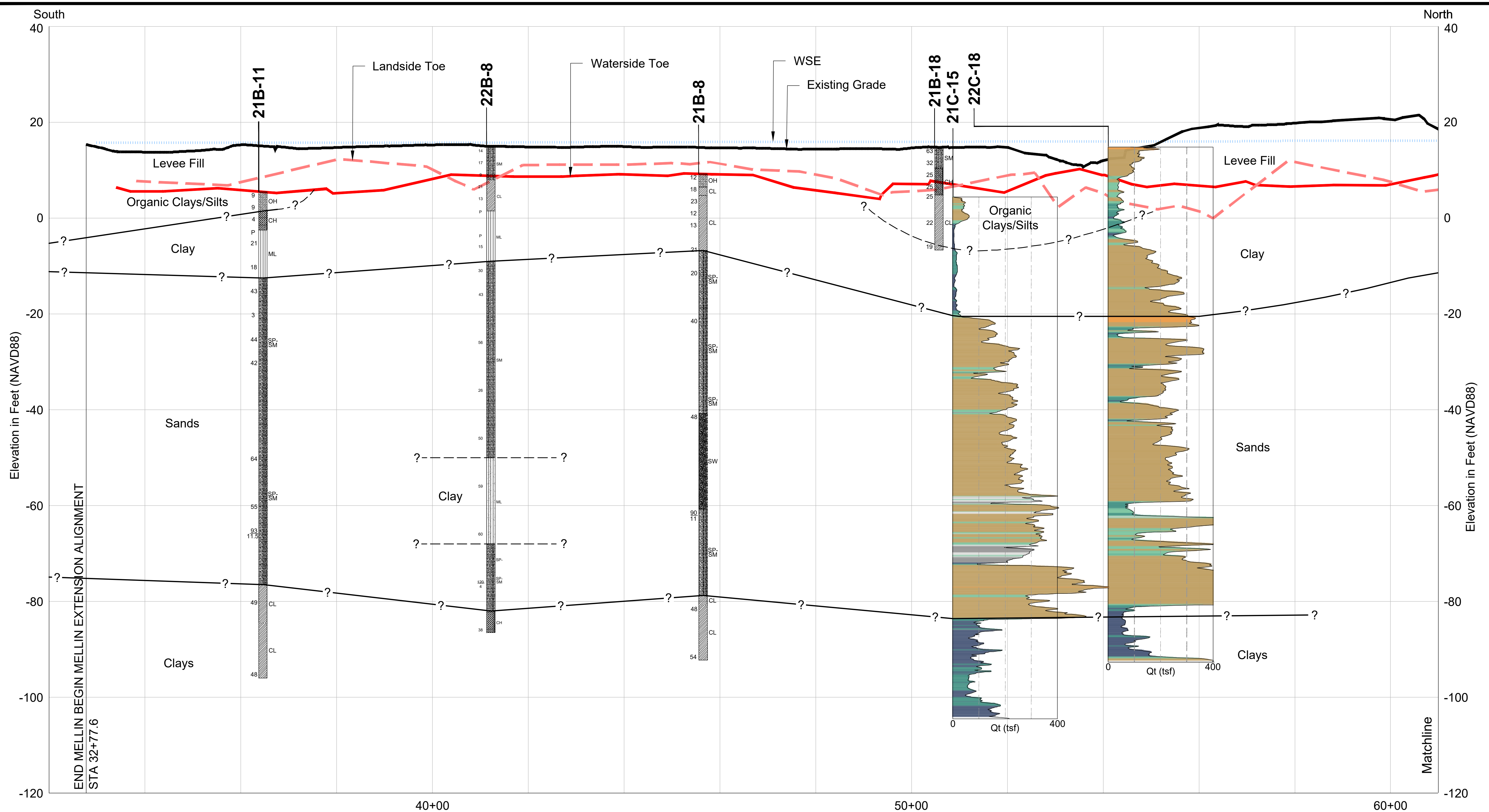
Idealized Geologic Profile
Mellin Levee
Station 16+00 to 32+78

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-10

Filename: E:\J_SEA\110214\006\110214-006 Profiles.dwg Layout: Mellin (2) Date: 01-27-2023 Login: SAC



Stationing Along Mellin Extension Alignment

NOTE

See Plate No. A-1 for profile legend and notes.

0 20 40

Vertical Scale in Feet

0 200 400

Horizontal Scale in Feet

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

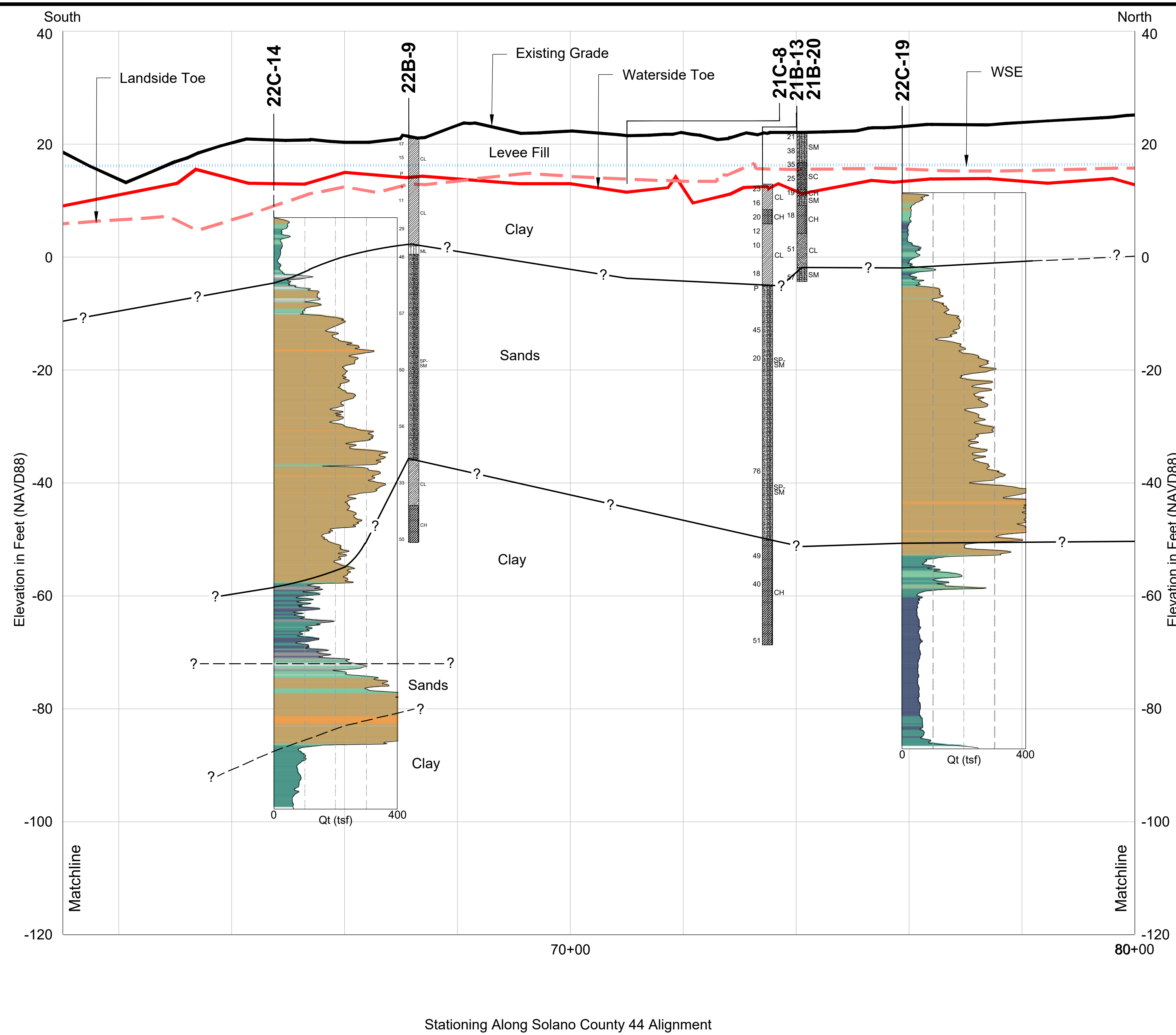
Idealized Geologic Profile
Mellin Extension
Station 32+78 to 61+02

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-11

Filename: E:\JI_SEA\110214\006\110214-006 Profiles.dwg Layout: Mellin Extension (1) Date: 01-27-2023 Login: SAC



NOTE

See Plate No. A-1 for profile legend and notes.

Vertical Scale in Feet (0, 20, 40)

Horizontal Scale in Feet (0, 200, 400)

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

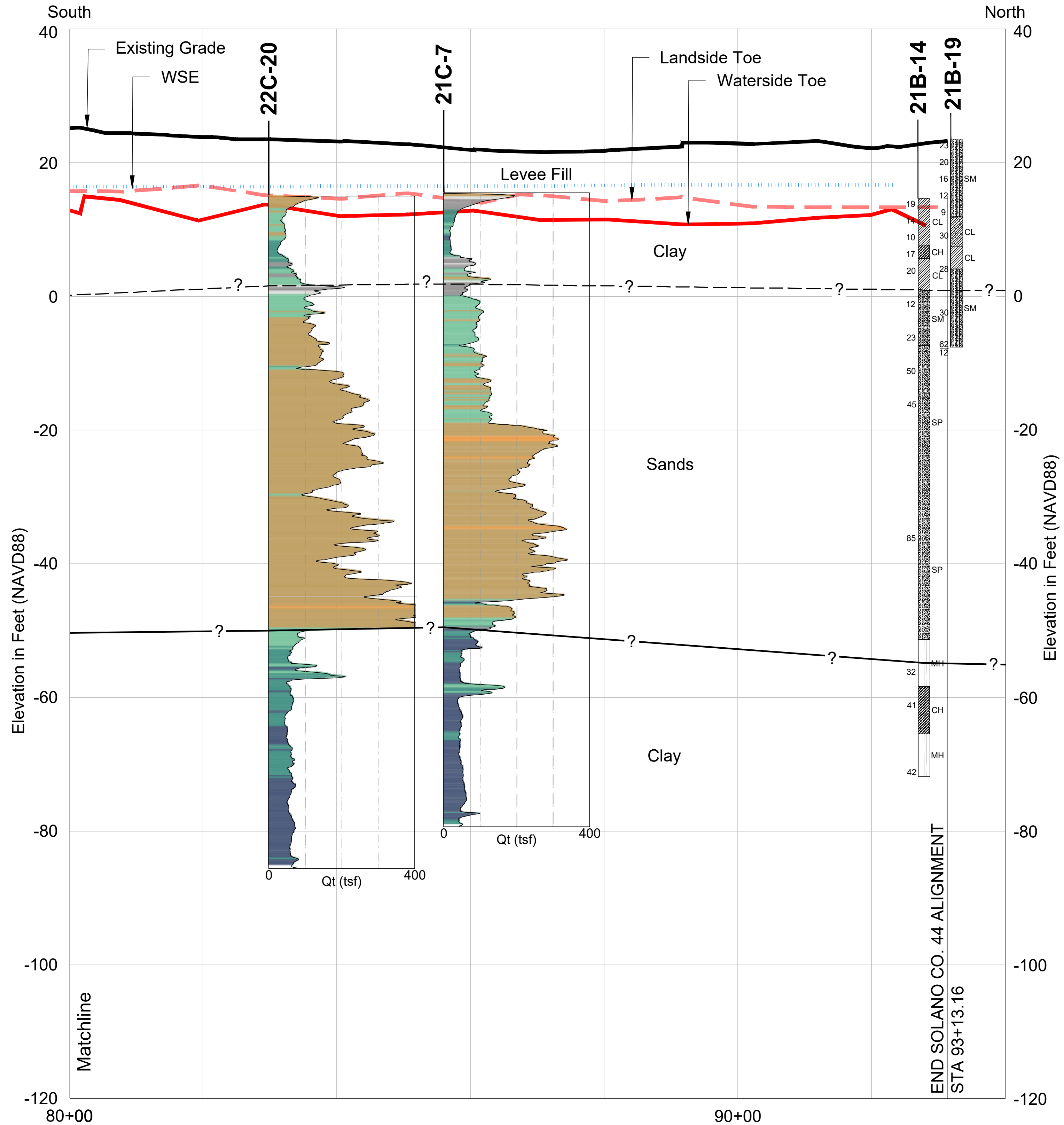
Idealized Geologic Profile
Solano County 44
Station 61+02 to 80+00

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-12

Filename: E:\J_SEA\110214\006\110214-006 Profiles.dwg Layout: Solano County 44 (1) Date: 01-27-2023 Login: SAC



Stationing Along Solano County 44 Alignment

NOTE

See Plate No. A-1 for profile legend and notes.

0 20 40

Vertical Scale in Feet

0 200 400

Horizontal Scale in Feet

Vertical Exaggeration = 10X

Little Egbert Multi-Benefit Project
Solano County, California

Idealized Geologic Profile
Solano County 44
Station 80+00 to 93+13

SHANNON & WILSON
GEOTECHNICAL AND ENVIRONMENTAL ENGINEERS

Project No. 907.03

Plate No. A-13

Filename: E:\J_SEA\110214\006\110214-006 Profiles.dwg Layout: Solano County 44 (2) Date: 01-27-2023 Login: SAC

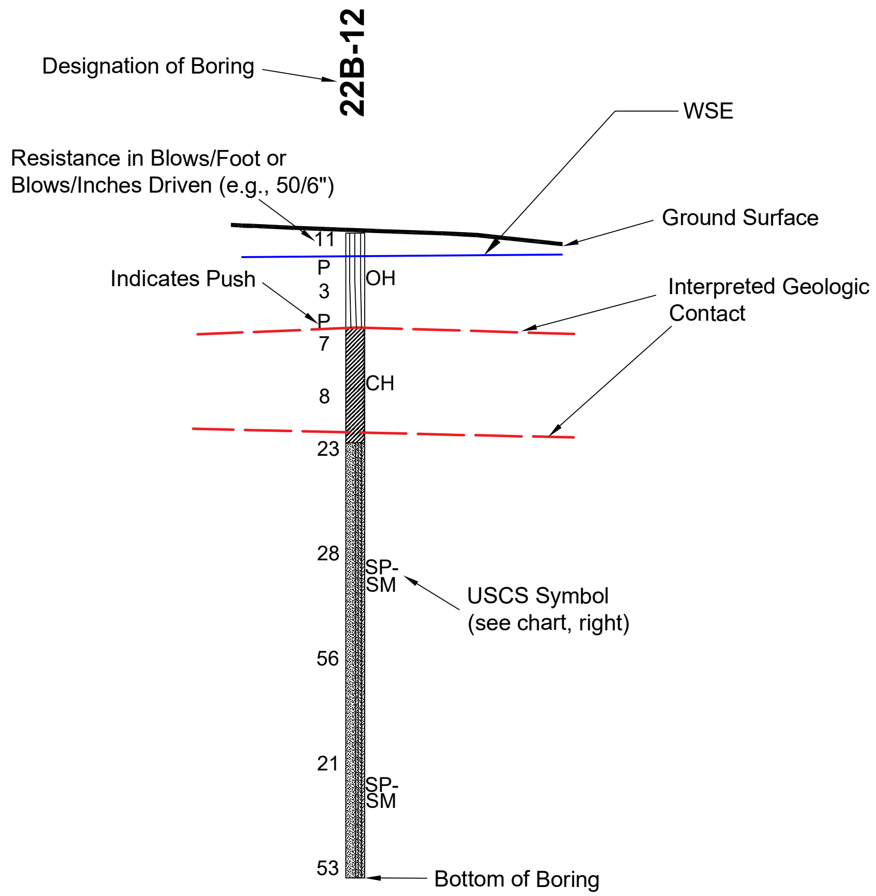
APPENDIX B: IDEALIZED SUBSURFACE CROSS SECTIONS

Appendix B

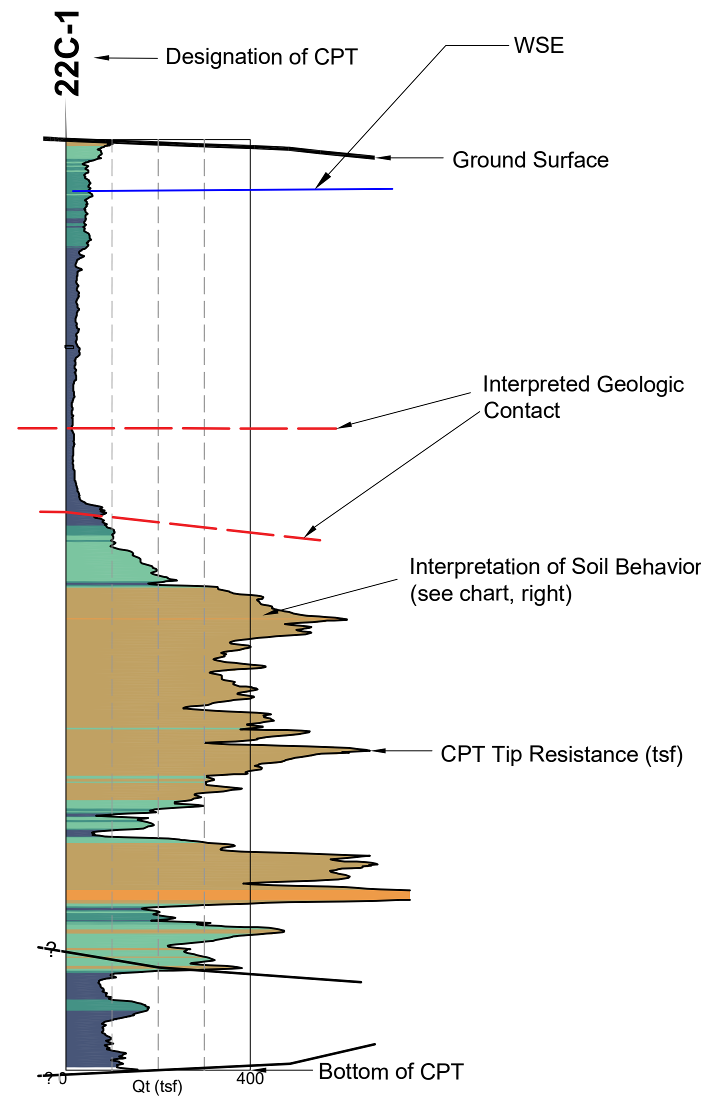
Idealized Subsurface Cross Sections

PLATES

BORING LOG LEGEND



CONE PENETRATION TEST (CPT) LEGEND



DRAFT

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

UNIFIED SOIL CLASSIFICATION SYSTEM- ASTM D 2487

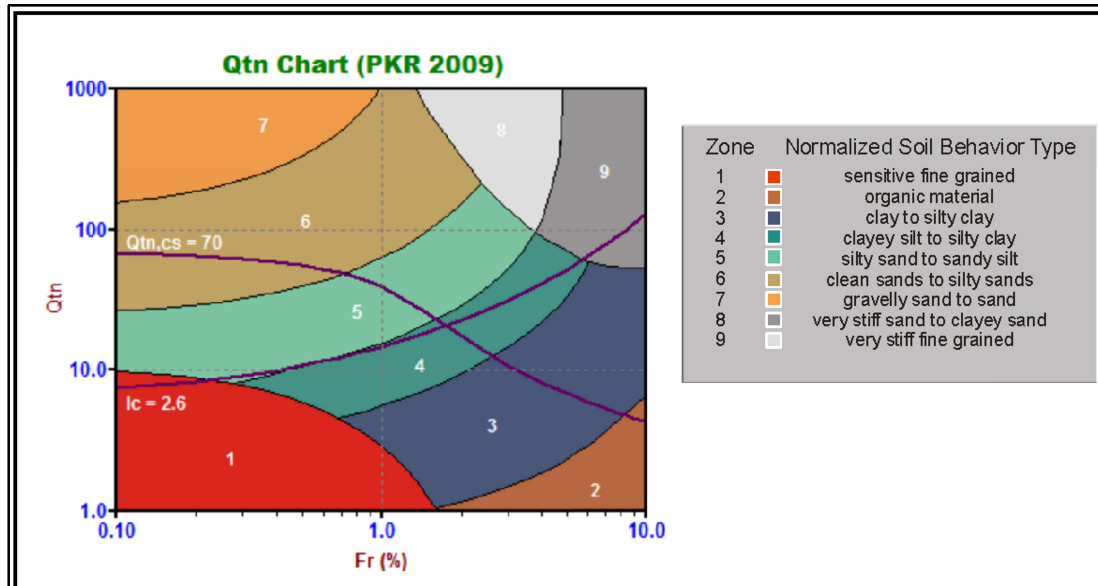


Figure 4. Normalized Soil Behavior Type Chart using Q_{tn} (SBT Qtn)

Note: Interpretation of Soil Behavior Type is based on the charts described by Robertson et al (2009).

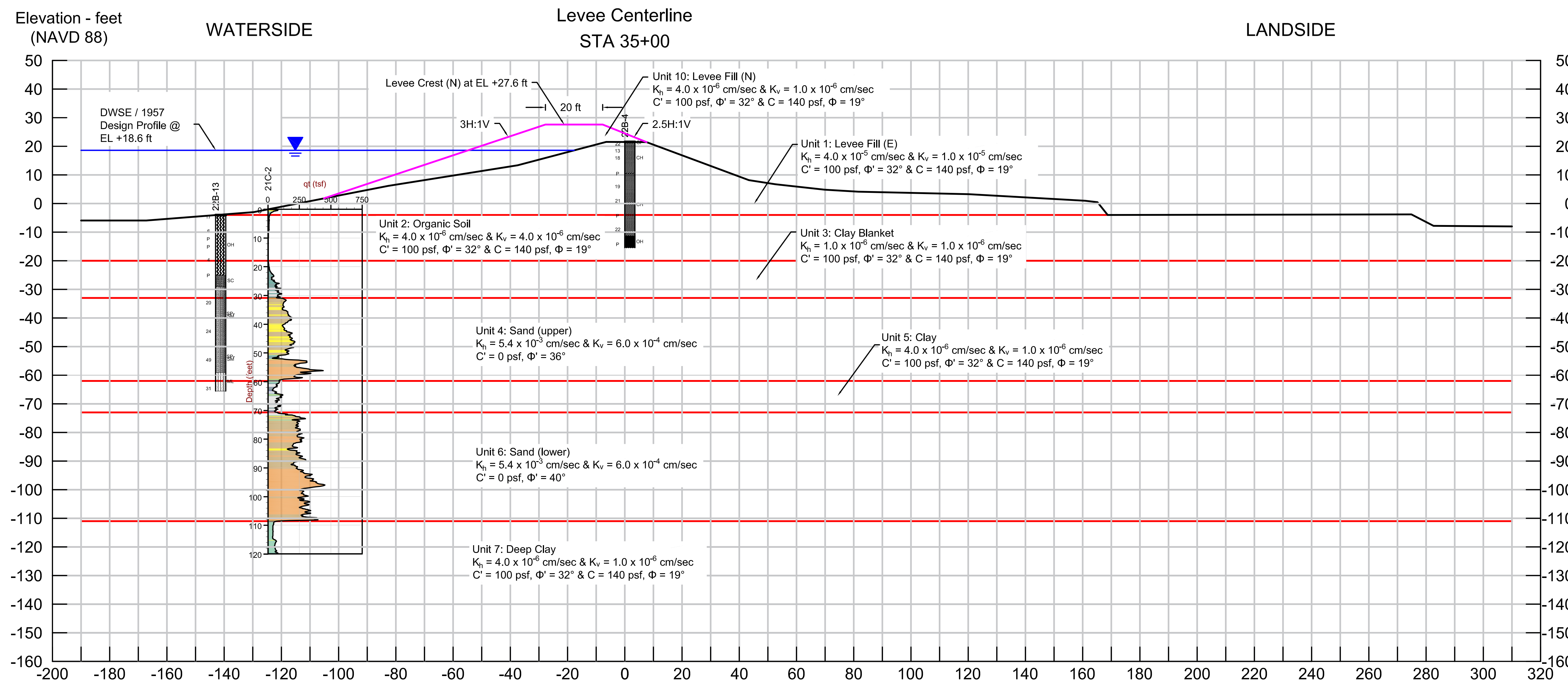
NOTES

1. The profiles are constructed from surface elevations based on the North American Vertical Datum 1988 (NAVD88). The geology shown is derived from borings conducted by Shannon & Wilson, Inc. for this study and from borings conducted by Shannon & Wilson and others for previous studies. Elevations and geologic contacts should be considered approximate. Contacts between borings are based on local geologic experience; however, variations between the profile and actual conditions are likely to exist.
2. Detailed logs of the current project explorations are presented in the data report.

SOURCES

1. This figure is based on surveys in the field and on the sources listed below.
3. Project alignment and grades were adapted from CAD files LE_PRofiles-Sections_2022,09.30 and LE-M-Ext-44-Prf-Sect.dwg, provided by MBK, received 9-30-2022 and 11-07-2022 respectively.

Little Egbert Multi-Benefit Project Solano County, California		**Cross Section Legend**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. B-1

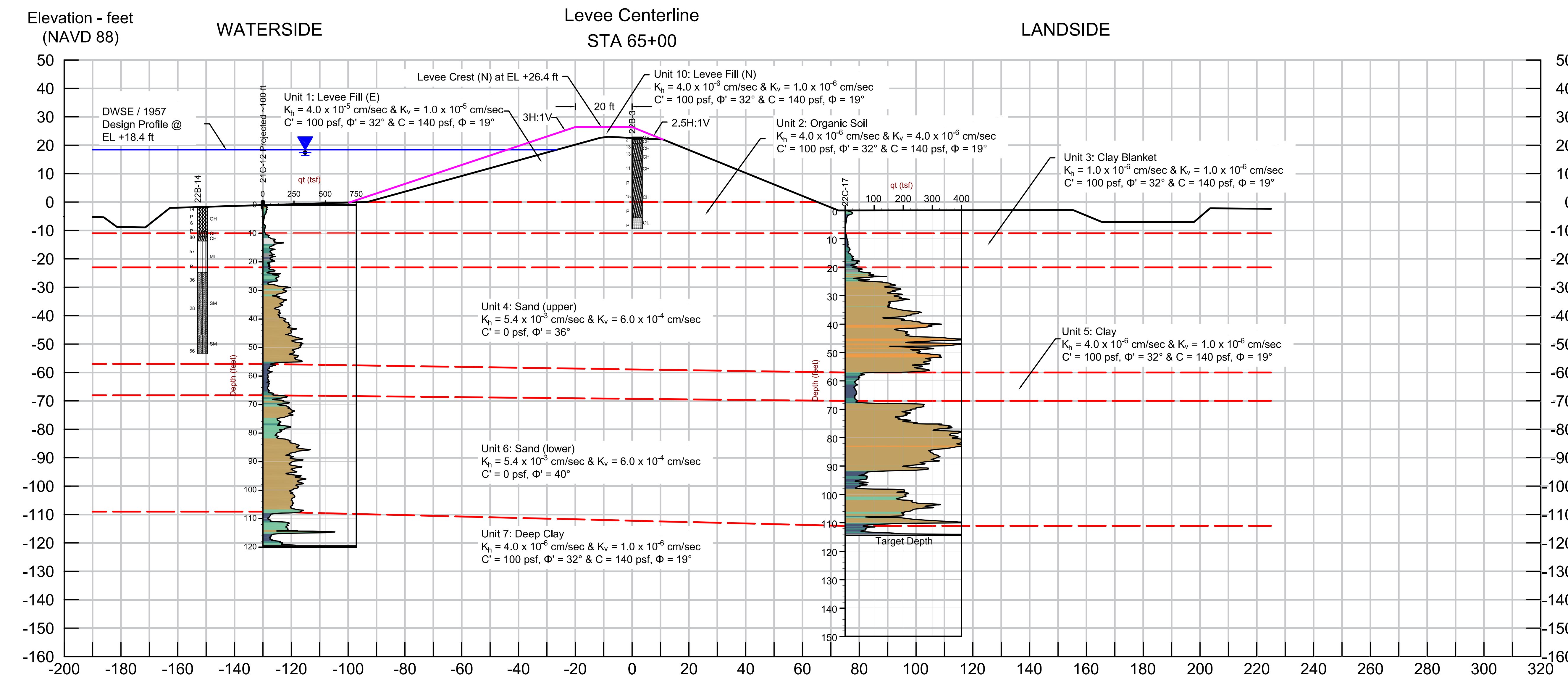


40 feet

SCALE:
H: 1" = 40'
V: 1" = 40'

40 feet

Little Egbert Multi-Benefit Project Solano County, California		**Station 35+00 (RD 536)** **Cross Section**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. B-2



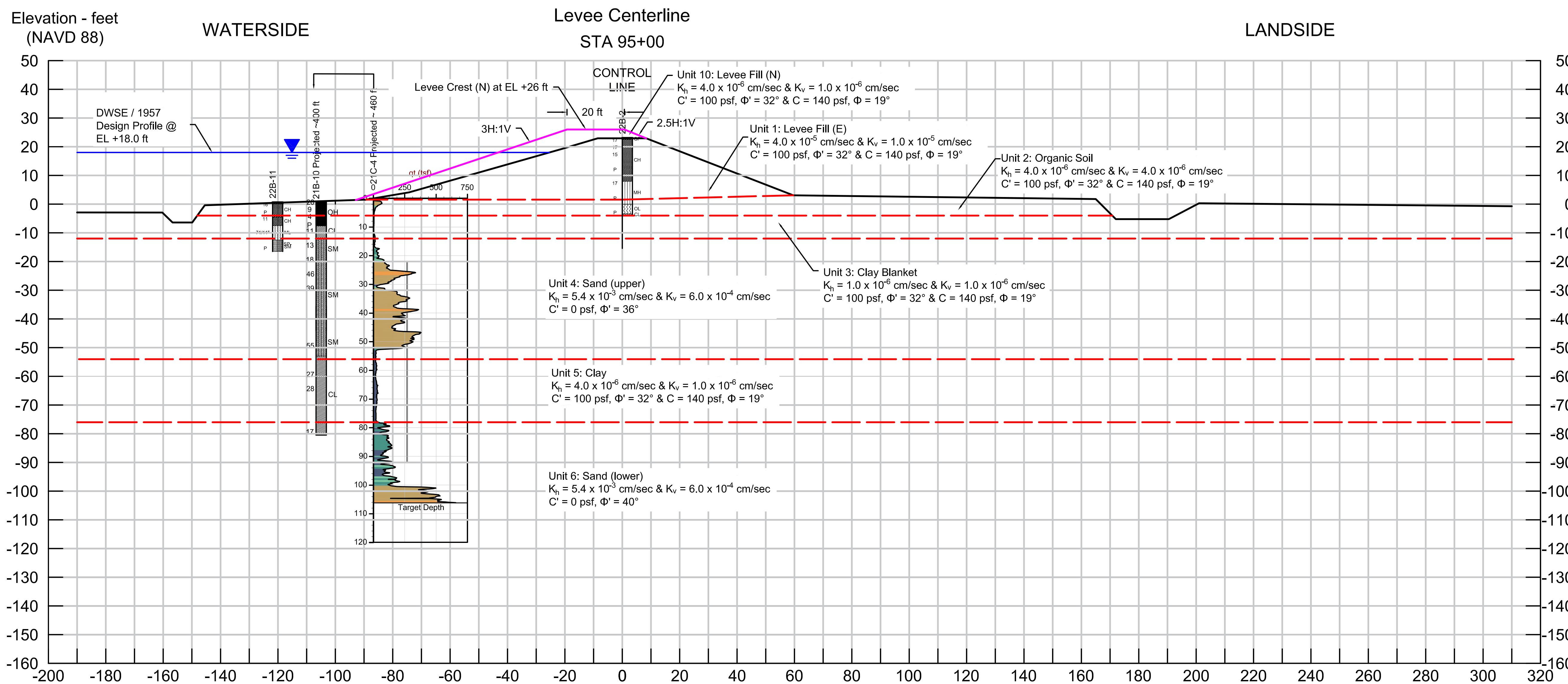
SCALE:
H: 1" = 40'
V: 1" = 40'

40 feet

40 feet

Little Egbert Multi-Benefit Project Solano County, California	**Station 65+00 (RD 536)** **Cross Section**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. B-3

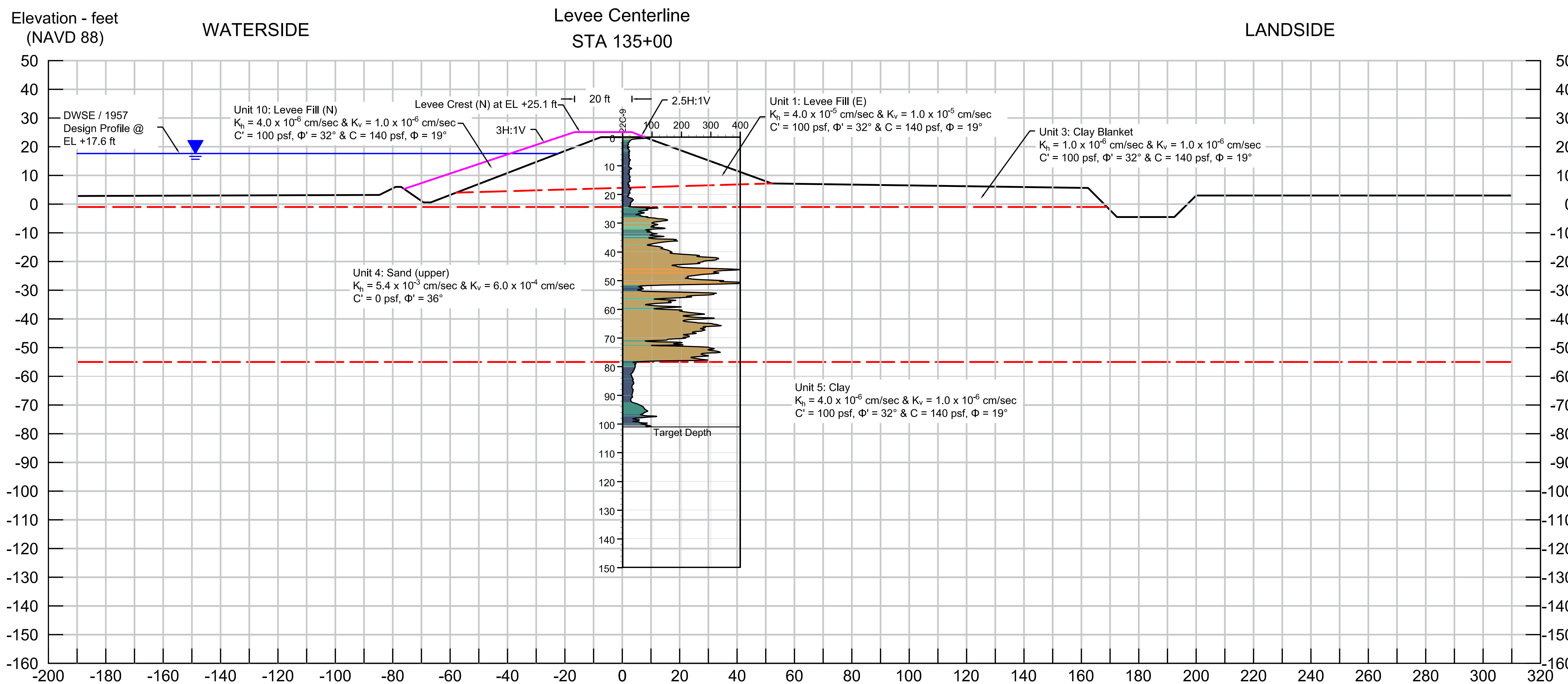


40 feet

SCALE:
H: 1" = 40'
V: 1" = 40'

40 feet

Little Egbert Multi-Benefit Project Solano County, California	**Station 95+00 (RD 536)** **Cross Section**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. B-4

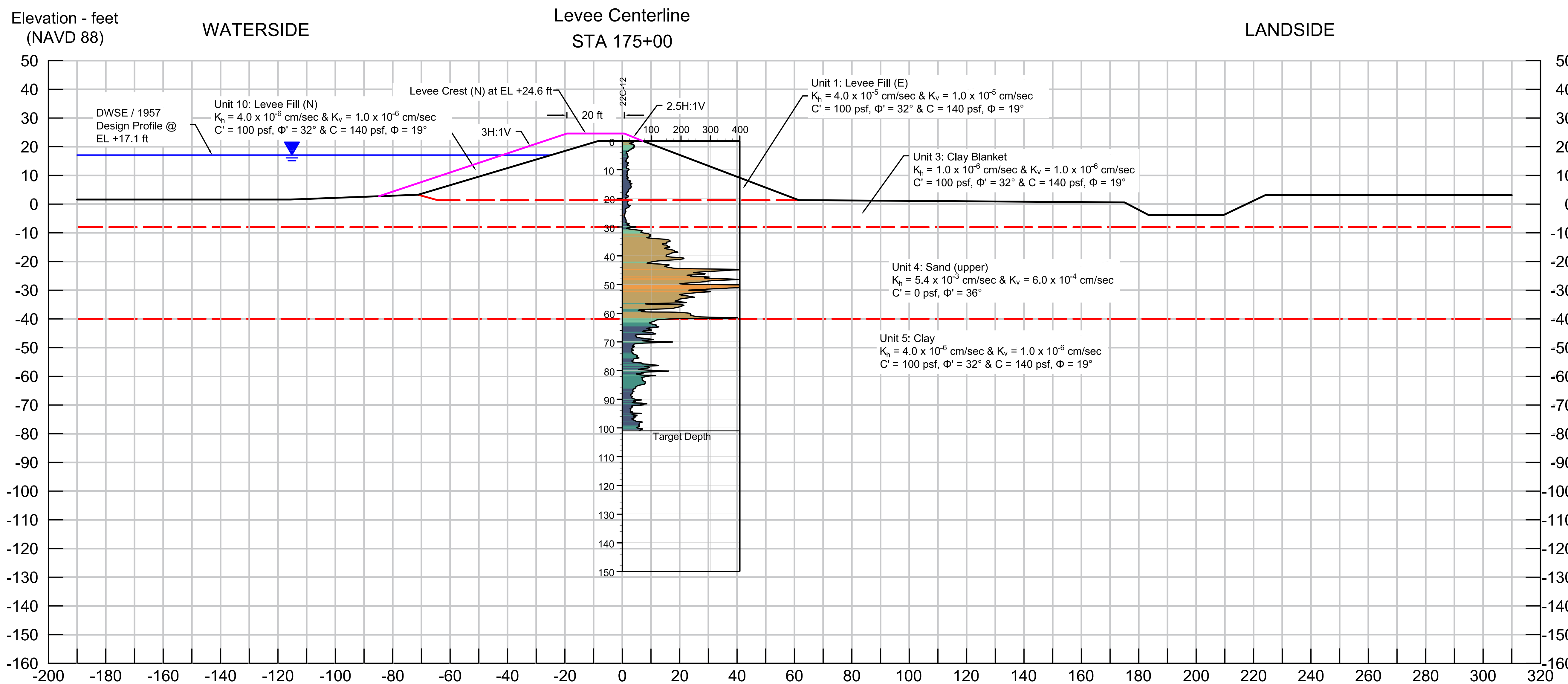


40 feet

SCALE:
H: 1" = 40'
V: 1" = 40'

40 feet

Little Egbert Multi-Benefit Project Phase II Solano County, California		**Station 135+00 (RD 536)** **Cross Section**	
Shannon & Wilson, Inc.	Project No. 907.03		Plate No. B-5



SCALE:
H: 1" = 40'
V: 1" = 40'

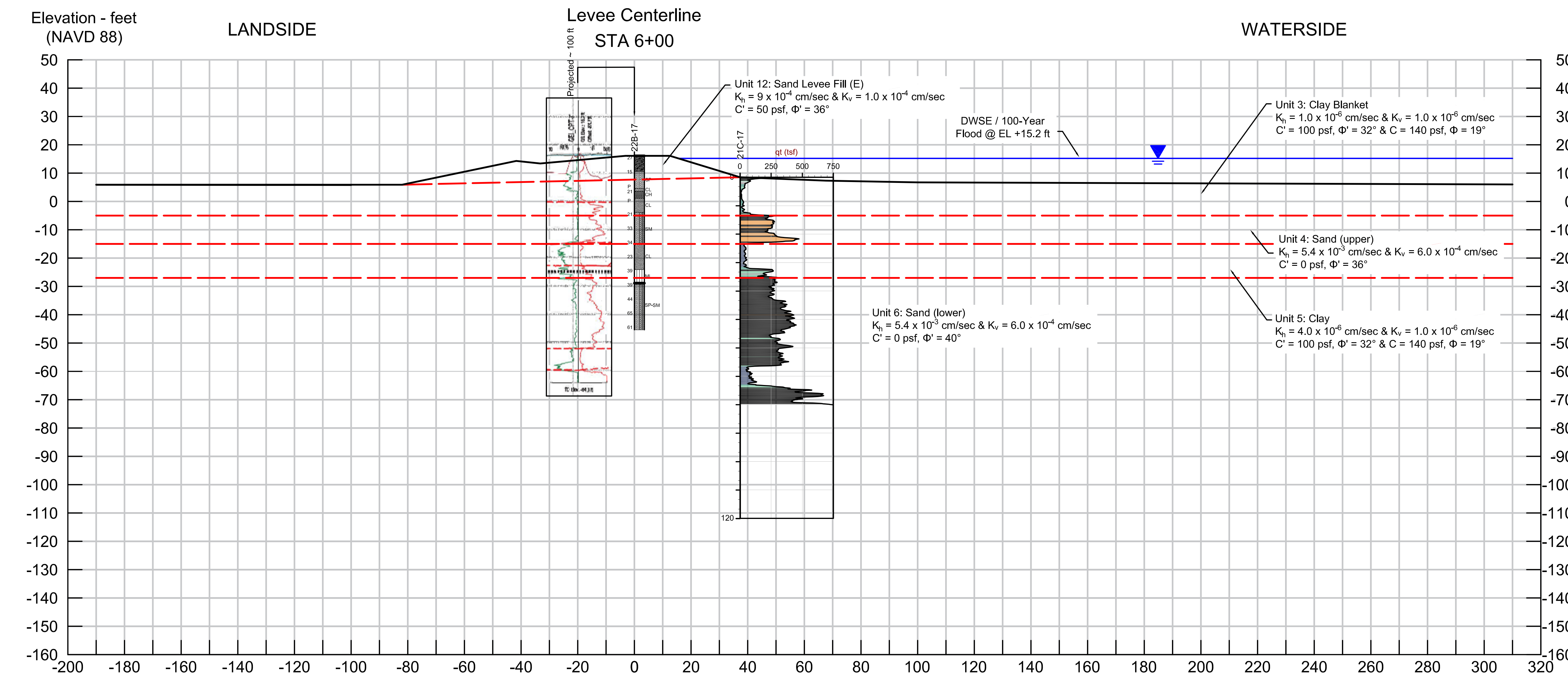
40 feet

40 feet

Little Egbert Multi-Benefit Project
Solano County, California

Station 175+00 (RD 536)
Cross Section

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No.B-6

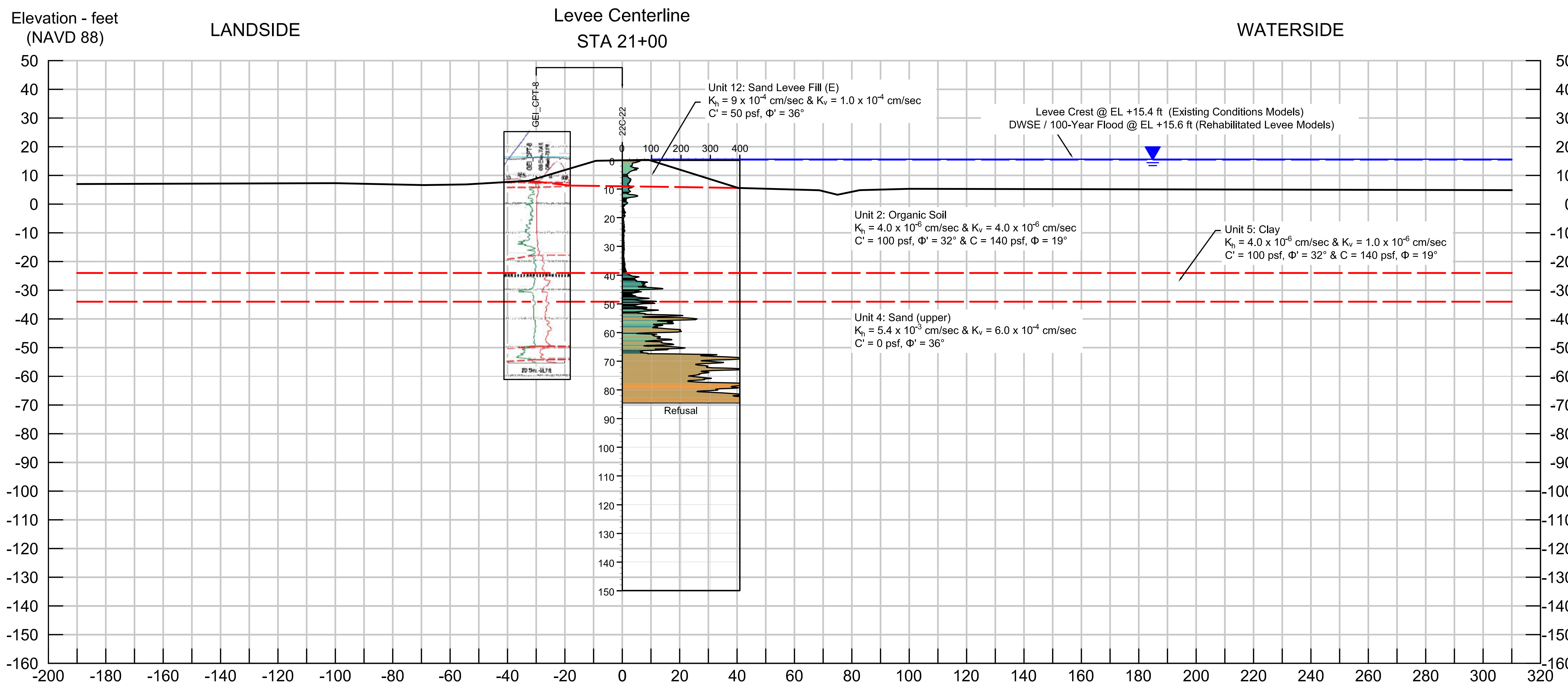


40 feet

SCALE:
H: 1" = 40'
V: 1" = 40'

40 feet

Little Egbert Multi-Benefit Project Solano County, California		**Station 6+00 (Mellin)** **Cross Section**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. B-7



40 feet

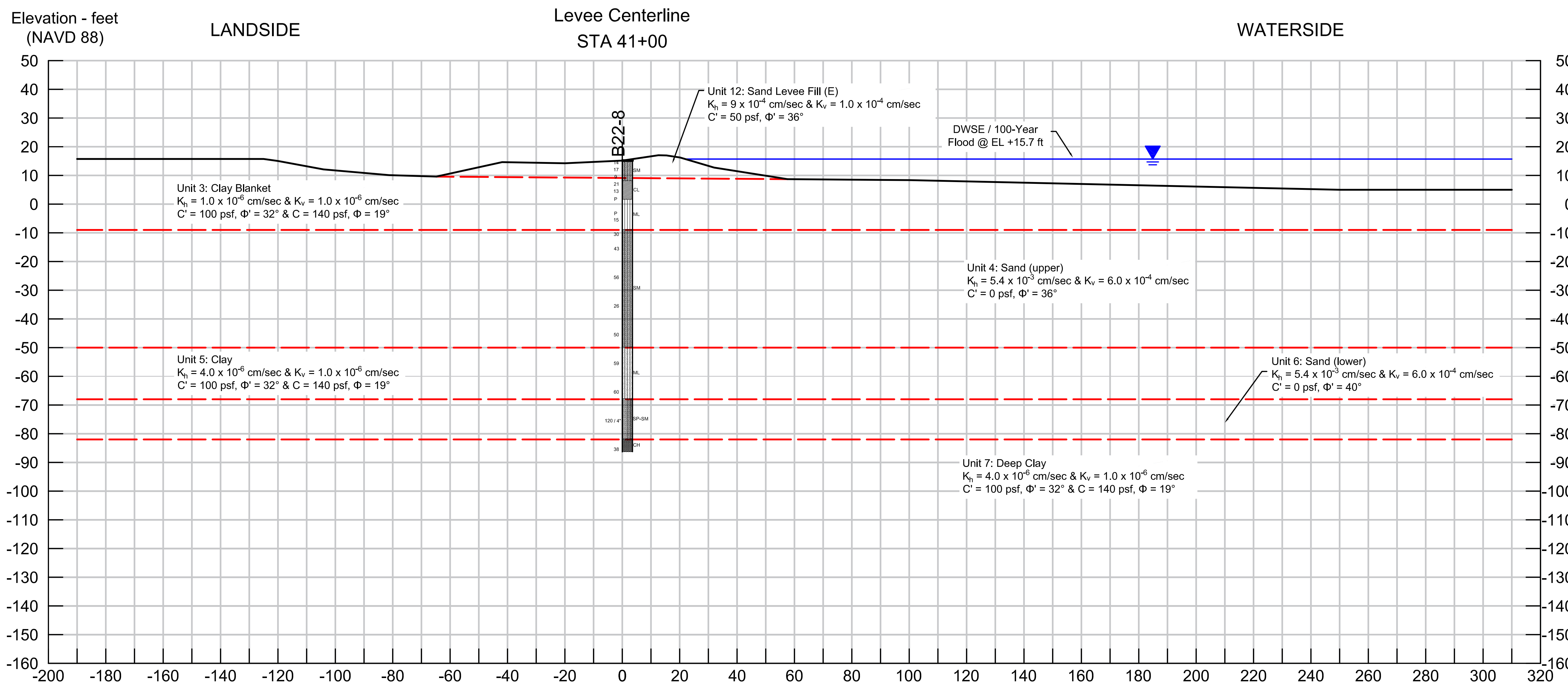
SCALE:
H: 1" = 40'
V: 1" = 40'

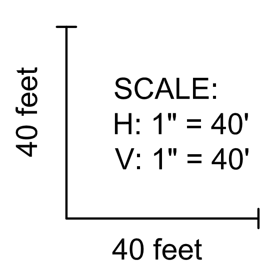
40 feet

Little Egbert Multi-Benefit Project
Solano County, California

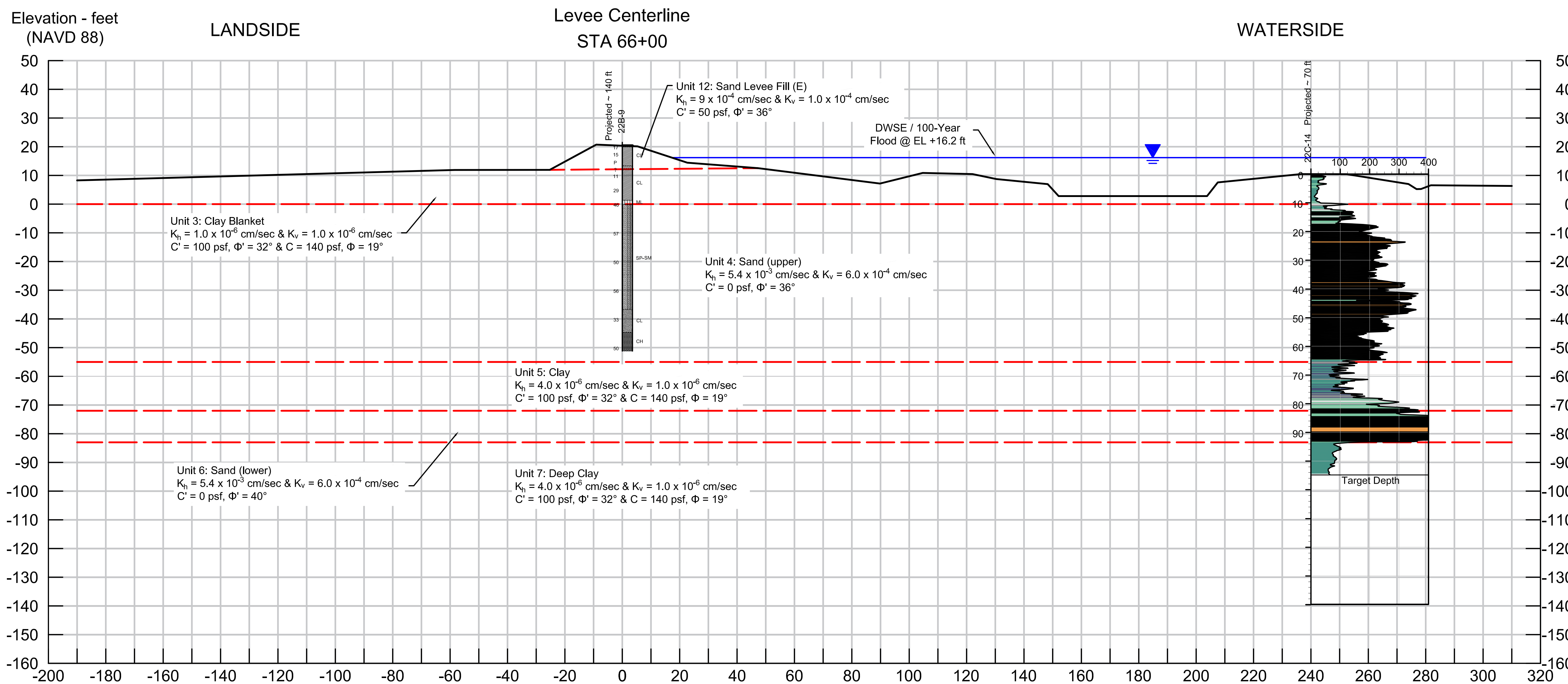
Station 21+00 (Mellin)
Cross Section

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. B-8





Little Egbert Multi-Benefit Project Solano County, California	**Station 41+00 (Mellin) Cross Section**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. B-9



SCALE:
H: 1" = 40'
V: 1" = 40'

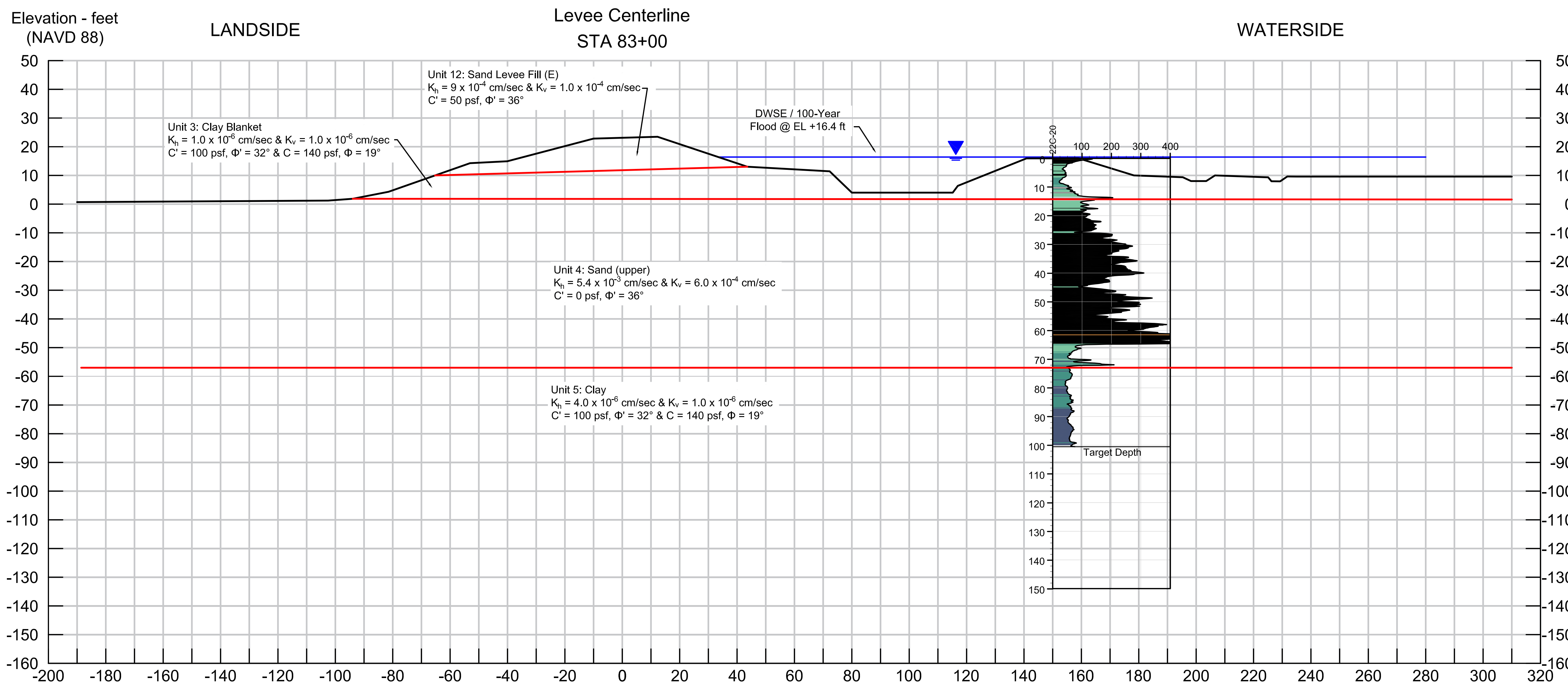
40 feet

40 feet

Little Egbert Multi-Benefit Project
Solano County, California

Station 66+00 (Mellin)
Cross Section

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. B-10



40 feet

SCALE:
H: 1" = 40'
V: 1" = 40'

40 feet

Little Egbert Multi-Benefit Project Solano County, California		**Station 83+00 (Mellin) Cross Section**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. B-11

APPENDIX C: BORROW AREA MAPS

Appendix C

Borrow Area Maps

PLATES

[Exploration Name]
[(Depth to Bottom of Fat Clay , Depth to Bottom of Lean Clay)]

N

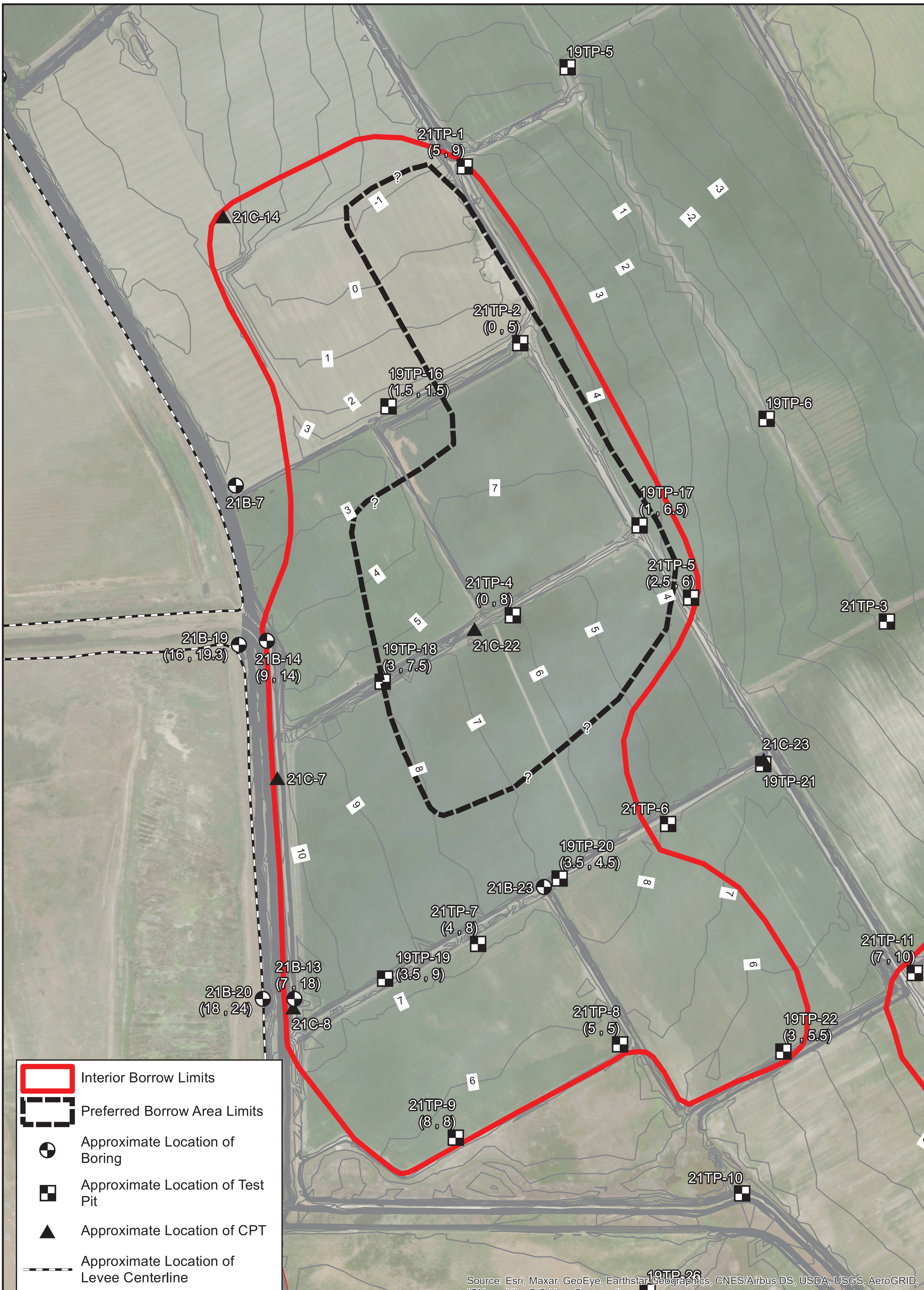
0 1,000 Feet

1 inch = 1,000 feet

Little Egbert Multi-Benefit Project
Solano County, California

Borrow Area Map

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. C-1



[Exploration Name]
[(Depth to Bottom of Fat Clay , Depth to Bottom of Lean Clay)]

N

0 500 Feet

1 inch = 500 feet

Little Egbert Multi-Benefit Project
Solano County, California

Borrow Area Map
Zone 1

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. C-2

[Exploration Name]
[(Depth to Bottom of Fat Clay , Depth to Bottom of Lean Clay)]

N

0 500 Feet

1 inch = 500 feet

Little Egbert Multi-Benefit Project
Solano County, California

Borrow Area Map
Zone 2

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. C-3

[Exploration Name]
[(Depth to Bottom of Fat Clay , Depth to Bottom of Lean Clay)]

N

0 500 Feet 1 inch = 500 feet	Little Egbert Multi-Benefit Project Solano County, California	**Borrow Area Map** **Zone 3**
	Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. C-4

APPENDIX D: ANALYSIS PARAMETER SELECTION

Appendix D

Analysis Parameter Selection

CONTENTS

Plates

APPENDIX D
Analysis Parameter Selection

D-1 MATERIAL PROPERTIES

D-1.1 General

We developed material properties and parameters for analysis based on field data, laboratory test results, the Guidance Document (2015), and our experience. This appendix provides a discussion of the parameter selection methodology. We reviewed the data collected in this investigation to evaluate the engineering properties of each unit and to select parameters. After review and selection, we compared the selected parameters to those provided in the Guidance Document (2015).

D-1.2 Soil Parameters for Seepage Analysis

The parameters used in the seepage analysis are presented in Table D-1. We present a discussion of the selected soil parameters below.

Table D-1: Soil Parameters for Seepage Analysis

Material	Vertical Conductivity (cm/sec)	Permeability Ratio (k_h/k_v)	Horizontal Conductivity (cm/sec)
Unit 1: Clay Levee Fill (Existing)	1×10^{-5}	4	4×10^{-5}
Unit 2: Organic Soil	4×10^{-6}	1	4×10^{-6}
Unit 3: Clay Blanket	1×10^{-6}	1	1×10^{-6}
Unit 4: Sand (Upper)	6×10^{-4}	9	5.4×10^{-3}
Unit 5: Clay	1×10^{-6}	4	4×10^{-6}
Unit 6: Sand (Lower)	6×10^{-4}	9	5.4×10^{-3}
Unit 7: Deep Clay	1×10^{-6}	4	4×10^{-6}
Unit 8: Cutoff Wall	1×10^{-6}	1	1×10^{-6}
Unit 9: Clay Cap	1×10^{-6}	4	4×10^{-6}
Unit 10: Levee Fill (New)	1×10^{-6}	4	4×10^{-6}
Unit 11: Drain Rock	1×10^{0}	10	1×10^{1}
Unit 12: Sand Levee Fill (Existing)	1×10^{-4}	9	9×10^{-4}

The permeability values were estimated based on laboratory test data to evaluate soil type. For reference, we have presented the Guidance Document's recommended vertical hydraulic conductivity (Figure A2-30) versus fines content plot on Plate D-2. We have included Table A2-12 on Plates D-3 and D-4. We have included the values from Table D-1 on Plates D-3 and D-4 for reference. A summary of the fines content, material finer than the number 200 sieve, of each soil unit is presented on Plate D-1. A summary of the fines content by elevation is plotted on Plate D-5.

The permeability of the clay fill (Unit 1) was compared to the presumptive values for clay fills placed in an uncontrolled manner.

The permeability of the organic soil (Unit 2) was selected at the high-permeability bound of the range of presumptive values to reflect the effects of seasonal drying. We used an anisotropic ratio of 1. The actual vertical permeability is likely higher than the horizontal permeability where the ground has been desiccated (anisotropic value below 1).

The permeability of Units 3, 5 and 7 were selected near the high-permeability bound of the presumptive values for natural, intact clays. We used an anisotropic ratio of 1 for Unit 3 for same reason as noted above for Unit 2. We selected an anisotropic ratio of 4 for the deeper clay deposits (Units 5 and 7).

We estimated the permeability of the native sand soils (Units 4 and 6) based on sieve analysis test data and compared them to the presumptive values presented in the Guidance Document (2015) for silty sands with less than 25 percent fines. The fines content of the native sand soils (Units 4 and 6) varied from 4 to 49 percent with an average fines content of 14 percent. We used a permeability ratio of 9 for the sand units because the units are alluvial and stratified.

The vertical conductivity and permeability ratio of the cutoff wall (Unit 8) was selected from the recommended vertical hydraulic conductivity from the Guidance Document (2015) for soil-bentonite or soil-cement-bentonite cutoff walls.

The clay cap and new levee fill (Units 9 and 10) will be required to meet the requirements for Central Valley Flood Protection Board (CVFPB) for levee fill. To meet this criteria, the material will have at least 20 percent fines and 100 percent passing the 2-inch sieve. The fines will have a plasticity index of at least 8 and less than 40, and a maximum liquid limit of 45. This material would classify as the controlled placement, clayey fines, under the embankments group. We selected an anisotropic ratio of 4 for the deeper clay deposits (Units 9 and 10).

We estimated the vertical permeability of drain rock (Unit 11) to be 1 cm/s.

We estimated the permeability of the existing sand fill (Unit 12) based on sieve analysis test data and the presumptive values presented in the Guidance Document (2015) for uncontrolled embankments. The fines content of the sand fill varied from 3 to 45 percent with an average fines content of 20 percent. We used a permeability ratio of 9 for the sand fill because the fill is stratified and non-uniform.

D-1.3 Soil Parameters for Slope Stability Analysis

The parameters used in the slope stability analysis are presented in Table D-2. We present a discussion of the selected soil parameters below.

For reference, we have presented the Figure 5-1 in the Guidance Document (2015) which categorizes non-free draining soils based on soil types groups on Plate D-6. For reference, we included Tables 5-4 and 5-5 of the Guidance Document (2015), on Plates D-7 and D-8, respectively. We have included the units from Table D-2 on Plates D-7 and D-8 for reference.

We estimated total unit weights of the units based on laboratory test results. Total unit weight based on laboratory test data is plotted versus depth and is presented on Plate D-9.

We plotted the Liquid Limit and Plasticity Index laboratory test results with elevation on Plates D-10 and D-11, respectively. We also plotted the Atterberg Limits test results according to the soil groups defined on Figure 5-1 of the Guidance Document (2015) on Plate D-12. The soil parameters used for the slope stability analysis are presented in Table D-2. We present a discussion of the selected soil parameters below.

Table D-2: Soil Parameters for Slope Stability Analysis

Material	Total Unit Weight (pcf)	Effective Strength Parameters		Undrained Strength Parameters			
				Rapid Drawdown		End of Construction	
		Cohesion (psf)	Friction Angle (deg)	Cohesion (psf)	Friction Angle (deg)	Cohesion (psf)	Friction Angle (deg)
Unit 1: Clay Levee Fill (Existing)	100	100	32	140	19	1,800	0
Unit 2: Organic Soil	95	100	32	140	19	See Discussion Below	0
Unit 3: Clay Blanket	125	100	32	140	19	2,500	0
Unit 4: Sand (Upper)	125	0	36	--	--	--	--
Unit 5: Clay	125	100	32	140	19	2,500	0
Unit 6: Sand (Lower)	125	0	40	--	--	--	--
Unit 7: Deep Clay	125	100	32	140	19	2,500	0
Unit 8: Cutoff Wall	120	50	30	--	--	--	--
Unit 9: Clay Cap	120	150	32	--	--	--	--
Unit 10: Levee Fill (New)	125	100	32	140	19	1,800	--
Unit 11: Drain Rock	135	0	40	--	--	--	--
Unit 12: Sand Levee Fill (Existing)	125	50	36	--	--	--	--

We estimated the effective stress strengths of the fine-grained, mineral soils (Units 1, 3, 5, and 7) using the boring and CPT data and the laboratory test results. We compared the selected values to the value in Table 5-4 of the Guidance Document (2015).

We estimated the effective stress strengths of the organic soils (Unit 2) using results from Isotropically-Consolidated Undrained Triaxial (TxCU) strength testing from this project site. We compared the values with the limiting effective stress parameters in Table 5-4 of the Guidance Document (2015) for Group 3 foundation soils.

Effective stress strength parameters for the sand units (Units 4,6, and 12) are based on the $(N_1)_{60}$-values encountered during subsurface exploration. We modified field penetration resistance (blow counts) to $(N_1)_{60}$-values by correcting for sampler size (C_s), hammer energy (C_E), borehole diameter (C_B) rod length (C_R), and overburden pressure (C_N). The $(N_1)_{60}$-values for sand soils are plotted by elevation on Plate D-13. We used averaged $(N_1)_{60}$-values for each sand unit and estimated the effective friction angle using Hatanaka & Uchida (1996). The average $(N_1)_{60}$-values and estimated effective friction angles are presented in Table D-3. We assumed that the native sand soil (Units 4 and 6) does not have cohesion. We assumed 50 psf cohesion for the sand fill.

Table D-3: Effective Friction Angle Correlation

Material	$(N_1)_{60}$	Average $(N_1)_{60}$	Hatanaka and Uchida (1996) Effective Friction Angle (degrees)	Hatanaka and Uchida (1996) Average Effective Friction Angle (degrees)	Design Friction Angle (Degrees)
Unit 4: Sand (Upper)	3 - 82	35	27 - 56	43	36
Unit 6: Sand (Lower)	18 – 73	51	36 – 53	48	40
Unit 12: Sand Levee Fill (Existing)	7 – 84	27	30 – 56	40	36

For the Cutoff Wall, Clay Cap, New Levee Fill, and Drain Rock, (Units 8 through 11, respectively) we reviewed the recommended strength values presented in Table 5-5 of the Guidance Document (2015), which is presented on Plate D-8

. We selected effective cohesion and friction angles similar to those presented on Plate D-8, with the exception of the cutoff wall (Unit 8). The recommended effective stress strength values for cutoff walls shown on Plate D-8 are undrained strengths, and we selected an effective cohesion and friction angle of 50psf and 30 degrees for Unit 8.

We used undrained strengths for selecting the strength parameters for the rapid drawdown and end-of-construction analyses. We developed undrained strengths for the fine-grained soil materials (Units 1-3, 5, 7, 10). For the rapid drawdown analysis, we selected undrained strength parameters based on site-specific, TxCU tests for the organic soil (Unit 2) and we used the same values for Units 1, 3, 5, 7, and 10.

For the end-of-construction analysis, we selected strength parameters based on Unconsolidated, Undrained Triaxial (TxUU) laboratory tests as well as pocket penetrometer and torvane strengths measured during exploration. We also used the tip resistances from CPTs to develop strength parameters for the end-of-construction analysis. We modeled the undrained shear strength of the organic soil assuming that the soils were normally consolidated with a ratio of undrained shear strength (S_u) to preconsolidation stress (p) of 0.3 (i.e., $S_u/p=0.3$). For organic soils outside of the levee footprint, we modeled a 5-foot thick soil crust with an undrained shear strength of 1000 psf. Below the 5-foot thick crust, we modeled the organic soils as normally consolidated with the S_u/p ratio described above.

D-1.4 Soil Parameters for Settlement Analysis

For the settlement analysis, we modeled the organic soil (Unit 2) as normally-consolidated and compressible. We modeled the other soil units as relatively incompressible and ignored them in our analysis. We used the soil unit weights presented in Table D-2 for the settlement analysis. We assumed a range of compression ratios (C_c / $(1+e_0)$) from 0.25 to 0.45 to estimate a range of settlement. The range of compression ratios is based on laboratory consolidation testing. The laboratory consolidation test results are summarized in Table D-4.

Table D-4: Summary of Consolidation Laboratory Tests

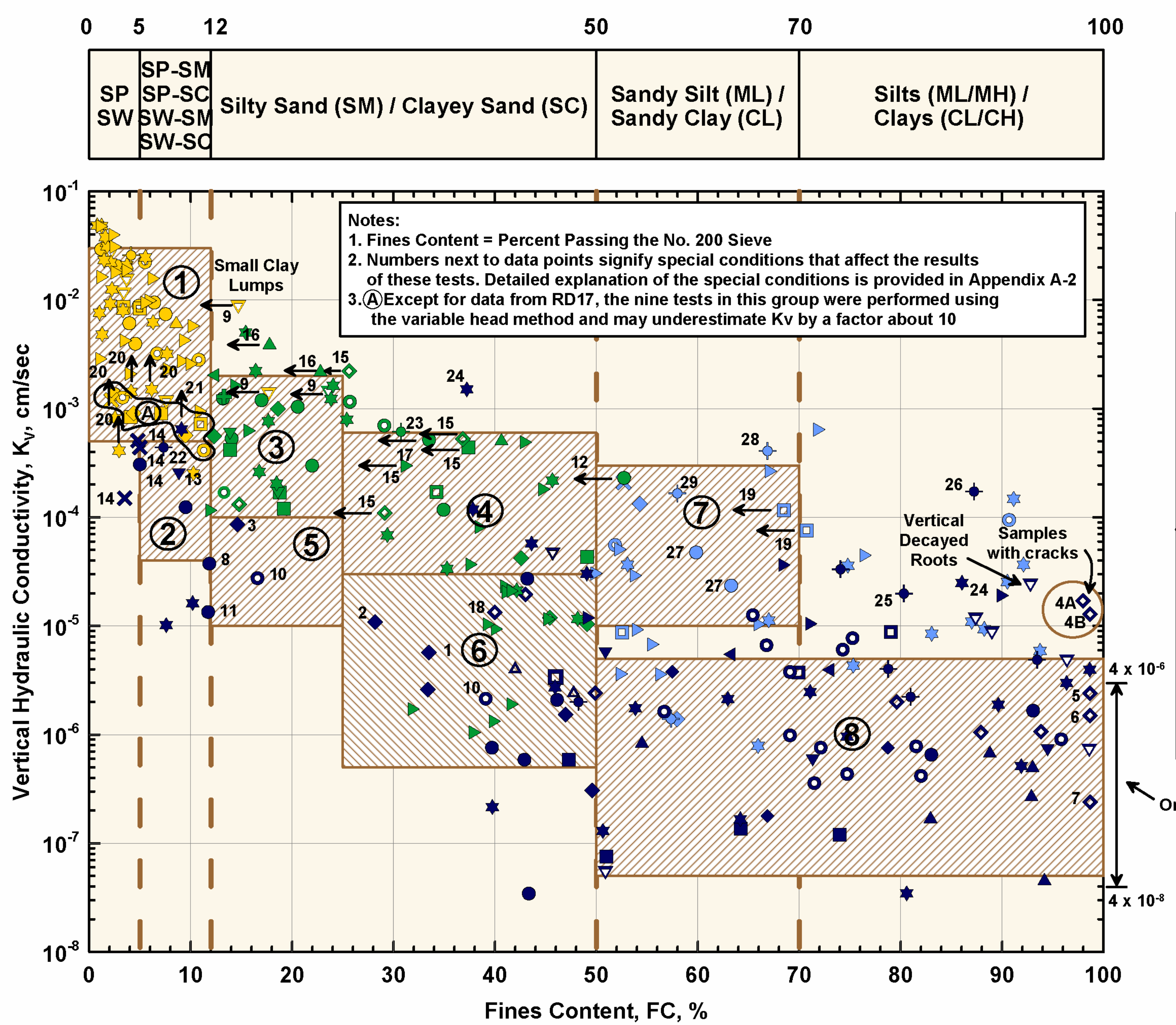
Material	Compression Ratio	Re-compression Ratio	Pre-consolidation Pressure (psf)	Over-consolidation Ratio
Unit 2: Organic Soil	0.22 – 0.47	0.04 – 0.07	1,000 – 2,300	1 - 2

Unit Number	Material Description	(N1)60	Average (N1)60	Pocket Penetrometer (tsf)	Torvane (tsf)	Water Content (%)	Dry Unit Weight (pcf)	Total Unit Weight (pcf)	LL (%)	PI (%)	Liquidity Index (%)	% Passing No. 200 Sieve
1	Clay Levee Fill (Existing)	--	--	0.5-4.5	0.7	14-72	56-110	78-132	45-101	18-74	-1.1 to 0.8	43-84
2	Organic Soil	--	--	0.2-4.5	0.2-0.7	20-174	29-99	79-125	40-111	22-61	0.1 to 2.8	45-100
3	Clay Blanket	--	--	0.5-4.5	0.1-0.5	16-56	67-115	100-144	21-77	5-49	-0.3 to 0.8	20-87
4	Sand (Upper)	3-82	35	--	--	8-41	80-130	110-140	--	--	--	4-49
5	Clay	--	--	1.5-4.5	--	21-32	88-111	113-134	26-69	11-47	0.1 to 0.5	47 to 75
6	Sand (Lower)	18-73	51	--	--	17-22	103-111	127-130	--	--	--	--
7	Deep Clay	--	--	2-4.5	--	27-28	97-99	123-126	67	44	0.1	--
12	Sand Levee Fill (Existing)	7-84	51	--	--	2-30	86-116	91-128	--	--	--	3-45

Little Egbert Multi-Benefit Project
Solano County, California

Summary of Field and Lab Test Results

Shannon and Wilson | Project No. 907.03 | Plate No. D-1



Colour	Soil Type
Yellow	Clean Sand Materials : SP, and SP-SM
Green	Silty Sands (SM)
Light blue	Silts (ML, MH)
Dark blue	Sandy Clays, Clayey Sands and Clays (SP-SC, SC, CL, CH)

Soil Group		Range of fines content (%)	Range of hydraulic conductivity (cm/sec)
1	SP, SW, SP-SM, SW-SM	0 - 12	5×10^{-4} to 3×10^{-2}
2	SP-SC, SW-SC	5 - 12	4×10^{-5} to 5×10^{-4}
3	SM	12 - 25	1×10^{-4} to 2×10^{-3}
4	SM	25 - 50	1×10^{-5} to 6×10^{-4}
5	SC	12 - 25	1×10^{-5} to 1×10^{-4}
6	SC	25 - 50	5×10^{-7} to 3×10^{-5}
7	ML Sandy silt	50 - 70	1×10^{-5} to 3×10^{-4}
8	Sandy clay, clays CL, CH	50 - 100	5×10^{-8} to 5×10^{-6}
9	Organic Clay and Silts(OH)		4×10^{-8} to 4×10^{-6} *

* Results of Eleven Tests

VARIATION OF VERTICAL HYDRAULIC CONDUCTIVITY WITH FINES CONTENT: RECOMMENDATIONS FOR SEAPAGE ANALYSIS

DWR Levee Evaluation Program
ULE Special Testing Program
DWR Guidance Document
California Department of Water Resources
November 2013 Sacramento, CA

Q:\132217\4 Internal Project Data\4-05 Reports & Narratives\2013-01 Appendix A-2 DWR Guidance Document\Appendix A-2 New Version\Figures\11x17 K vs FC2.grf

FIGURE A2-30

Source: California Department of Water Resources (2015). Guidance Document for Geotechnical Analyses, Urban Levee Evaluations Project, April 2015.

Little Egbert Multi-Benefit Project Solano County, California		**Variation of Vertical Hydraulic Conductivity With Fines Content**
Shannon & Wilson	Project No. 907.03	Plate No. D-2

TABLE A2-12
REVISED RECOMMENDATIONS FOR
PRESUMPTIVE VALUES OF HYDRAULIC CONDUCTIVITY
UNOFFICIAL GUIDANCE FOR DWR USE

Soil Type/Group			Presumptive Hydraulic Conductivity (k_v) (cm/sec)	Anisotropic Ratio k_h/k_v	Comments	Design Values
Cut-off Walls	Soil-Bentonite		1×10^{-6}	1		1×10^{-6} (Unit 8)
	Soil-Cement-Bentonite		1×10^{-6}	1		
	Cement-Bentonite		1×10^{-7}	1		
Clean Sands and Gravels: SP, GP, SW, GW Fines Content (FC) ≤ 5% $0.06 \leq D_{10} < 3mm$			5×10^{-1} to 1×10^{-3}	1 - 4	If gradation data are available, use K-C equation or other correlation between D_{10} and k	
Sands and Gravels 5% < FC ≤ 12% $0.06 \leq D_{10} < 3mm$	Silty Fines SP-SM, SW-SM GP-GM, GW-GM		**3×10^{-2} to 5×10^{-4}**			
	Plastic Fines SP-SC, SW-SC GP-GC, GW-GC		**5×10^{-5} to 5×10^{-4}**			
Silty and Clayey Sands and Gravels (SM, SC, SM-SC, GM, GC, GM-GC)	Natural Soils	Silty Fines - less than **25%** fines	**2×10^{-3} to 1×10^{-4}**	1 - 4*	Consider amount of cementation	6×10^{-4} (Units 4,6)
		Silty Fines - more than **25%** fines	**6×10^{-4} to 1×10^{-5}**			
		Clayey Fines - less than **25%** fines	**1×10^{-4} to 1×10^{-5}**			
		Clayey Fines - more than **25%** fines	**3×10^{-5} to 5×10^{-7}**			
	Embankments	Controlled Placement - silty fines	1×10^{-4} to 1×10^{-6}	1 - 4		
		Controlled Placement - clayey fines	1×10^{-5} to 1×10^{-7}			1×10^{-6} (Units 9, 10)
		Uncontrolled	1×10^{-3} to 1×10^{-6}	1 - 4*		1×10^{-4} (Unit 12)
Sandy Silts (ML, ML/SM)	Natural Soils		**3×10^{-4} to 1×10^{-5}**	1 - 4*	Consider amount of cementation	
	Embankments	Controlled Placement	1×10^{-5} to 1×10^{-7}	1 - 4		
		Uncontrolled Placement	1×10^{-4} to 1×10^{-6}	1 - 4*		

Note:

Recommended revisions are in bold type

Source: California Department of Water Resources (2015). Guidance Document for Geotechnical Analyses, Urban Levee Evaluations Project, April 2015.

Little Egbert Multi-Benefit Project Solano County, California	**Table A2-12** **Revised Recommendations for Presumptive Values of Hydraulic Conductivity**
Shannon and Wilson	Project No. 907.03 | Plate No. D-3

TABLE A2-12 REVISED RECOMMENDATIONS FOR PRESUMPTIVE VALUES OF HYDRAULIC CONDUCTIVITY UNOFFICIAL GUIDANCE FOR DWR USE					
Soil Type/Group			**Presumptive Hydraulic Conductivity (k_v) (cm/sec)**	**Anisotropic Ratio k_h/k_v**	**Comments**
Silts (ML, MH)	Natural Soils		**3×10^{-5} to 4×10^{-6}**	1 - 4	
	Embankments	Controlled Placement	1×10^{-5} to 1×10^{-7}	1 - 4	
		Uncontrolled Placement	1×10^{-4} to 1×10^{-6}	1 - 4	
Clays (CL, CL-ML, CH, OH)	Natural Soils	Intact	**5×10^{-6} to 5×10^{-8}**	1 - 4	Consider amount of cementation
		Cracking Due to Desiccation Through Entire Layer	**2×10^{-5} to 2×10^{-6}**	1 - 4	
	Embankments	Controlled Placement	1×10^{-6} to 1×10^{-8}	1 - 4	
		Uncontrolled Placement	1×10^{-4} to 1×10^{-7}	1 - 4	
Organic (OH, OL)			**4×10^{-6} to 4×10^{-8}**	1 - 4	
Peats			1×10^{-3} to 1×10^{-5}	1 - 4*	

*** This table is applicable to consistently uniform layers. When dealing with composite layers, analyst needs to determine the element to identify the associated range. Stratification could result in Anisotropic Ratio (AR) values of up to 9 based on field conditions.**

Design Values

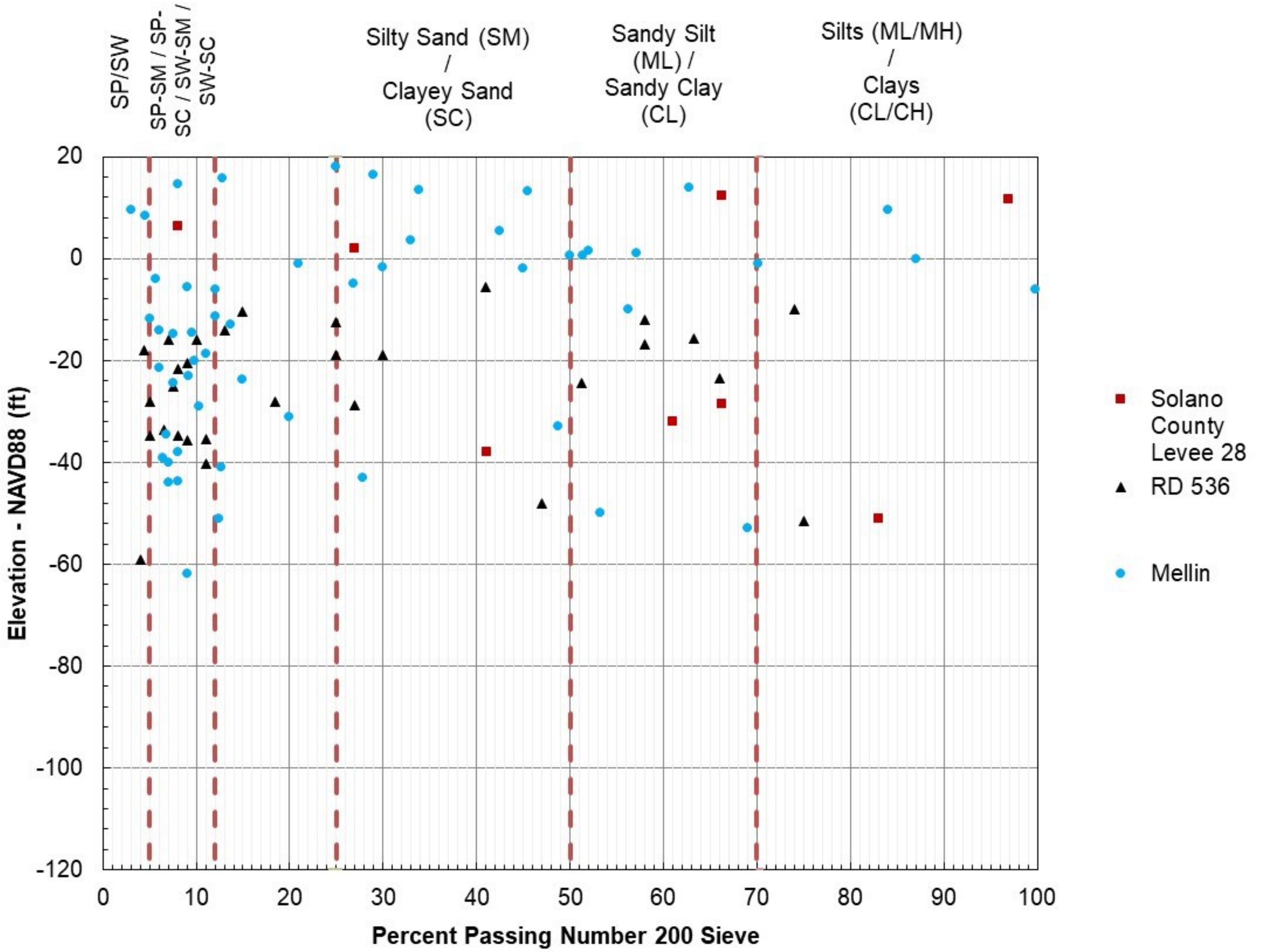
- 1×10^{-6} (Units 3, 5, 7)
- 1×10^{-5} (Unit 1)
- 4×10^{-6} (Unit 2)

Note:

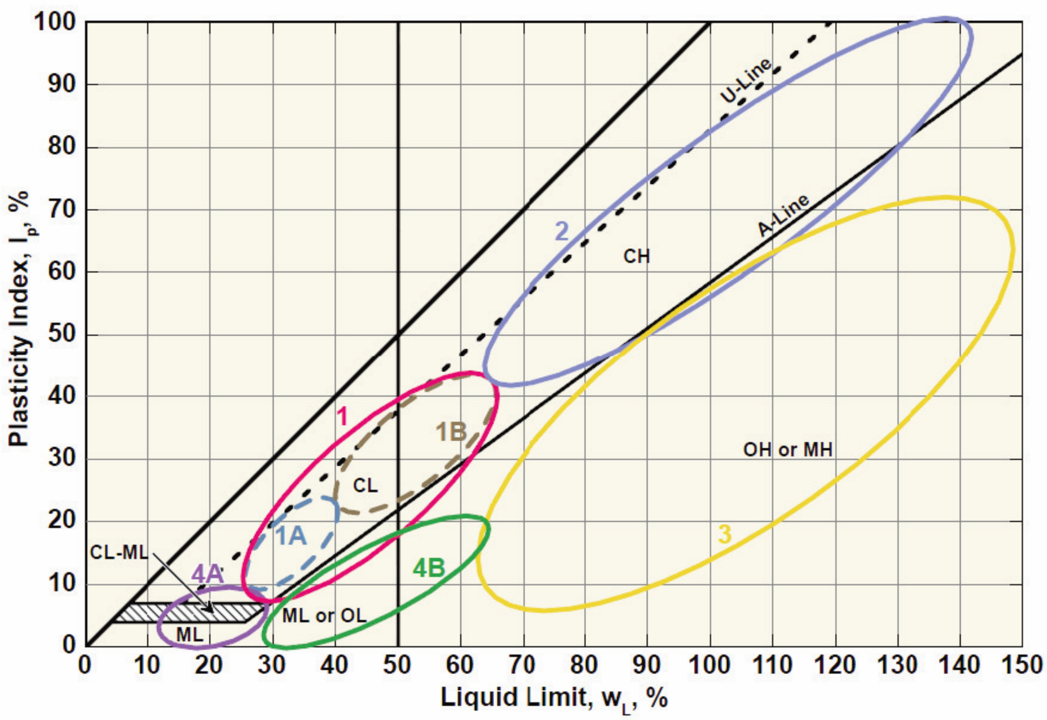
Recommended revisions are in bold type

Source: California Department of Water Resources (2015). Guidance Document for Geotechnical Analyses, Urban Levee Evaluations Project, April 2015.

Little Egbert Multi-Benefit Project Solano County, California	**Table A2-12 (continued) Revised Recommendations for Presumptive Values of Hydraulic Conductivity**	
Shannon and Wilson	Project No. 907.03	Plate No. D-4



Little Egbert Multi-Benefit Project Solano County, California	**Percent Passing No. 200 Sieve Results**	
Shannon and Wilson	Project No. 907.03	Plate No. D-5



Department of Water Resources Division of Flood Management	URS	Non-Free Draining Soils – Modified Plasticity Chart URBAN LEVEE EVALUATIONS	Figure 5-1

Source: California Department of Water Resources (2015). Guidance Document for Geotechnical Analyses, Urban Levee Evaluations Project, April 2015.

Table 5-4 Summary of Strength Relationships for Non-Free-Draining Soils for Steady-State Conditions

Soil Type [1, 4]	Site-Specific Drained Strength Related Data Available	Site-Specific Strength Related Data Limited or Not Available	
		OCR ≥ 2, or Liquidity Index ≤ 0.6	OCR < 2, or Liquidity Index > 0.6
Group 1 Soils Foundation Layers	c′ + Φ′ as determined from strength tests c′ ≤ 200 psf Φ′ ≤ 35 degrees	c′ = 0.015 x σ'_p ≤ 150 psf, if σ'_p is known c′ ≤ 100 psf, if σ_p is not known Φ′ = 28 to 32 degrees (Units 3, 5, 7)	c′ = 0 Φ′ = 30 to 32 degrees
Group 1 Soils Embankment Layers [3]	c′ + Φ′ as determined from strength tests c′ ≤ 100 psf Φ′ ≤ 32 degrees	c′ = 0.01 x σ'_p ≤ 100 psf, if σ'_p is known c′ = 50 psf, if σ'_p is not known Φ′ = 28 to 32 degrees [2] (Unit 1)	c′ = 0 Φ′ =27 to 30 degrees
Group 2 Soils Foundation Layers	c′ + Φ′ as determined from strength tests c′ ≤ 200 psf (Unit 2) Φ′ ≤ 32 degrees	c′ = 0.02 σ'_p ≤ 100 psf, if σ'_p is known c′ ≤ 75 psf, if σ'_p is not known Φ′ = 27 to 30 degrees	c′ = 0 Φ′ = 27 to 30 degrees
Group 2 Soils Embankment Layers	c′ + Φ′ as determined from strength tests, but: c′ ≤ 100 psf Φ′ ≤ 32 degrees	c′ = 0.01 x σ'_p ≤ 75 psf, if σ'_p is known c′ ≤ 50 psf, if σ'_p is not known Φ′ = 27 to 30 degrees [2]	c′ = 0 Φ′ = 27 to 30 degrees [2]
Group 3 Soils/Organic Soils Foundation Layers	c′ + Φ′ as determined from strength tests c′ ≤ 100 psf Φ′ ≤ 32 degrees	c′ = 0.02 σ'_p ≤ 75 psf, if σ'_p is known c′ ≤ 50 psf, if σ'_p is not known Φ′ = 27 to 31 degrees[2, 3]	c′ = 0 Φ′ = 27 to 30 degrees[2]
Group 3 Soils/Organic Soils Embankment Layers	c′ + Φ′ as determined from strength tests c′ ≤ 75 psf Φ′ ≤ 32 degrees	c′ = 0.01 x σ'_p ≤ 50 psf, if σ'_p is known c′ ≤ 0 psf, if σ'_p is not known	c′ = 0 Φ′ = 27 to 28 degrees[2, 3]
Group 4 Soils Foundation Layers	c′ + Φ′ as determined from strength tests c′ ≤ 150 psf Φ′ ≤ 36 degrees	c′ = 0.015 σ'_p ≤ 75 psf, if σ'_p is known c′ ≤ 50 psf, if σ'_p is not known Φ′ = 31 to 34 degrees	c′ = 0 Φ′ = 30 to 34 degrees
Group 4 Soils Embankment Soils	c′ + Φ′ as determined from strength tests c′ ≤ 100 psf Φ′ ≤ 34 degrees	c′ = 0.01 σ'_p ≤ 50 psf, if σ'_p is known c′ = 0 psf, if σ'_p is not known Φ′ = 30 to 33 degrees	c′ = 0 Φ′ = 28 to 32 degrees

Legend:
c′ = effective cohesion
Φ′ = effective friction angle
σ'_{vm} = effective vertical maximum past pressure

Notes:
1 See Figure 5-1 for definition of soil groups.
2 ULE analysts must consider construction processes and potential variability that might not have been captured by available tests when selecting parameters for slope stability.
3 For embankment soils, ULE analysts should consider the effects of construction processes and potential variability of the placement conditions when selecting conservative parameters for slope stability analysis.
4 For Group 1 soils used in a remediation effort, see recommendations in Section 5.8.3.2

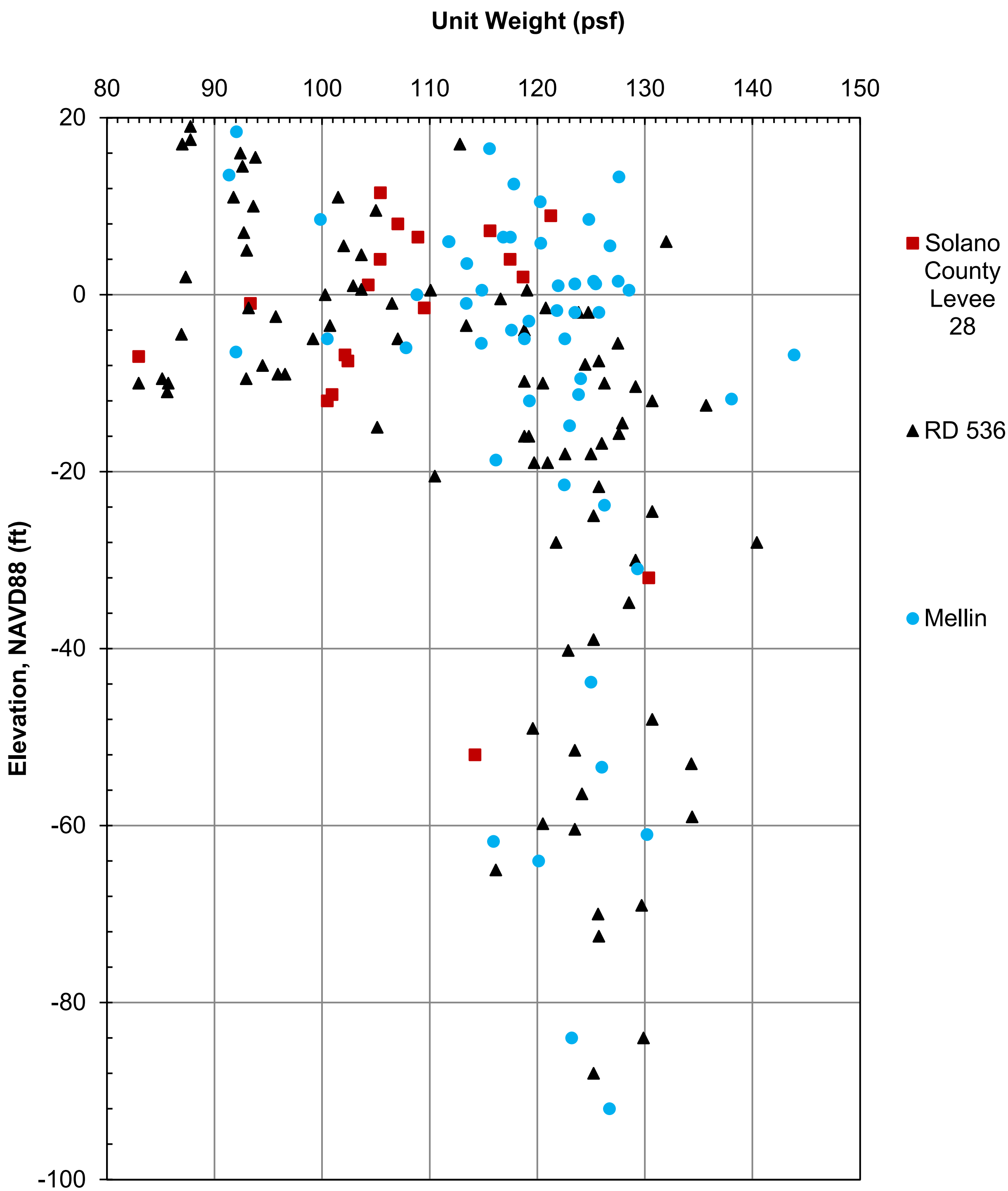
Source: California Department of Water Resources (2015). Guidance Document for Geotechnical Analyses, Urban Levee Evaluations Project, April 2015.

Table 5-5 Recommended Material Properties[1] for ULE Remedial Alternatives

Remedial Alternative	Component of Remedial Alternative		c'	φ'	c	φ	k_h	k_v	Total Unit Weight
			(psf)	deg.	(psf)	deg	(cm/sec)	(cm/sec)	(pcf)
Cutoff Wall/DSM Wall	Clay Cap/Fill (Unit 9)		100	31	360	4	1.0E-06	2.5E-07	125
	SB (Unit 8)		300	0	360	4	5.0E-07	5.0E-07	100
	SCB		500	0	360	4	1.0E-07	1.0E-07	120
	CB		500	0			1.0E-06	1.0E-06	70
Drained Stability Berm/Toe Berm	Berm Fill	Cohesionless	0	34	0	34	1.0E-03	2.5E-04	120
		Cohesive	100	32	360	4	1.0E-06	3.0E-07	125
	Berm Drainage Material		0	35	0	35	5.0E-02	5.0E-02	130
	Berm Filter Material		0	34	0	34	1.0E-03	1.0E-03	120
Seepage Berm	Berm Fill	Cohesionless	0	34	0	34	1.0E-03	2.5E-04	120
		Cohesive	100	32	360	4	1.0E-06	3.0E-07	125
(Unit 11)	Berm Drainage Material		0	35	0	35	5.0E-02	5.0E-02	130
	Berm Filter Material		0	34	0	34	1.0E-03	1.0E-03	120
Combination Seepage-Stability Berm	Berm Fill	Cohesionless	0	34	0	34	1.0E-03	2.5E-04	120
		Cohesive	100	32	360	4	1.0E-06	3.0E-07	125
	Berm Drainage Material		0	35	0	35	5.0E-02	5.0E-02	130
	Berm Filter Material		0	34	0	34	1.0E-03	1.0E-03	120
Rock Slope Protection	Launch Rock		0	40	0	40	1.0E+00	1.0E+00	135
	Sand Bedding		0	34	0	34	1.0E-03	1.0E-03	120
Replacement Levee	Clay Fill (Unit 10)		100	31	360	4	1.0E-06	2.5E-07	125
Geometry and Freeboard Repairs (Levee Raise/ Levee Widening)	Clay Fill		100	31	360	4	1.0E-06	2.5E-07	125
Ditch Fill			Locally available material assumed for fill						
Relief Well			Used in Marysville Study Area						

[1] Local materials or conditions may warrant site-specific material properties

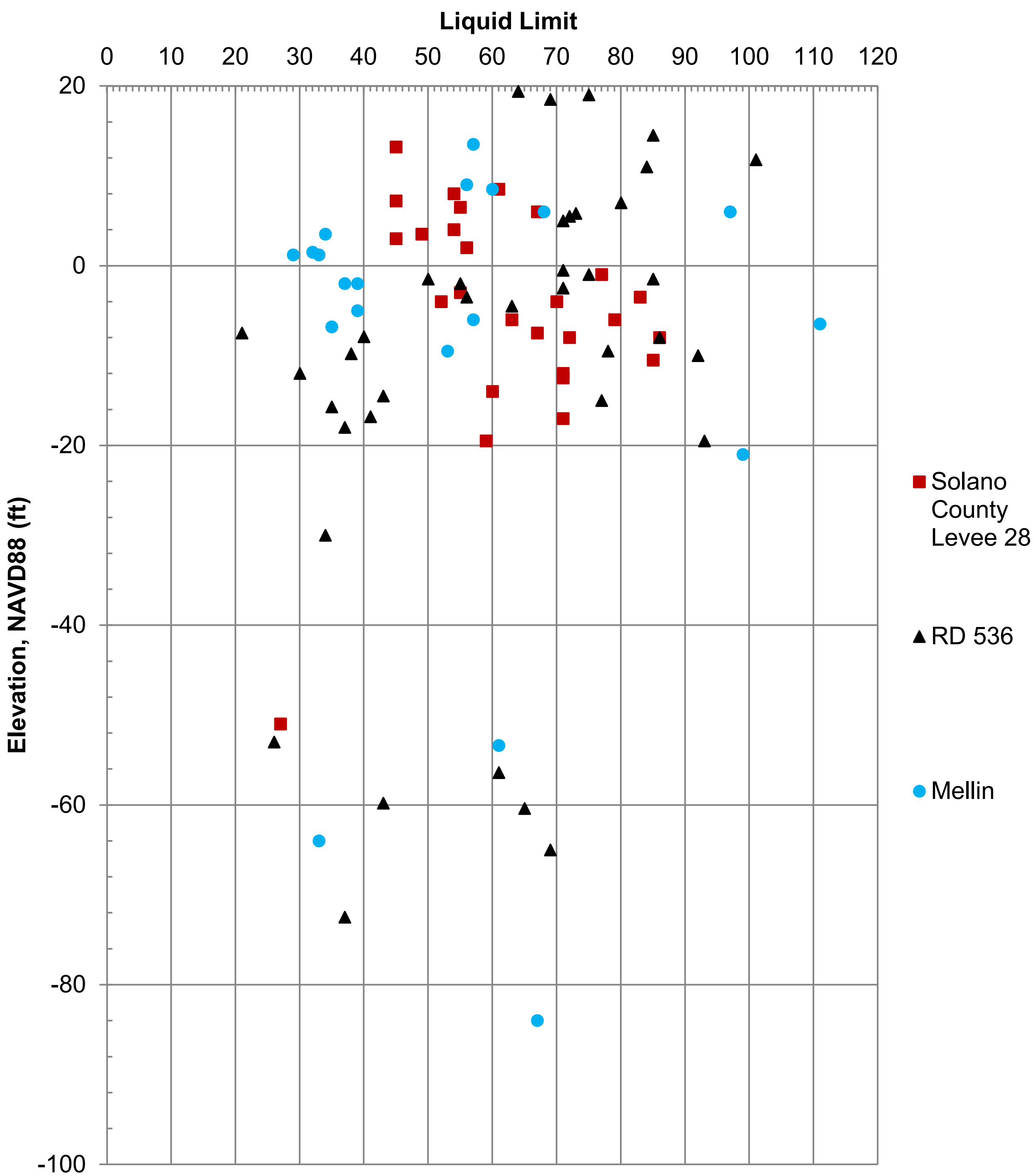
Source: California Department of Water Resources (2015). Guidance Document for Geotechnical Analyses, Urban Levee Evaluations Project, April 2015.



Little Egbert Multi-Benefit Project
Solano County, California

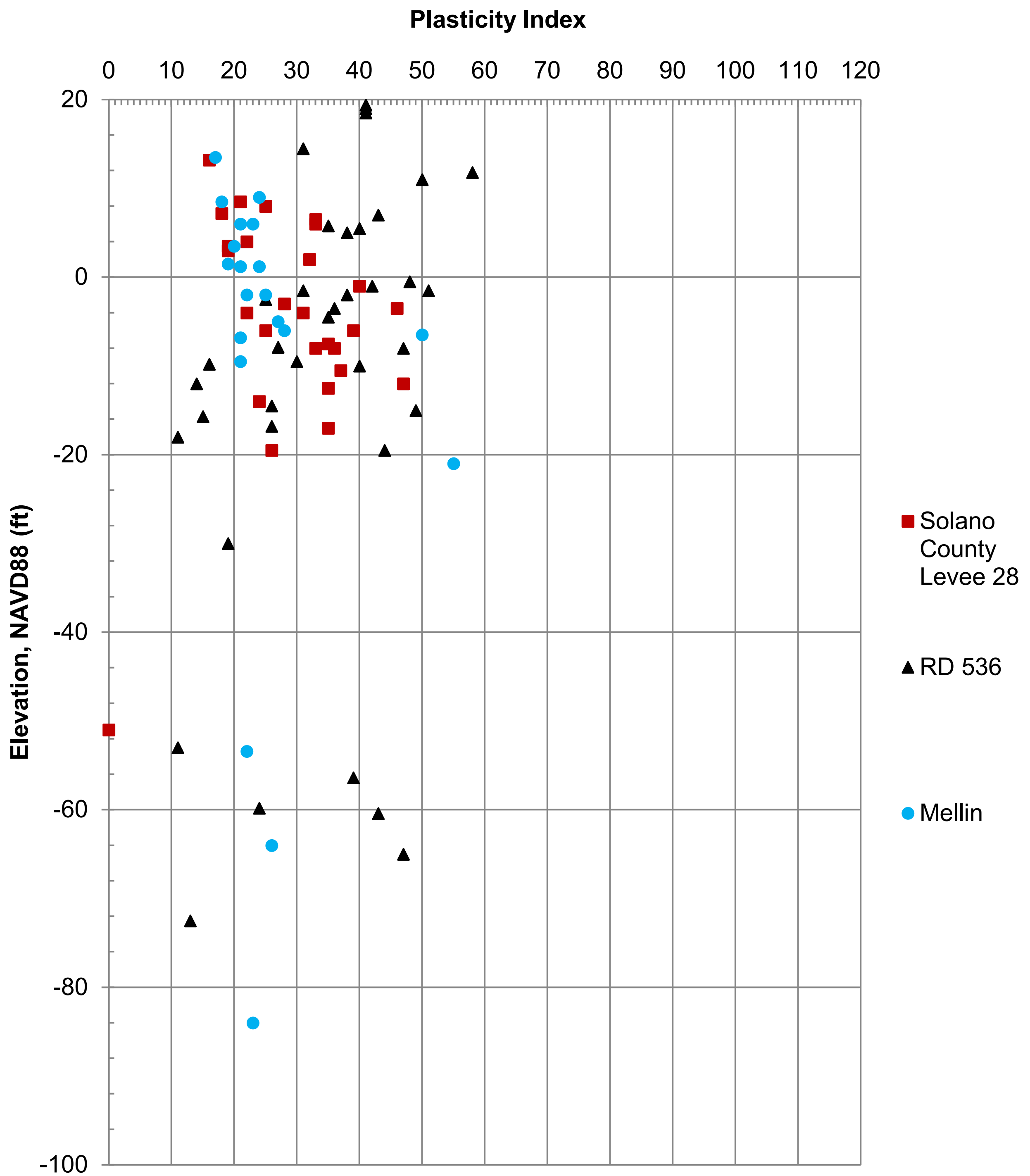
Total Unit Weight Laboratory Test Results

Shannon and Wilson	Project No. 907.03	Plate No. D-9



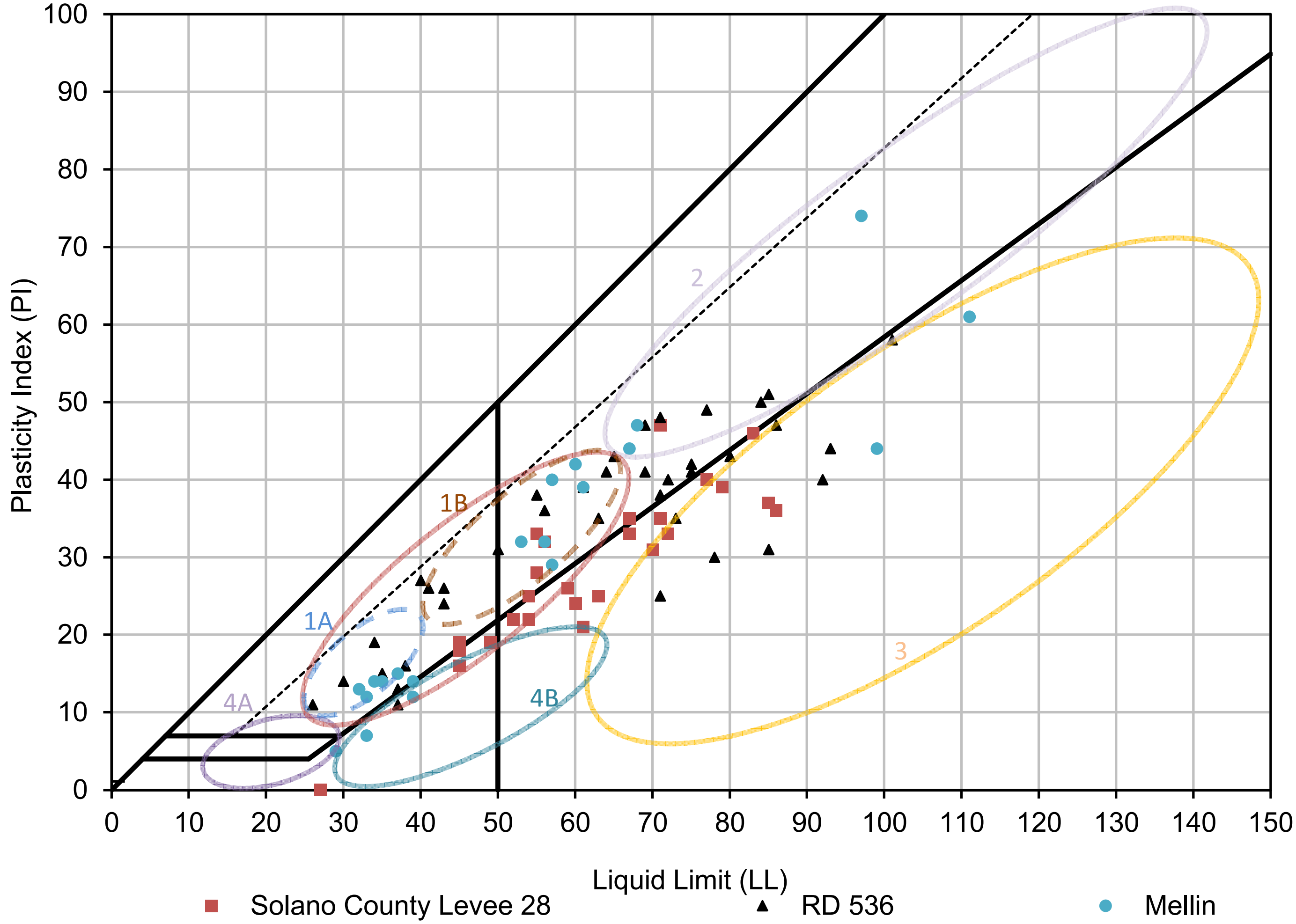
Little Egbert Multi-Benefit Project Solano County, California	**Liquid Limit Laboratory Test Results**

Shannon and Wilson	Project No. 907.03	Plate No. D-10



Little Egbert Multi-Benefit Project Solano County, California	**Plasticity Index Laboratory Test Results**

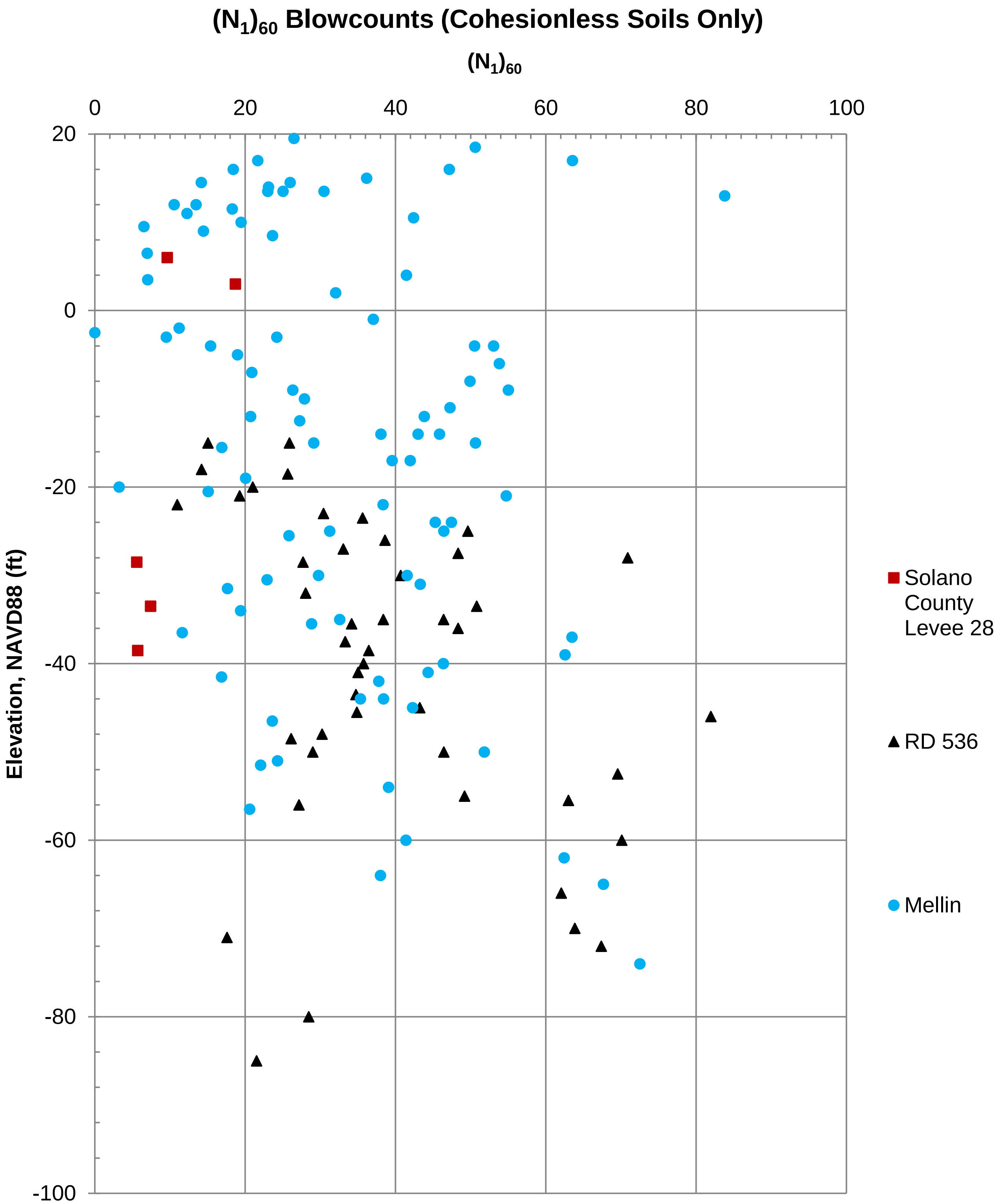
Shannon and Wilson	Project No. 907.03	Plate No. D-11



Little Egbert Multi-Benefit Project
Solano County, California

Atterberg Limits Test Results

Hultgren - Tillis Engineers	Project No. 907.03	Plate No. D-12



Little Egbert Multi-Benefit Project
Solano County, California

$(N_1)_{60}$ Blow Counts

Shannon and Wilson	Project No. 907.03	Plate No. D-13

APPENDIX E: SEEPAGE ANALYSIS

Appendix E

Seepage Analysis

CONTENTS

Plates

APPENDIX E: SEEPAGE ANALYSIS

APPENDIX E
Seepage Analysis

E-1 SEEPAGE ANALYSIS

E-1.1 General

We performed analysis to evaluate seepage at the ten locations listed in the Basis of Design section of this report. The subsurface conditions at these locations are described in the main text and depicted in Appendix B. The details of the analysis and results are presented below.

E-1.2 Analysis and Results

We performed seepage analysis using computer program SEEP/W. We analyzed seepage for the design water surface elevation (DWSE) and the hydraulic top of levee (HTOL). The DWSE and HTOL elevations at each station are presented in the Basis of Design section of this report.

The seepage analyses assume steady state flow conditions. The seepage models and results are shown for each section on Plates E-1 through E-60. The models include existing conditions and a rehabilitated levee without a seepage berm or cutoff for all ten sections. For sections within station ranges where we recommend a seepage berm or cutoff, we also modeled a rehabilitated levee with a cutoff and a rehabilitated levee with a seepage berm.

The model extends 2,000 feet landward and 1,000 feet on the waterside. The model includes a high mesh density (1 foot by 1 foot to 2 feet by 2 feet) in and around the levee embankment within approximately 150 to 450 feet from the levee centerline and a lower mesh density (4 feet by 4 feet) outside of approximately 450 feet from the levee centerline.

The model includes a no-flow boundary condition along the vertical face of the waterside boundary and the bottom of each model; the modeled water level (either DWSE or HTOL) as a total head boundary condition applied to the surface of the waterside of the levee slope; and a total head boundary condition along the vertical face of the landside boundary which matched the landside ground surface elevation. Along the levee crown, landside slope and landside ground surface, a no-flow boundary condition, the model includes the "potential seepage face review" option in SEEP/W. At landside ditches, we modeled two cases, each with a different boundary condition to represent the potential for the landside ditch to be full of water or empty. We modeled the landside ditch as full by setting the faces of the ditch to a total head boundary condition which matched the elevation of the top of the ditch. We modeled the landside ditch as empty by setting the faces of the ditch to a no-flow boundary condition with the "potential seepage face review" option checked. No other flows into or out of the system were modeled in the analysis, such as infiltration and evapo-transpiration.

We calculated the average vertical exit gradient through the clay foundation at the landside levee toe and in the bottom of landside ditches. Tables E-1 through E-4 present the average vertical gradients (y-gradients) for the existing conditions and the rehabilitated levees. The plates present additional data and the graphical output of the program SEEP/W, including total head contours, localized gradients (xy-and y-gradients), flux and the resulting phreatic surface.

Table E-1: Average Exit Gradients for Existing Levees

Levee	Station	Levee Toe		Landside Ditch			
				Empty		Full	
		DWSE	HTOL	DWSE	HTOL	DWSE	HTOL
RD 536	35+00	0.16	0.19	0.32	0.35	0.17	0.19
	65+00	0.26	0.29	0.56	0.6	0.3	0.34
	95+00	0.11	0.17	1.37	1.5	0.57	0.71
	135 +00	0.30	0.46	No Blanket in Landside Ditch			
	175+00	0.68	0.80	2.63	2.87	1.62	1.85
Mellin	6+00	0.28	0.31	No Landside Ditch			
	21+00	0.03*	0.03*	No Landside Ditch			
Mellin Extension	41+00	0.32	0.34	No Landside Ditch			
Solano County Levee 44	66+00	0.23**	0.34**	No Landside Ditch			
	83+00	No Clay Blanket		No Landside Ditch			

*Existing Levee Crest is Lower than DWSE and HTOL. Water surface for this run was set at the existing levee crown elevation.

**Seepage flows downward at levee toe (i.e.: negative gradient). Published exit gradient corresponds to location approximately 150 feet from levee toe.

Table E-2: Average Exit Gradients for Rehabilitated Levees

Levee	Station	Levee Toe		Landside Ditch			
				Empty		Full	
		DWSE	HTOL	DWSE	HTOL	DWSE	HTOL
RD 536	35+00	0.16	0.18	0.32	0.34	0.16	0.18
	65+00	0.25	0.29	0.55	0.59	0.29	0.33
	95+00	0.1	0.16	1.35	1.48	0.55	0.68
	135 +00	0.29	0.46	No Blanket in Landside Ditch			
	175+00	0.66	0.77	2.58	2.8	1.57	1.8
Mellin	6+00	0.20	0.29	No Landside Ditch			
	21+00	0.07	0. 09	No Landside Ditch			
Mellin Extension	41+00	0.32	0.37	No Landside Ditch			
Solano County Levee 44	66+00	0.32**	0.44**	No Landside Ditch			
	83+00	No Clay Blanket		No Landside Ditch			

*Existing Levee Crest is Lower than DWSE and HTOL. Water surface for this run was set at the existing levee crown elevation.

**Seepage flows downward at levee toe (i.e.: negative gradient). Published exit gradient corresponds to location approximately 150 feet from levee toe.

Table E-3: Average Exit Gradients for Rehabilitated Levees with Cutoff

Levee	Station	Levee Toe		Landside Ditch			
				Empty		Full	
		DWSE	HTOL	DWSE	HTOL	DWSE	HTOL
RD 536	95+00	-0.13	-0.14	0.73	0.78	-0.06	-0.01
	135+00	-0.1	-0.19	No Blanket in Landside Ditch			
	175+00	0.05	0.07	0.67	0.69	0.26	0.28
Solano County Levee 44	66+00	< 0.01	< 0.01	No Landside Ditch			
	83+00	No Clay Blanket		No Landside Ditch			

Note- Negative exit gradients indicate downward flow. Positive Exit gradients indicate upward flow.

Table E-4: Average Exit Gradients for Rehabilitated Levees with Seepage Berm

Levee	Station	Levee Toe		End of Berm Toe		Landside Ditch			
						Empty		Full	
		DWSE	HTOL	DWSE	HTOL	DWSE	HTOL	DWSE	HTOL
RD 536	95+00	-0.16	-0.14	0.16	0.23	1.35	1.5	0.57	0.7
	135+00	-0.11	-0.08	-0.02	-0.02	No Blanket in Landside Ditch			
	175+00	-0.11	-0.11	0.37	0.43	1.25	1.36	0.72	0.82
Solano County Levee 44	66+00	< 0.01	-0.02	0.21	0.1	No Landside Ditch			
	83+00	< 0.01	< 0.01	No Clay Blanket		No Landside Ditch			

Note- Negative exit gradients indicate downward flow. Positive Exit gradients indicate upward flow.

Our analysis shows that the vertical exit gradients for RD 536 Levee Stations 35+00 and 65+00 meet the design criteria without a cutoff wall or seepage berm.

Our analysis for RD 536 Station 95+00 shows that this section meets the design criteria for average exit gradient at the levee toe without a cutoff wall or seepage berm but does not meet the design criteria in the landside ditch. The landside levee toe is higher at Station 95+00 than at other stations nearby, which tends to reduce the average vertical gradient at the toe. If the toe was modeled at a lower elevation, the average vertical gradient at the toe would be higher. With a cutoff wall, the average vertical exit gradients meet the design criteria at the landside toe and in landside ditches. With a seepage berm, the average vertical exit gradient meets the design criteria at the landside toe but not in the landside ditch. Modifications to the landside ditch would be required with a seepage berm.

Our analysis for RD 536 Station 135+00 meets the design criteria for average exit gradient at the levee toe without a cutoff wall or seepage berm. As modeled, the landside ditch penetrates through the clay blanket layer on the landside. With this configuration, the ditch would be susceptible to piping and sand boils, which are not accounted for in the average exit gradient calculation. If the ditch did not penetrate through the clay blanket layer, the average vertical gradient at the toe would be higher. Based on these factors, we conclude that seepage remediation such as a cutoff or berm is appropriate. A cutoff wall is highly effective in both lowering the average vertical gradient at the levee toe and reducing the flow beneath the levee, which reduces the tendency for piping and sand boils in the ditch. A seepage berm lowers the average vertical gradient at the toe but does not reduce the underseepage flow. Modifications to the landside ditch may be required with a seepage berm to reduce the risk of boils in the ditch.

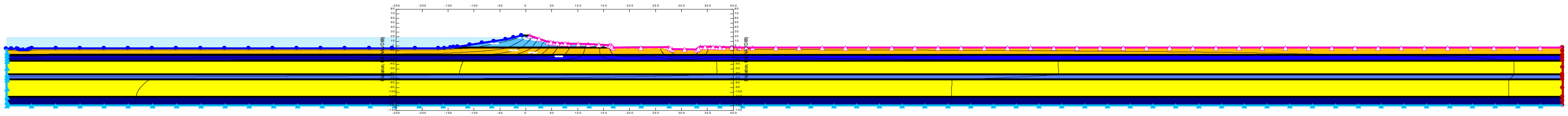
Our analysis for RD 536 Station 175+00 shows that this section does not meet the design criteria for average exit gradient at the levee toe or in the landside ditch without a cutoff wall. We conclude that seepage remediation, such as a seepage berm or cutoff wall, is appropriate. The model includes a thin clay blanket in the bottom of the landside ditch. Even with seepage remediation, the analysis indicates that high gradients could be present in the ditch for steady state seepage. These high uplift forces would cause cracking in the ditch, which would significantly increase vertical permeability in the ditch. To account for this increase, we modeled an anisotropic ratio (k_h/k_v) of (1/30) in the blanket soils within the ditch footprint for runs with a cutoff wall or seepage berm. With a cutoff wall, the average vertical exit gradients meet the design criteria at the landside toe and in landside ditches. With a seepage berm, the average vertical exit gradient meets the design criteria at the landside toe but not in the landside ditch. Modifications to the landside ditch may be required with a seepage berm.

Our analysis shows that the vertical exit gradients for Mellin Levee Station 6+00, Mellin Levee Station 21+00, and Mellin Extension Levee 41+00 meet the design criteria without a cutoff wall or seepage berm.

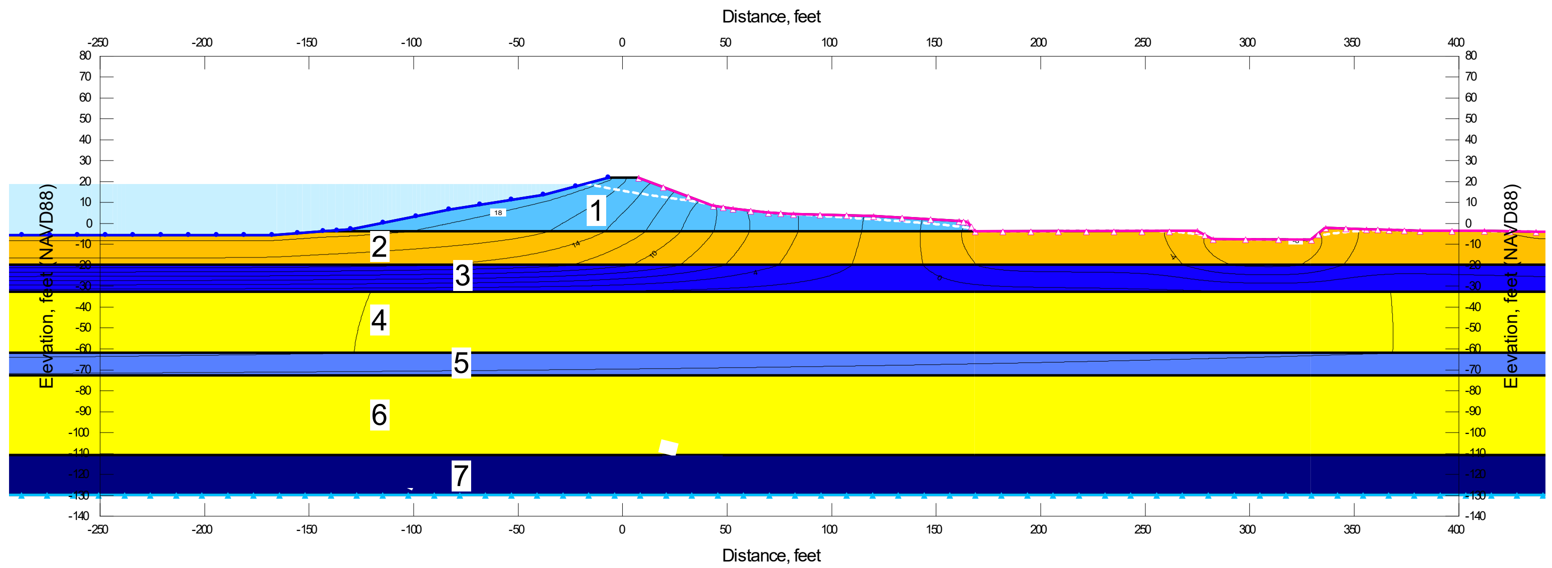
Our analysis for Solano County Levee 44 Station 66+00 shows that this section meets the design criteria for average exit gradient at the levee toe. The landside levee toe is higher at Station 66+00 than at other stations nearby, which tends to reduce the average vertical gradient at the toe. If the toe was modeled at a lower elevation, the average vertical gradient at the toe would be higher. Based on this result, we conclude that seepage remediation such as a cutoff or berm is required. Both the cutoff wall and the seepage berm reduce the vertical exit gradients at the levee toe.

Solano County Levee 44 Station 83+00 does not have a landside clay blanket and thus the design criteria for average exit gradient do not apply. The ground surface on the landside is below tide levels. We expect water will continue to flow below the levee into the depression. We conclude that this is an unacceptable risk. We conclude that areas with no landside blanket will also require remediation to reduce the risk of piping and boils at the levee toe. A cutoff wall reduces both the flow quantity and upward gradient near the levee toe. A seepage berm reduces the upward gradient near the levee toe but does not significantly reduce the underseepage flow.

Water Surface Elevation: 18.6 feet



SEEP/W MODEL



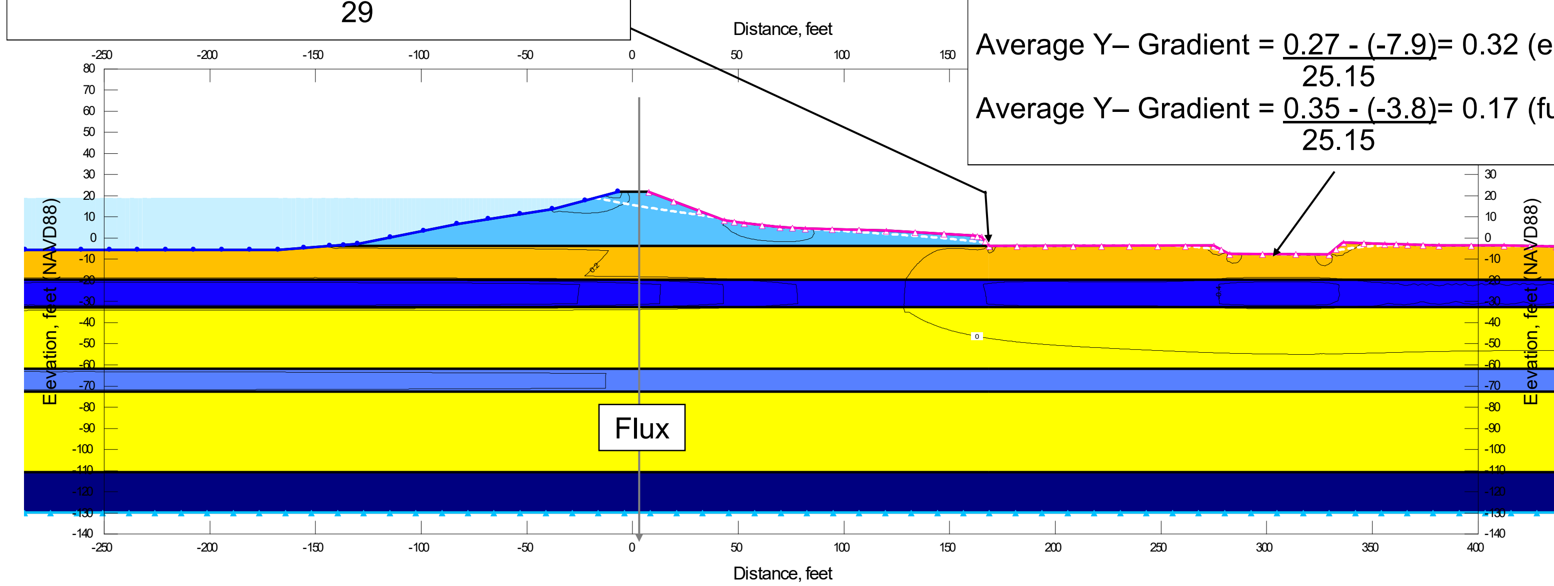
TOTAL HEAD CONTOURS

Local Y-Gradient = 0.22
Local XY-Gradient = 0.37
Flux = 1.54 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{0.78 - (-4)}{29}$ = 0.16

Max Y-Gradient = 0.40 (empty ditch) / 0.10 (full ditch)
Max XY-Gradient = 0.52 (empty ditch) / 0.11 (full ditch)

Average Y– Gradient = $\frac{0.27 - (-7.9)}{25.15}$= 0.32 (empty ditch)

Average Y– Gradient = $\frac{0.35 - (-3.8)}{25.15}$= 0.17 (full ditch)

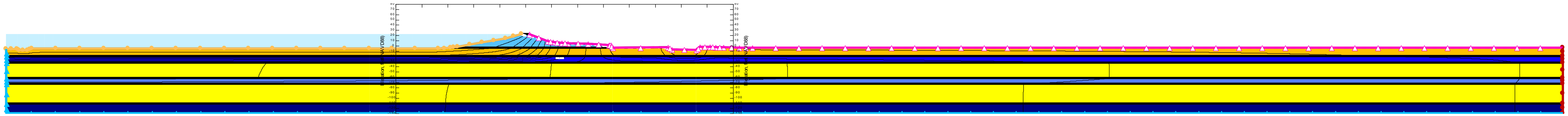


VERTICAL GRADIENT CONTOURS

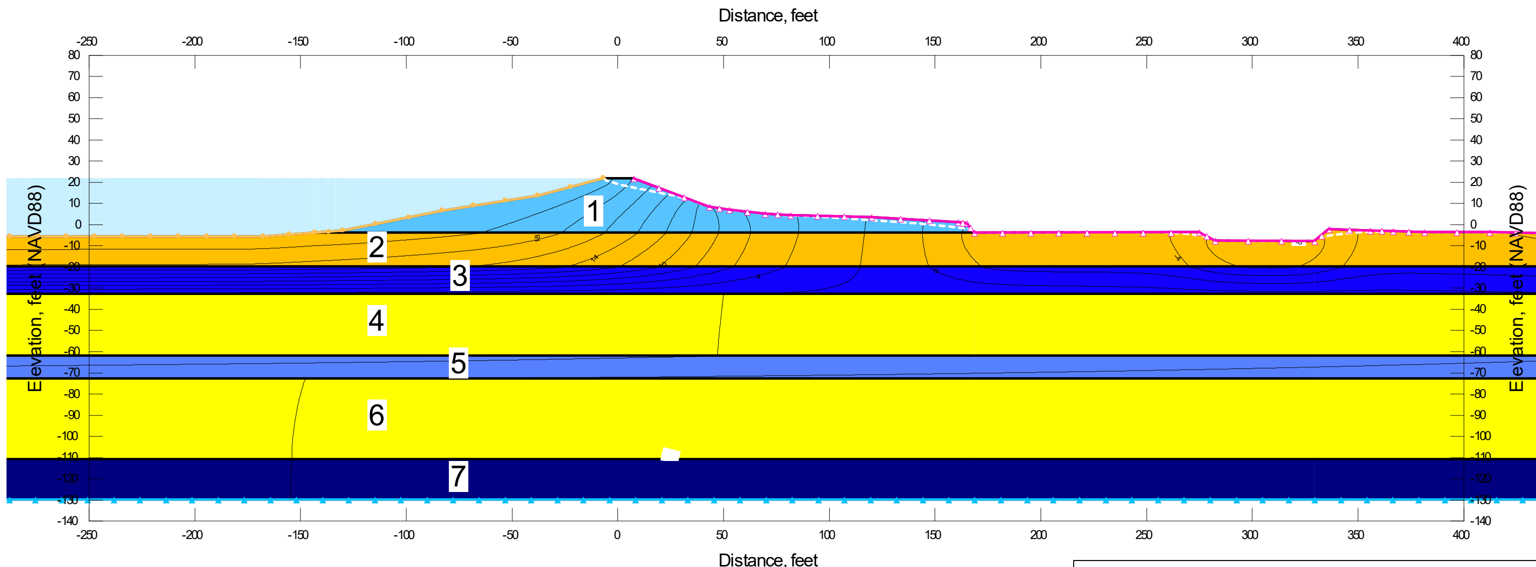
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 35+00** **Existing Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-1

Water Surface Elevation: 21.6 feet



SEEP/W MODEL

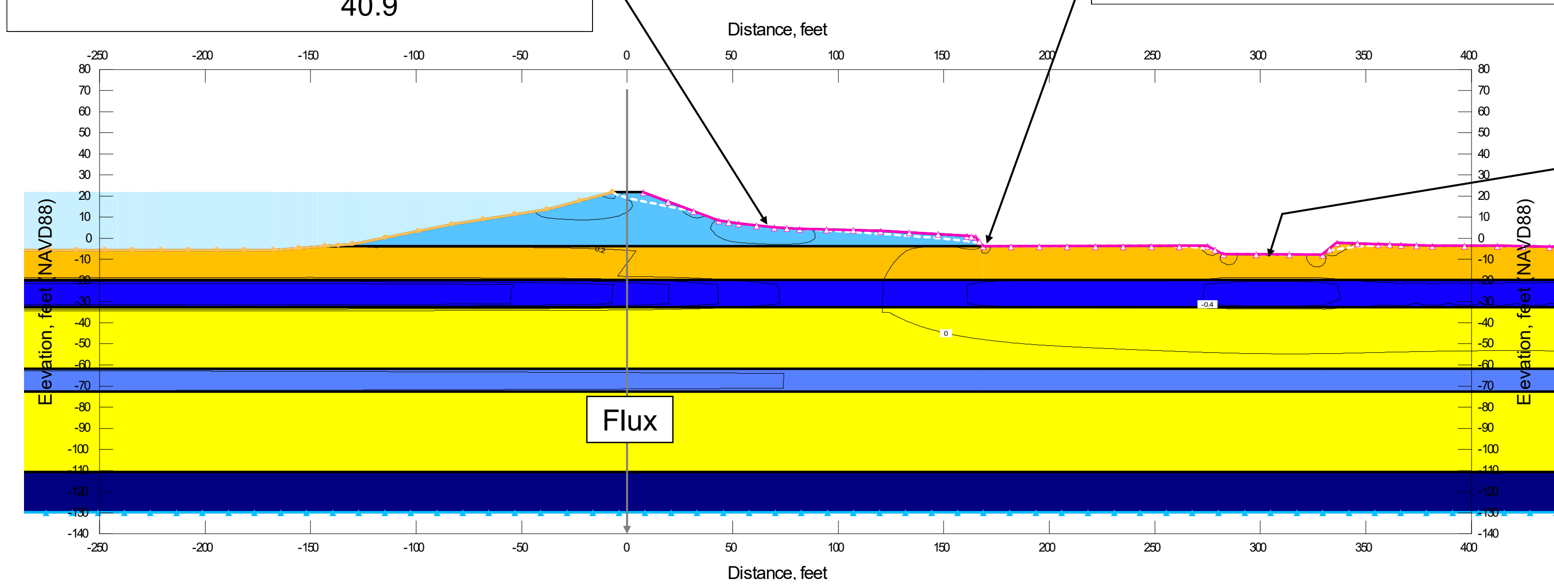


TOTAL HEAD CONTOURS

Local Y-Gradient = 0.16
Local XY-Gradient = 0.34
Flux = 1.79 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{2.1 - (7.9)}{40.9}$ = -0.14

Local Y Gradient = 0.24
Local XY-Gradient = 0.38
Average Y-Gradient = $\frac{1.41 - (-4)}{29}$ = 0.19

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9



Max Y-Gradient = 0.41 (empty ditch) / 0.11 (full ditch)
Max XY-Gradient = 0.54 (empty ditch) / 0.12 (full ditch)

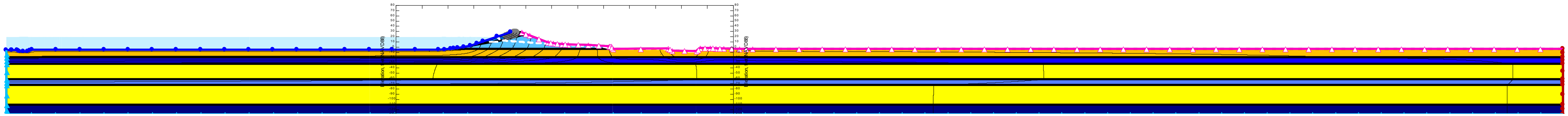
Average Y– Gradient = $\frac{0.84 - (-7.88)}{25.15}$ = 0.35 (empty ditch)

Average Y– Gradient = $\frac{0.92 - (-3.8)}{25.15}$ = 0.19 (full ditch)

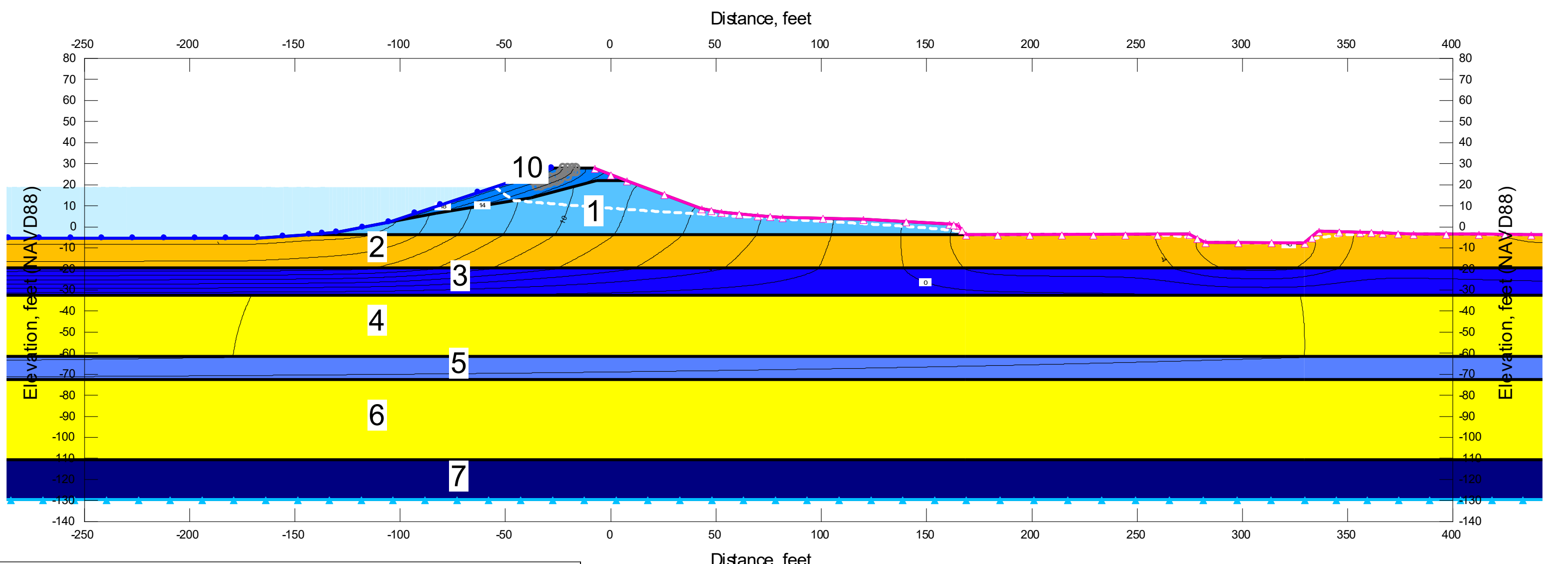
VERTICAL GRADIENT CONTOURS

Little Egbert Multi-Benefit Project Solano County, California		**Seepage Analysis** **RD 536 - Station 35+00** **Existing Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. E-2

Water Surface Elevation: 18.6 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

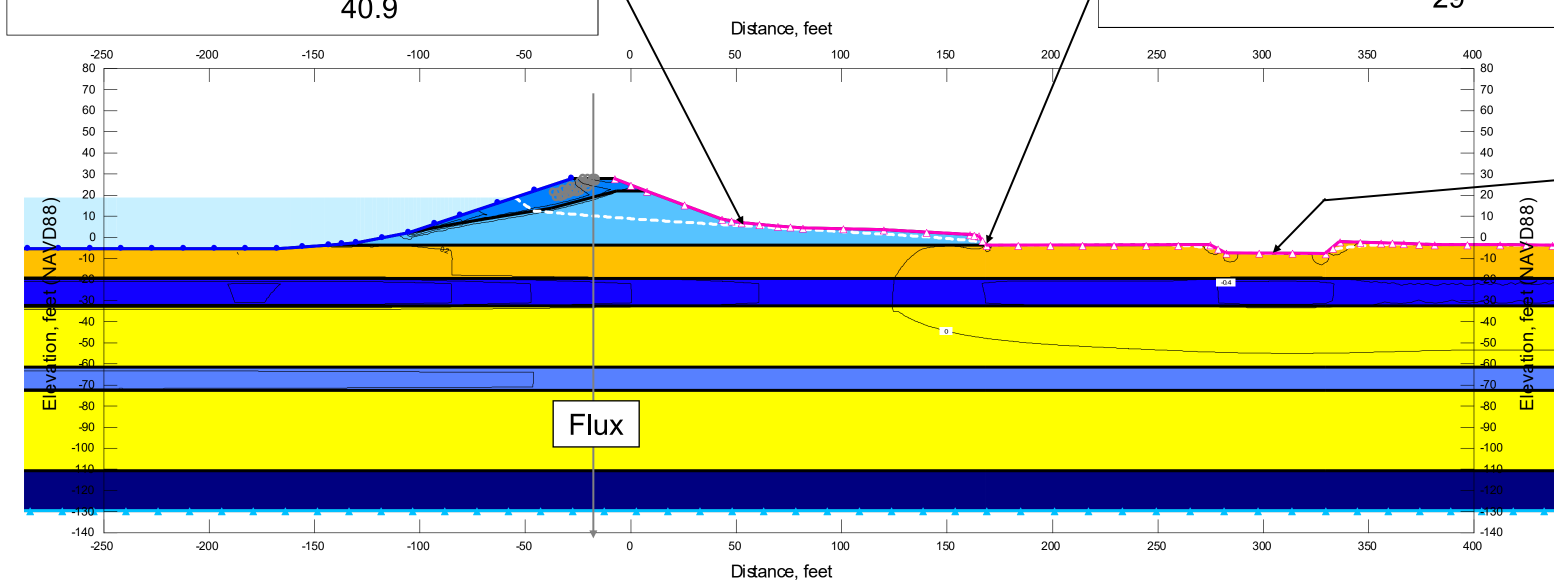
Local Y-Gradient = 0.037
Local XY-Gradient = 0.072
Flux = 1.42 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{1.14 - (5.64)}{40.9}$ = -0.11

Local Y-Gradient = 0.21
Local XY-Gradient = 0.35
Average Y-Gradient = $\frac{0.62 - (-4)}{29}$ = 0.16

Max Y-Gradient = 0.39 (empty ditch) / 0.10 (full ditch)
Max XY-Gradient = 0.52 (empty ditch) / 0.10 (full ditch)

Average Y– Gradient = $\frac{0.09 - (-7.9)}{25.15}$ = 0.32 (empty ditch)

Average Y– Gradient = $\frac{0.17 - (-3.8)}{25.15}$ = 0.16 (full ditch)

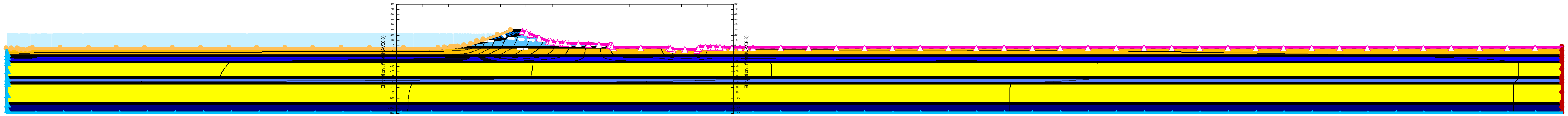


VERTICAL GRADIENT CONTOURS

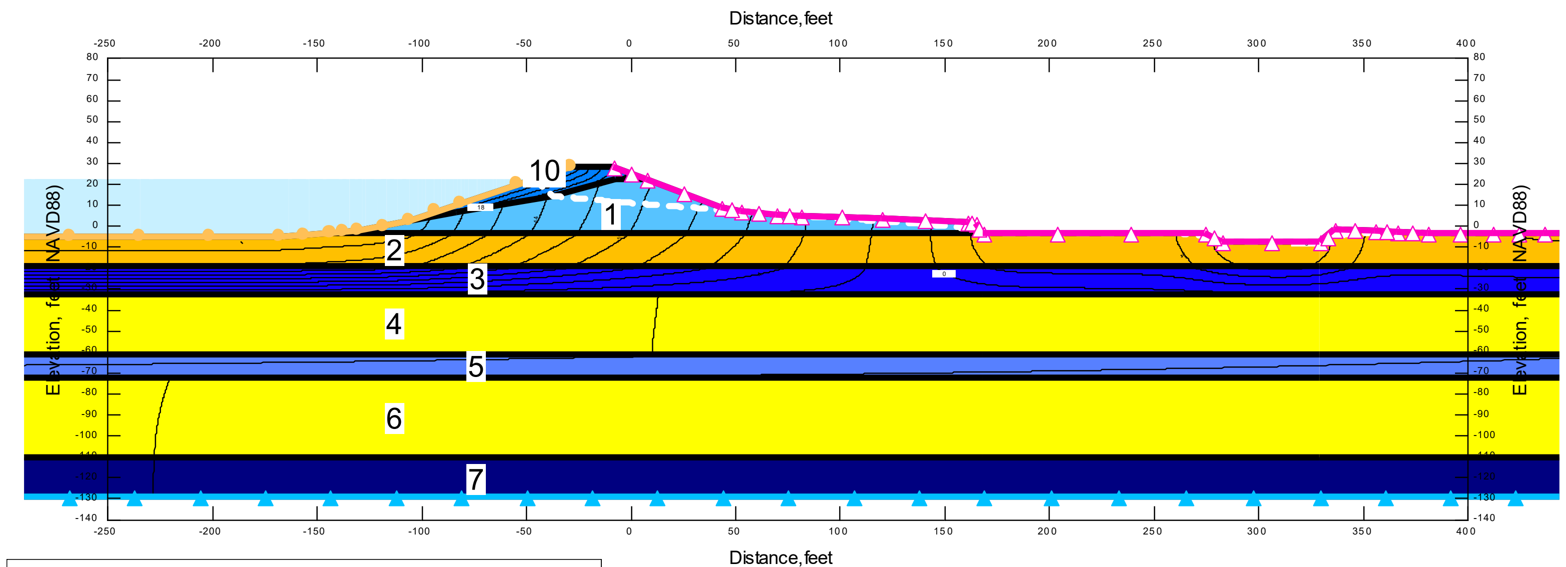
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 35+00** **Rehabilitated Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-3

Water Surface Elevation: 21.6 feet



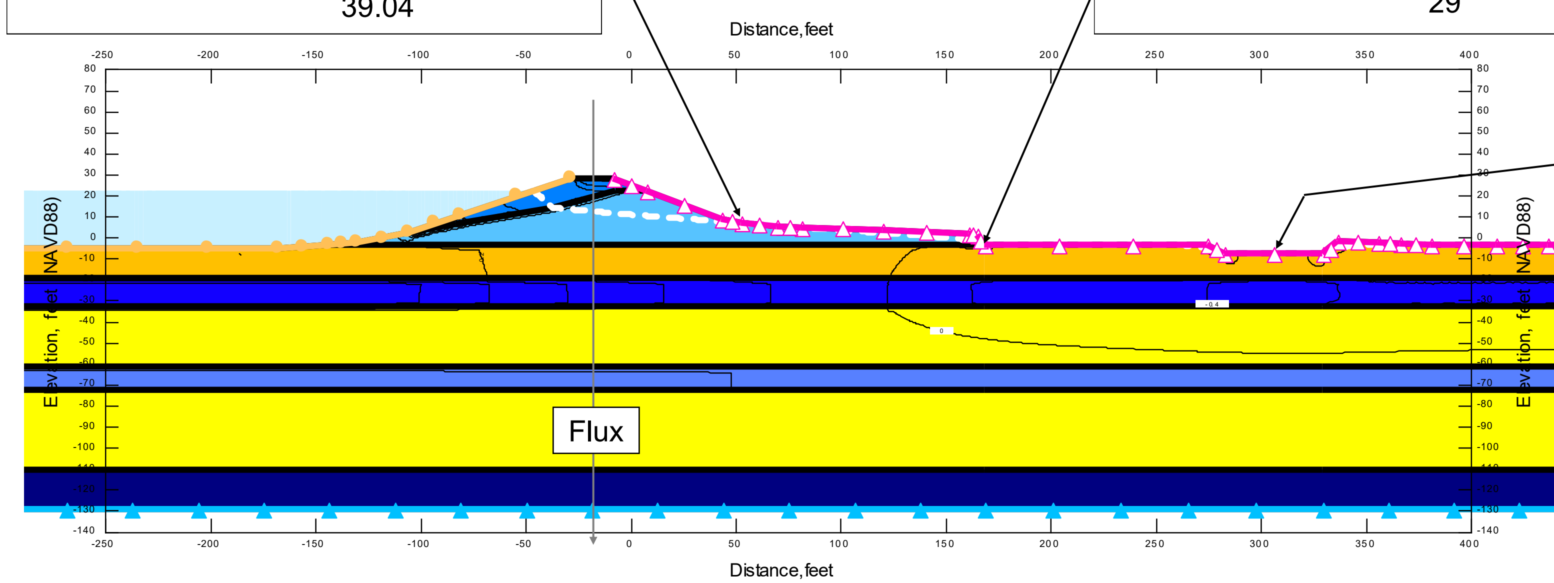
SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.058
Local XY-Gradient = 0.089
Flux = 1.61 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{1.85 - (7.07)}{39.04}$ = -0.13

Local Y-Gradient = 0.235
Local XY-Gradient = 0.4
Average Y-Gradient = $\frac{1.25 - (-4)}{29}$ = 0.18



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 0.41 (empty ditch) / 0.11 (full ditch)
Max XY-Gradient = 0.54 (empty ditch) / 0.12 (full ditch)

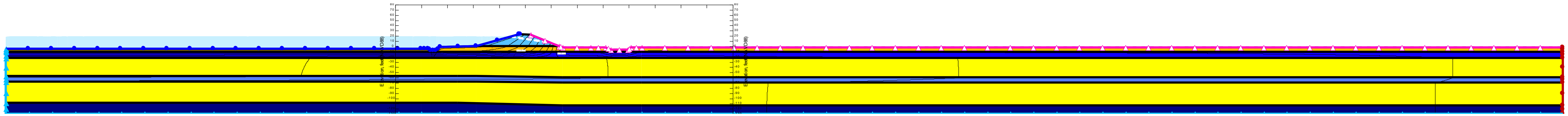
Average Y– Gradient = $\frac{0.66 - (-7.9)}{25.15}$= 0.34 (empty ditch)

Average Y– Gradient = $\frac{0.74 - (-3.8)}{25.15}$= 0.18 (full ditch)

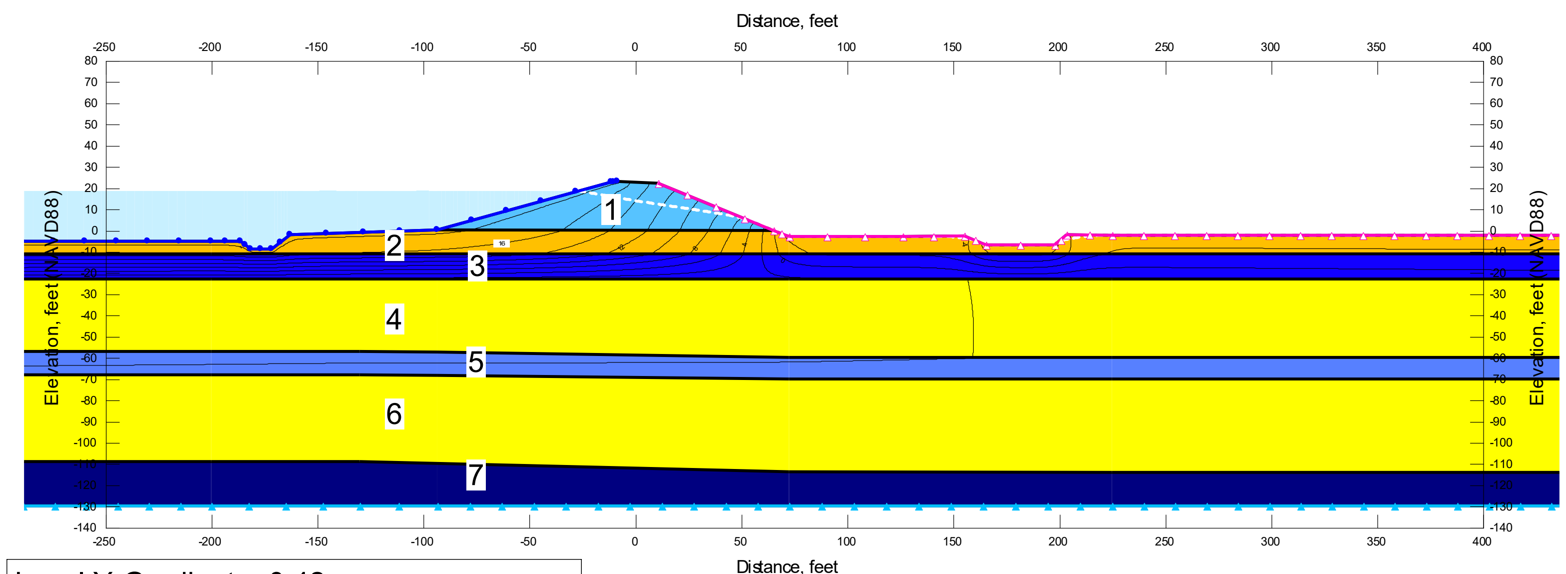
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 35+00** **Rehabilitated Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-4

Water Surface Elevation: 18.4 feet

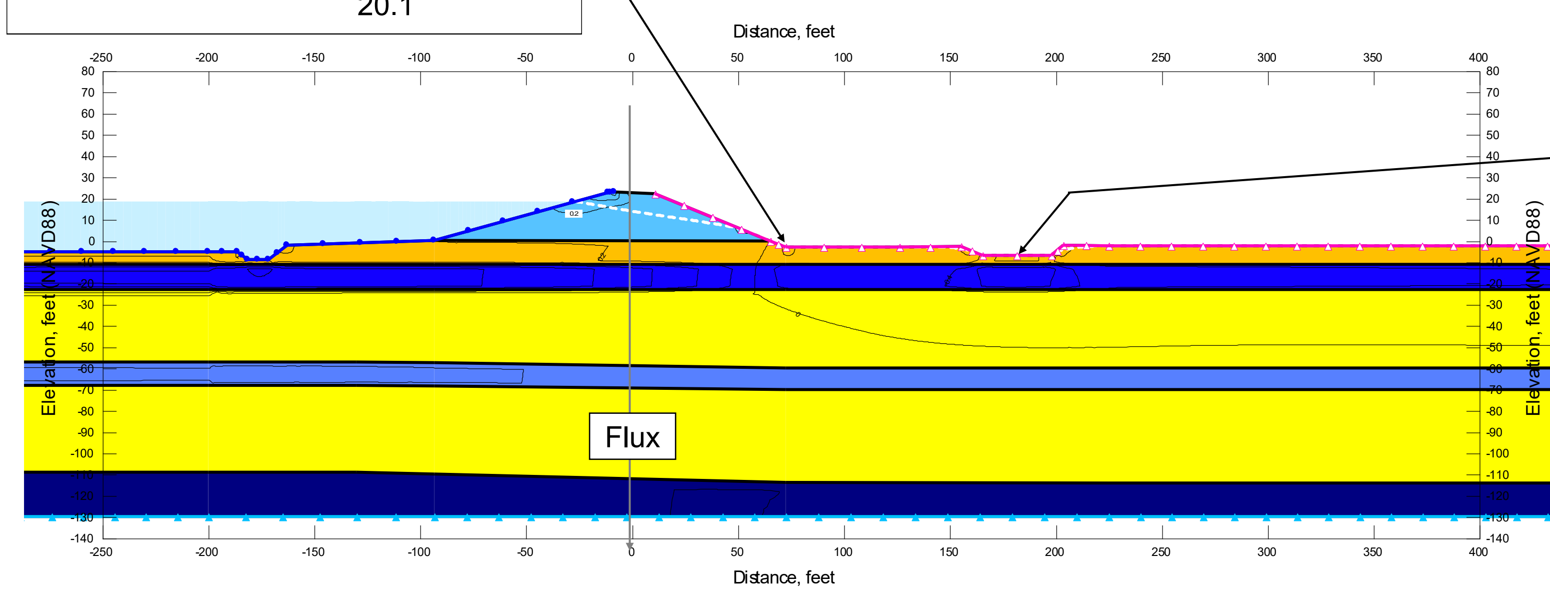


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.42
Local XY-Gradient = 0.517
Flux = 1.66 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{2.38 - (-2.9)}{20.1}$ = 0.26



VERTICAL GRADIENT CONTOURS

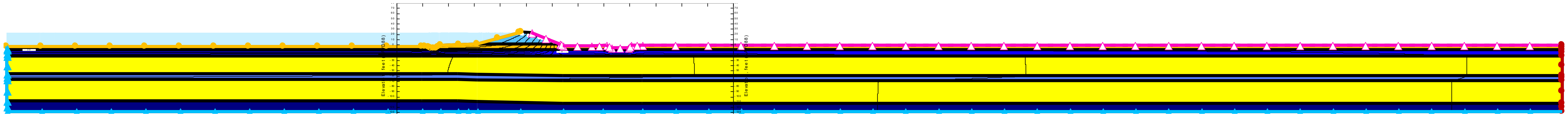
Max Y-Gradient = 0.43 (empty ditch) / 0.11 (full ditch)
Max XY-Gradient = 0.52 (empty ditch) / 0.12 (full ditch)

Average Y– Gradient = $\frac{1.91 - (-7.00)}{16}$ = 0.56 (empty ditch)
Average Y– Gradient = $\frac{1.97 - (-2.8)}{16}$ = 0.30 (full ditch)

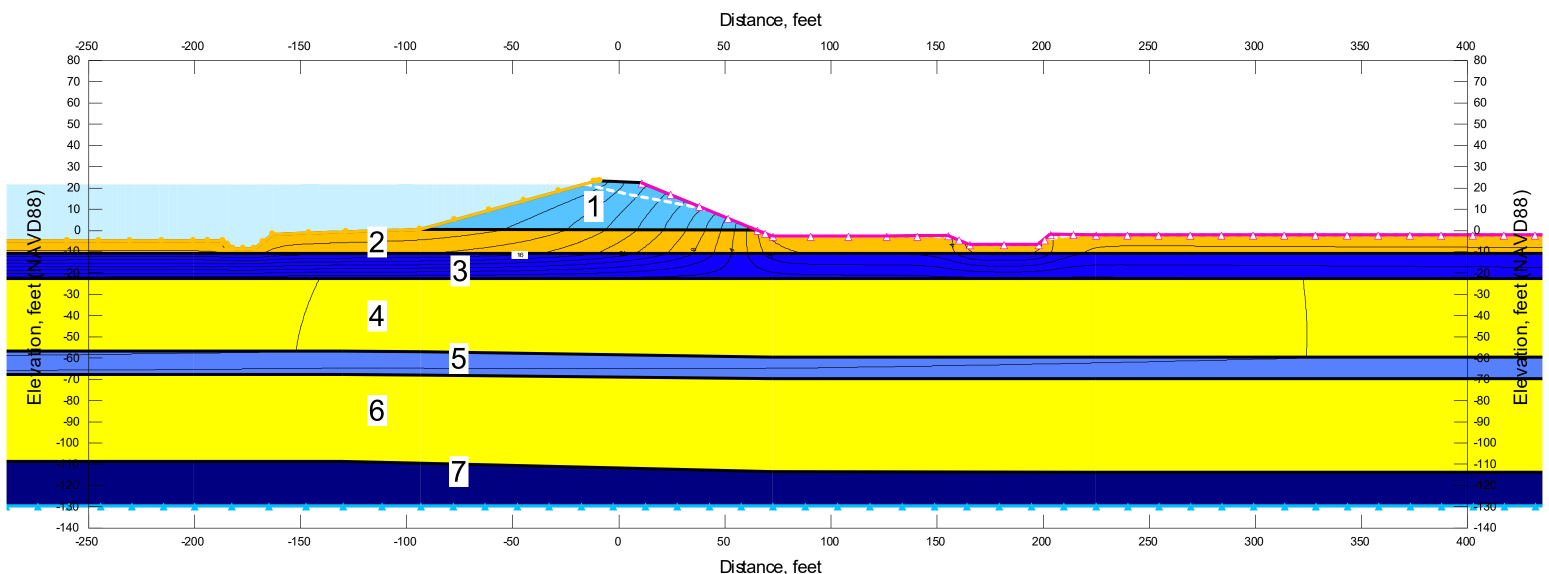
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 65+00** **Existing Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-5

Water Surface Elevation: 21.4 feet

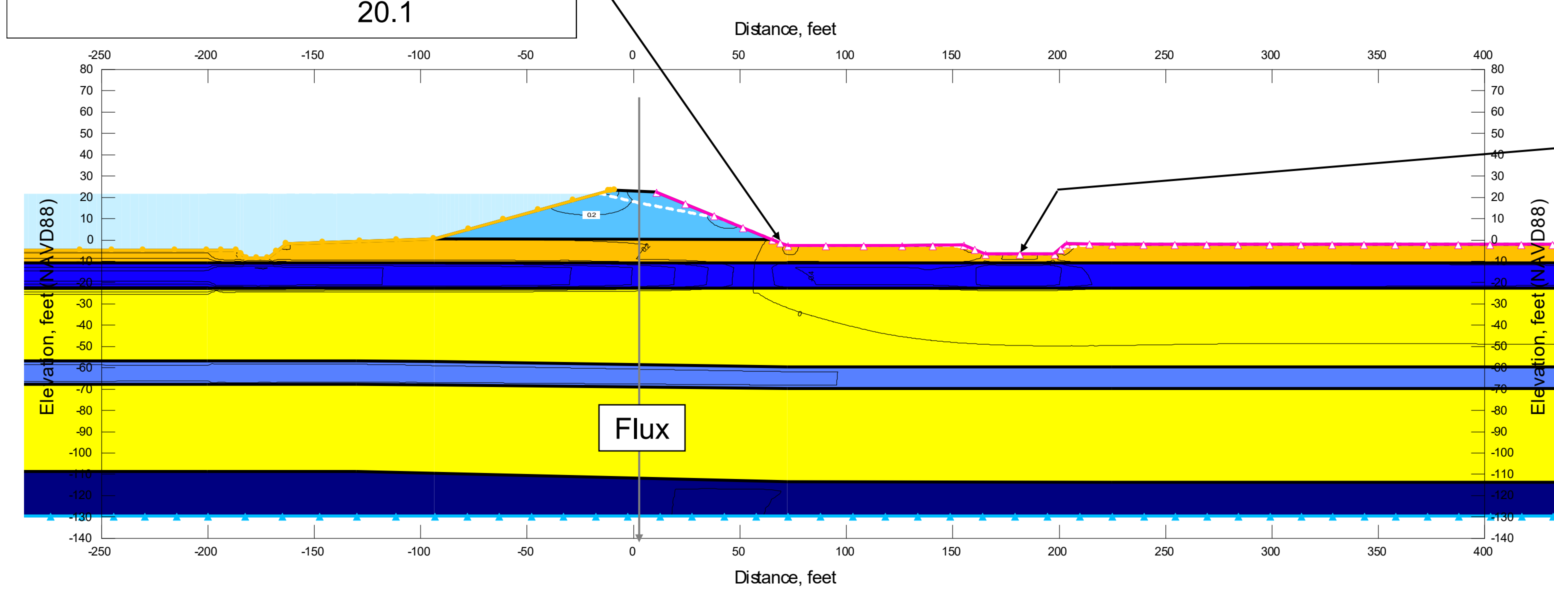


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.45
Local XY-Gradient = 0.533
Flux = 1.94 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{3.02 - (-2.9)}{20.1}$ = 0.29



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 0.45 (empty ditch) / 0.13 (full ditch)
Max XY-Gradient = 0.53 (empty ditch) / 0.13 (full ditch)

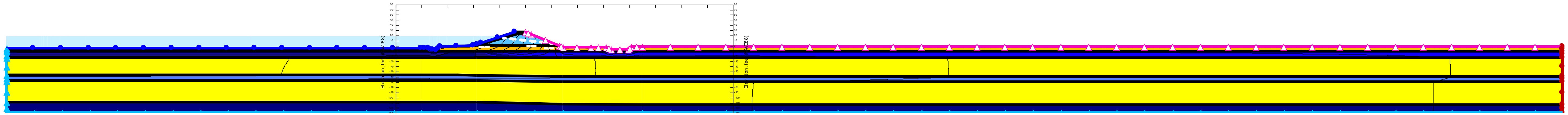
Average Y– Gradient = $\frac{2.55- (-7.00)}{16}$= 0.60 (empty ditch)

Average Y– Gradient = $\frac{2.6 - (-2.8)}{16}$= 0.34 (full ditch)

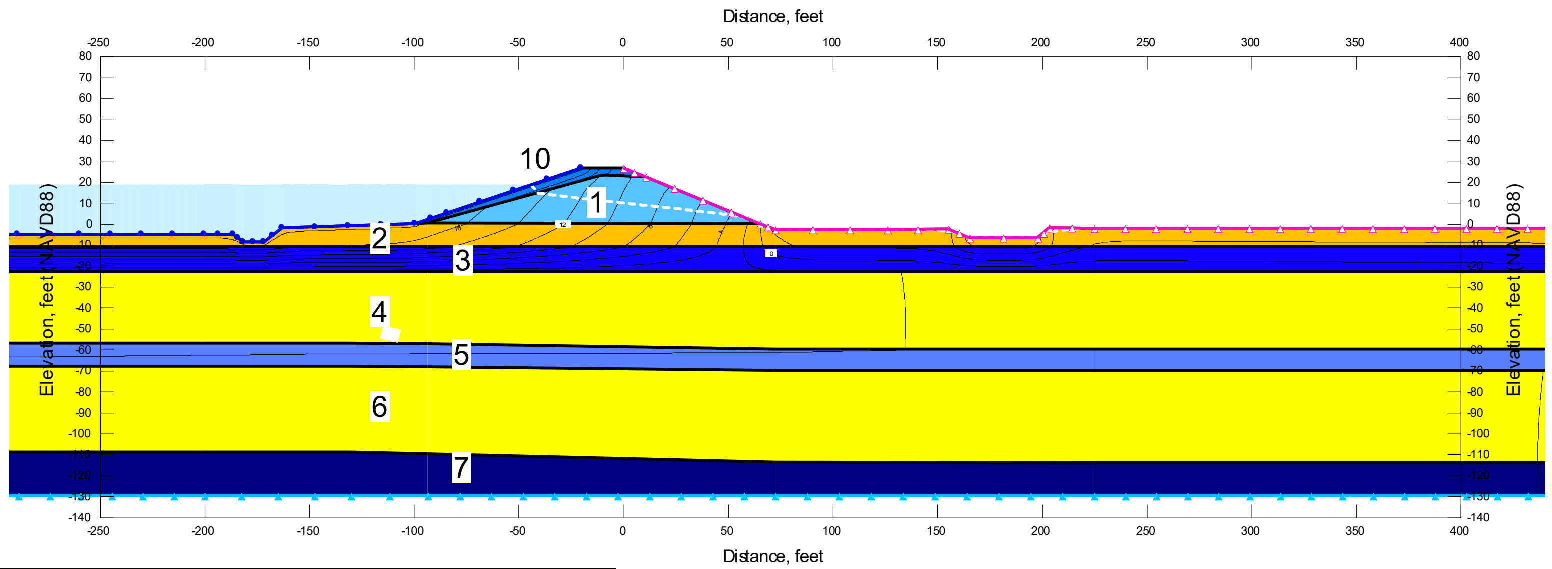
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California		**Seepage Analysis** **RD 536 - Station 65+00** **Existing Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. E-6

Water Surface Elevation: 18.4 feet

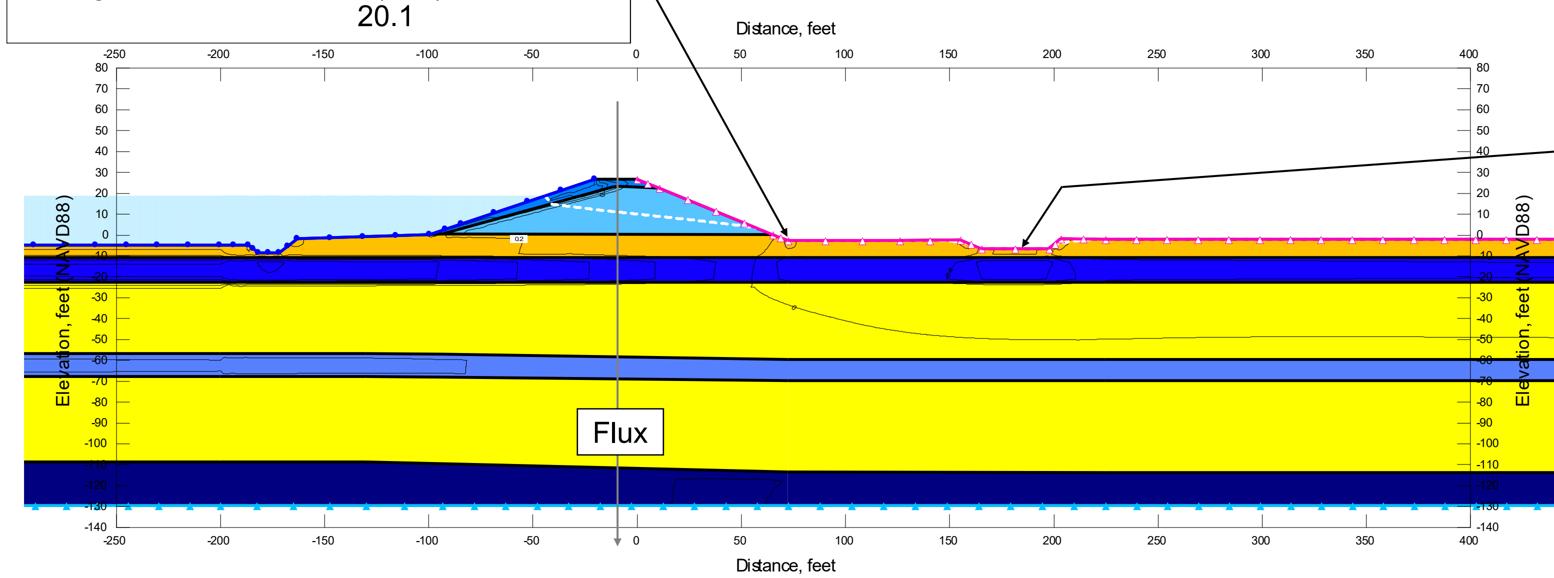


SEEP/W MODEL



Local Y-Gradient = 0.41
Local XY-Gradient = 0.50
Flux = 1.59 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{2.2 - (-2.9)}{20.1}$ = 0.254

TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 0.43 (empty ditch) / 0.11 (full ditch)
Max XY-Gradient = 0.51 (empty ditch) / 0.11 (full ditch)

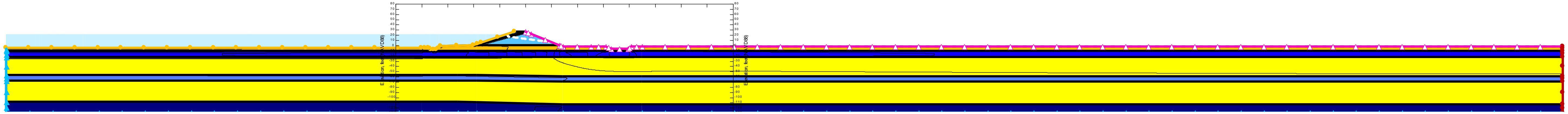
Average Y– Gradient = $\frac{1.82 - (-7.00)}{16}$ = 0.55 (empty ditch)

Average Y– Gradient = $\frac{1.88 - (-2.8)}{16}$ = 0.29 (full ditch)

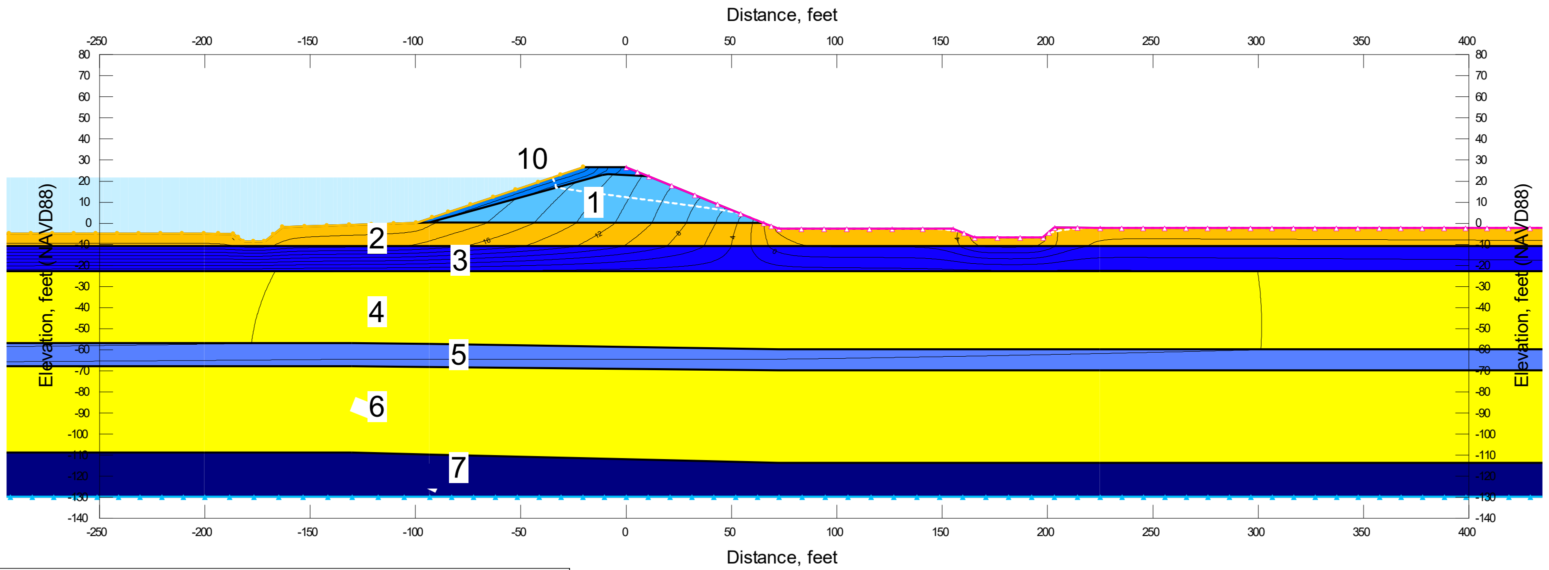
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 65+00** **Rehabilitated Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-7

Water Surface Elevation: 21.4 feet

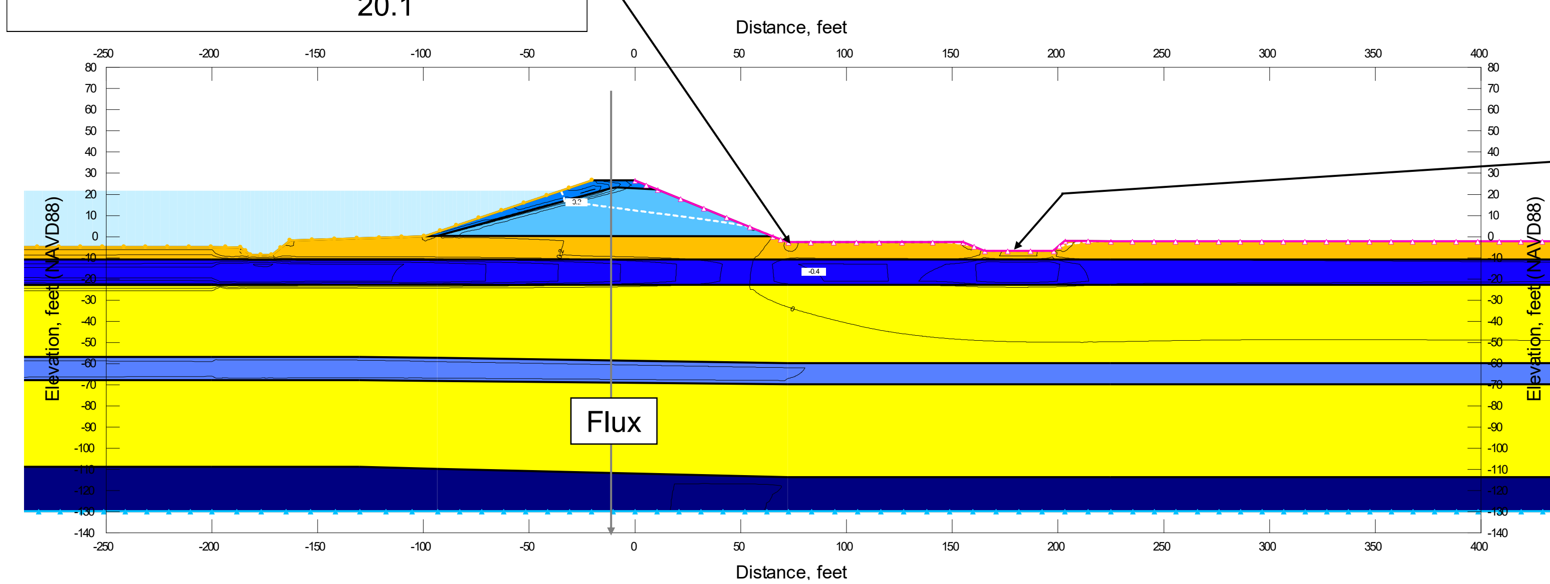


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.43
Local XY-Gradient = 0.52
Flux = 1.84 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{2.89 - (-2.9)}{20.1}$ = 0.29



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 0.44 (empty ditch) / 0.14 (full ditch)
Max XY-Gradient = 0.53 (empty ditch) / 0.15 (full ditch)

Average Y– Gradient = $\frac{2.45 - (-7.00)}{16}$ = 0.59 (empty ditch)

Average Y– Gradient = $\frac{2.51 - (-2.8)}{16}$ = 0.33 (full ditch)

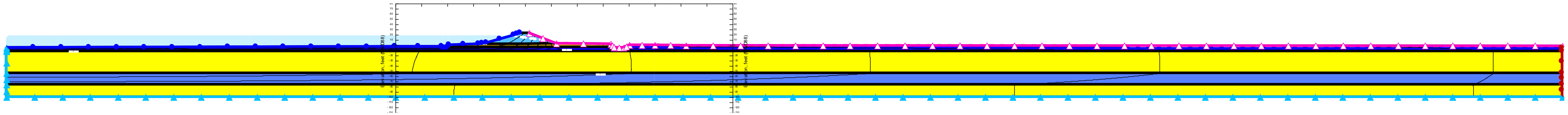
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
(orange)	Unit 2: Organic Soil	4.0×10^{-6}	1
(blue)	Unit 3: Clay Blanket	1.0×10^{-6}	1
(yellow)	Unit 4: Sand (Upper)	5.4×10^{-3}	9
(medium blue)	Unit 5: Clay	4.0×10^{-6}	4
(yellow)	Unit 6: Sand (Lower)	5.4×10^{-3}	9
(dark blue)	Unit 7: Deep Clay	4.0×10^{-6}	4
(purple)	Unit 8: Cutoff Wall	1.0×10^{-6}	1
(blue)	Unit 9: Clay Cap	4.0×10^{-6}	4
(blue)	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
(gray)	Unit 11: Drain Rock	1.0×10^{1}	10
(yellow)	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

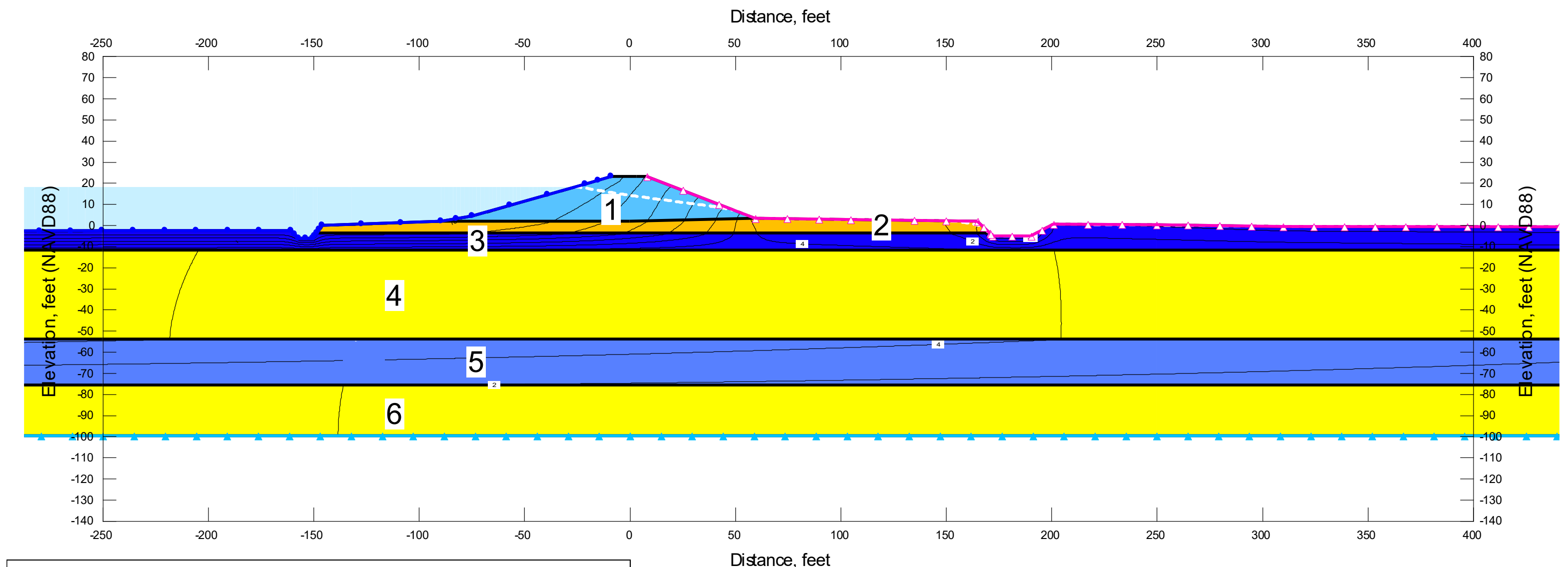
Seepage Analysis
RD 536 - Station 65+00
Rehabilitated Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-8

Water Surface Elevation: 18 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

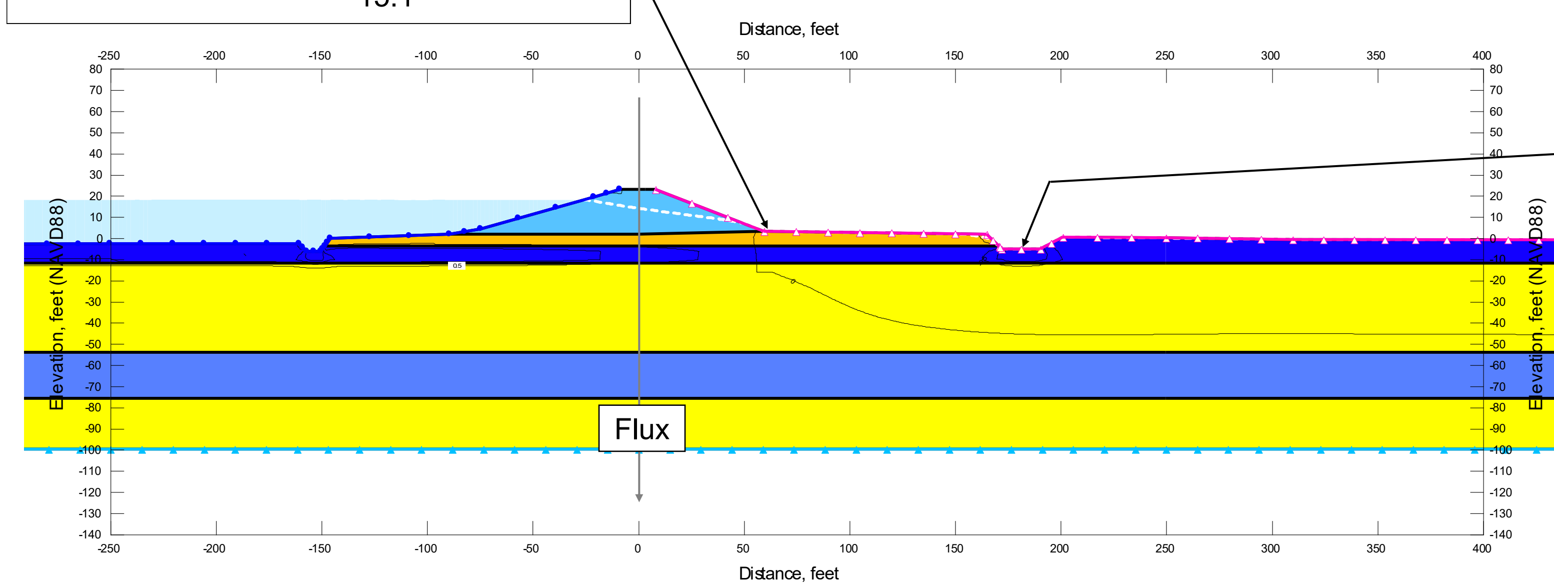
Local Y-Gradient = 0.22
Local XY-Gradient = 0.35
Flux = 2.09×10^{-2} gpm/ft
Average Y-Gradient = $\frac{4.72 - (3.1)}{15.1}$ = 0.11

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Max Y-Gradient = 1.73 (empty ditch) / 0.65 (full ditch)
Max XY-Gradient = 2.14 (empty ditch) / 0.71 (full ditch)

Average Y– Gradient = $\frac{4.11 - (-5.2)}{6.8}$ = 1.37 (empty ditch)

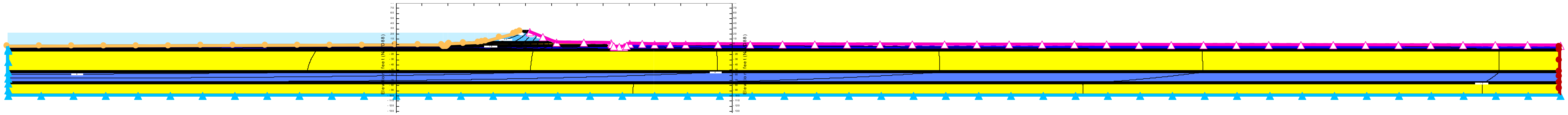
Average Y– Gradient = $\frac{4.20 - (0.3)}{6.8}$ = 0.57 (full ditch)



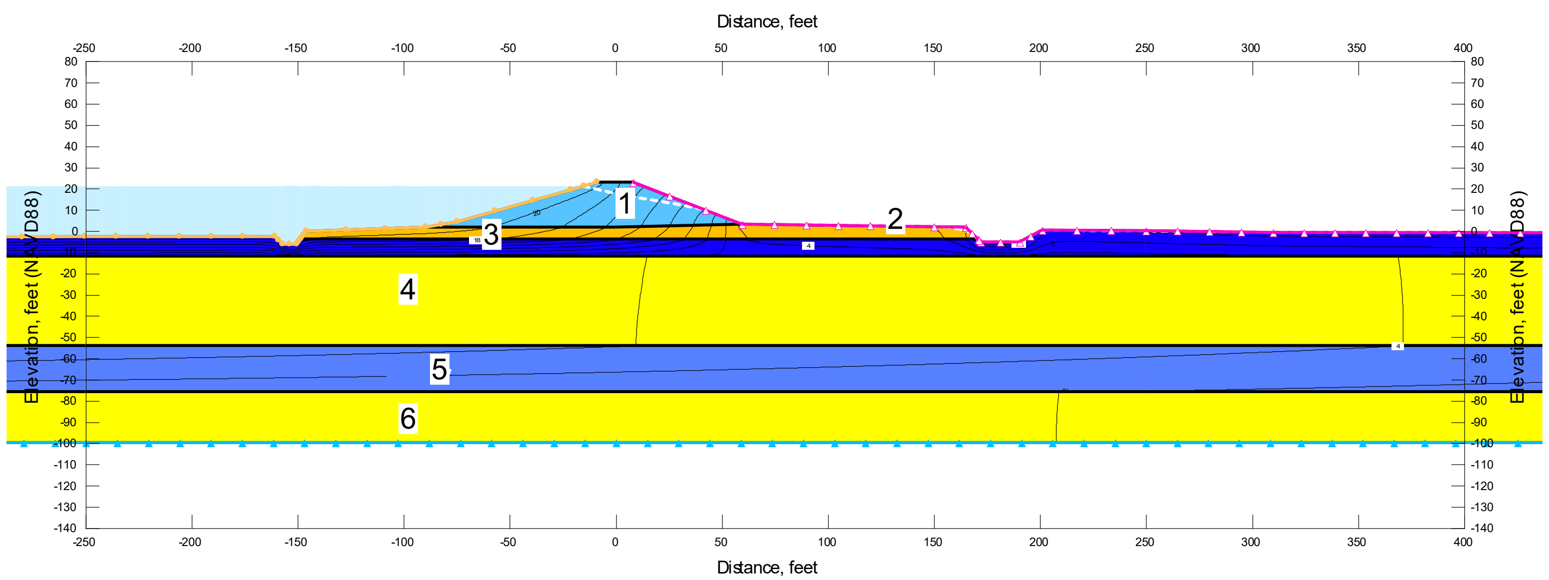
VERTICAL GRADIENT CONTOURS

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 95+00** **Existing Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-9

Water Surface Elevation: 21 feet

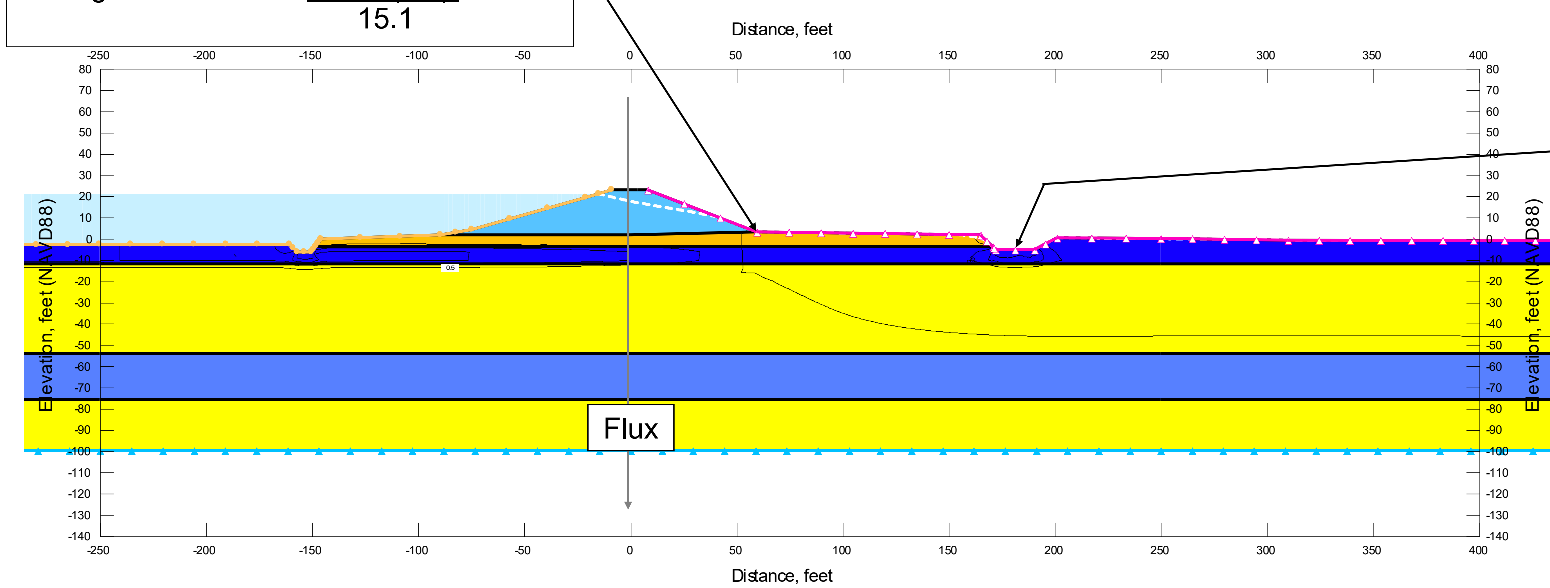


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.26
Local XY-Gradient = 0.39
Flux = 2.44 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{5.71 - (3.1)}{15.1} = 0.17$



VERTICAL GRADIENT CONTOURS

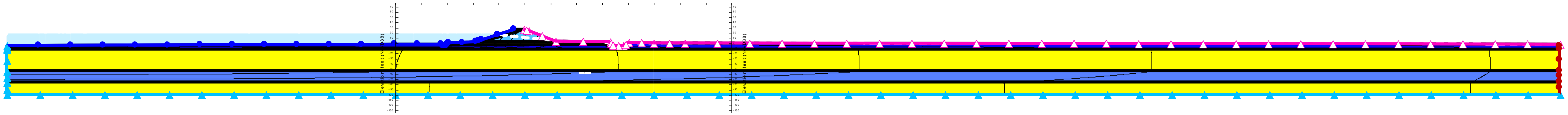
Max Y-Gradient = 1.88 (empty ditch) / 0.80 (full ditch)
Max XY-Gradient = 2.30 (empty ditch) / 0.88 (full ditch)

Average Y– Gradient = $\frac{5.01 - (-5.2)}{6.8}$ = 1.50 (empty ditch)
Average Y– Gradient = $\frac{5.10 - (0.3)}{6.8}$ = 0.71 (full ditch)

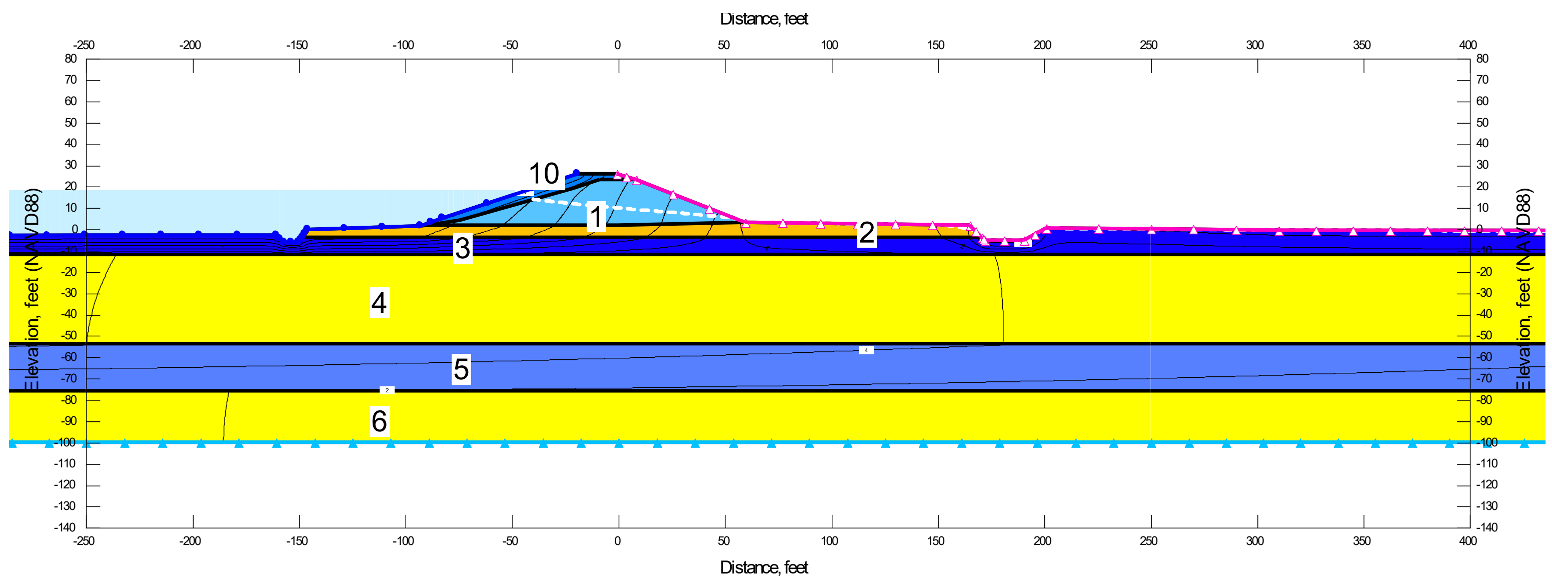
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 95+00** **Existing Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-10

Water Surface Elevation: 18 feet

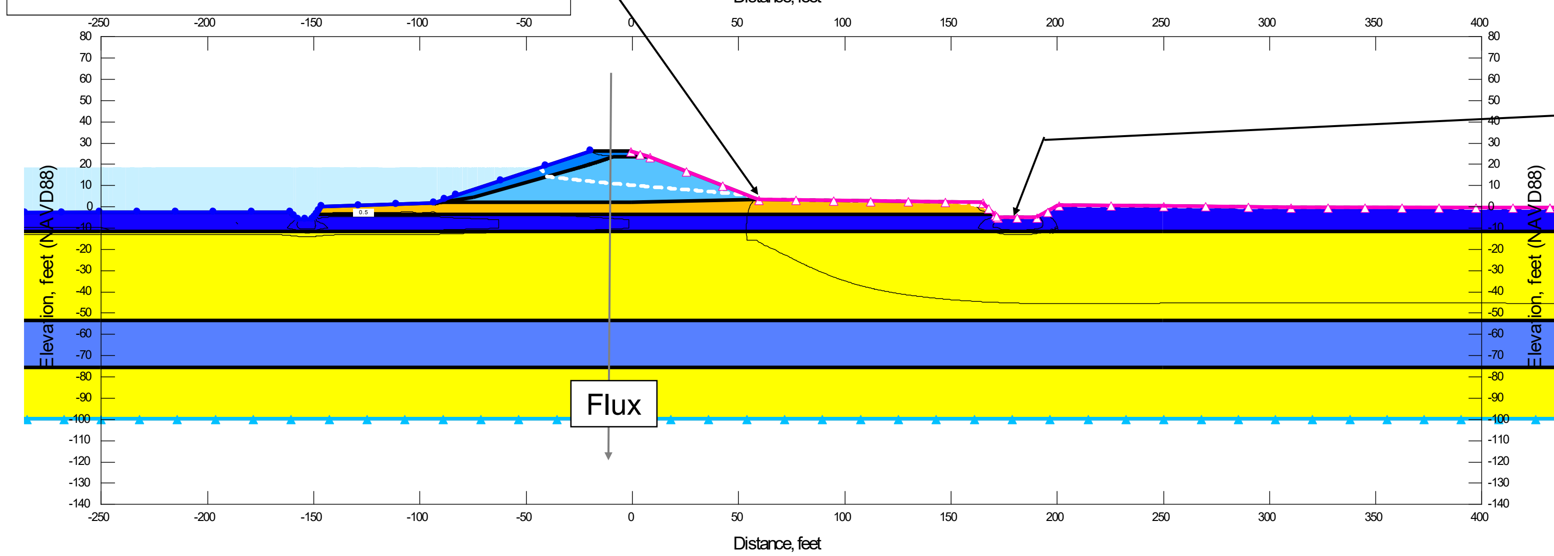


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.22
Local XY-Gradient = 0.36
Flux = 2.01 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{4.59 - (3.1)}{15.1}$ = 0.10



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 1.72 (empty ditch) / 0.63 (full ditch)
Max XY-Gradient = 2.11 (empty ditch) / 0.69 (full ditch)

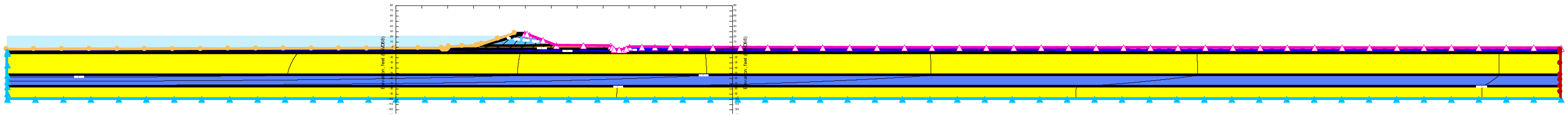
Average Y– Gradient = $\frac{3.98 - (-5.2)}{6.8}$ = 1.35 (empty ditch)

Average Y– Gradient = $\frac{4.06 - (0.3)}{6.8}$ = 0.55 (full ditch)

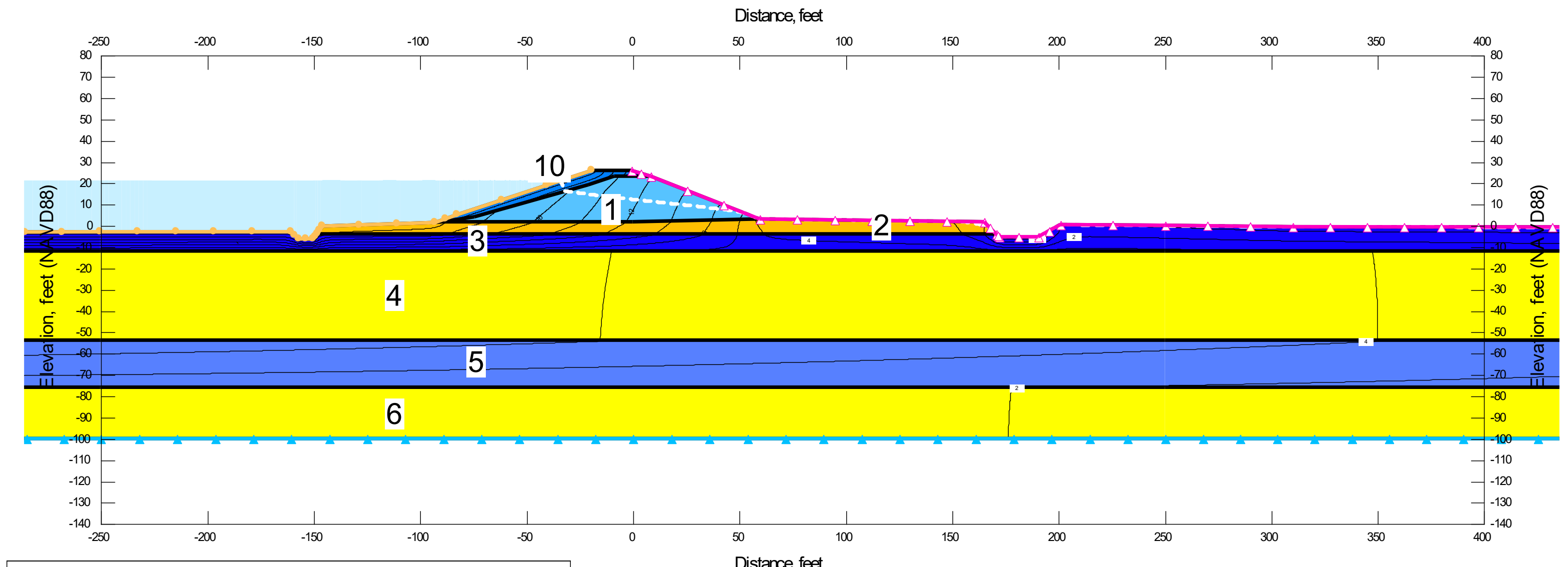
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 95+00** **Rehabilitated Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-11

Water Surface Elevation: 21 feet

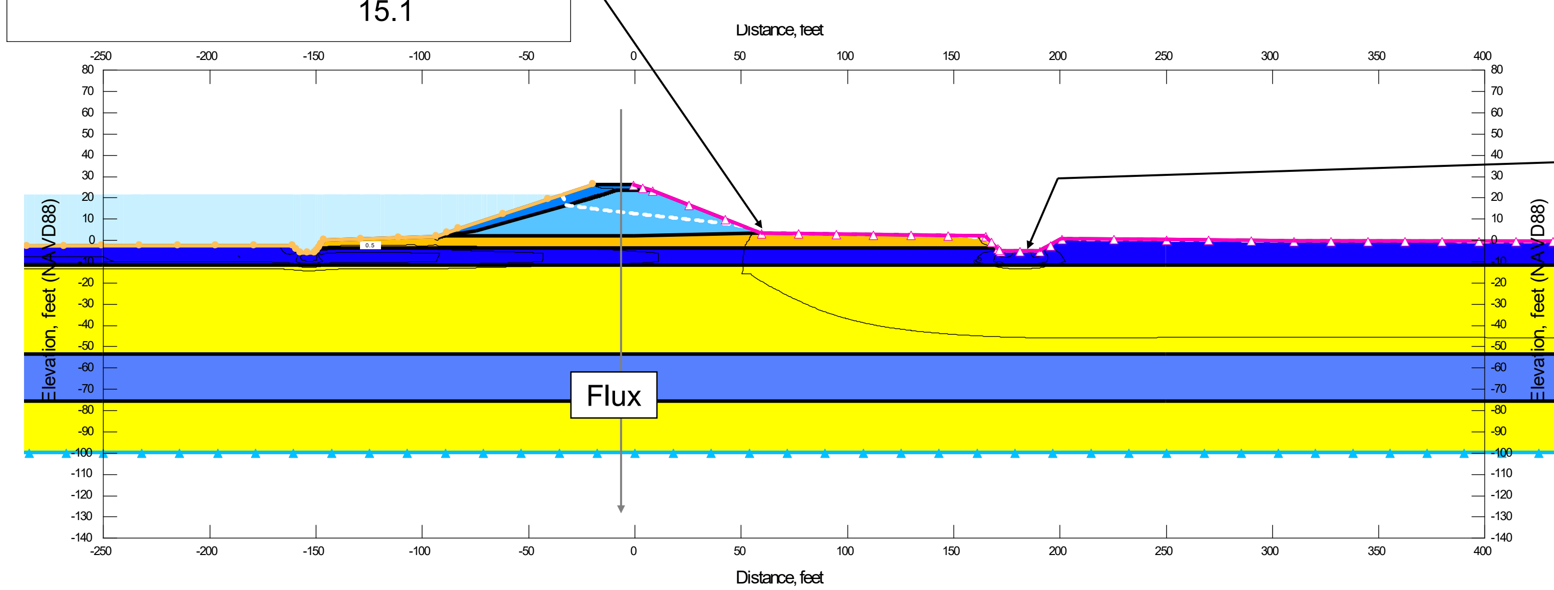


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.27
Local XY-Gradient = 0.40
Flux = 2.34 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{5.57 - (3.1)}{15.1}$ = 0.16



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 1.86 (empty ditch) / 0.78 (full ditch)
Max XY-Gradient = 2.28 (empty ditch) / 0.85 (full ditch)

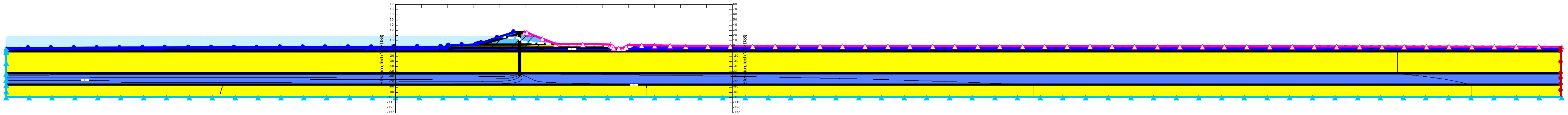
Average Y– Gradient = $\frac{4.87 - (-5.2)}{6.8}$= 1.48 (empty ditch)

Average Y– Gradient = $\frac{4.95 - (0.3)}{6.8}$= 0.68 (full ditch)

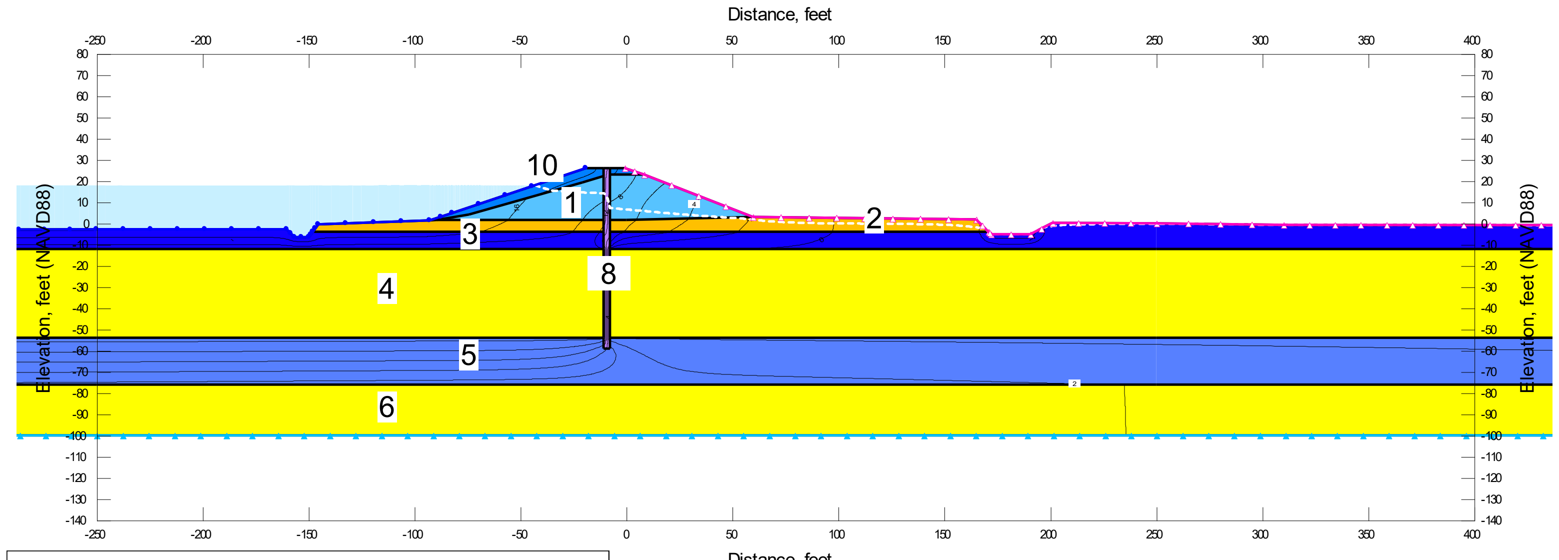
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 95+00** **Rehabilitated Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-12

Water Surface Elevation: 18 feet



SEEP/W MODEL



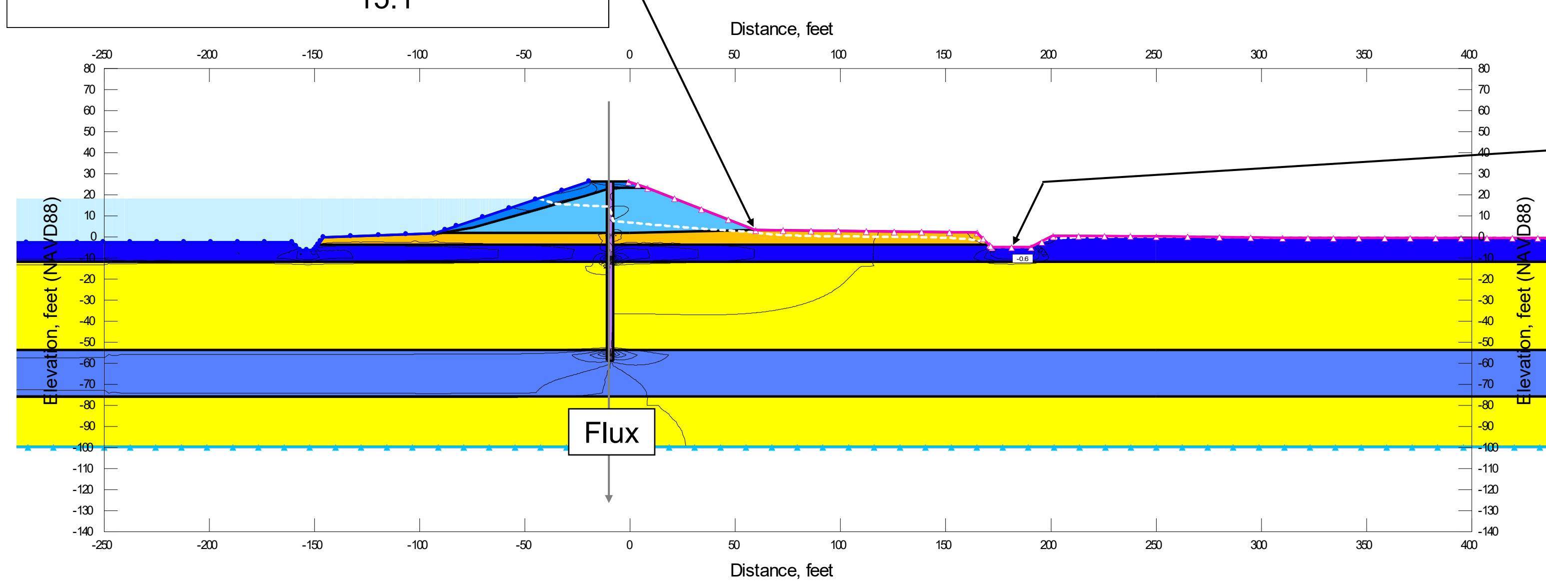
TOTAL HEAD CONTOURS

Local Y-Gradient = -0.12
Local XY-Gradient = 0.21
Flux = 9.41 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{-0.08 - (1.95)}{15.1} = -0.13$

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
(orange)	Unit 2: Organic Soil	4.0×10^{-6}	1
(blue)	Unit 3: Clay Blanket	1.0×10^{-6}	1
(yellow)	Unit 4: Sand (Upper)	5.4×10^{-3}	9
(medium blue)	Unit 5: Clay	4.0×10^{-6}	4
(yellow)	Unit 6: Sand (Lower)	5.4×10^{-3}	9
(dark navy)	Unit 7: Deep Clay	4.0×10^{-6}	4
(lavender)	Unit 8: Cutoff Wall	1.0×10^{-6}	1
(blue)	Unit 9: Clay Cap	4.0×10^{-6}	4
(bright blue)	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
(light gray)	Unit 11: Drain Rock	1.0×10^{1}	10
(yellow)	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Max Y-Gradient = 0.97 (empty ditch) / -0.06 (full ditch)
Max XY-Gradient = 1.33 (empty ditch) / 0.07 (full ditch)

Average Y– Gradient = $\frac{-0.23 - (-5.2)}{6.8}$ = 0.73 (empty ditch)
Average Y– Gradient = $\frac{-0.09 - (0.3)}{6.8}$ = -0.06 (full ditch)



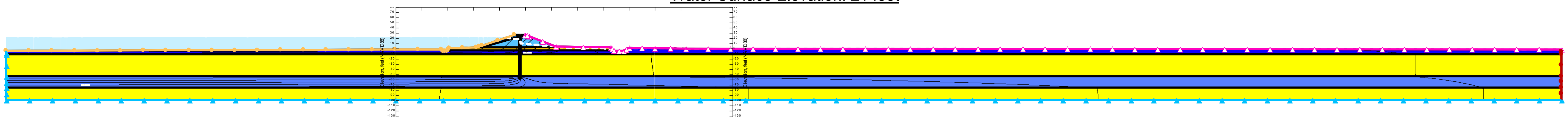
VERTICAL GRADIENT CONTOURS

Little Egbert Multi-Benefit Project
Solano County, California

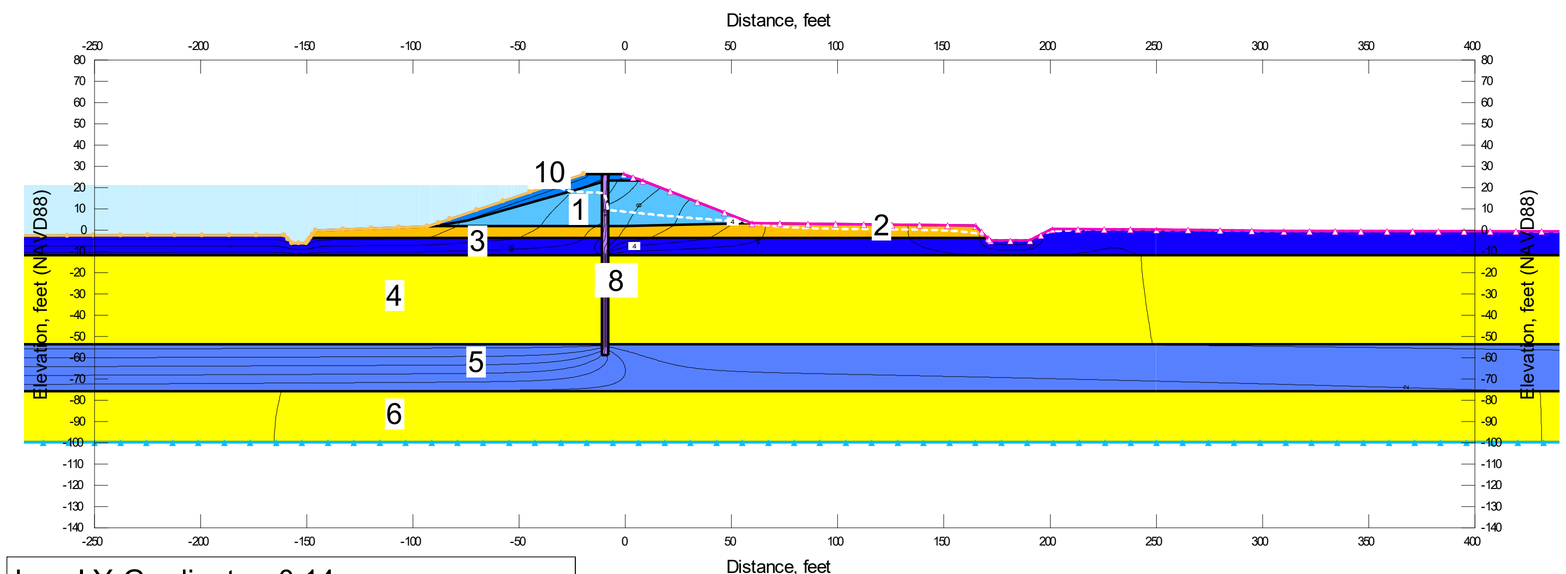
Seepage Analysis
RD 536 - Station 95+00
Rehabilitated Levee with Cutoff Wall (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-13

Water Surface Elevation: 21 feet

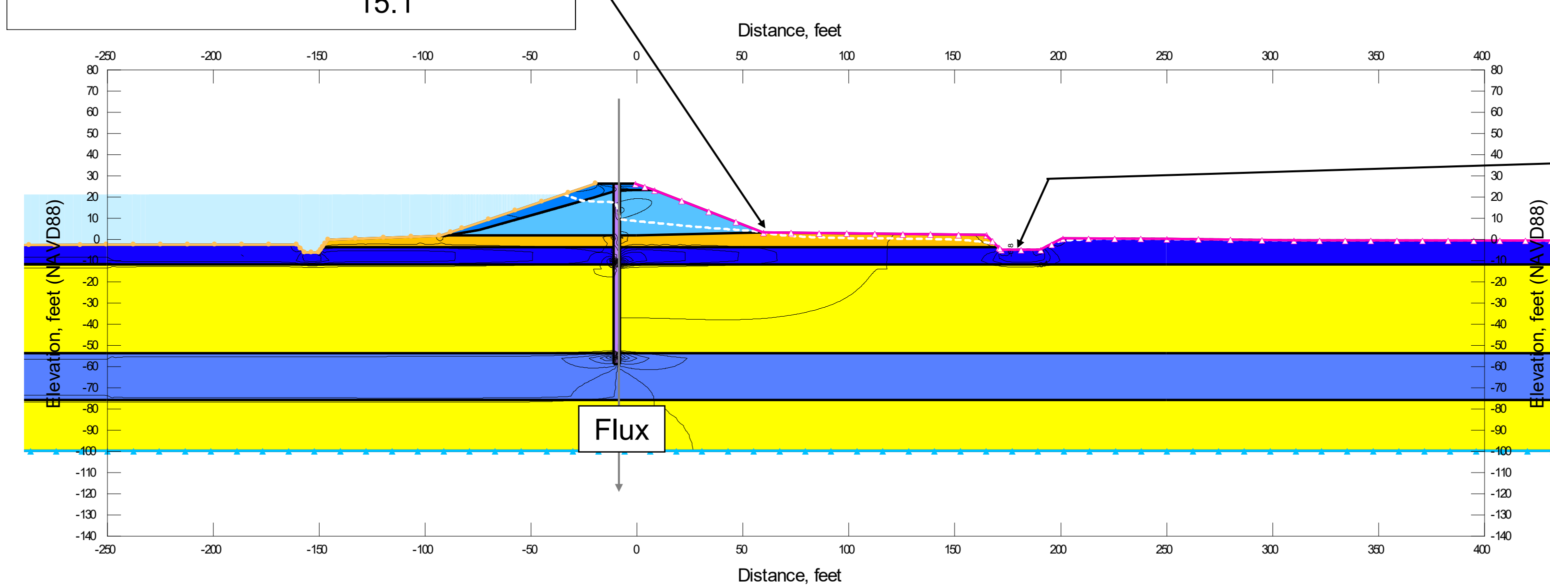


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = -0.14
Local XY-Gradient = 0.31
Flux = 1.09 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{0.04 - (2.1)}{15.1}$ = -0.14



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 1.03 (empty ditch) / -0.01 (full ditch)
Max XY-Gradient = 1.39 (empty ditch) / 0.02 (full ditch)

Average Y– Gradient = $\frac{0.07 - (-5.2)}{6.8}$= 0.78 (empty ditch)

Average Y– Gradient = $\frac{0.20 - (0.3)}{6.8}$= -0.01 (full ditch)

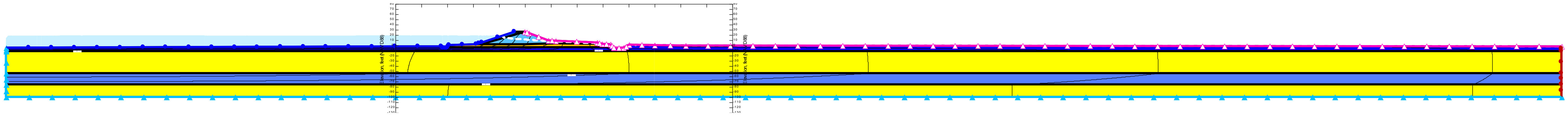
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

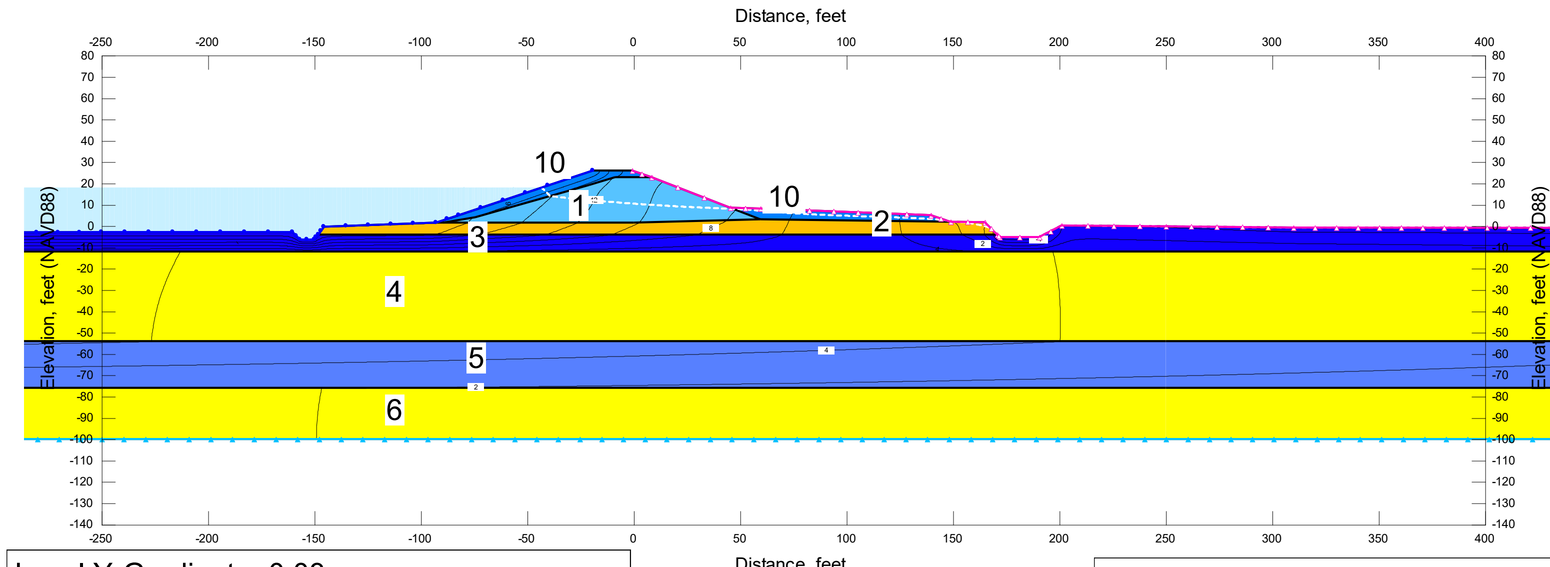
Seepage Analysis
RD 536 - Station 95+00
Rehabilitated Levee with Cutoff Wall (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-14

Water Surface Elevation: 18 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

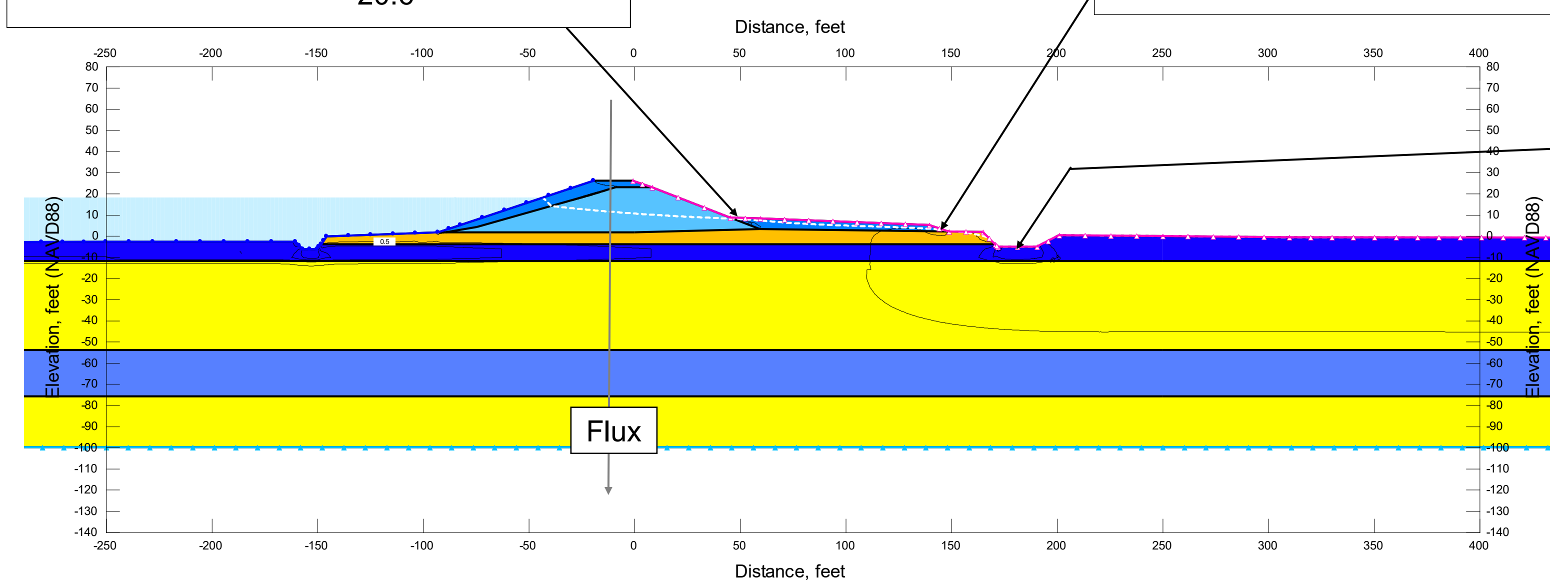
Local Y-Gradient = 0.03
Local XY-Gradient = 0.05
Flux = -1.99 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{4.85 - (8.2)}{20.6}$ = -0.16

Local Y-Gradient = 0.05
Local XY-Gradient = -0.20
Average Y-Gradient = $\frac{4.25 - (2)}{14}$ = 0.16

Max Y-Gradient = 1.73 (empty ditch) / 0.65 (full ditch)
Max XY-Gradient = 2.13 (empty ditch) / 0.71 (full ditch)

Average Y– Gradient = $\frac{4.0 - (-5.2)}{6.8}$ = 1.35 (empty ditch)

Average Y– Gradient = $\frac{4.17 - (0.3)}{6.8}$ = 0.57 (full ditch)



VERTICAL GRADIENT CONTOURS

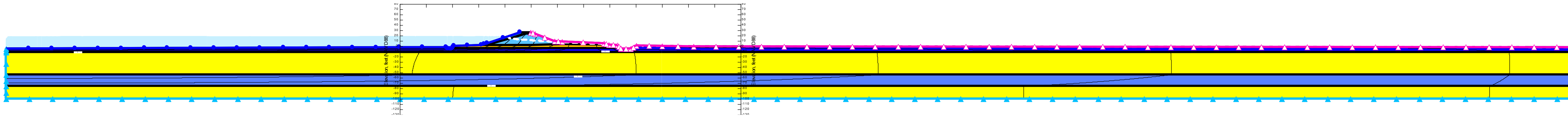
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

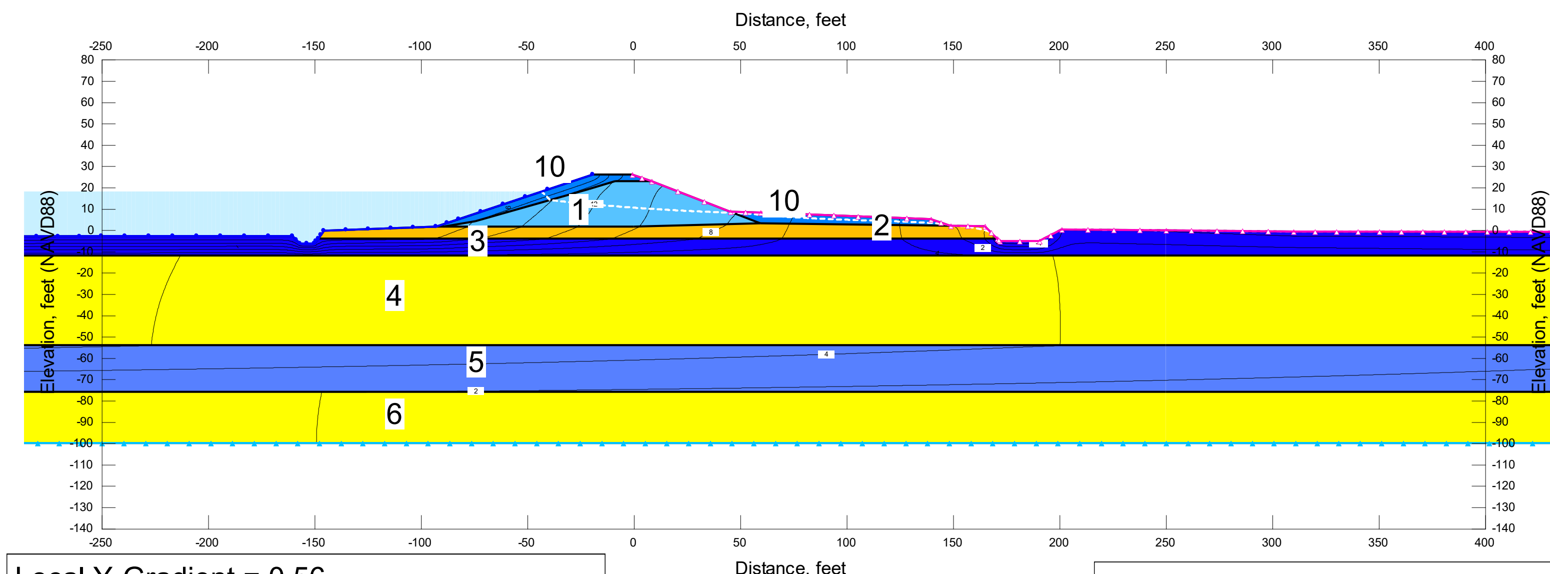
Seepage Analysis
RD 536 - Station 95+00
Rehabilitated Levee with Seepage Berm (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-15

Water Surface Elevation: 21 feet



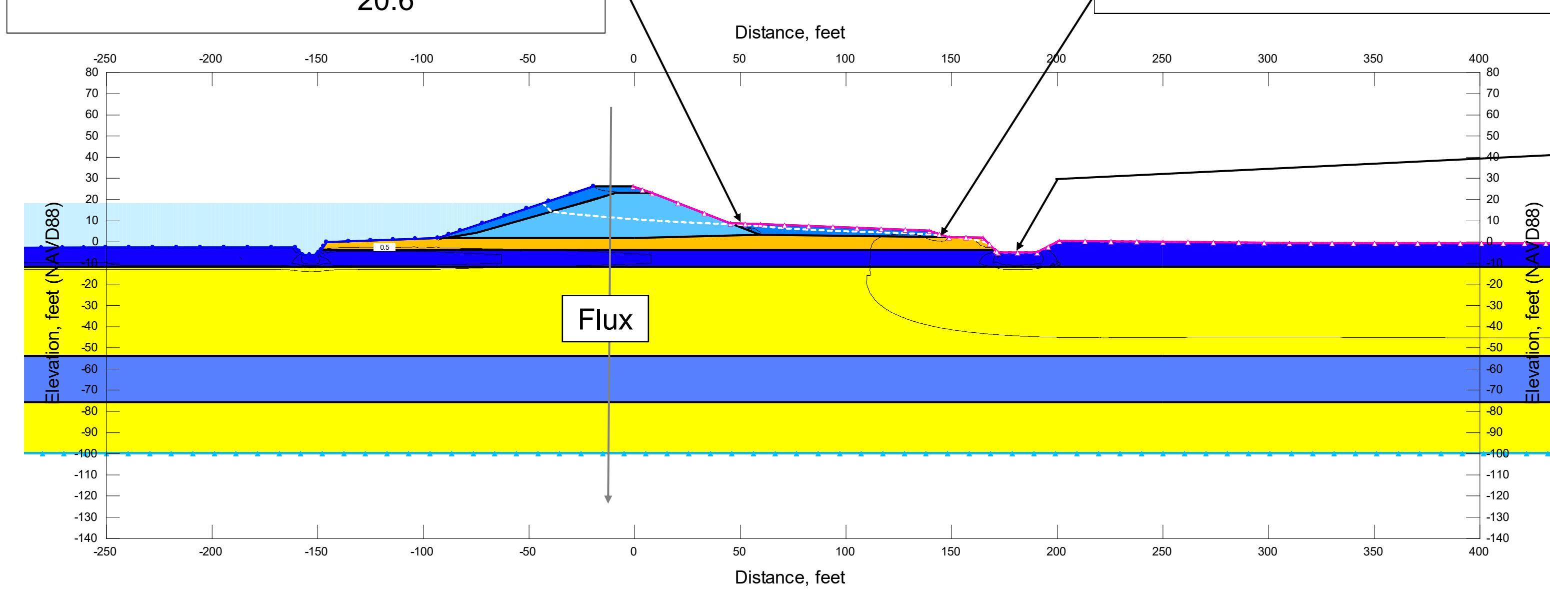
SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.56
Local XY-Gradient = 0.59
Flux = 2.32 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{5.79 - (8.6)}{20.6}$ = -0.136

Local Y-Gradient = 0.15
Local XY-Gradient = 0.31
Average Y-Gradient = $\frac{5.25 - (2)}{14}$ = 0.23



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 1.88 (empty ditch) / 0.80 (full ditch)
Max XY-Gradient = 2.3 (empty ditch) / 0.88 (full ditch)

Average Y– Gradient = $\frac{5.0 - (-5.2)}{6.8}$= 1.5 (empty ditch)
Average Y– Gradient = $\frac{5.08 - (0.3)}{6.8}$= 0.70 (full ditch)

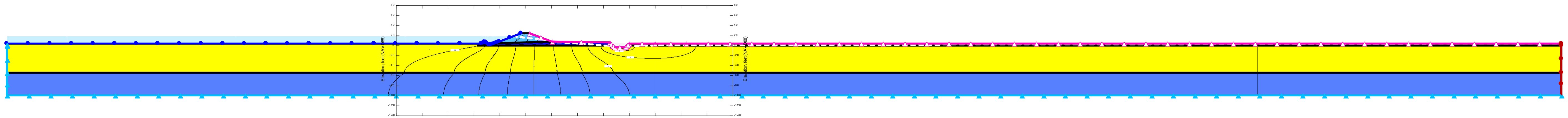
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

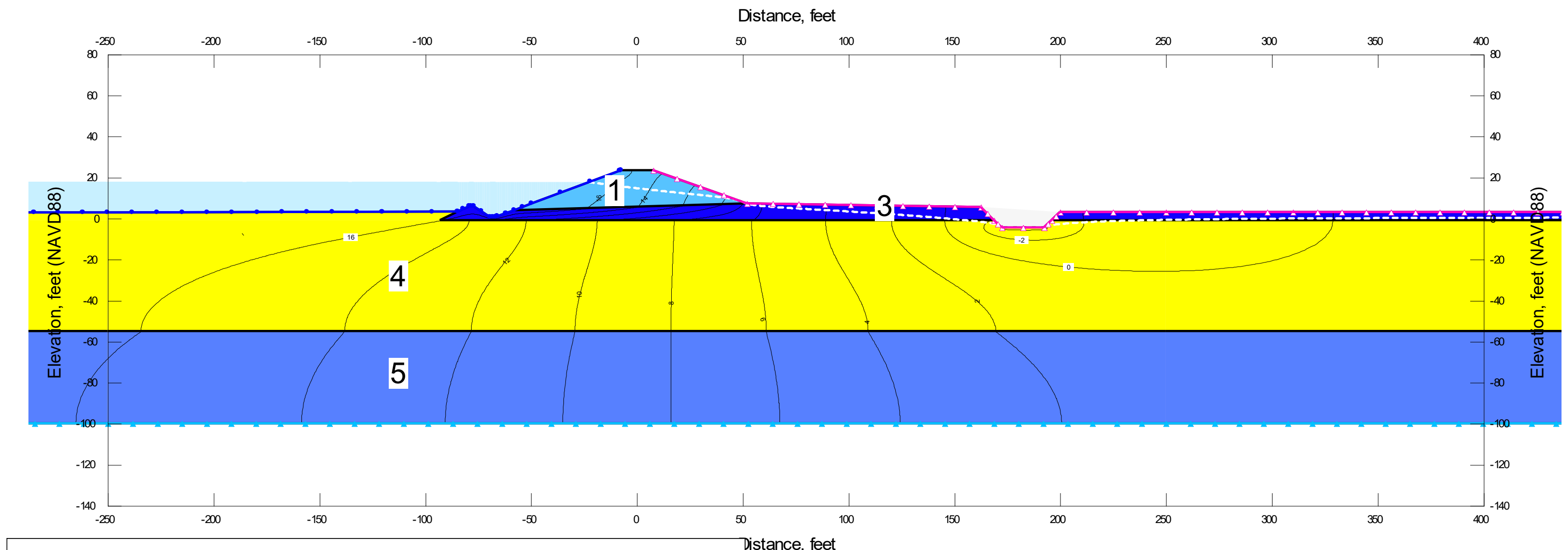
Seepage Analysis
RD 536 - Station 95+00
Rehabilitated Levee with Seepage Berm (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-16

Water Surface Elevation: 17.6 feet

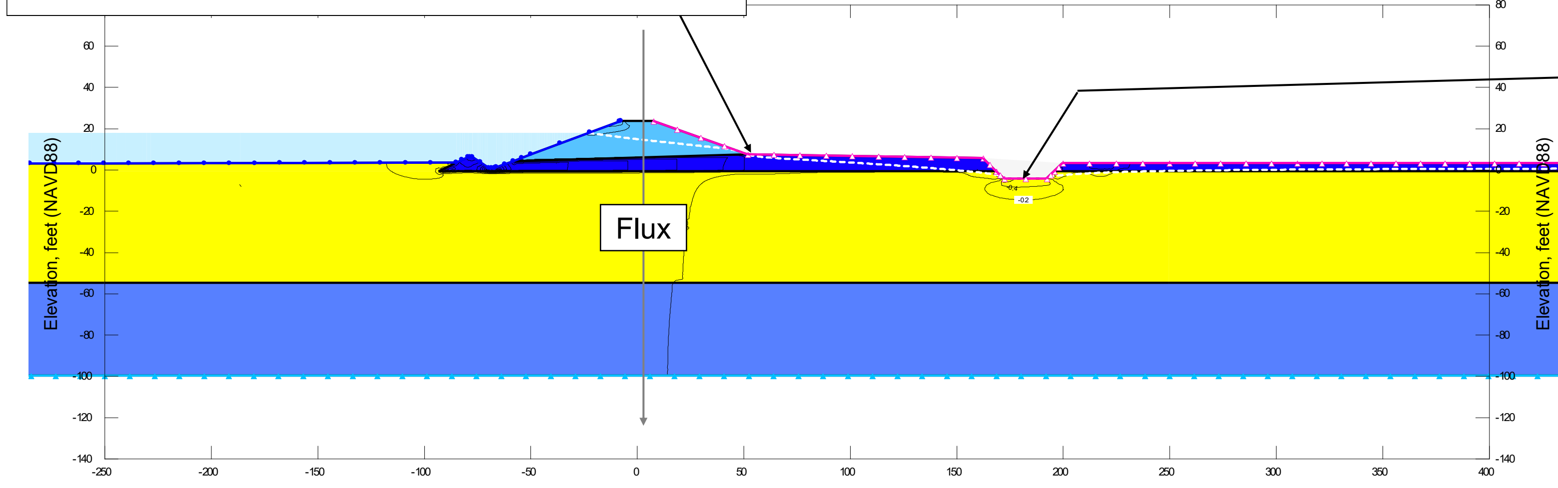


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = -0.04
Local XY-Gradient = 0.34
Flux = 2.12 X 10^{-1} gpm/ft
Average Y-Gradient = $\frac{6.12 - (7.2)}{8.2}$ = -0.13 (empty ditch)
Average Y-Gradient = $\frac{9.62 - (7.2)}{8.2}$ = 0.30 (full ditch)



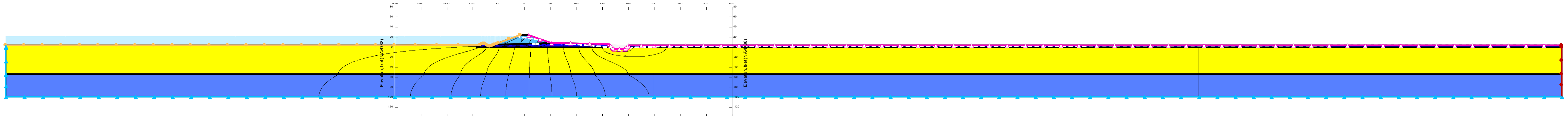
VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 0.70 (empty ditch)
Max Y-Gradient = 0.37 (full ditch)
Max XY-Gradient = 0.93 (empty ditch)
Max XY-Gradient = 0.46 (full ditch)

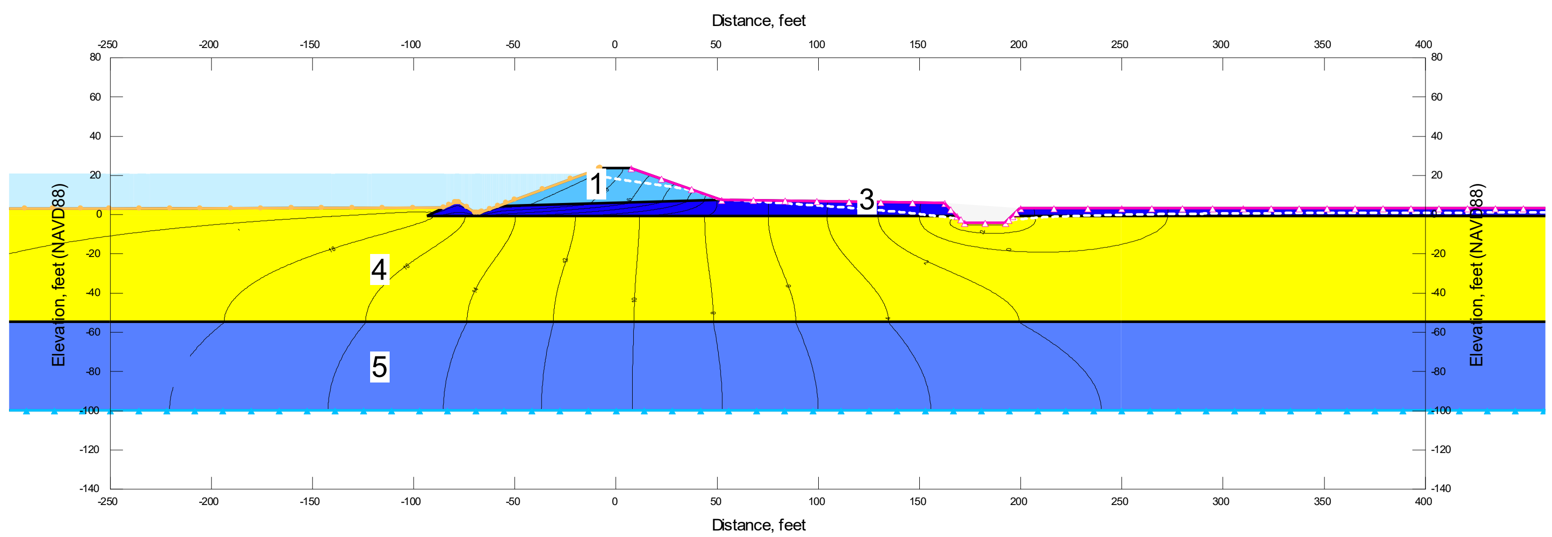
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 135+00** **Existing Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-17

Water Surface Elevation: 20.6 feet

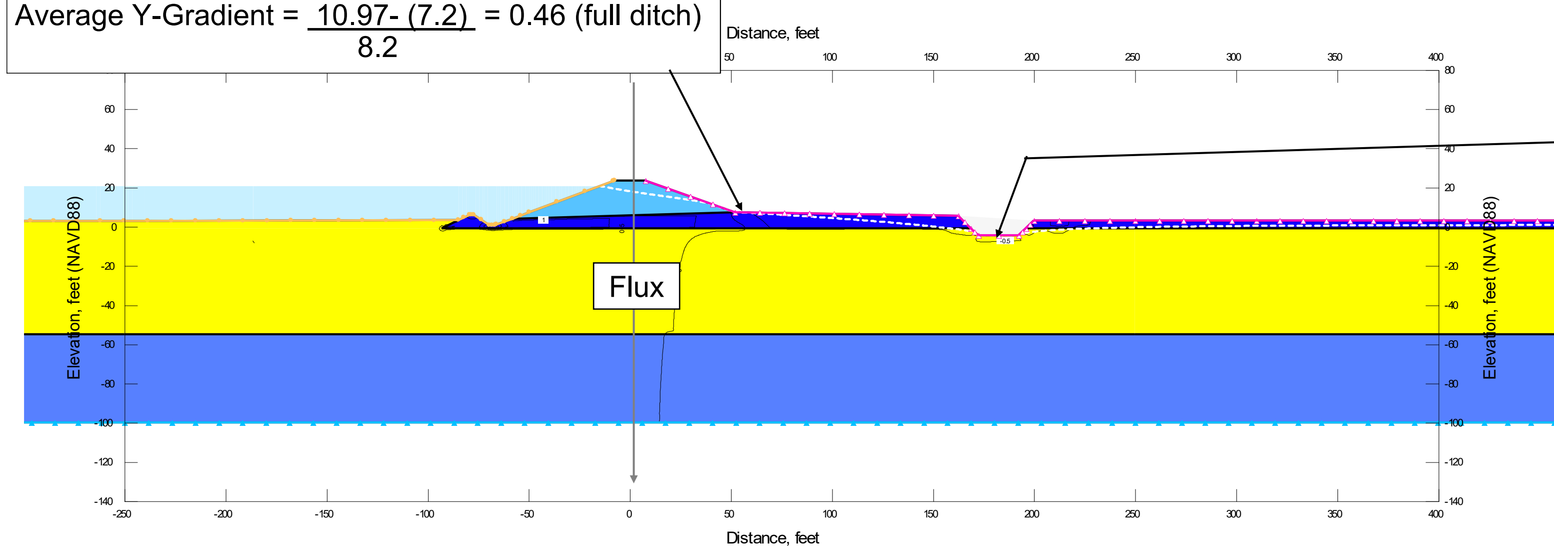


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.18
Local XY-Gradient = 0.38
Flux = 2.42×10^{-1} gpm/ft
Average Y-Gradient = $\frac{7.5 - (7.2)}{8.2}$ = 0.04 (empty ditch)
Average Y-Gradient = $\frac{10.97 - (7.2)}{8.2}$ = 0.46 (full ditch)



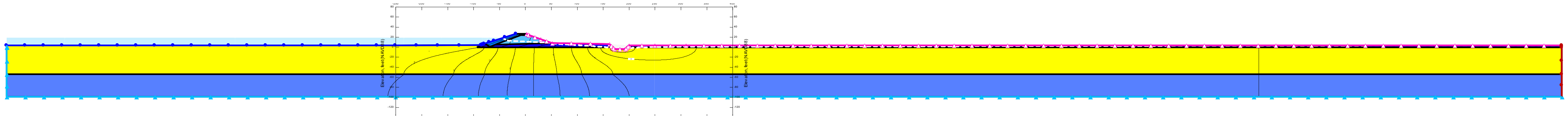
VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 0.78 (empty ditch)
Max Y-Gradient = 0.45 (full ditch)
Max XY-Gradient = 1.01 (empty ditch)
Max XY-Gradient = 0.55 (full ditch)

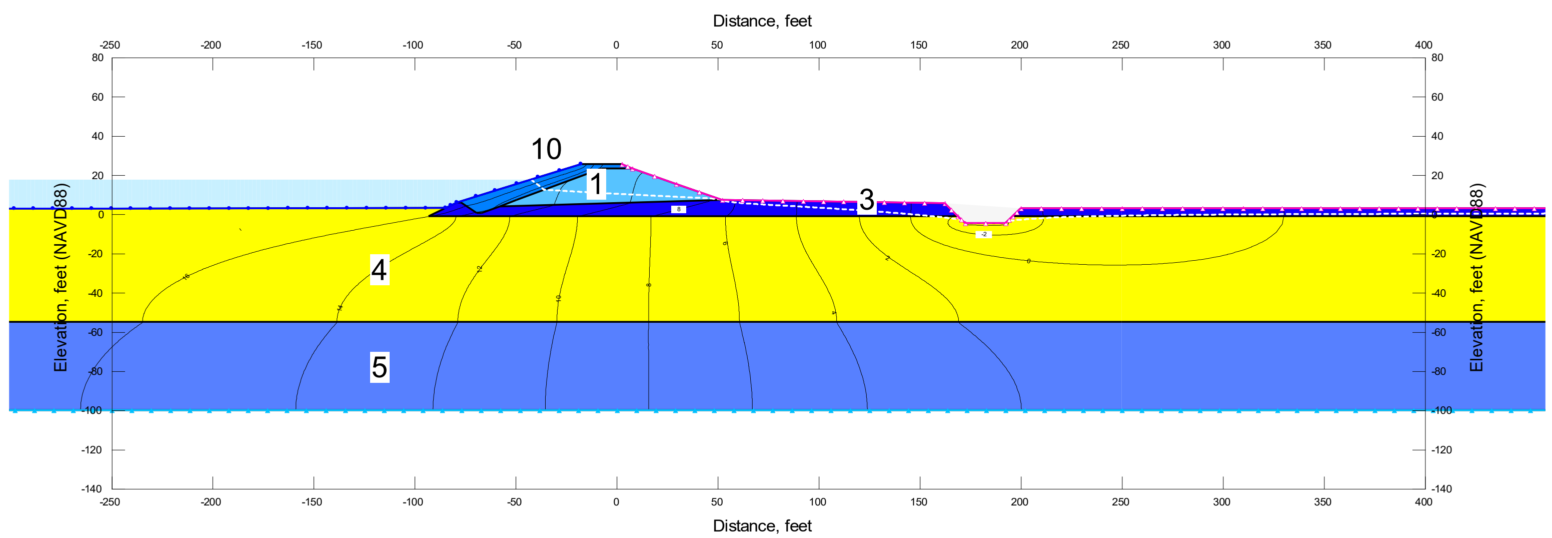
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 135+00** **Existing Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-18

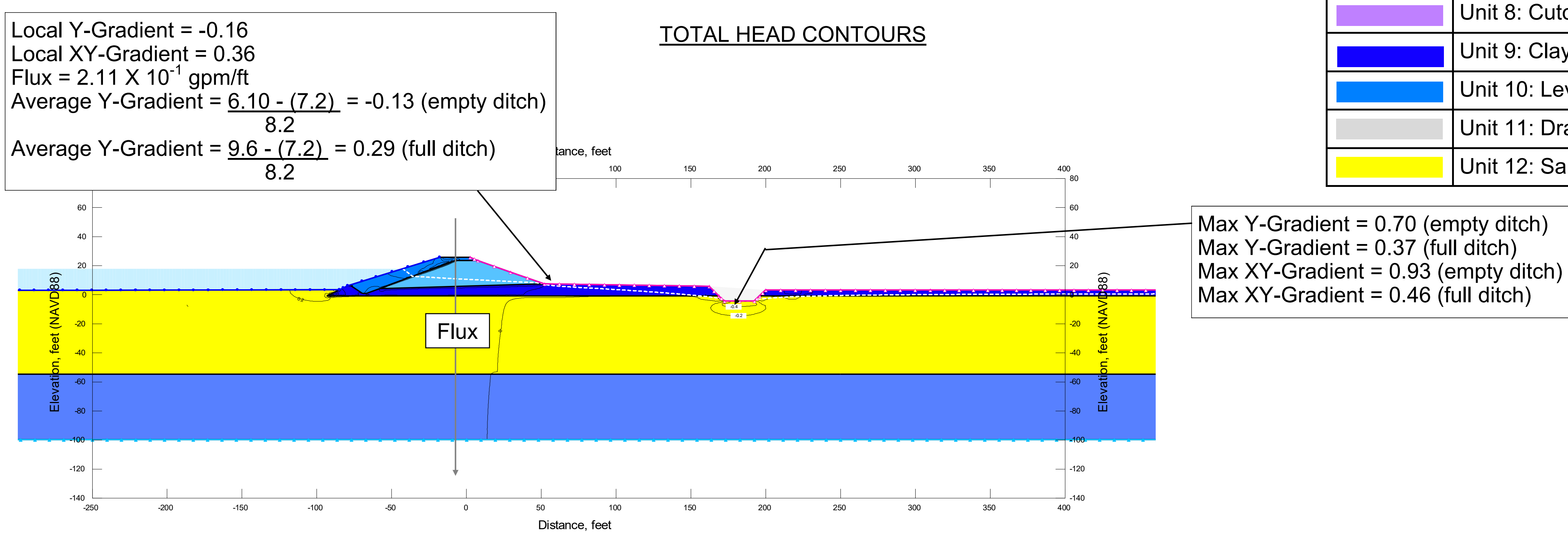
Water Surface Elevation: 17.6 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



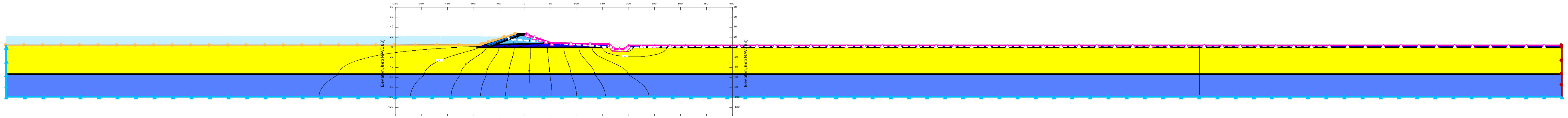
VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES

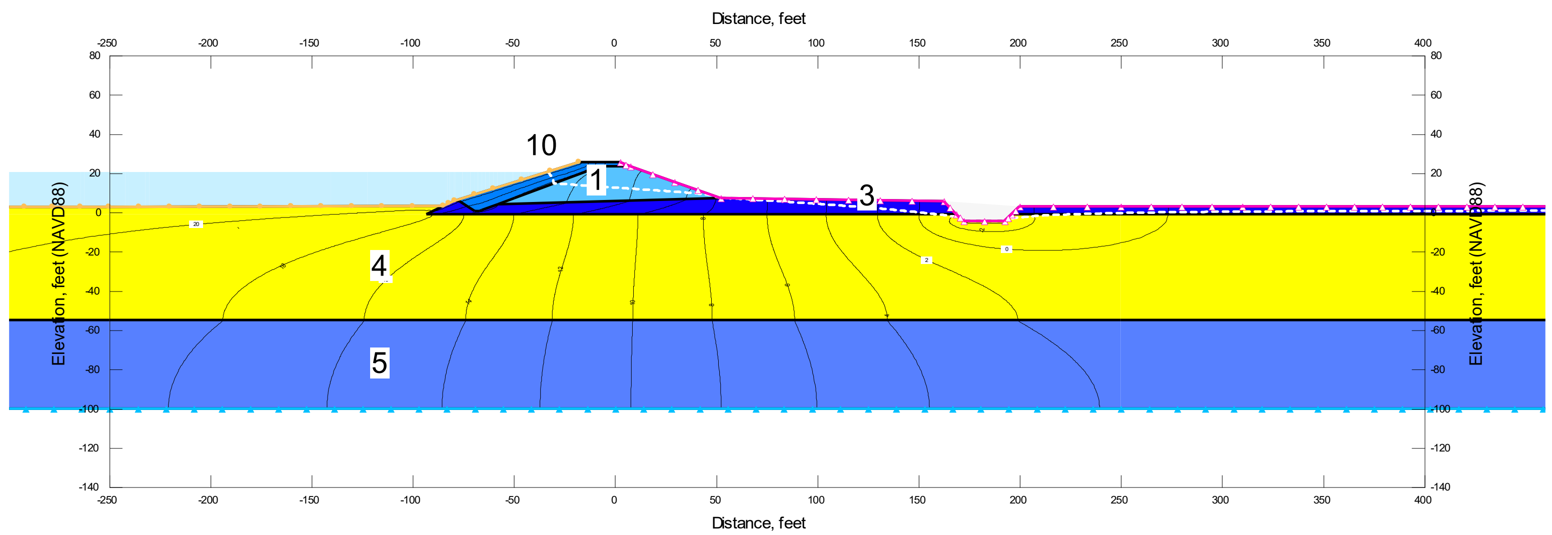
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 135+00** **Rehabilitated Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-19

Water Surface Elevation: 20.6 feet



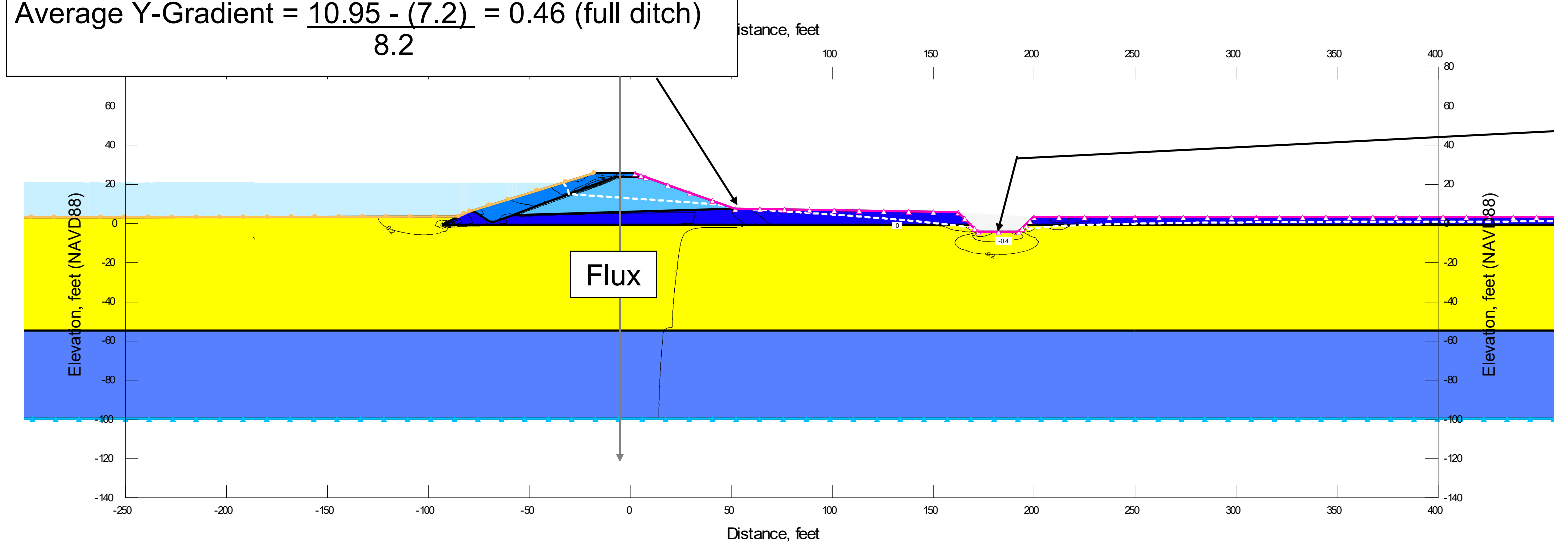
SEEP/W MODEL



TOTAL HEAD CON-

Local Y-Gradient = 0.16
Local XY-Gradient = 0.38
Flux = 2.41 X 10^{-1} gpm/ft
Average Y-Gradient = $\frac{7.47 - (7.2)}{8.2}$ = 0.03 (empty ditch)
Average Y-Gradient = $\frac{10.95 - (7.2)}{8.2}$ = 0.46 (full ditch)

Max Y-Gradient = 0.78 (empty ditch)
Max Y-Gradient = 0.44 (full ditch)
Max XY-Gradient = 1.01 (empty ditch)
Max XY-Gradient = 0.55 (full ditch)

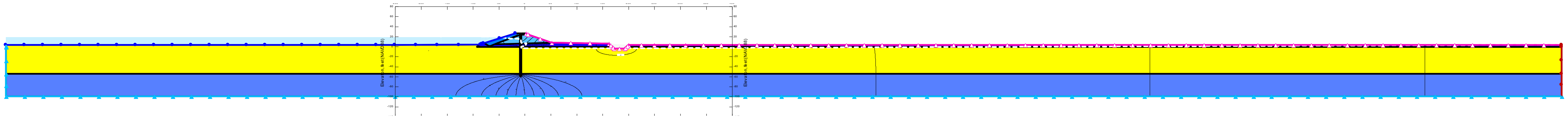


VERTICAL GRADIENT CONTOURS

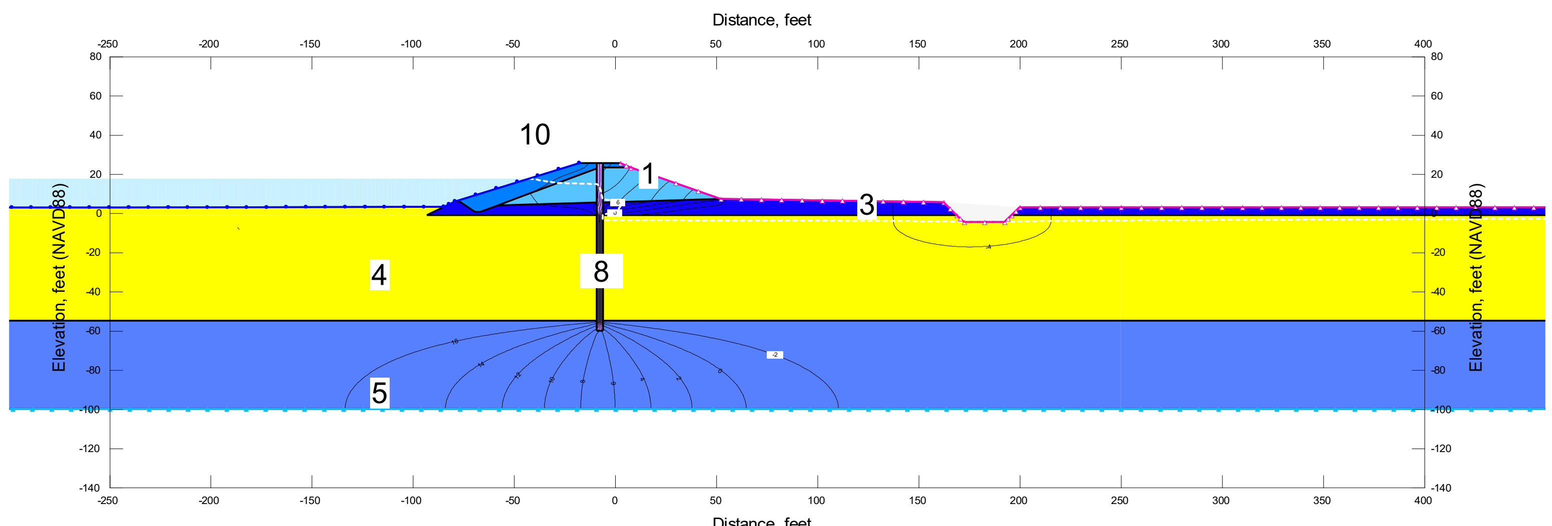
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 135+00** **Rehabilitated Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-20

Water Surface Elevation: 17.6 feet

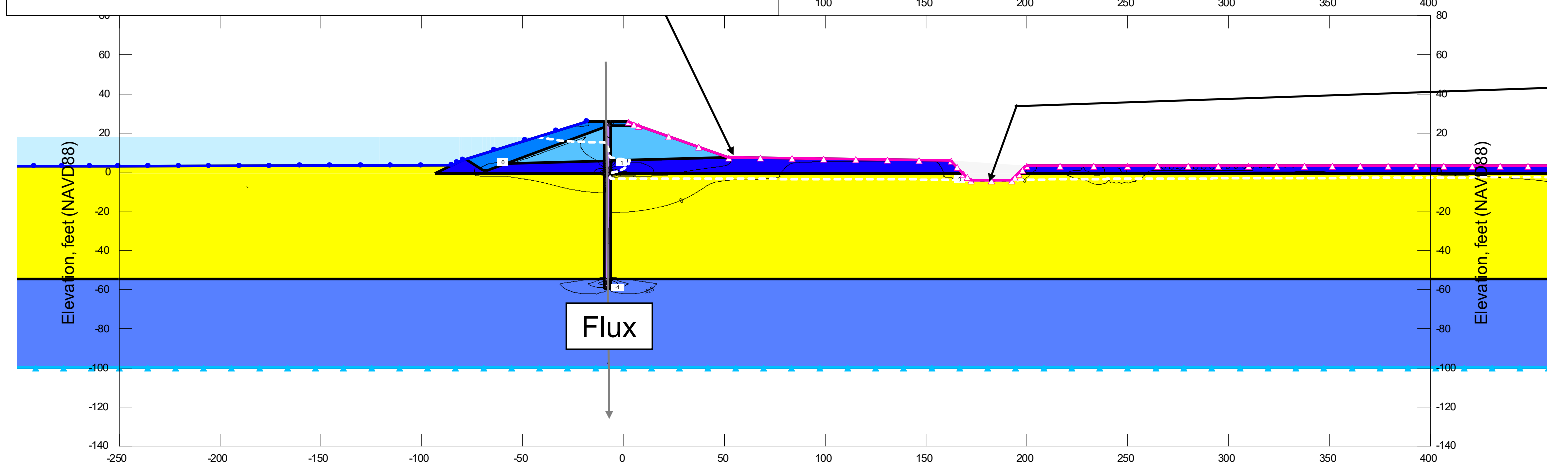


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = -0.82
Local XY-Gradient = 1.10
Flux = 6.82 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{-3.66 - (0.06)}{8.2}$ = -0.45 (empty ditch)
Average Y-Gradient = $\frac{3.21 - (4.03)}{8.2}$ = -0.10 (full ditch)



Max Y-Gradient = 0.09 (empty ditch)
Max Y-Gradient = 0.01 (full ditch)
Max XY-Gradient = 0.10 (empty ditch)
Max XY-Gradient = 0.01 (full ditch)

VERTICAL GRADIENT CONTOURS

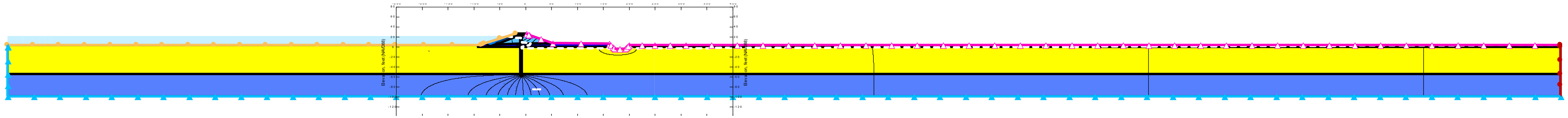
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

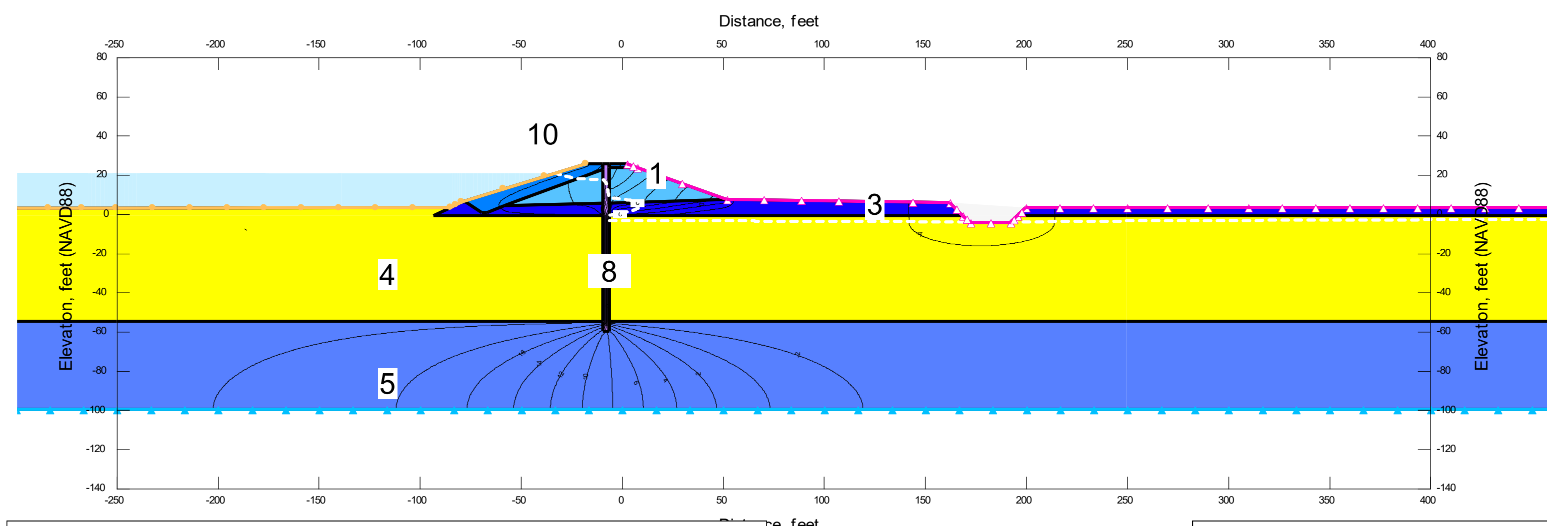
Seepage Analysis
RD 536 - Station 135+00
Rehabilitated Levee with Cutoff Wall (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-21

Water Surface Elevation: 20.6 feet



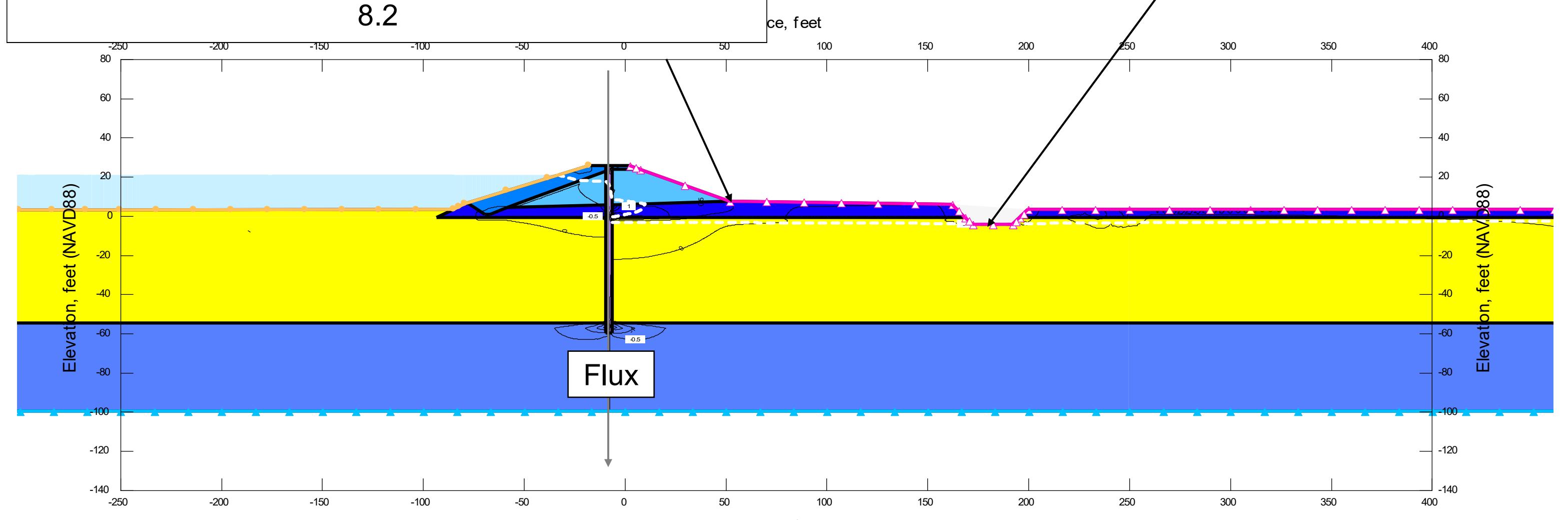
SEEP/W MODEL



Local Y-Gradient = -0.88
Local XY-Gradient = 1.09
Flux = 7.85 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{-3.57 - (0.99)}{8.2}$ = -0.56 (empty ditch)
Average Y-Gradient = $\frac{3.26 - (4.79)}{8.2}$ = -0.19 (full ditch)

TOTAL HEAD CONTOURS

Max Y-Gradient = 0.09 (empty ditch)
Max Y-Gradient = 0.01 (full ditch)
Max XY-Gradient = 0.10 (empty ditch)
Max XY-Gradient = 0.01 (full ditch)



VERTICAL GRADIENT CONTOURS

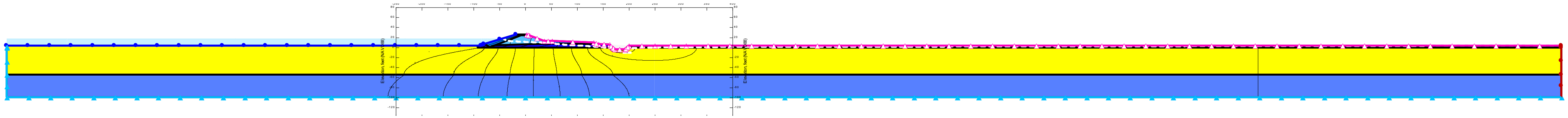
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

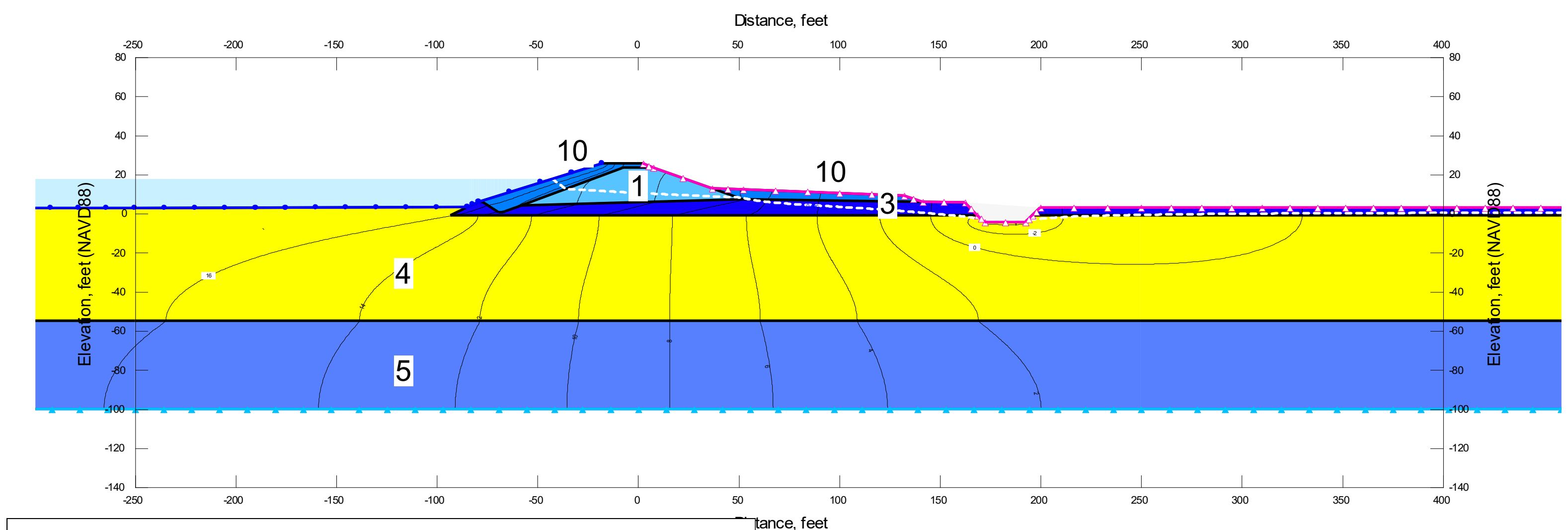
Seepage Analysis
RD 536 - Station 135+00
Rehabilitated Levee with Cutoff Wall (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-22

Water Surface Elevation: 17.6 feet



SEEP/W MODEL

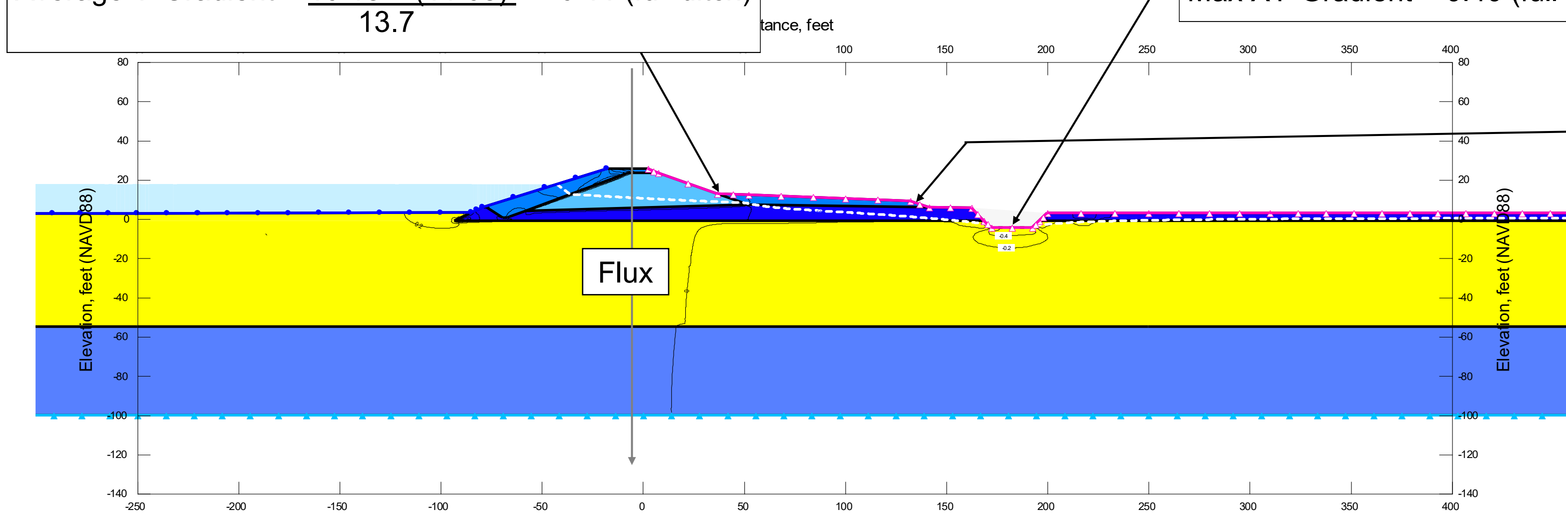


Local Y-Gradient = -0.03
Local XY-Gradient = 0.05
Flux = 2.11 X 10^{-1} gpm/ft
Average Y-Gradient = $\frac{6.9 - (8.8)}{13.7}$ = -0.14 (empty ditch)
Average Y-Gradient = $\frac{10.18 + (11.68)}{13.7}$ = -0.11 (full ditch)

TOTAL HEAD CONTOURS

Max Y-Gradient = 0.70 (empty ditch)
Max Y-Gradient = 0.37 (full ditch)
Max XY-Gradient = 0.93 (empty ditch)
Max XY-Gradient = 0.40 (full ditch)

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

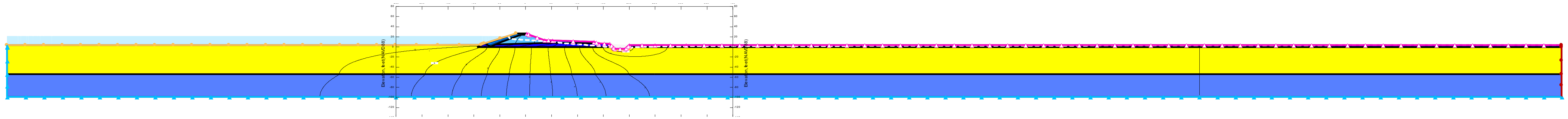


Local Y-Gradient = -0.01
Local XY-Gradient = 0.12
Average Y-Gradient = $\frac{0.31 - (0.45)}{6.9}$ = -0.02 (empty ditch)
Average Y-Gradient = $\frac{5.57 - (5.74)}{6.9}$ = -0.02 (full ditch)

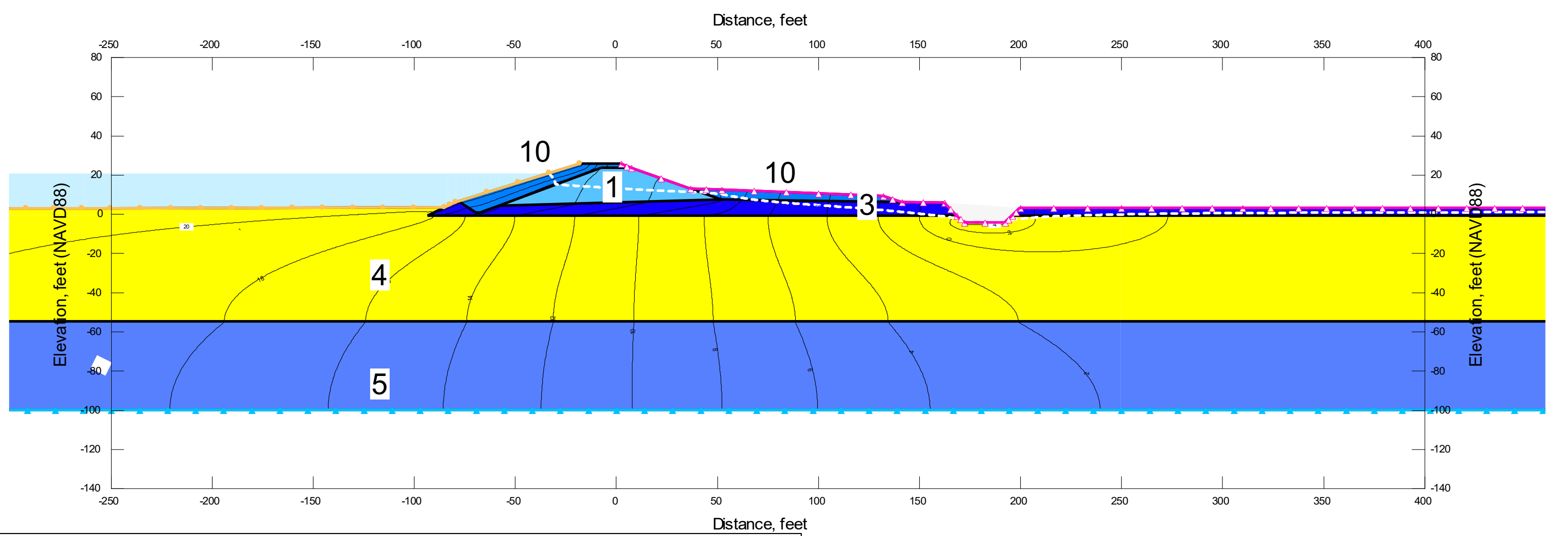
VERTICAL GRADIENT CONTOURS

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 135+00** **Rehabilitated Levee with Seepage Berm (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-23

Water Surface Elevation: 20.6 feet



SEEP/W MODEL

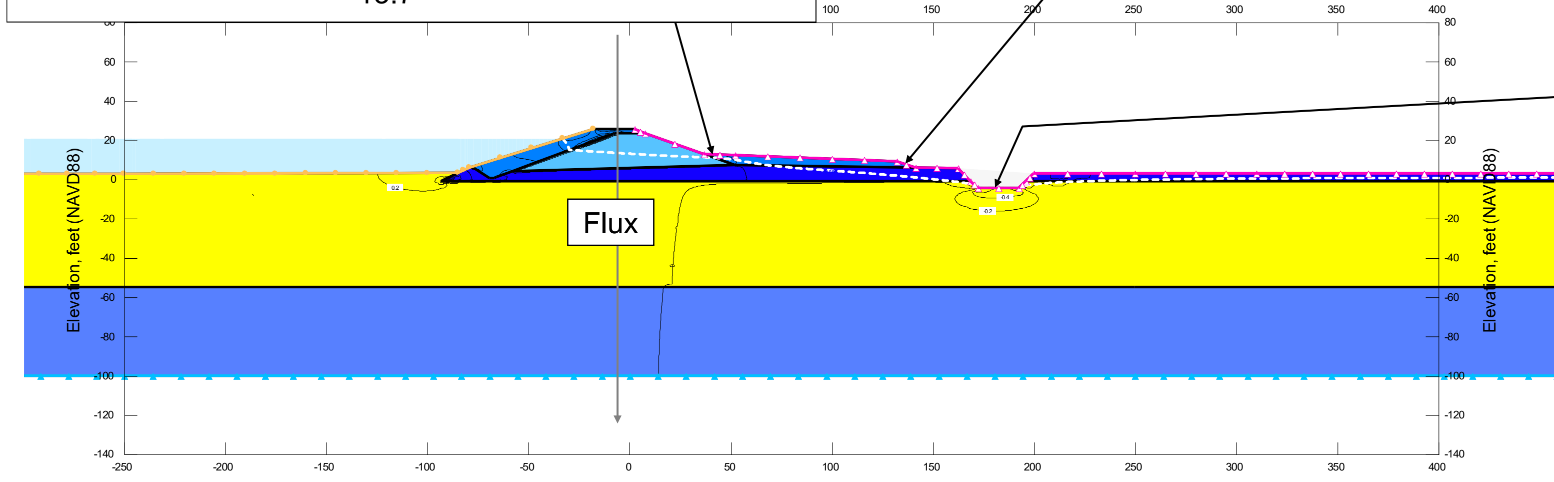


TOTAL HEAD CONTOURS

Local Y-Gradient = -0.03
Local XY-Gradient = 0.05
Flux = 2.41 X 10^{-1} gpm/ft
Average Y-Gradient = $\frac{11.66 - (12.82)}{13.7}$ = -0.08 (empty ditch)
Average Y-Gradient = $\frac{11.66 - (12.82)}{13.7}$ = -0.08 (full ditch)

Local Y-Gradient = -0.07
Local XY-Gradient = 0.14
Average Y-Gradient = $\frac{0.86 - (1.03)}{6.9}$ = -0.02

Max Y-Gradient = 0.78 (empty ditch)
Max Y-Gradient = 0.45 (full ditch)
Max XY-Gradient = 1.01 (empty ditch)
Max XY-Gradient = 0.48 (full ditch)



VERTICAL GRADIENT CONTOURS

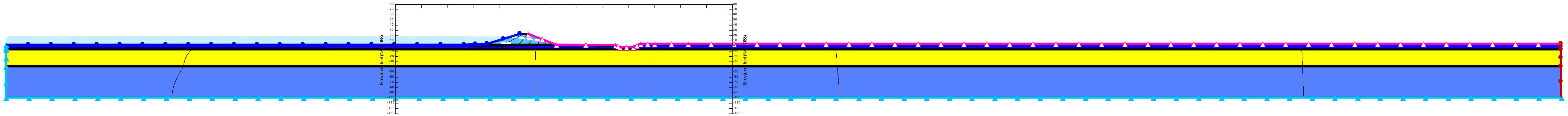
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

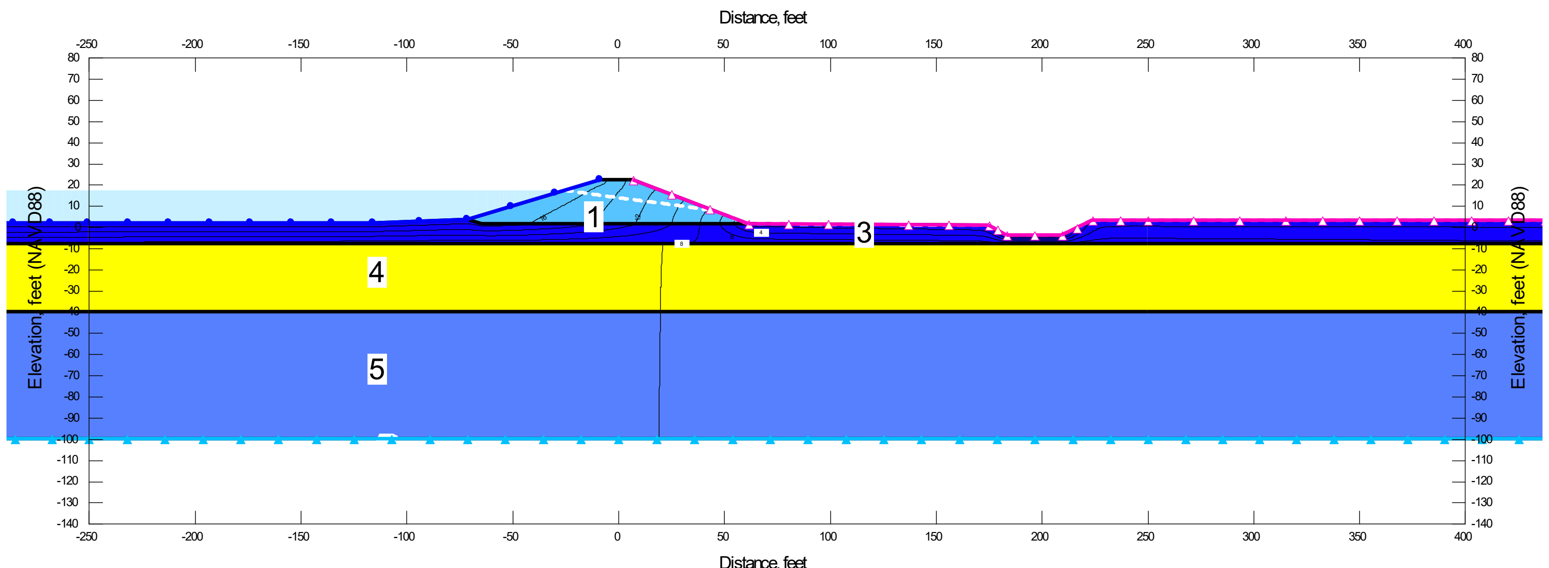
Seepage Analysis
RD 536 - Station 135+00
Rehabilitated Levee with Seepage Berm (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-24

Water Surface Elevation: 17.1 feet

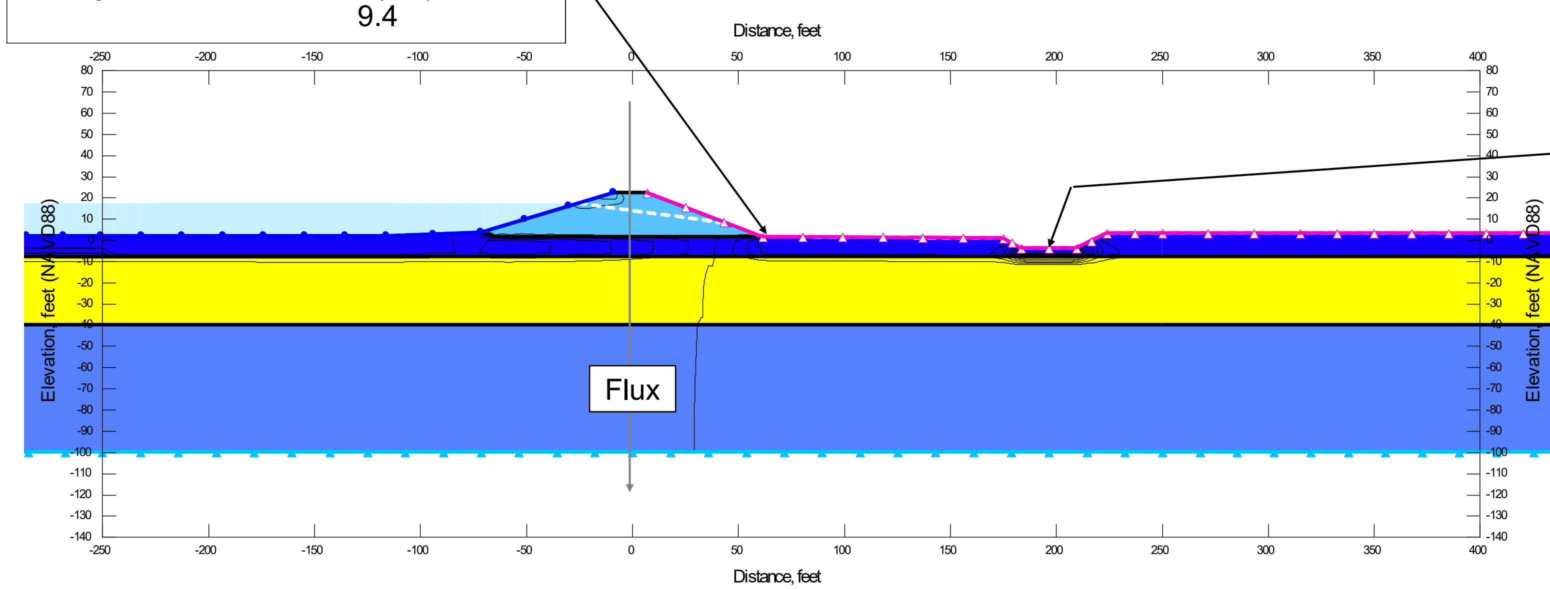


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.75
Local XY-Gradient = 0.75
Flux = 1.23 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{7.8 - (1.4)}{9.4}$ = 0.68



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 2.74 (empty ditch) / 1.66 (full ditch)
Max XY-Gradient = 2.87 (empty ditch) / 1.70 (full ditch)

Average Y– Gradient = $\frac{7.26 - (-3.8)}{4.2}$= 2.63 (empty ditch)

Average Y– Gradient = $\frac{7.41 - (0.6)}{4.2}$= 1.62 (full ditch)

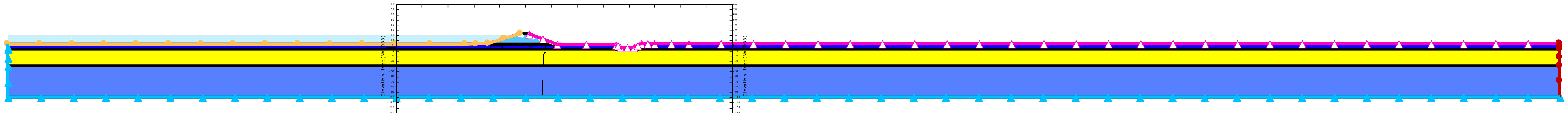
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

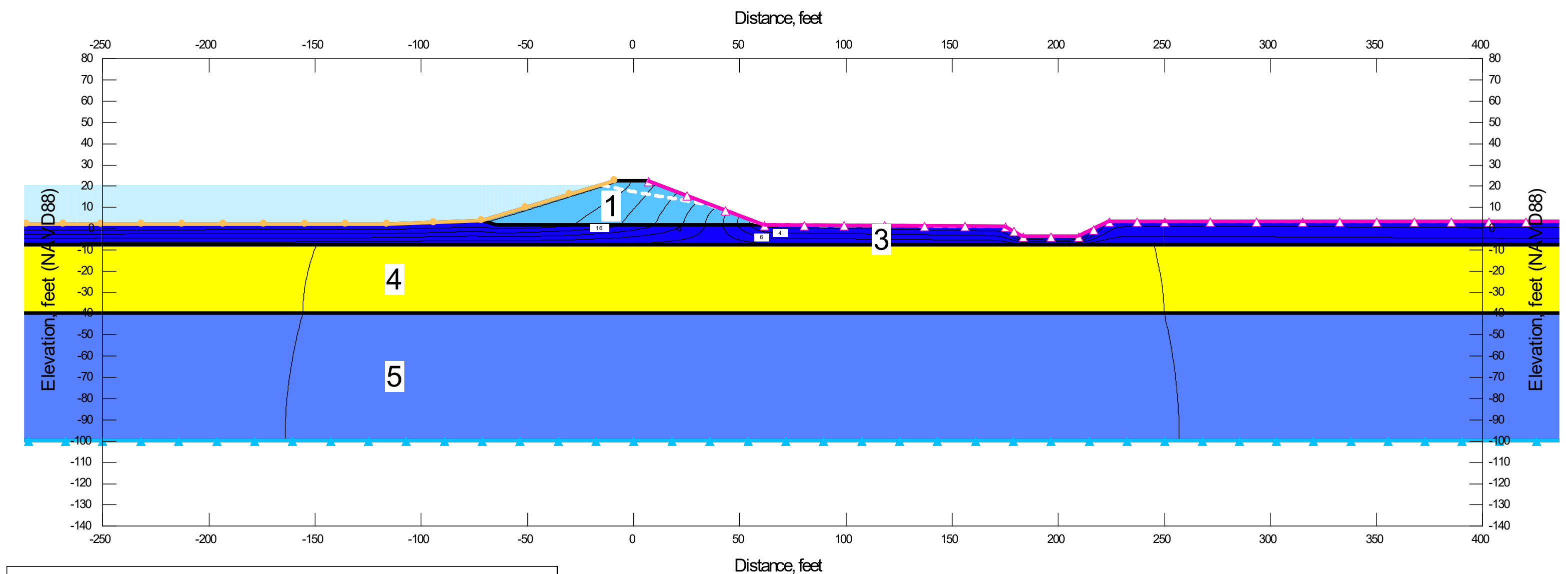
Seepage Analysis
RD 536 - Station 175+00
Existing Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-25

Water Surface Elevation: 20.1 feet

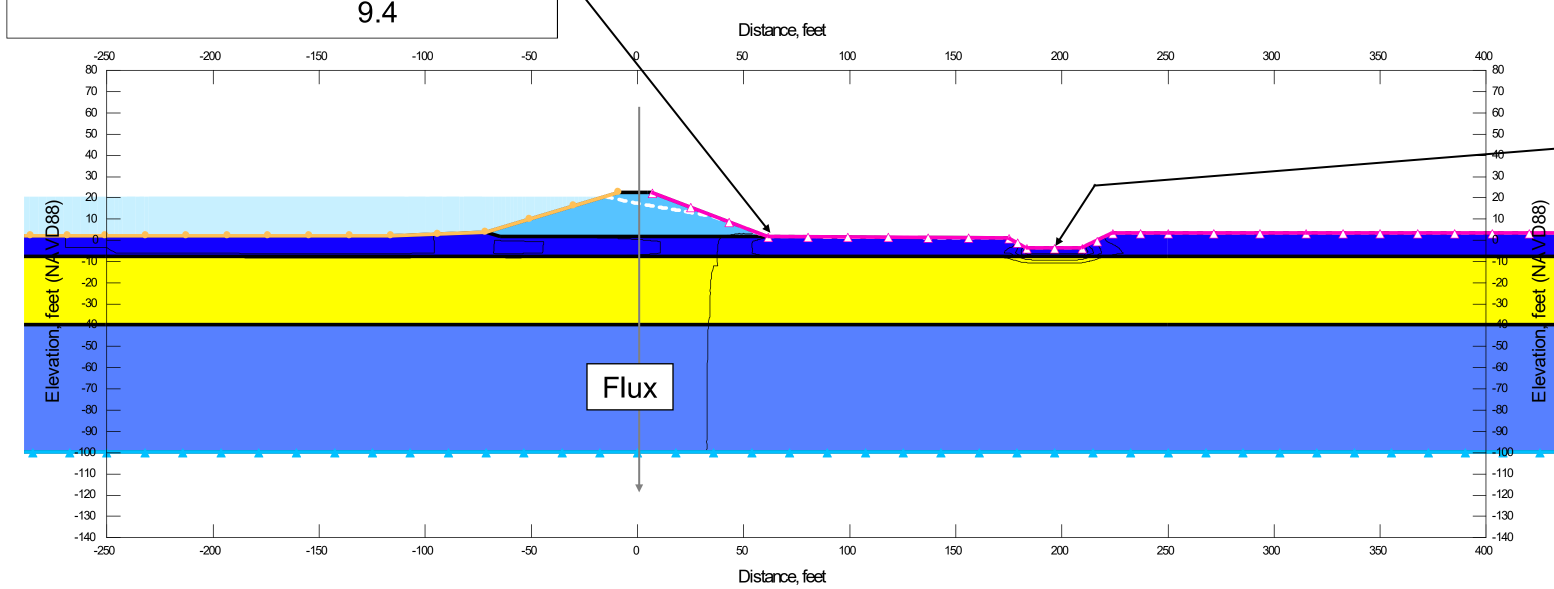


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.86
Local XY-Gradient = 0.86
Flux = 1.51 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{8.9 - (1.4)}{9.4}$ = 0.80



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 2.98 (empty ditch) / 1.90 (full ditch)
Max XY-Gradient = 3.11 (empty ditch) / 1.94 (full ditch)

Average Y– Gradient = $\frac{8.24 - (-3.8)}{4.2}$= 2.87 (empty ditch)

Average Y– Gradient = $\frac{8.39 - (0.6)}{4.2}$= 1.85 (full ditch)

SEEPAGE MODEL MATERIAL PROPERTIES

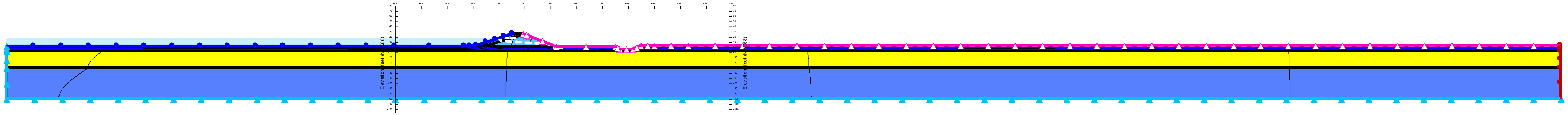
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

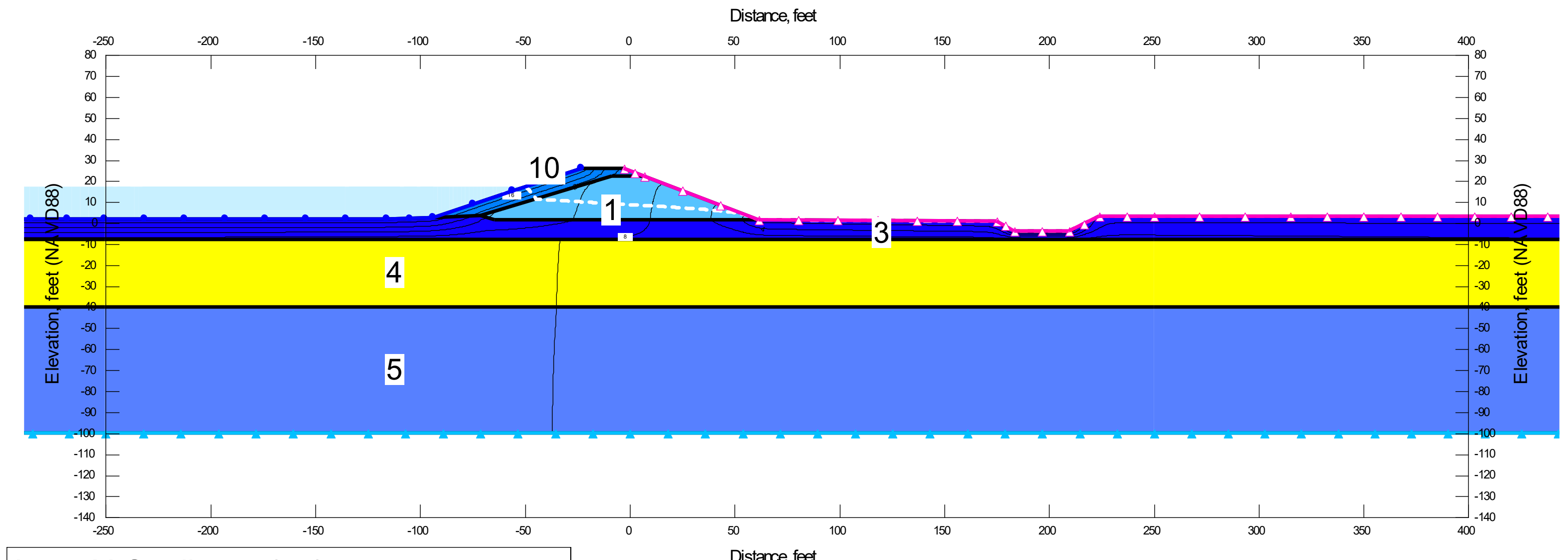
Seepage Analysis
RD 536 - Station 175+00
Existing Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-26

Water Surface Elevation: 17.1 feet

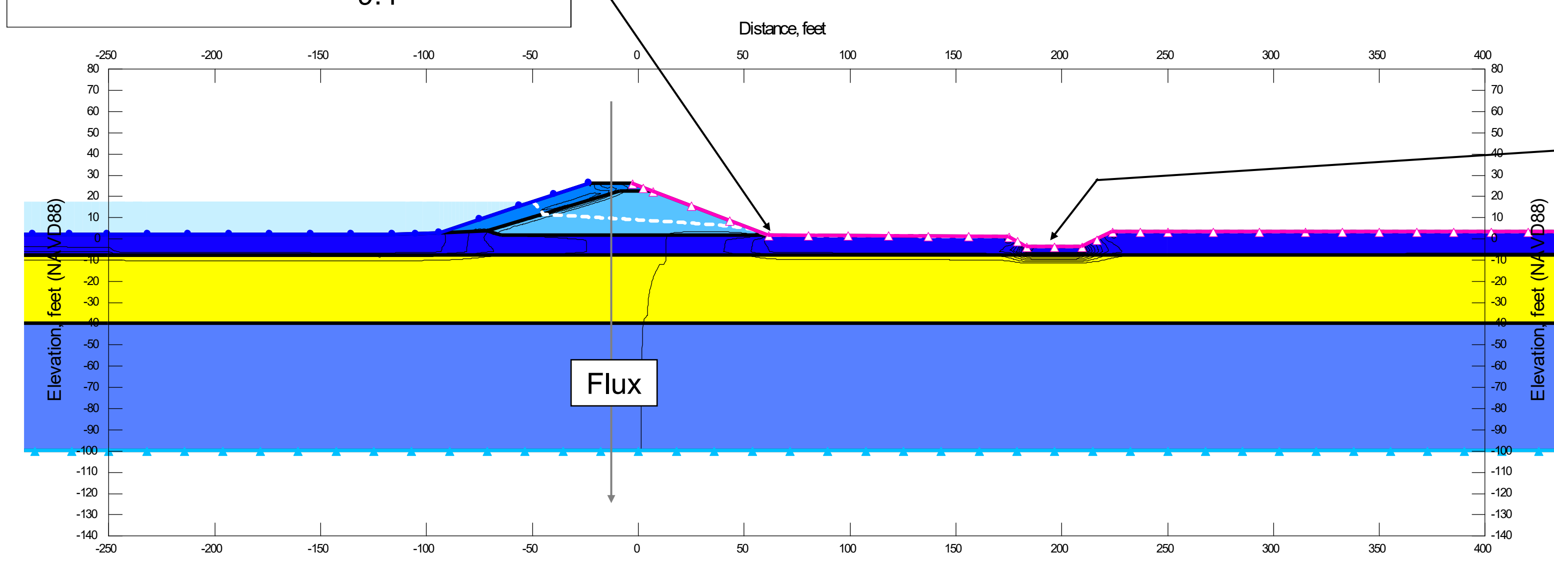


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.72
Local XY-Gradient = 0.72
Flux = 1.14 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{7.57 - (1.4)}{9.4}$ = 0.66



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 2.70 (empty ditch) / 1.61 (full ditch)
Max XY-Gradient = 2.82 (empty ditch) / 1.65 (full ditch)

Average Y– Gradient = $\frac{7.04 - (-3.8)}{4.2}$ = 2.58 (empty ditch)

Average Y– Gradient = $\frac{7.20 - (0.6)}{4.2}$ = 1.57 (full ditch)

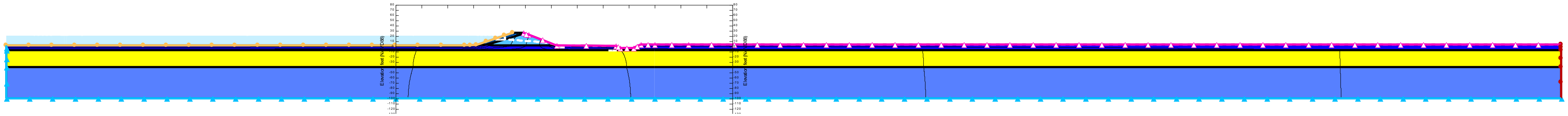
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
(orange)	Unit 2: Organic Soil	$4.0x10^{-6}$	1
(blue)	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
(yellow)	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
(medium blue)	Unit 5: Clay	$4.0x10^{-6}$	4
(yellow)	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
(dark navy)	Unit 7: Deep Clay	$4.0x10^{-6}$	4
(purple)	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
(blue)	Unit 9: Clay Cap	$4.0x10^{-6}$	4
(blue)	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
(grey)	Unit 11: Drain Rock	$1.0x10^{1}$	10
(yellow)	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

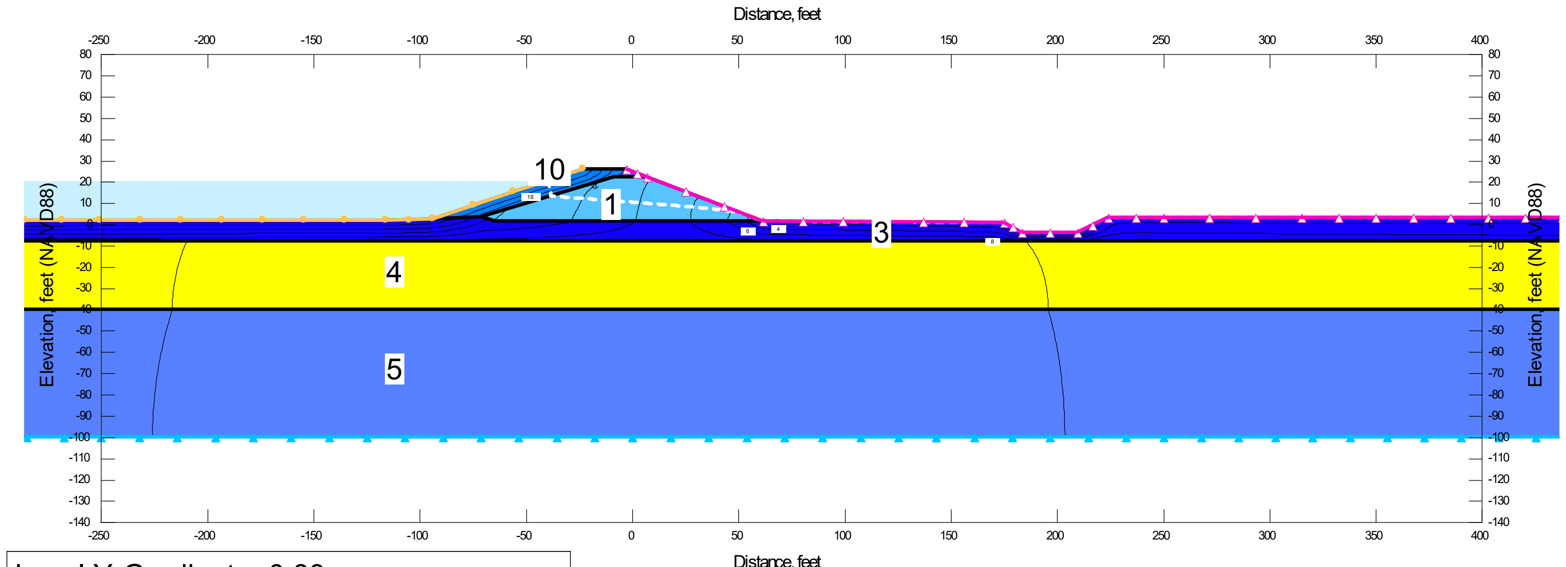
Seepage Analysis
RD 536 - Station 175+00
Rehabilitated Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-27

Water Surface Elevation: 20.1 feet

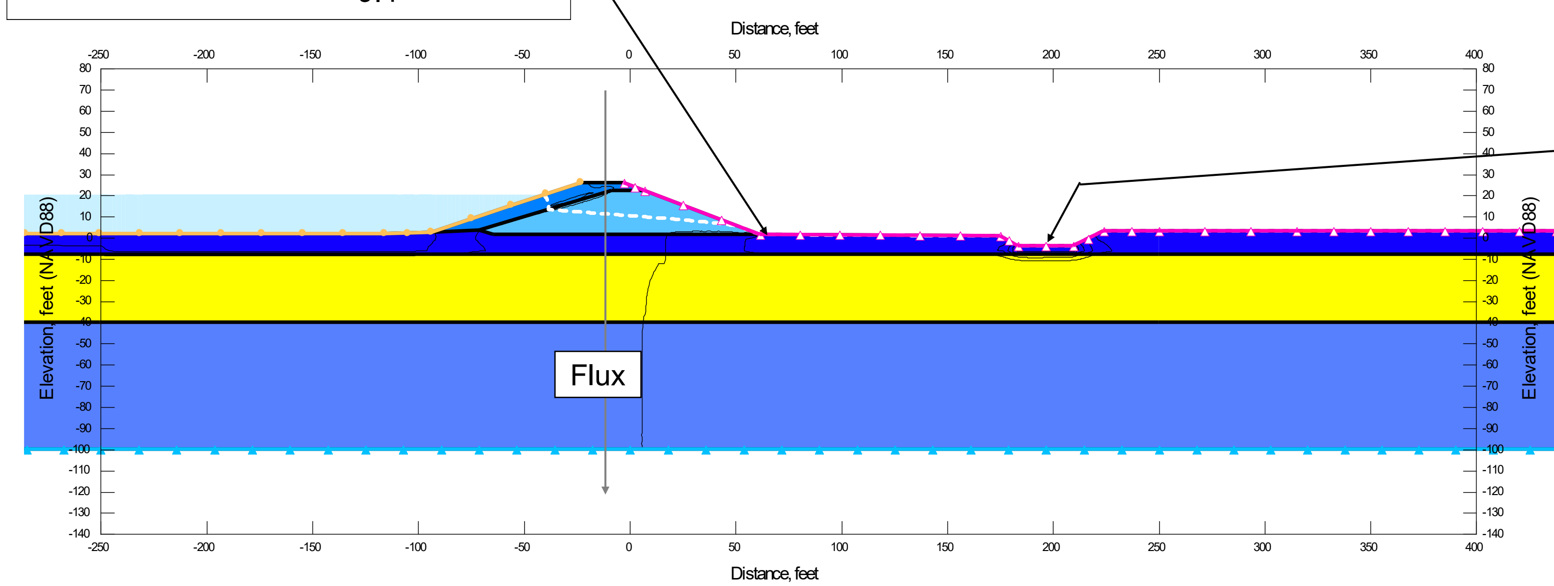


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.83
Local XY-Gradient = 0.83
Flux = 1.38 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{8.63 - (1.4)}{9.4}$ = 0.77



VERTICAL GRADIENT CONTOURS

Max Y-Gradient = 2.92 (empty ditch) / 1.84 (full ditch)
Max XY-Gradient = 3.05 (empty ditch) / 1.88 (full ditch)

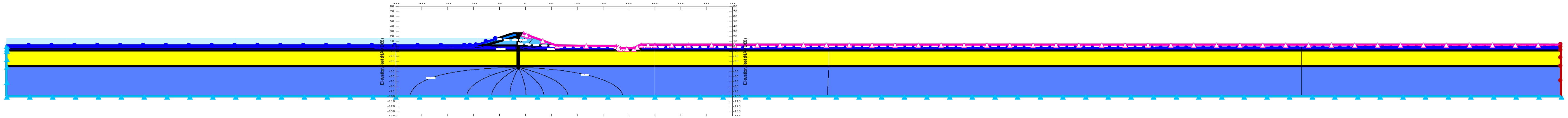
Average Y– Gradient = $\frac{7.98 - (-3.8)}{4.2}$= 2.80 (empty ditch)

Average Y– Gradient = $\frac{8.14 - (0.6)}{4.2}$= 1.80 (full ditch)

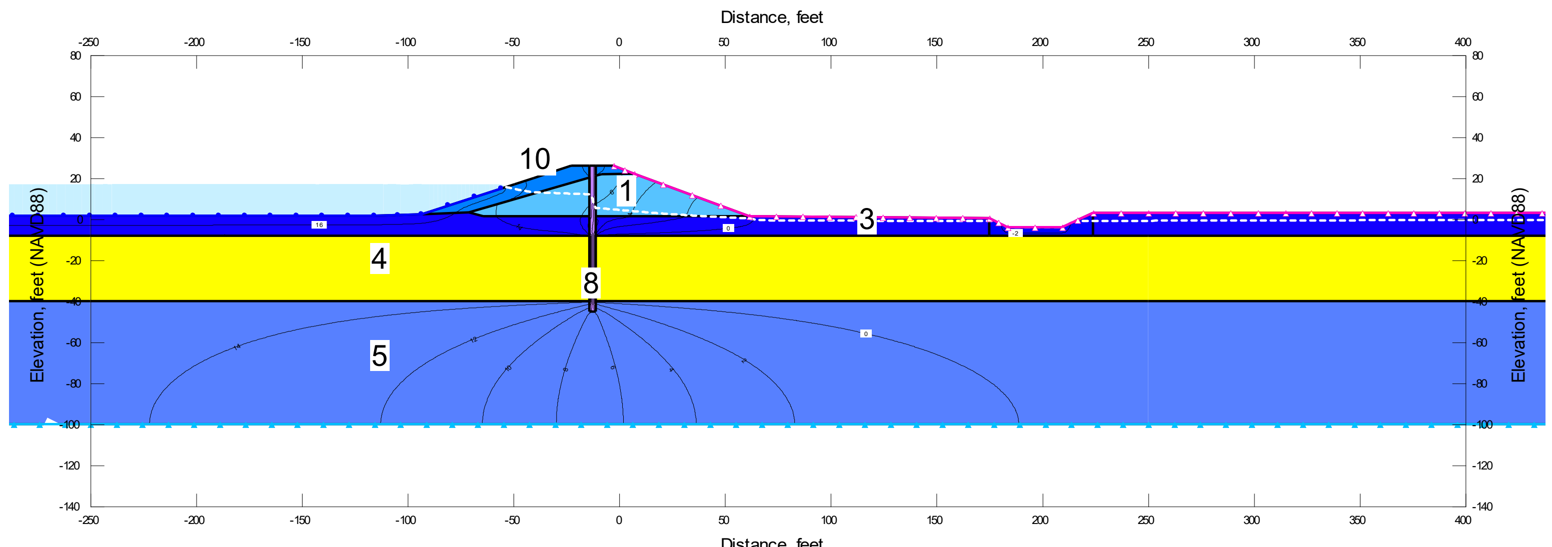
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 175+00** **Rehabilitated Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-28

Water Surface Elevation: 17.1 feet



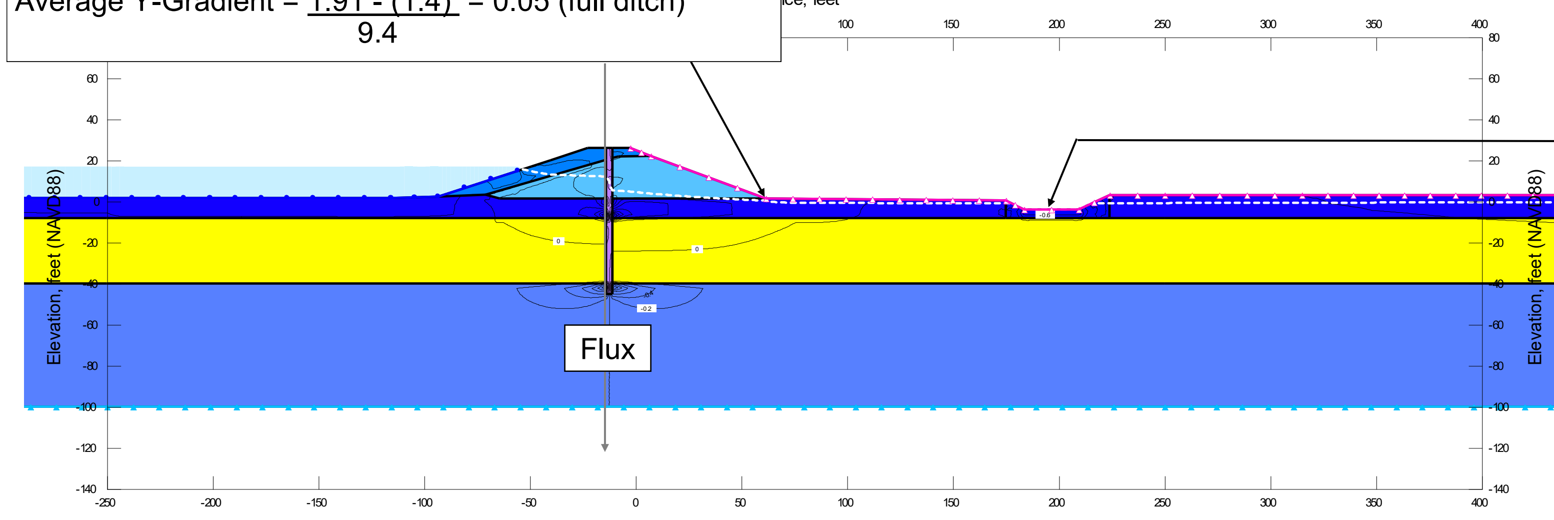
SEEP/W MODEL



Local Y-Gradient = -0.18 (empty ditch)/ 0.09 (full ditch)
Local XY-Gradient = 0.22 (empty ditch)/ 0.26 (full ditch)
Flux = 3.49 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{-0.67 - (0.72)}{9.4}$ = -0.15 (empty ditch)
Average Y-Gradient = $\frac{1.91 - (1.4)}{9.4}$ = 0.05 (full ditch)

TOTAL HEAD CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1 (0.033 near ditch)
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9



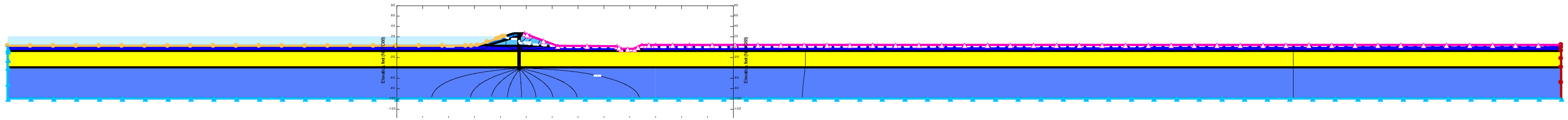
Max Y-Gradient = 0.66 (empty ditch) / 0.26 (full ditch)
Max XY-Gradient = 0.75 (empty ditch) / 0.26 (full ditch)

Average Y– Gradient = $\frac{-1.0 - (-3.8)}{4.2}$= 0.67 (empty ditch)
Average Y– Gradient = $\frac{1.7 - (0.6)}{4.2}$= 0.26 (full ditch)

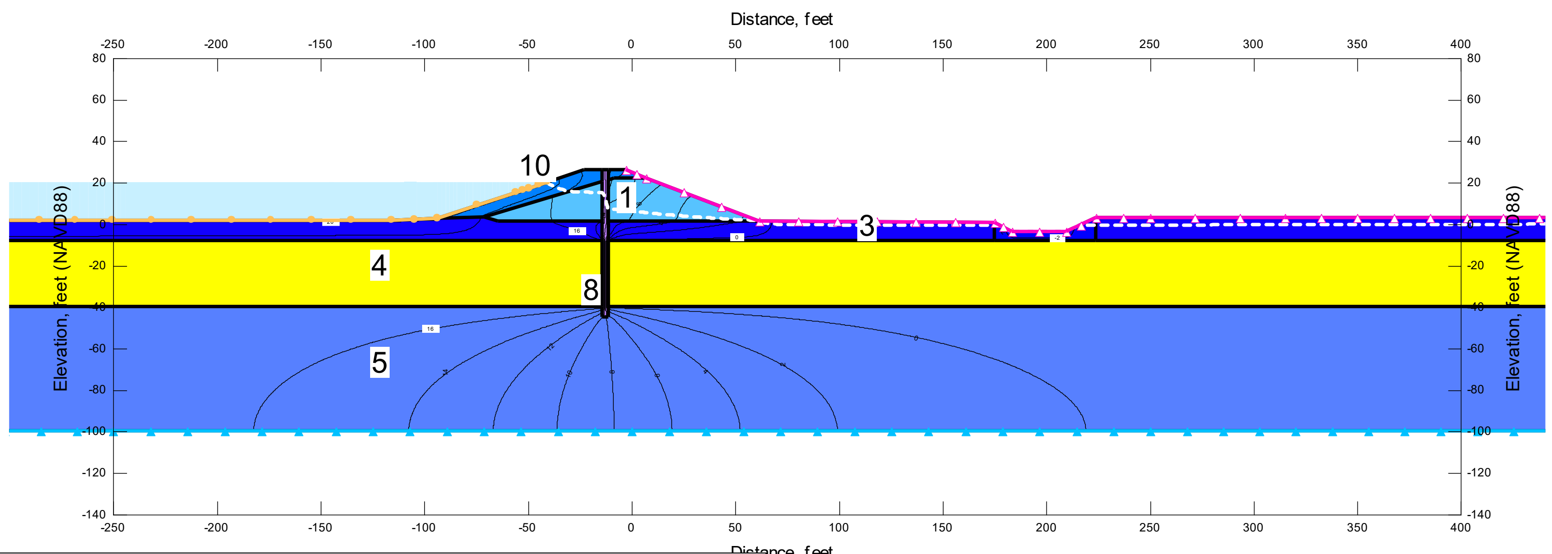
VERTICAL GRADIENT CONTOURS

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 175+00** **Rehabilitated Levee with Cutoff Wall (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-29

Water Surface Elevation: 20.1 feet



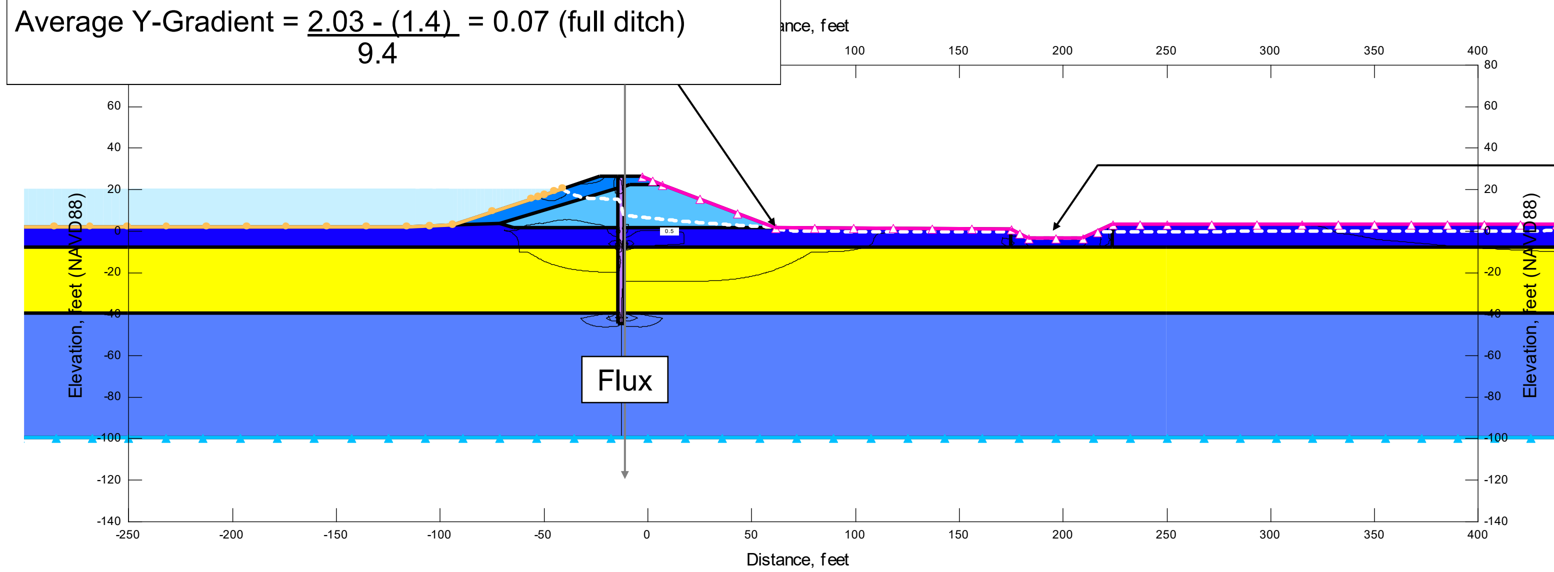
SEEP/W MODEL



Local Y-Gradient = -0.23 (empty ditch)/ 0.11 (full ditch)
Local XY-Gradient = 0.31 (empty ditch)/ 0.31 (full ditch)
Flux = 4.11 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{-0.51 - (1.4)}{9.4}$ = -0.20 (empty ditch)
Average Y-Gradient = $\frac{2.03 - (1.4)}{9.4}$ = 0.07 (full ditch)

TOTAL HEAD CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1 (0.033 near ditch)
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9



Max Y-Gradient = 0.69 (empty ditch) / 0.28 (full ditch)
Max XY-Gradient = 0.78 (empty ditch) / 0.28 (full ditch)

Average Y– Gradient = $\frac{-0.92 - (-3.8)}{4.2}$ = 0.69 (empty ditch)
Average Y– Gradient = $\frac{1.78 - (0.6)}{4.2}$ = 0.28 (full ditch)

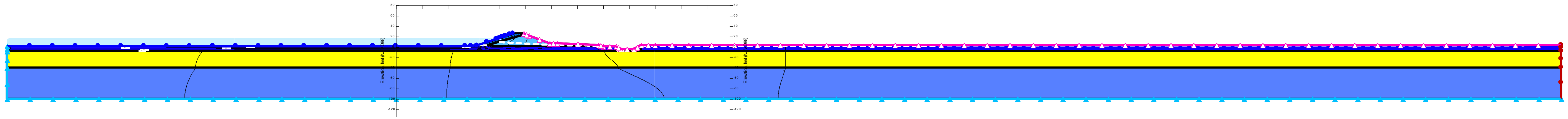
VERTICAL GRADIENT CONTOURS

Little Egbert Multi-Benefit Project
Solano County, California

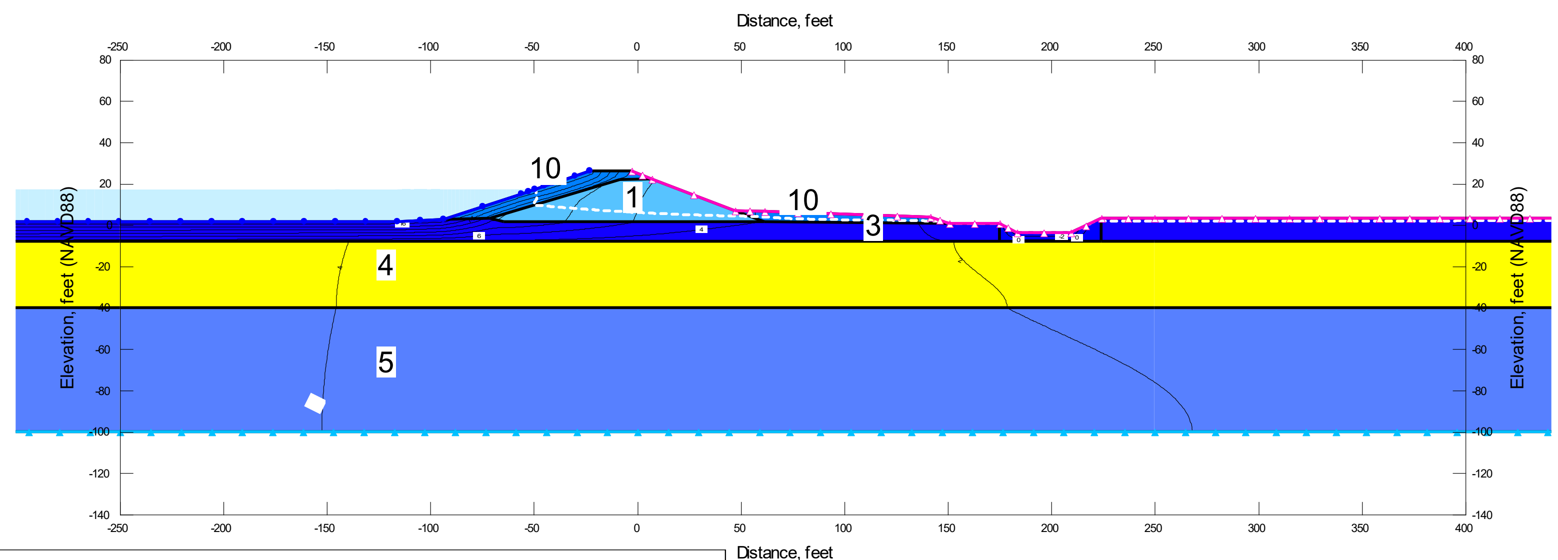
Seepage Analysis
RD 536 - Station 175+00
Rehabilitated Levee with Cutoff Wall (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-30

Water Surface Elevation: 17.1 feet



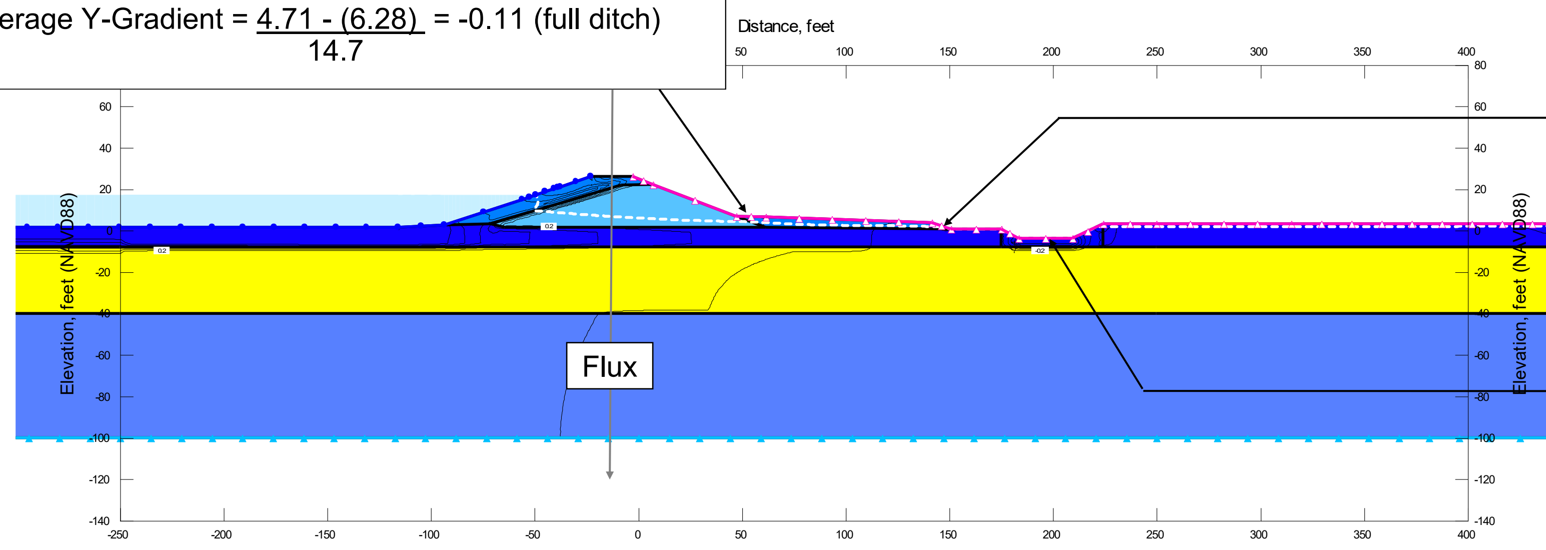
SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.01 (empty ditch)/ 0.01 (full ditch)
Local XY-Gradient = 0.06 (empty ditch)/ 0.06 (full ditch)
Flux = 1.70 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{2.77 - (4.29)}{14.7}$ = -0.10 (empty ditch)
Average Y-Gradient = $\frac{4.71 - (6.28)}{14.7}$ = -0.11 (full ditch)

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1 (0.033 near ditch)
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9



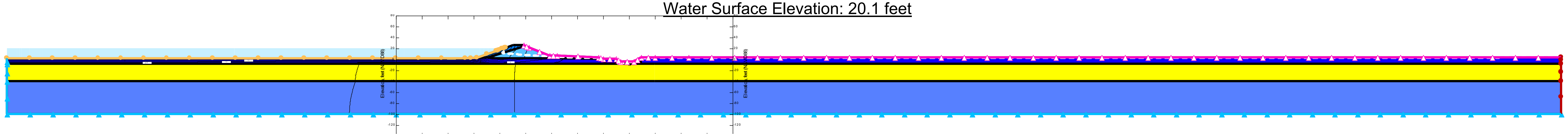
Local Y-Gradient = 0.17 (empty ditch)/ 0.43 (full ditch)
Local XY-Gradient = 0.22 (empty ditch)/ 0.51 (full ditch)
Average Y-Gradient = $\frac{2.02 - (0.77)}{8.8}$ = 0.14 (empty ditch)
Average Y-Gradient = $\frac{4.06 - (0.77)}{8.8}$ = 0.37 (full ditch)

Max Y-Gradient = 1.26 (empty ditch) / 0.73 (full ditch)
Max XY-Gradient = 1.34 (empty ditch) / 0.75 (full ditch)
Average Y– Gradient = $\frac{1.43 - (-3.8)}{4.2}$= 1.25 (empty ditch)
Average Y– Gradient = $\frac{3.64 - (0.6)}{4.2}$= 0.72 (full ditch)

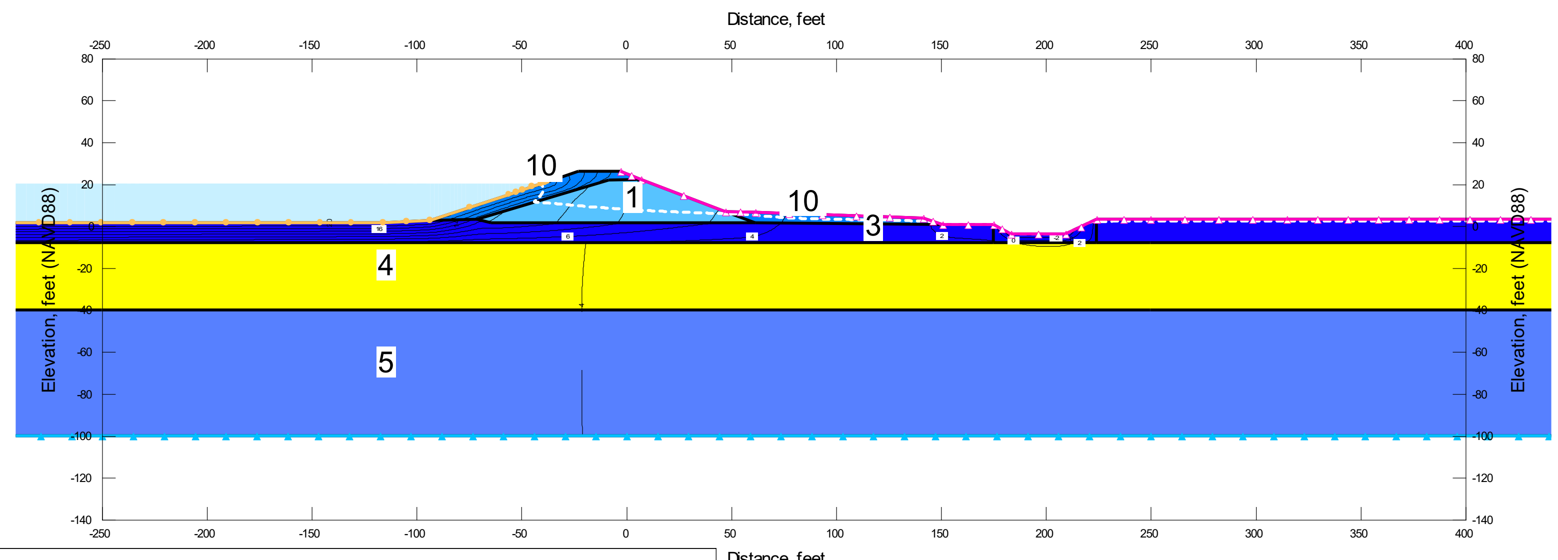
VERTICAL GRADIENT CONTOURS

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **RD 536 - Station 175+00** **Rehabilitated Levee with Seepage Berm (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-31

Water Surface Elevation: 20.1 feet



SEEP/W MODEL

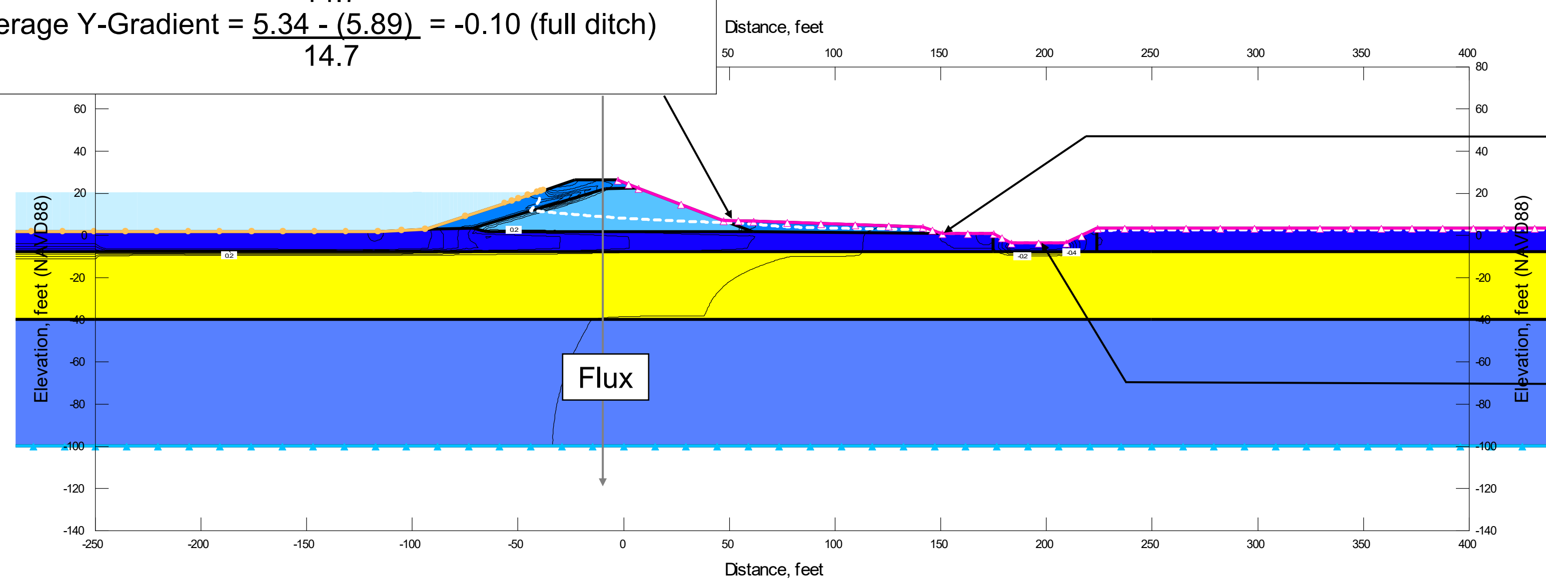


TOTAL HEAD CONTOURS

Local Y-Gradient = 0.01 (empty ditch)/ 0.16 (full ditch)
Local XY-Gradient = 0.03 (empty ditch)/ 0.19 (full ditch)
Flux = 1.77 X 10^{-2} gpm/ft

Average Y-Gradient = $\frac{3.48 - (5.89)}{14.7}$ = -0.16 (empty ditch)

Average Y-Gradient = $\frac{5.34 - (5.89)}{14.7}$ = -0.10 (full ditch)



VERTICAL GRADIENT CONTOURS

Local Y-Gradient = 0.24 (empty ditch)/ 0.49 (full ditch)
Local XY-Gradient = 0.31 (empty ditch)/ 0.57 (full ditch)

Average Y-Gradient = $\frac{2.59 - (0.77)}{8.8}$ = 0.21 (empty ditch)

Average Y-Gradient = $\frac{4.57 - (0.77)}{8.8}$ = 0.43 (full ditch)

Max Y-Gradient = 1.38 (empty ditch) / 0.84 (full ditch)
Max XY-Gradient = 1.46 (empty ditch) / 0.86 (full ditch)

Average Y– Gradient = $\frac{1.91 - (-3.8)}{4.2}$ = 1.36 (empty ditch)

Average Y– Gradient = $\frac{4.05 - (0.6)}{4.2}$ = 0.82 (full ditch)

SEEPAGE MODEL MATERIAL PROPERTIES

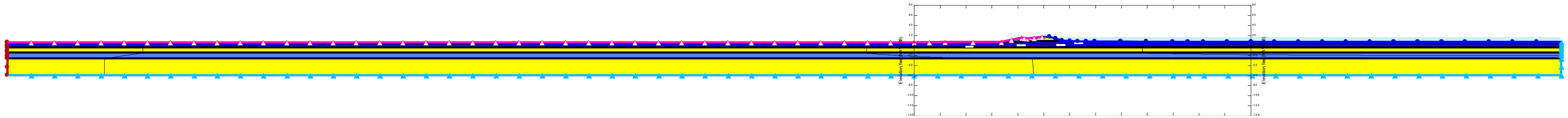
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1 (0.033 near ditch)
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

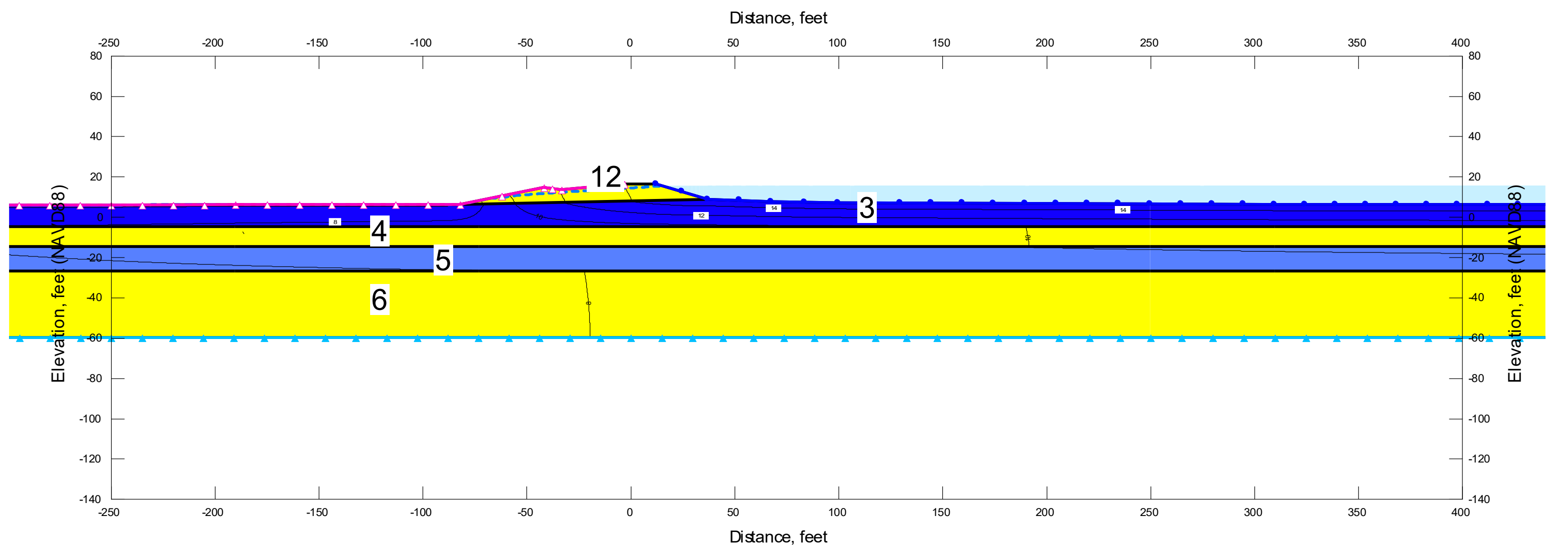
Seepage Analysis
RD 536 - Station 175+00
Rehabilitated Levee with Seepage Berm (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-32

Water Surface Elevation: 15.2 feet

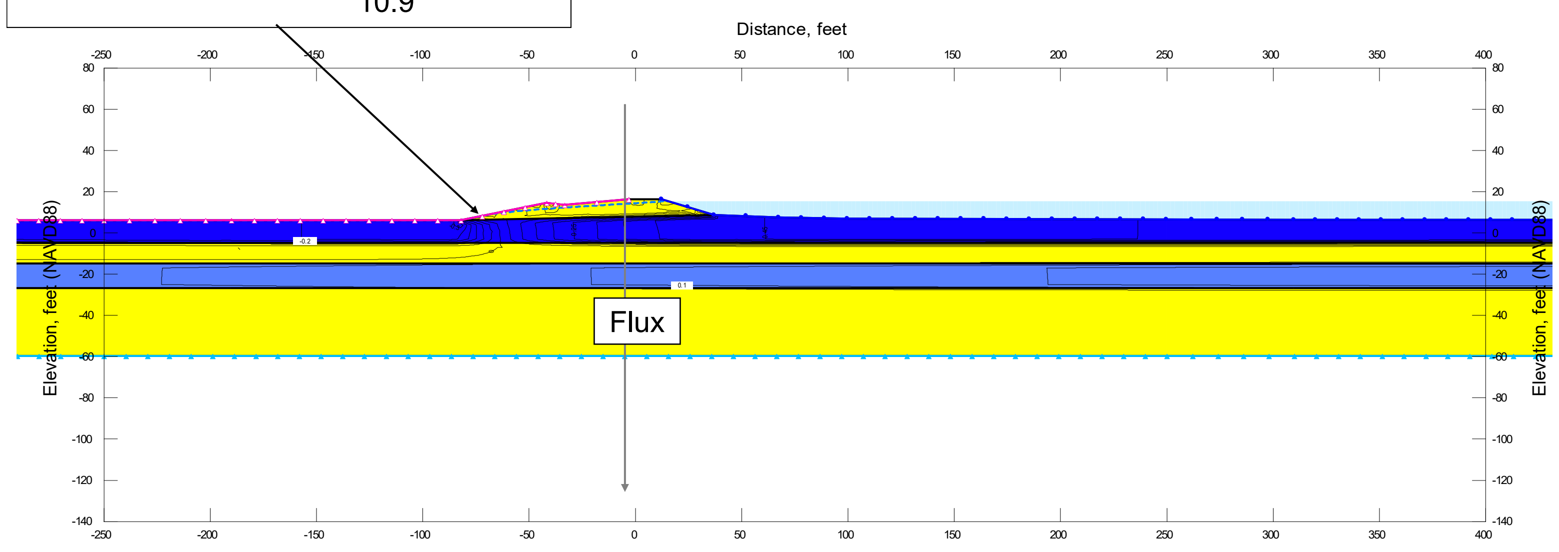


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.24
Local XY-Gradient = 0.27
Flux = 3.57 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{8.93 - (5.9)}{10.9}$ = 0.28

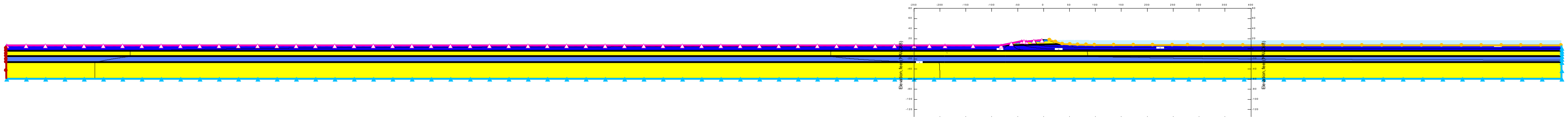


VERTICAL GRADIENT CONTOURS

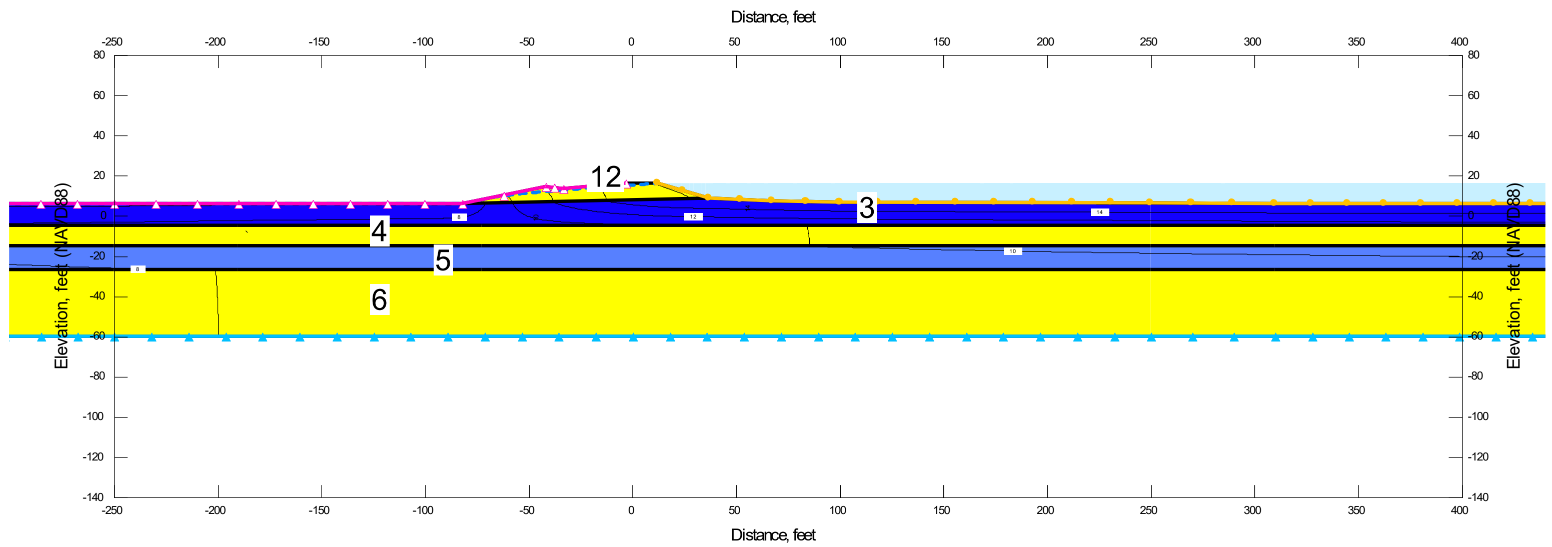
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
(orange)	Unit 2: Organic Soil	$4.0x10^{-6}$	1
(blue)	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
(yellow)	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
(medium blue)	Unit 5: Clay	$4.0x10^{-6}$	4
(yellow)	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
(dark navy)	Unit 7: Deep Clay	$4.0x10^{-6}$	4
(purple)	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
(blue)	Unit 9: Clay Cap	$4.0x10^{-6}$	4
(bright blue)	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
(grey)	Unit 11: Drain Rock	$1.0x10^{1}$	10
(yellow)	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 6+00** **Existing Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-33

Water Surface Elevation: 16.1 feet

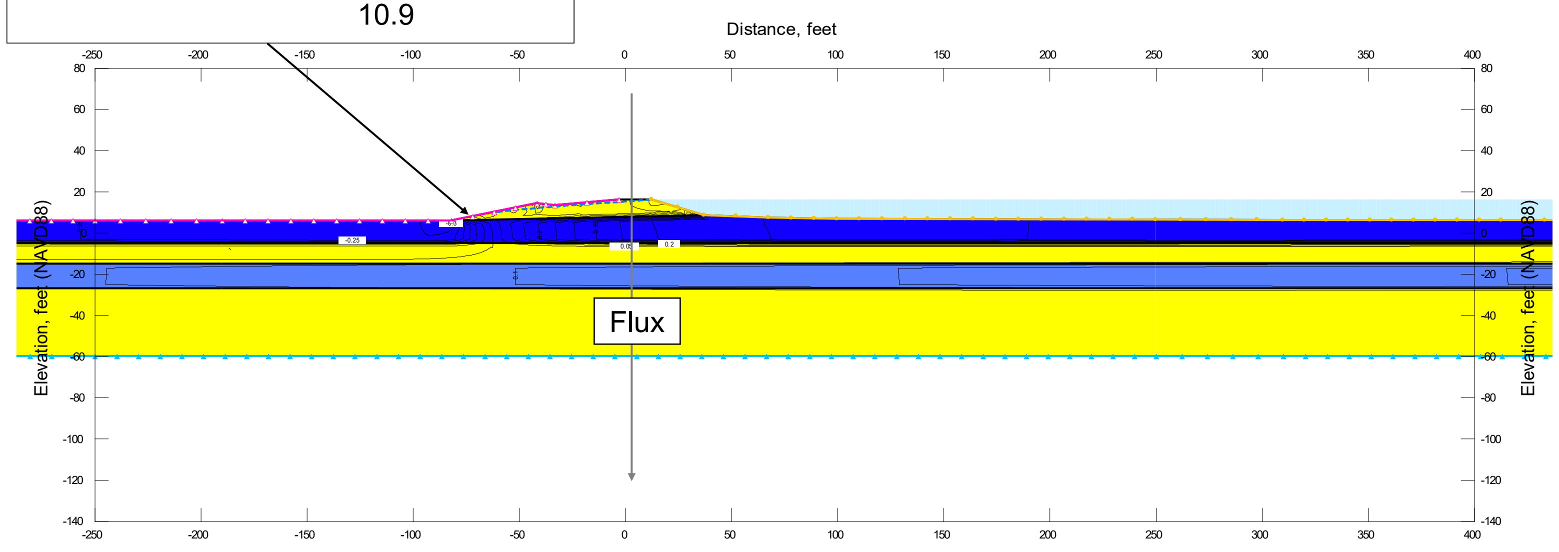


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.26
Local XY-Gradient = 0.29
Flux = 4.34 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{9.23 - (5.9)}{10.9}$ = 0.31



VERTICAL GRADIENT CONTOURS

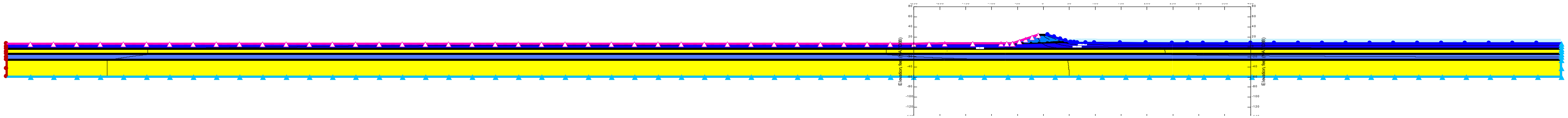
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

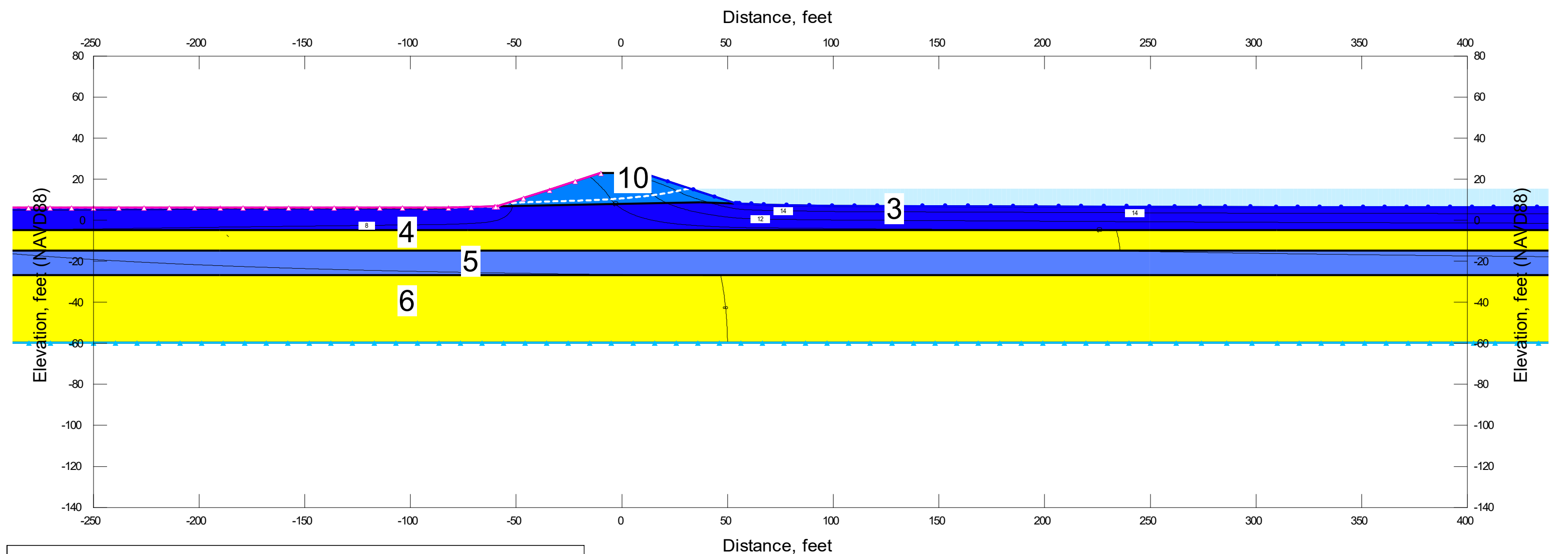
Seepage Analysis
Mellin - Station 6+00
Existing Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-34

Water Surface Elevation: 15.2 feet

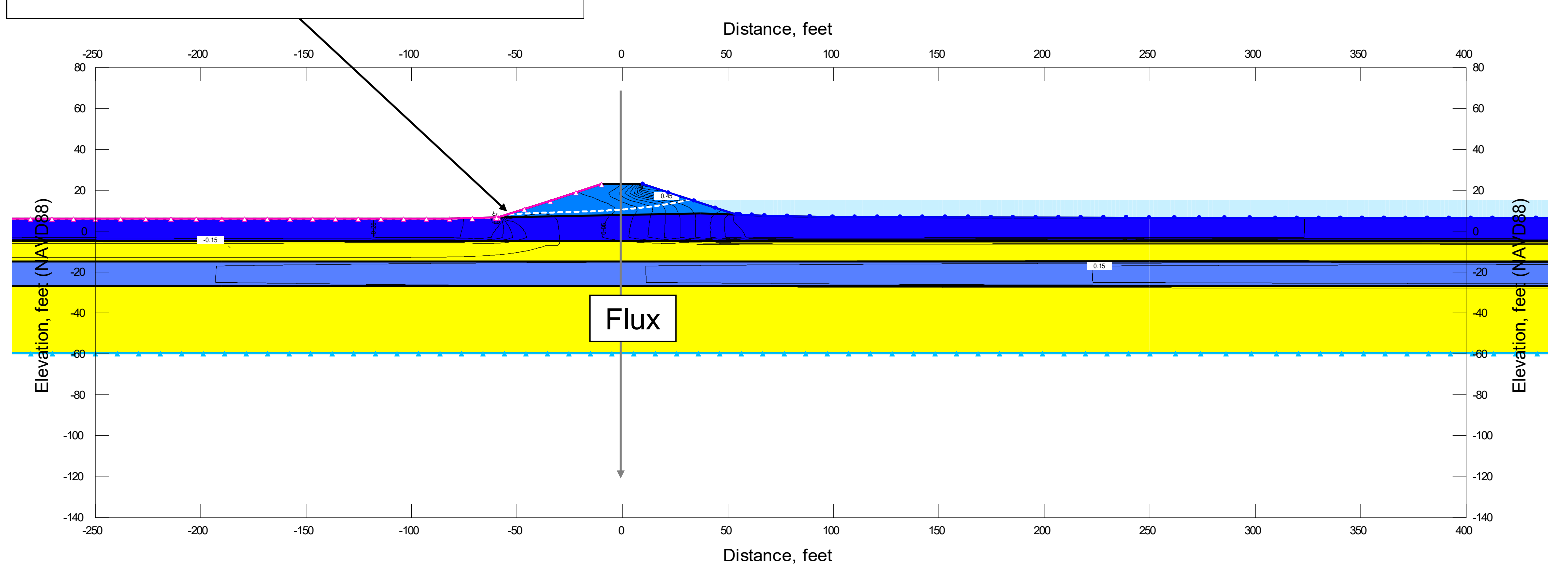


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.25
Local XY-Gradient = 0.35
Flux = 6.06×10^{-3} gpm/ft
Average Y-Gradient = $\frac{8.87 - (6.55)}{11.4} = 0.20$



VERTICAL GRADIENT CONTOURS

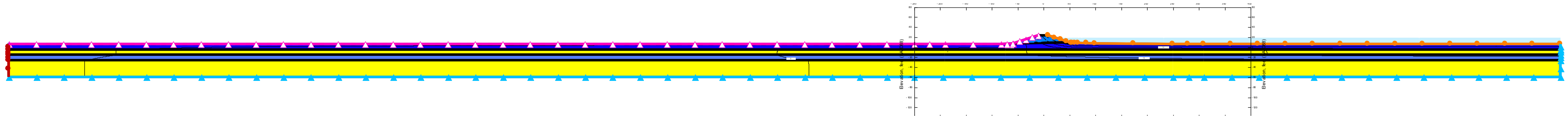
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

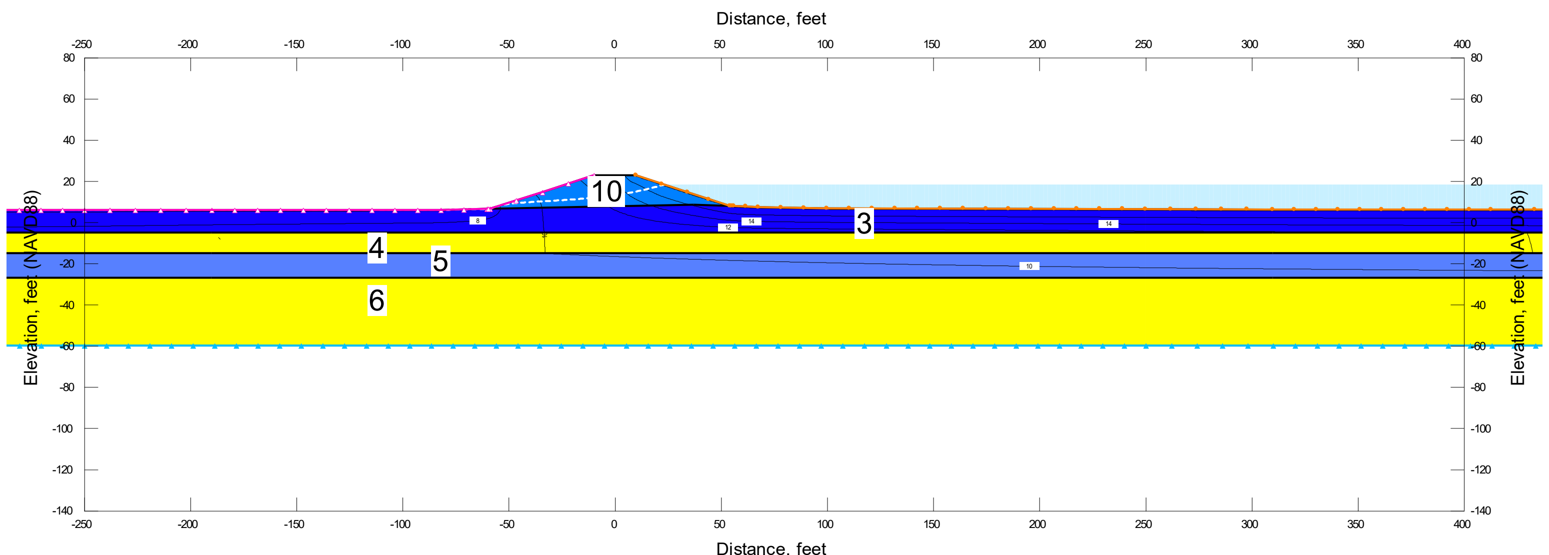
Seepage Analysis
Mellin - Station 6+00
Rehabilitated Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-35

Water Surface Elevation: 18.2 feet

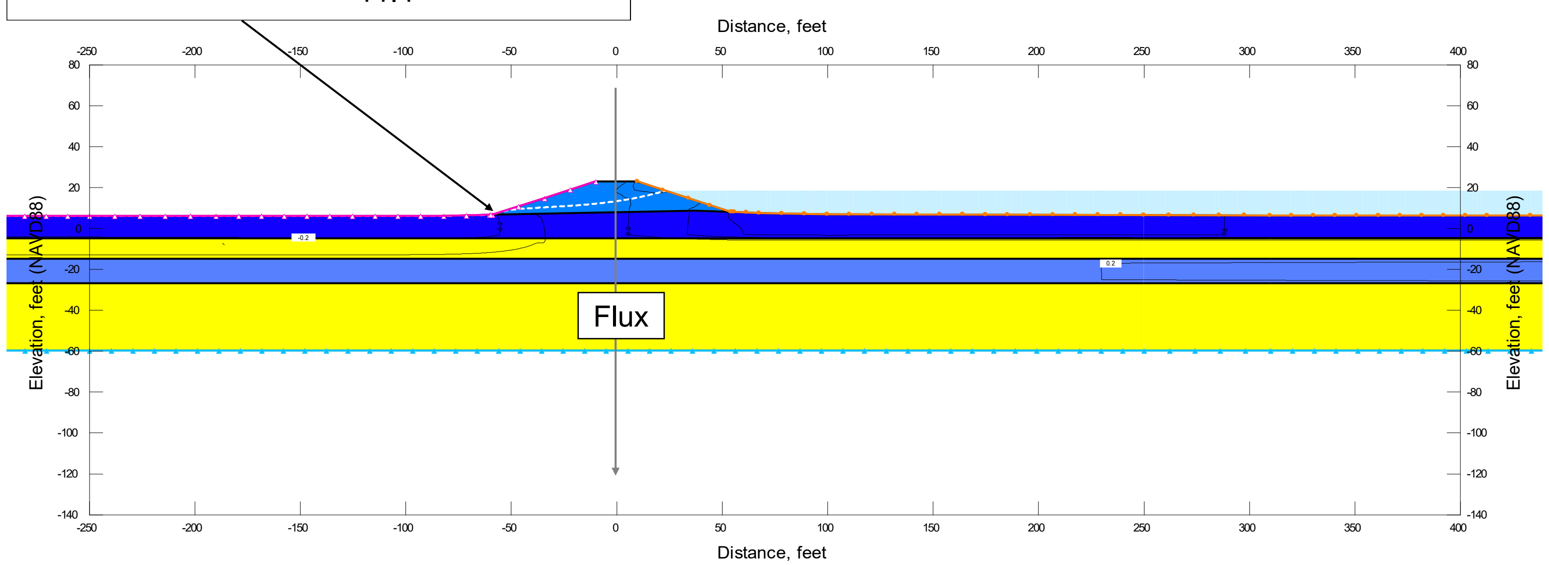


SEEP/W MODEL



Local Y-Gradient = 0.36
Local XY-Gradient = 0.46
Flux = 8.03 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{9.85 - (6.59)}{11.4} = 0.29$

TOTAL HEAD CONTOURS

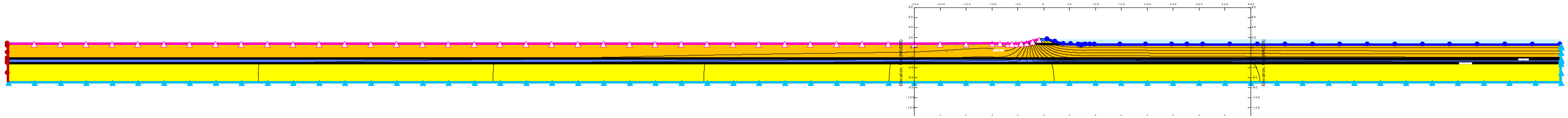


VERTICAL GRADIENT CONTOURS

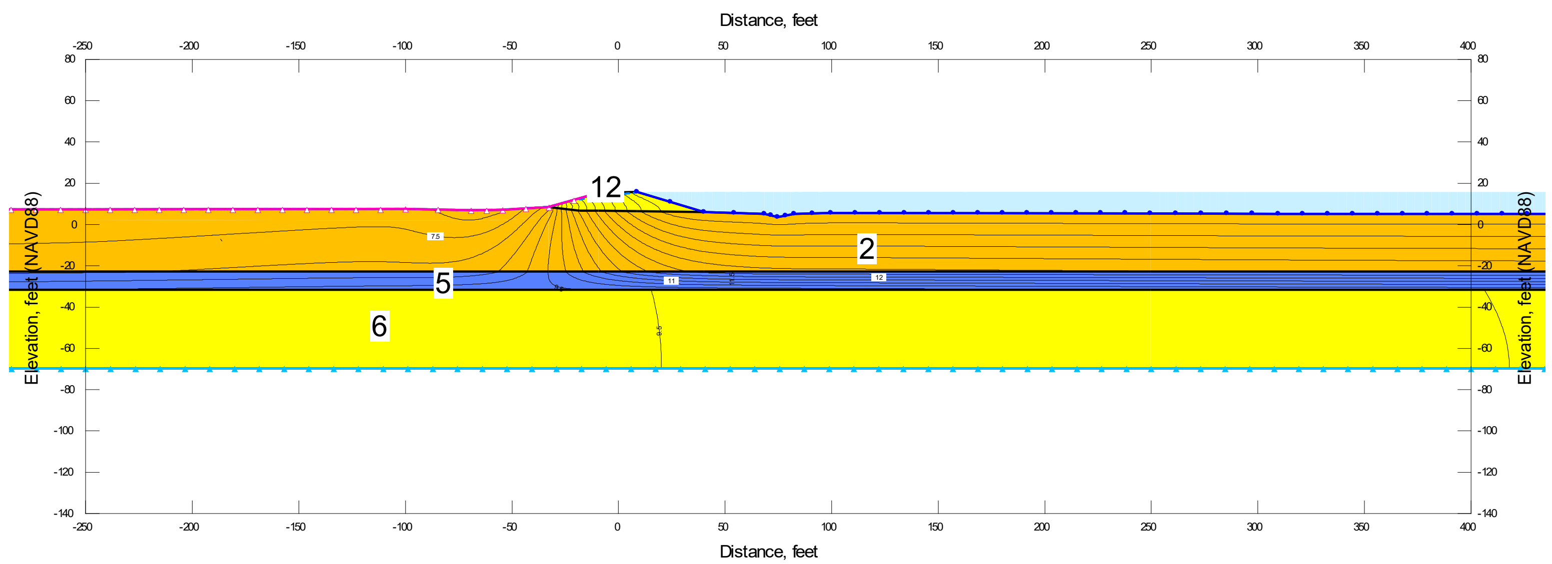
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
(orange)	Unit 2: Organic Soil	$4.0x10^{-6}$	1
(blue)	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
(yellow)	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
(medium blue)	Unit 5: Clay	$4.0x10^{-6}$	4
(yellow)	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
(dark navy)	Unit 7: Deep Clay	$4.0x10^{-6}$	4
(lavender)	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
(blue)	Unit 9: Clay Cap	$4.0x10^{-6}$	4
(bright blue)	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
(light gray)	Unit 11: Drain Rock	$1.0x10^{1}$	10
(yellow)	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 6+00** **Rehabilitated Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-36

Water Surface Elevation: 15.4 feet

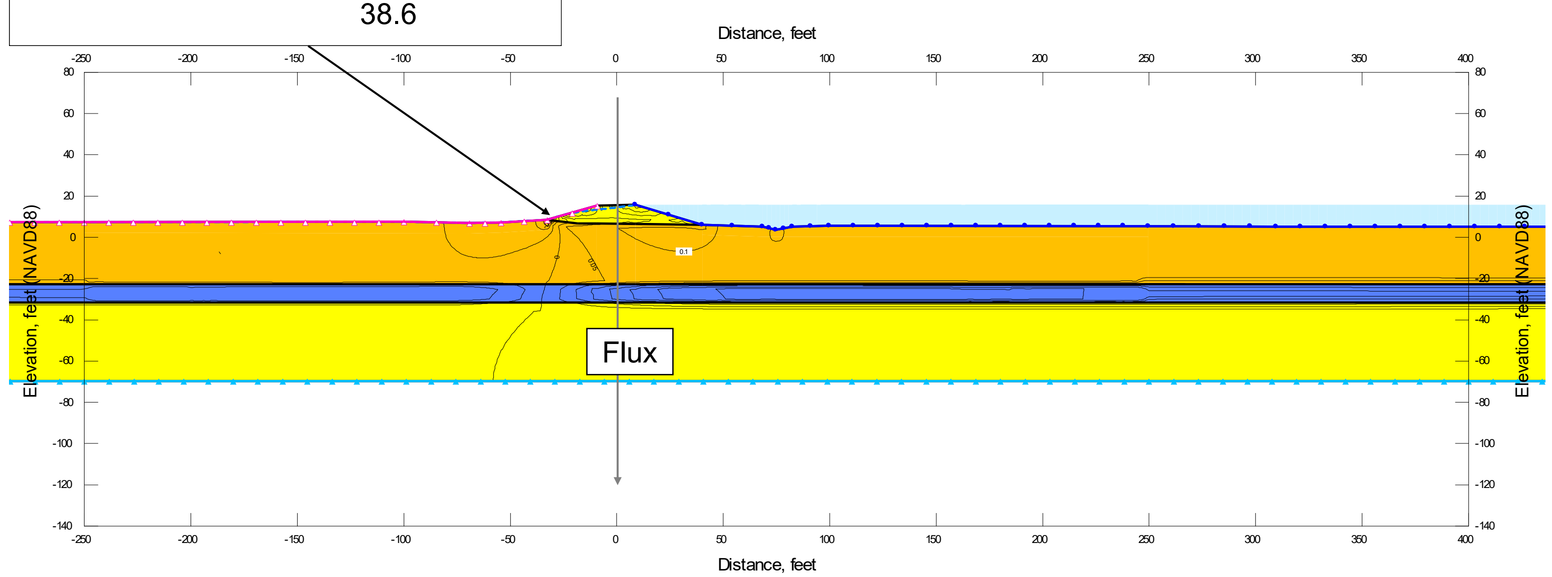


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.24
Local XY-Gradient = 0.35
Flux = 6.73 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{9.4 - (8.3)}{38.6}$ = 0.03



VERTICAL GRADIENT CONTOURS

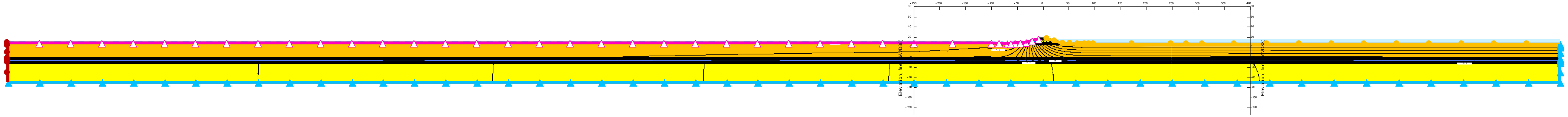
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

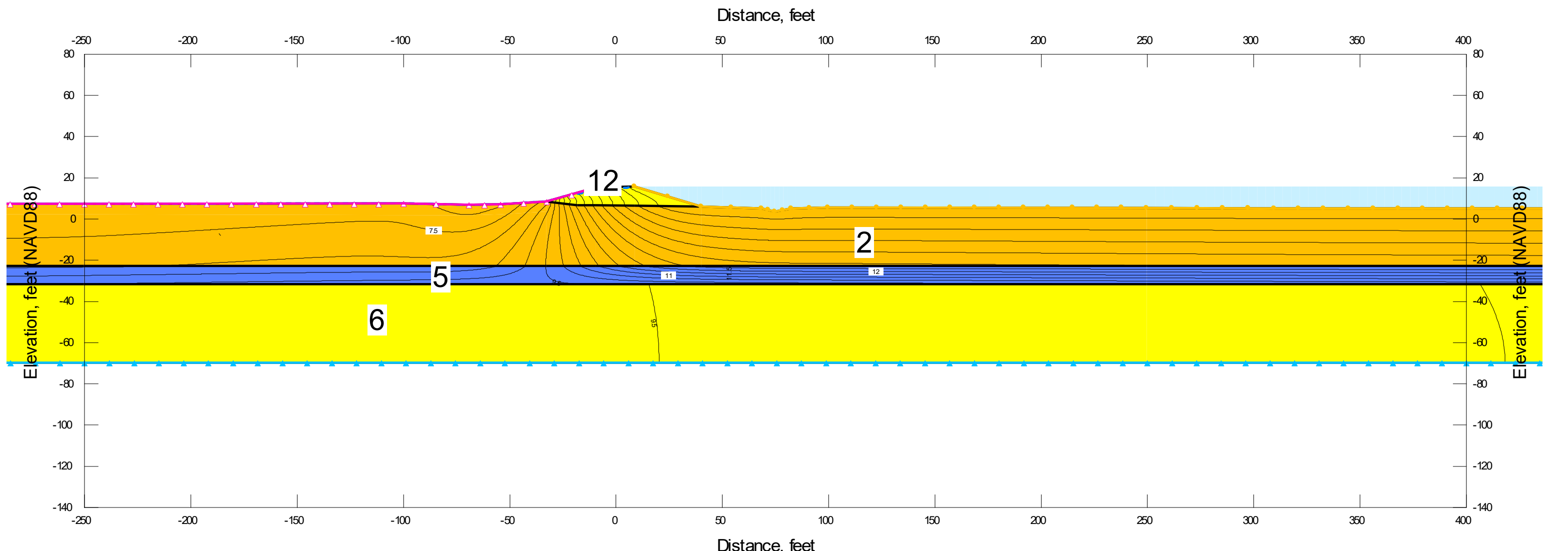
Seepage Analysis
Mellin - Station 21+00
Existing Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-37

Water Surface Elevation: 15.4 feet

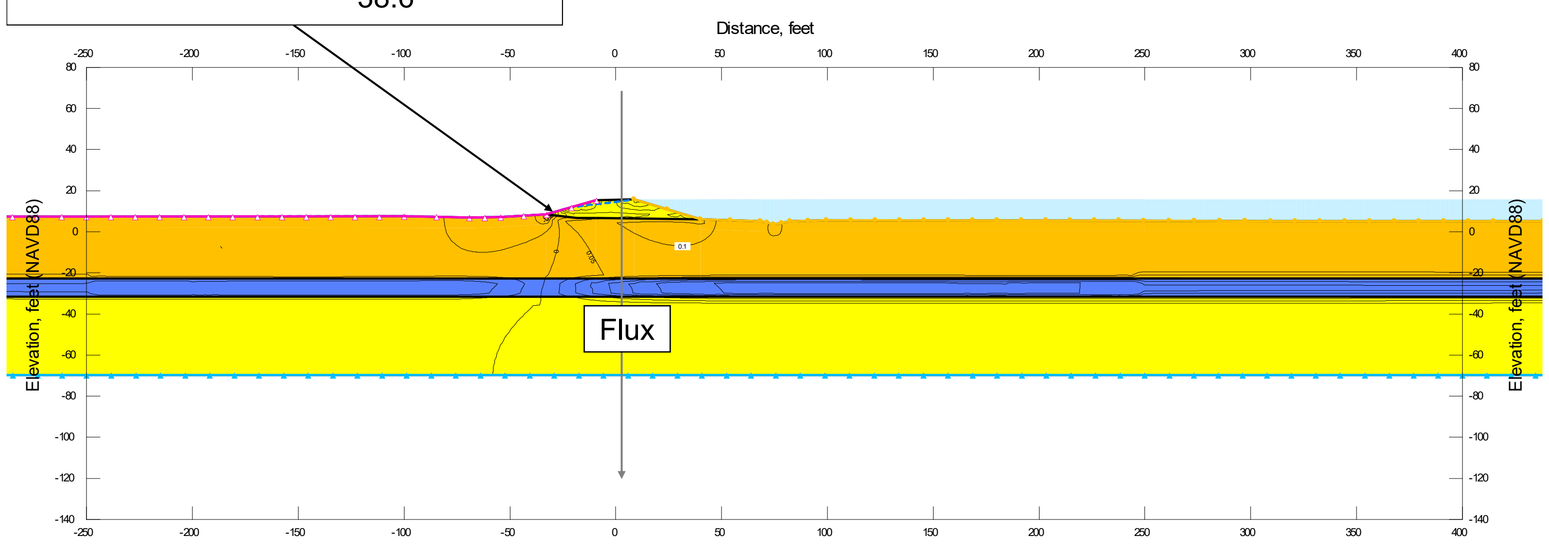


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.24
Local XY-Gradient = 0.35
Flux = 6.73 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{9.4 - (8.3)}{38.6}$ = 0.03



VERTICAL GRADIENT CONTOURS

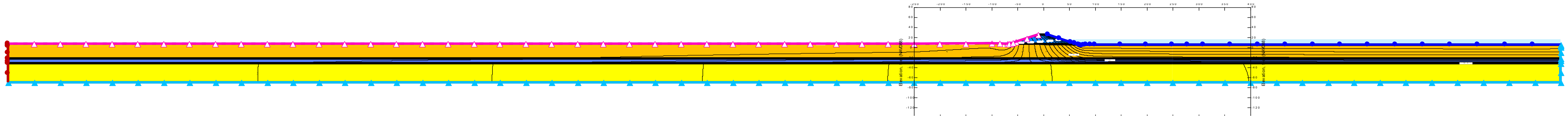
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
(orange)	Unit 2: Organic Soil	4.0×10^{-6}	1
(blue)	Unit 3: Clay Blanket	1.0×10^{-6}	1
(yellow)	Unit 4: Sand (Upper)	5.4×10^{-3}	9
(medium blue)	Unit 5: Clay	4.0×10^{-6}	4
(yellow)	Unit 6: Sand (Lower)	5.4×10^{-3}	9
(dark navy)	Unit 7: Deep Clay	4.0×10^{-6}	4
(lavender)	Unit 8: Cutoff Wall	1.0×10^{-6}	1
(blue)	Unit 9: Clay Cap	4.0×10^{-6}	4
(bright blue)	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
(light gray)	Unit 11: Drain Rock	1.0×10^{1}	10
(yellow)	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

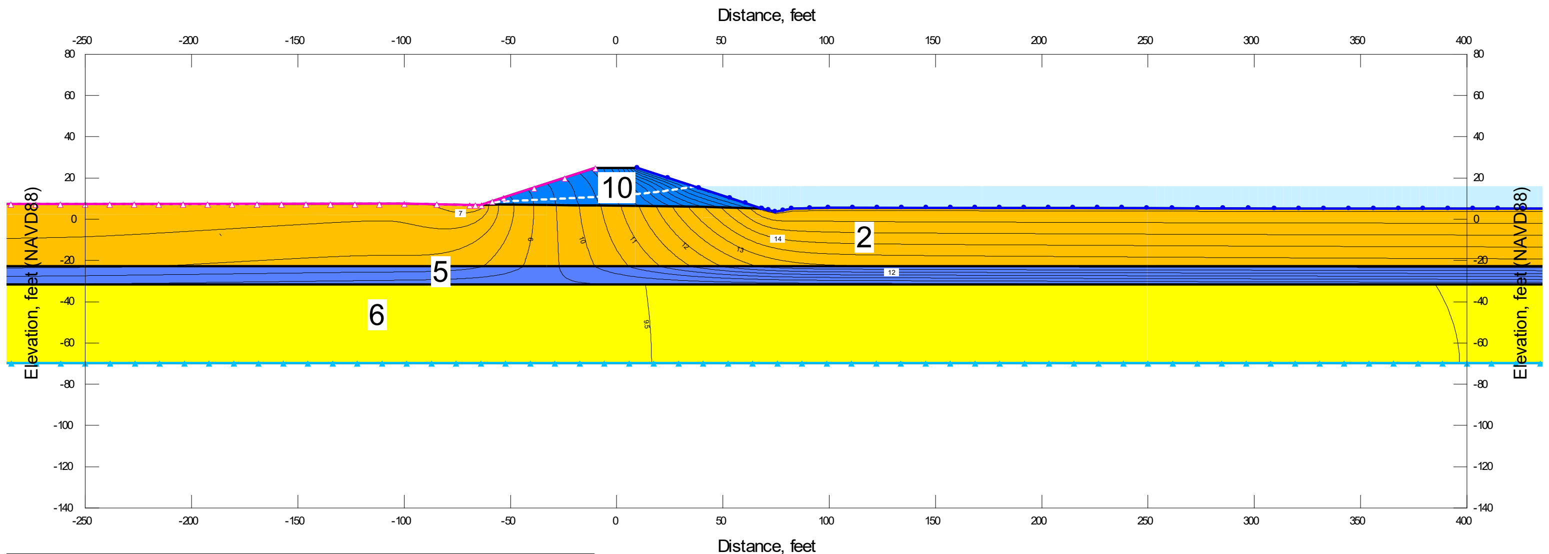
Seepage Analysis
Mellin - Station 21+00
Existing Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-38

Water Surface Elevation: 15.6 feet

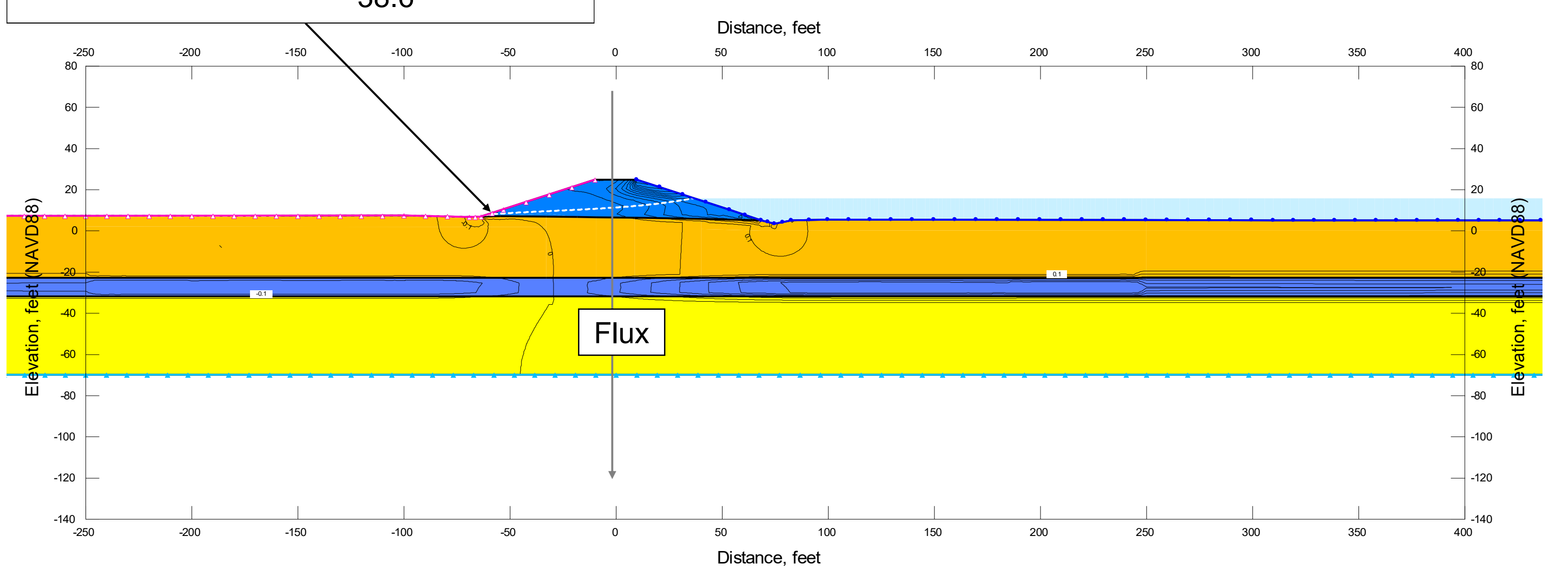


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.10
Local XY-Gradient = 0.23
Flux = 5.07 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{9.37 - (6.71)}{38.6}$ = 0.07



VERTICAL GRADIENT CONTOURS

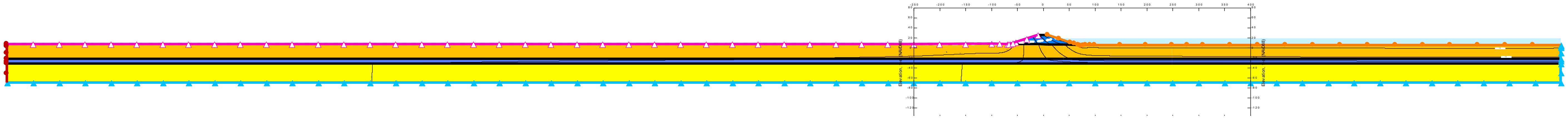
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0\text{x}10^{-5}$	4
	Unit 2: Organic Soil	$4.0\text{x}10^{-6}$	1
	Unit 3: Clay Blanket	$1.0\text{x}10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4\text{x}10^{-3}$	9
	Unit 5: Clay	$4.0\text{x}10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4\text{x}10^{-3}$	9
	Unit 7: Deep Clay	$4.0\text{x}10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0\text{x}10^{-6}$	1
	Unit 9: Clay Cap	$4.0\text{x}10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0\text{x}10^{-6}$	4
	Unit 11: Drain Rock	$1.0\text{x}10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0\text{x}10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

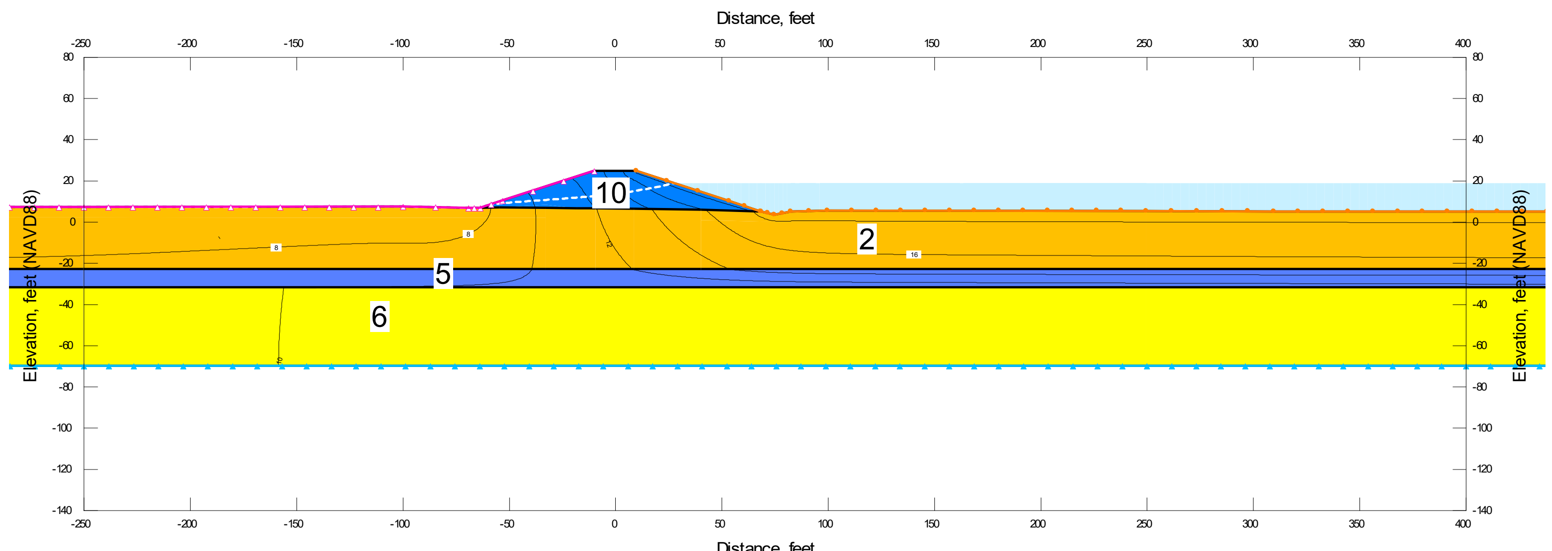
Seepage Analysis
Mellin - Station 21+00
Rehabilitated Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-39

Water Surface Elevation: 18.6 feet

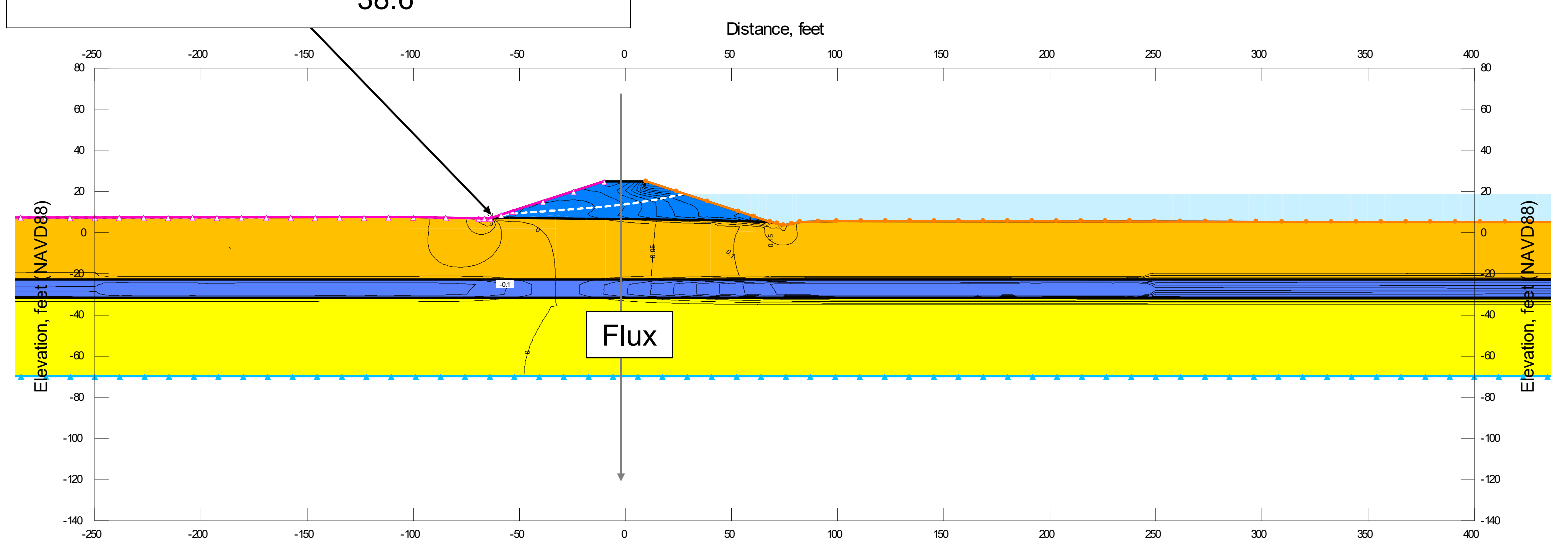


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.20
Local XY-Gradient = 0.33
Flux = 6.87 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{10.20 - (6.71)}{38.6}$ = 0.09



VERTICAL GRADIENT CONTOURS

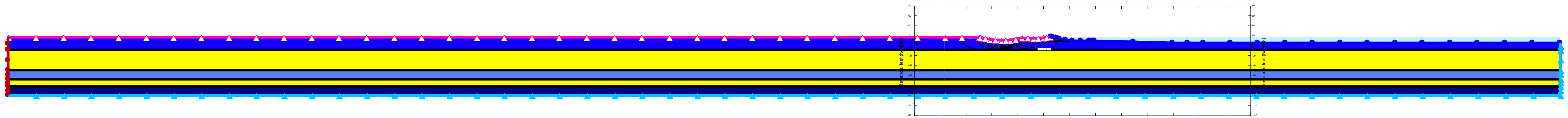
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

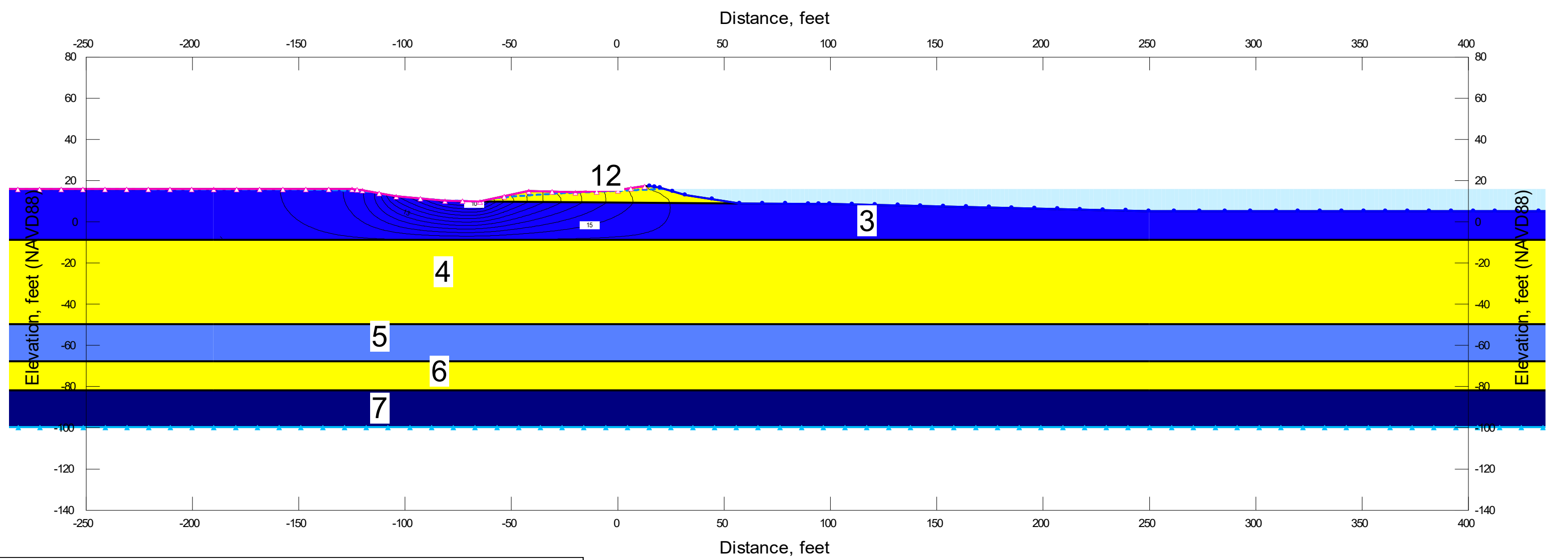
Seepage Analysis
Mellin - Station 21+00
Rehabilitated Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-40

Water Surface Elevation: 15.7 feet

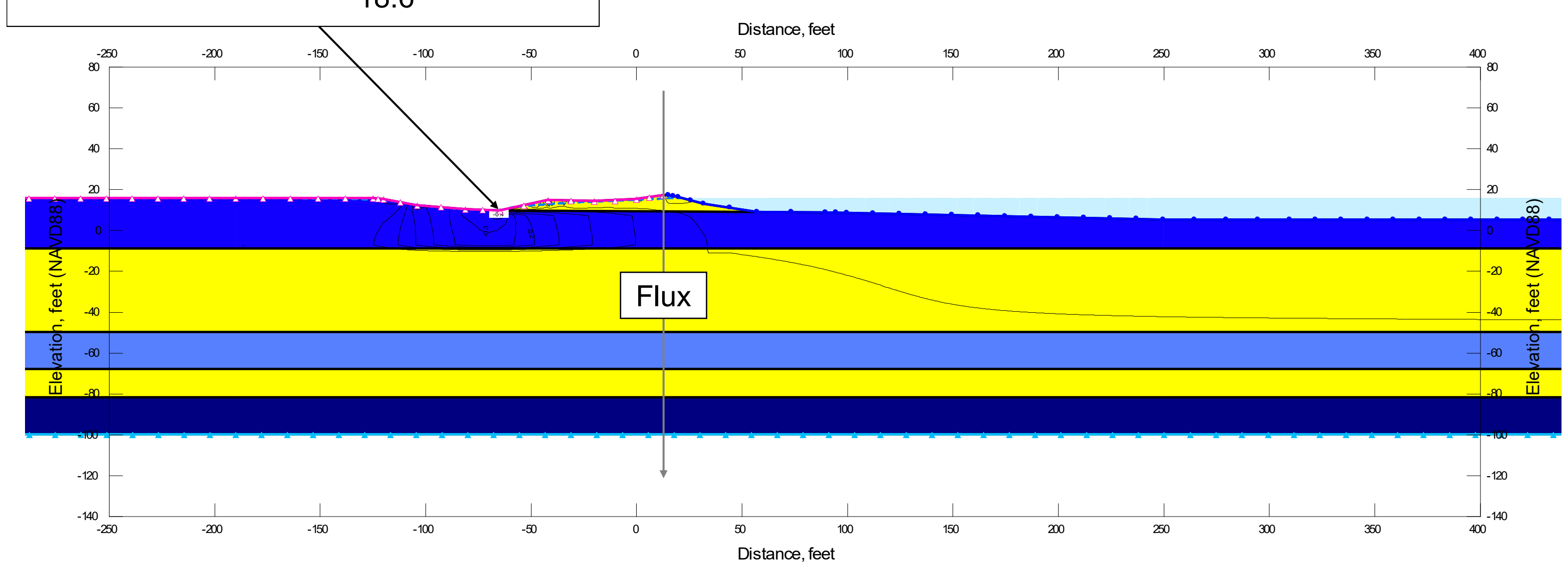


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.32
Local XY-Gradient = 0.35
Flux = 1.89 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{15.58 - (9.62)}{18.6}$ = 0.32



VERTICAL GRADIENT CONTOURS

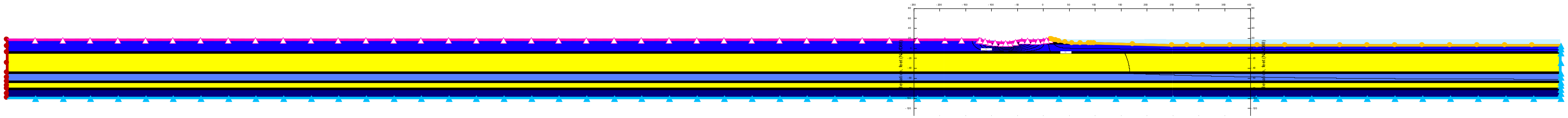
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

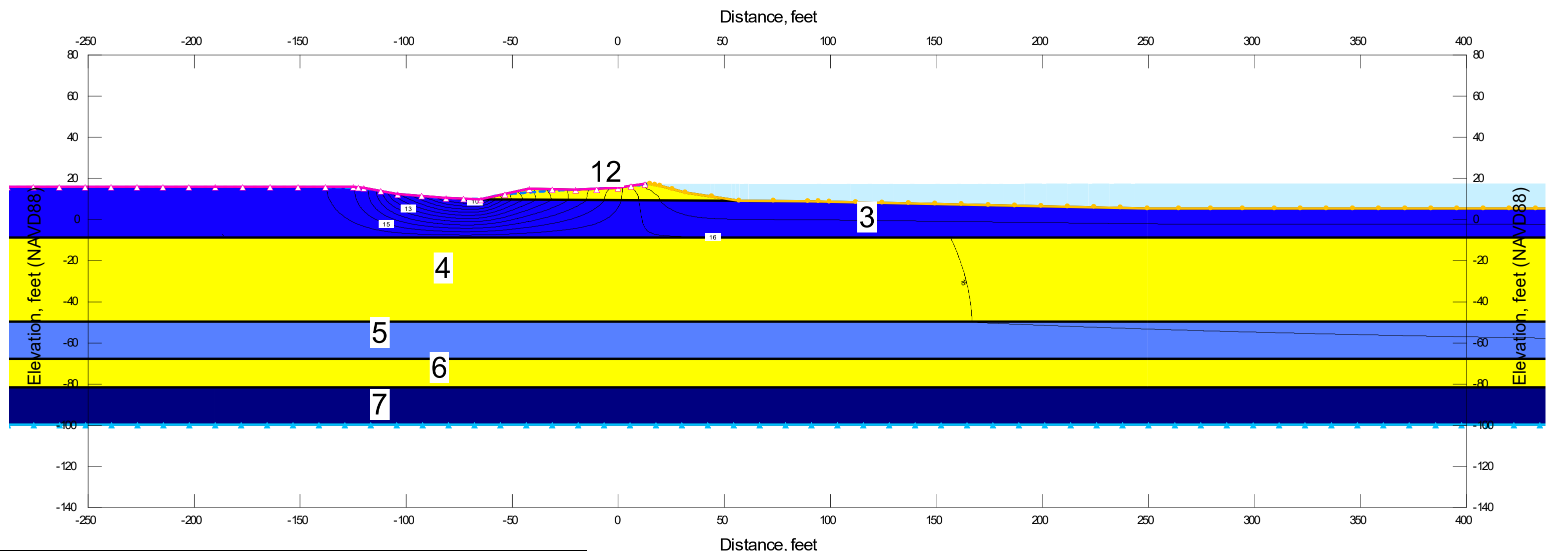
Seepage Analysis
Mellin - Station 41+00
Existing Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-41

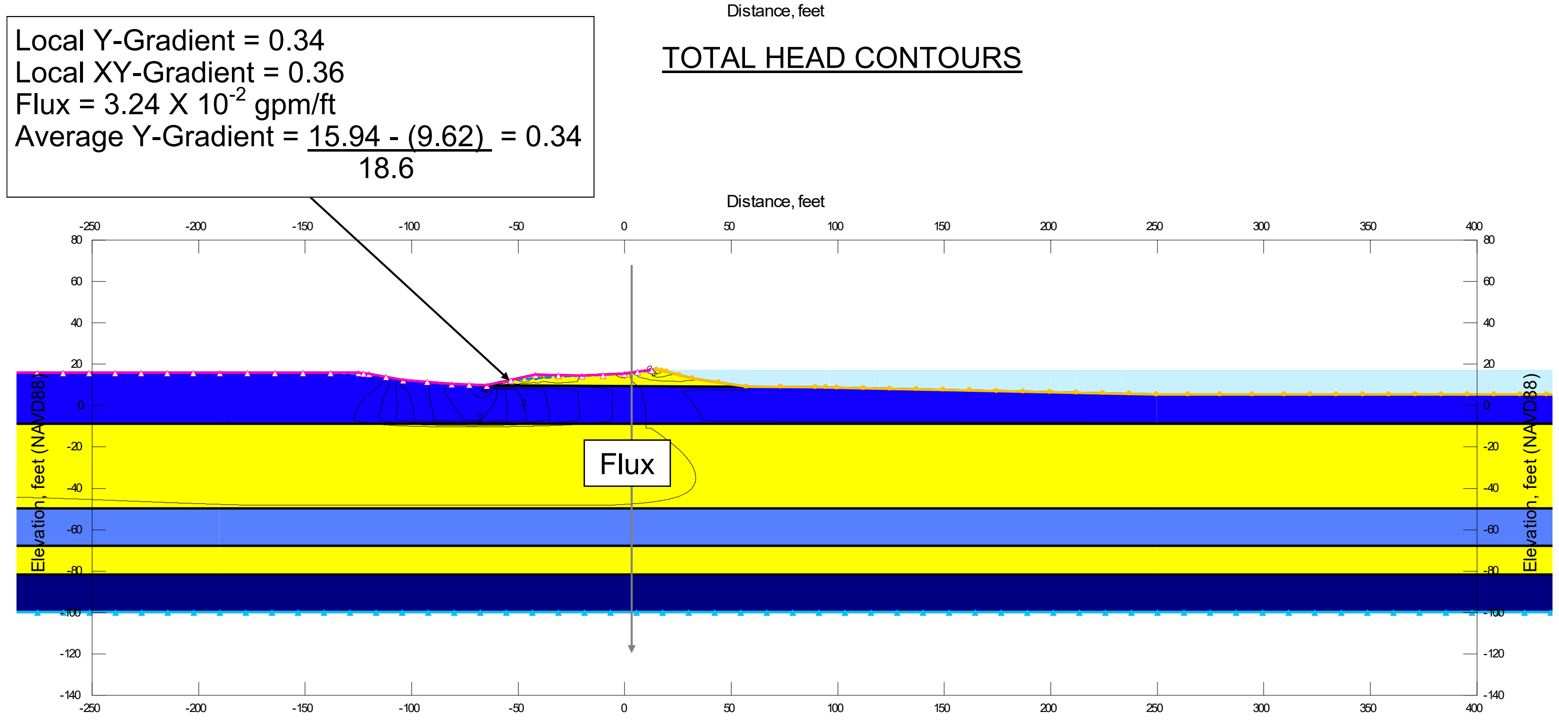
Water Surface Elevation: 17.0 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

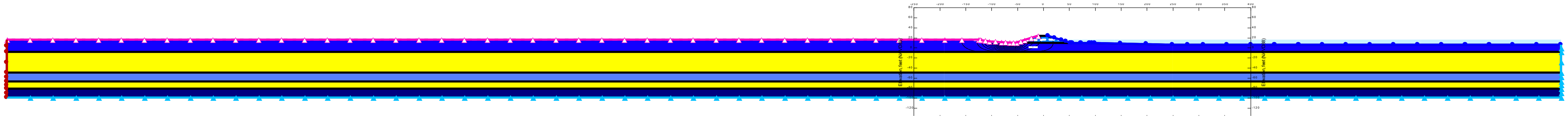
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

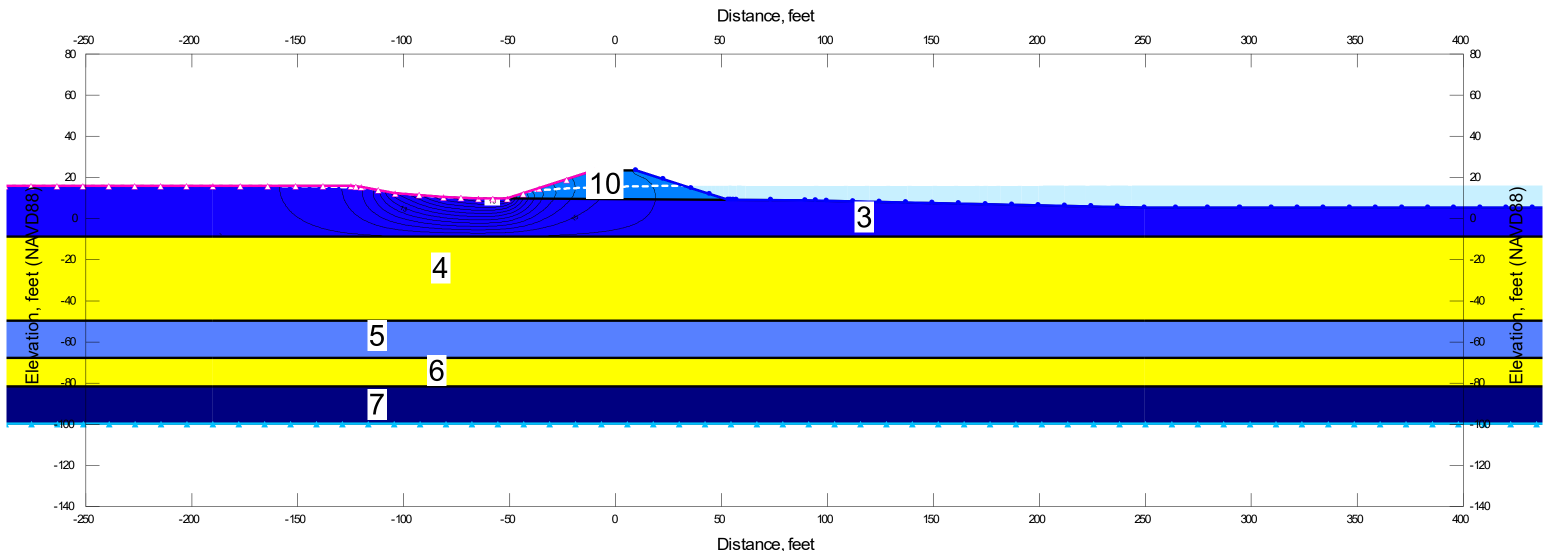
Seepage Analysis
Mellin - Station 41+00
Existing Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-42

Water Surface Elevation: 15.7 feet

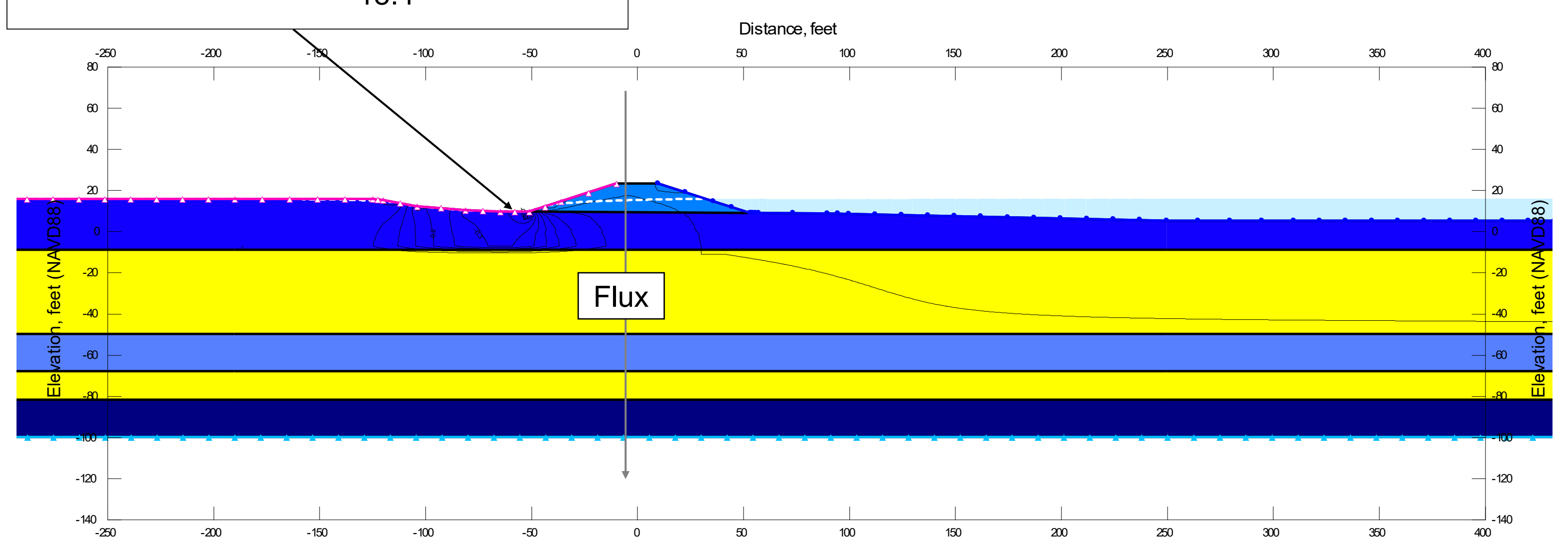


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.49
Local XY-Gradient = 0.56
Flux = 1.06 X 10^{-4} gpm/ft
Average Y-Gradient = $\frac{15.58 - (9.64)}{18.4}$ = 0.32



VERTICAL GRADIENT CONTOURS

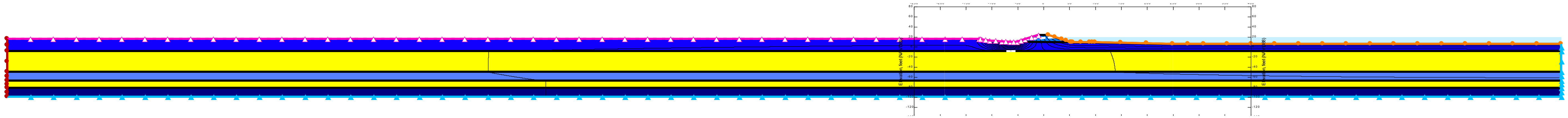
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

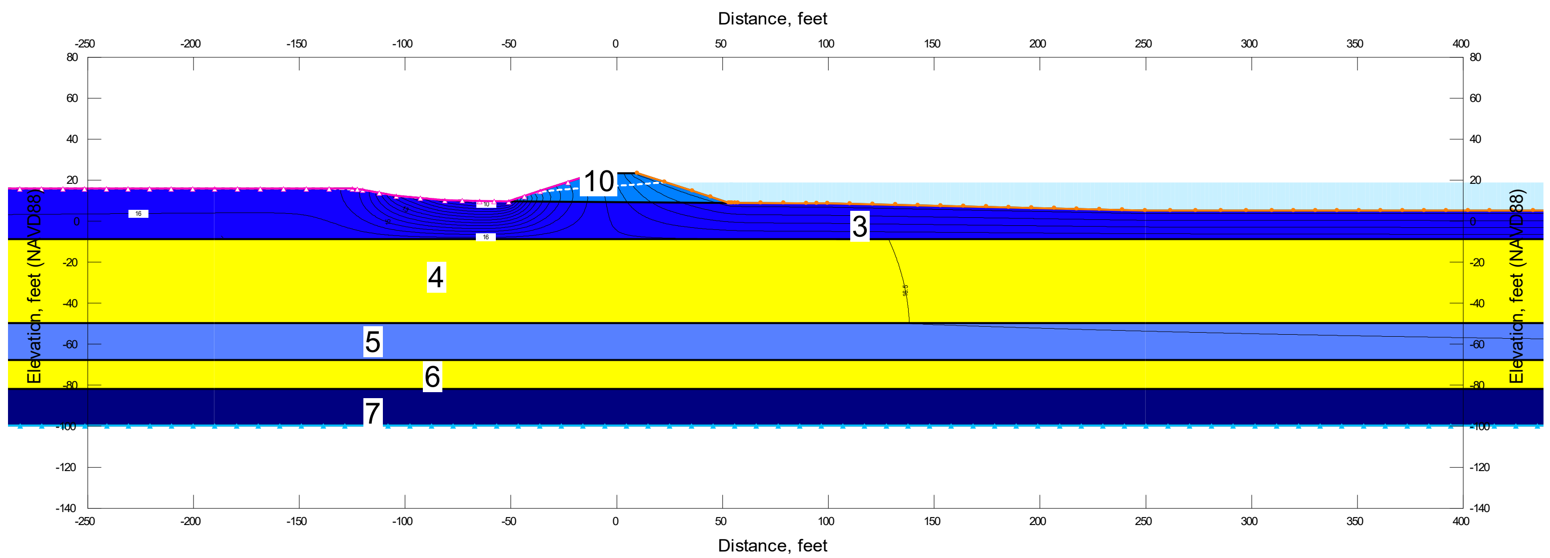
Seepage Analysis
Mellin - Station 41+00
Rehabilitated Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-43

Water Surface Elevation: 18.7 feet

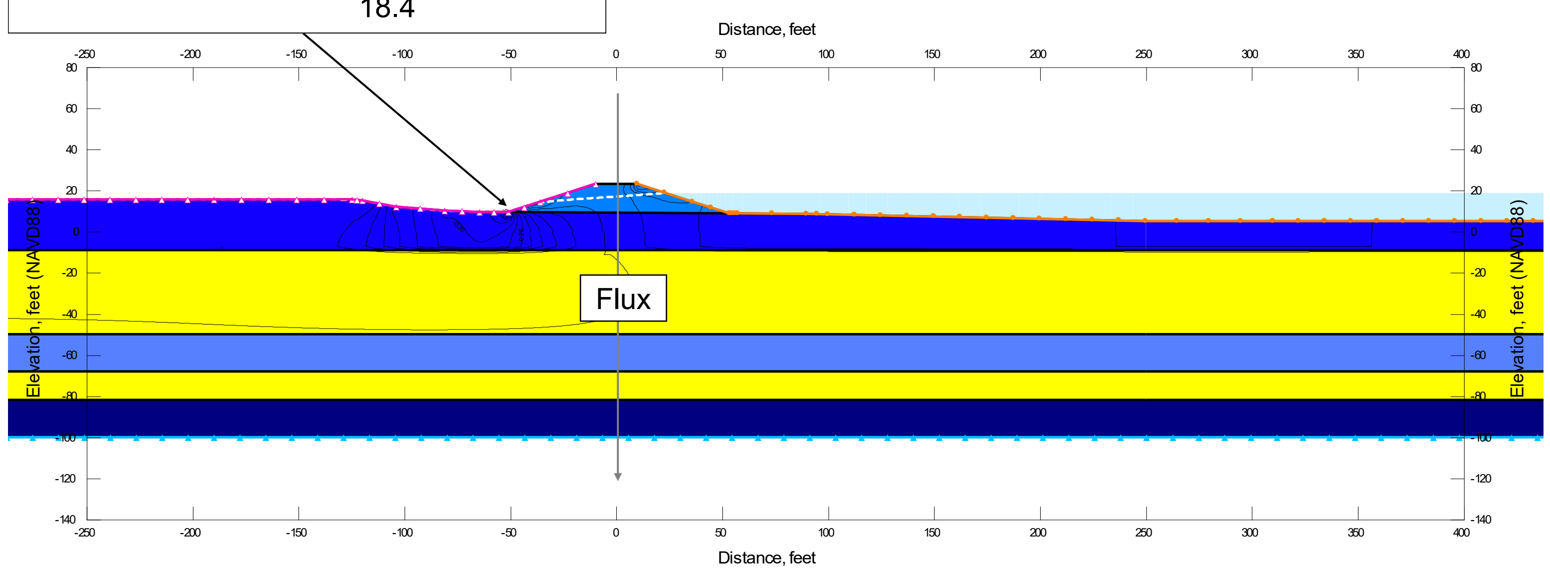


SEEP/W MODEL



Local Y-Gradient = 0.54
Local XY-Gradient = 0.62
Flux = 2.1 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{16.39 - (9.65)}{18.4}$ = 0.37

TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

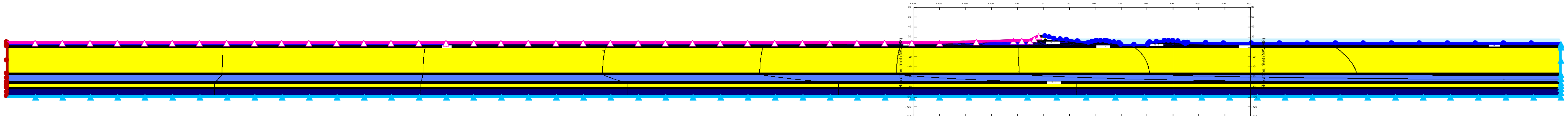
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

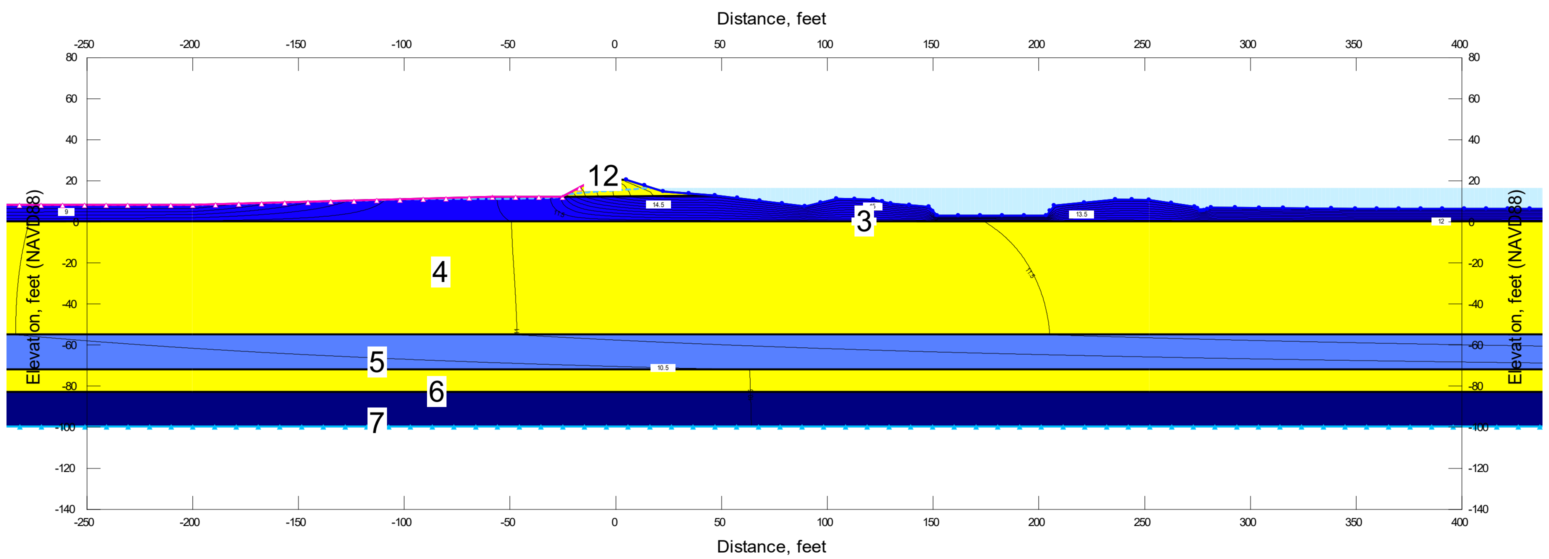
Seepage Analysis
Mellin - Station 41+00
Rehabilitated Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-44

Water Surface Elevation: 16.2 feet

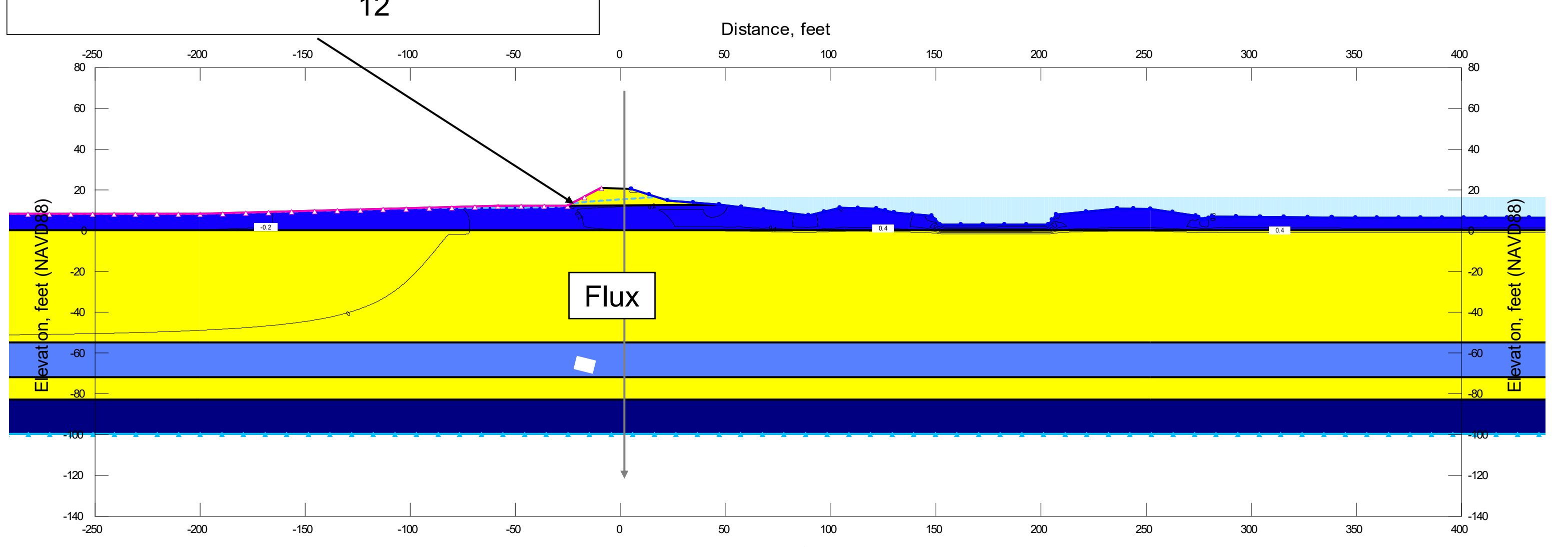


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.12
Local XY-Gradient = 0.28
Flux = 2.64 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{11.05 - (12)}{12}$ = -0.08



VERTICAL GRADIENT CONTOURS

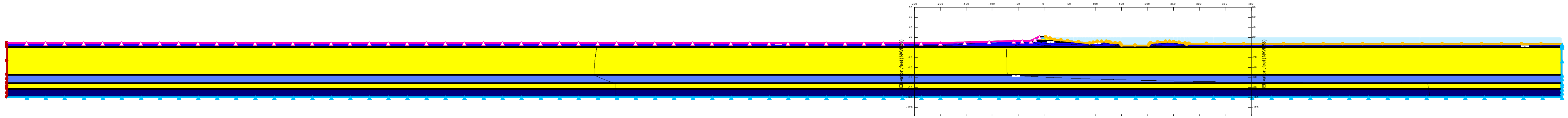
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
(orange)	Unit 2: Organic Soil	4.0×10^{-6}	1
(blue)	Unit 3: Clay Blanket	1.0×10^{-6}	1
(yellow)	Unit 4: Sand (Upper)	5.4×10^{-3}	9
(medium blue)	Unit 5: Clay	4.0×10^{-6}	4
(yellow)	Unit 6: Sand (Lower)	5.4×10^{-3}	9
(dark blue)	Unit 7: Deep Clay	4.0×10^{-6}	4
(purple)	Unit 8: Cutoff Wall	1.0×10^{-6}	1
(blue)	Unit 9: Clay Cap	4.0×10^{-6}	4
(blue)	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
(grey)	Unit 11: Drain Rock	1.0×10^{1}	10
(yellow)	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

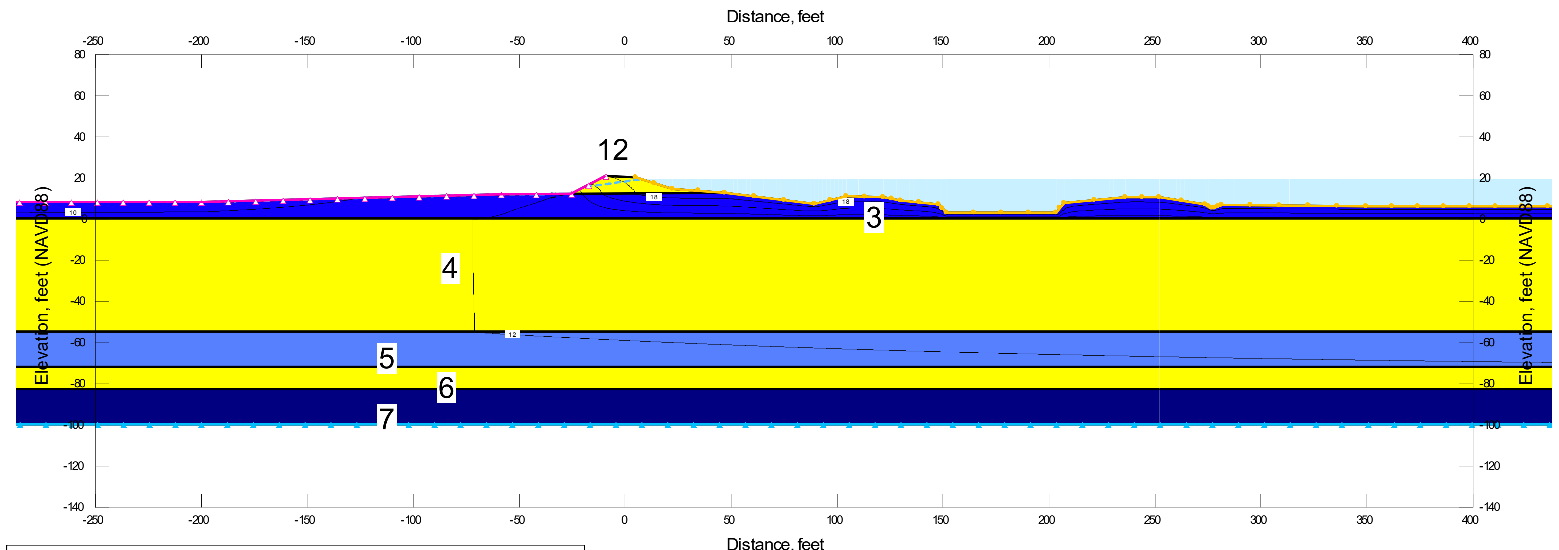
Seepage Analysis
Mellin - Station 66+00
Existing Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-45

Water Surface Elevation: 19.2 feet

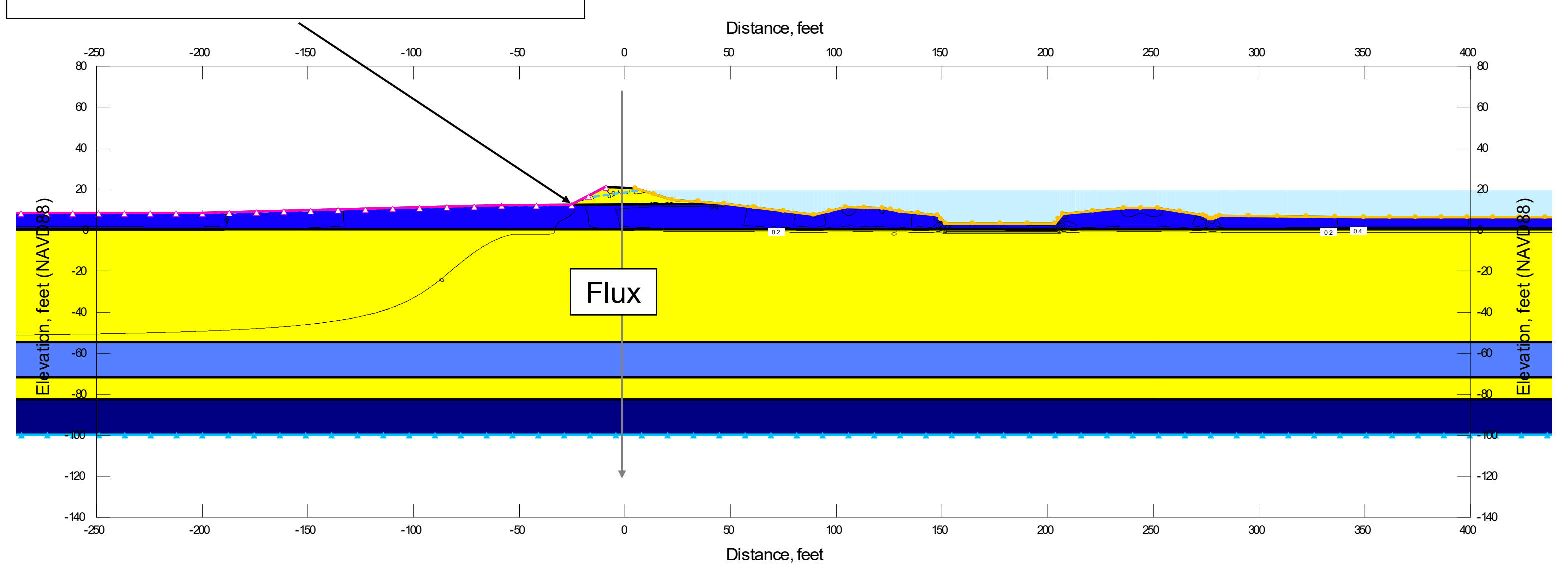


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.07
Local XY-Gradient = 0.29
Flux = 6.91 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{12.14 - (12)}{11.9}$ = 0.01



VERTICAL GRADIENT CONTOURS

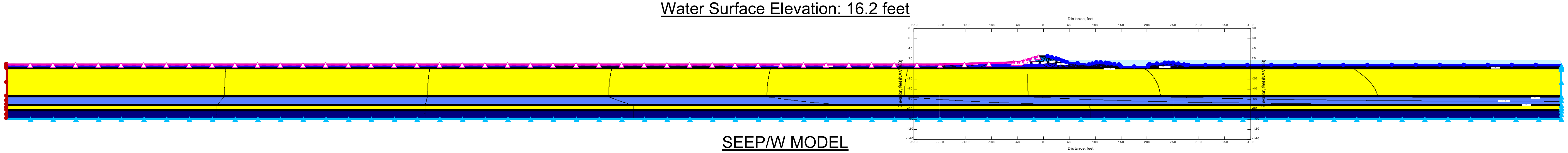
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

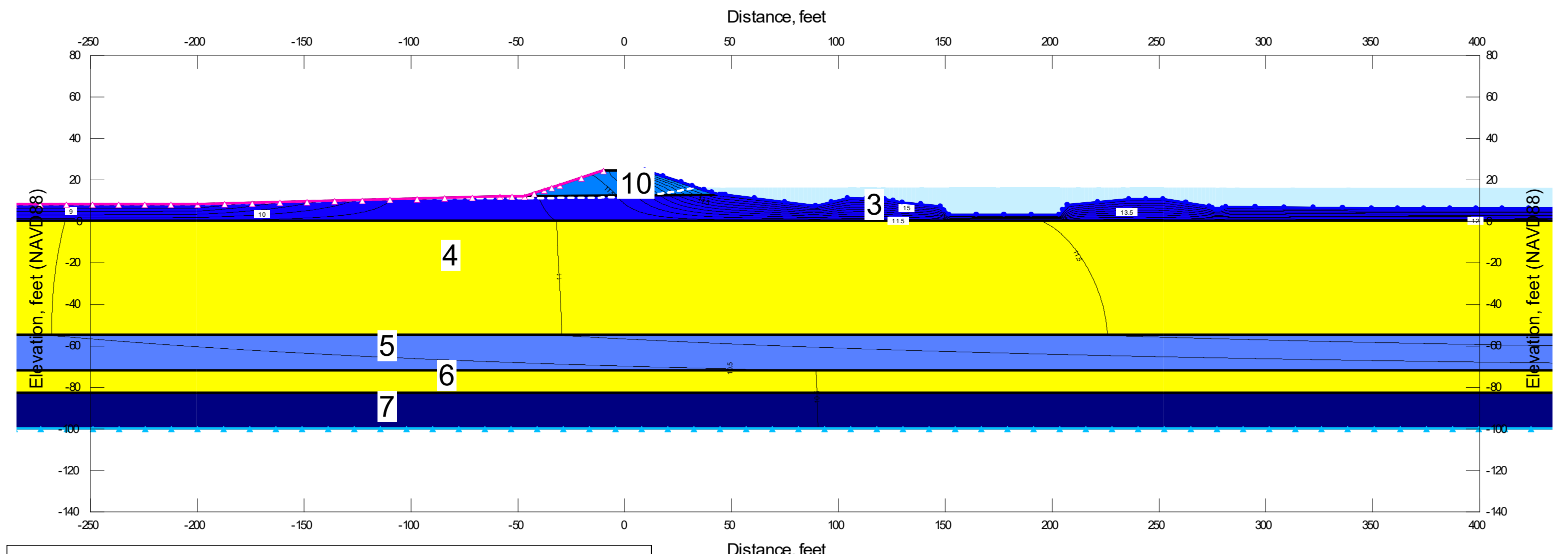
Seepage Analysis
Mellin - Station 66+00
Existing Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-46

Water Surface Elevation: 16.2 feet

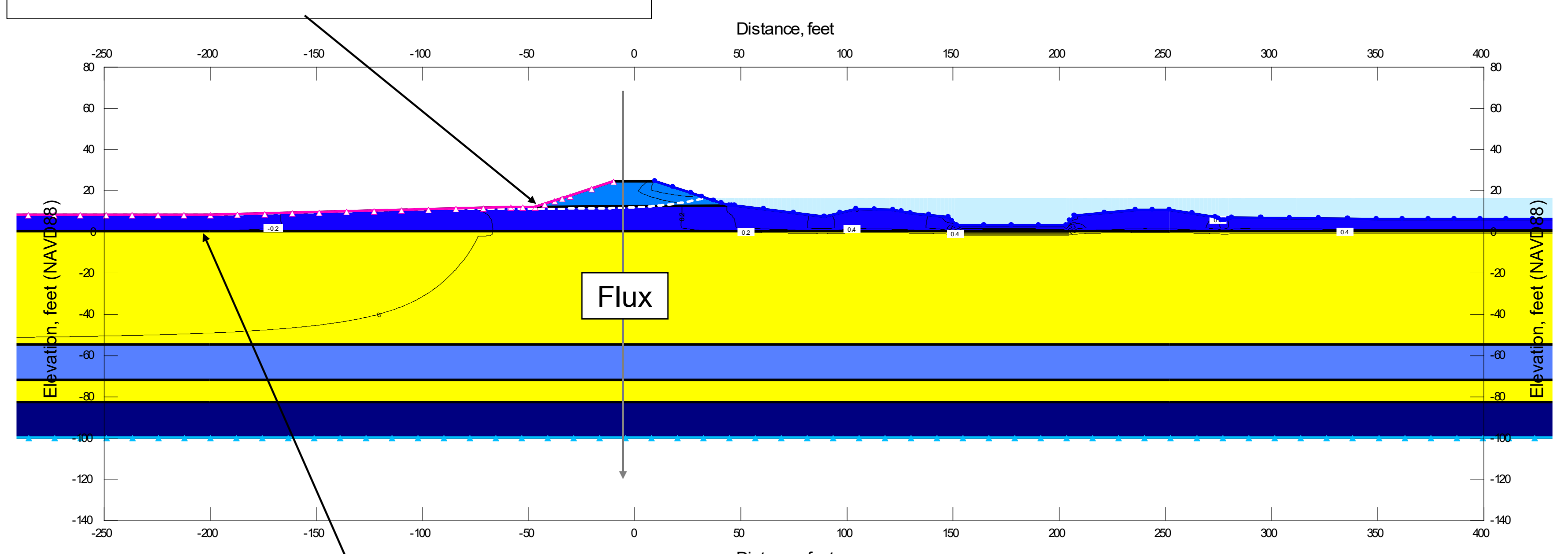


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = <0.01
Local XY-Gradient = <0.01
Flux = 1.04 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{10.97 - (10.98)}{11.8}$ = <0.01



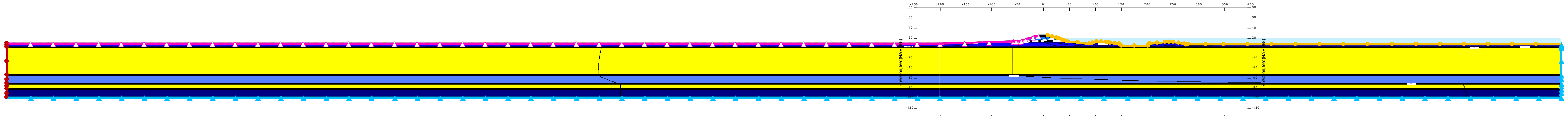
Average Y-Gradient = $\frac{10.63 - (8.05)}{8.05}$ = 0.32

VERTICAL GRADIENT CON-

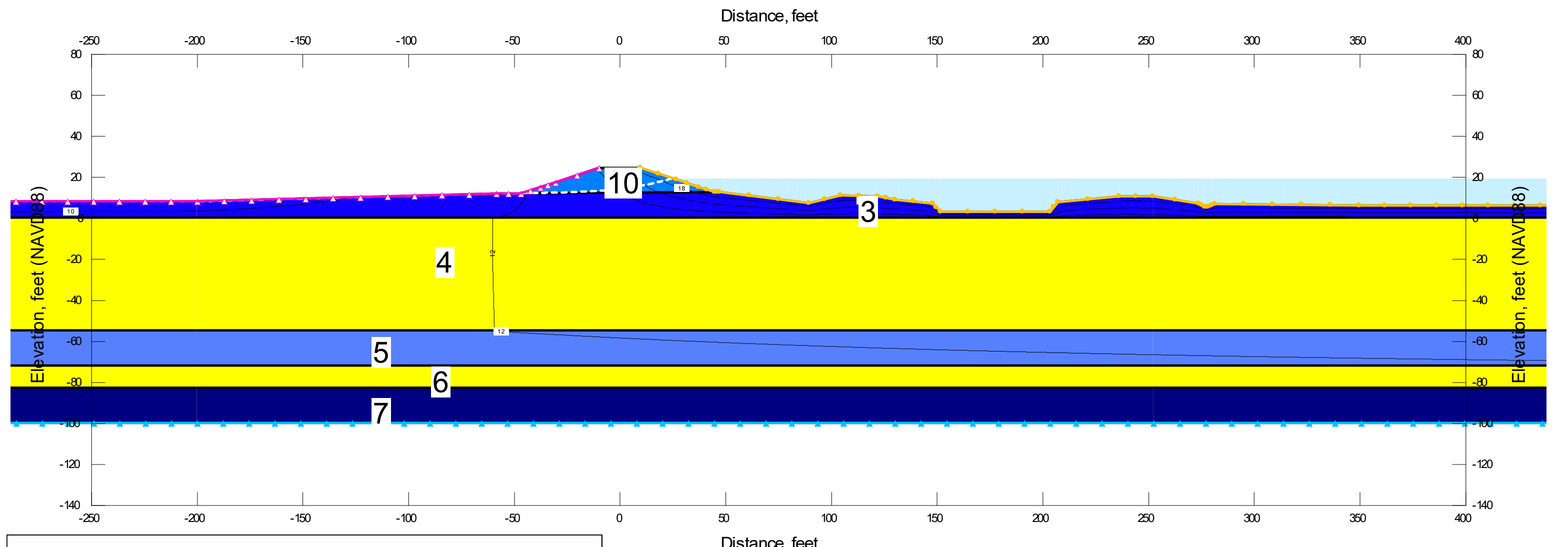
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 66+00** **Rehabilitated Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-47

Water Surface Elevation: 19.2 feet

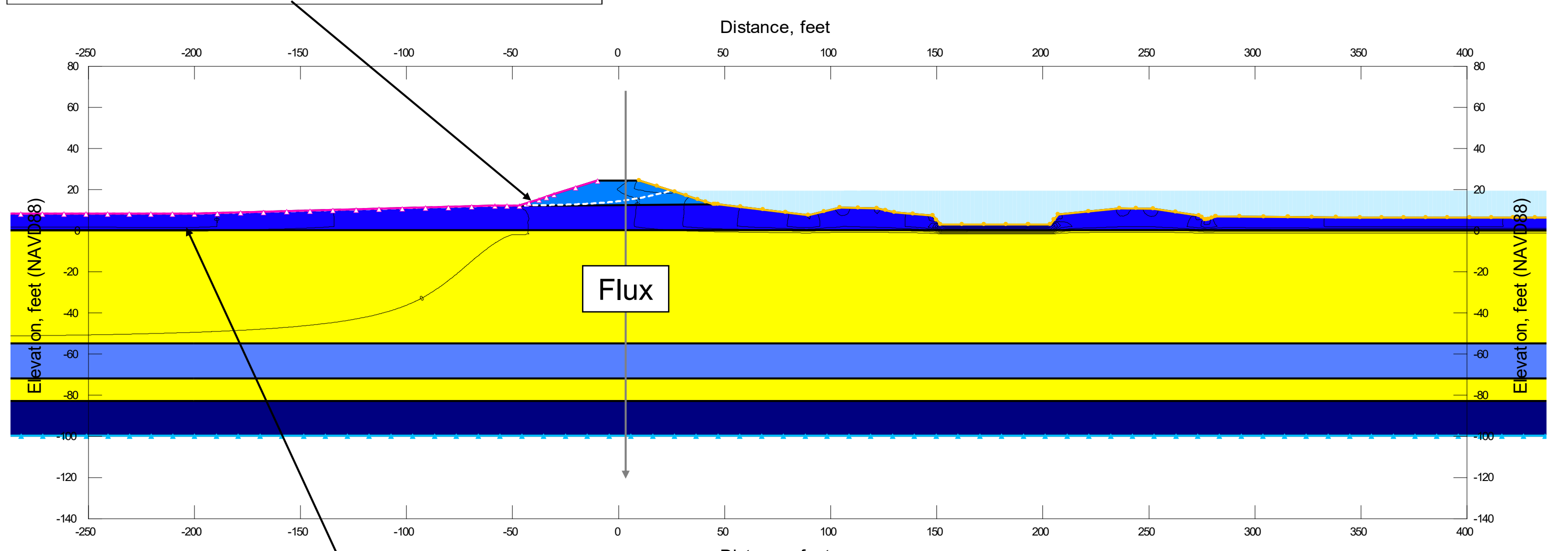


SEEP/W MODEL



Local Y-Gradient = 0.01
Local XY-Gradient = 0.04
Flux = 1.42 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{12.04 - (11.9)}{11.8}$ = 0.01

TOTAL HEAD CONTOURS



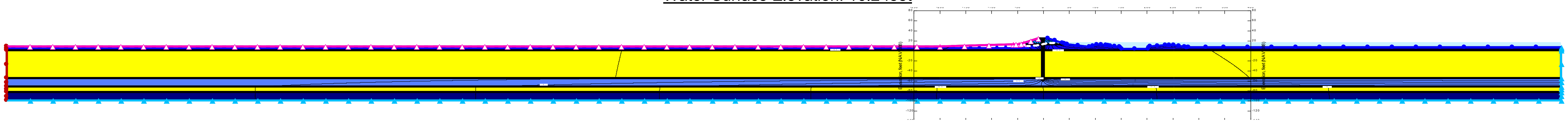
Average Y-Gradient = $\frac{11.59 - (8.05)}{8.05}$ = 0.44

VERTICAL GRADIENT CONTOURS

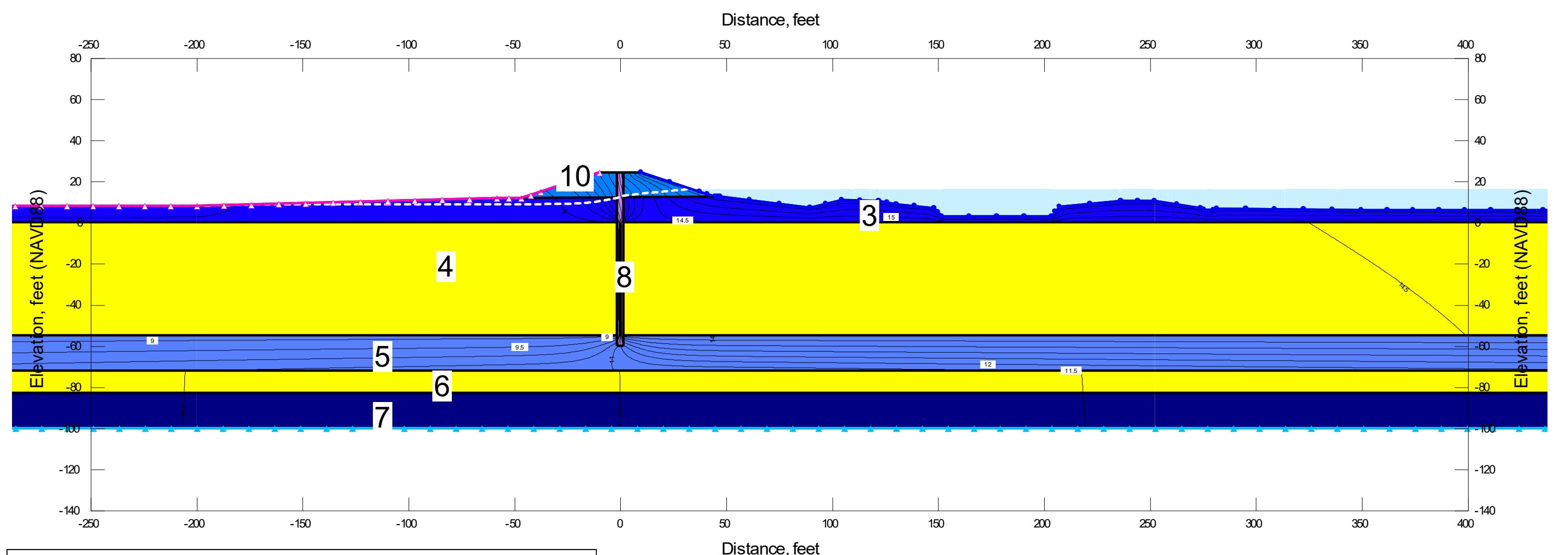
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
(orange)	Unit 2: Organic Soil	4.0×10^{-6}	1
(blue)	Unit 3: Clay Blanket	1.0×10^{-6}	1
(yellow)	Unit 4: Sand (Upper)	5.4×10^{-3}	9
(medium blue)	Unit 5: Clay	4.0×10^{-6}	4
(yellow)	Unit 6: Sand (Lower)	5.4×10^{-3}	9
(dark blue)	Unit 7: Deep Clay	4.0×10^{-6}	4
(purple)	Unit 8: Cutoff Wall	1.0×10^{-6}	1
(blue)	Unit 9: Clay Cap	4.0×10^{-6}	4
(bright blue)	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
(light grey)	Unit 11: Drain Rock	1.0×10^{1}	10
(yellow)	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California		**Seepage Analysis** **Mellin - Station 66+00** **Rehabilitated Levee (HTOL)**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. E-48

Water Surface Elevation: 16.2 feet

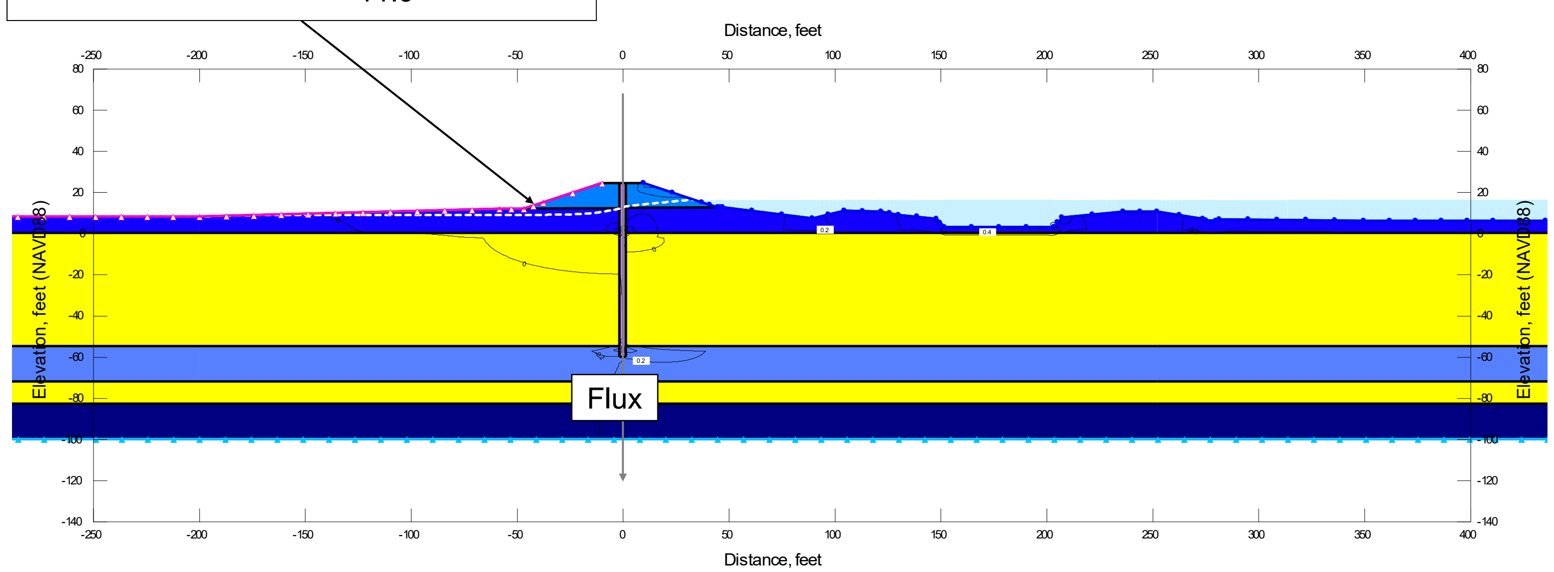


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = <0.01
Local XY-Gradient = <0.01
Flux = 4.0 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{8.86 - (8.84)}{11.9}$ = <0.01

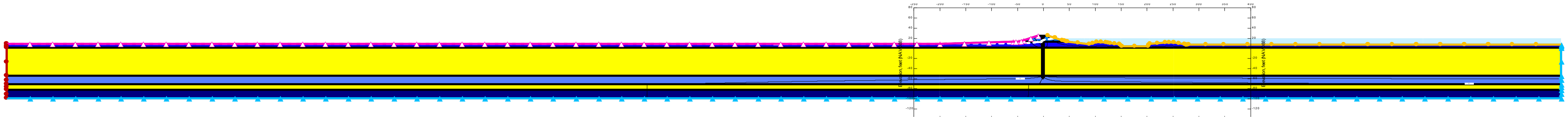


VERTICAL GRADIENT CONTOURS

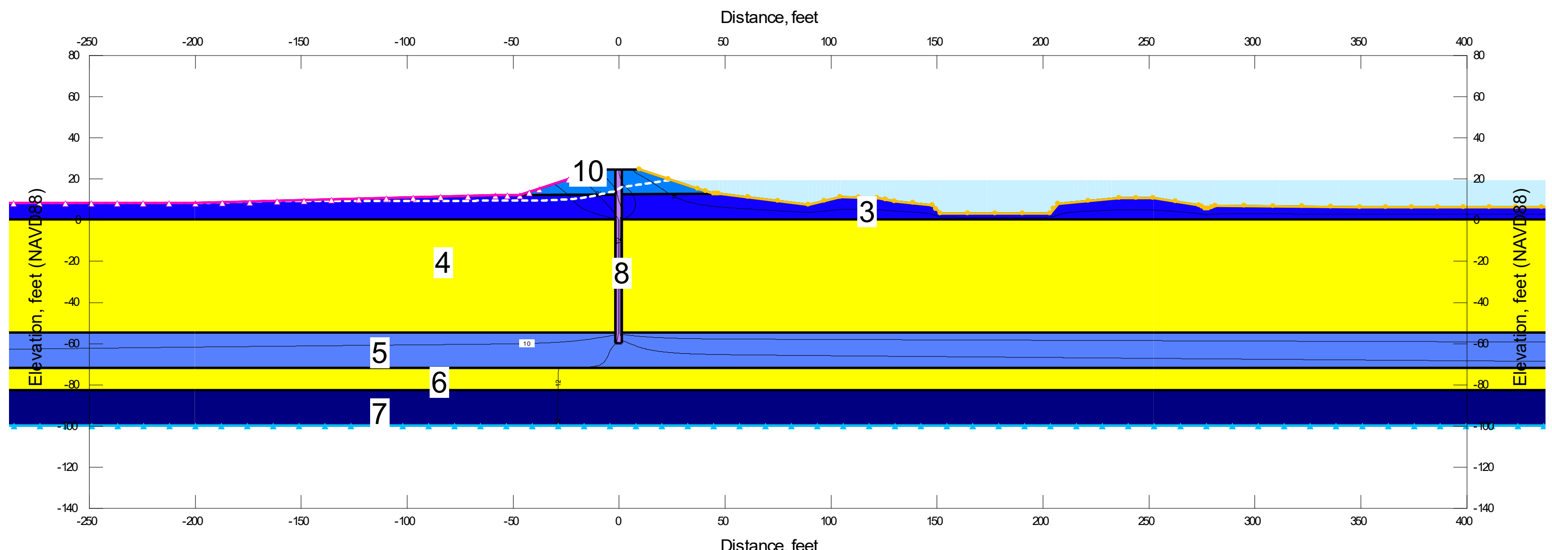
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 66+00** **Rehabilitated Levee with Cutoff Wall (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. E-49

Water Surface Elevation: 19.2 feet

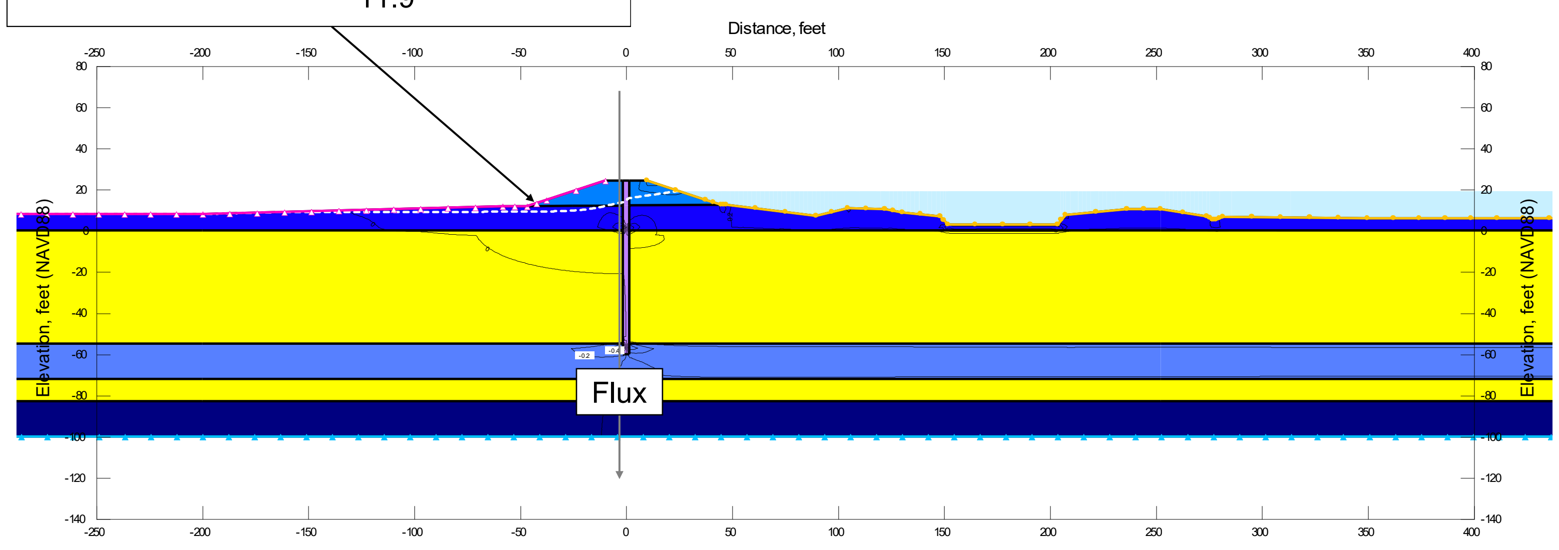


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = <0.01
Local XY-Gradient = 0.01
Flux = 5.4 X 10^{-3} gpm/ft
Average Y-Gradient = $\frac{9.21 - (9.16)}{11.9}$ = <0.01



VERTICAL GRADIENT CONTOURS

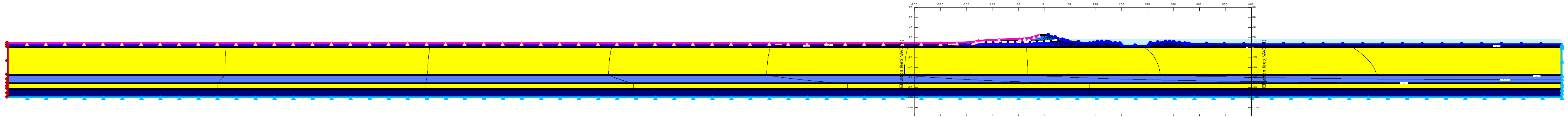
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
(orange)	Unit 2: Organic Soil	$4.0x10^{-6}$	1
(blue)	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
(yellow)	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
(medium blue)	Unit 5: Clay	$4.0x10^{-6}$	4
(yellow)	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
(dark navy)	Unit 7: Deep Clay	$4.0x10^{-6}$	4
(lavender)	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
(blue)	Unit 9: Clay Cap	$4.0x10^{-6}$	4
(bright blue)	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
(light gray)	Unit 11: Drain Rock	$1.0x10^{1}$	10
(yellow)	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

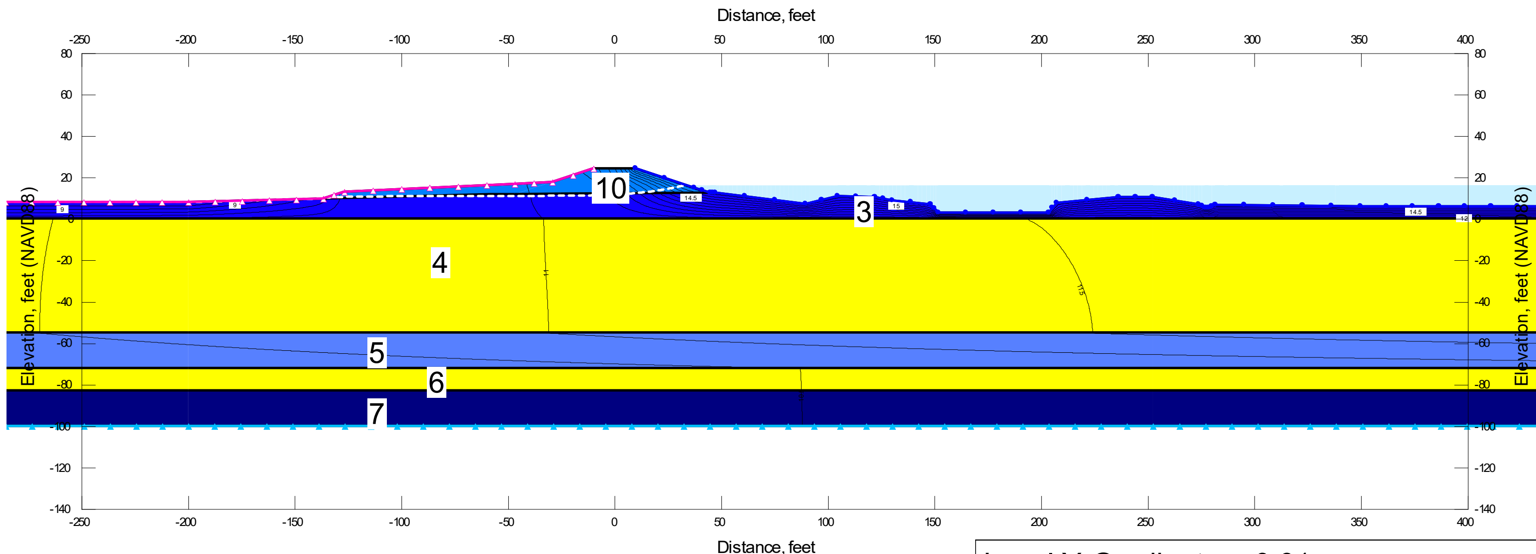
Seepage Analysis
Mellin - Station 66+00
Rehabilitated Levee with Cutoff Wall (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-50

Water Surface Elevation: 16.2 feet



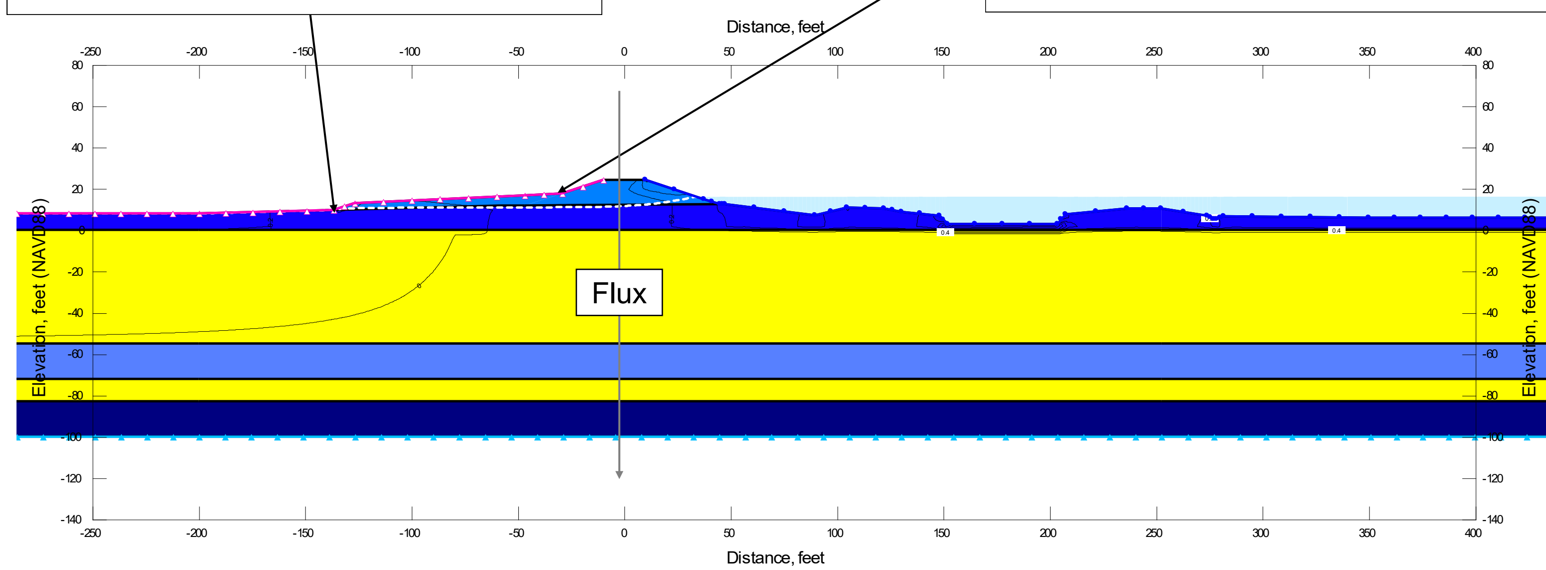
SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.07
Local XY-Gradient = 0.17
Average Y-Gradient = $\frac{10.77 - (9.76)}{9.7} = 0.10$

Local Y-Gradient = <0.01
Local XY-Gradient = 0.01
Flux = 1.04 X 10^{-2} gpm/ft
Average Y-Gradient = $\frac{11 - (11.07)}{17.3} = <0.01$



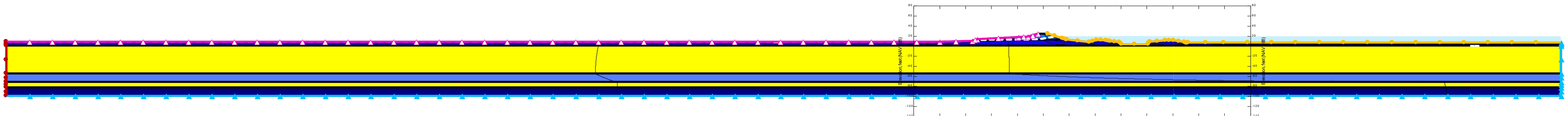
VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

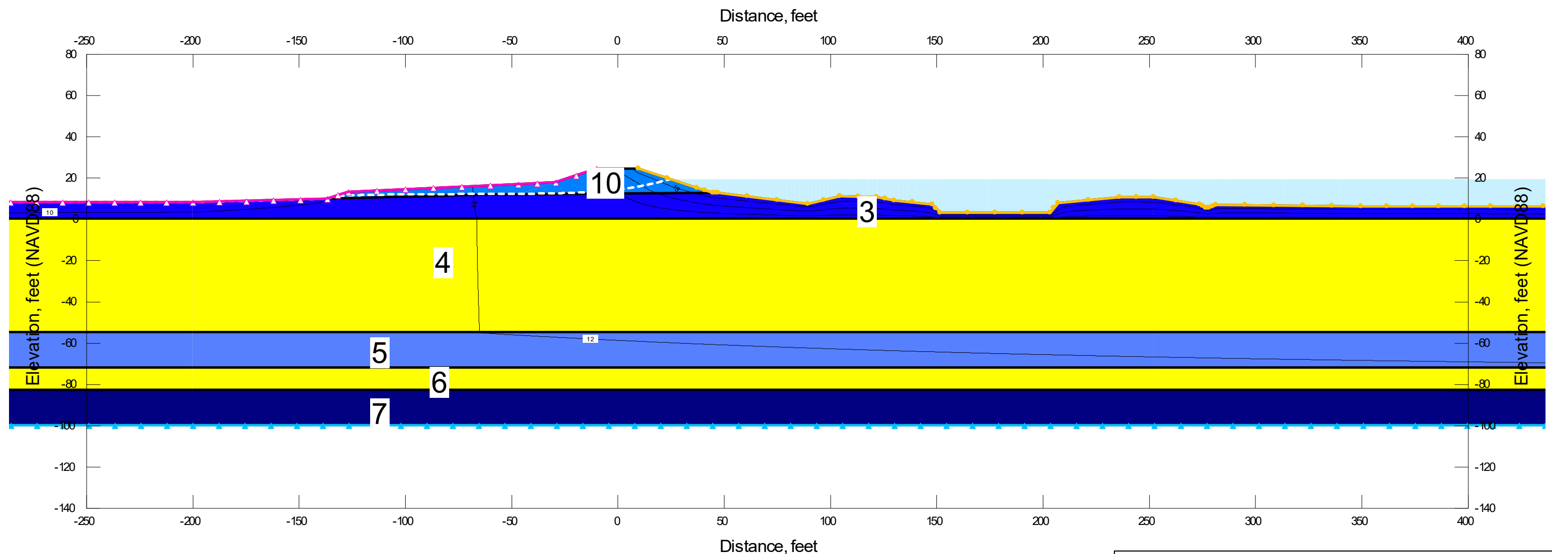
Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 66+00** **Rehabilitated Levee with Seepage Berm (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-51

17.3

Water Surface Elevation: 19.2 feet



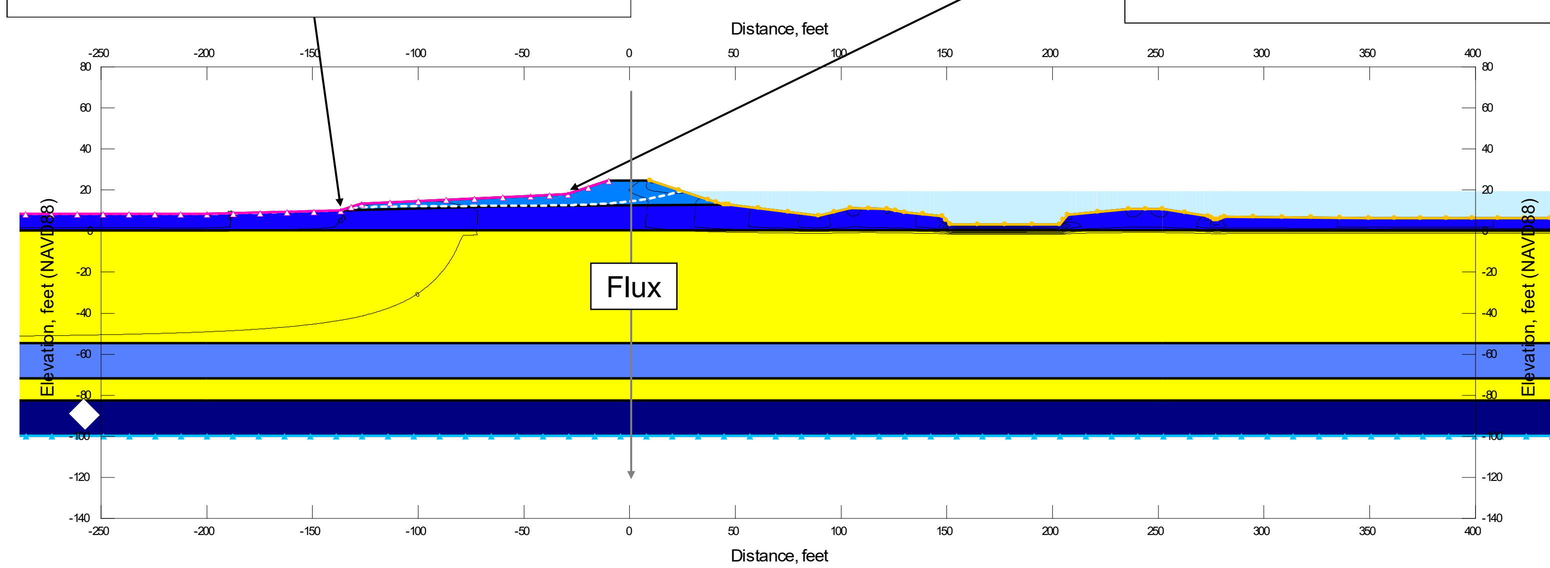
SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = 0.2
Local XY-Gradient = 0.31
Average Y-Gradient = $\frac{11.78 - (9.77)}{9.7}$ = 0.21

Local Y-Gradient = -0.02
Local XY-Gradient = 0.04
Flux = 2.95 X 10^{-2} gpm/ft
Average Y-Gradient = 12.11- (12.43) = -0.02



VERTICAL GRADIENT CONTOURS

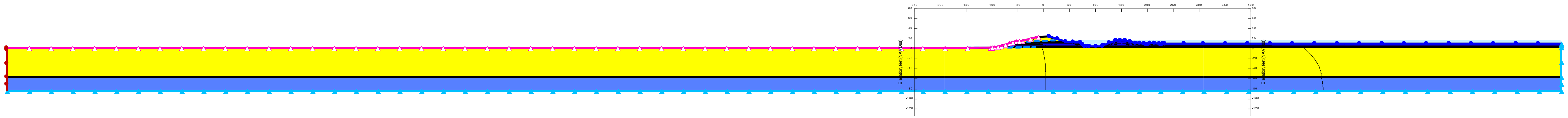
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

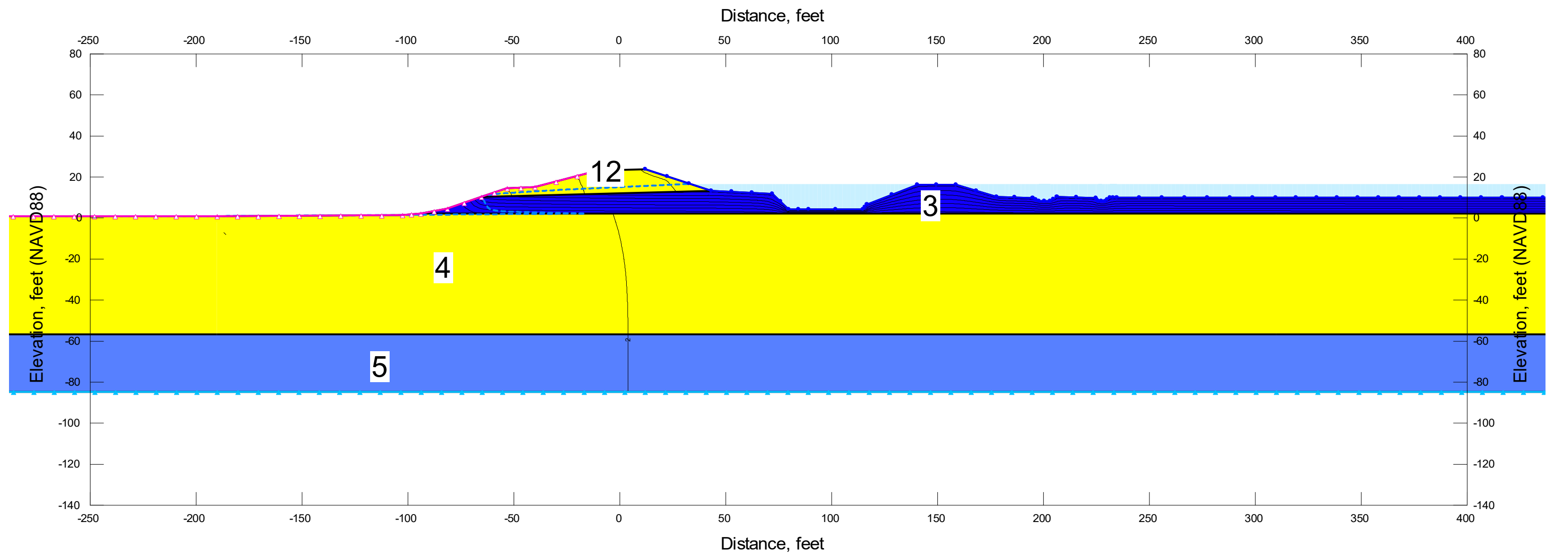
Seepage Analysis
Mellin - Station 66+00
Rehabilitated Levee with Seepage Berm (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-52

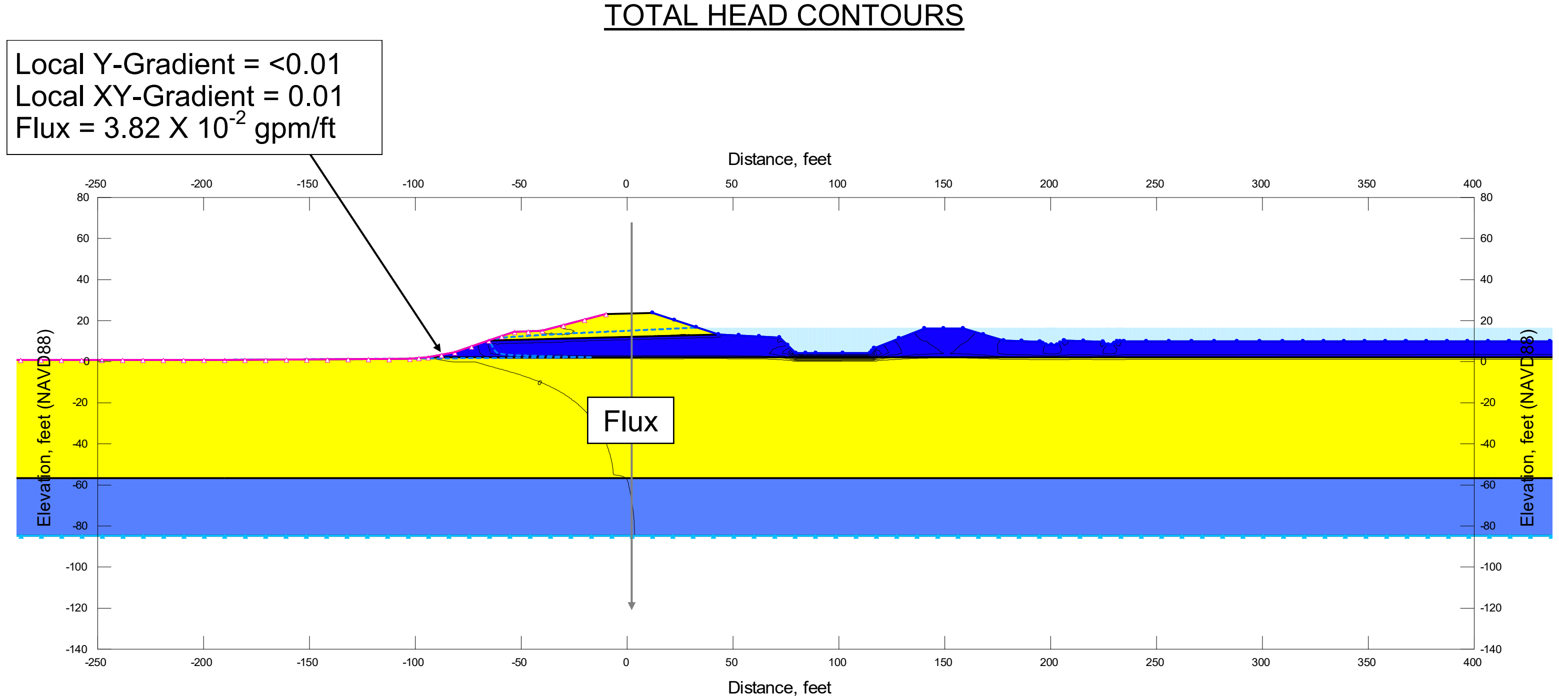
Water Surface Elevation: 16.4 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

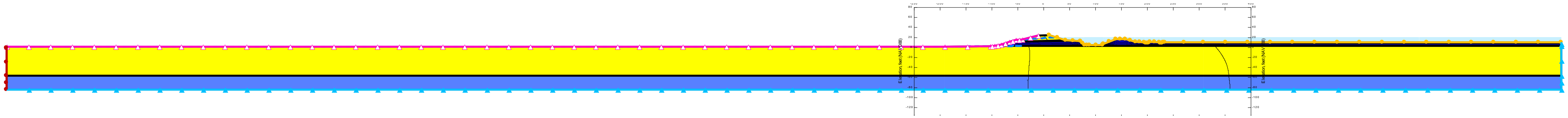
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

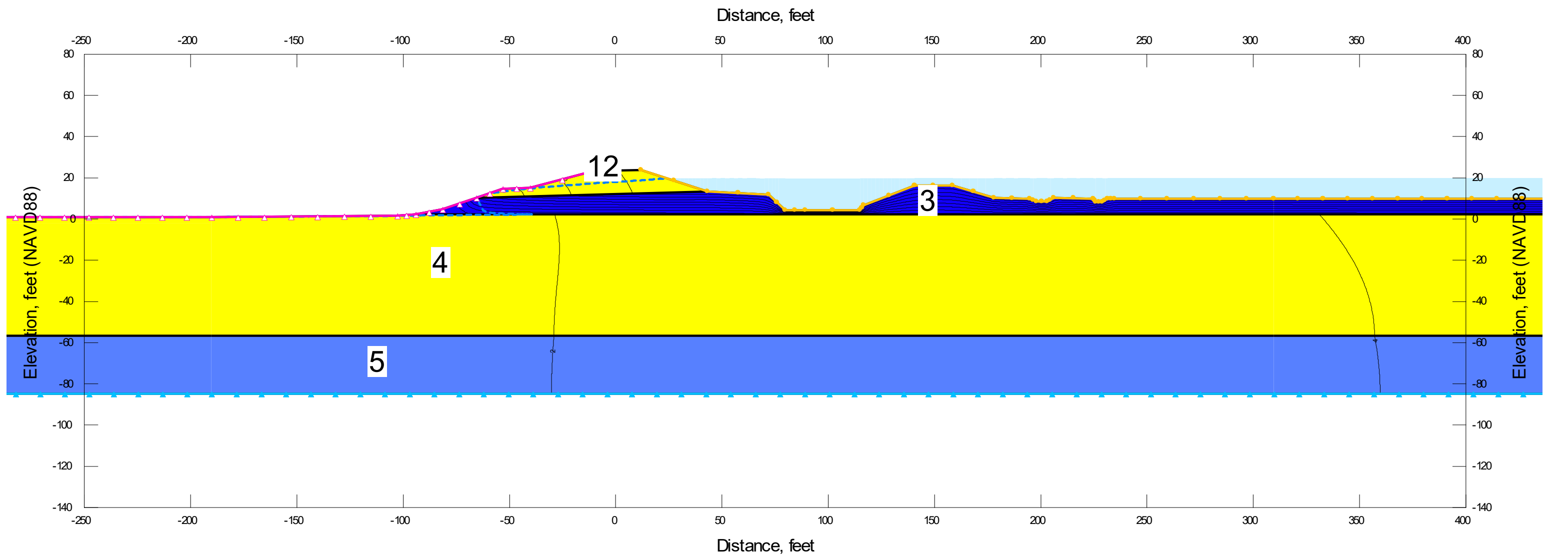
Seepage Analysis
Mellin - Station 83+00
Existing Levee (DWSE)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-53

Water Surface Elevation: 19.4 feet

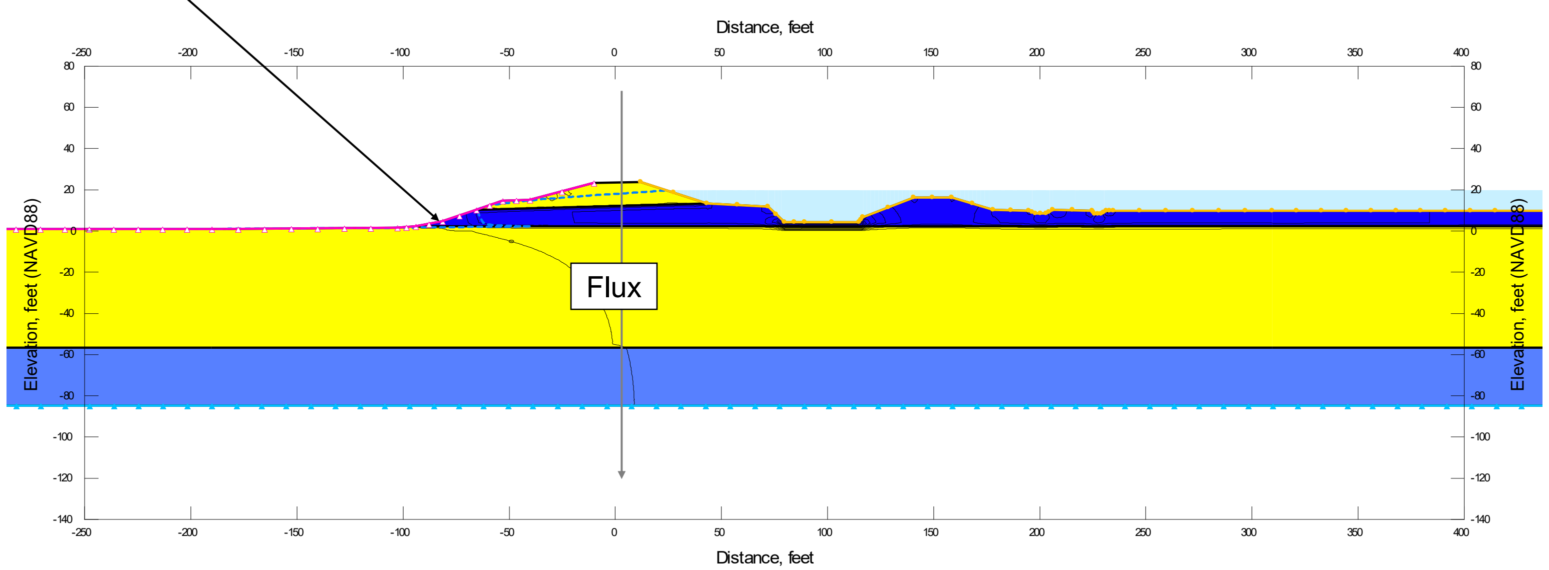


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = <0.01
Local XY-Gradient = 0.01
Flux = 6.23 X 10^{-2} gpm/ft



VERTICAL GRADIENT CONTOURS

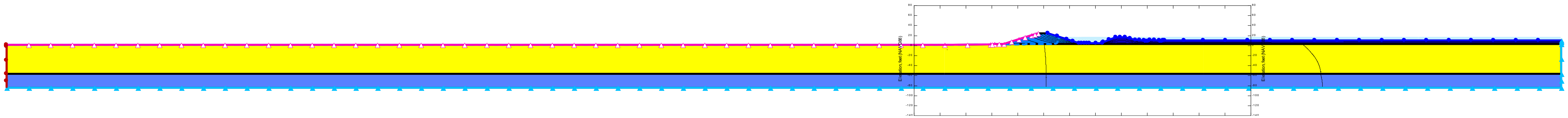
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
(light blue)	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
(orange)	Unit 2: Organic Soil	4.0×10^{-6}	1
(blue)	Unit 3: Clay Blanket	1.0×10^{-6}	1
(yellow)	Unit 4: Sand (Upper)	5.4×10^{-3}	9
(medium blue)	Unit 5: Clay	4.0×10^{-6}	4
(yellow)	Unit 6: Sand (Lower)	5.4×10^{-3}	9
(dark navy)	Unit 7: Deep Clay	4.0×10^{-6}	4
(lavender)	Unit 8: Cutoff Wall	1.0×10^{-6}	1
(blue)	Unit 9: Clay Cap	4.0×10^{-6}	4
(azure)	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
(light gray)	Unit 11: Drain Rock	1.0×10^{1}	10
(yellow)	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

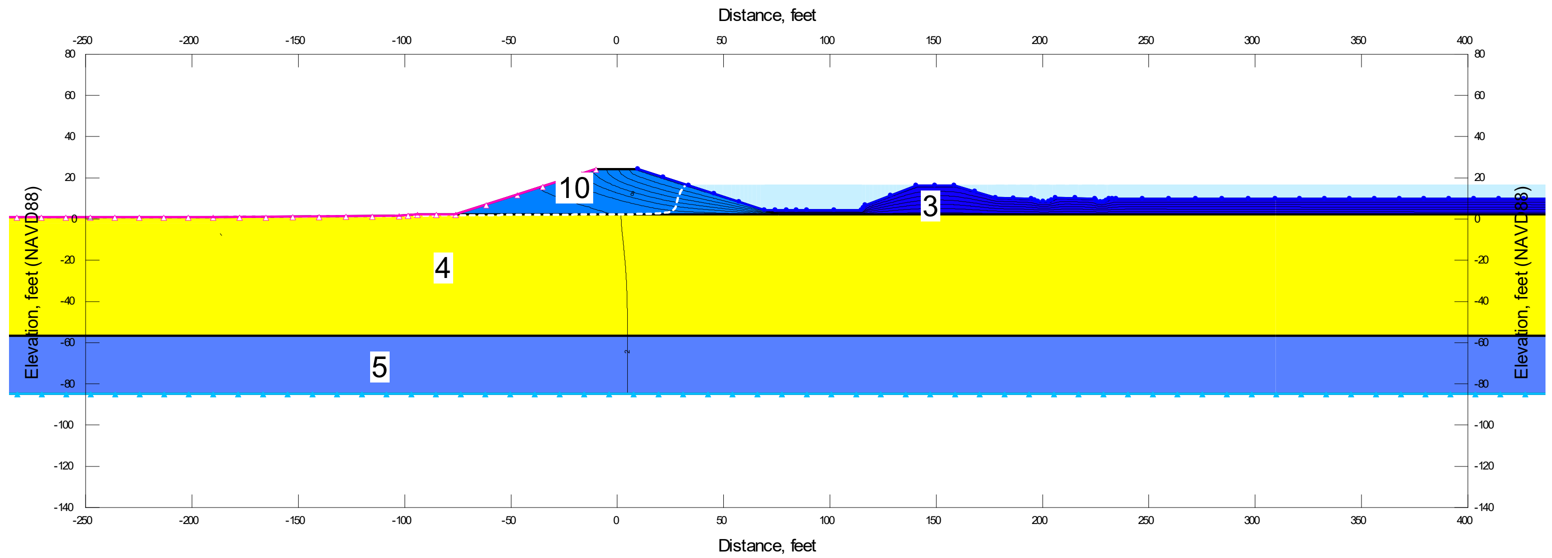
Seepage Analysis
Mellin - Station 83+00
Existing Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-54

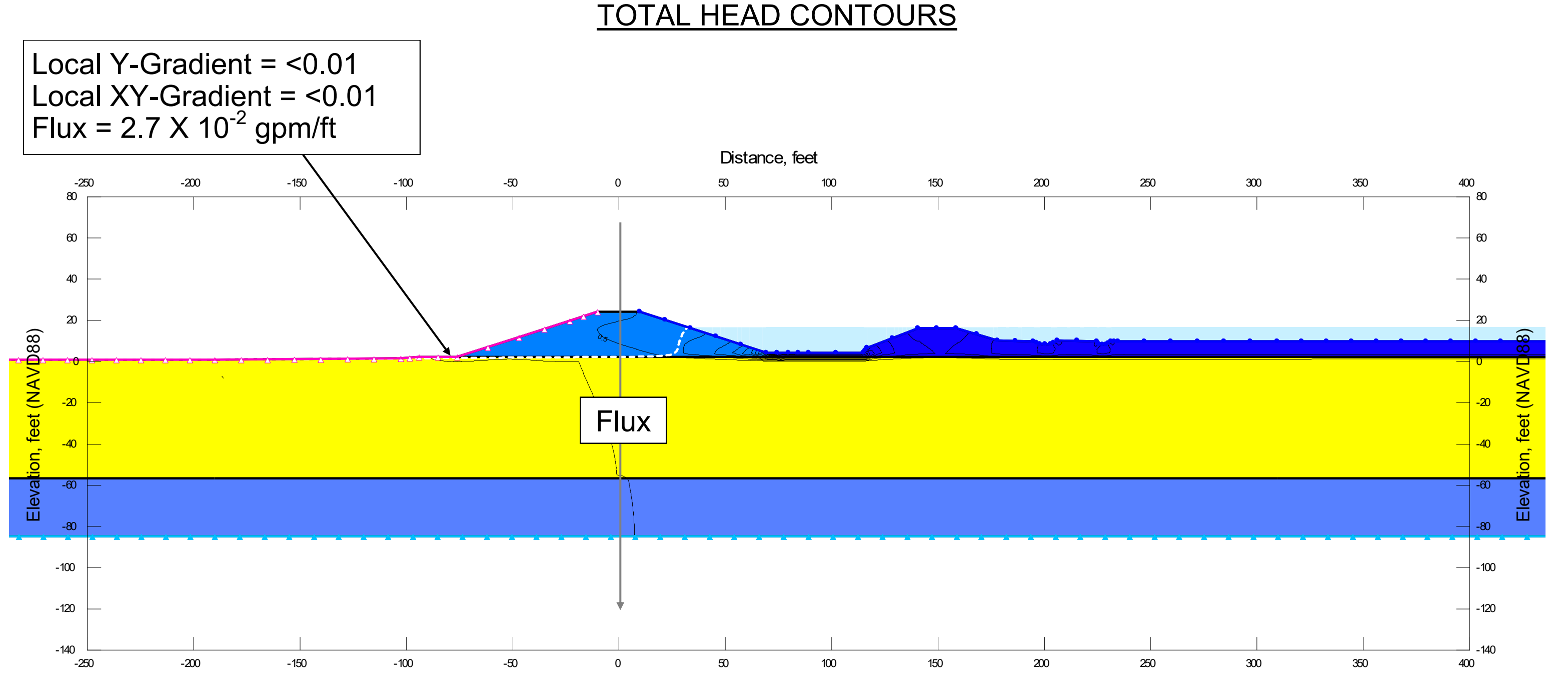
Water Surface Elevation: 16.4 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

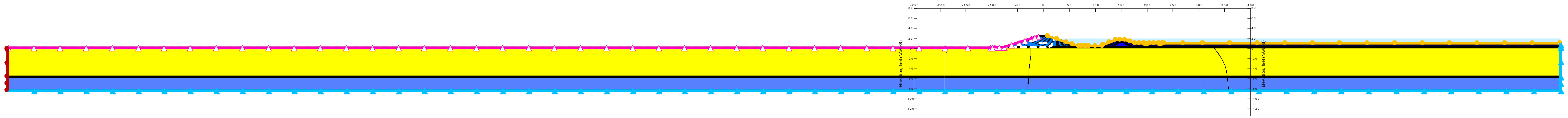


VERTICAL GRADIENT CONTOURS

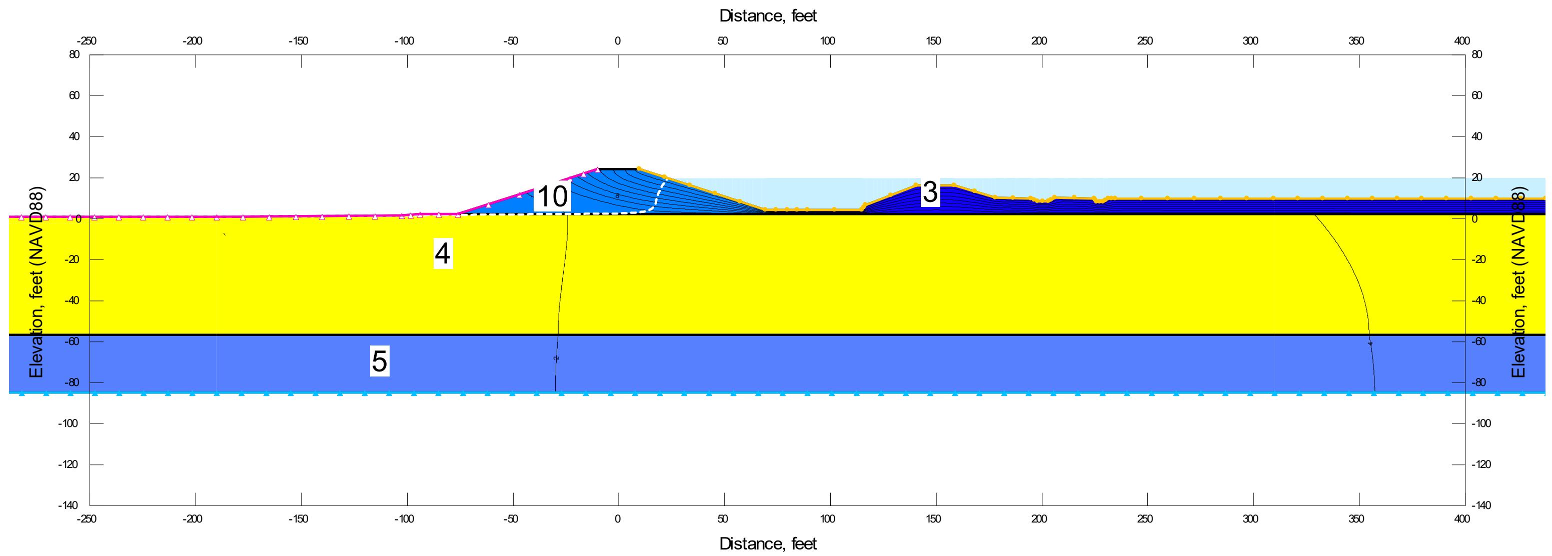
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 83+00** **Rehabilitated Levee (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-55

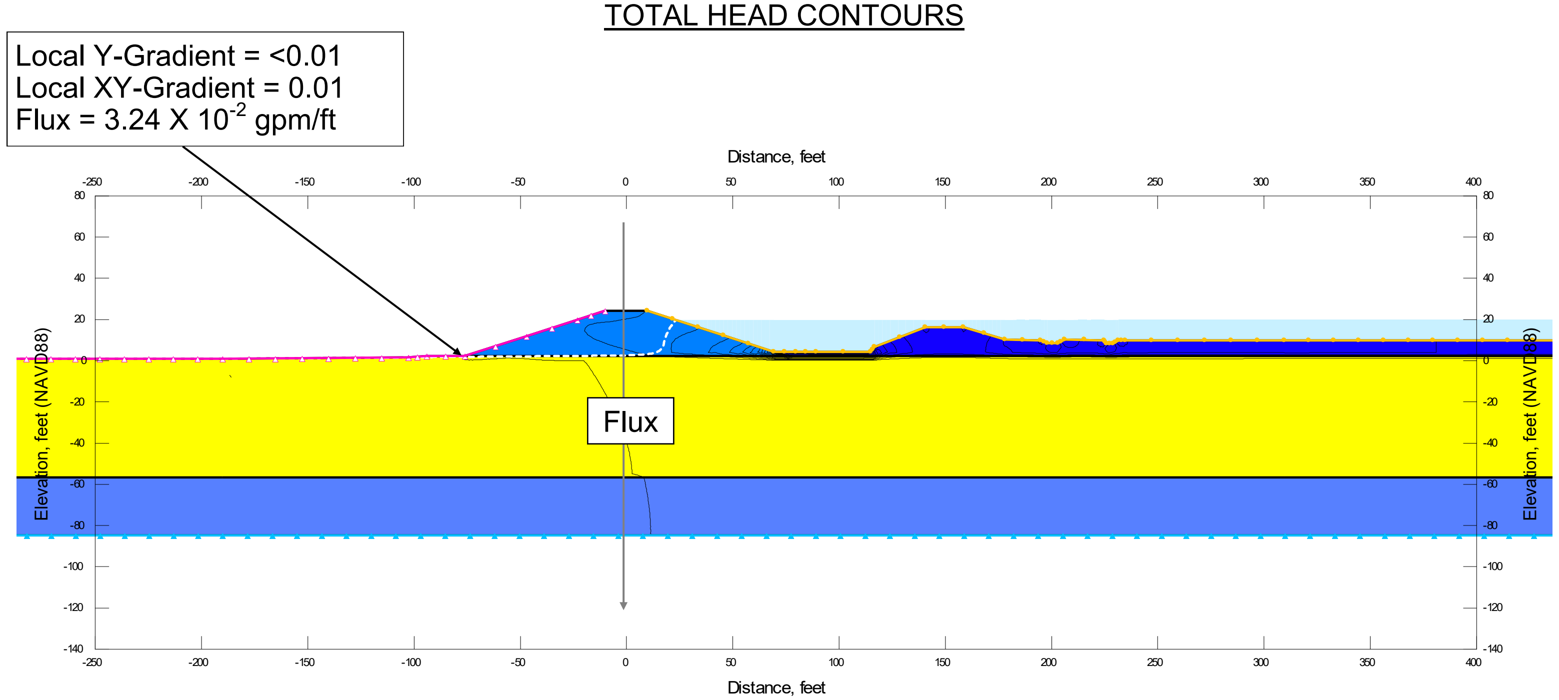
Water Surface Elevation: 19.4 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

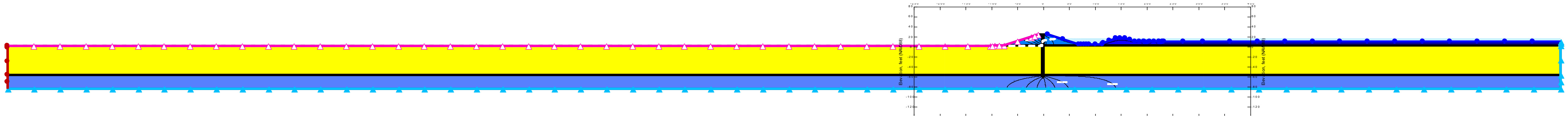
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project
Solano County, California

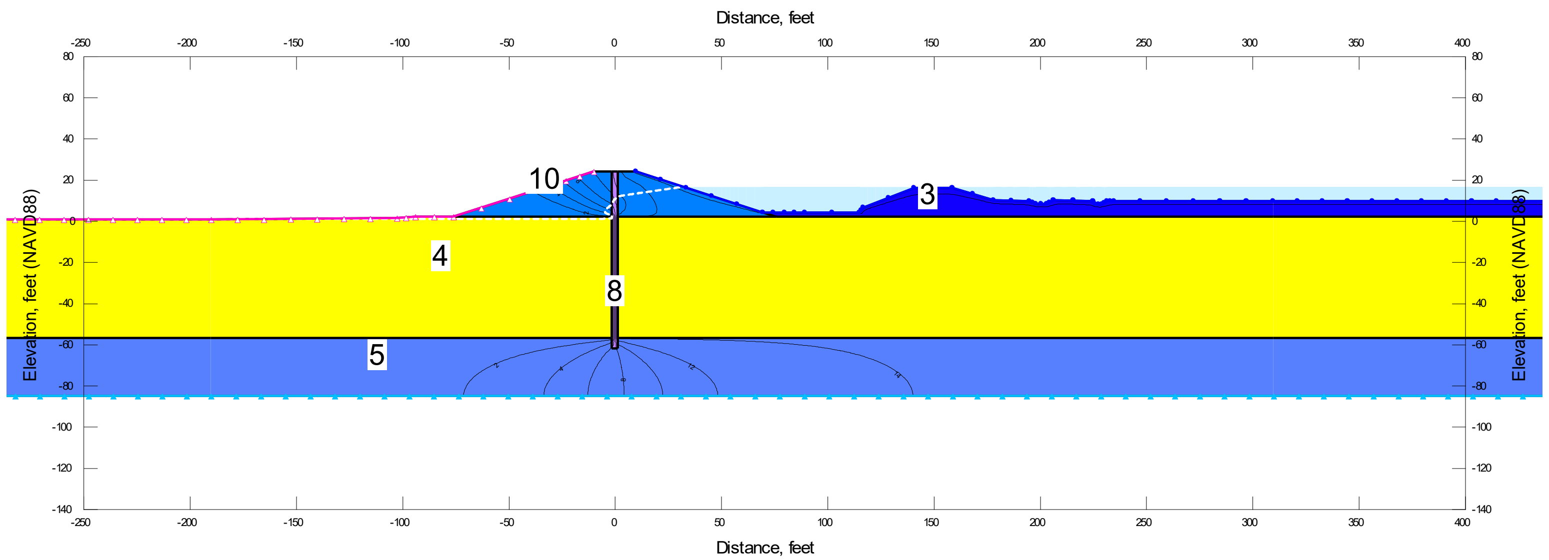
Seepage Analysis
Mellin - Station 83+00
Rehabilitated Levee (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-56

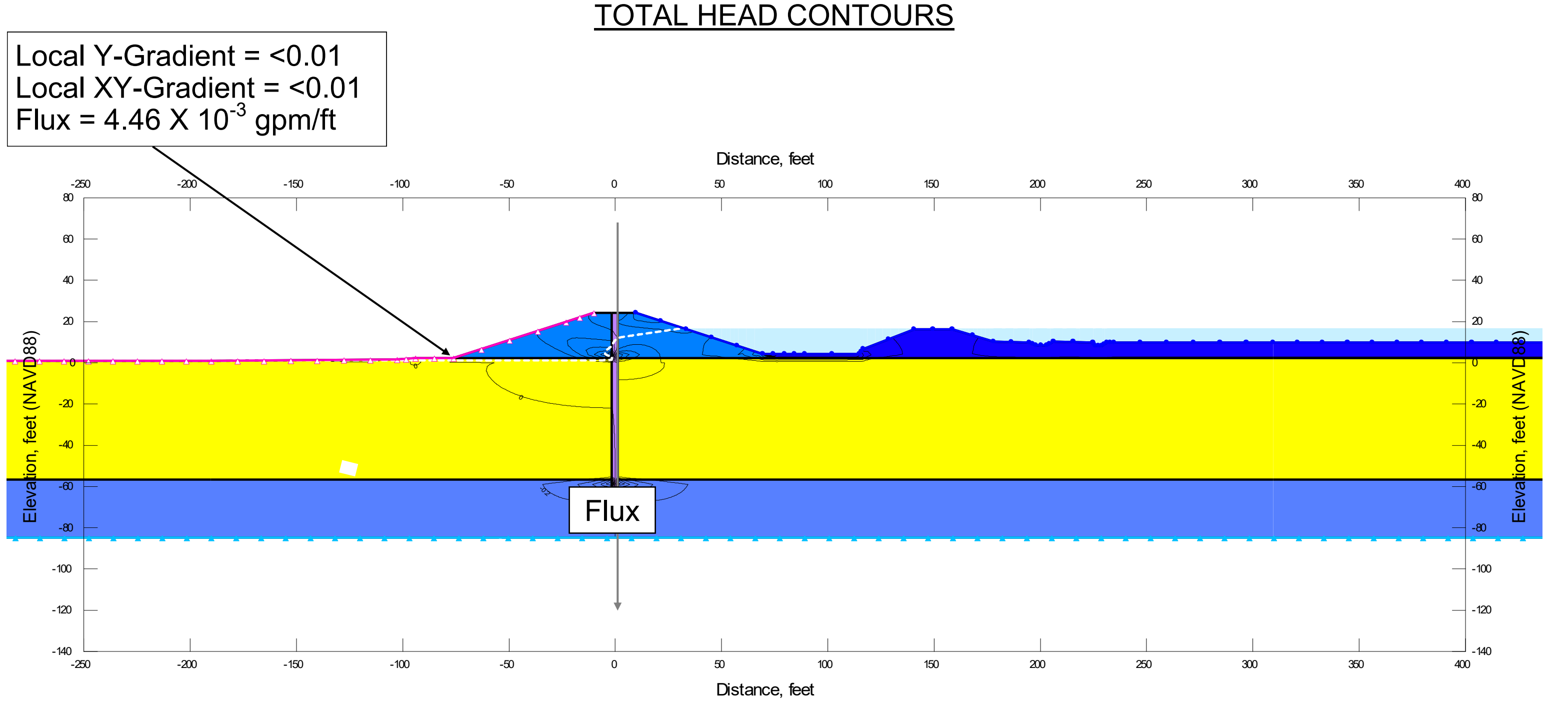
Water Surface Elevation: 19.2 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

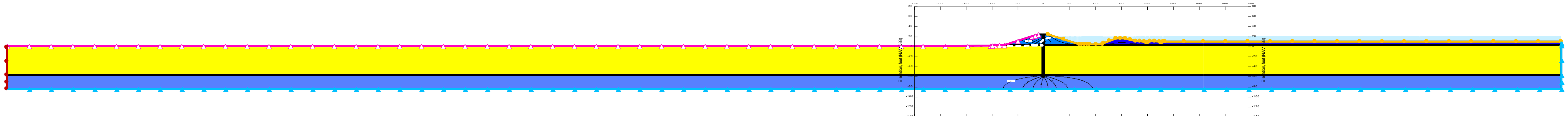


VERTICAL GRADIENT CONTOURS

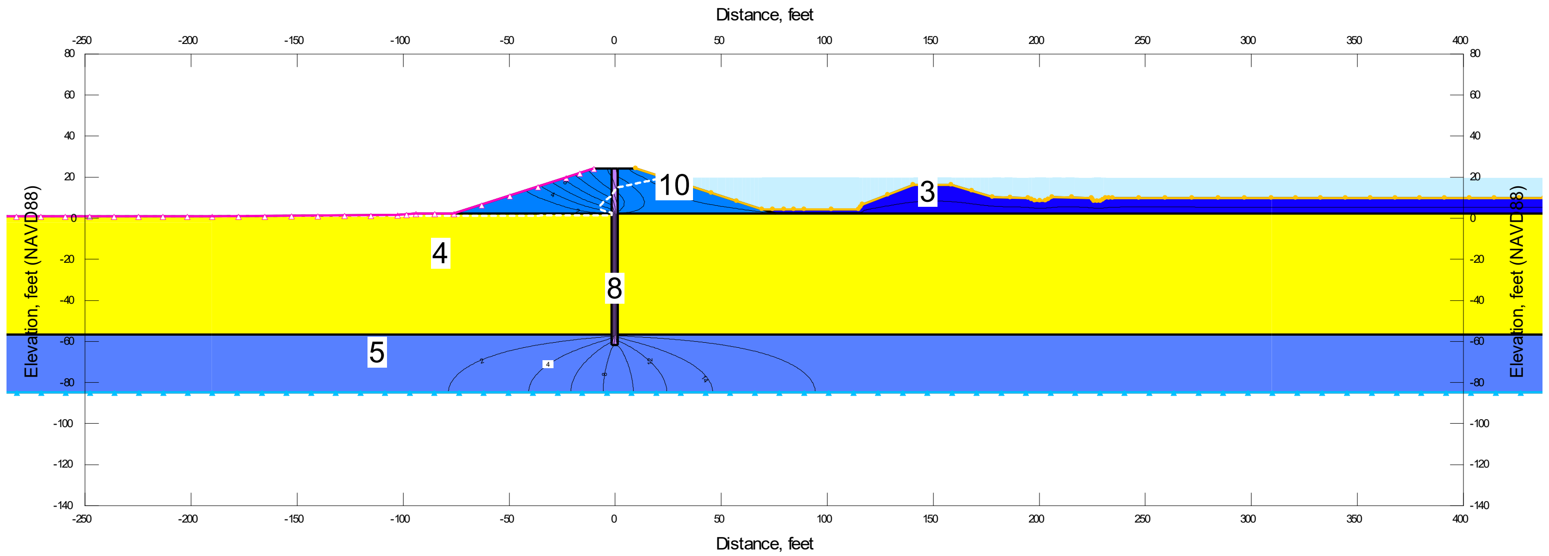
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	4.0×10^{-5}	4
	Unit 2: Organic Soil	4.0×10^{-6}	1
	Unit 3: Clay Blanket	1.0×10^{-6}	1
	Unit 4: Sand (Upper)	5.4×10^{-3}	9
	Unit 5: Clay	4.0×10^{-6}	4
	Unit 6: Sand (Lower)	5.4×10^{-3}	9
	Unit 7: Deep Clay	4.0×10^{-6}	4
	Unit 8: Cutoff Wall	1.0×10^{-6}	1
	Unit 9: Clay Cap	4.0×10^{-6}	4
	Unit 10: Levee Fill (N)	4.0×10^{-6}	4
	Unit 11: Drain Rock	1.0×10^{1}	10
	Unit 12: Sand Levee Fill (E)	9.0×10^{-4}	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 83+00** **Rehabilitated Levee with Cutoff Wall (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-57

Water Surface Elevation: 16.4 feet

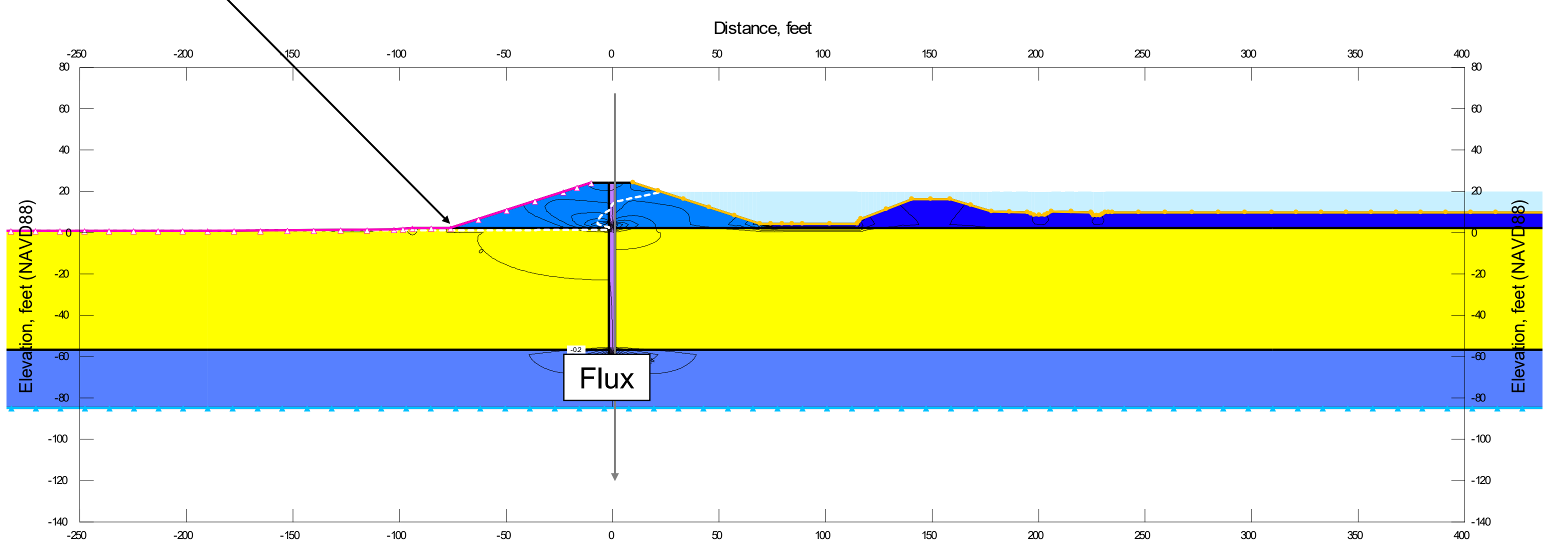


SEEP/W MODEL



TOTAL HEAD CONTOURS

Local Y-Gradient = <0.01
Local XY-Gradient = <0.01
Flux = 5.34 X 10^{-3} gpm/ft



VERTICAL GRADIENT CONTOURS

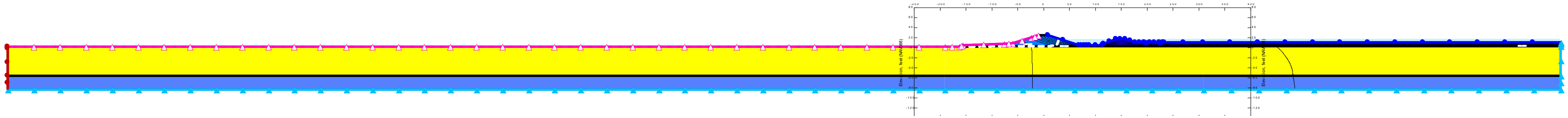
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project
Solano County, California

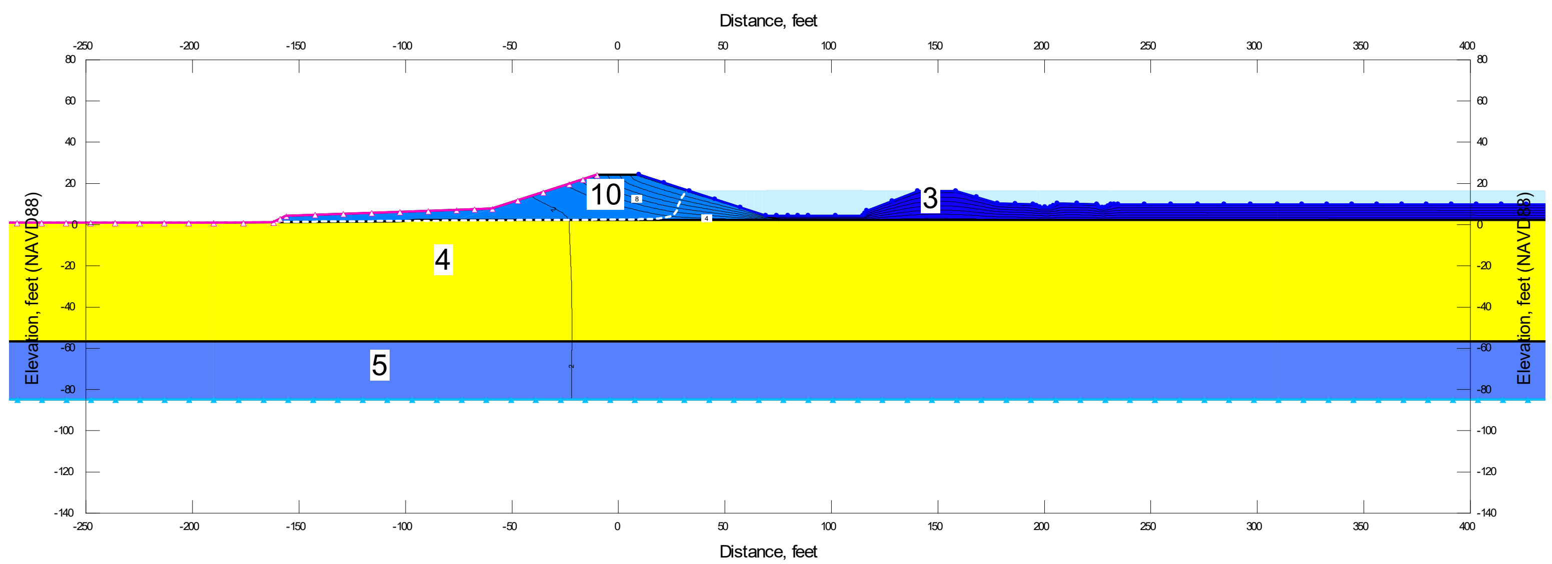
Seepage Analysis
Mellin - Station 83+00
Rehabilitated Levee with Cutoff Wall (HTOL)

Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. E-58

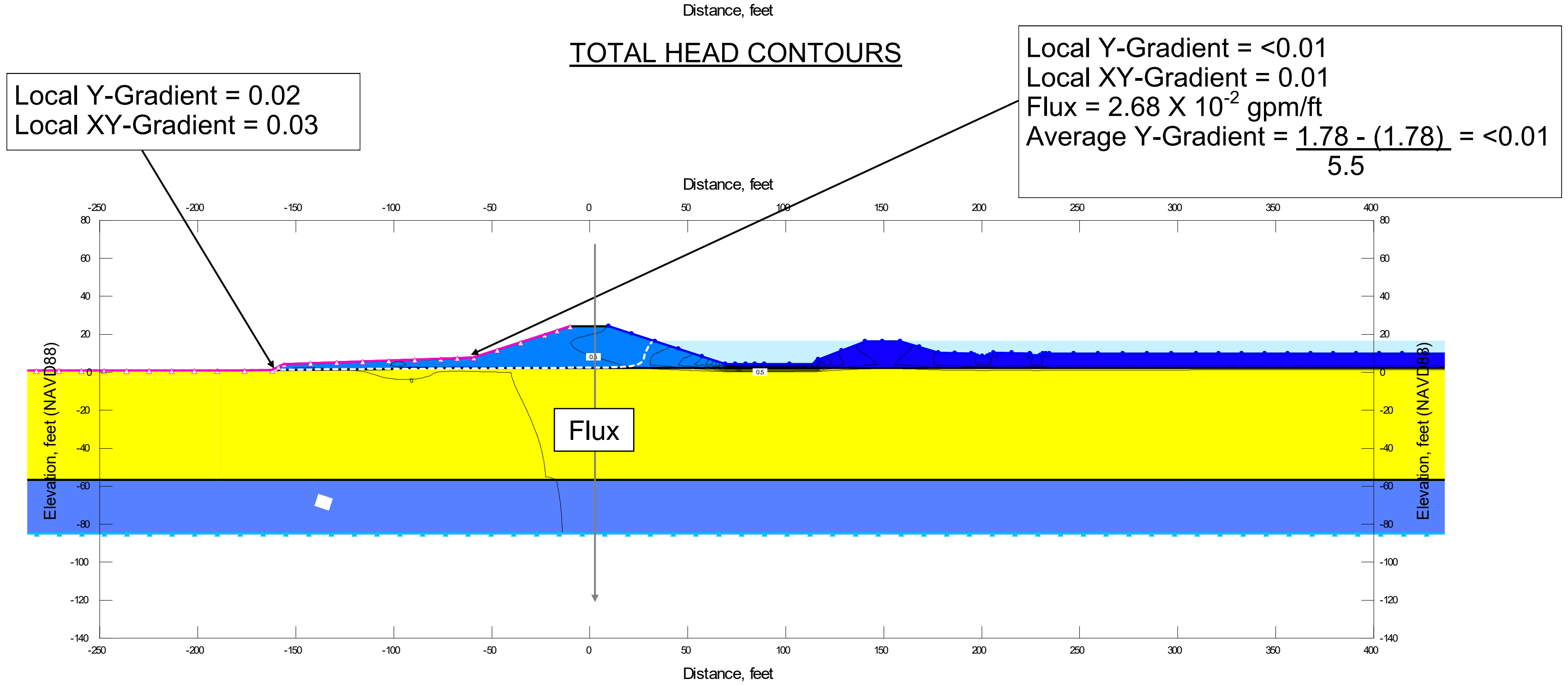
Water Surface Elevation: 16.4 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS

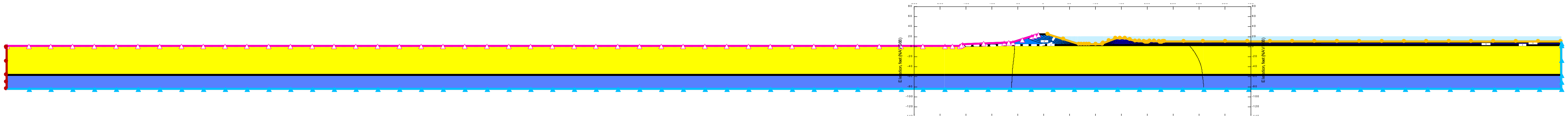


VERTICAL GRADIENT CONTOURS

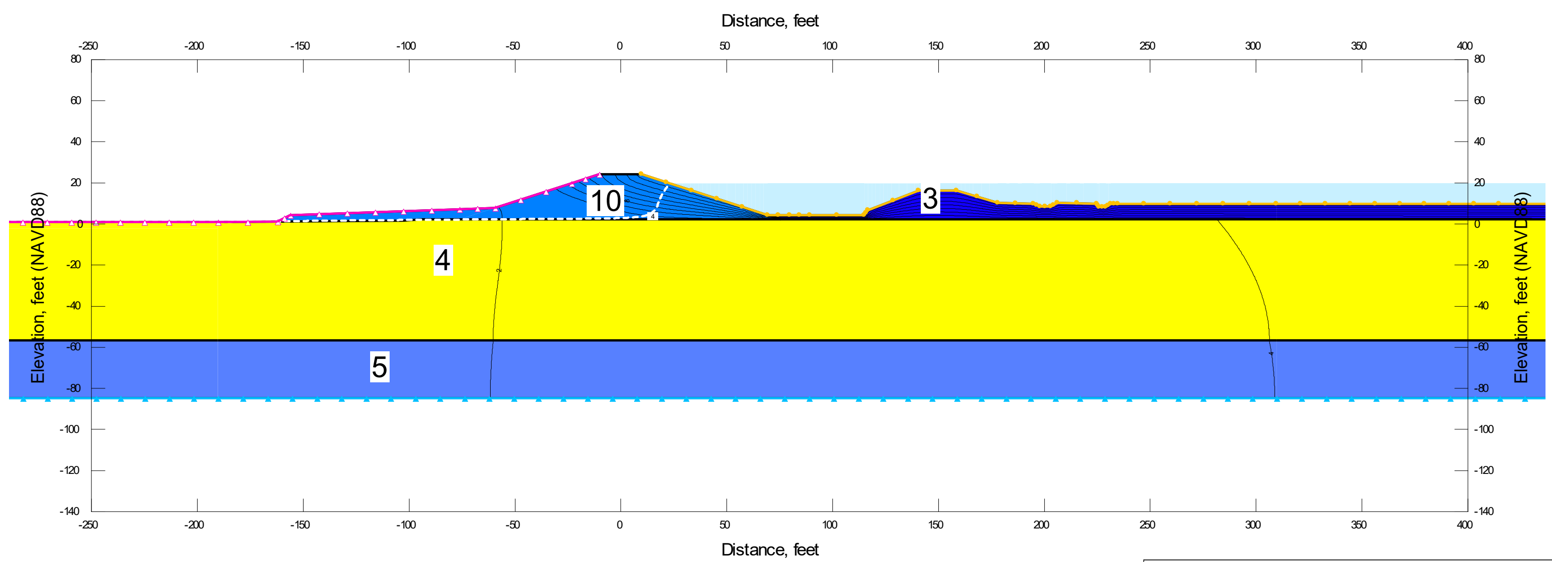
SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 83+00** **Rehabilitated Levee with Seepage Berm (DWSE)**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. E-59

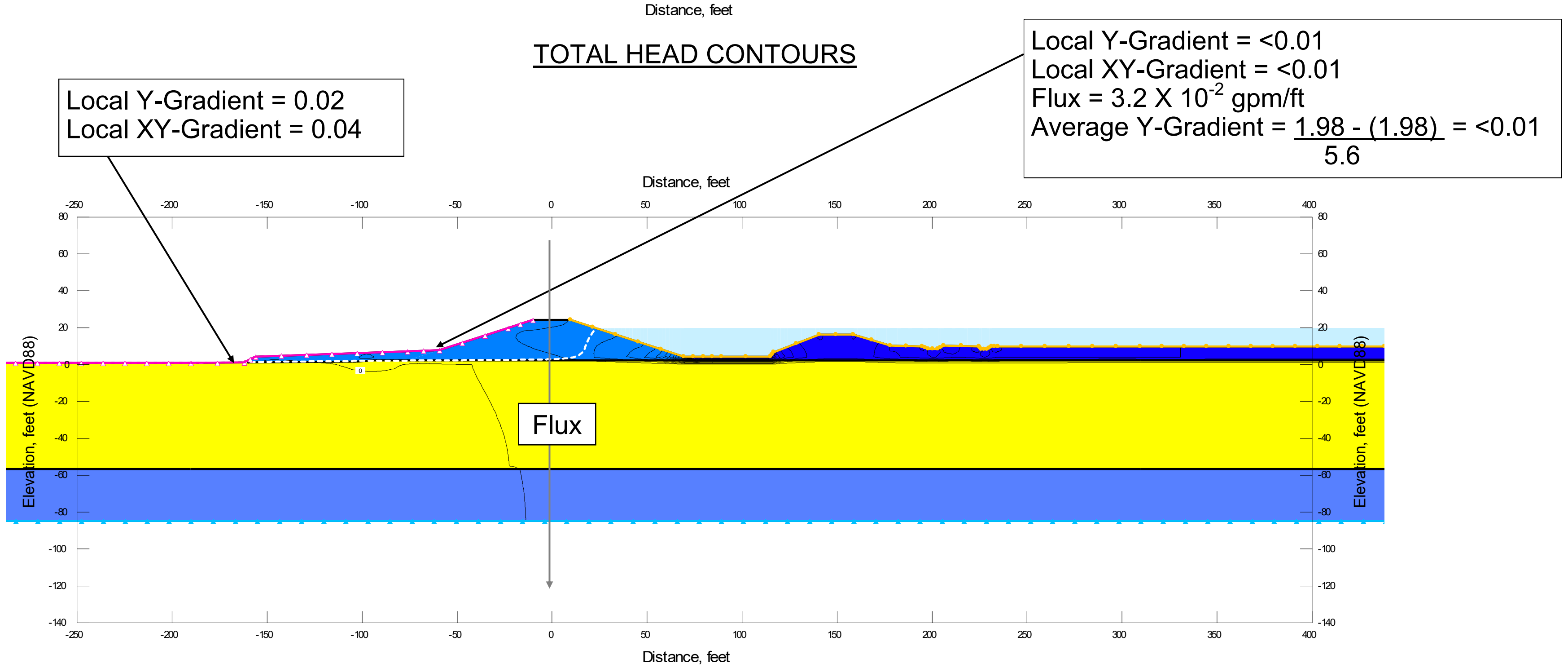
Water Surface Elevation: 19.2 feet



SEEP/W MODEL



TOTAL HEAD CONTOURS



VERTICAL GRADIENT CONTOURS

SEEPAGE MODEL MATERIAL PROPERTIES			
LAYER COLOR	MATERIAL TYPE	HORIZONTAL CONDUCTIVITY, k_H (cm/s)	HORIZ./VERT. CONDUCTIVITY RATIO, k_H/k_V
	Unit 1: Levee Fill (E)	$4.0x10^{-5}$	4
	Unit 2: Organic Soil	$4.0x10^{-6}$	1
	Unit 3: Clay Blanket	$1.0x10^{-6}$	1
	Unit 4: Sand (Upper)	$5.4x10^{-3}$	9
	Unit 5: Clay	$4.0x10^{-6}$	4
	Unit 6: Sand (Lower)	$5.4x10^{-3}$	9
	Unit 7: Deep Clay	$4.0x10^{-6}$	4
	Unit 8: Cutoff Wall	$1.0x10^{-6}$	1
	Unit 9: Clay Cap	$4.0x10^{-6}$	4
	Unit 10: Levee Fill (N)	$4.0x10^{-6}$	4
	Unit 11: Drain Rock	$1.0x10^{1}$	10
	Unit 12: Sand Levee Fill (E)	$9.0x10^{-4}$	9

Little Egbert Multi-Benefit Project Solano County, California	**Seepage Analysis** **Mellin - Station 83+00** **Rehabilitated Levee with Seepage Berm (HTOL)**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. E-60

Appendix F

Slope Stability Analysis

CONTENTS

Plates

APPENDIX F: SLOPE STABILITY ANALYSIS

APPENDIX F
Slope Stability Analysis

F-1 SLOPE STABILITY ANALYSIS

F-1.1 General

We performed analysis to check the factors of safety for the landside and waterside slopes for steady state seepage and rapid drawdown loading conditions before and after the levee rehabilitation. We also analyzed the factor of safety for the landside and waterside slopes for the end-of-construction condition. The stability analysis was performed on the same cross sections that were analyzed for seepage. We used the computer program SLOPE/W and Spencer's method of analysis. We presented the parameters we used in the slope stability analysis in Appendix D. We used effective stress strength parameters for analyzing the factors of safety under steady-state seepage conditions. We analyzed the stability of the landslide slope for steady state seepage conditions for the DWSE and HTOL by importing pore water pressures calculated in the seepage analysis. We analyzed the stability of the waterside slope for steady state seepage conditions by assuming a phreatic surface in the levee corresponding to a water level at the mean tide level. For the rapid drawdown analysis, we used the feature in SLOPE/W that used the Staged Rapid Drawdown Analysis option based on the Duncan et al., 1990 procedure and both the effective stress and undrained strength envelopes. For the end-of-construction analysis we used undrained strength parameters. We modeled a 5-foot tension crack in the levee fill for the end-of-construction case.

The results of our slope stability analysis are summarized in Tables F-1 and F-2 and presented on Plates F-1 through F-71. The factors of safety meet the required factor of safety criteria described in the Basis of Design section of this report.

Table F-1 – Factors of Safety for Landside Slopes

Levee	Station	Existing Levee		Rehabilitated Levee		
				End of Construction	Effective Strength	
		DWSE	HTOL	Undrained Strength	DWSE	HTOL
RD 536	35+00	1.97	1.78	2.38	2.15	2.00
	65+00	1.39	1.28	1.97	1.51	1.42
	95+00	1.70	1.54	3.09	1.85	1.71
	135+00	2.19	1.95	5.78	2.37	2.19
	175+00	1.67	1.51	4.47	1.81	1.68
Mellin	6+00	2.96	2.88	5.50	2.26	2.16
	21+00	2.13	2.13	1.61	2.00	1.93
Mellin Extension	41+00	3.23	3.34	7.40	2.08	1.98
Solano County Levee 44	66+00	2.02	1.86	7.29	2.79	2.63
	83+00	2.50	2.48	3.61	2.39	2.39

Table F-2 – Factors of Safety for Waterside Slopes

Levee	Station	Existing Levee		Rehabilitated Levee		
				End of Construction	Effective Strength	
		MTL	Rapid Drawdown	Undrained Strength	Average Tide Level	Rapid Drawdown
RD 536	35+00	2.96	1.98	1.72	1.97	1.46
	65+00	2.41	1.56	2.21	2.06	1.47
	95+00	2.48	1.57	2.75	2.14	1.50
	135+00	2.25	1.44	4.19	2.40	1.62
	175+00	2.71	1.66	4.72	2.34	1.66
Mellin	6+00	3.43	2.48	5.95	2.76	1.90
	21+00	2.80	1.95	1.46	2.17	1.50
Mellin Extension	41+00	4.06	2.90	6.69	2.79	1.87
Solano County Levee 44	66+00	3.44	3.02	5.86	2.95	2.17
	83+00	2.94	2.31	4.12	2.37	1.78

F-1.2 Pseudo-Static Loading and Seismic Deformation

We performed a pseudo-static slope stability analysis for the existing levee and the rehabilitated levee for both landside and waterside slopes. We used the feature in

SLOPE/W that used the Staged Pseudo-Static Analysis option based on the Duncan et al., 1990 procedure and both the effective stress and undrained strength envelopes. The pseudo-static analysis applies a horizontal force at the center of gravity to model an earthquake force. The yield coefficient is the value of the force resulting in a factor of safety of 1.0. The analysis assumes that materials do not lose strength during earthquake shaking. Table F-3 presents the yield coefficients (K_y).

We analyzed seismic deformation using the simplified procedure presented in the Guidance Document (2015). The analysis is based on an earthquake with a 200-year return period and moment magnitude of 7.0. We estimate that peak horizontal acceleration (PHA) along these levee reaches is 0.23g. Deformations can be estimated based on the ratio of the yield acceleration (K_y) to the maximum seismic coefficient (K_{max}). We estimate that K_{max} is 0.16, based on site location and levee geometry for landside and waterside slopes. The K_y/K_{max} ratio is greater than 0.5 for the landside and waterside slopes for all stations analyzed. If the K_y/K_{max} ratio is greater than 0.5 then "minimal or negligible seismic displacements are anticipated" (URS Guidance Document, 2015). The results of the analysis indicate that the slopes will experience minor slope deformation of likely less than 0.1 ft of deformation under the design level earthquake.

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

Levee	Station	Existing Levee		Rehabilitated Levee	
		Landside	Waterside	Landside	Waterside
		Undrained Strength		Undrained Strength	
RD 536	35+00	0.29	0.30	0.20	0.20
	65+00	0.30	0.30	0.19	0.23
	95+00	0.38	0.38	0.26	0.26
	135+00	0.46	0.40	0.40	0.33
	175+00	0.42	0.43	0.28	0.30
Mellin	6+00	0.34	0.34	0.30	0.30
	21+00	0.28	0.28	0.25	0.23
Mellin Extension	41+00	0.44	0.38	0.40	0.36
Solano County Levee 44	66+00	0.52	0.48	0.46	0.42
	83+00	0.45	0.45	0.35	0.35

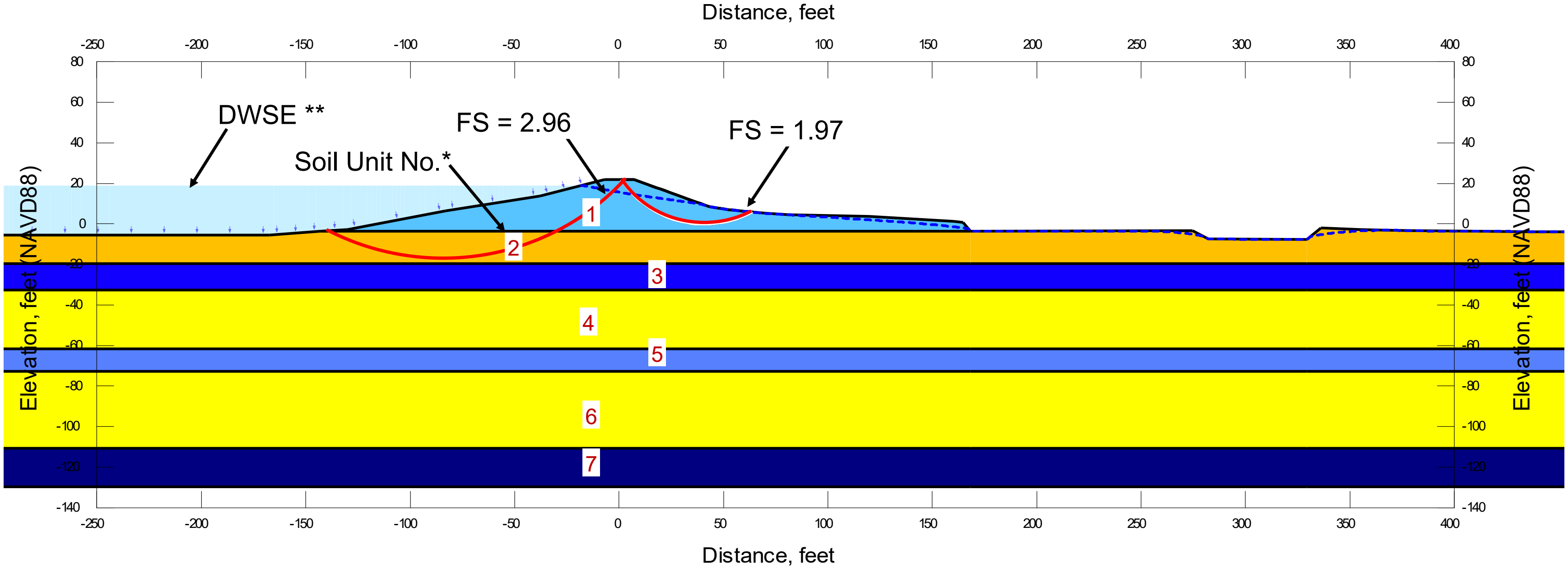
STABILITY MODEL MATERIAL PROPERTIES									
UNIT NO.	LAYER COLOR	MATERIAL TYPE	UNIT WEIGHT (pcf)	EFFECTIVE STRENGTH		UNDRAINED STRENGTH		END OF CONSTRUCTION	
				COHESION (psf)	FRICTION ANGLE (degrees)	COHESION (psf)	FRICTION ANGLE (degrees)	COHESION (psf)	FRICTION ANGLE (degrees)
1		Clay Levee Fill (E)	100	100	32	140	19	1,800	0
2		Organic Soil	95	100	32	140	19	See Note Below	0
3		Clay Blanket	125	100	32	140	19	2,500	0
4		Sand (Upper)	125	0	36	--	--	--	--
5		Clay	125	100	32	140	19	2,500	0
6		Sand (Lower)	125	0	40	--	--	--	--
7		Deep Clay	125	100	32	140	19	2,500	0
8		Cutoff Wall	120	50	30	--	--	--	--
9		Clay Cap	120	150	32	--	--	--	--
10		Clay Levee Fill (N)	125	100	32	140	19	1,800	--
11		Drain Rock	135	0	40	--	--	--	--
12		Sand Levee Fill (E)	125	50	36	--	--	--	--

Note: For the End of Construction case, we modeled the undrained shear strength of the organic soil assuming that the soils were normally consolidated with a ratio of undrained shear strength (S_u) to preconsolidation stress (p) of 0.3 (i.e., S_u/p=0.3). For organic soils outside of the levee footprint, we modeled a 5-foot thick soil crust with an undrained shear strength of 1,000 psf. Below the 5-foot thick crust, we modeled the organic soils as normally consolidate with the S_u/p ratio described above.

Little Egbert Multi-Benefit Project
Solano County, California

Soil Parameters for Slope Stability Analysis

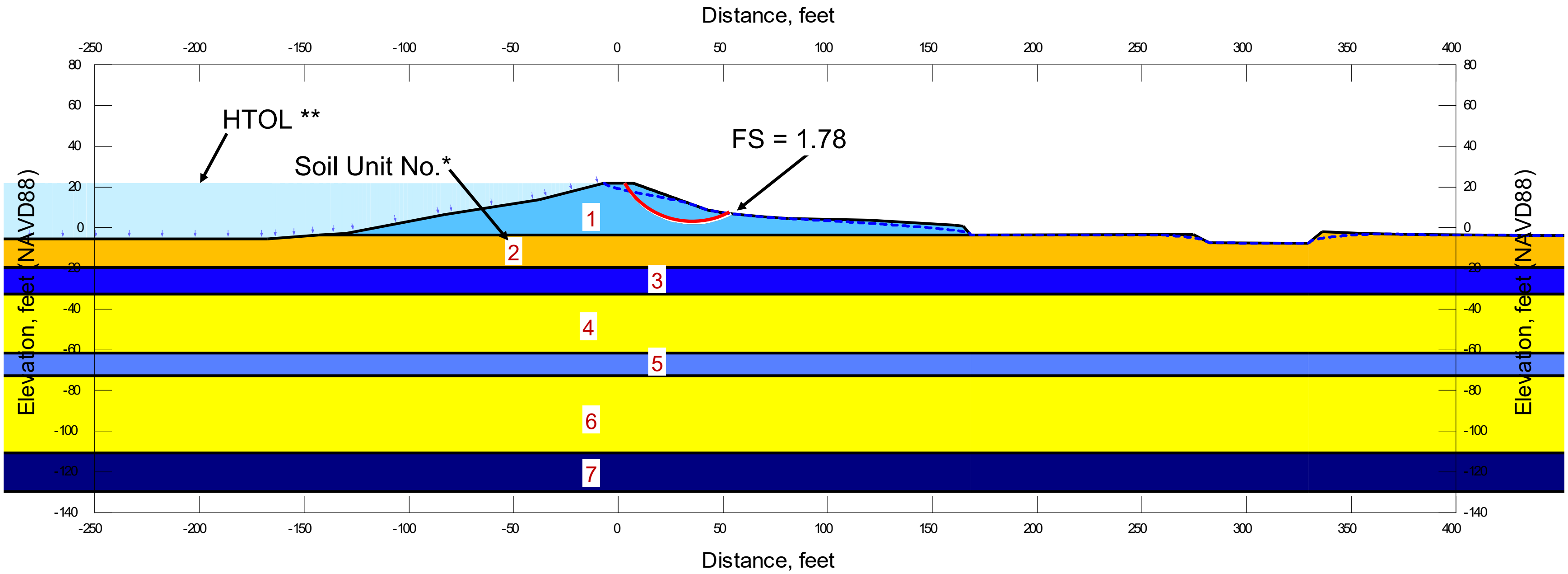
Shannon & Wilson, Inc. | Project No. 907.03 | Plate No. F-1



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 35+00** **Existing Levee - DWSE / MTL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-2

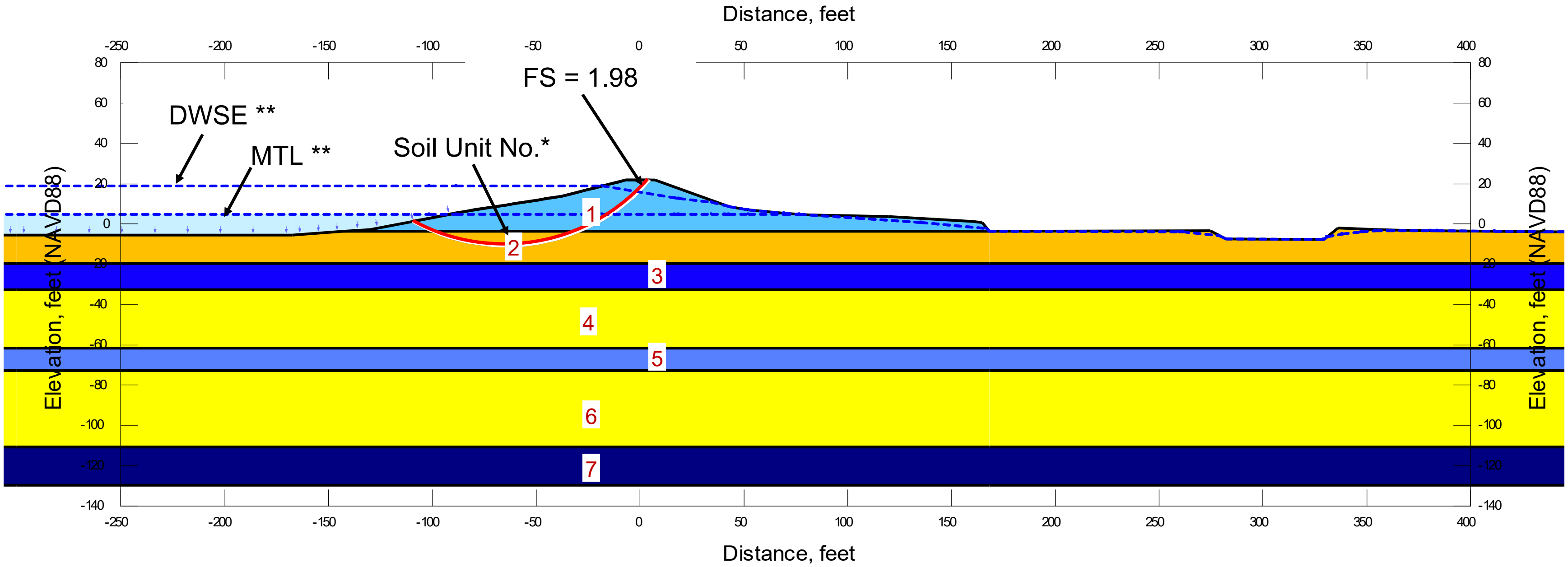


* See Plate F-1 for material (soil unit) properties of stability model

** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

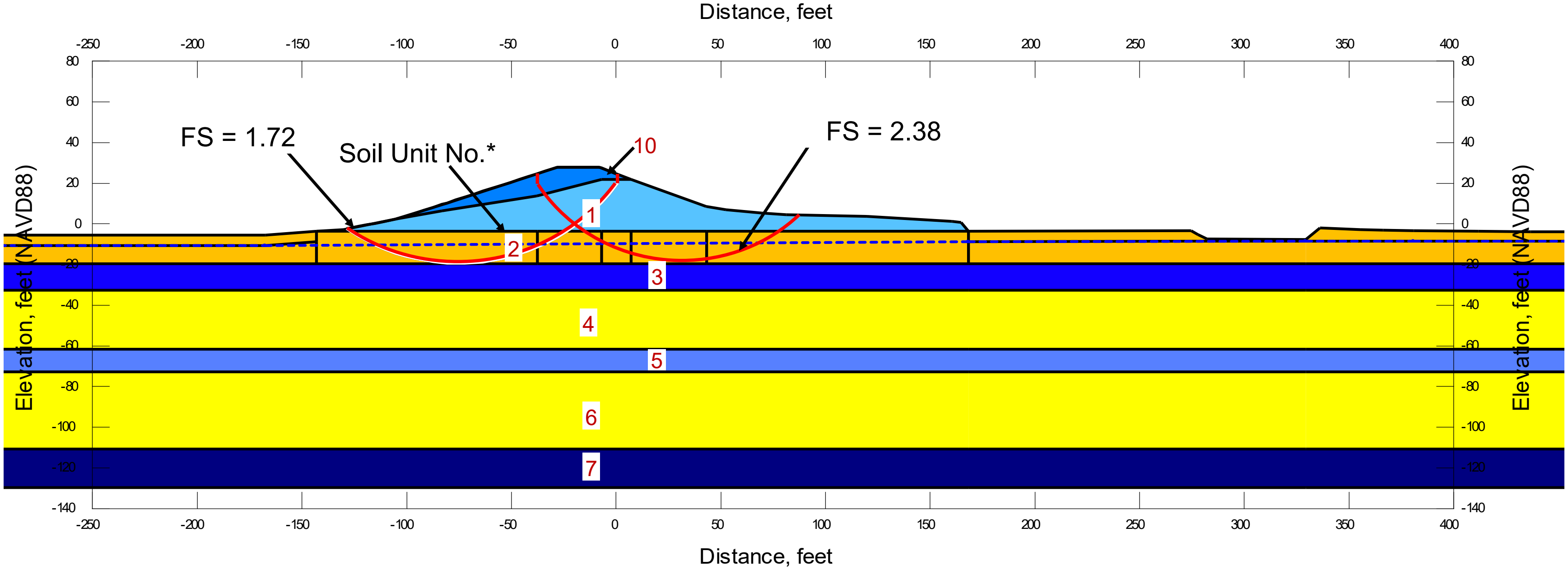
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 35+00** **Existing Levee - HTOL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-3



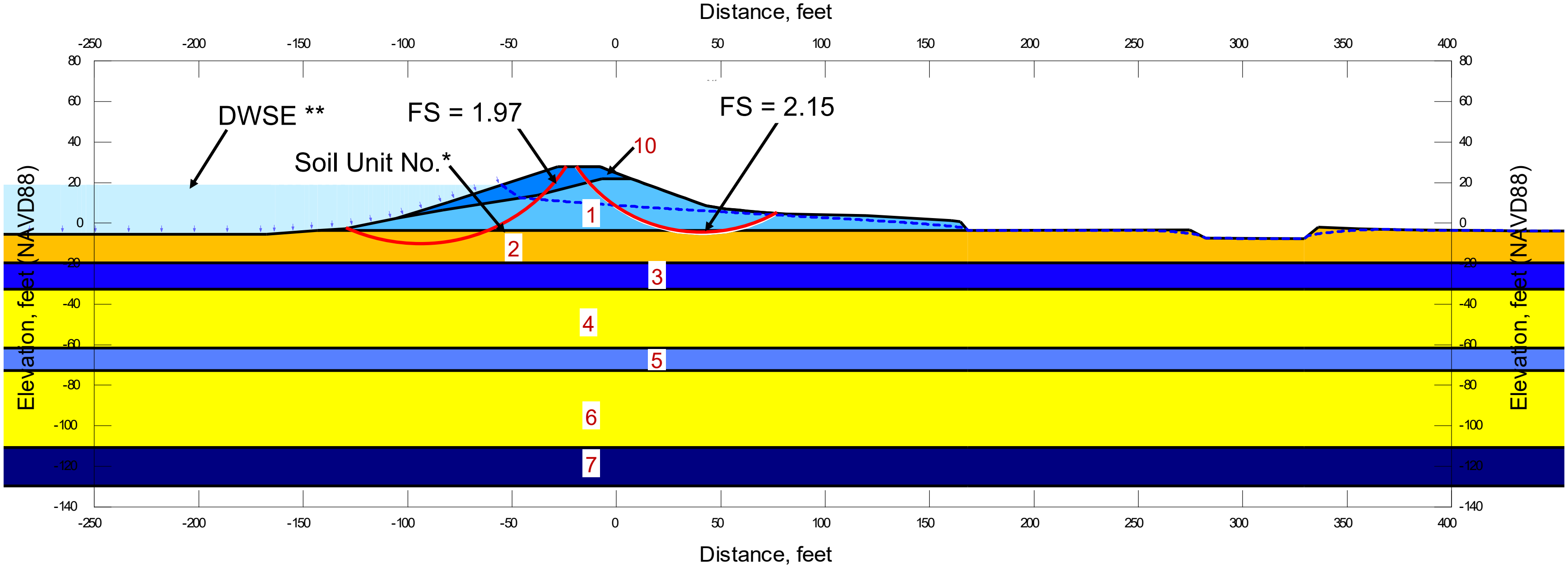
* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 35+00** **Existing Levee**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. F-4



* See Plate F-1 for material (soil unit) properties of stability model
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

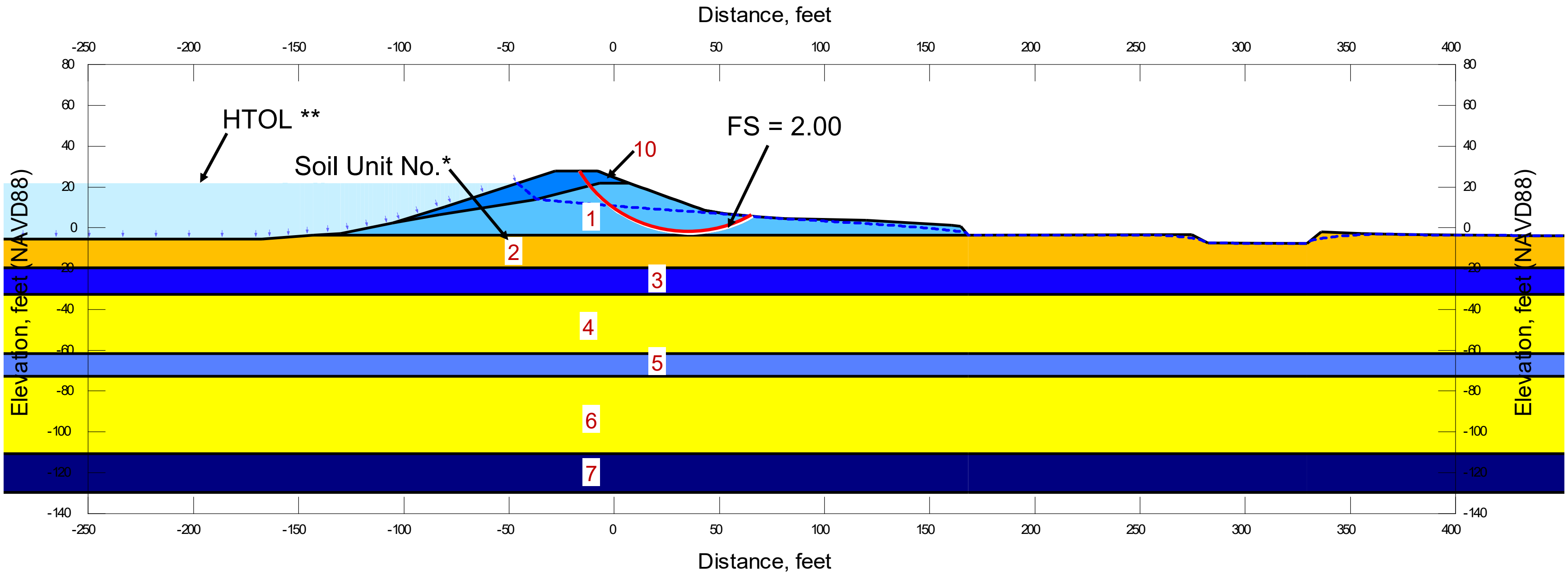
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction RD 536 - Station 35+00 Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-5



*   See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage RD 536 - Station 35+00 Rehabilitated Levee - DWSE / MTL**

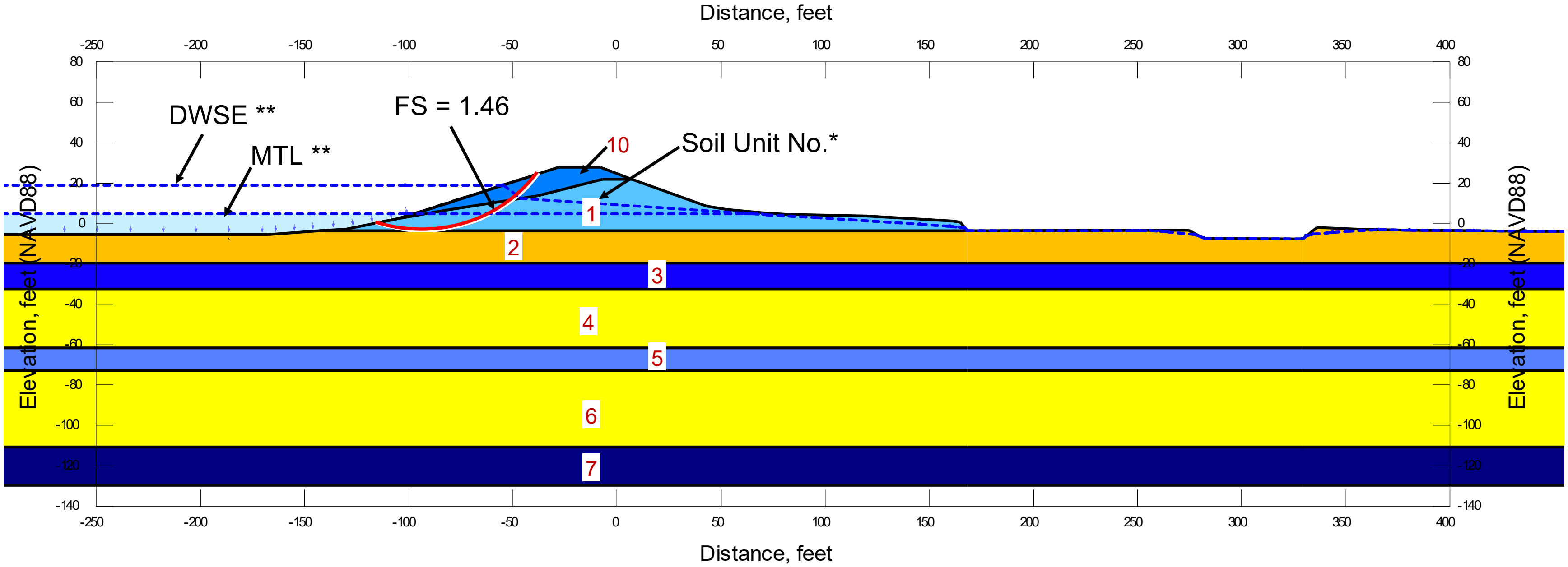
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-6



* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 35+00** **Rehabilitated Levee - HTOL**

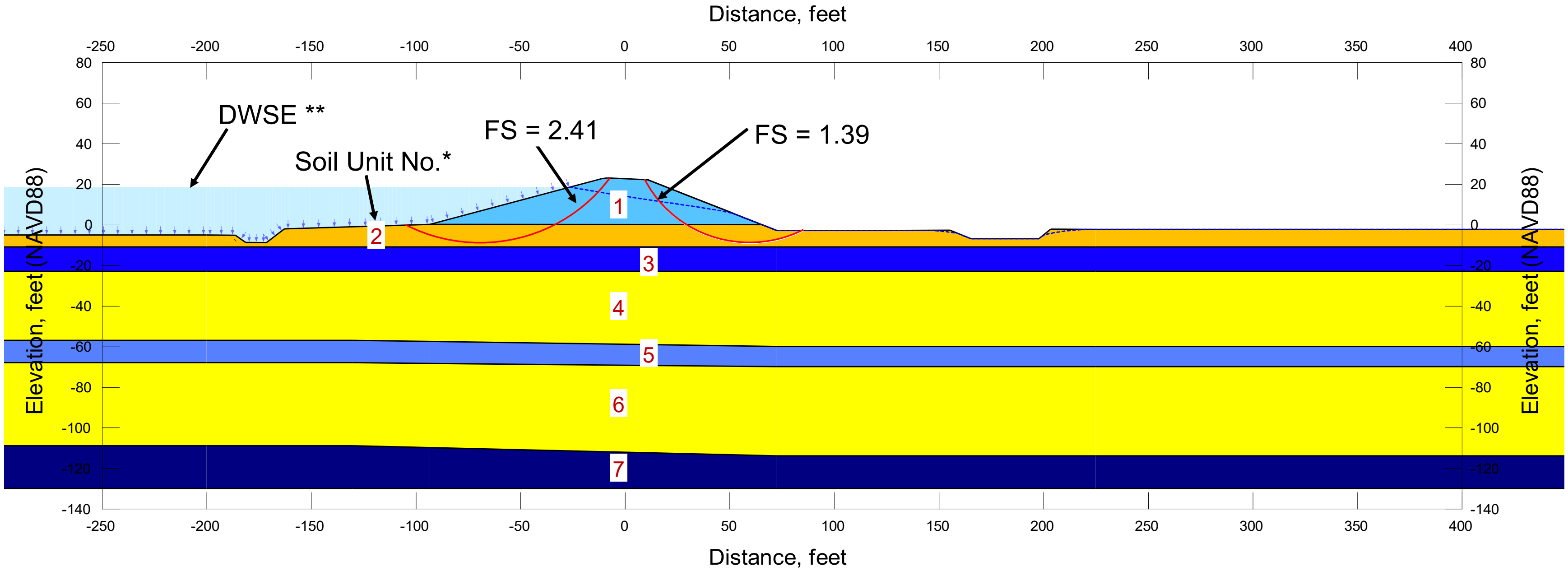
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-7



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 35+00** **Rehabilitated Levee**

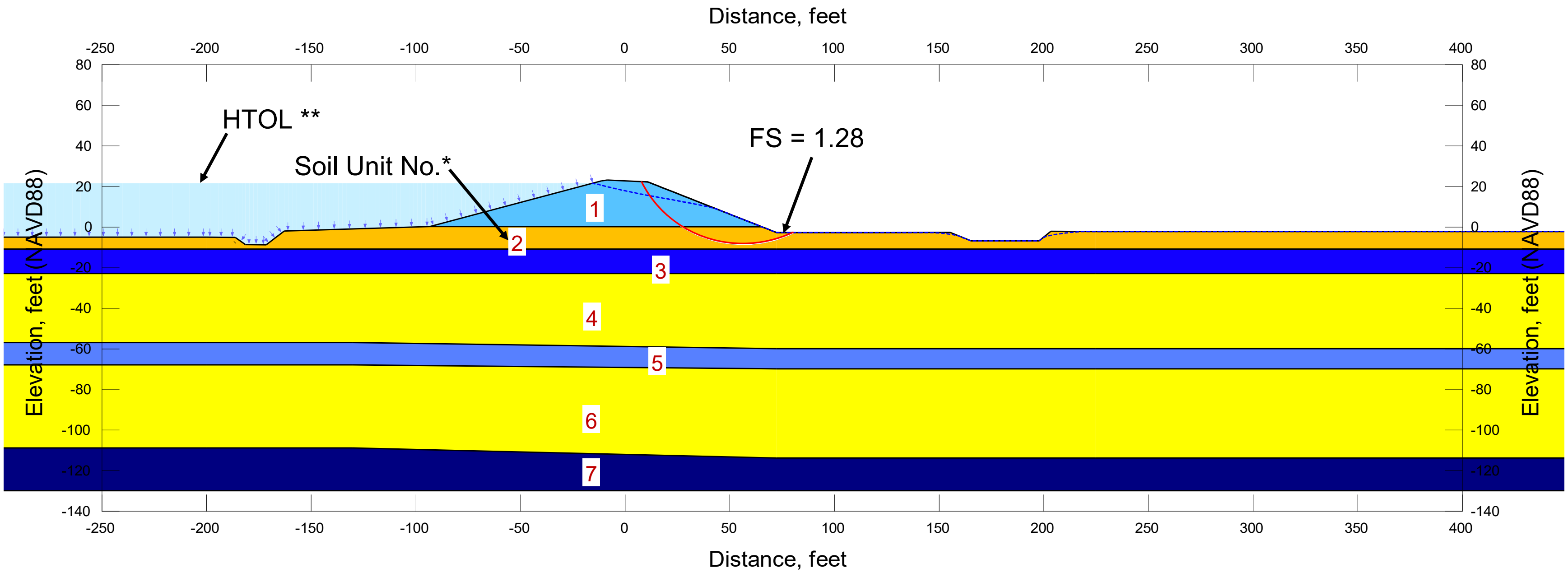
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-8



* See Plate F-1 for material (soil unit) properties of stability model

** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage RD 536 - Station 65+00 Existing Levee - DWSE / MTL**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. F-9

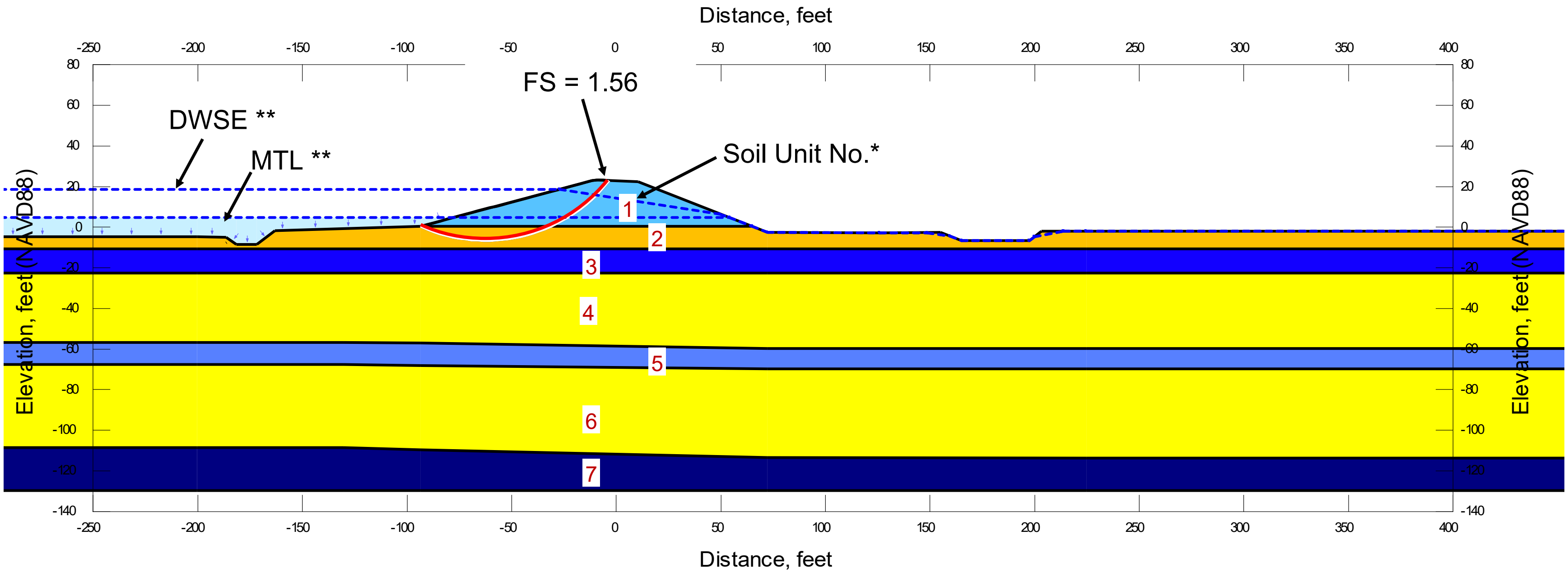


* See Plate F-1 for material (soil unit) properties of stability model

** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

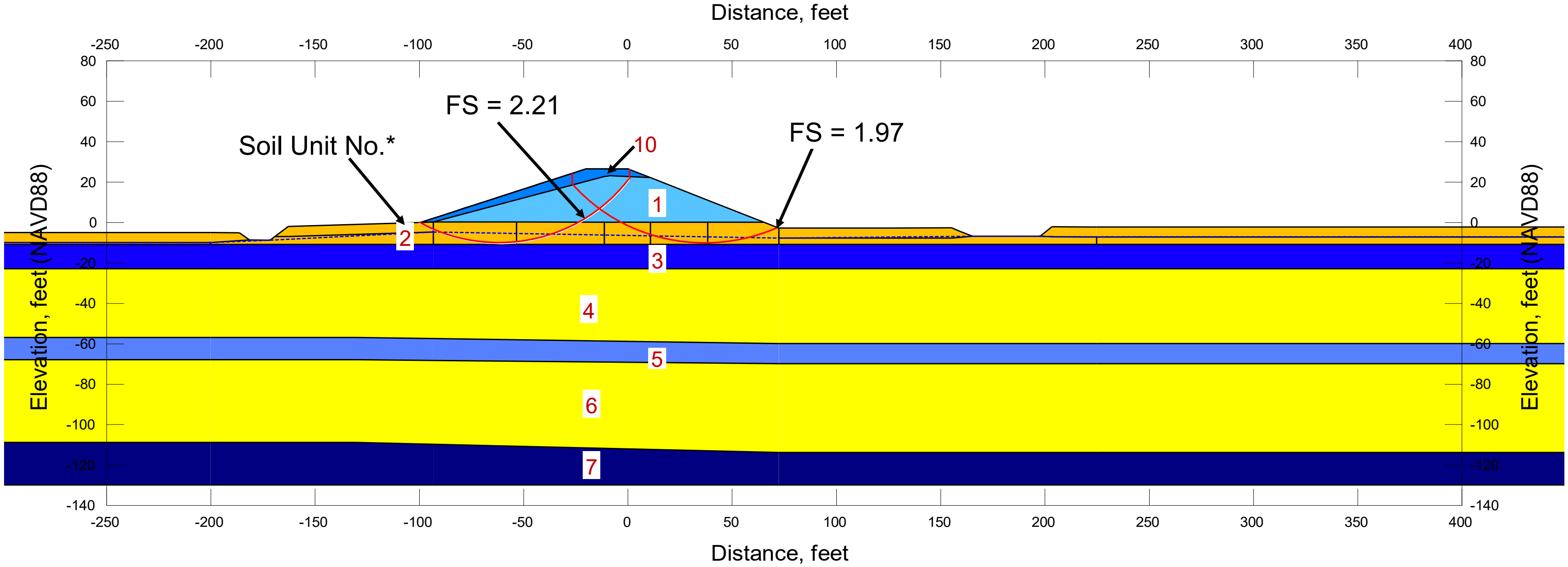
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 65+00** **Existing Levee - HTOL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-10



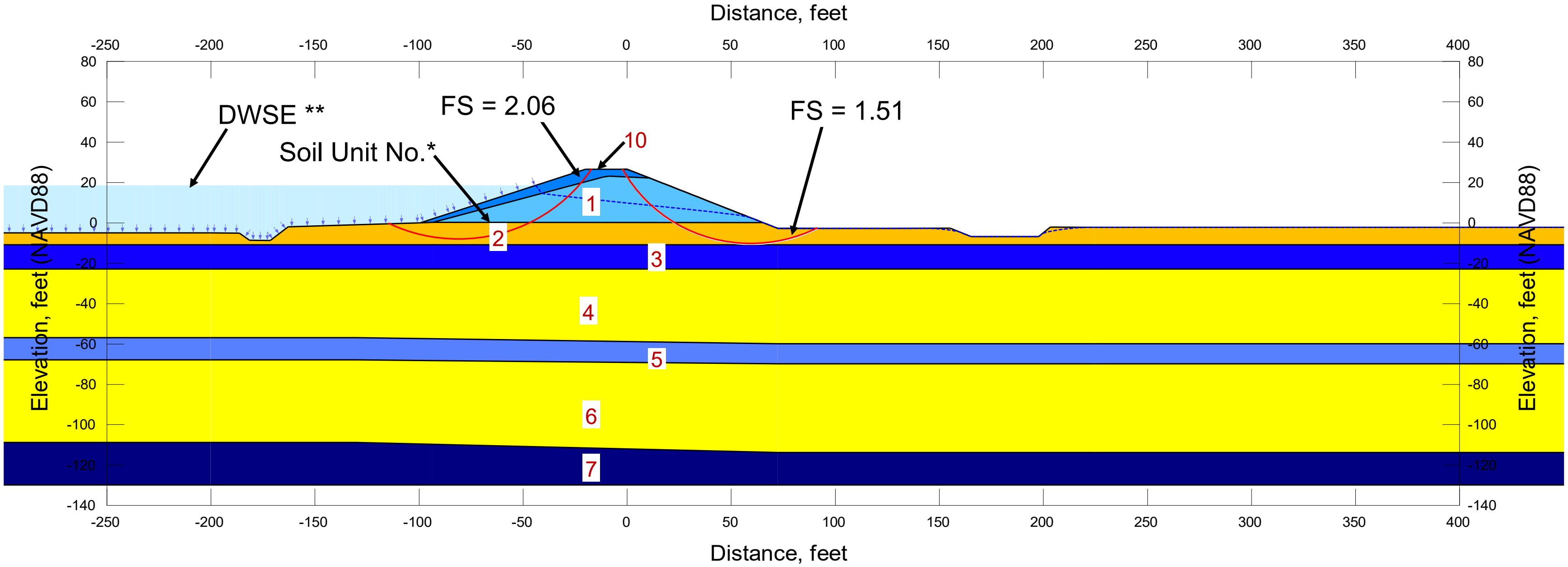
*   See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 65+00** **Existing Levee**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-11



*   See Plate F-1 for material (soil unit) properties of stability model
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

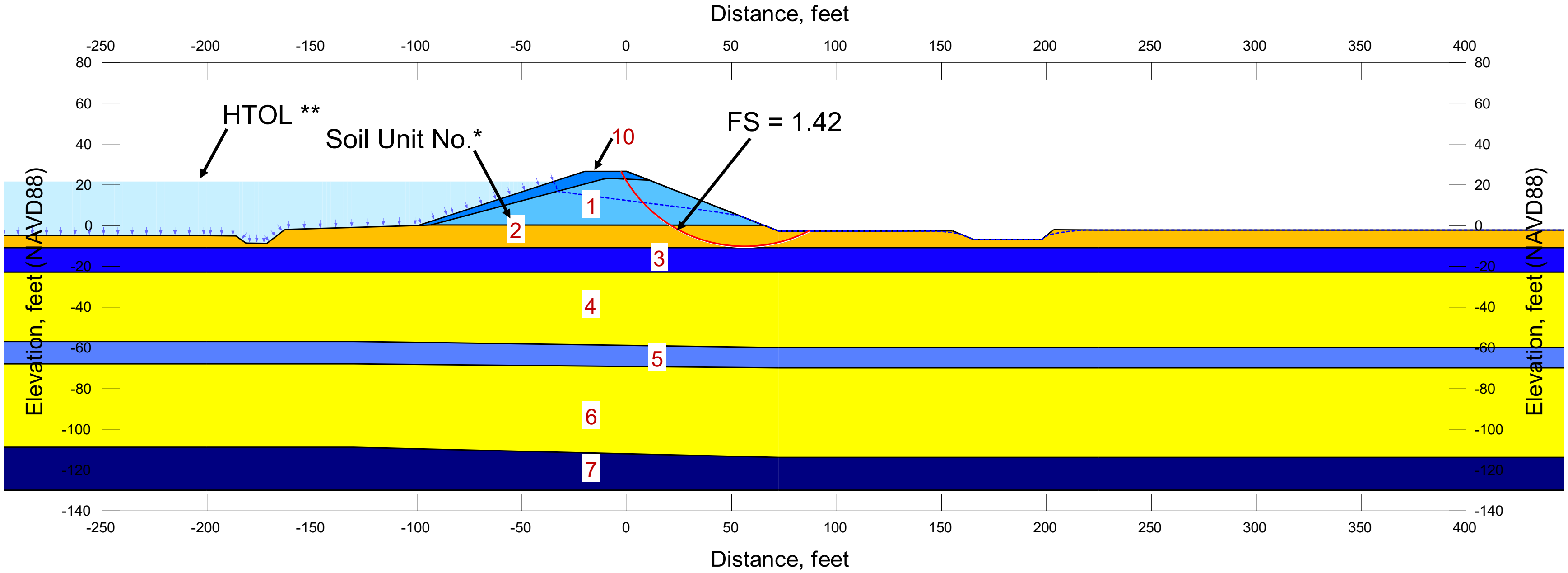
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction** **RD 536 - Station 65+00**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-12



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

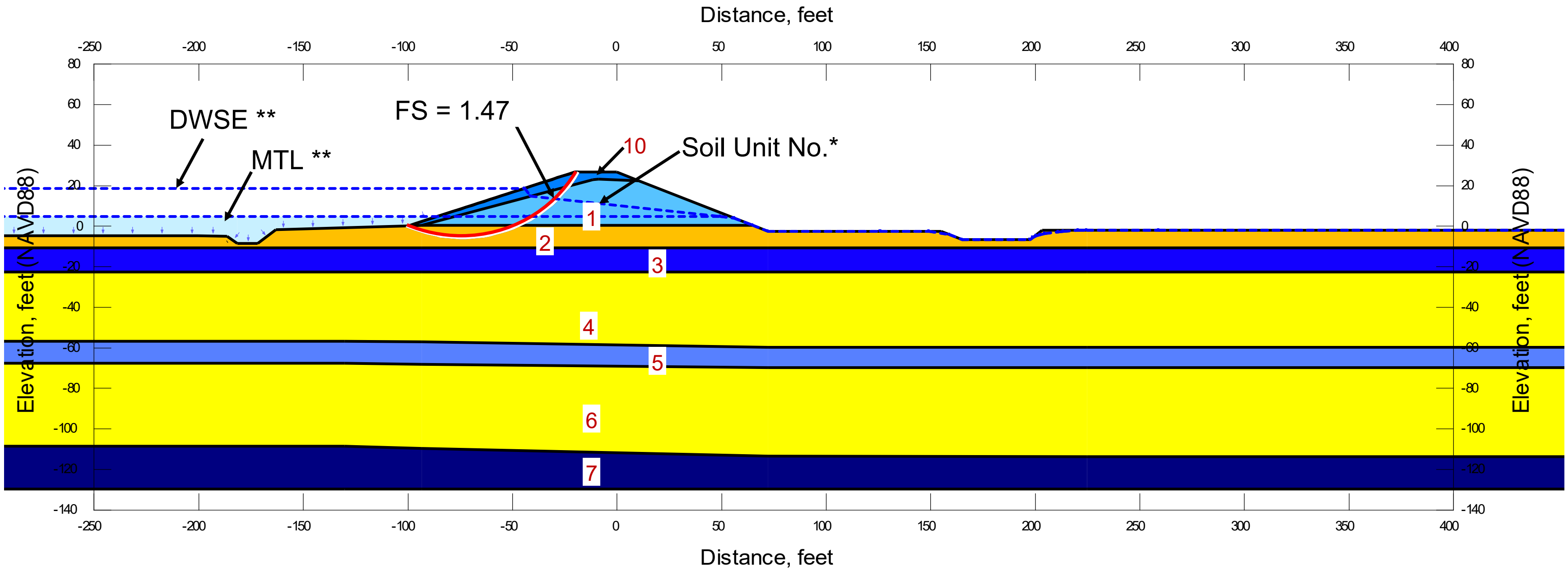
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 65+00** **Rehabilitated Levee - DWSE / MTL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-13



* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

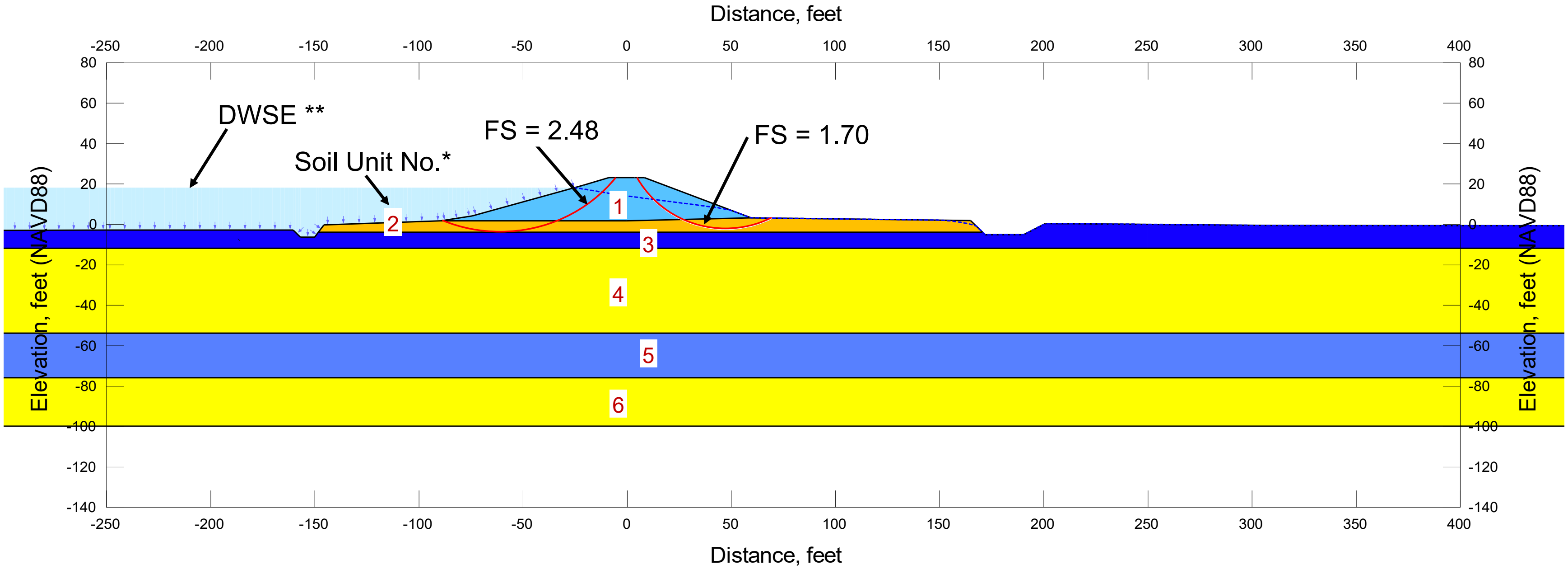
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 65+00** **Rehabilitated Levee - HTOL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-14



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 65+00** **Rehabilitated Levee**

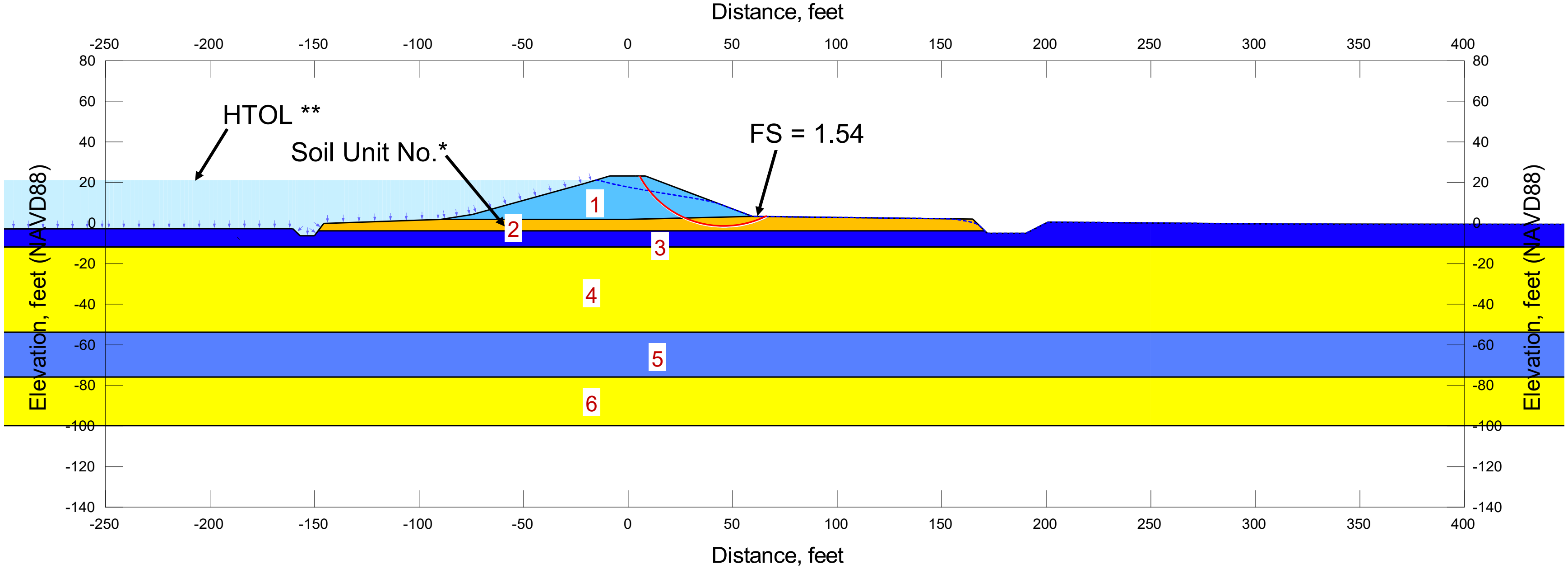
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-15



*   See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

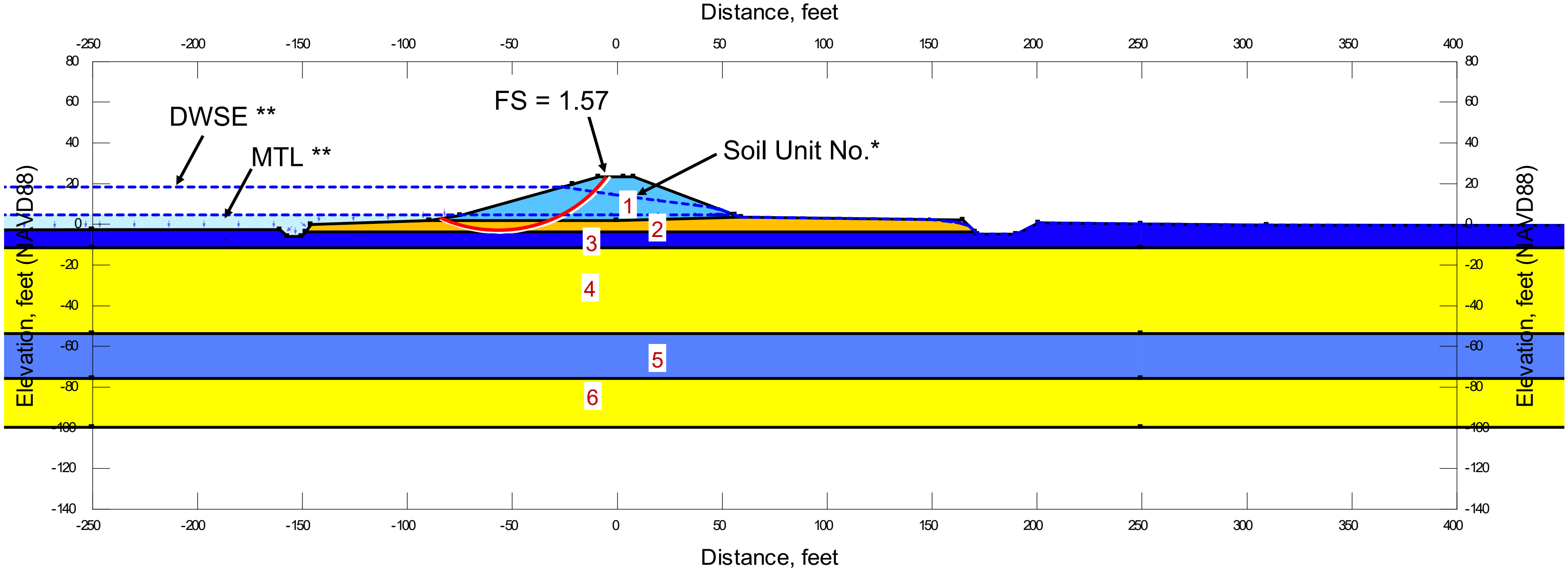
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 95+00** **Existing Levee - DWSE / MTL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-16



*   See Plate F-1 for material (soil unit) properties of stability model
**   Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

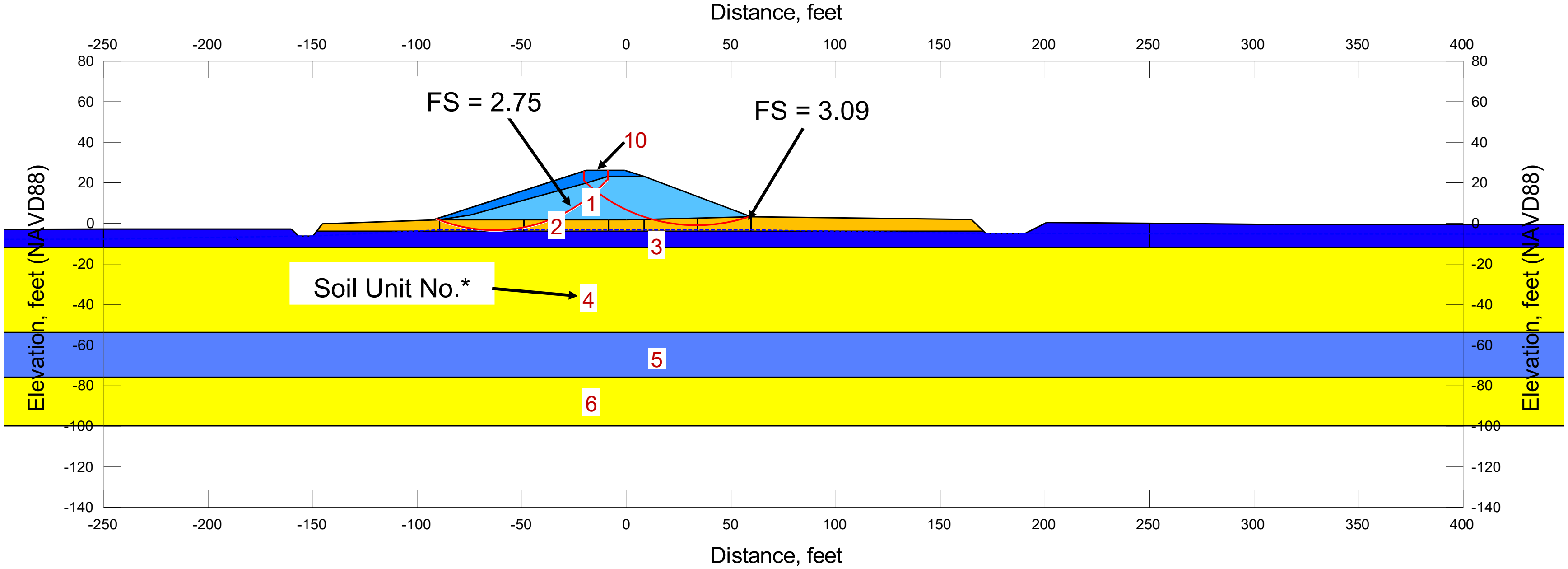
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 95+00** **Existing Levee - HTOL**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-17



* See Plate F-1 for material (soil unit) properties of stability model

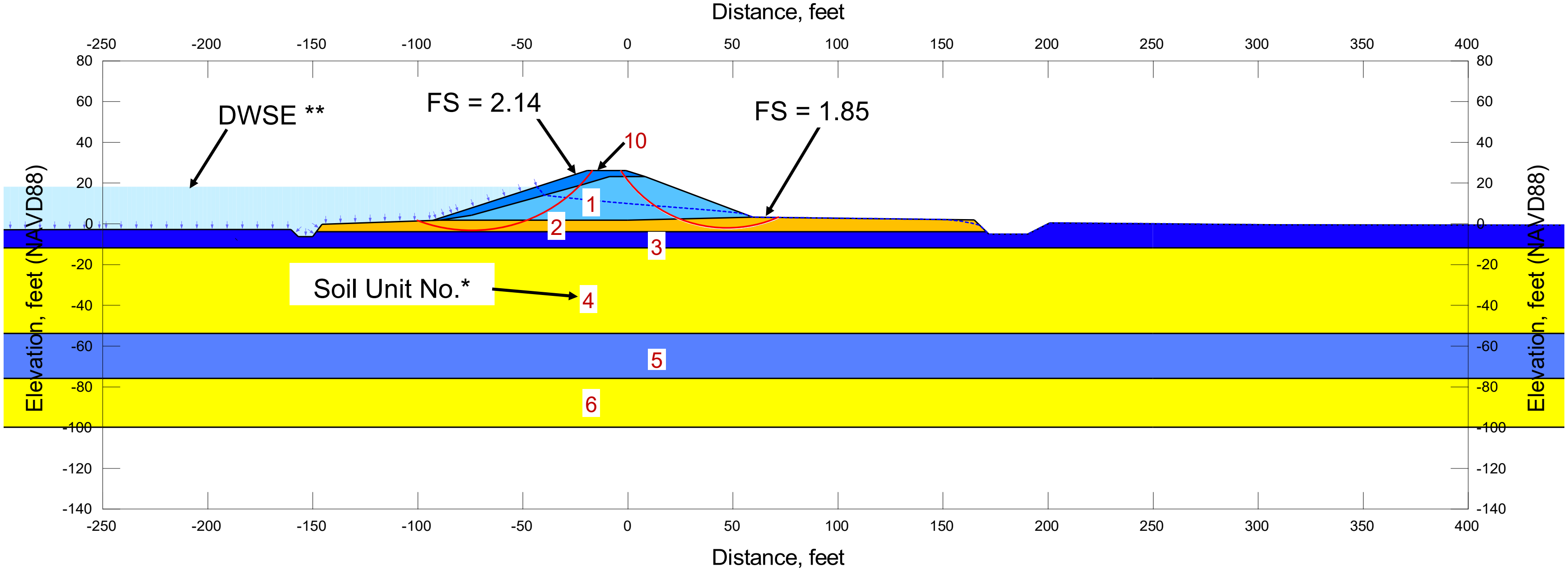
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 95+00** **Existing Levee**
Shannon & Wilson, Inc.	Project No. 907.03 Plate No. F-18



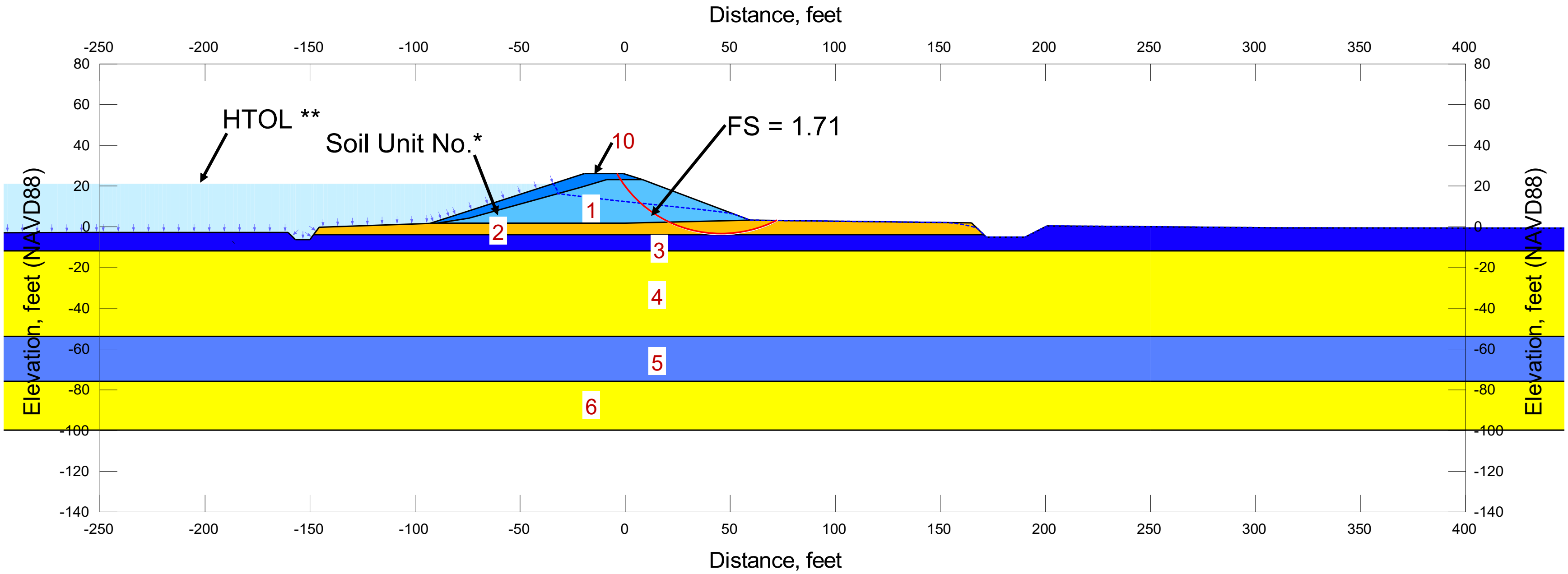
*   See Plate F-1 for material (soil unit) properties of stability model
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

Little Egbert Multi-Benefit Project Solano County, California		**Slope Stability Results - End of Construction RD 536 - Station 95+00 Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-19



*   See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 95+00** **Rehabilitated Levee - DWSE / MTL**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-20

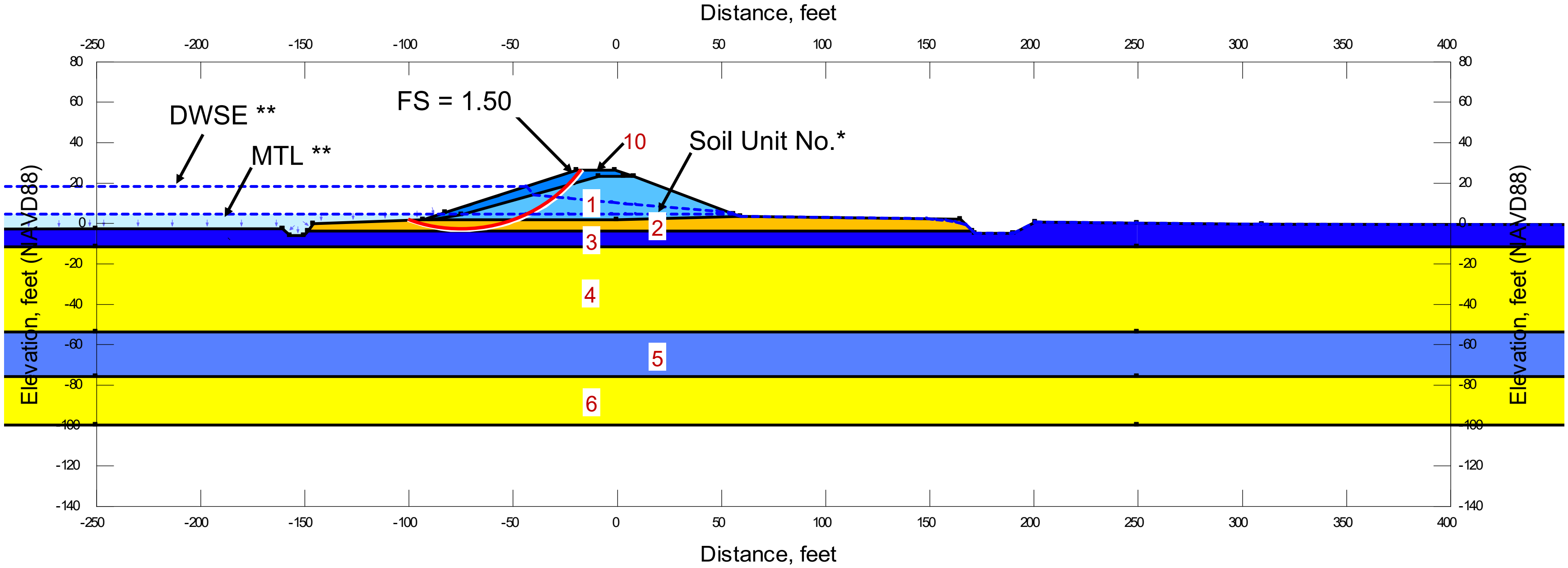


* See Plate F-1 for material (soil unit) properties of stability model

** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

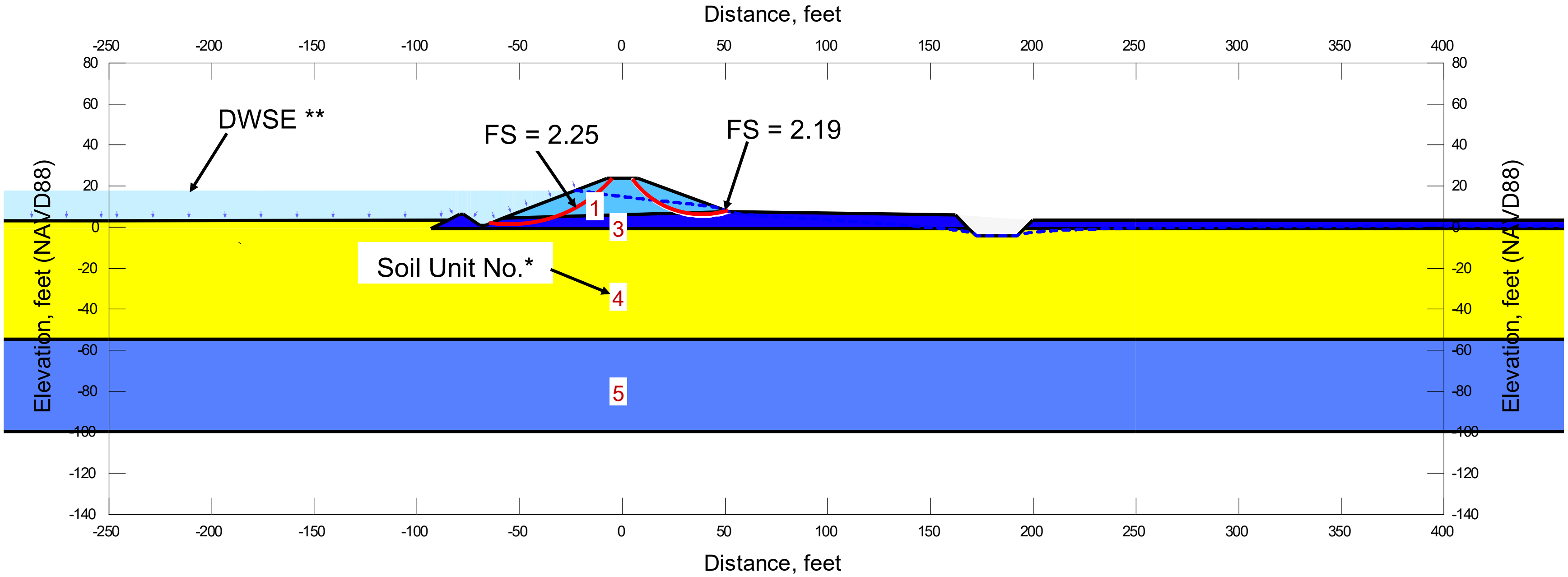
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage RD 536 - Station 95+00 Rehabilitated Levee - HTOL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-21



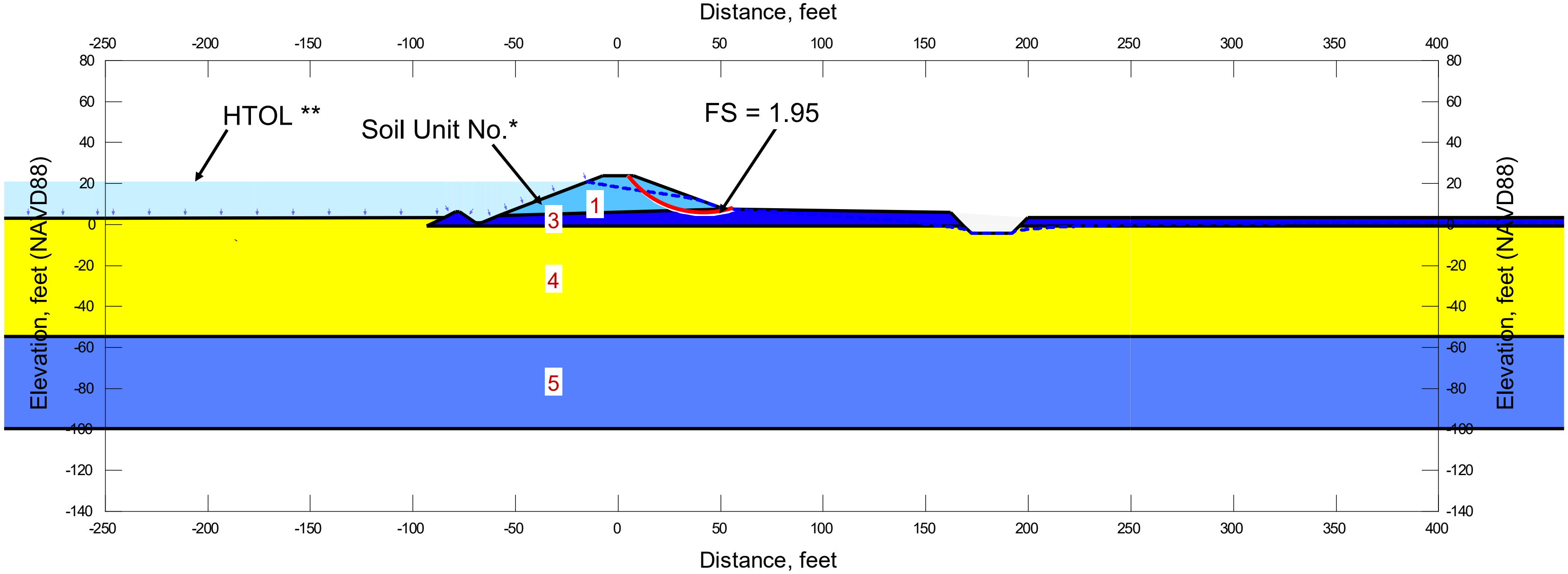
* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California		**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 95+00** **Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-22



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

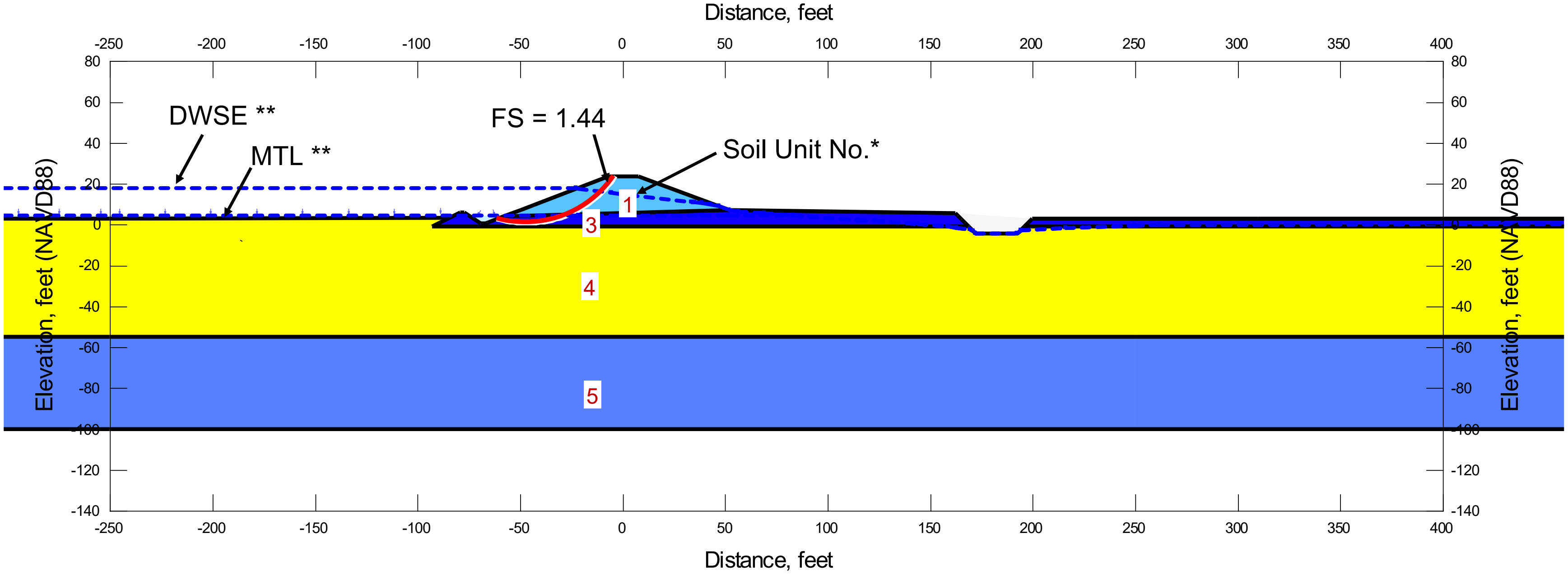
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 135+00** **Existing Levee - DWSE / MTL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-23



* See Plate F-1 for material (soil unit) properties of stability model

** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

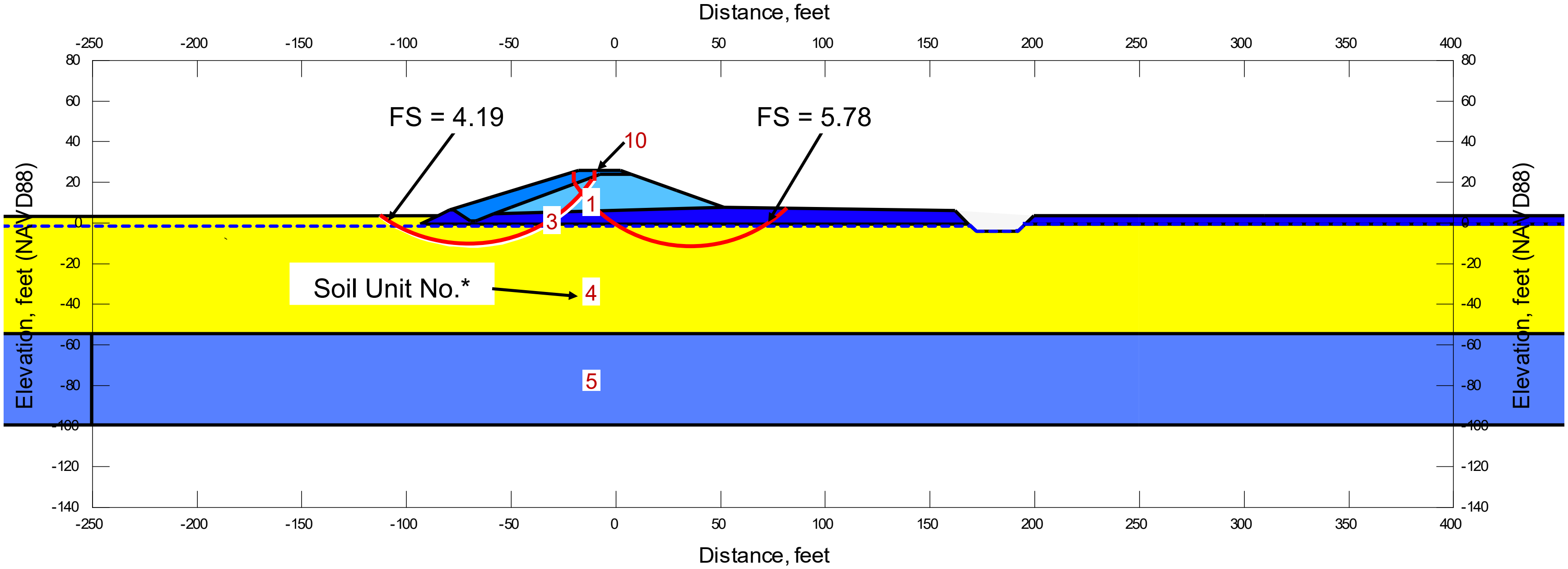
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 135+00** **Existing Levee - HTOL**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-24



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 135+00** **Existing Levee**

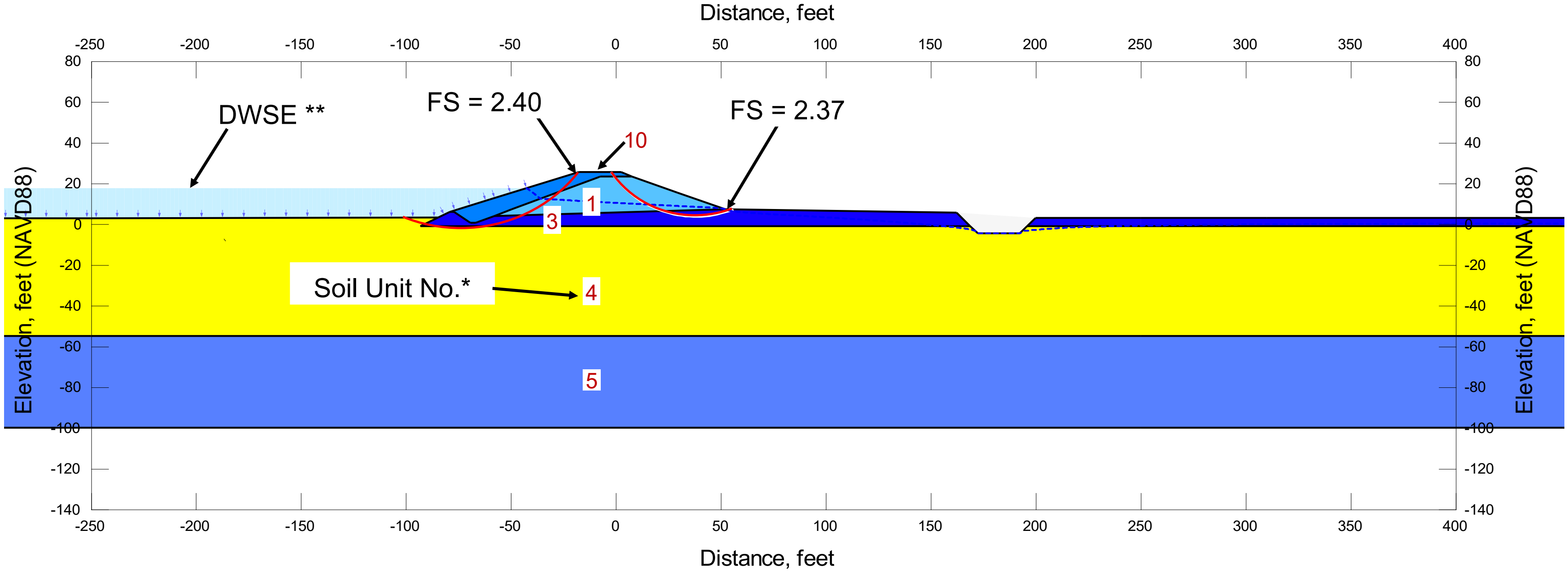
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-25



* See Plate F-1 for material (soil unit) properties of stability model

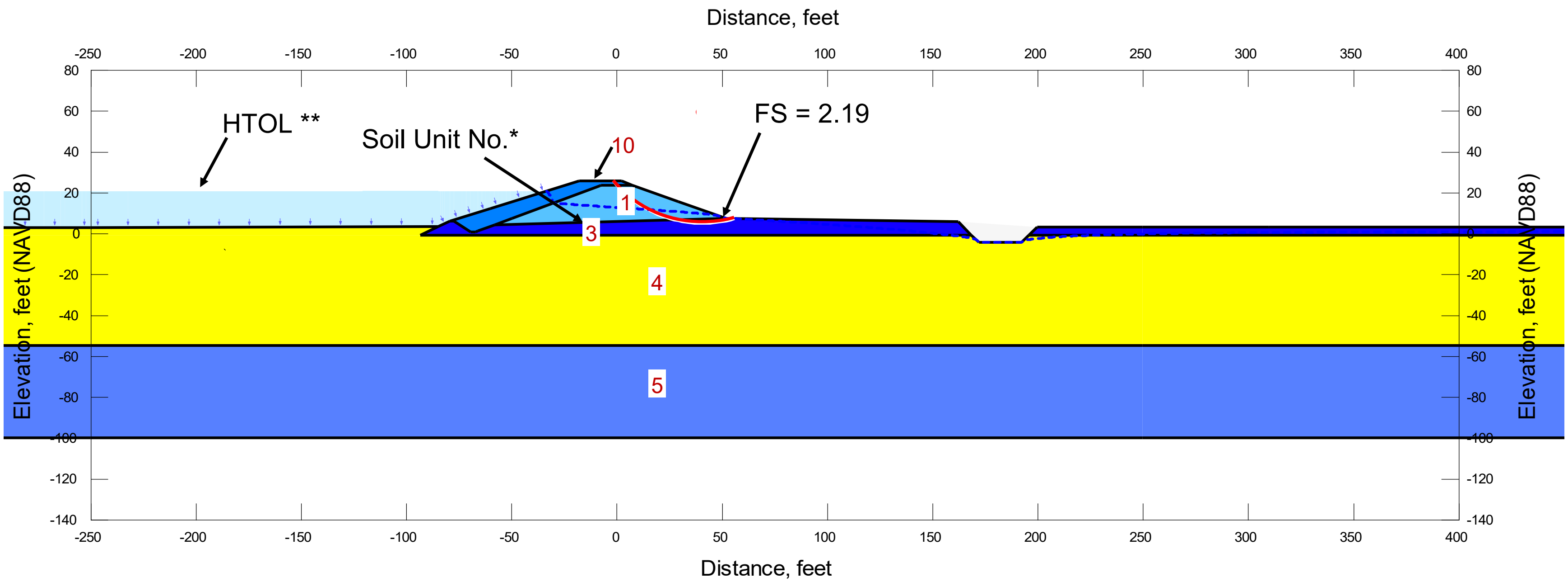
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction** **RD 536 - Station 135+00** **Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. F-26



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

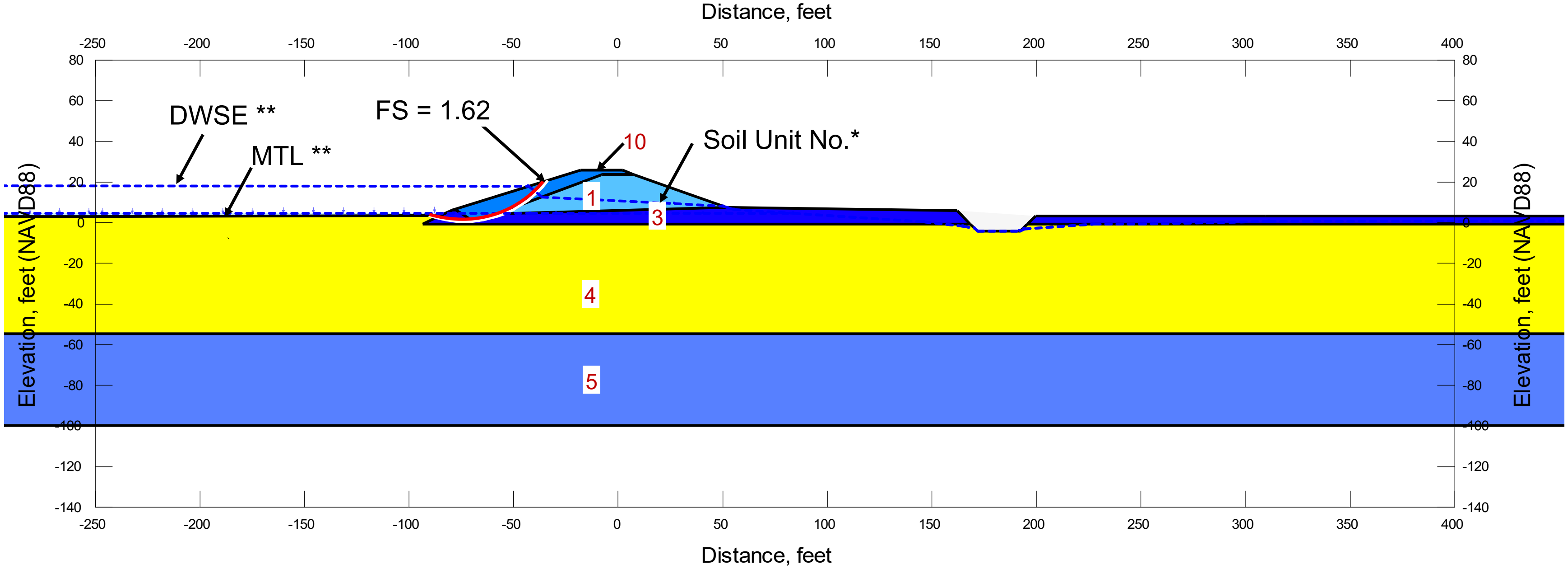
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 135+00** **Rehabilitated Levee - DWSE / MTL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-27



*   See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

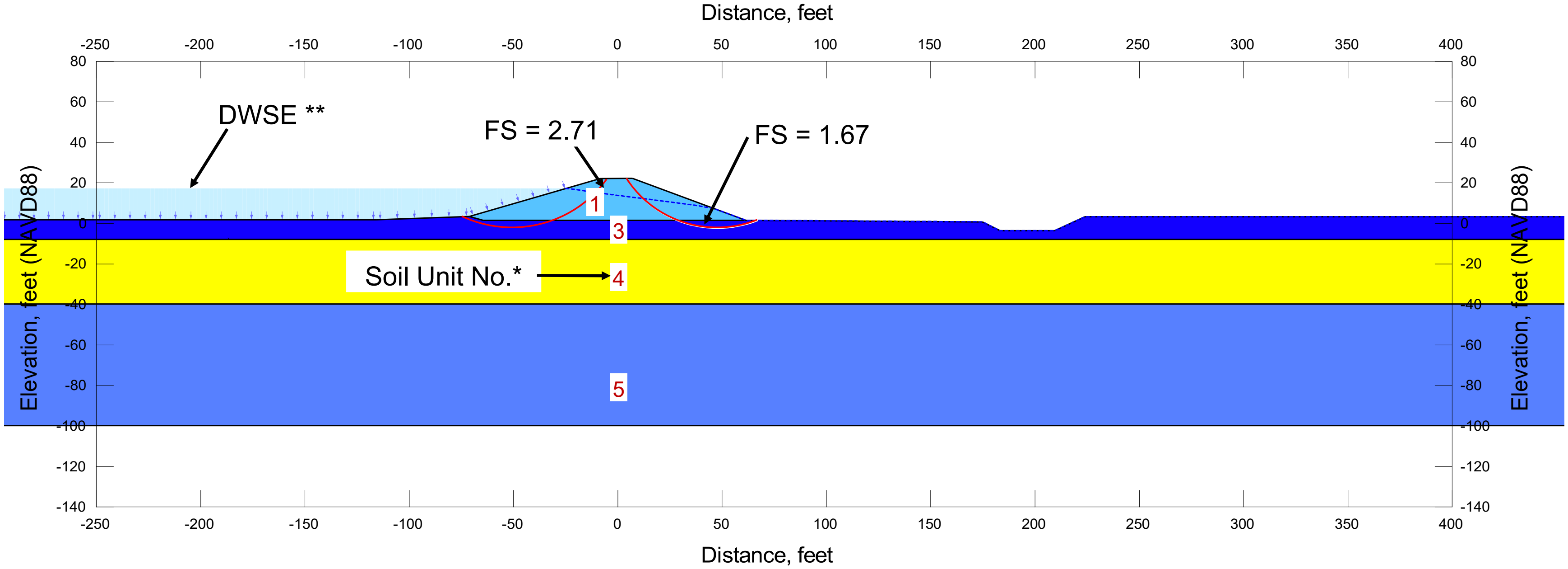
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 135+00** **Rehabilitated Levee - HTOL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-28



*   See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

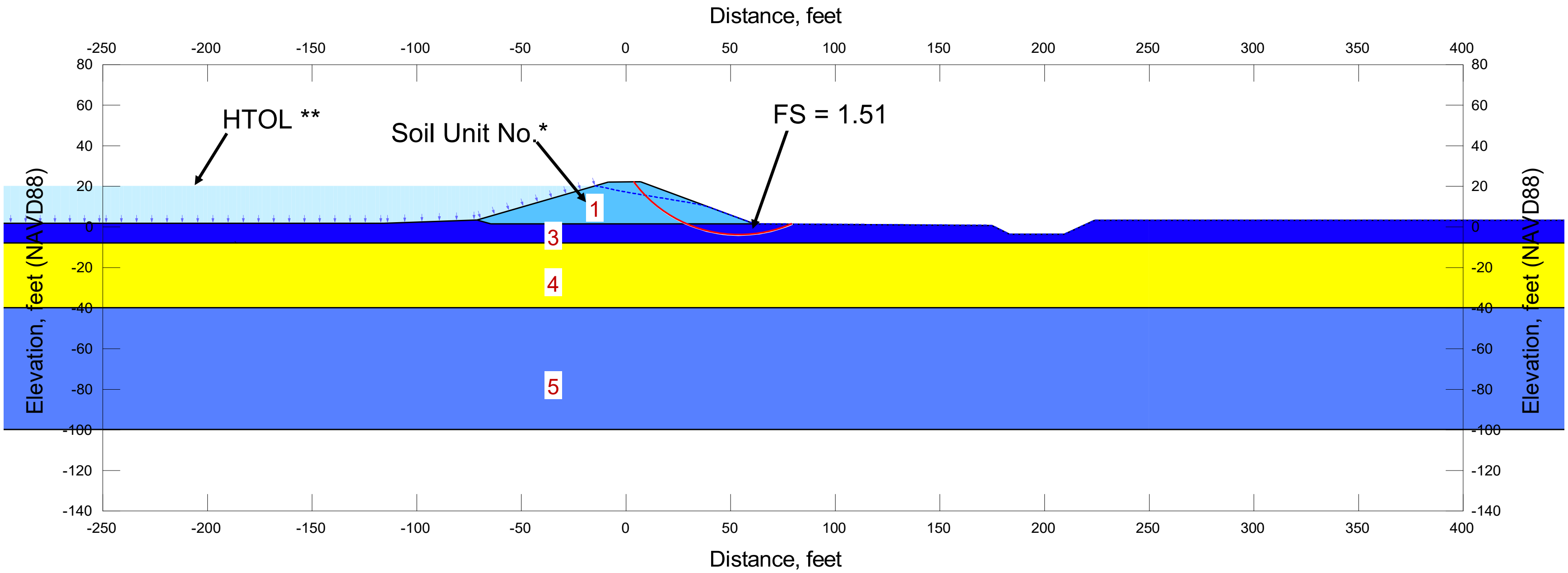
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 135+00** **Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-29



* See Plate F-1 for material (soil unit) properties of stability model

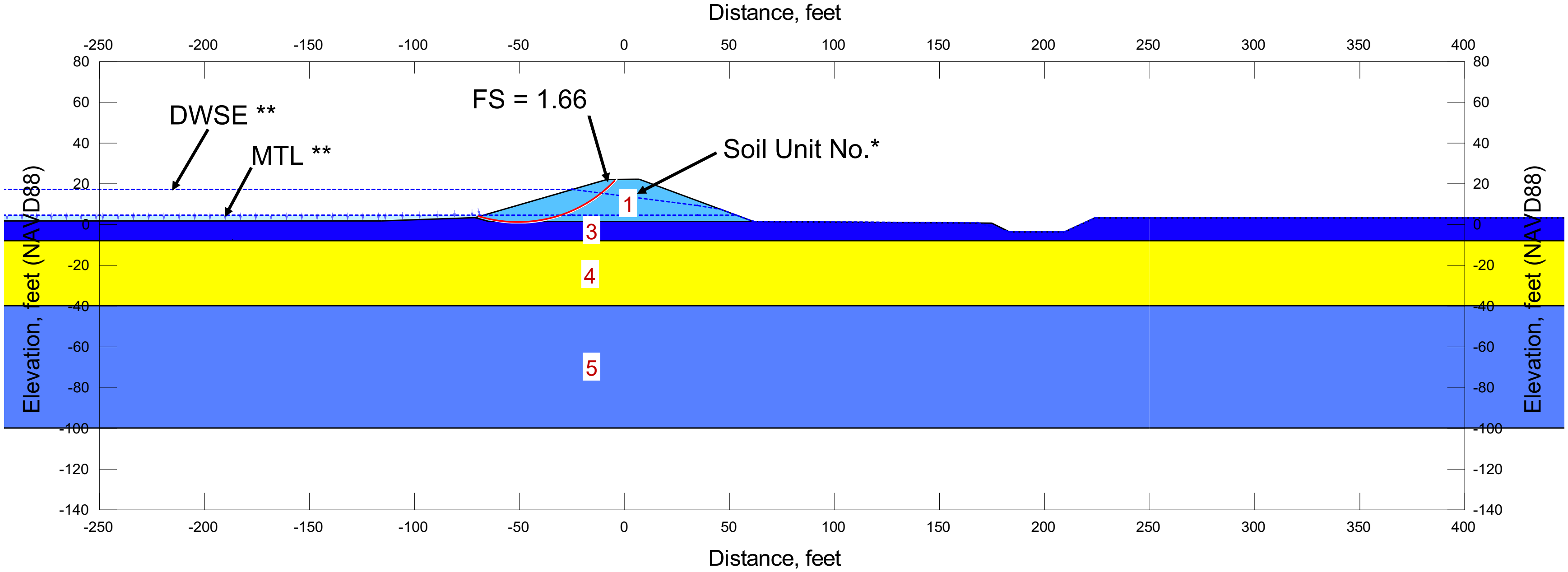
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 175+00** **Existing Levee - DWSE / MTL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-30



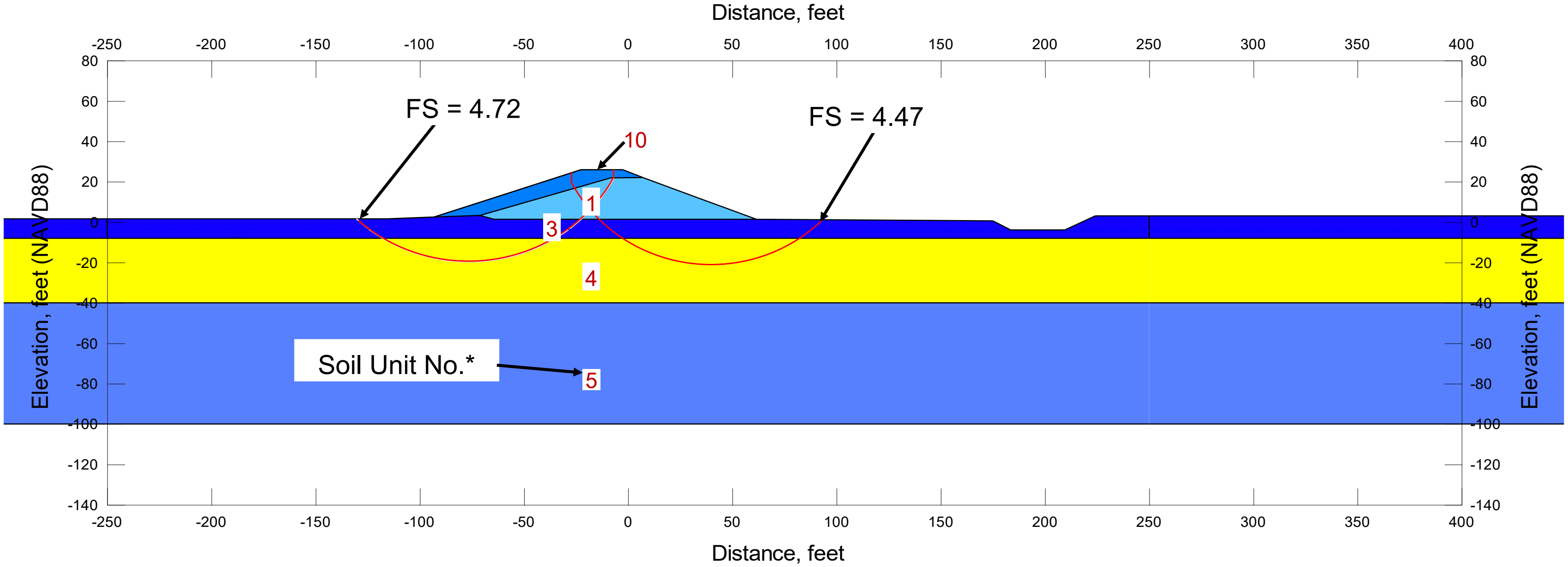
* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **RD 536 - Station 175+00** **Existing Levee - HTOL**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. F-31



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

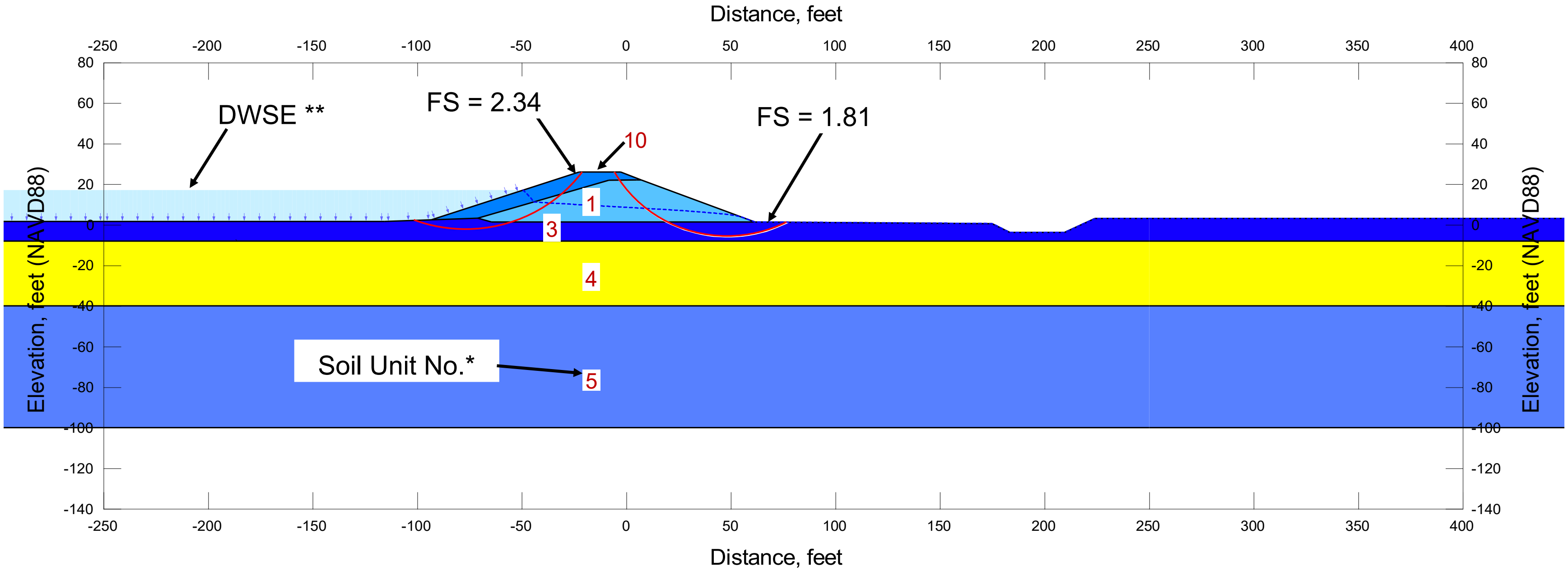
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 175+00** **Existing Levee**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-32



* See Plate F-1 for material (soil unit) properties of stability model
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction** **RD 536 - Station 175+00** **Rehabilitated Levee**

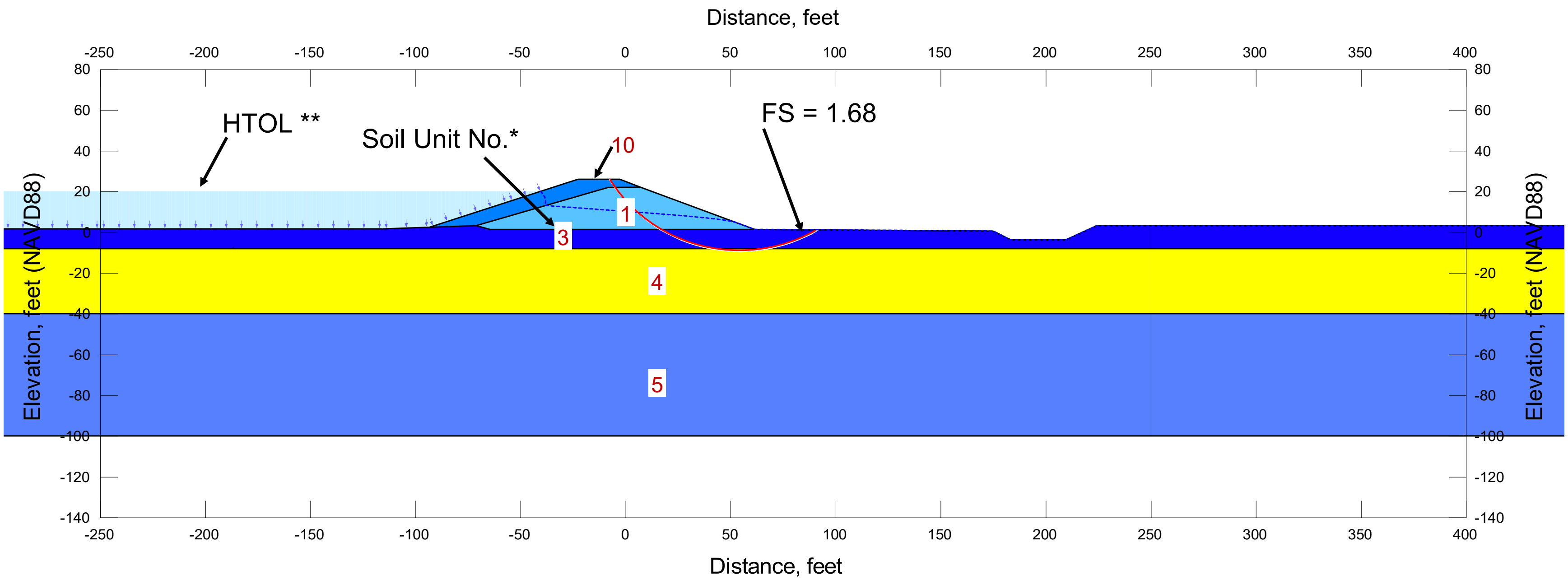
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-33



* See Plate F-1 for material (soil unit) properties of stability model

** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

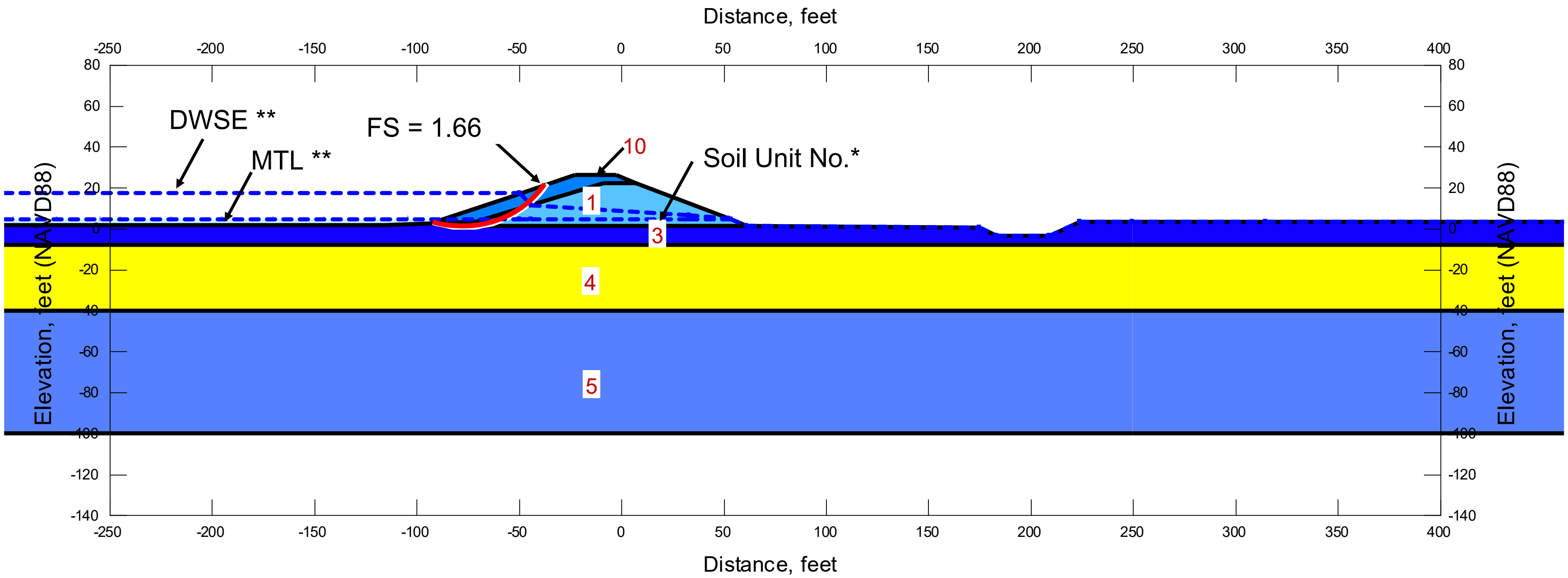
Little Egbert Multi-Benefit Project Solano County, California		**Slope Stability Results - Steady State Seepage** **RD 536 - Station 175+00** **Rehabilitated Levee - DWSE / MTL**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-34



* See Plate F-1 for material (soil unit) properties of stability model

** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage RD 536 - Station 175+00 Rehabilitated Levee - HTOL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-35

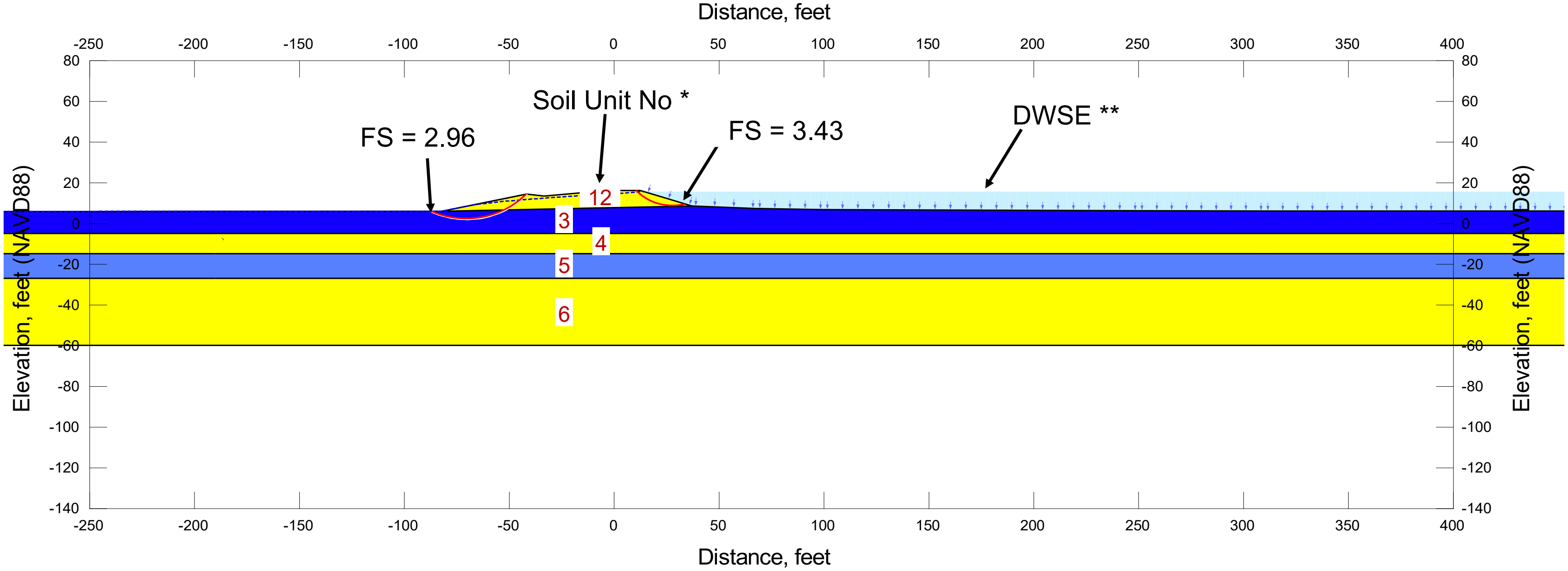


* See Plate F-1 for material (soil unit) properties of stability model

** Design water surface elevation (DWSE) and mid-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **RD 536 - Station 175+00** **Rehabilitated Levee**

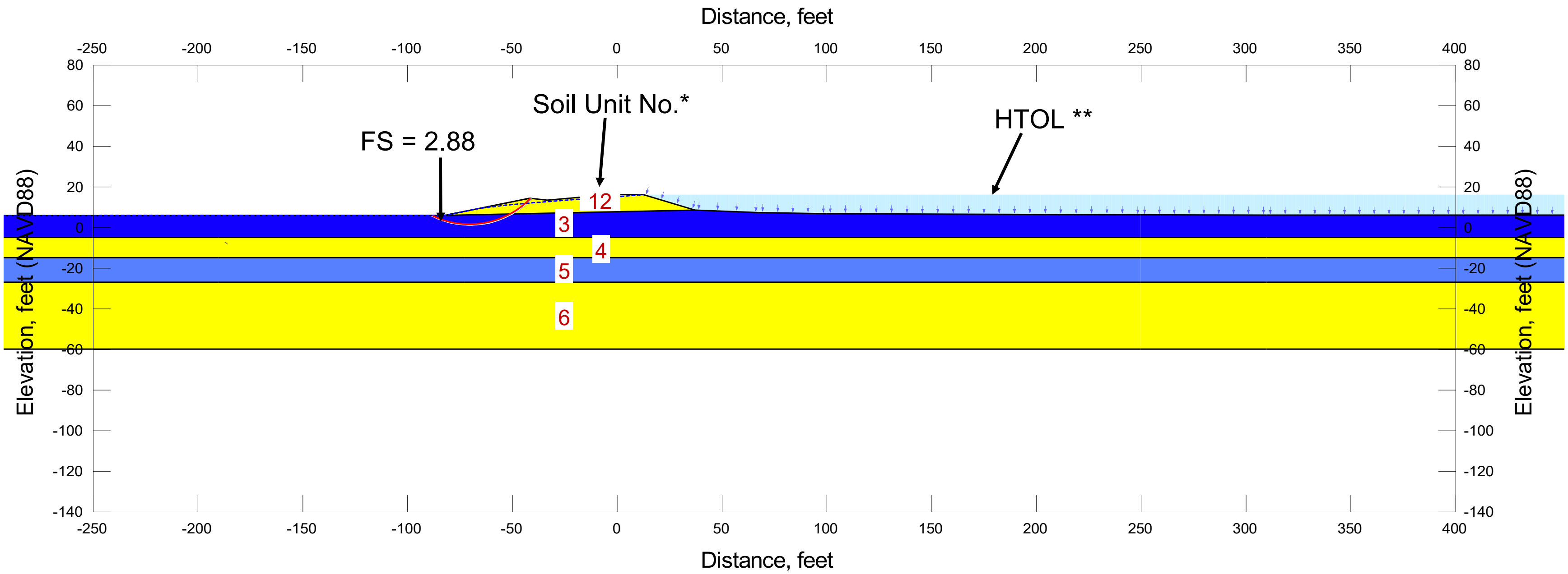
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-36



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 6+00** **Existing Levee - DWSE / MTL**

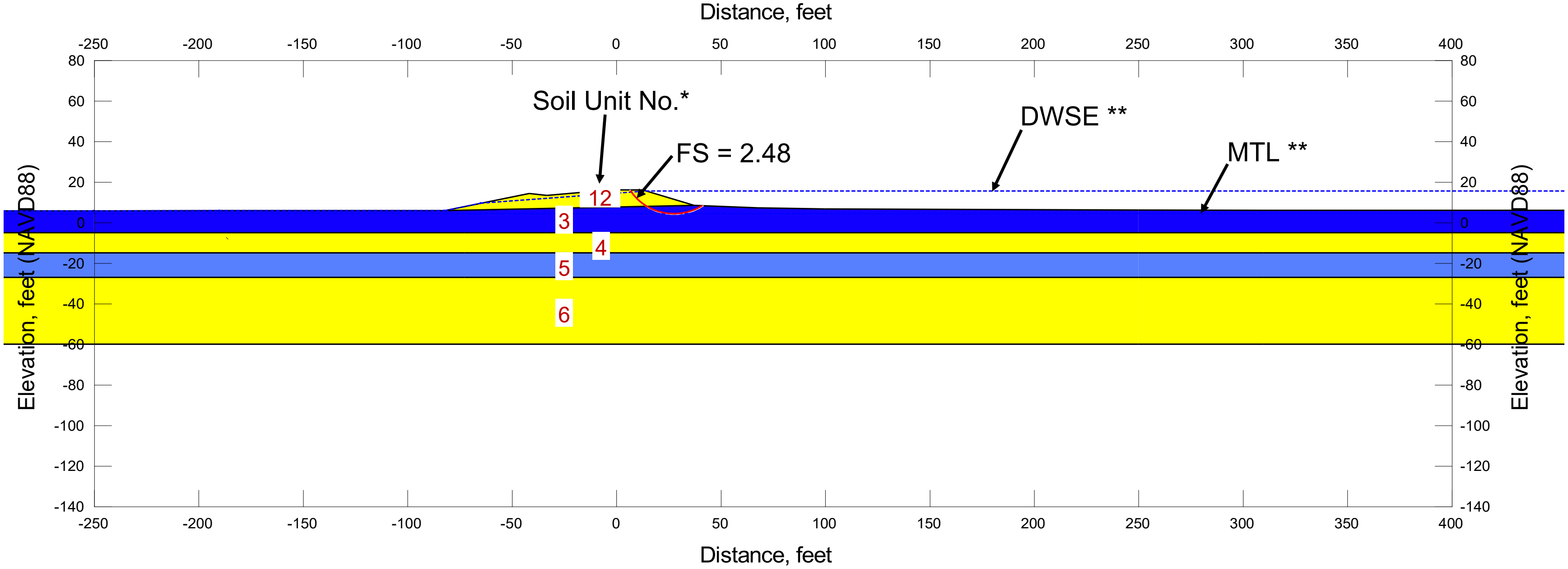
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-37



* See Plate F-1 for material (soil unit) properties of stability model

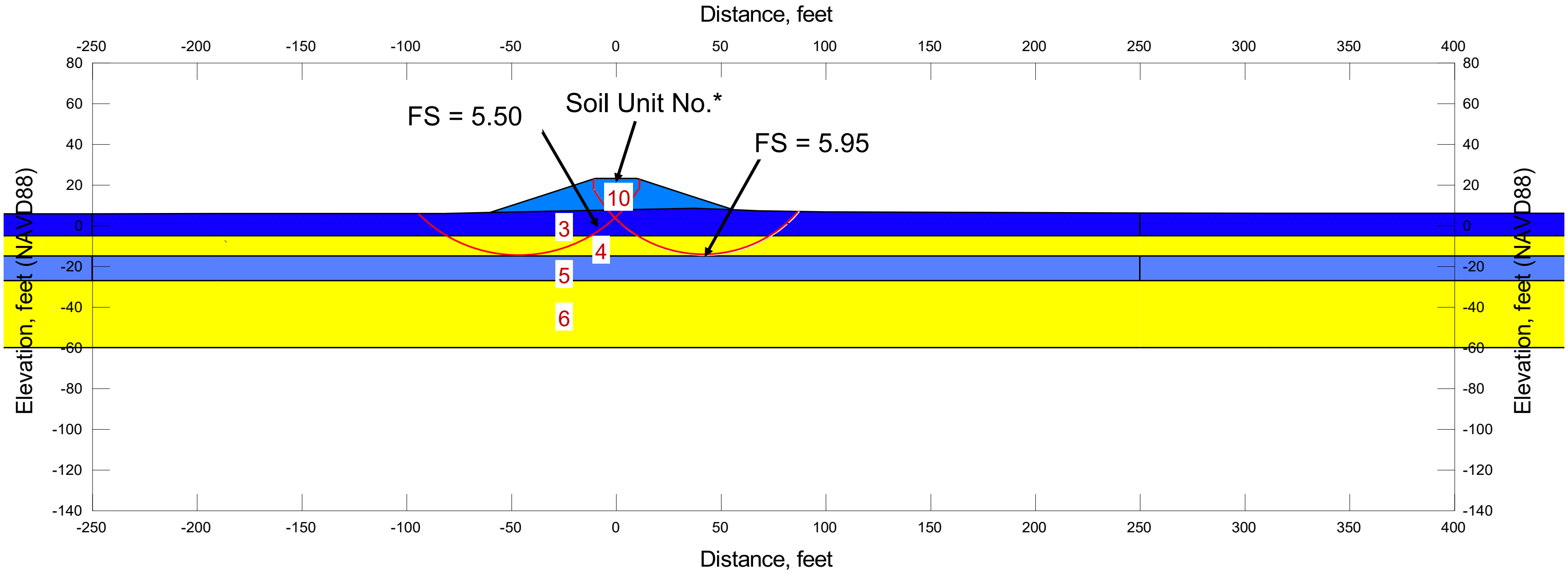
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 6+00** **Existing Levee - HTOL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-38



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

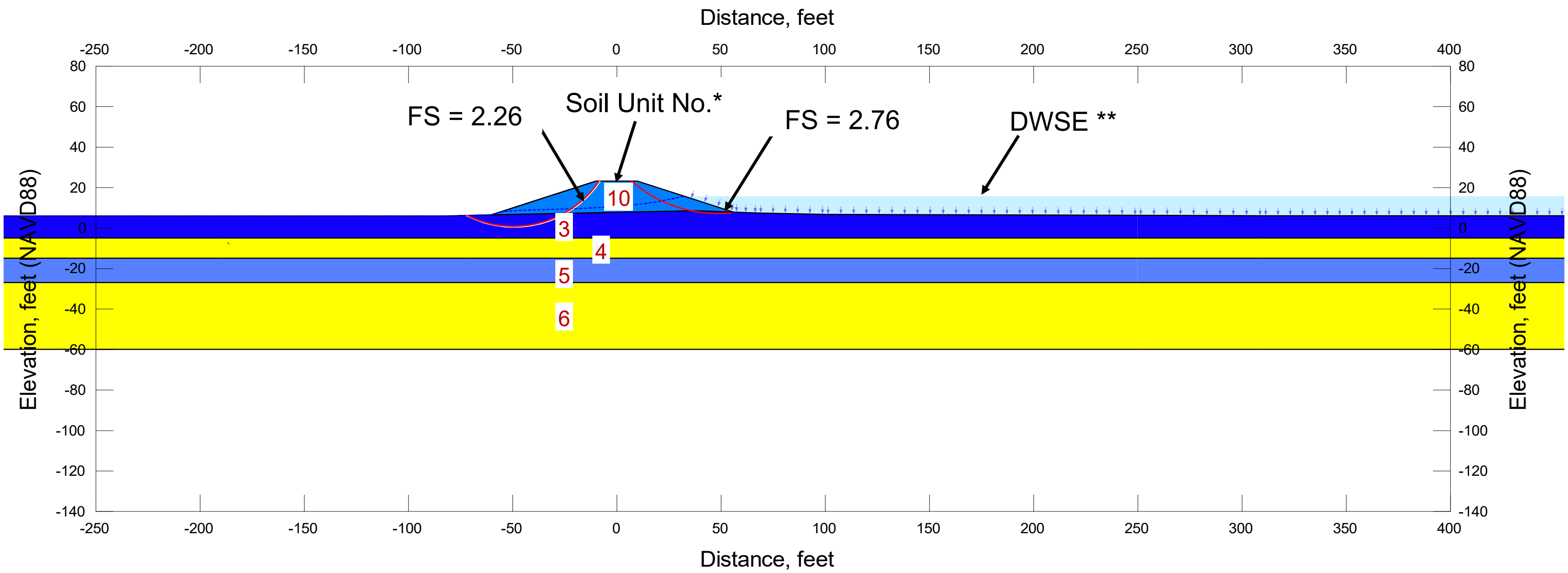
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown Mellin - Station 6+00 Existing Levee**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-39



* See Plate F-1 for material (soil unit) properties of stability model

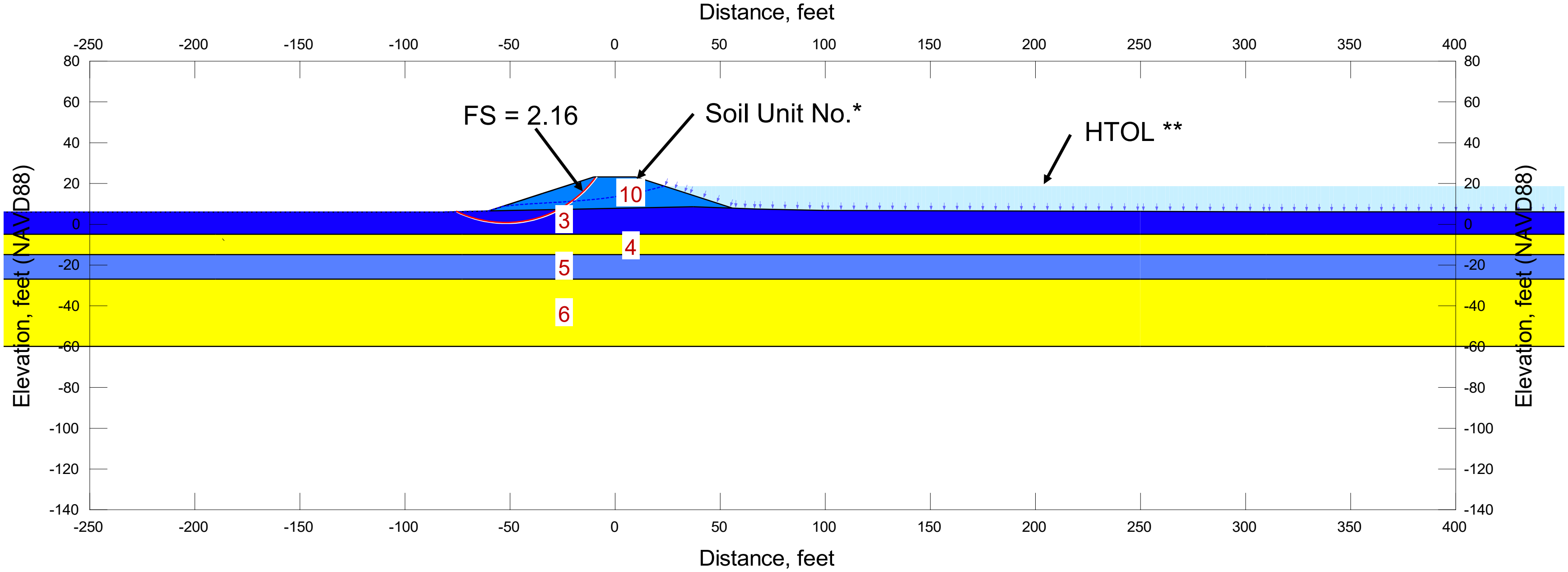
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction** **Mellin - Station 6+00** **Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-40



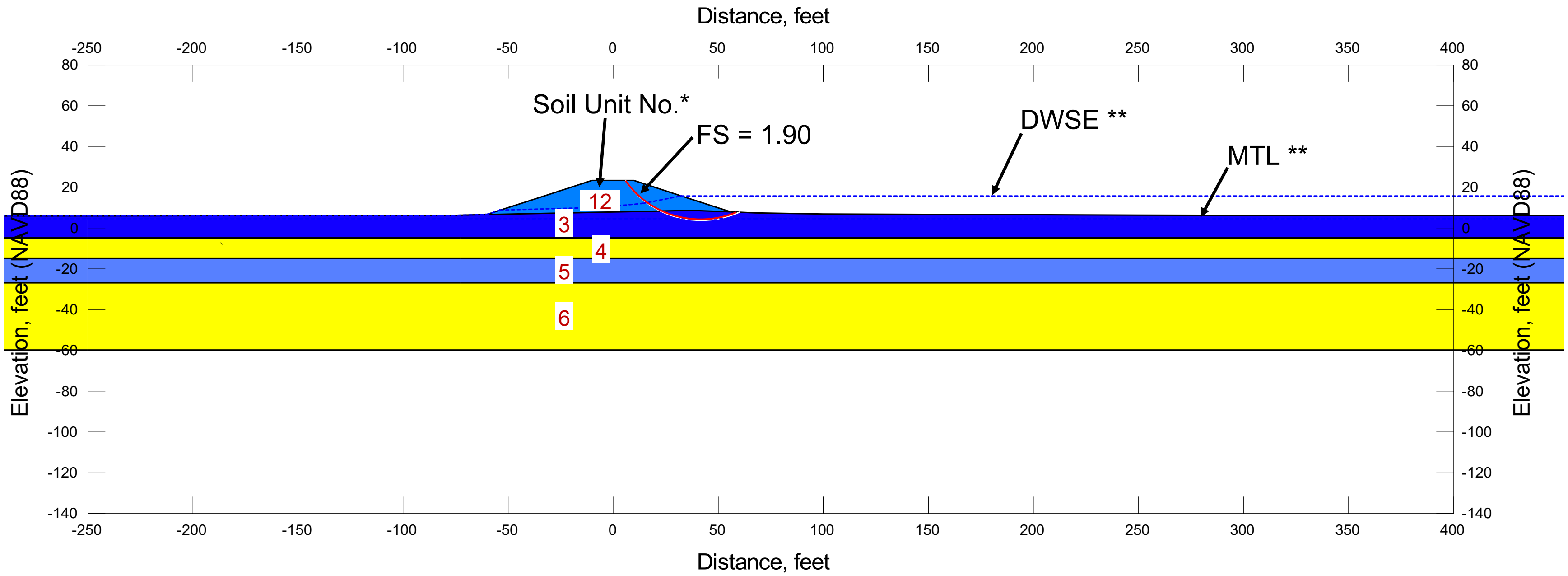
* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage Mellin - Station 6+00 Rehabilitated Levee - DWSE / MTL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-41



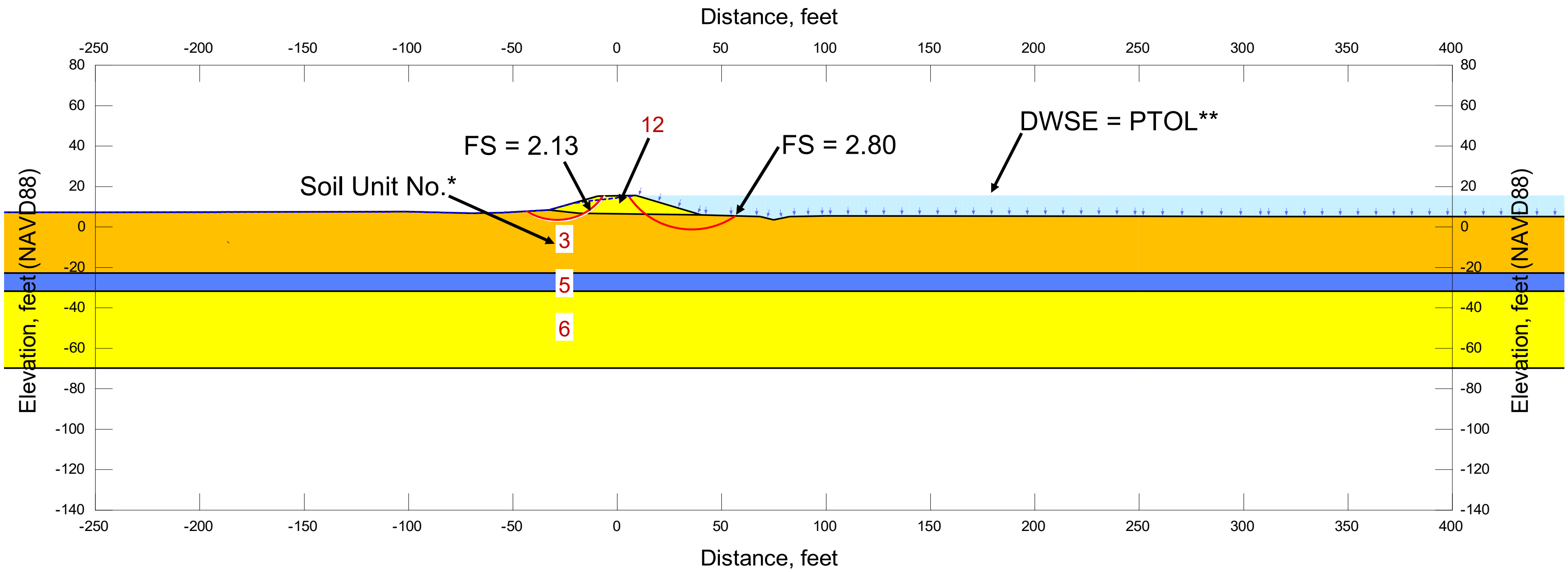
* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 6+00** **Rehabilitated Levee - HTOL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-42



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were for the rapid drawdown (RDD) slope stability analysis.

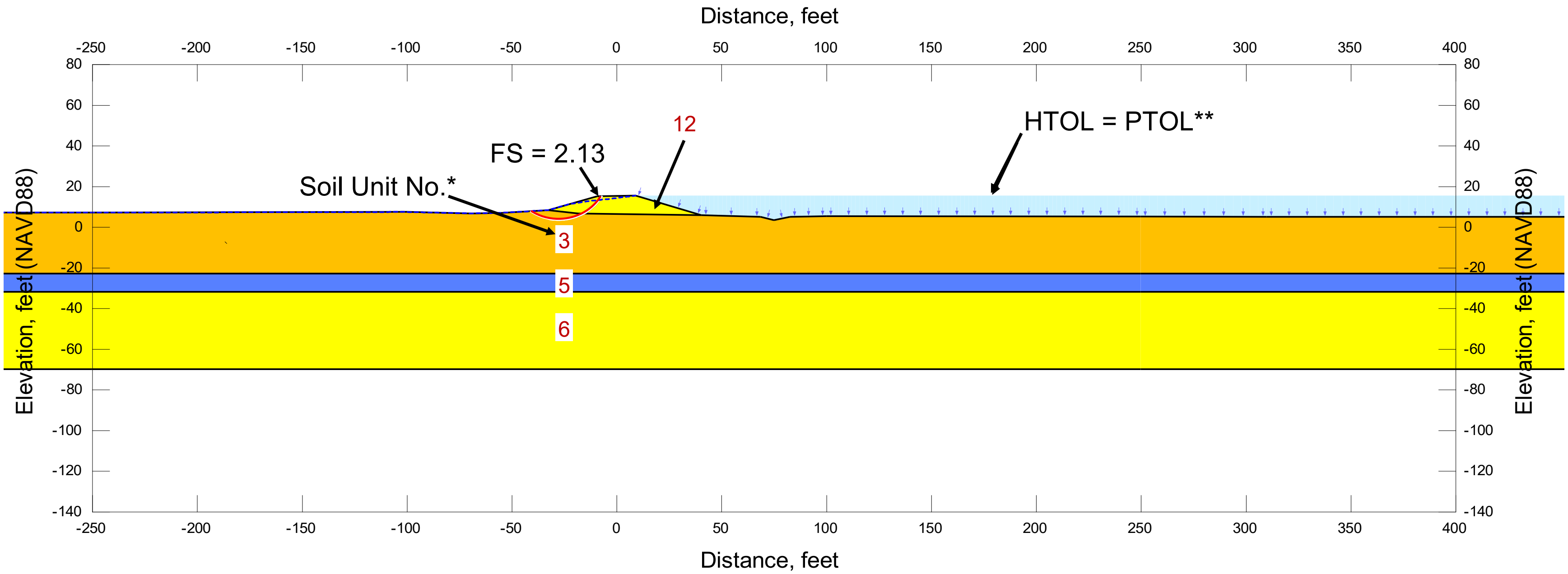
Little Egbert Multi-Benefit Project Solano County, California		**Slope Stability Results - Rapid Drawdown** **Mellin - Station 6+00** **Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-43



*   See Plate F-1 for material (soil unit) properties of stability model
** Elevation of the physical top of the levee (PTOL) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 21+00** **Existing Levee - DWSE / MTL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-44

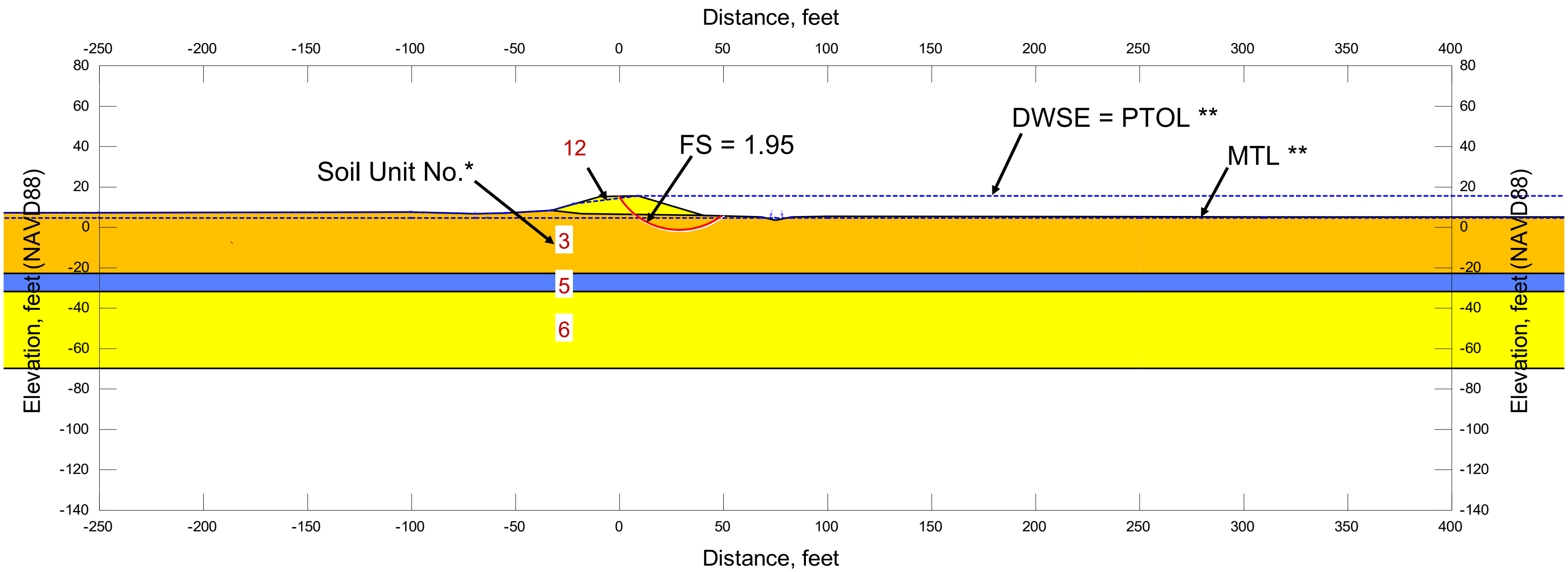


* See Plate F-1 for material (soil unit) properties of stability model

** Elevation of the physical top of the levee (PTOL) was used in landside (LS) slope stability analysis.

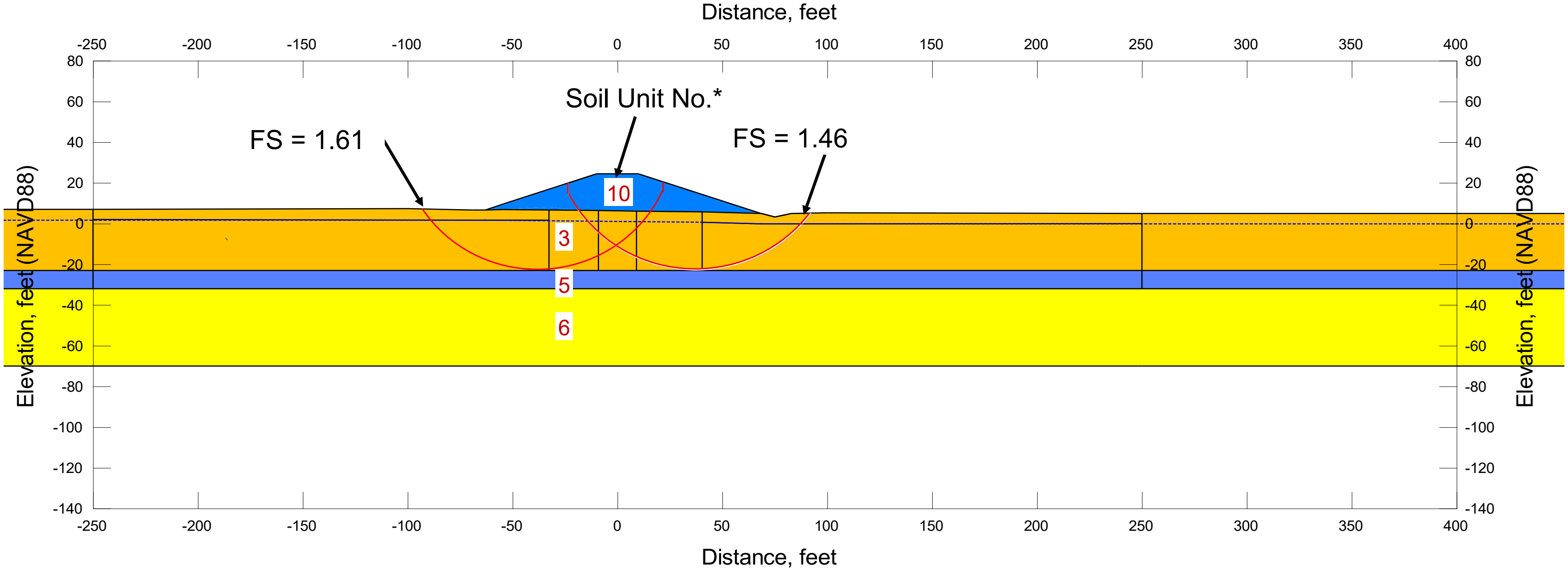
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 21+00** **Existing Levee - HTOL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-45



* See Plate F-1 for material (soil unit) properties of stability model
** Elevation of the physical top of the levee (PTOL) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

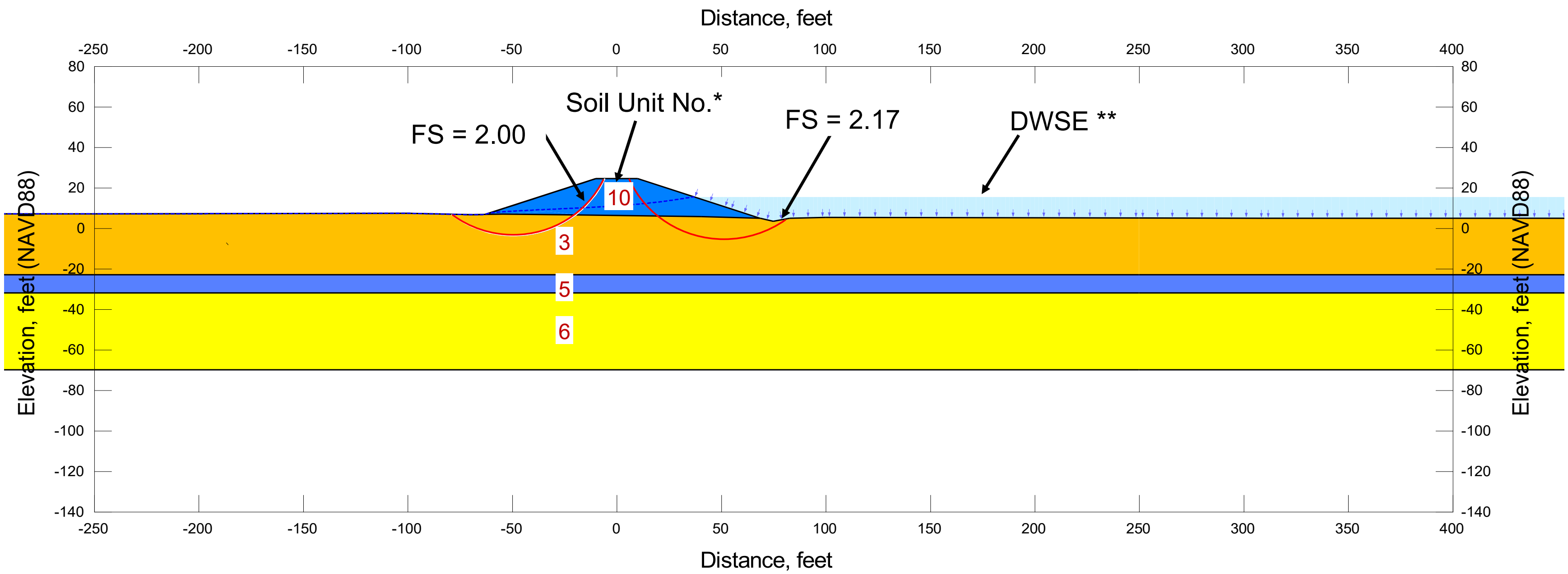
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **Mellin - Station 21+00** **Existing Levee**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-46



* See Plate F-1 for material (soil unit) properties of stability model

** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

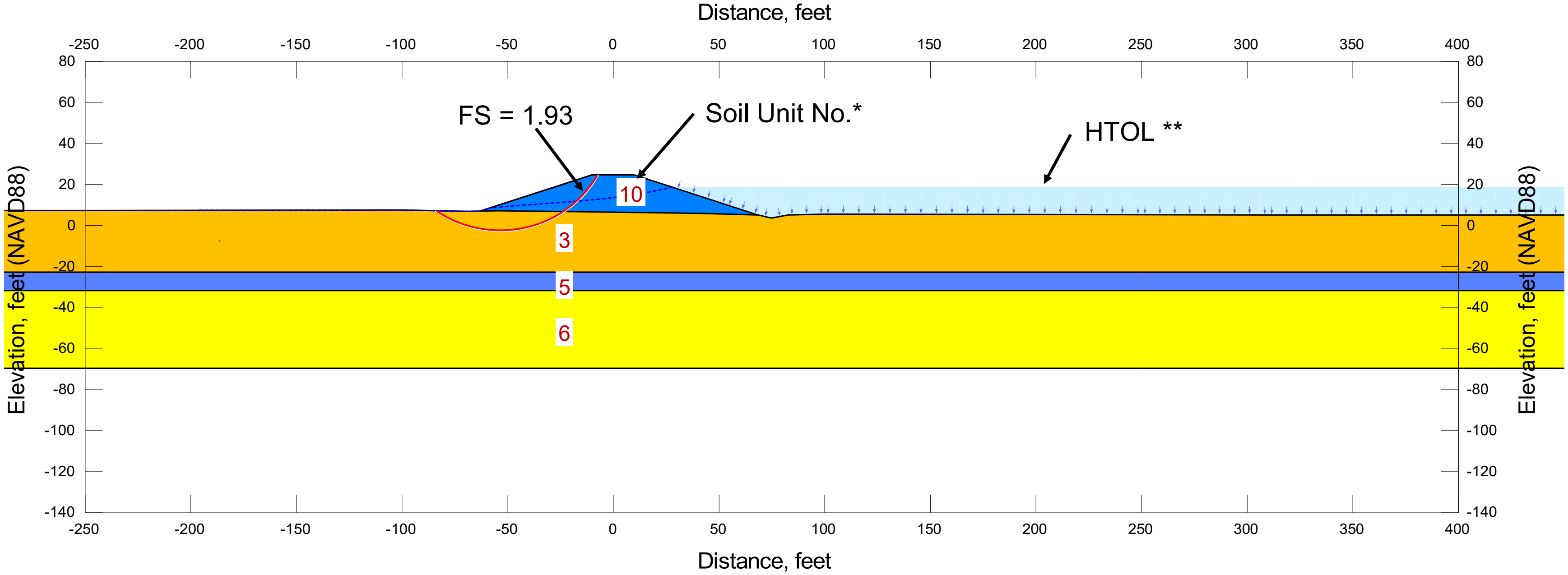
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction** **Mellin - Station 21+00** **Rehabilitated Levee**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-47



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 21+00** **Rehabilitated Levee - DWSE / MTL**

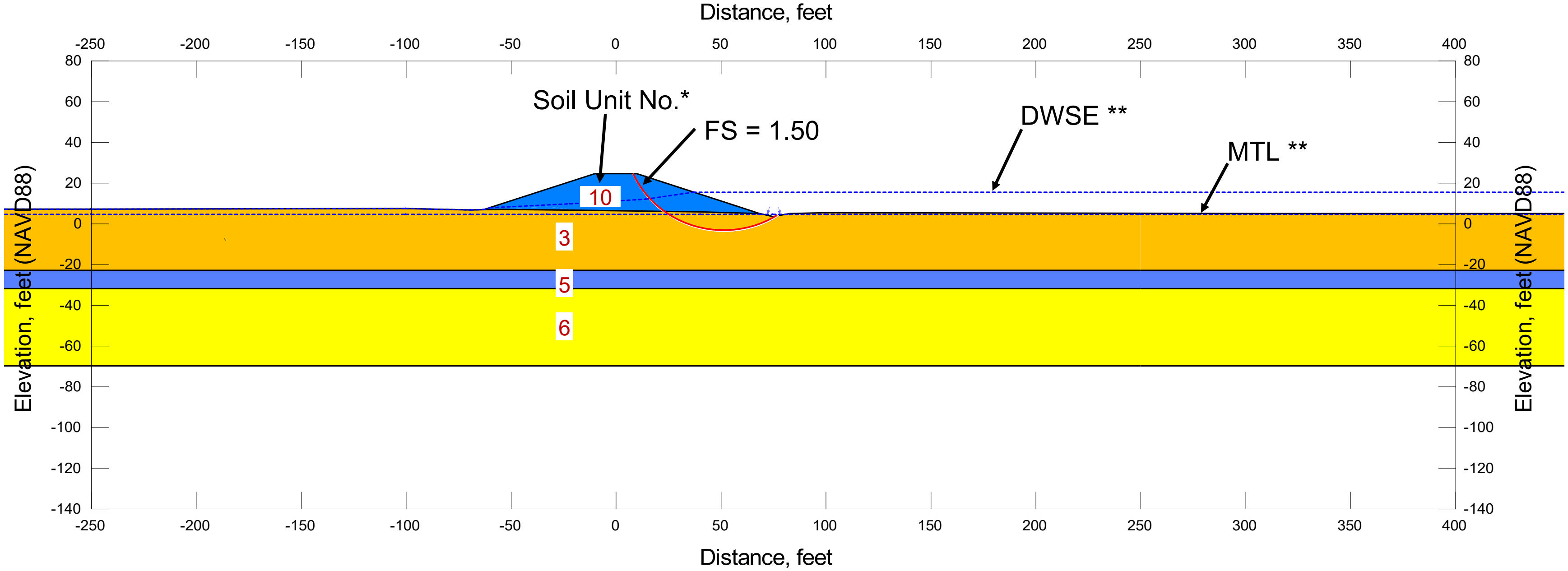
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-48



* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 21+00** **Rehabilitated Levee - HTOL**

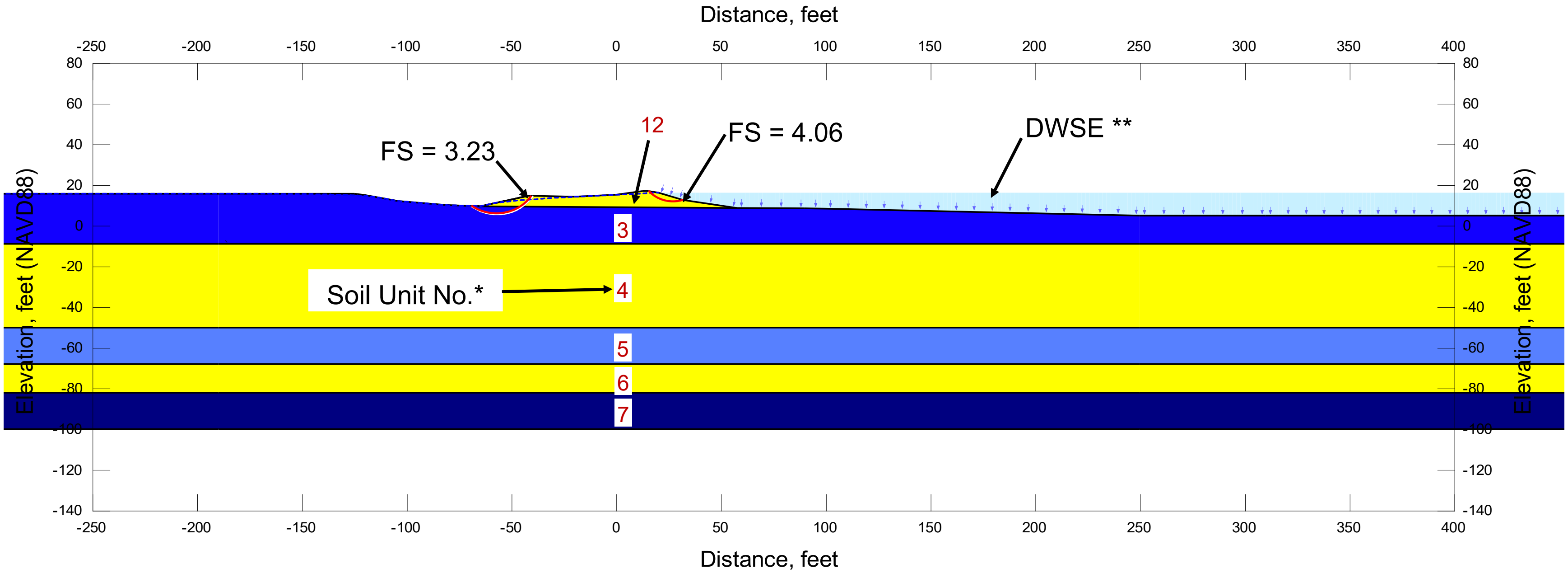
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-49



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **Mellin - Station 21+00** **Rehabilitated Levee**

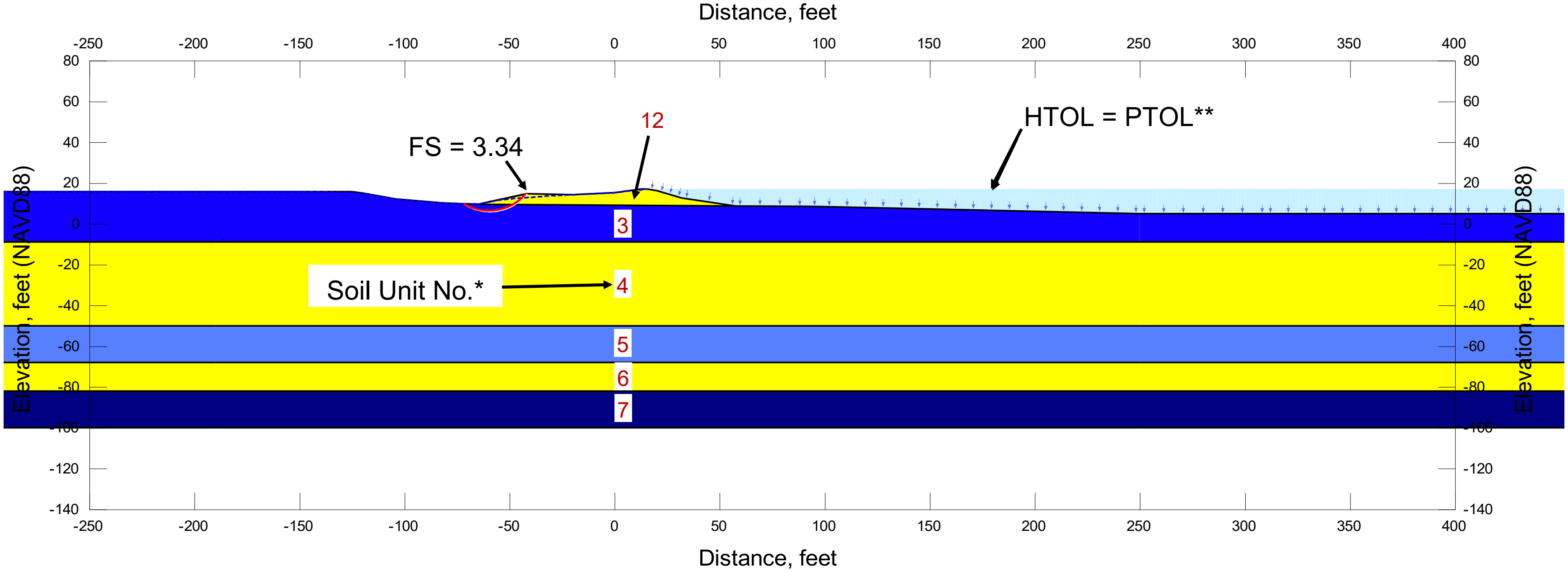
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-50



* See Plate F-1 for material (soil unit) properties of stability model

** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

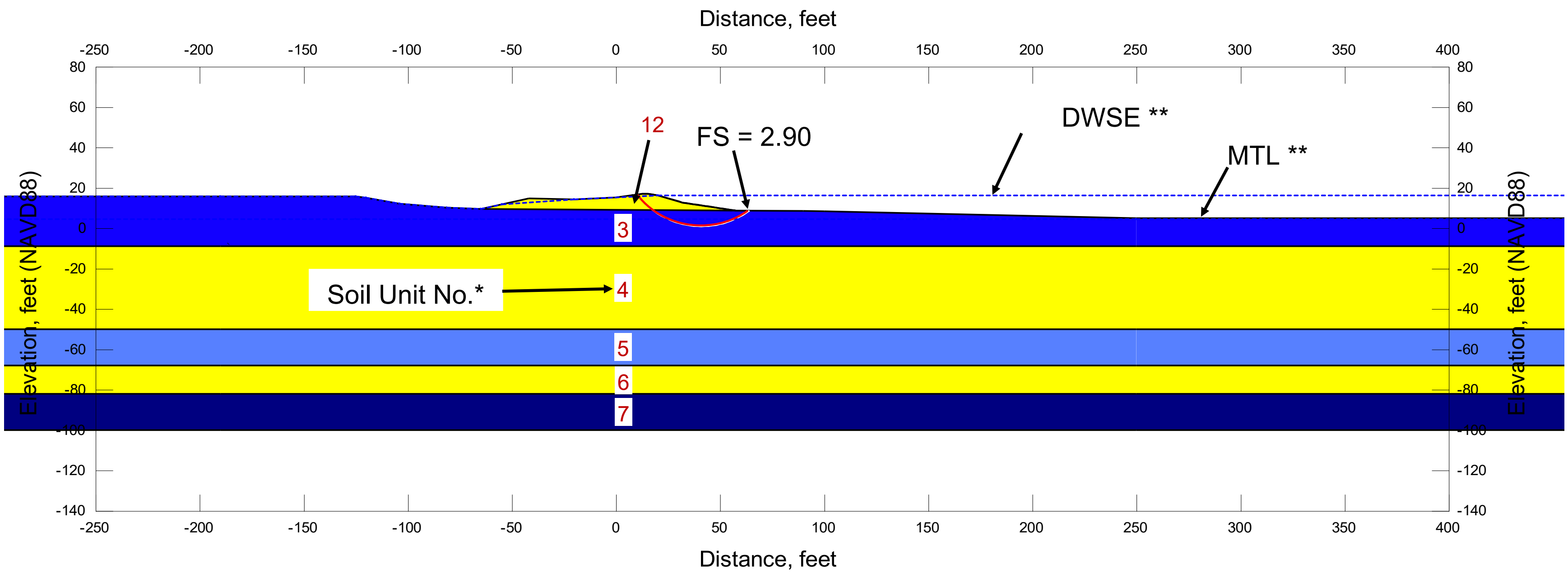
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 41+00** **Existing Levee - DWSE / MTL**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. F-51



* See Plate F-1 for material (soil unit) properties of stability model

** Elevation of the physical top of the levee (PTOL) was used in landside (LS) slope stability analysis.

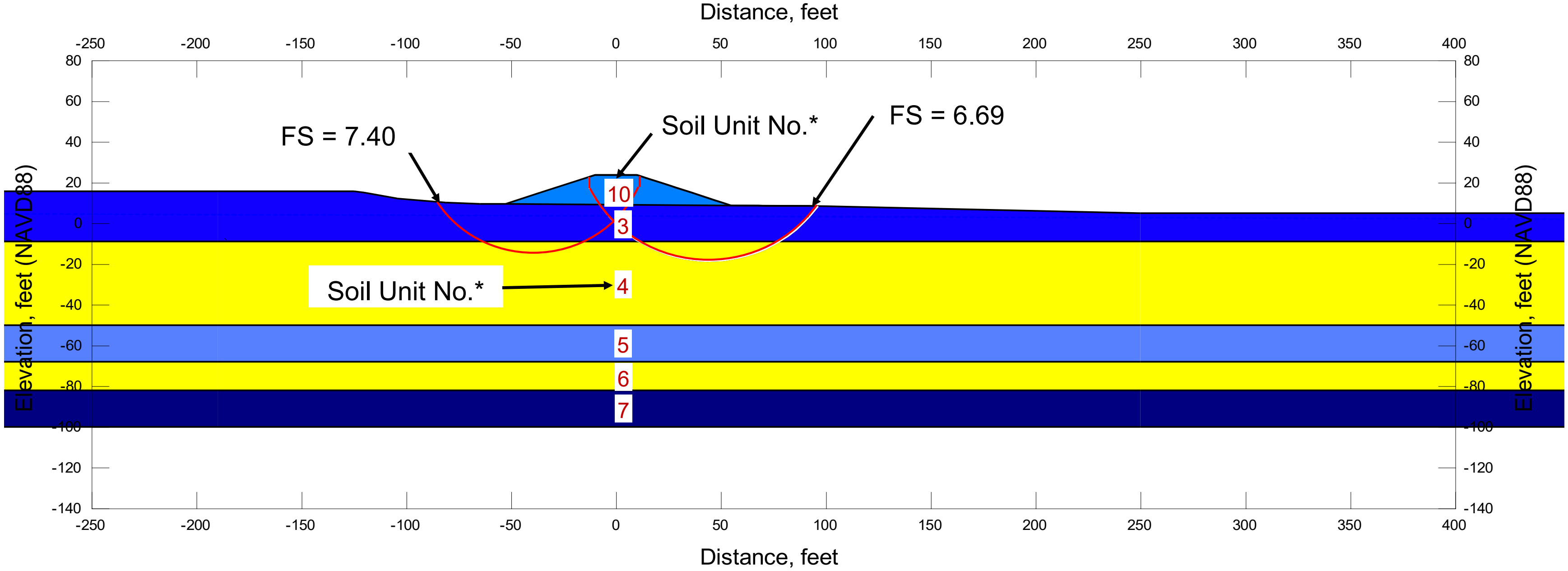
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 41+00** **Existing Levee - HTOL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-52



* See Plate F-1 for material (soil unit) properties of stability model

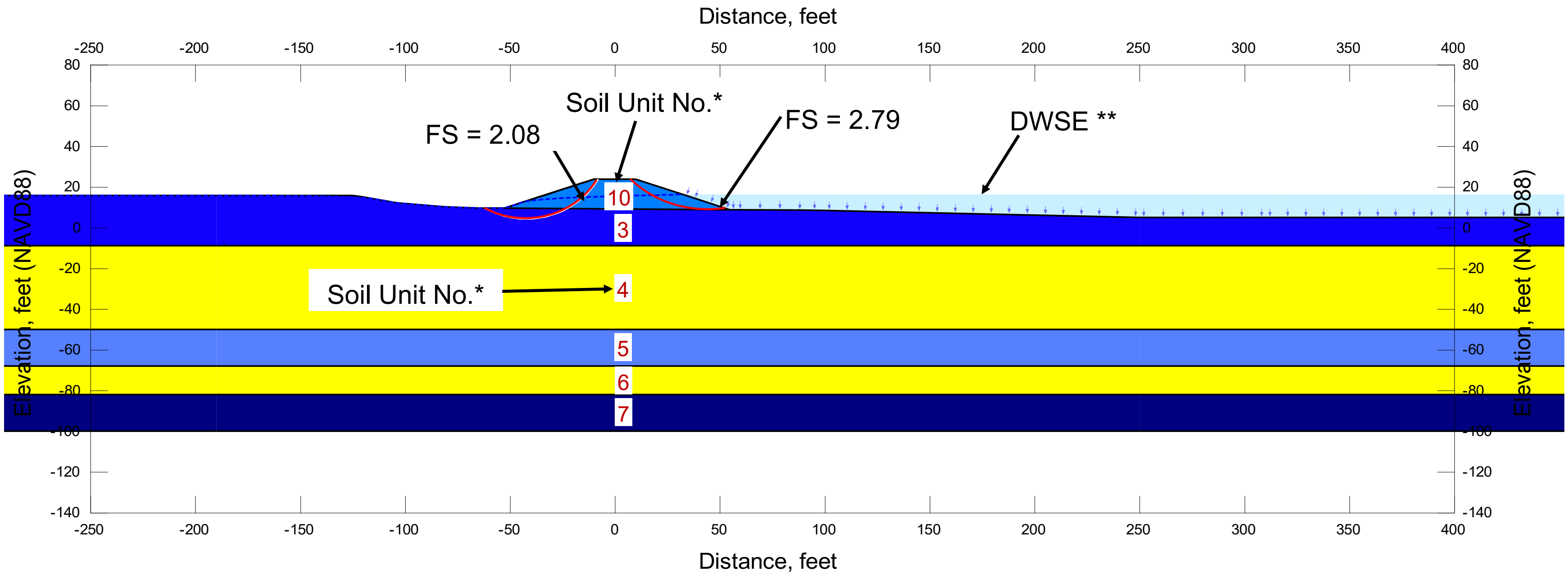
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **Mellin - Station 41+00** **Existing Levee**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-53



*   See Plate F-1 for material (soil unit) properties of stability model
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

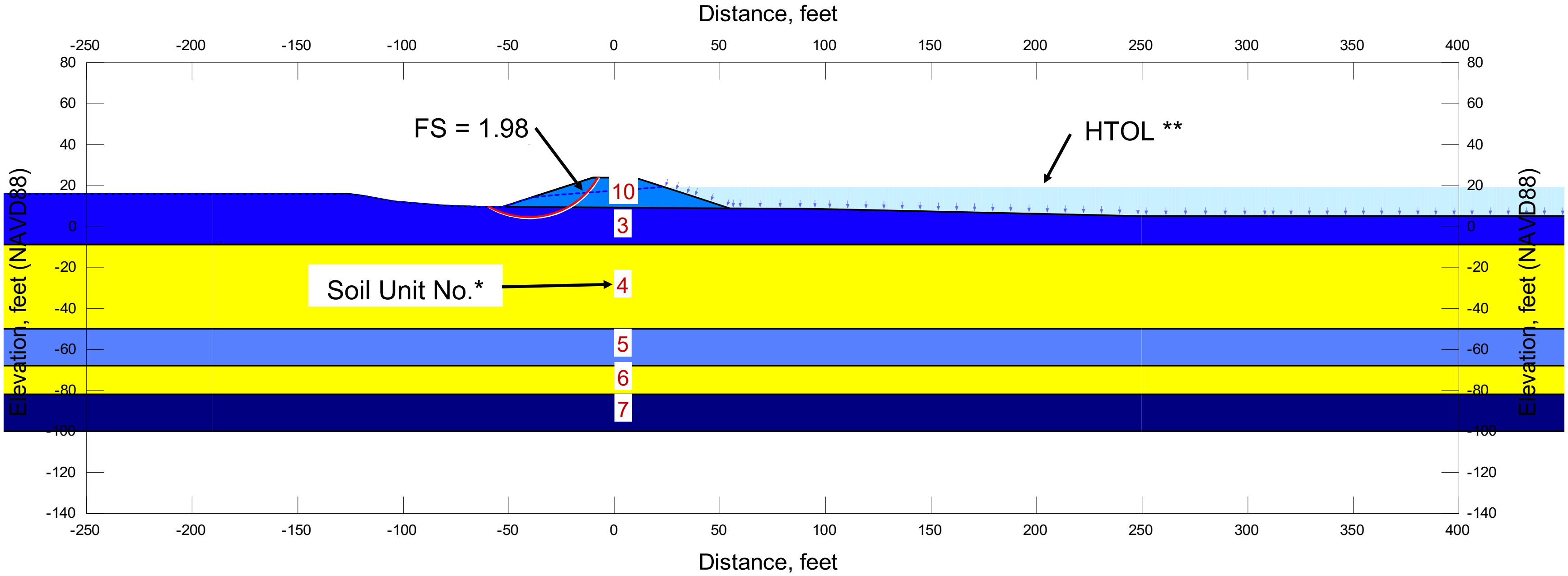
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction** **Mellin - Station 41+00** **Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-54



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

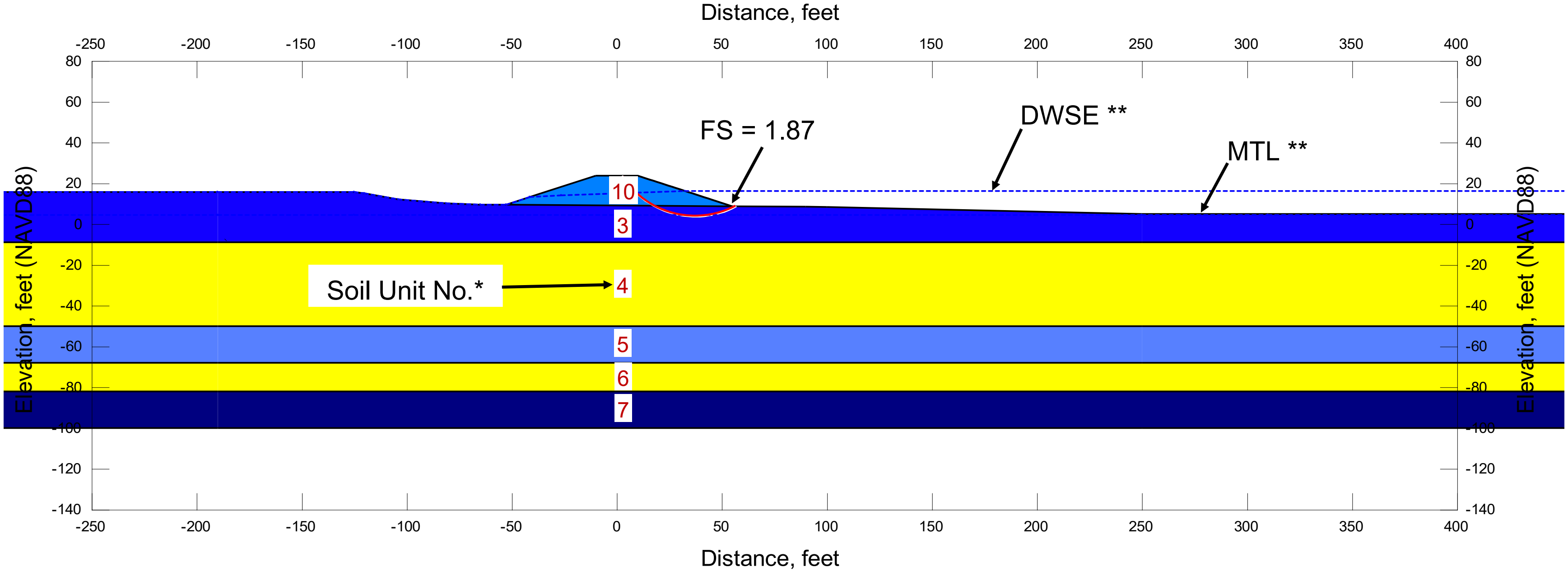
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage Mellin - Station 41+00 Rehabilitated Levee - DWSE / MTL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-55



*   See Plate F-1 for material (soil unit) properties of stability model
**   Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

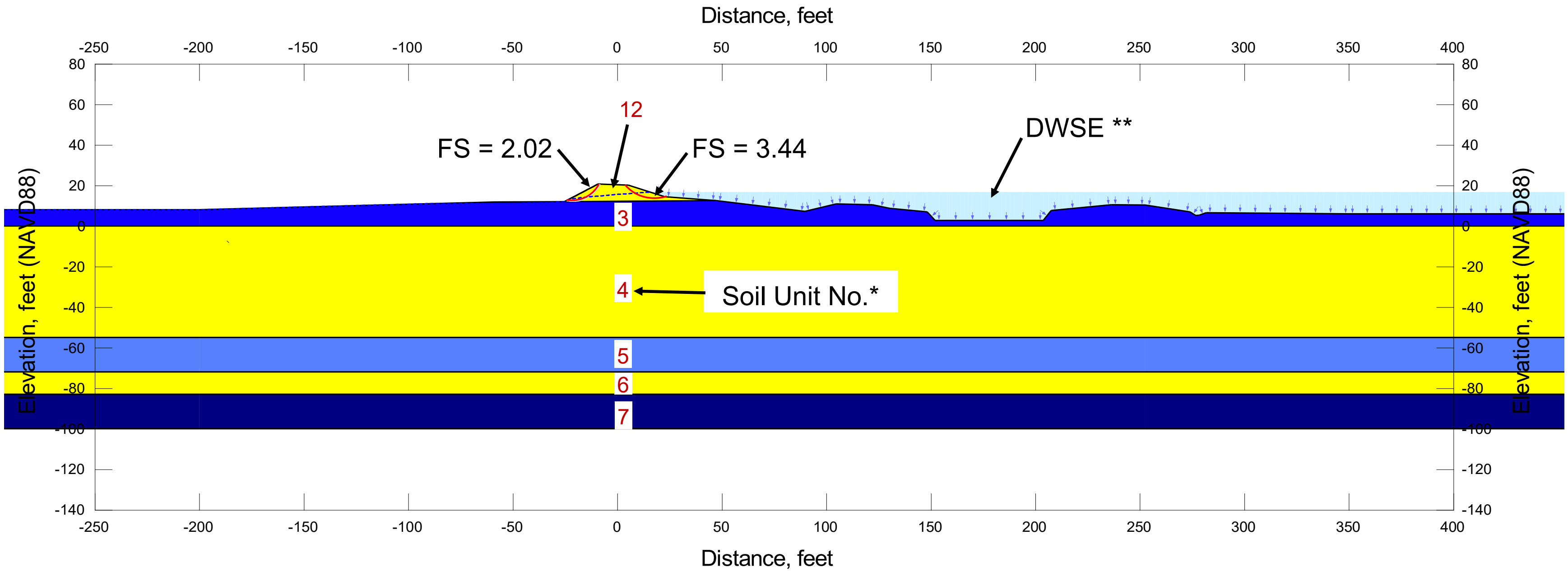
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 41+00** **Rehabilitated Levee - HTOL**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-56



* See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **Mellin - Station 41+00** **Rehabilitated Levee**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-57

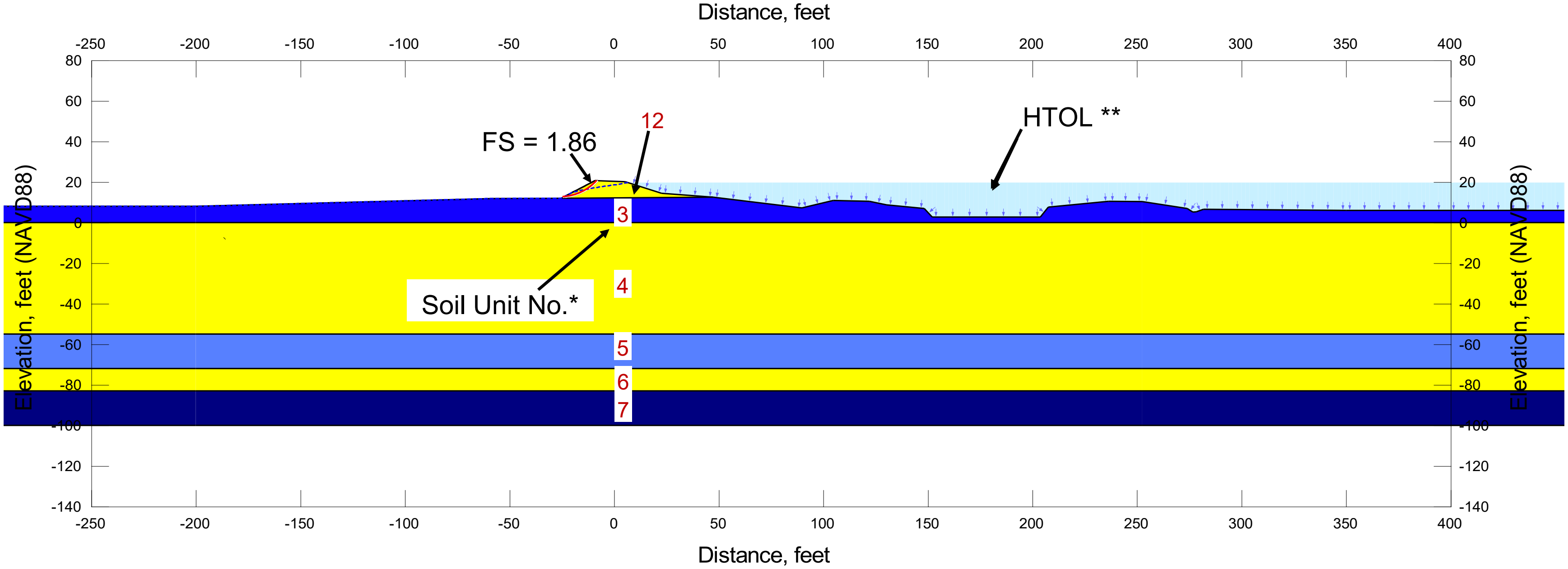


* See Plate F-1 for material (soil unit) properties of stability model

** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 66+00** **Existing Levee - DWSE / MTL**

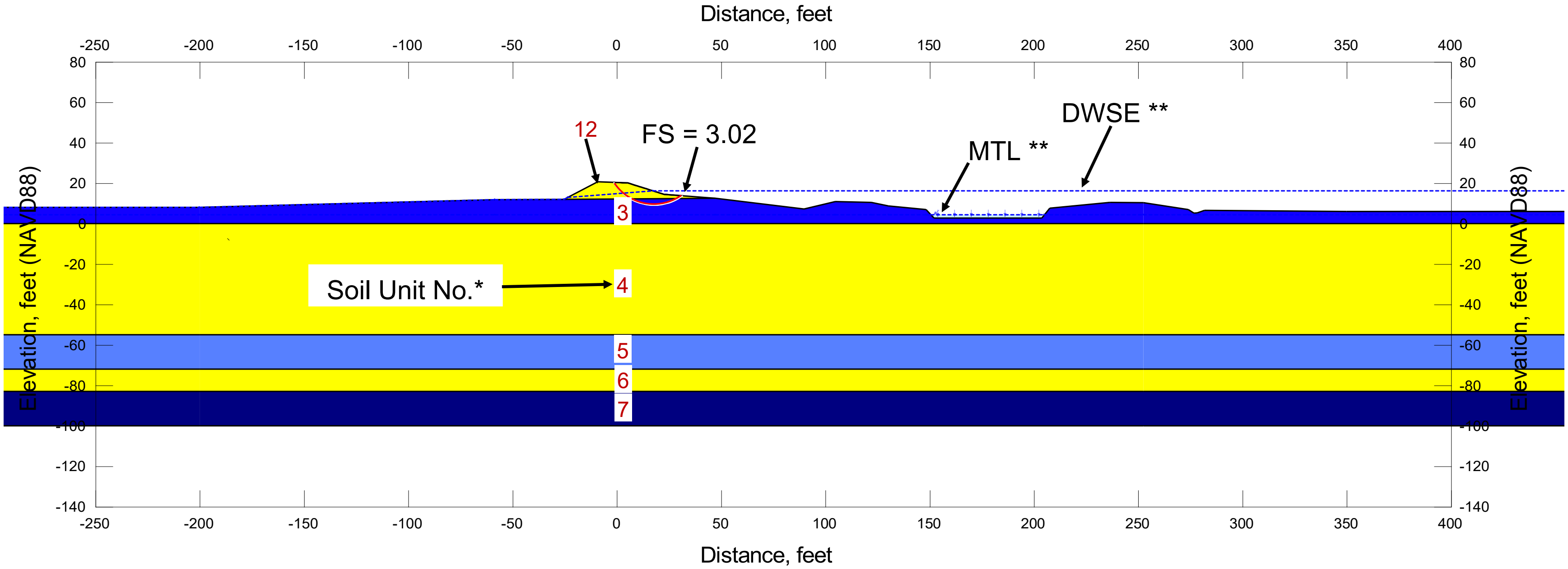
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-58



* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 66+00** **Existing Levee - HTOL**

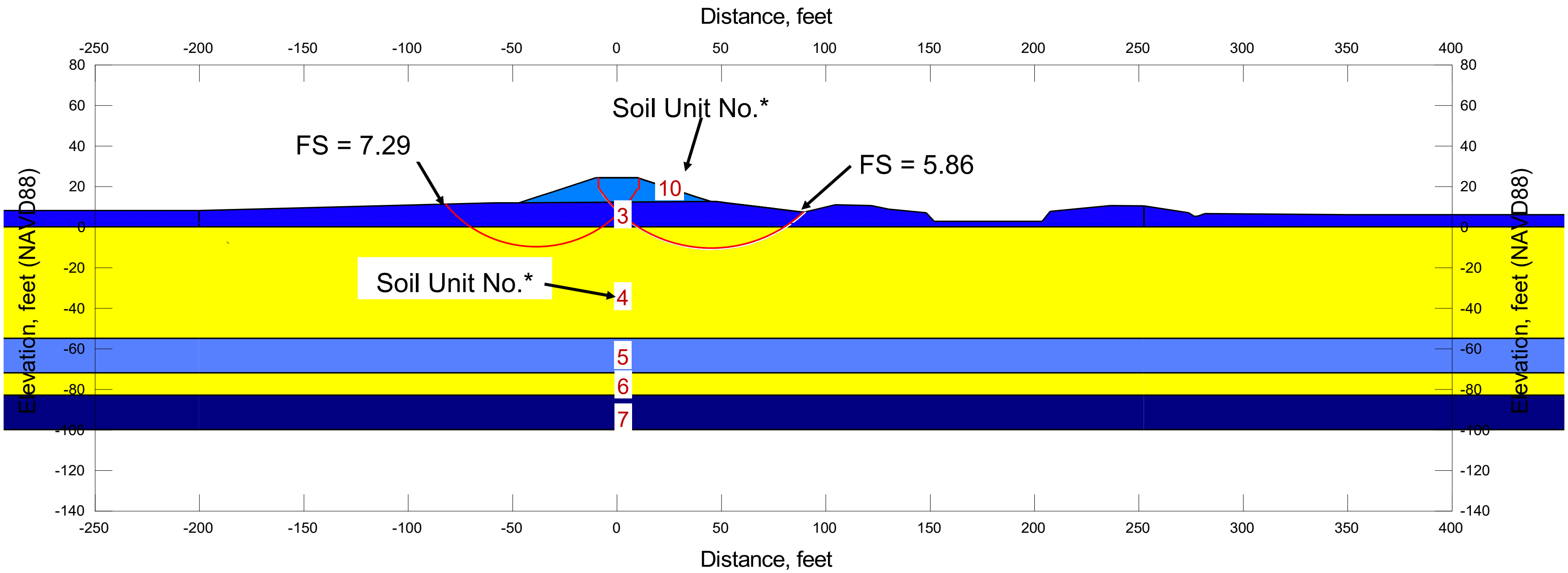
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-59



* See Plate F-1 for material (soil unit) properties of stability model

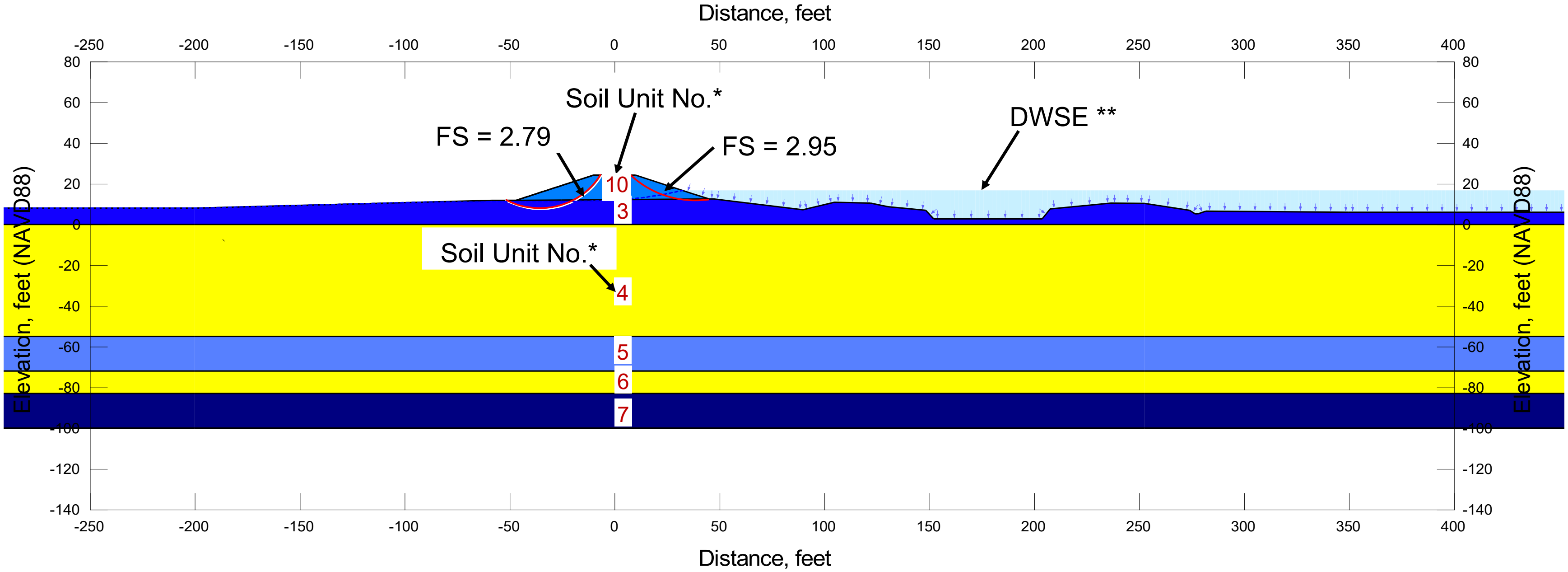
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **Mellin - Station 66+00** **Existing Levee**	
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-60



* See Plate F-1 for material (soil unit) properties of stability model
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

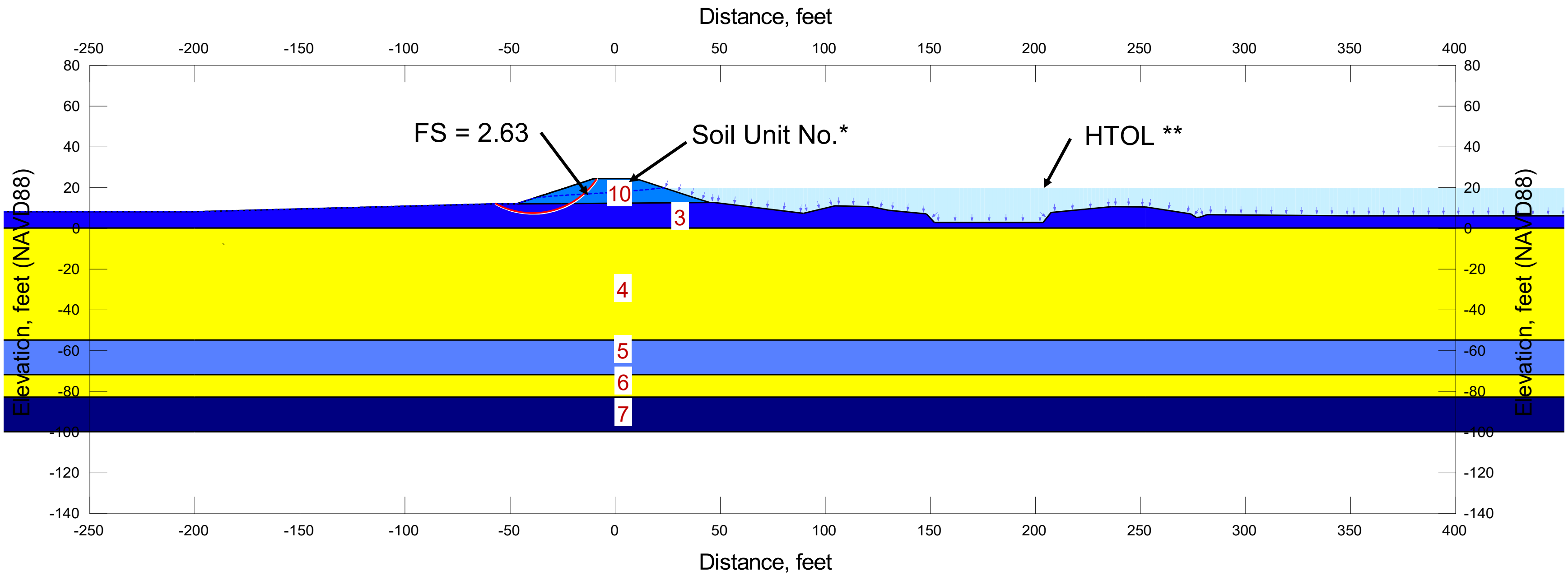
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction Mellin - Station 66+00 Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03
	Plate No. F-61



* See Plate F-1 for material (soil unit) properties of stability model

** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

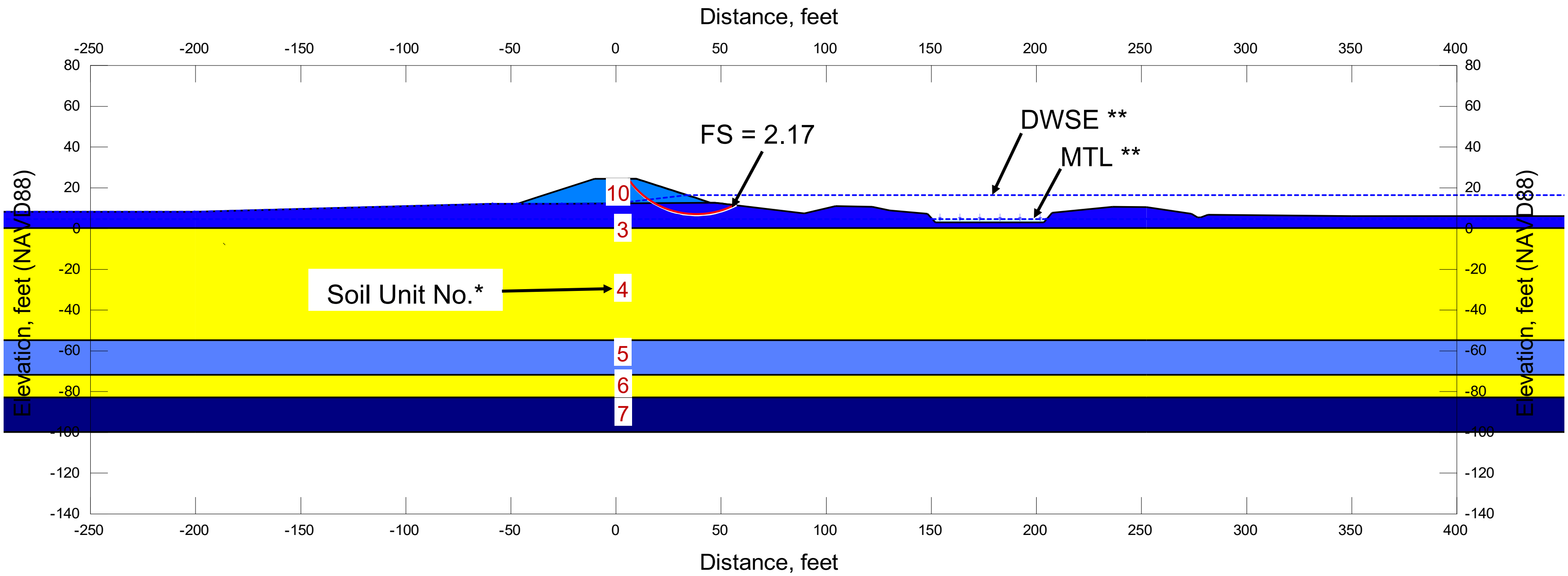
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage Mellin - Station 66+00 Rehabilitated Levee - DWSE / MTL**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-62



* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

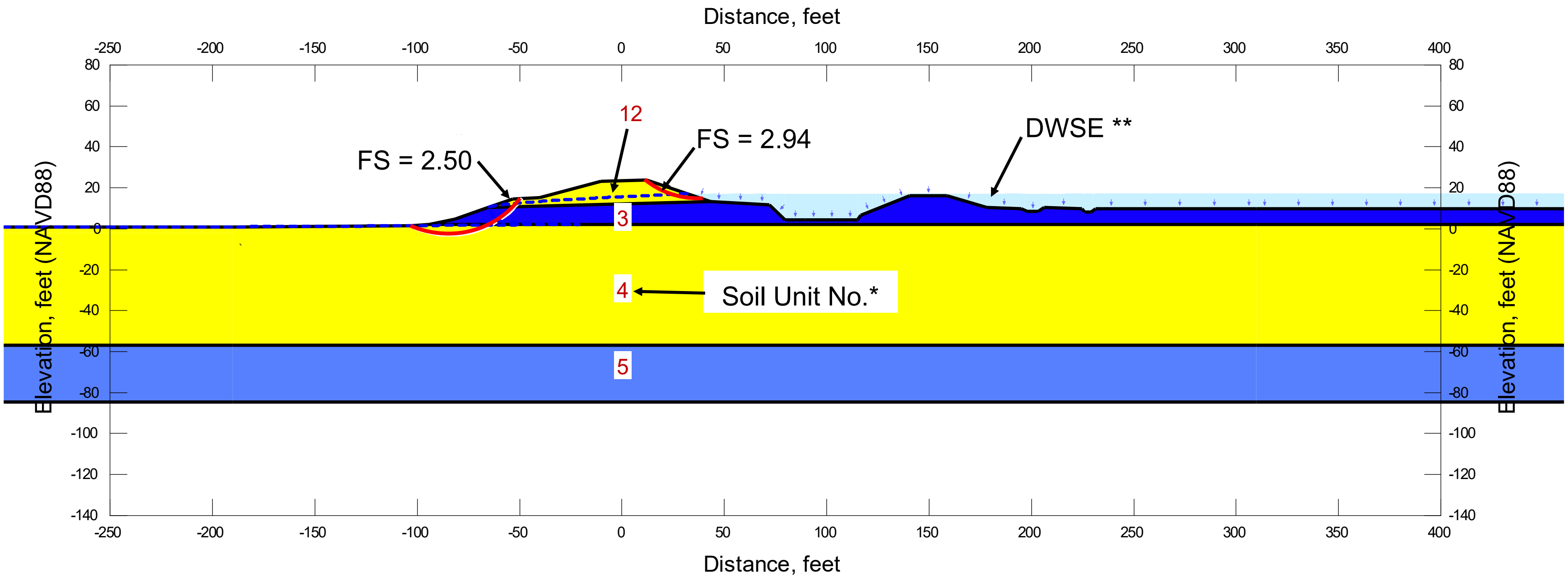
Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 66+00** **Rehabilitated Levee - HTOL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-63



*   See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California		**Slope Stability Results - Rapid Drawdown Mellin - Station 66+00 Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-64

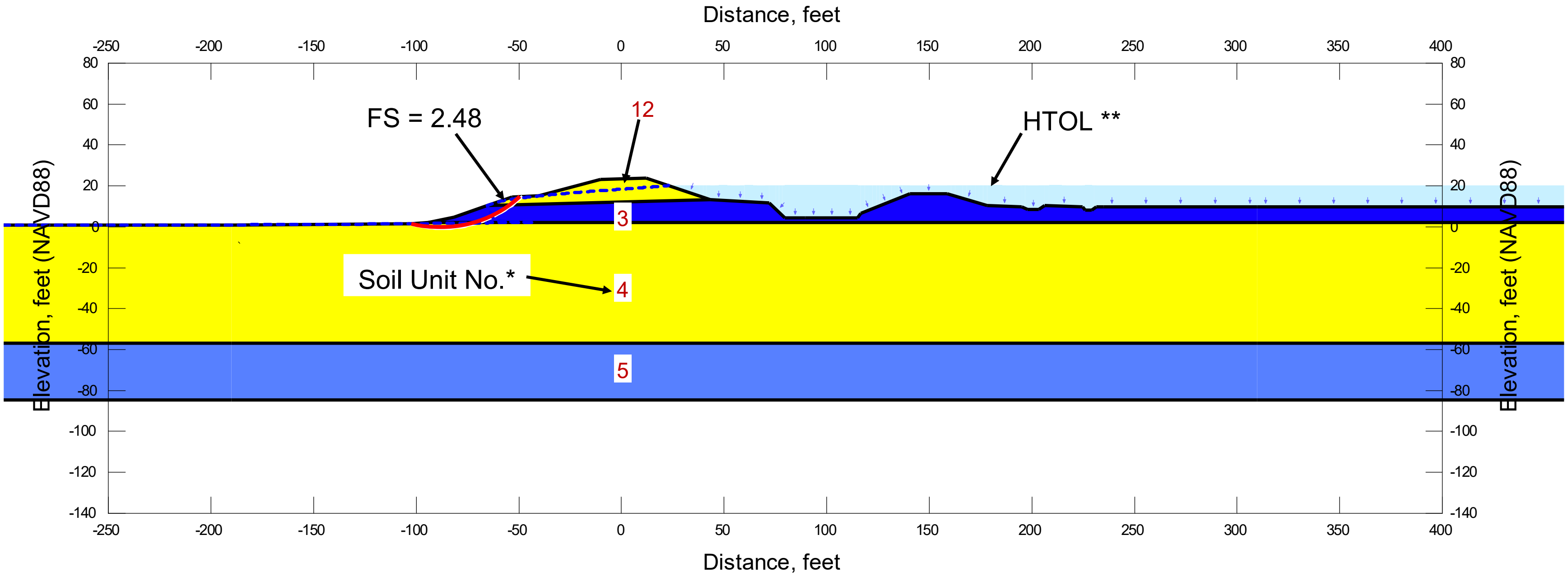


* See Plate F-1 for material (soil unit) properties of stability model

** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 83+00** **Existing Levee - DWSE / MTL**

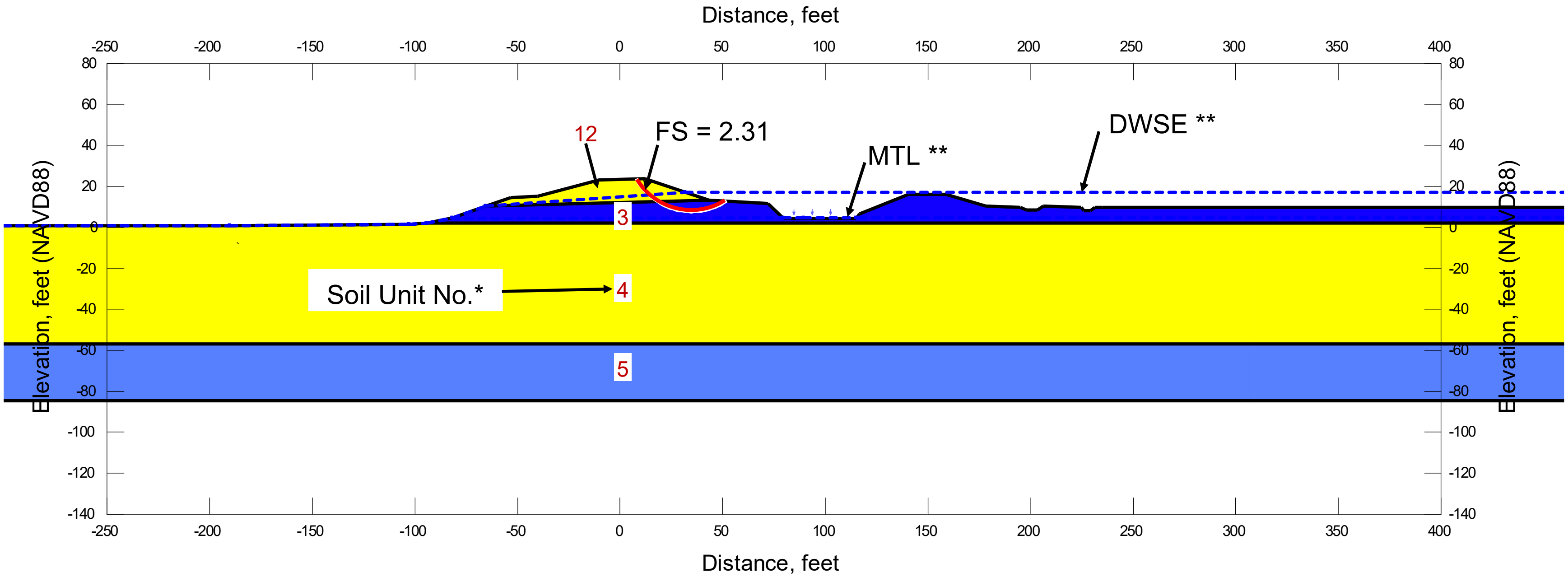
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-65



* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 83+00** **Existing Levee - HTOL**

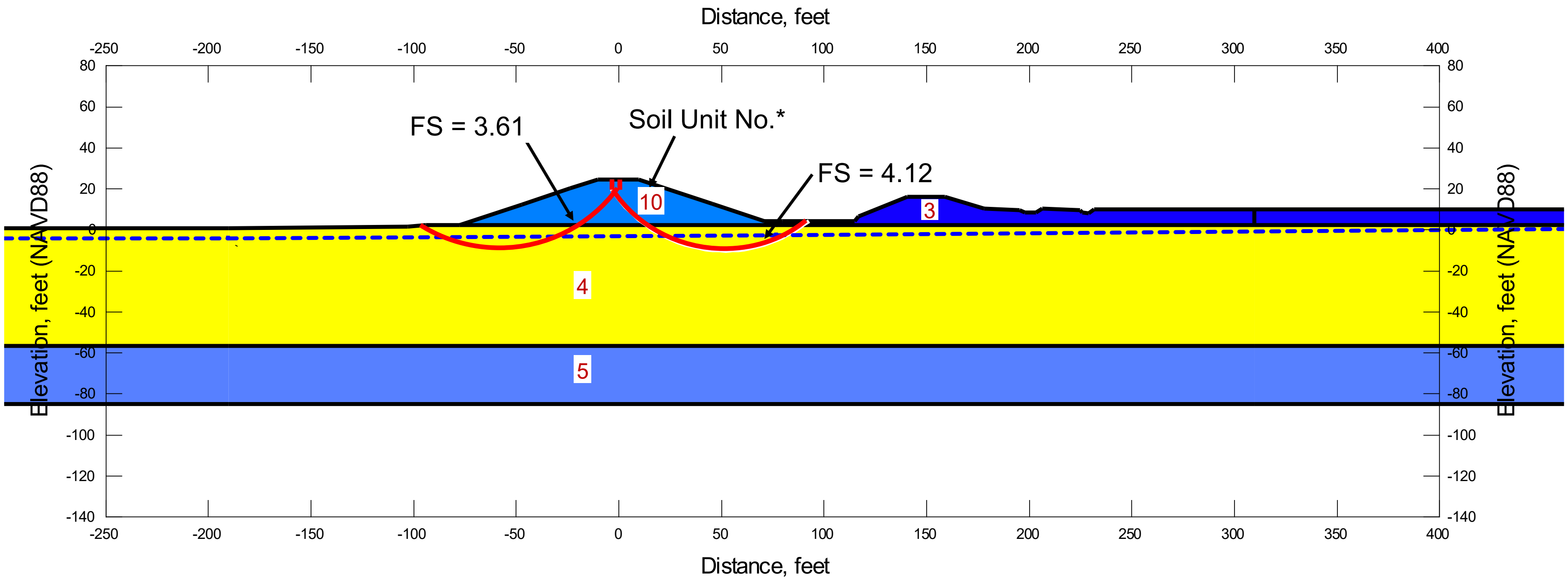
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-66



*   See Plate F-1 for material (soil unit) properties of stability model

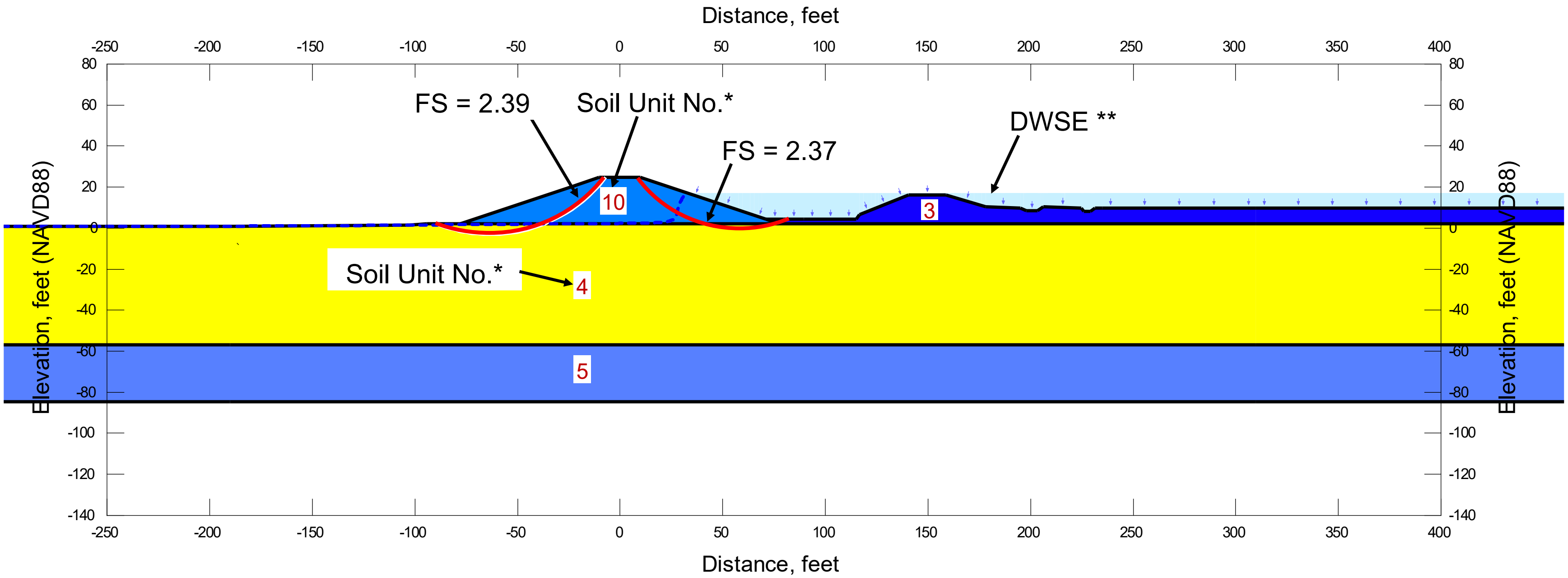
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **Mellin - Station 83+00** **Existing Levee**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. F-67



* See Plate F-1 for material (soil unit) properties of stability model
** Groundwater surface approximately 5 feet below slope toe was used in both landside (LS) and waterside (WS) slope stability analyses.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - End of Construction** **Mellin - Station 83+00** **Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03 — Plate No. F-68

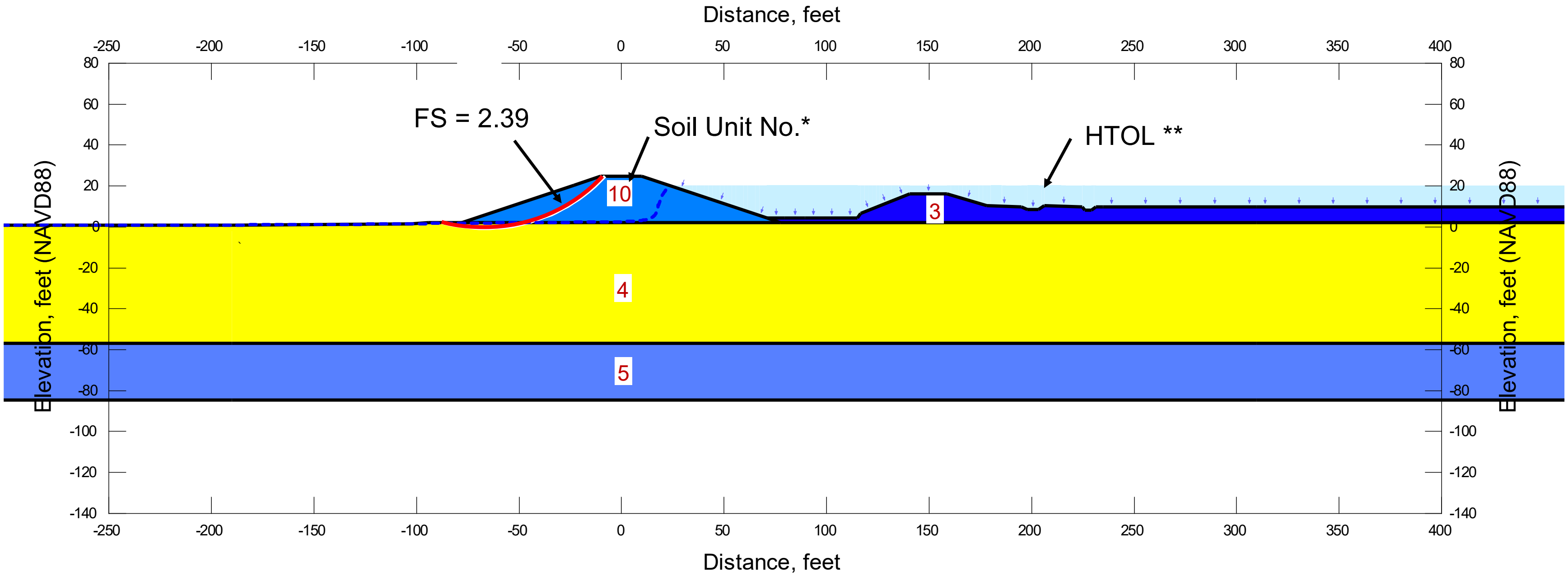


* See Plate F-1 for material (soil unit) properties of stability model

** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used in landside (LS) and waterside (WS) slope stability analyses, respectively.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 83+00** **Rehabilitated Levee - DWSE / MTL**

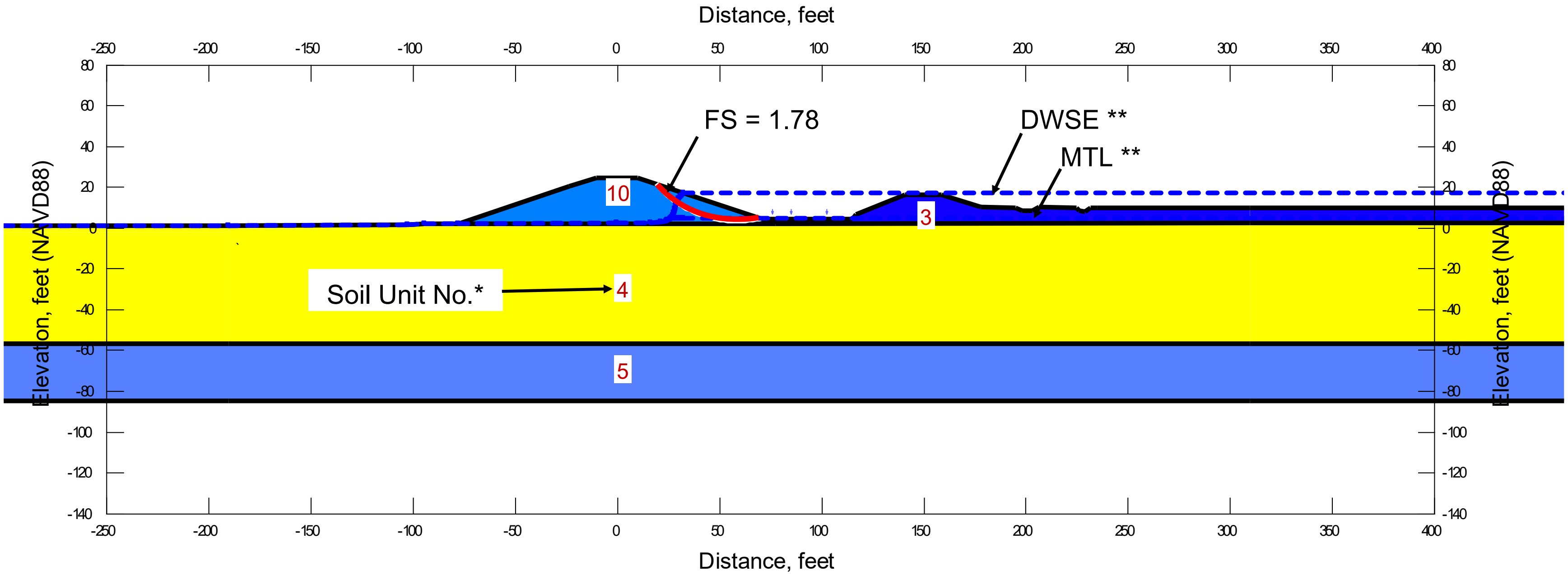
Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-69



* See Plate F-1 for material (soil unit) properties of stability model
** Hydraulic Top of Levee (HTOL) water surface was used in landside (LS) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Steady State Seepage** **Mellin - Station 83+00** **Rehabilitated Levee - HTOL**

Shannon & Wilson, Inc.	Project No. 907.03	Plate No. F-70



*   See Plate F-1 for material (soil unit) properties of stability model
** Design water surface elevation (DWSE) and mean-tide-level (MTL) were used for the rapid drawdown (RDD) slope stability analysis.

Little Egbert Multi-Benefit Project Solano County, California	**Slope Stability Results - Rapid Drawdown** **Mellin - Station 83+00** **Rehabilitated Levee**
Shannon & Wilson, Inc.	Project No. 907.03 / Plate No. F-71

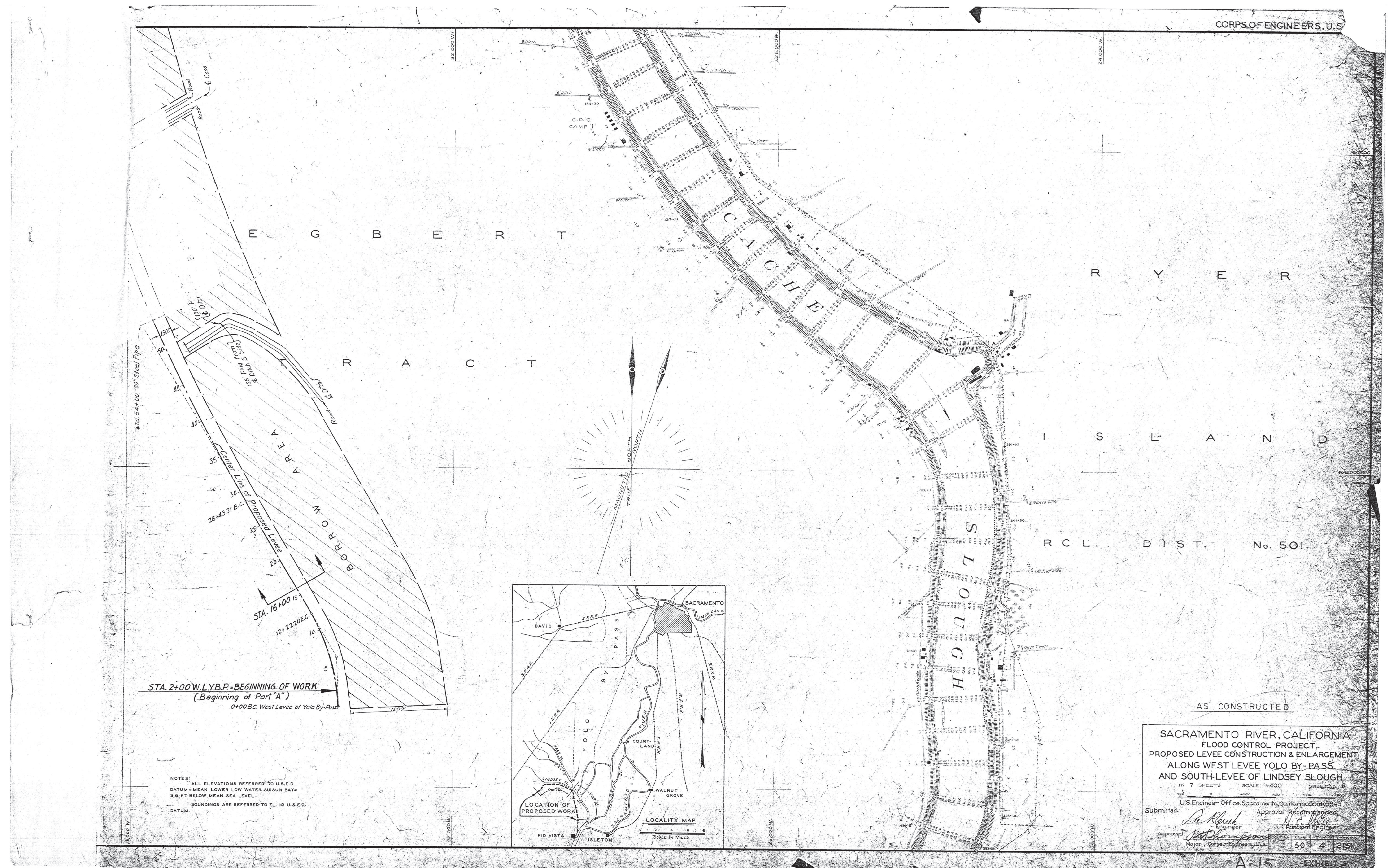
APPENDIX G: AS-BUILT DRAWINGS

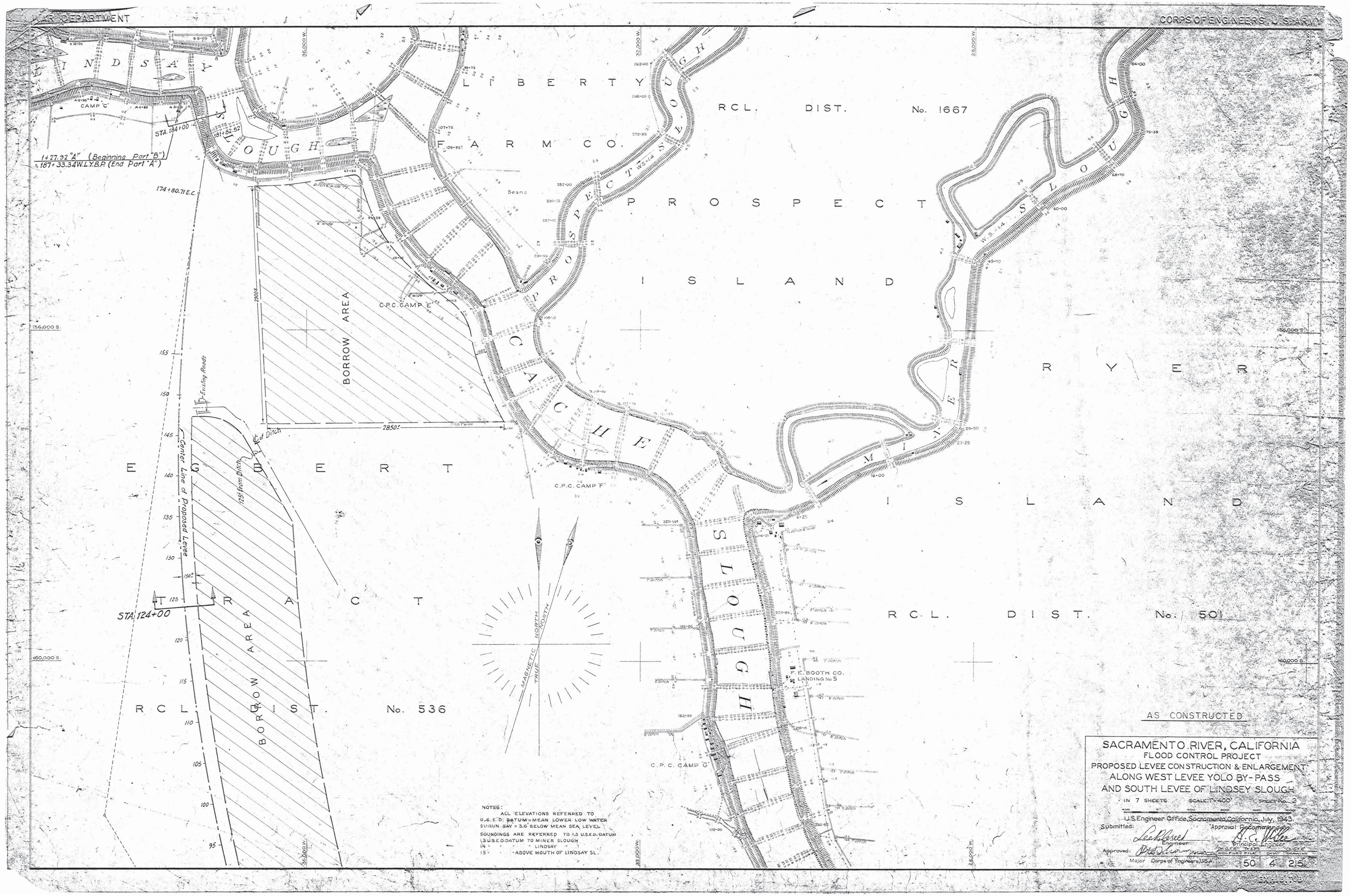
Appendix G

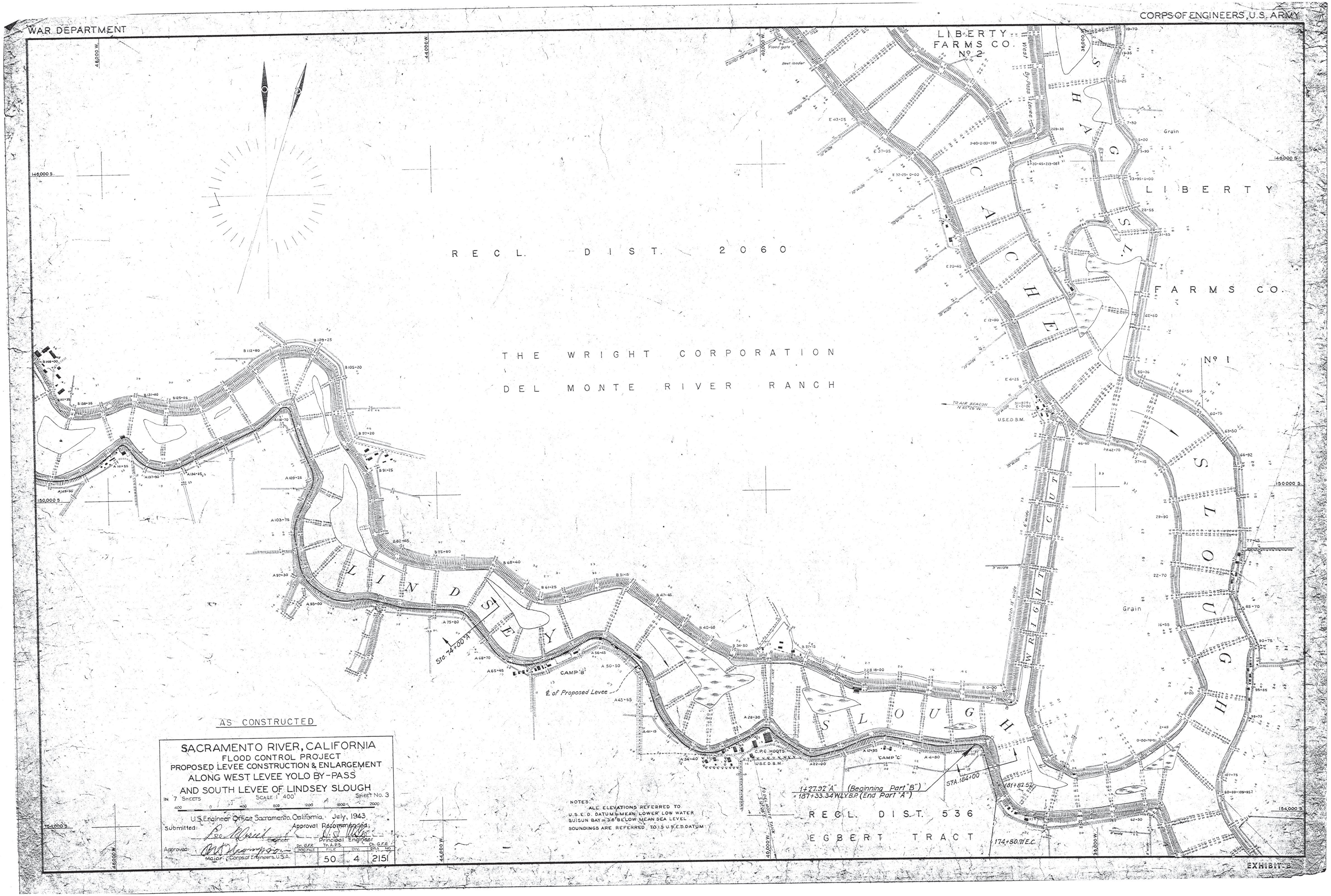
As-Built Drawings

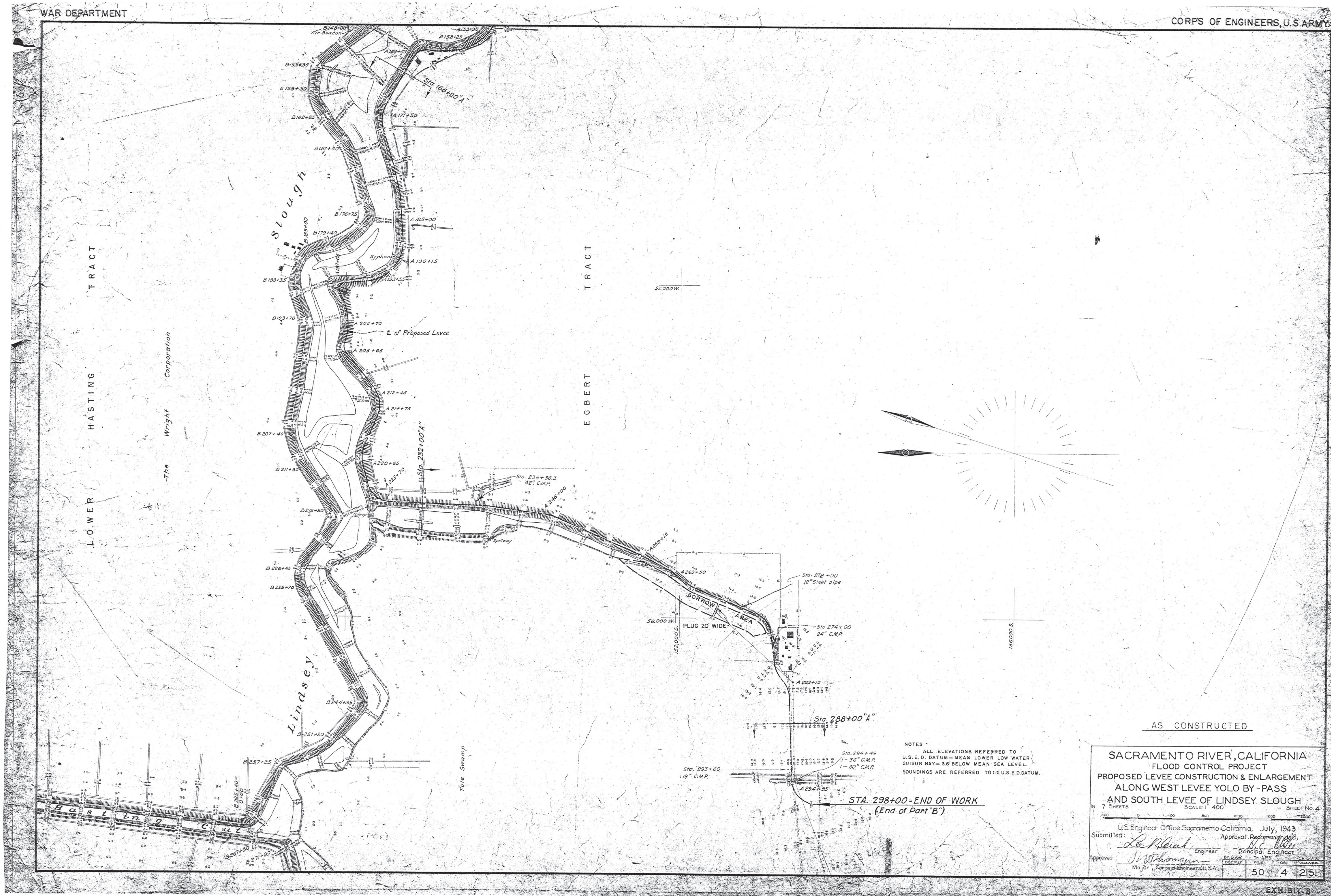
PLATES

Plates through	G-1 G-11	As-Built Drawings

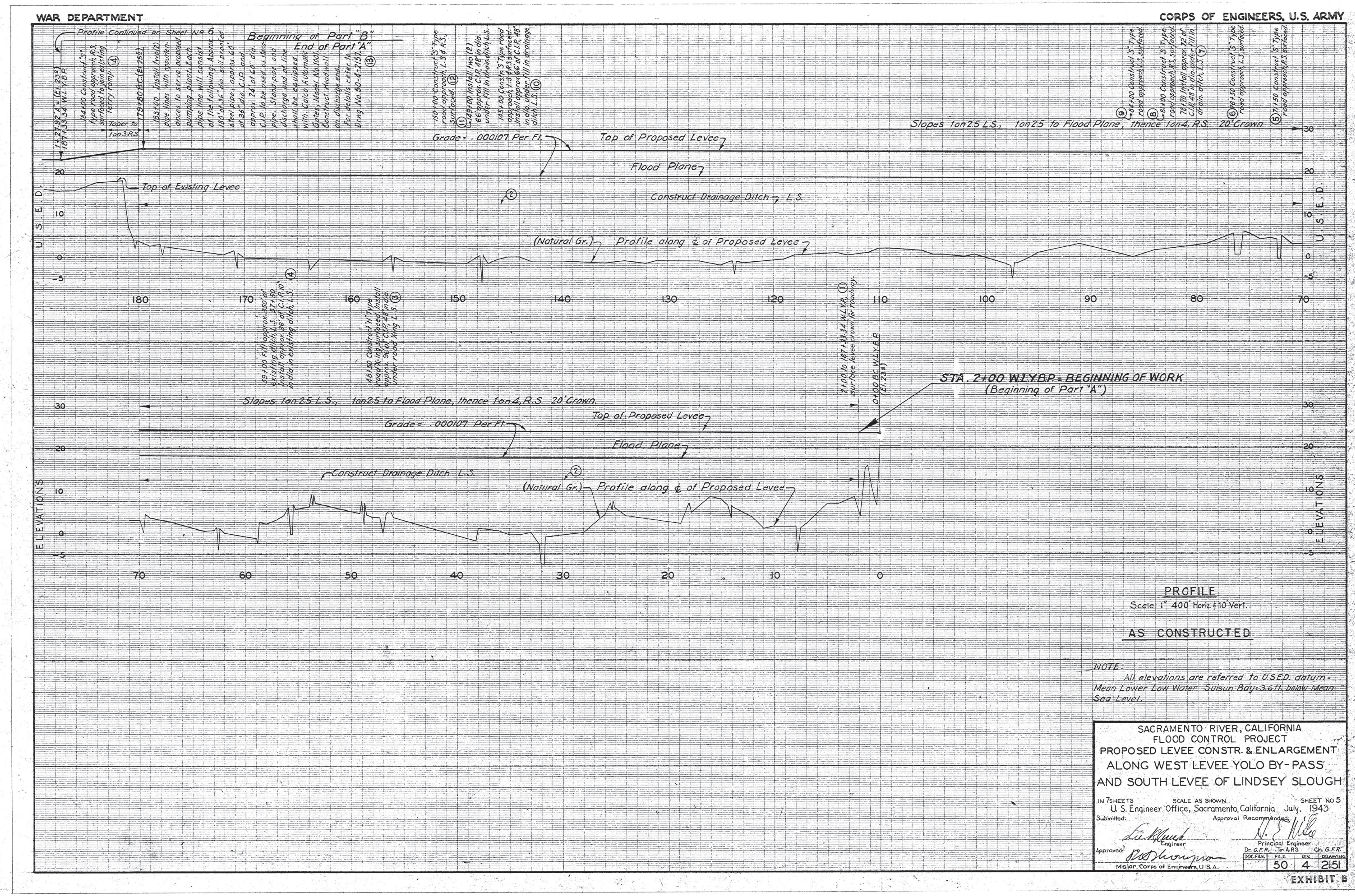

CORPS OF ENGINEERS, U.S.
EGBERT TRACT
RYER ISLAND
RCL. DIST. No. 501
CACHE SLOUGH
BORROW AREA
Center Line of Proposed Levee
STA. 16+00
STA. 2+00 W.L.Y.B.P. = BEGINNING OF WORK
(Beginning of Part "A")
0+00 B.C. West Levee of Yolo By-Pass
C.P.C. CAMP
MAGNETIC NORTH
TRUE NORTH
NOTES:
ALL ELEVATIONS REFERRED TO U.S.E.D.
DATUM = MEAN LOWER LOW WATER SUISUN BAY = 3.6 FT. BELOW MEAN SEA LEVEL.
SOUNDINGS ARE REFERRED TO EL. 13 U.S.E.D. DATUM.
SACRAMENTO
DAVIS
YOLO BY PASS
COURTLAND
WALNUT GROVE
RIO VISTA
ISLETON
LOCATION OF PROPOSED WORK
LOCALITY MAP
SCALE IN MILES
AS CONSTRUCTED
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
PROPOSED LEVEE CONSTRUCTION & ENLARGEMENT
ALONG WEST LEVEE YOLO BY-PASS
AND SOUTH LEVEE OF LINDSEY SLOUGH
IN 7 SHEETS SCALE: 1" = 400'
U.S. Engineer Office, Sacramento, California, July, 1943
Submitted:
Engineer
Approval Recommended:
Principal Engineer
Approved:
Major, Corps of Engineers, U.S.A.
FILE 50
DIV. 4
DRAWING 2151
A-15
EXHIBIT

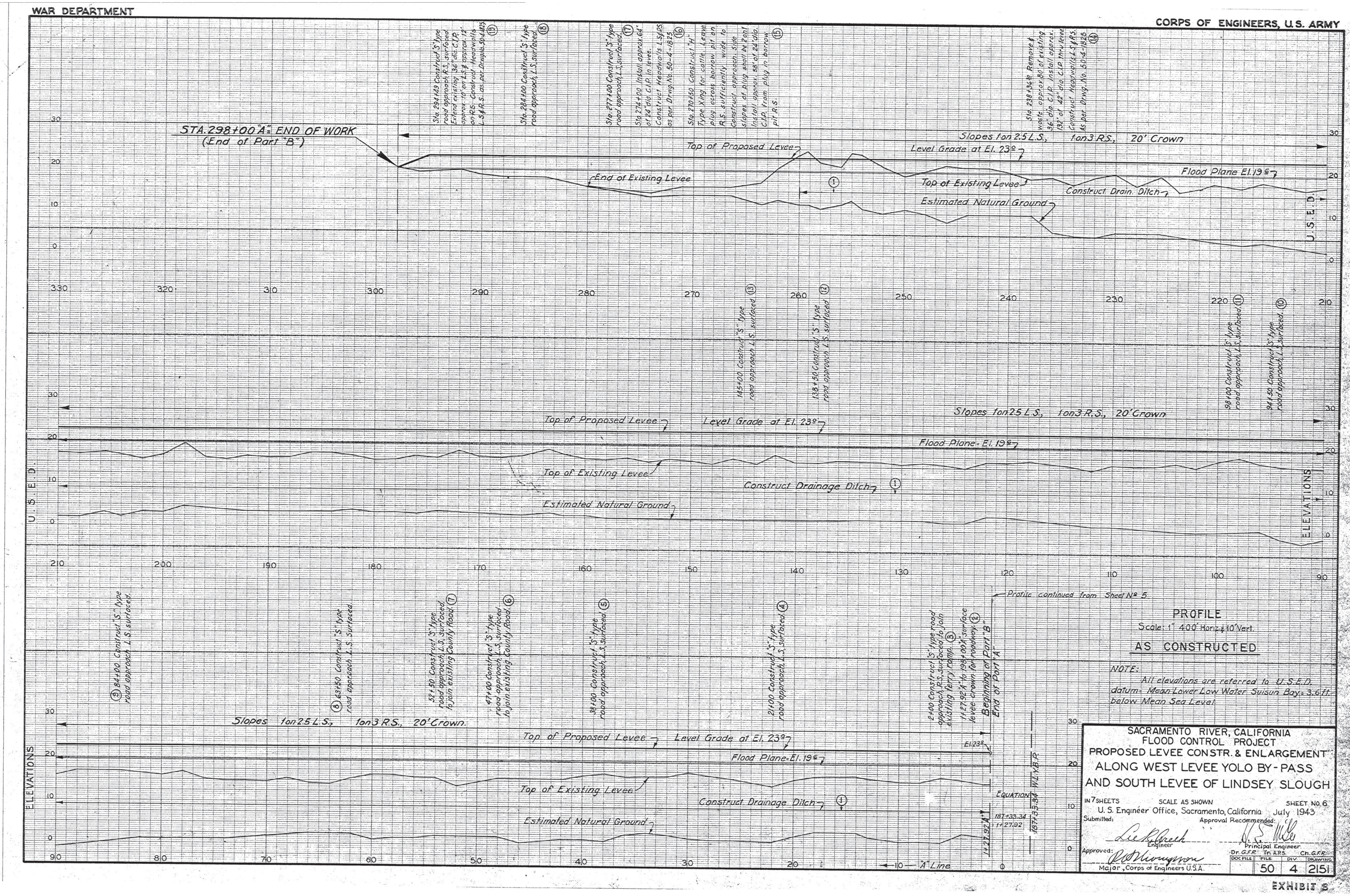

WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
LINDSAY SLOUGH
LIBERTY FARM CO.
RCL. DIST. No. 1667
PROSPECT SLOUGH
PROSPECT ISLAND
MINER SLOUGH
RYER ISLAND
RCL. DIST. No. 501
CACHE SLOUGH
EGBERT TRACT
RCL. DIST. No. 536
BORROW AREA
C.P.C. CAMP "E"
C.P.C. CAMP "F"
C.P.C. CAMP "G"
F. E. BOOTH CO. LANDING No. 5
Center Line of Proposed Levee
STA. 124+00
STA. 184+00
1+27.92 "A" (Beginning Part "B")
187+33.34 W.L.Y.B.P. (End Part "A")
174+80.71 E.C.
Existing Roads
MAGNETIC NORTH
TRUE NORTH
NOTES:
ALL ELEVATIONS REFERRED TO U.S.E.D. DATUM = MEAN LOWER LOW WATER SUISUN BAY = 3.0' BELOW MEAN SEA LEVEL
SOUNDINGS ARE REFERRED TO 1.3 U.S.E.D. DATUM
AS CONSTRUCTED
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
PROPOSED LEVEE CONSTRUCTION & ENLARGEMENT
ALONG WEST LEVEE YOLO BY-PASS
AND SOUTH LEVEE OF LINDSEY SLOUGH
IN 7 SHEETS SCALE: 1"=400' SHEET No. 2
U.S. Engineer Office, Sacramento, California, July, 1943
Submitted:
Engineer
Approval Recommended:
Principal Engineer
Approved:
Major Corps of Engineers, U.S.A.
50 4 251

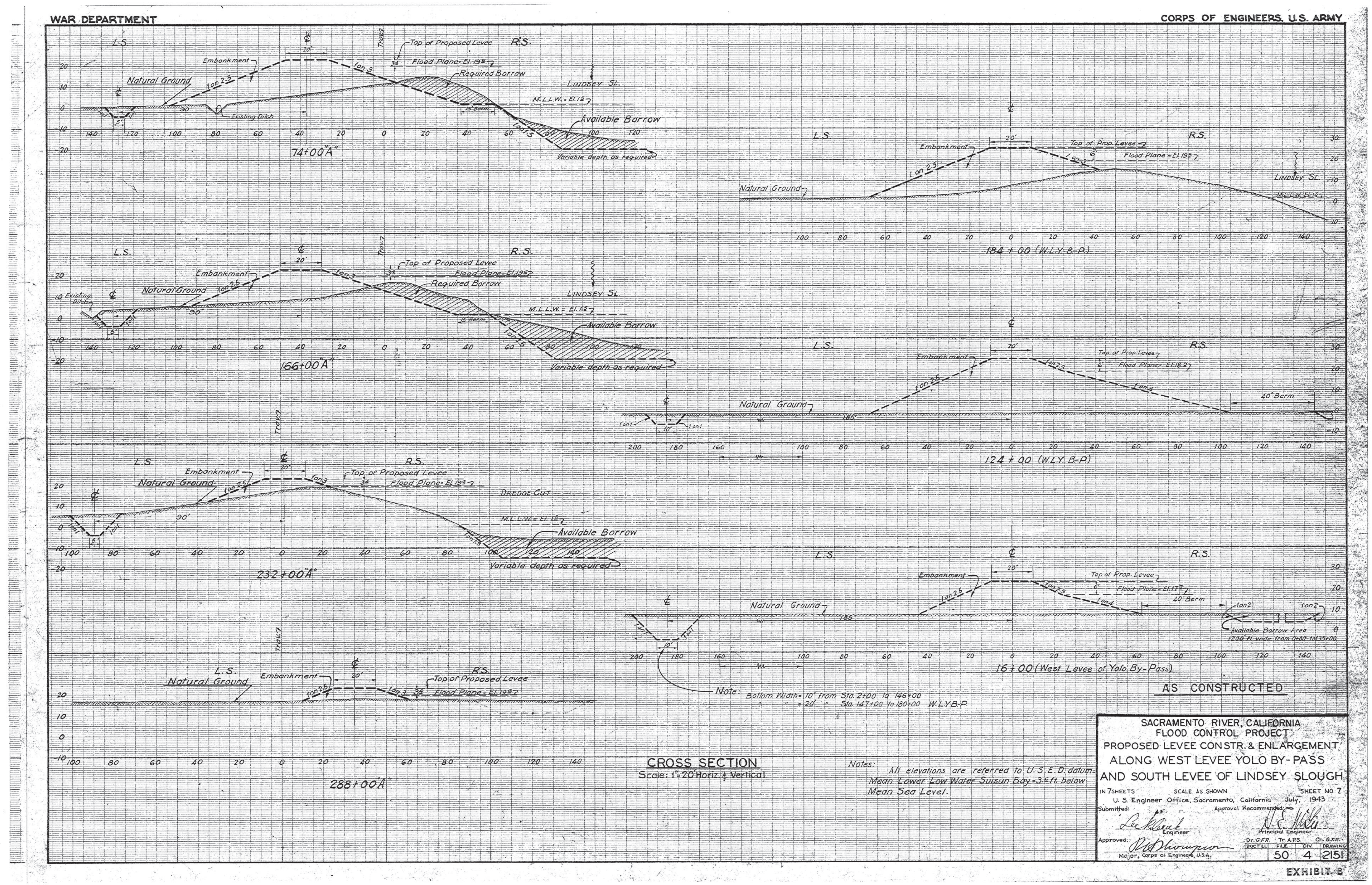

WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
LIBERTY FARMS CO. No. 2
CACHE SLOUGH
LIBERTY FARMS CO. No. 1
RECL. DIST. 2060
THE WRIGHT CORPORATION
DEL MONTE RIVER RANCH
LINDSEY SLOUGH
WRIGHT CUT
SLOUGH
Grain
CAMP "B"
CAMP "C"
℄ of Proposed Levee
NOTES:
ALL ELEVATIONS REFERRED TO U.S.E.D. DATUM = MEAN LOWER LOW WATER SUISUN BAY = 3.0 BELOW MEAN SEA LEVEL
SOUNDINGS ARE REFERRED TO U.S.E.D. DATUM
1+27.92 "A" (Beginning Part "B") = 187+33.34 W.L.Y.B.P. (End Part "A")
STA. 184+00
RECL. DIST. 536
EGBERT TRACT
AS CONSTRUCTED
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
PROPOSED LEVEE CONSTRUCTION & ENLARGEMENT
ALONG WEST LEVEE YOLO BY-PASS
AND SOUTH LEVEE OF LINDSEY SLOUGH
IN 7 SHEETS
SCALE 1" 400'
SHEET No. 3
U.S. Engineer Office Sacramento, California, July, 1943.
Submitted:
Engineer
Approval Recommended;
Principal Engineer
Approved:
Major, Corps of Engineers, U.S.A.
DOC. FILE
FILE 50
DIV. 4
DRAWING 2151
EXHIBIT B

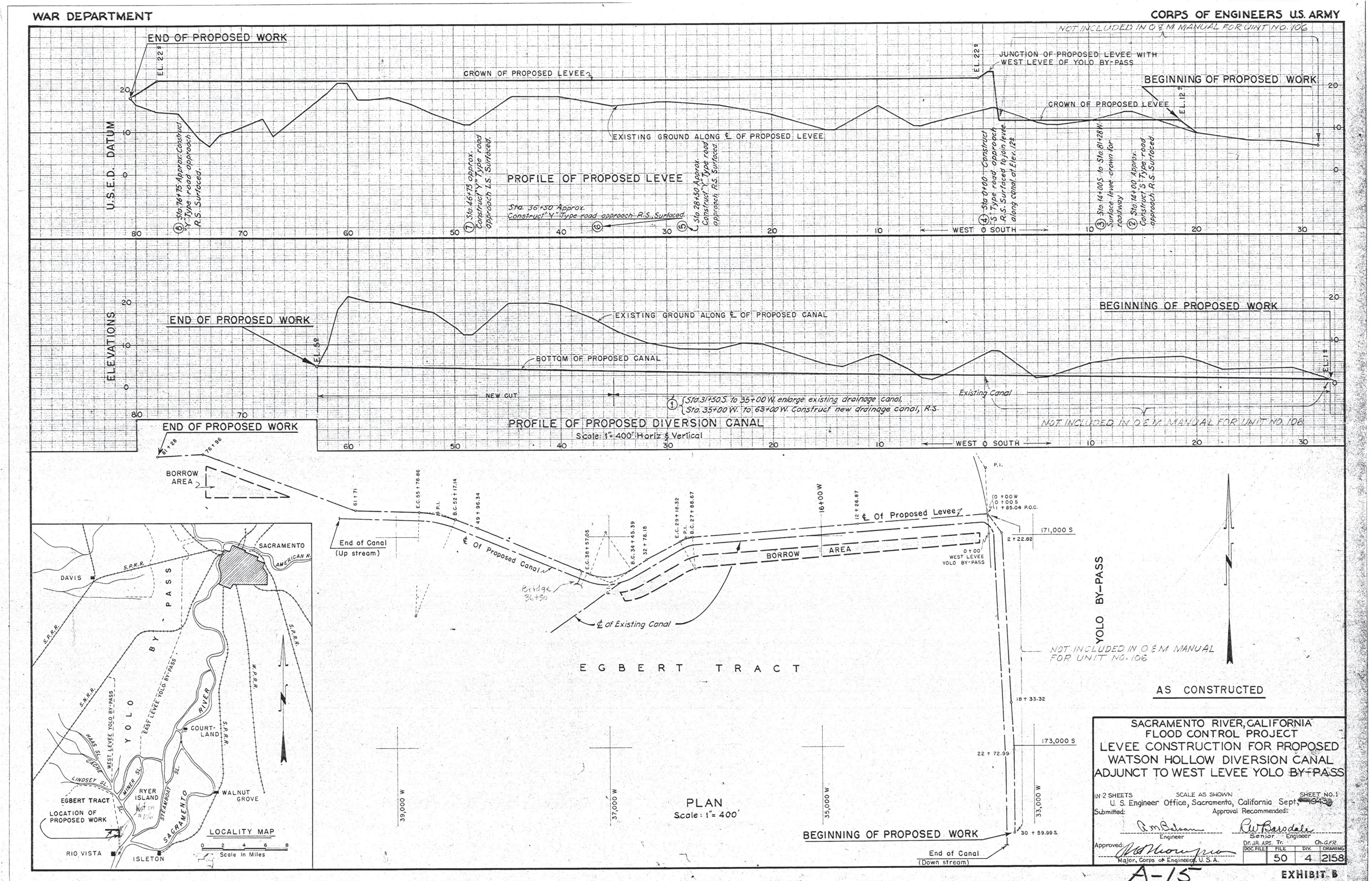


WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
LOWER HASTING TRACT
The Wright Corporation
EGBERT TRACT
Lindsey Slough
Hasting Cut
Tule Swamp
℄ of Proposed Levee
Sta. 166+00 "A"
Sta. 232+00 "A"
Sta. 288+00 "A"
BORROW AREA
PLUG 20' WIDE
Sta. 272+00 12" Steel pipe
Sta. 274+00 24" C.M.P.
Sta. 238+36.3 42" C.M.P.
Sta. 293+60 18" C.M.P.
Sta. 294+49 1-36" C.M.P. 1-60" C.M.P.
Syphon
Spillway
Air Beacon
STA. 298+00 = END OF WORK
(End of Part "B")
AS CONSTRUCTED
NOTES -
ALL ELEVATIONS REFERRED TO U.S.E.D. DATUM = MEAN LOWER LOW WATER SUISUN BAY = 3.6' BELOW MEAN SEA LEVEL.
SOUNDINGS ARE REFERRED TO 1.5 U.S.E.D. DATUM.
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
PROPOSED LEVEE CONSTRUCTION & ENLARGEMENT
ALONG WEST LEVEE YOLO BY-PASS
AND SOUTH LEVEE OF LINDSEY SLOUGH
IN 7 SHEETS
SCALE 1" 400'
SHEET No. 4
U.S. Engineer Office Sacramento California, July, 1943
Submitted:
Engineer
Approval Recommended;
Principal Engineer
Approved:
Major, Corps of Engineers, U.S.A.
50 4 2151
EXHIBIT-3

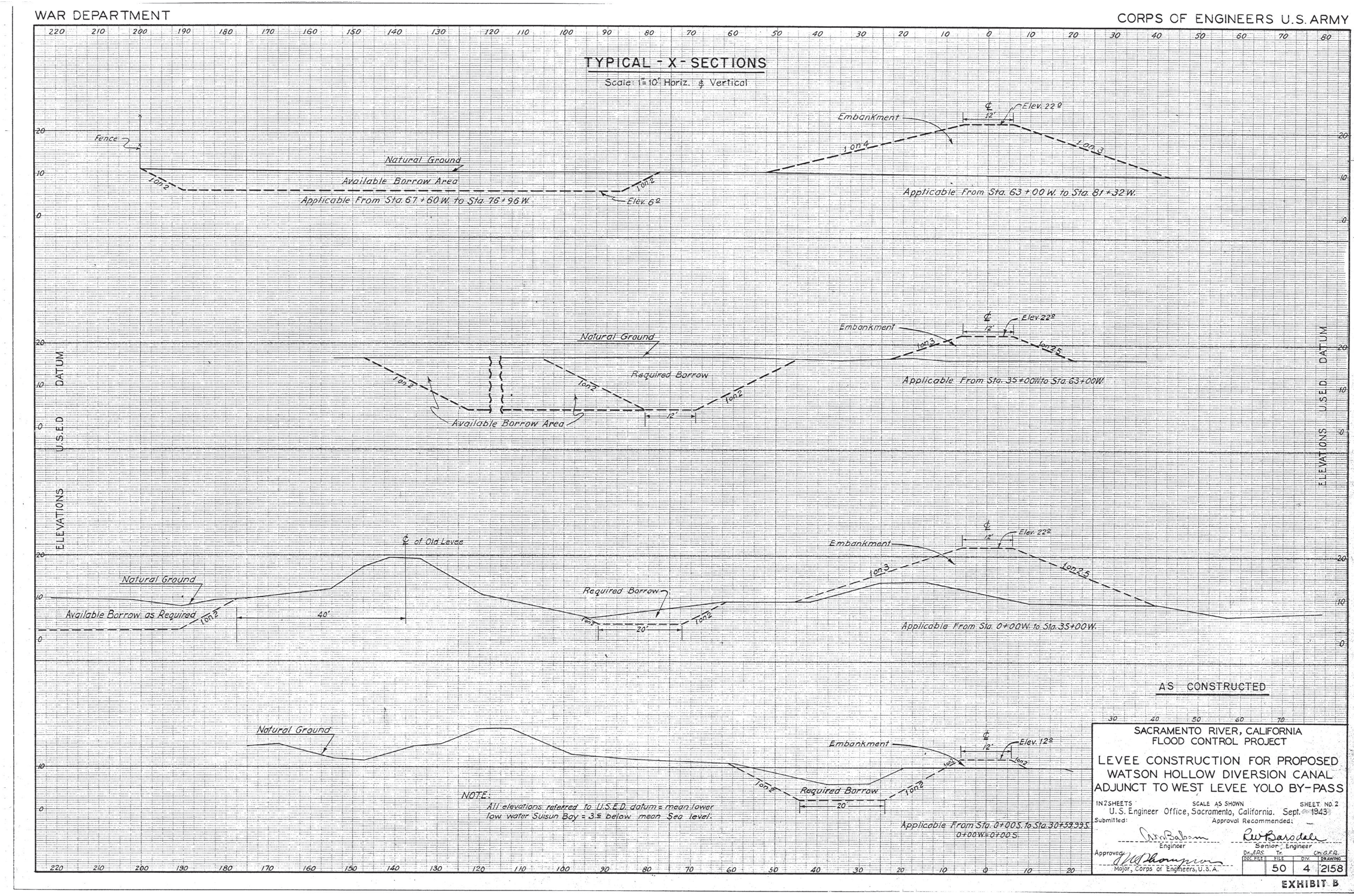

WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
Profile Continued on Sheet No 6
Beginning of Part "B"
End of Part "A"
Top of Proposed Levee
Flood Plane
Top of Existing Levee
Construct Drainage Ditch L.S.
(Natural Gr.) Profile along ℄ of Proposed Levee
Grade = .000107 Per Ft.
Slopes 1 on 2.5 L.S., 1 on 2.5 to Flood Plane, thence 1 on 4, R.S. 20' Crown
STA. 2+00 W.L.Y.B.P. = BEGINNING OF WORK
(Beginning of Part "A")
U.S.E.D.
ELEVATIONS
PROFILE
Scale: 1" = 400' Horiz. & 10' Vert.
AS CONSTRUCTED
NOTE:
All elevations are referred to U.S.E.D. datum = Mean Lower Low Water Suisun Bay, 3.6 ft. below Mean Sea Level.
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
PROPOSED LEVEE CONSTR. & ENLARGEMENT
ALONG WEST LEVEE YOLO BY-PASS
AND SOUTH LEVEE OF LINDSEY SLOUGH
IN 7 SHEETS
SCALE AS SHOWN
SHEET NO 5
U.S. Engineer Office, Sacramento, California July, 1943
Submitted:
Approval Recommended:
Engineer
Principal Engineer
Approved:
Major, Corps of Engineers, U.S.A.
50 4 2151
EXHIBIT B


WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
STA. 298+00 "A" END OF WORK
(End of Part "B")
Slopes 1 on 2.5 L.S., 1 on 3 R.S., 20' Crown
Top of Proposed Levee
Level Grade at El. 23.0
Flood Plane El. 19.6
End of Existing Levee
Top of Existing Levee
Construct Drain Ditch
Estimated Natural Ground
U.S.E.D.
Construct Drainage Ditch
ELEVATIONS
Profile continued from Sheet No. 5
Beginning of Part "B"
End of Part "A"
EQUATION
"A" Line
PROFILE
Scale: 1" 400' Horiz. & 10' Vert.
AS CONSTRUCTED
NOTE:
All elevations are referred to U.S.E.D. datum = Mean Lower Low Water Suisun Bay = 3.6 ft. below Mean Sea Level.
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
PROPOSED LEVEE CONSTR. & ENLARGEMENT
ALONG WEST LEVEE YOLO BY-PASS
AND SOUTH LEVEE OF LINDSEY SLOUGH
IN 7 SHEETS
SCALE AS SHOWN
SHEET NO. 6
U.S. Engineer Office, Sacramento, California July 1943
Submitted:
Engineer
Approval Recommended:
Principal Engineer
Approved:
Major, Corps of Engineers U.S.A.
Dr. G.F.R. Tr. A.P.S. Ch. G.F.R.
DOC FILE FILE DIV. DRAWING
50 4 2151
EXHIBIT B

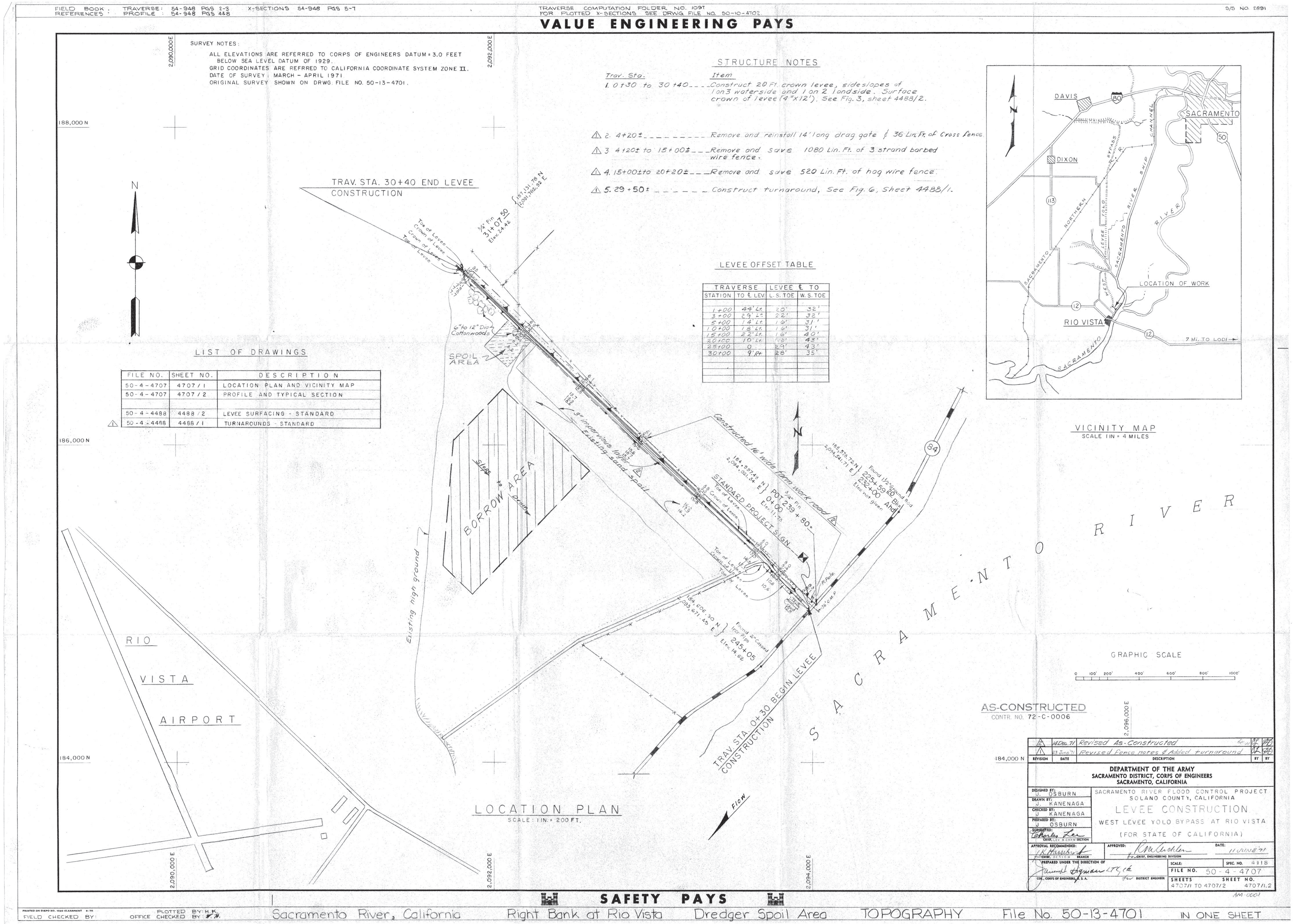

WAR DEPARTMENT
CORPS OF ENGINEERS, U.S. ARMY
74+00"A"
166+00"A"
232+00"A"
288+00"A"
184+00 (W.L.Y. B-P)
124+00 (W.L.Y. B-P)
16+00 (West Levee of Yolo By-Pass)
Top of Proposed Levee
Flood Plane
Required Borrow
Available Borrow
Variable depth as required
Natural Ground
Embankment
Existing Ditch
LINDSEY SL.
DREDGE CUT
40' Berm
Available Borrow Area
Note: Bottom Width = 10' from Sta. 2+00 to 146+00
= 20' " Sta. 147+00 to 180+00 W.L.Y.B-P.
AS CONSTRUCTED
CROSS SECTION
Scale: 1" = 20' Horiz. & Vertical
Notes: All elevations are referred to U.S.E.D. datum. Mean Lower Low Water Suisun Bay + 3± ft. below Mean Sea Level.
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
PROPOSED LEVEE CONSTR. & ENLARGEMENT
ALONG WEST LEVEE YOLO BY-PASS
AND SOUTH LEVEE OF LINDSEY SLOUGH
IN 7 SHEETS
SCALE AS SHOWN
SHEET NO. 7
U. S. Engineer Office, Sacramento, California July, 1943
Submitted:
Approval Recommended:
Engineer
Principal Engineer
Approved:
Major, Corps of Engineers, U.S.A.
50
4
2151
EXHIBIT B



WAR DEPARTMENT
CORPS OF ENGINEERS U.S. ARMY
END OF PROPOSED WORK
CROWN OF PROPOSED LEVEE
EXISTING GROUND ALONG ℄ OF PROPOSED LEVEE
PROFILE OF PROPOSED LEVEE
U.S.E.D. DATUM
JUNCTION OF PROPOSED LEVEE WITH WEST LEVEE OF YOLO BY-PASS
BEGINNING OF PROPOSED WORK
NOT INCLUDED IN O & M MANUAL FOR UNIT NO. 106
ELEVATIONS
EXISTING GROUND ALONG ℄ OF PROPOSED CANAL
BOTTOM OF PROPOSED CANAL
NEW CUT
Existing Canal
PROFILE OF PROPOSED DIVERSION CANAL
Scale: 1"=400' Horiz & Vertical
BORROW AREA
End of Canal (Up stream)
℄ Of Proposed Canal
℄ Of Proposed Levee
℄ of Existing Canal
E G B E R T   T R A C T
YOLO BY-PASS
AS CONSTRUCTED
PLAN
Scale: 1" = 400'
End of Canal (Down stream)
LOCALITY MAP
SACRAMENTO
DAVIS
RYER ISLAND
WALNUT GROVE
RIO VISTA
ISLETON
EGBERT TRACT
LOCATION OF PROPOSED WORK
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
LEVEE CONSTRUCTION FOR PROPOSED
WATSON HOLLOW DIVERSION CANAL
ADJUNCT TO WEST LEVEE YOLO BY-PASS
IN 2 SHEETS
SCALE AS SHOWN
SHEET NO. 1
U. S. Engineer Office, Sacramento, California
Submitted:
Approval Recommended:
Approved:
Major, Corps of Engineers, U.S.A.
50
4
2158
A-15
EXHIBIT B



WAR DEPARTMENT
CORPS OF ENGINEERS U.S. ARMY
TYPICAL - X - SECTIONS
Scale: 1"=10' Horiz. & Vertical
ELEVATIONS U.S.E.D. DATUM
Fence
Natural Ground
Available Borrow Area
1 on 2
Elev. 6º
Applicable From Sta. 67+60 W. to Sta. 76+96 W.
Embankment
Elev. 22º
12'
1 on 4
1 on 3
Applicable From Sta. 63+00 W. to Sta. 81+32 W.
Natural Ground
Required Borrow
Available Borrow Area
Embankment
Elev. 22º
1 on 3
1 on 2.5
Applicable From Sta. 35+00 W. to Sta. 63+00 W.
℄ of Old Levee
Natural Ground
Available Borrow as Required
40'
Required Borrow
20'
Embankment
Elev. 22º
1 on 3
1 on 2.5
Applicable From Sta. 0+00 W. to Sta. 35+00 W.
AS CONSTRUCTED
Natural Ground
Embankment
Elev. 12º
Required Borrow
20'
NOTE:
All elevations referred to U.S.E.D. datum = mean lower low water Suisun Bay = 3± below mean Sea level.
Applicable From Sta. 0+00 S. to Sta. 30+59.99 S.
0+00 W. = 0+00 S.
SACRAMENTO RIVER, CALIFORNIA
FLOOD CONTROL PROJECT
LEVEE CONSTRUCTION FOR PROPOSED
WATSON HOLLOW DIVERSION CANAL
ADJUNCT TO WEST LEVEE YOLO BY-PASS
IN 2 SHEETS
SCALE AS SHOWN
SHEET NO. 2
U.S. Engineer Office, Sacramento, California. Sept. 1943
Submitted:
Engineer
Approval Recommended:
Senior Engineer
Approved:
Major, Corps of Engineers, U.S.A.
Dr. A.P.S.
Tr.
Ch. G.F.R.
DOC. FILE
FILE 50
DIV. 4
DRAWING 2158
EXHIBIT B

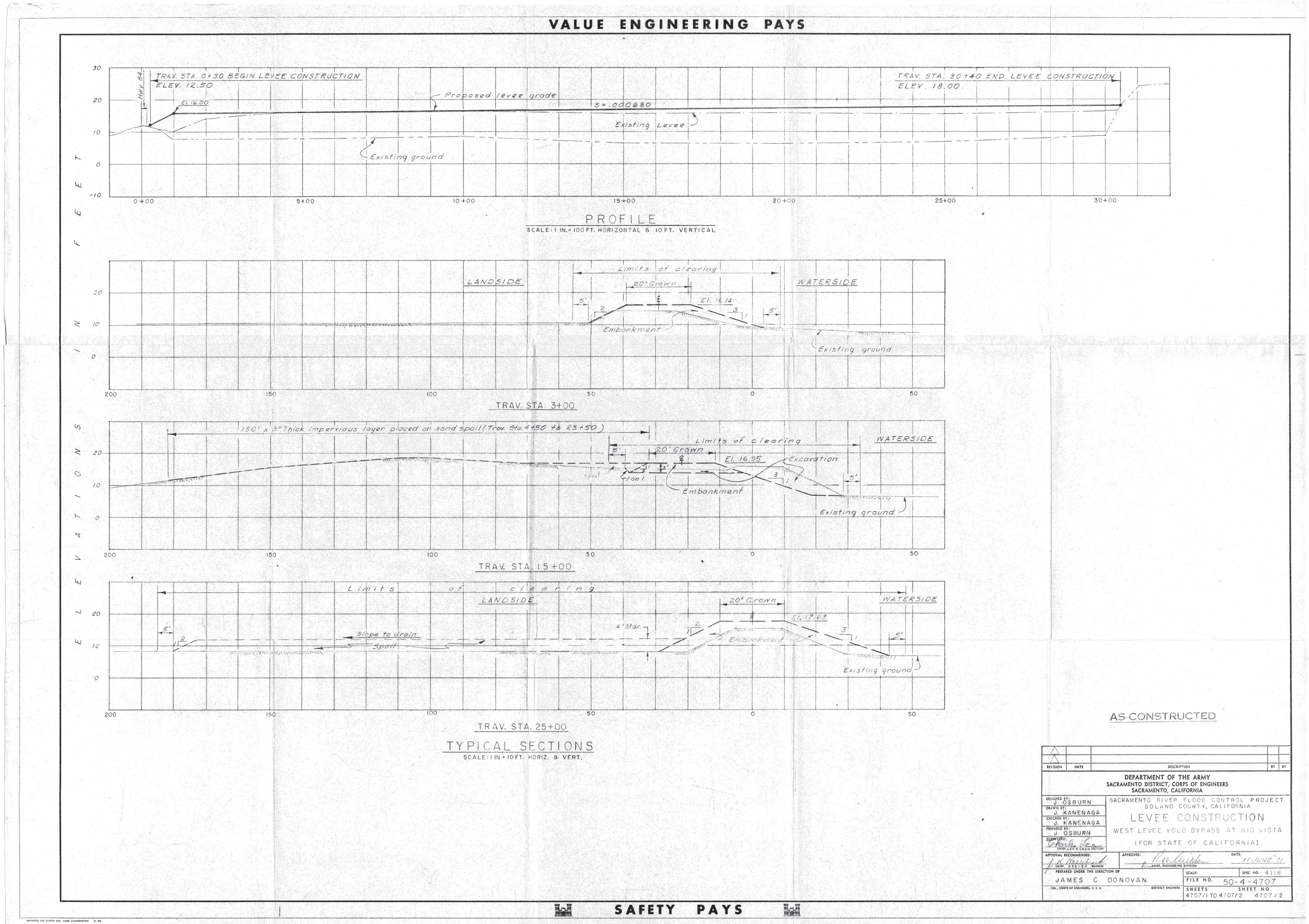


LIST OF DRAWINGS

FILE NO.	SHEET NO.	DESCRIPTION
50-4-4707	4707/1	LOCATION PLAN AND VICINITY MAP
50-4-4707	4707/2	PROFILE AND TYPICAL SECTION
50-4-4488	4488/2	LEVEE SURFACING - STANDARD
50-4-4488	4488/1	TURNAROUNDS - STANDARD

LEVEE OFFSET TABLE

TRAVERSE		LEVEE ℄ TO	
STATION	TO ℄ LEV.	L.S. TOE	W.S. TOE
1+00	44' Lt.	20'	32'
3+00	29' Lt.	22'	32'
5+00	14' Lt.	16'	31'
10+00	18' Lt.	16'	31'
15+00	22' Lt.	16'	40'
20+00	10' Lt.	15'	43'
25+00	0	29'	43'
30+00	9' Rt.	28'	35'



VALUE ENGINEERING PAYS
TRAV. STA. 0+30 BEGIN LEVEE CONSTRUCTION
ELEV. 12.50
TRAV. STA. 30+40 END LEVEE CONSTRUCTION
ELEV. 18.00
Proposed levee grade
S=.000680
Existing Levee
Existing ground
0+00
5+00
10+00
15+00
20+00
25+00
30+00
PROFILE
SCALE: 1 IN. = 100 FT. HORIZONTAL & 10 FT. VERTICAL
ELEVATIONS IN FEET
LANDSIDE
WATERSIDE
Limits of clearing
20' Crown
El. 16.14
Embankment
Existing ground
TRAV. STA. 3+00
150' x 3" Thick impervious layer placed on sand spoil (Trav. Sta. 4+50 to 23+50)
20' Crown
El. 16.95
Excavation
Embankment
Existing ground
TRAV. STA. 15+00
Limits of clearing
LANDSIDE
WATERSIDE
20' Crown
El. 17.63
4' Max.
Slope to drain
Spoil
Embankment
Existing ground
TRAV. STA. 25+00
TYPICAL SECTIONS
SCALE: 1 IN. = 10 FT. HORIZ. & VERT.
AS-CONSTRUCTED
REVISION
DATE
DESCRIPTION
BY
BY
DEPARTMENT OF THE ARMY
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA
DESIGNED BY: J. OSBURN
DRAWN BY: J. KANENAGA
CHECKED BY: J. KANENAGA
PREPARED BY: J. OSBURN
SUBMITTED:
CHIEF, LEV & CHAN SECTION
SACRAMENTO RIVER FLOOD CONTROL PROJECT
SOLANO COUNTY, CALIFORNIA
LEVEE CONSTRUCTION
WEST LEVEE YOLO BYPASS AT RIO VISTA
(FOR STATE OF CALIFORNIA)
APPROVAL RECOMMENDED:
CHIEF, DESIGN BRANCH
APPROVED:
CHIEF, ENGINEERING DIVISION
DATE: 11 JUNE '71
PREPARED UNDER THE DIRECTION OF
JAMES C DONOVAN
COL., CORPS OF ENGINEERS, U. S. A.
DISTRICT ENGINEER
SCALE:
SPEC. NO. 4118
FILE NO. 50-4-4707
SHEETS 4707/1 TO 4707/2
SHEET NO. 4707/2
SAFETY PAYS

APPENDIX H: GROUNDWATER AND SURFACE WATER LEVEL DATA

Appendix H

Groundwater and Surface Water Level Data

PLATES

⊗ Approximate Location of Water Level Logger

Approximate Location of Levee Centerline

N

0 2,000 Feet

1 inch = 2,000 feet

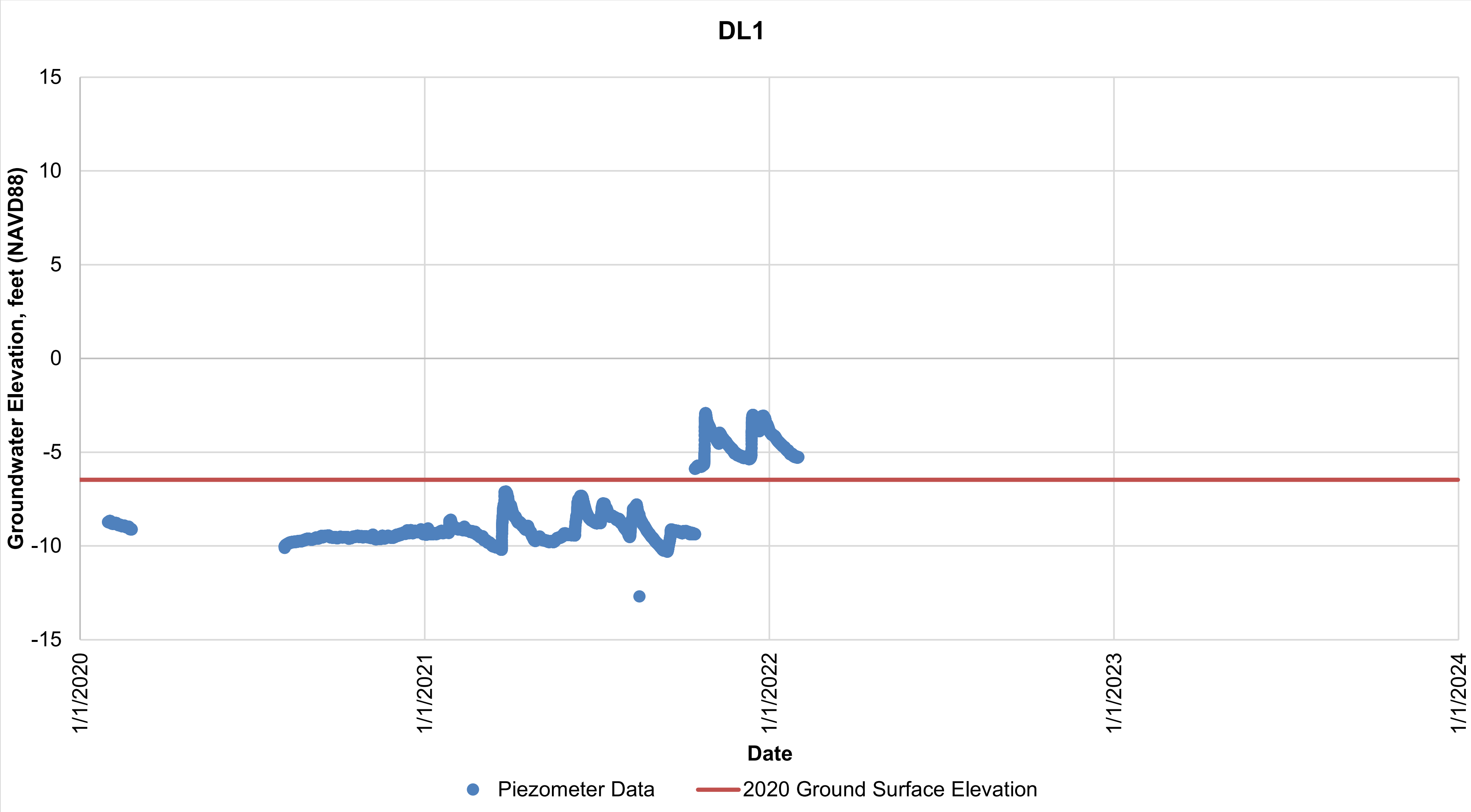
Little Egbert Multi-Benefit Project
Solano County, California

Water Level Logger Map

Shannon & Wilson

Project No. 907.03

Plate No. H-1



NOTES

1. Approximate Ground Surface Elevation = -6.48
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL1

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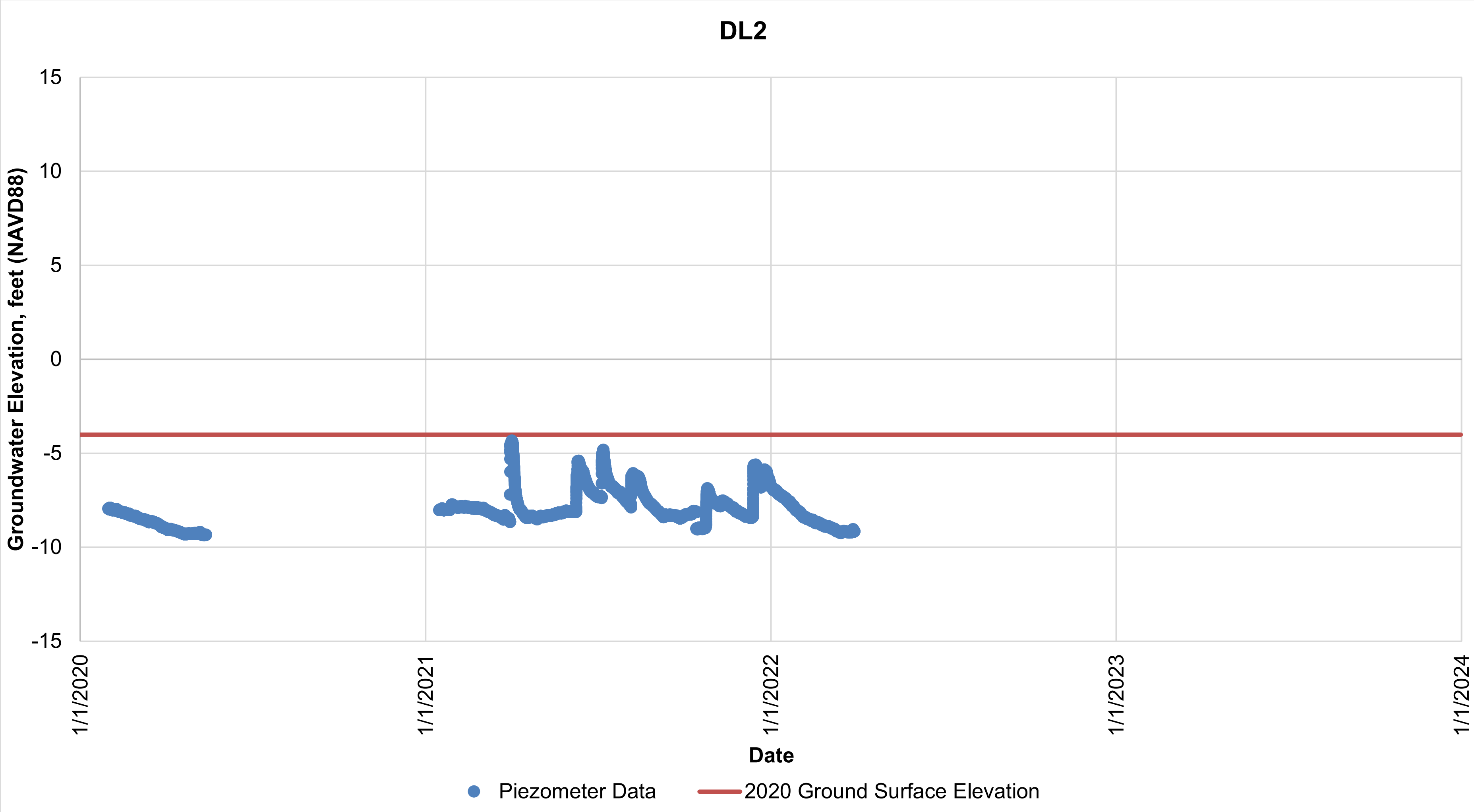
FIG. H-2

FIG. H-2

Piezometer Data (DL 1-7).xlsx 7/27/2023



NOTES

1. Approximate Ground Surface Elevation = -4.01
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL2

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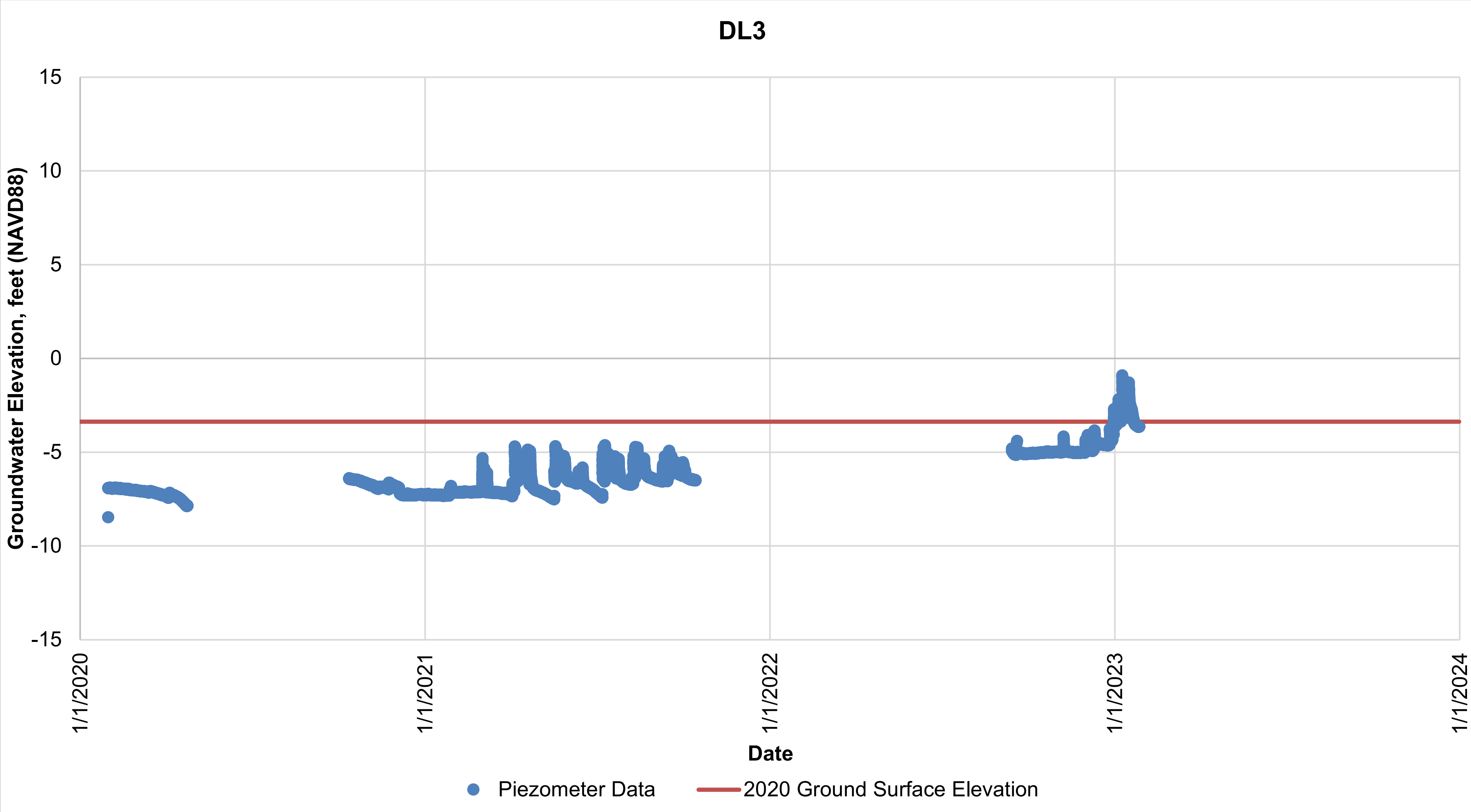
FIG. H-3

FIG. H-3



NOTES

1. Approximate Ground Surface Elevation = -3.38
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL3

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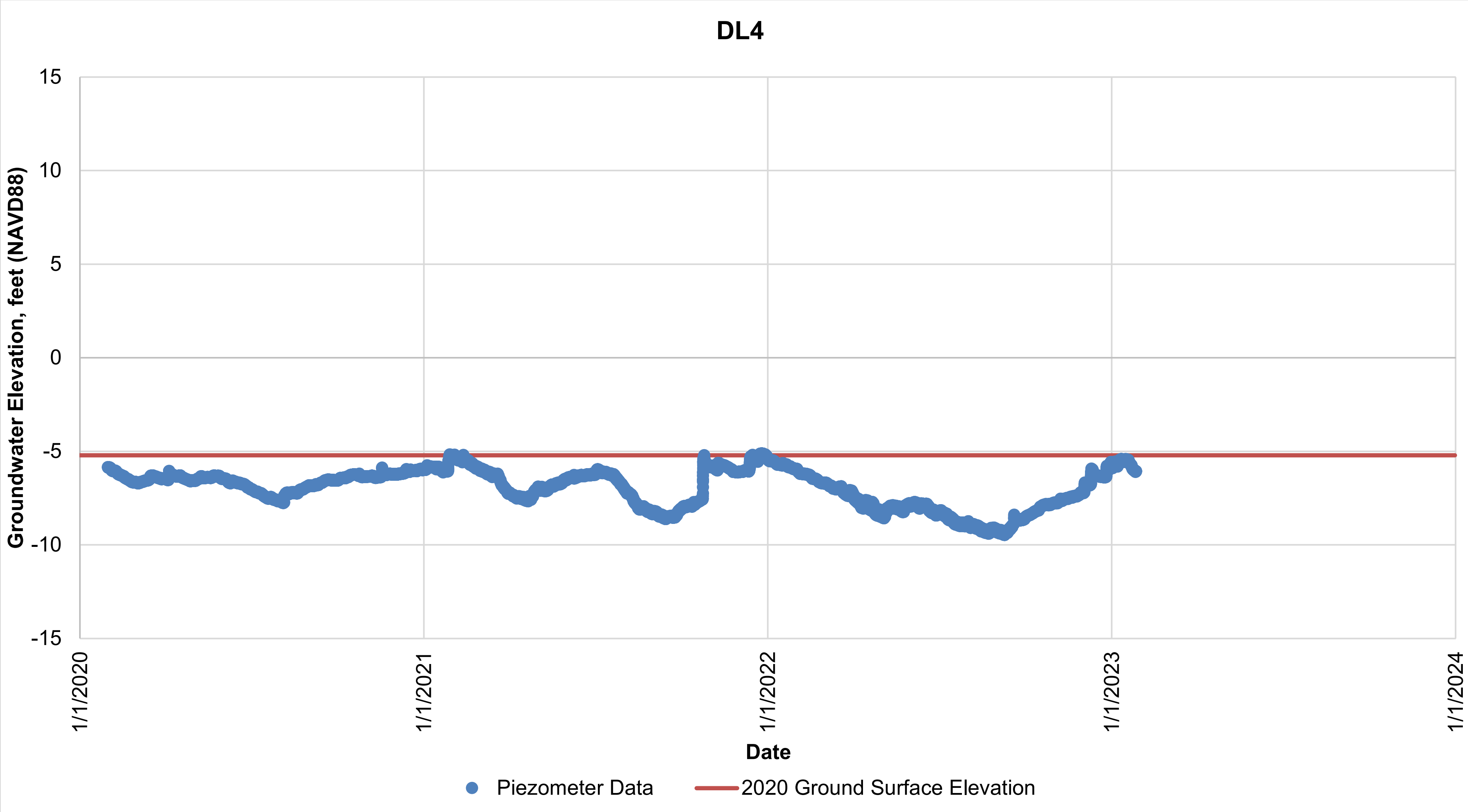
FIG. H-4



NOTES

1. Approximate Ground Surface Elevation = -5.21
2. Data Received From Westervelt Ecological Services on June 19, 2023.

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Solano County, California

PIEZOMETRIC DATA
DL4

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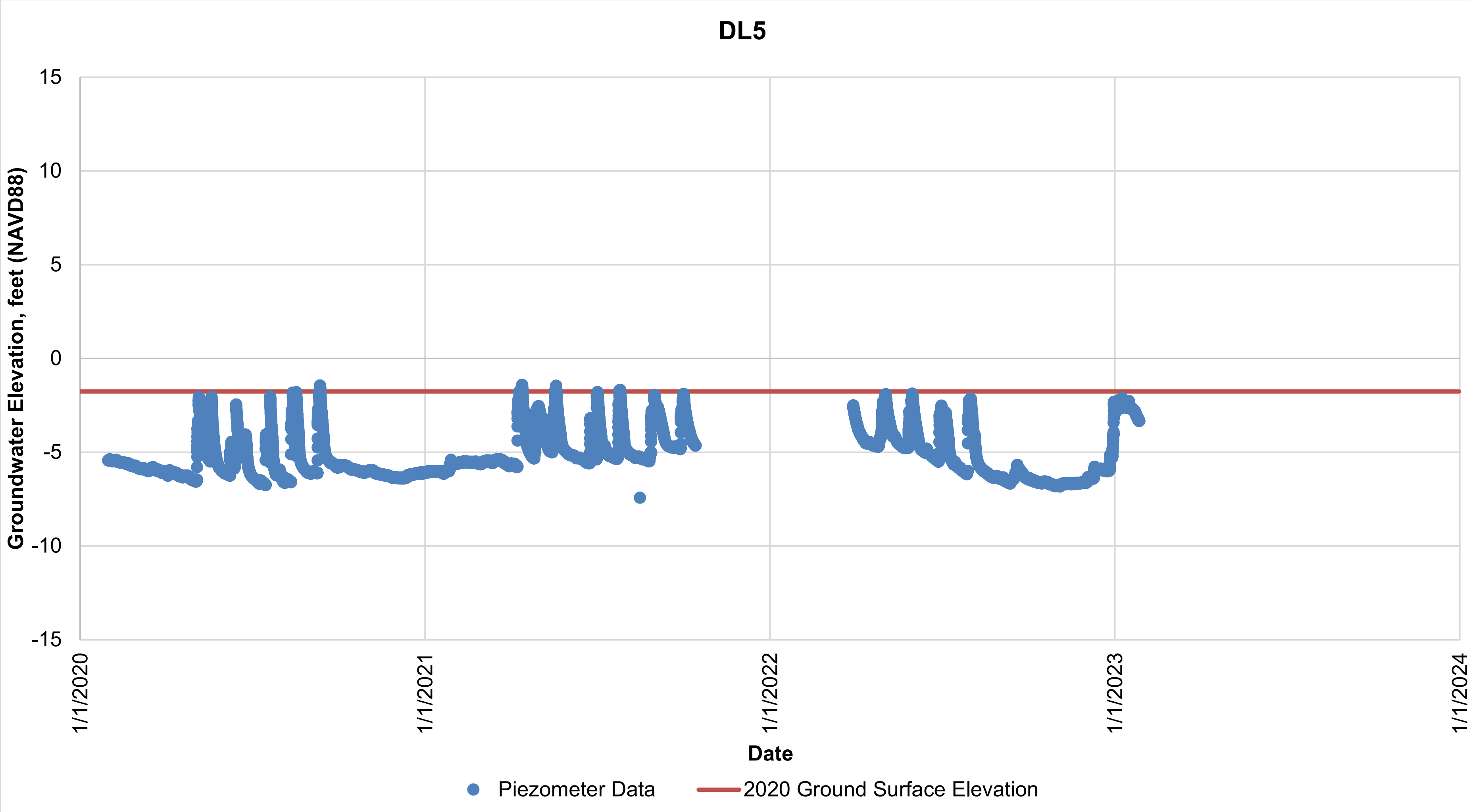
FIG. H-5

FIG. H-5



NOTES

1. Approximate Ground Surface Elevation = -1.76
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL5

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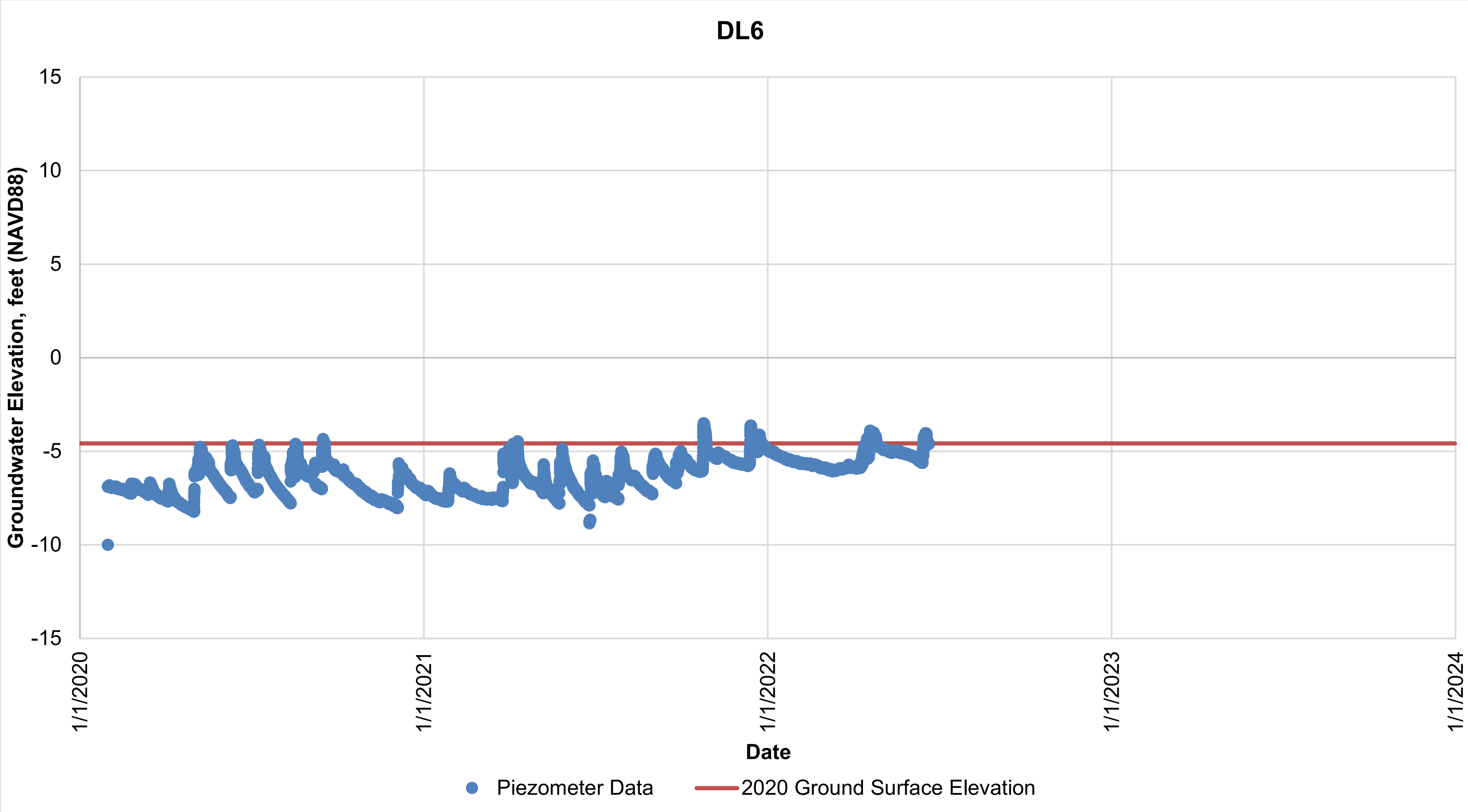
FIG. H-6

FIG. H-6



NOTES

1. Approximate Ground Surface Elevation = -4.57
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL6

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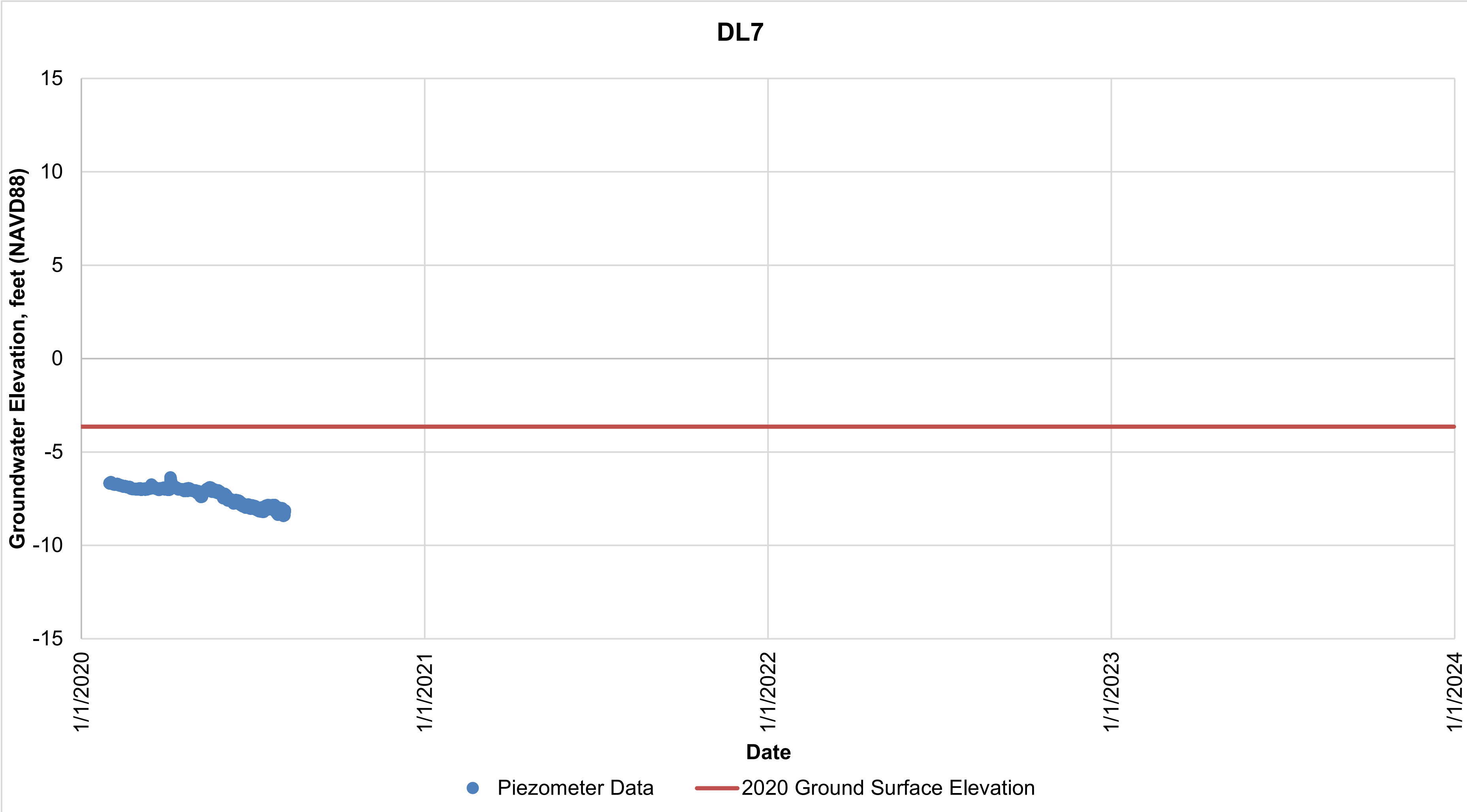
FIG. H-7

FIG. H-7



NOTES

1. Approximate Ground Surface Elevation = -3.64
2. Data Received From Westervelt Ecological Services on June 19, 2023.

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Solano County, California

PIEZOMETRIC DATA
DL7

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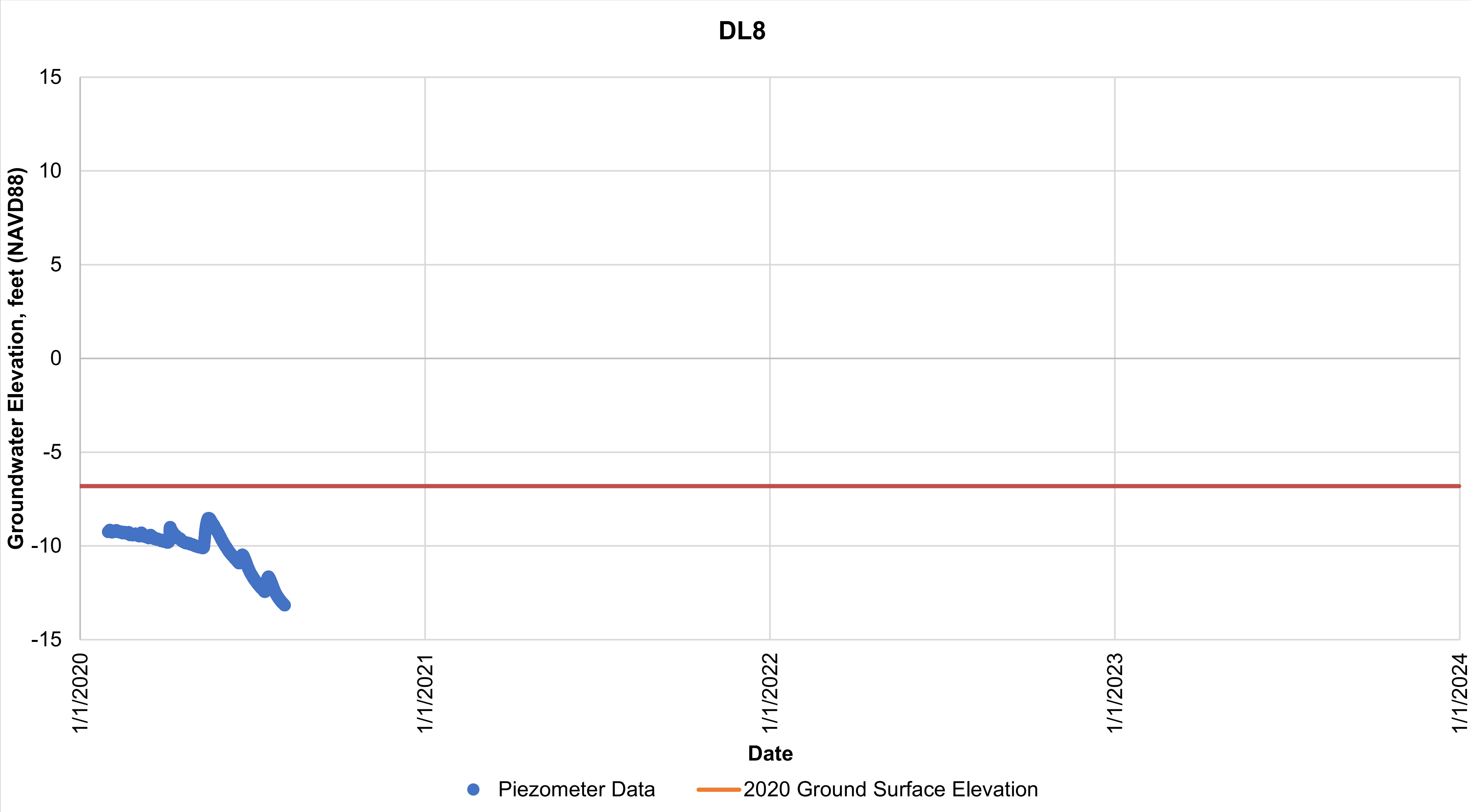
FIG. H-8

FIG. H-8



NOTES

1. Approximate Ground Surface Elevation = -6.81
2. Data Received From Westervelt Ecological Services on June 19, 2023.

FIG. H-9

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL8

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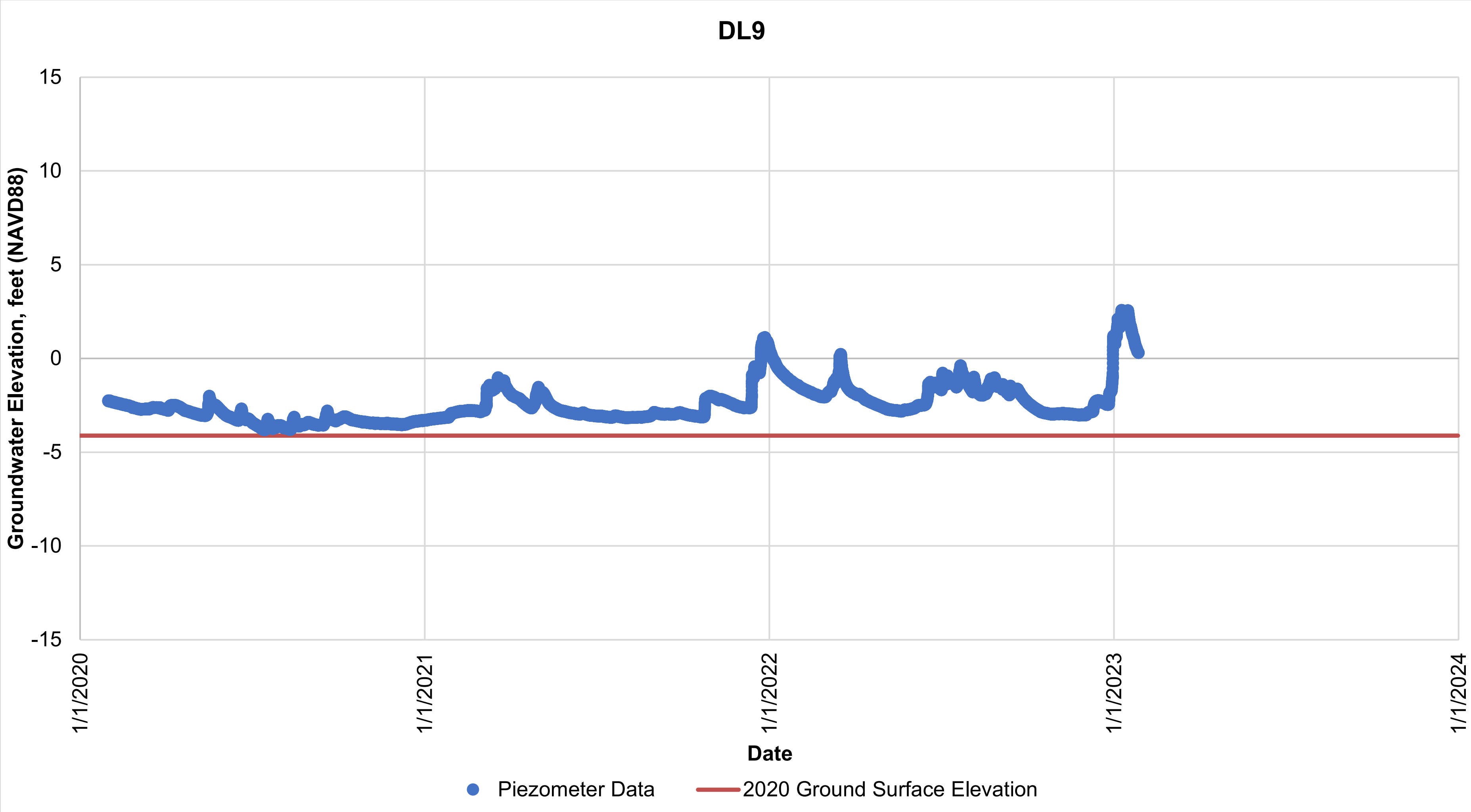
FIG. H-9



NOTES

1. Approximate Ground Surface Elevation = -4.12
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL9

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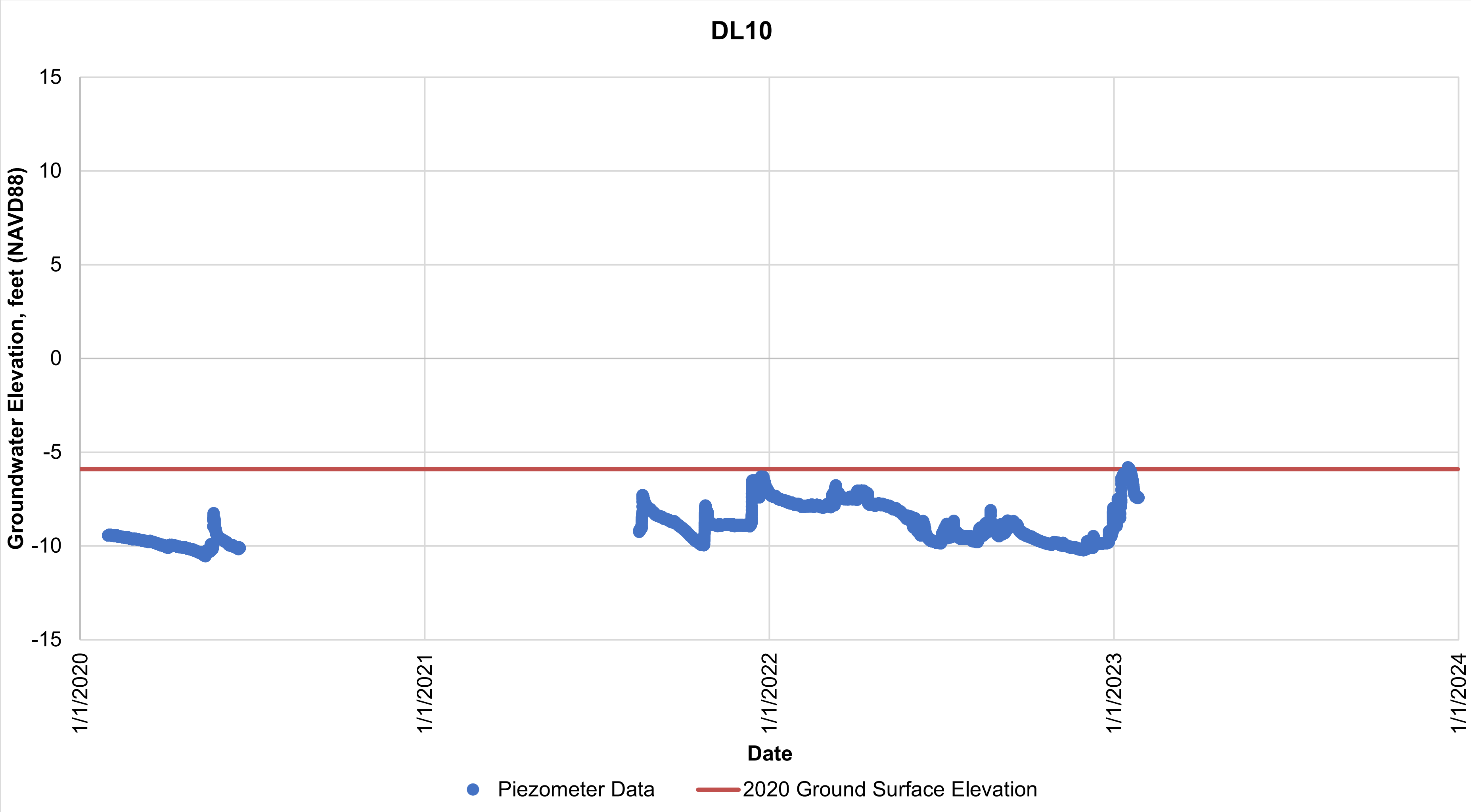
FIG. H-10

FIG. H-10



NOTES

1. Approximate Ground Surface Elevation = -5.90
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL10

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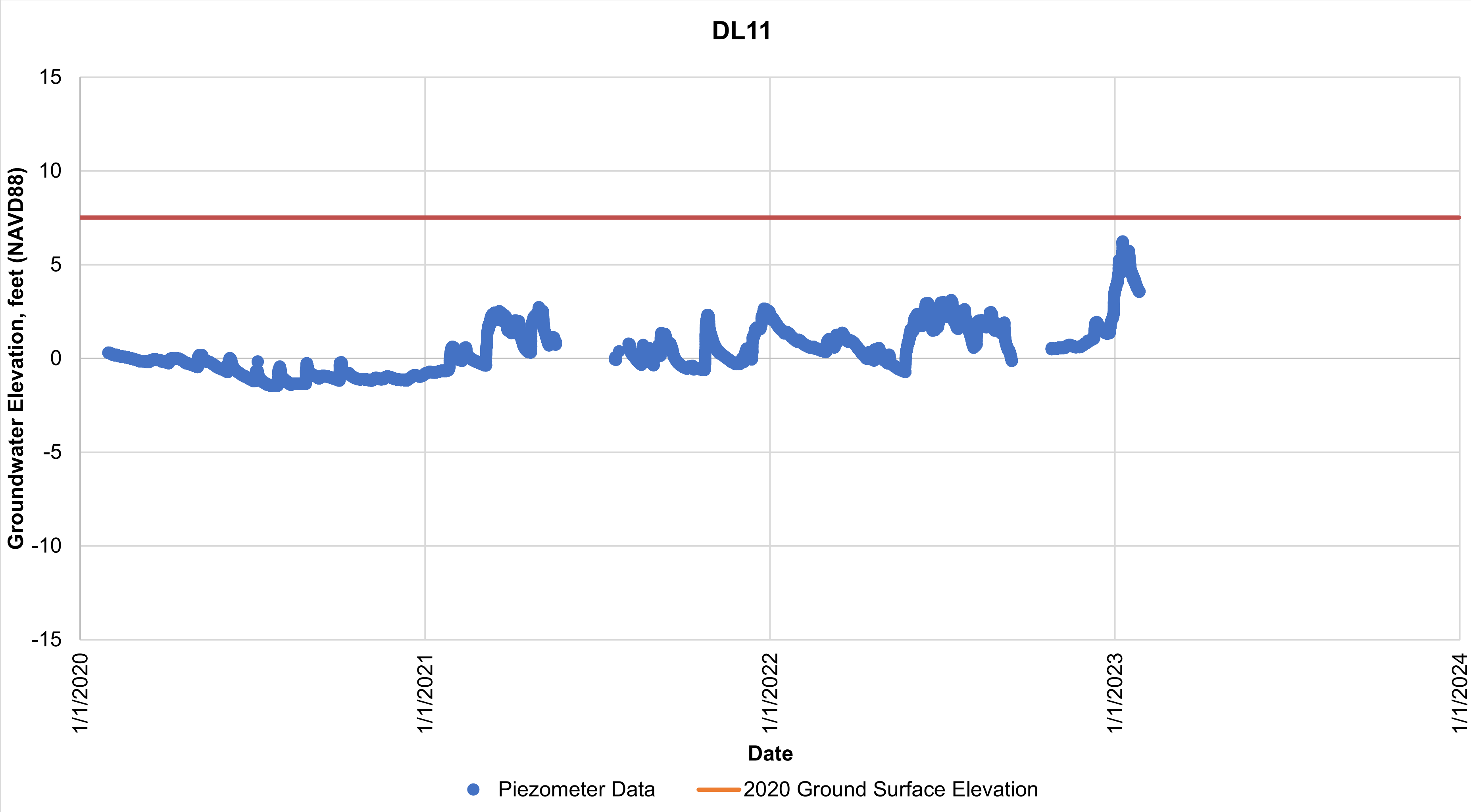
FIG. H-11

FIG. H-11



NOTES

1. Approximate Ground Surface Elevation = 7.52
2. Data Received From Westervelt Ecological Services on June 19, 2023.

FIG. H-12

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL11

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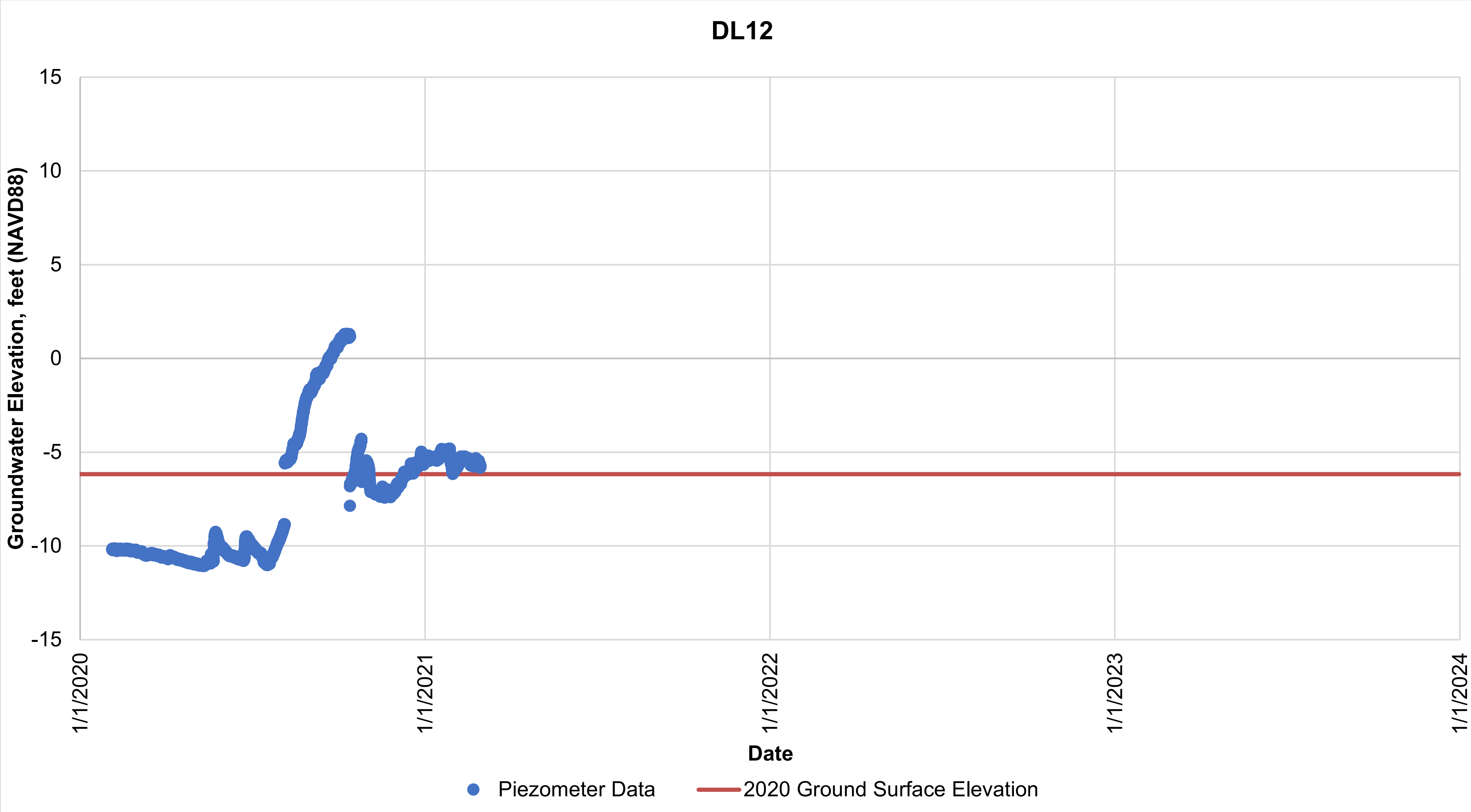
FIG. H-12



NOTES

1. Approximate Ground Surface Elevation = -6.17
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL12

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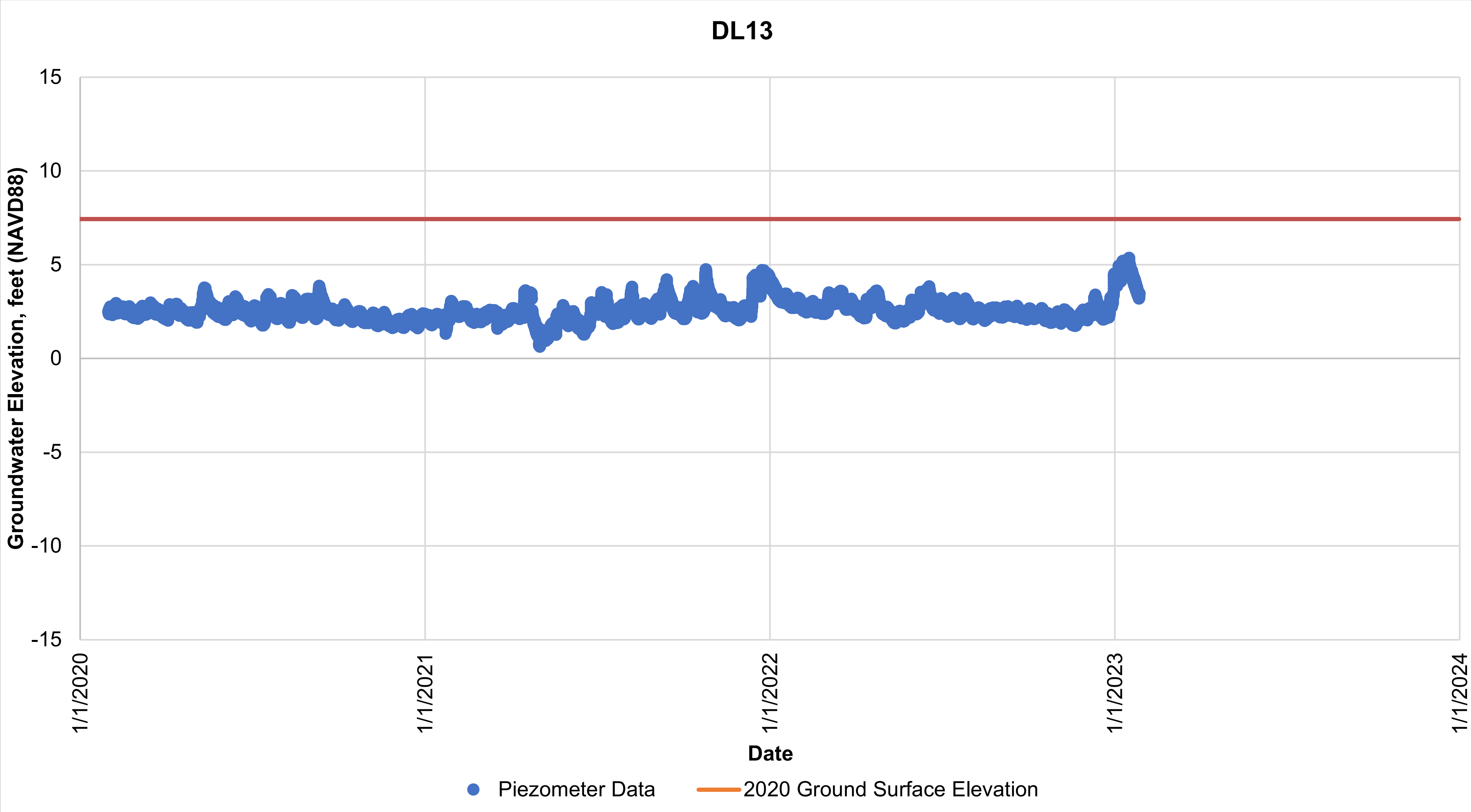
FIG. H-13

FIG. H-13



NOTES

1. Approximate Ground Surface Elevation = 7.43
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
DL13

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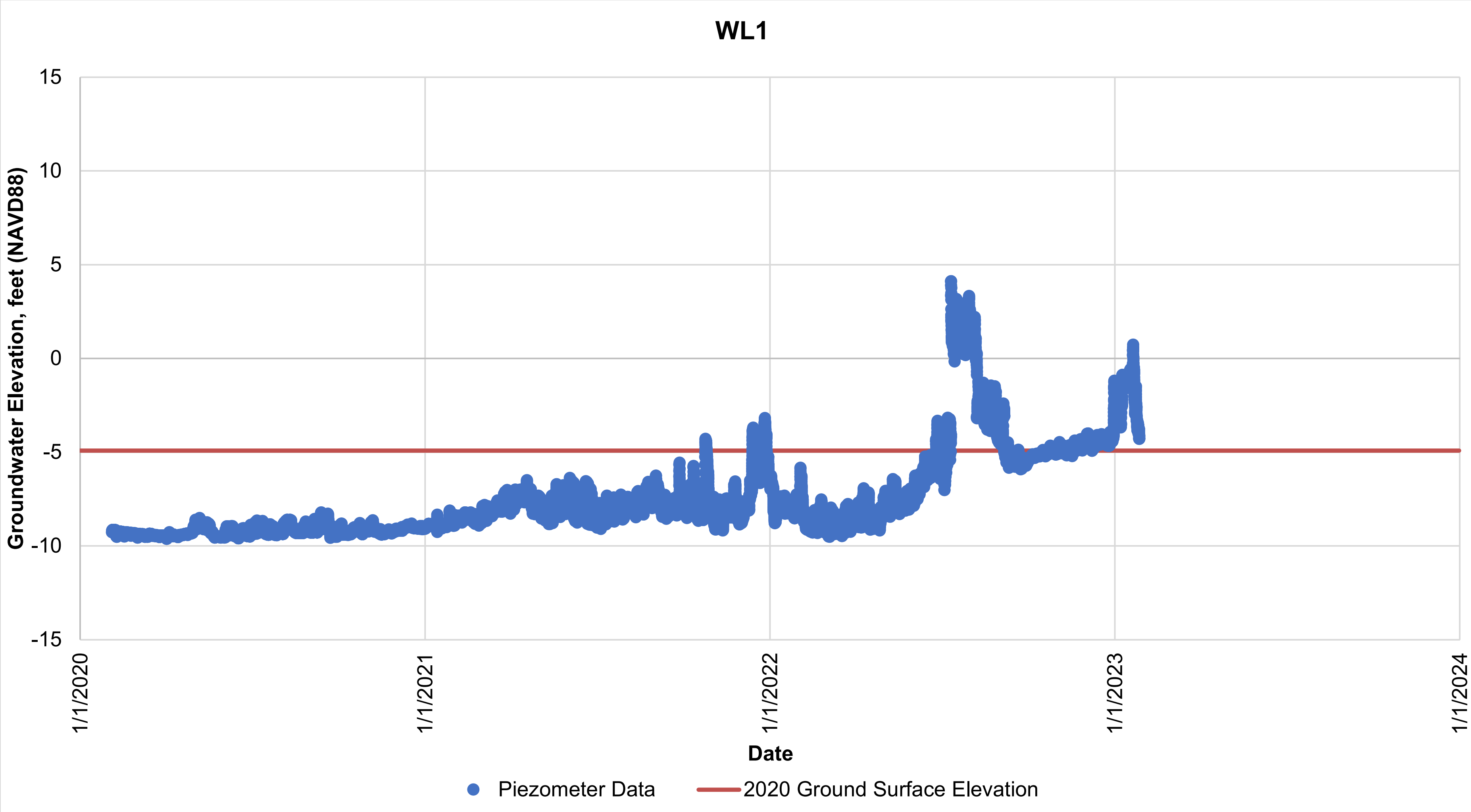
FIG. H-14



NOTES

1. Approximate Ground Surface Elevation = -4.92
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
WL1

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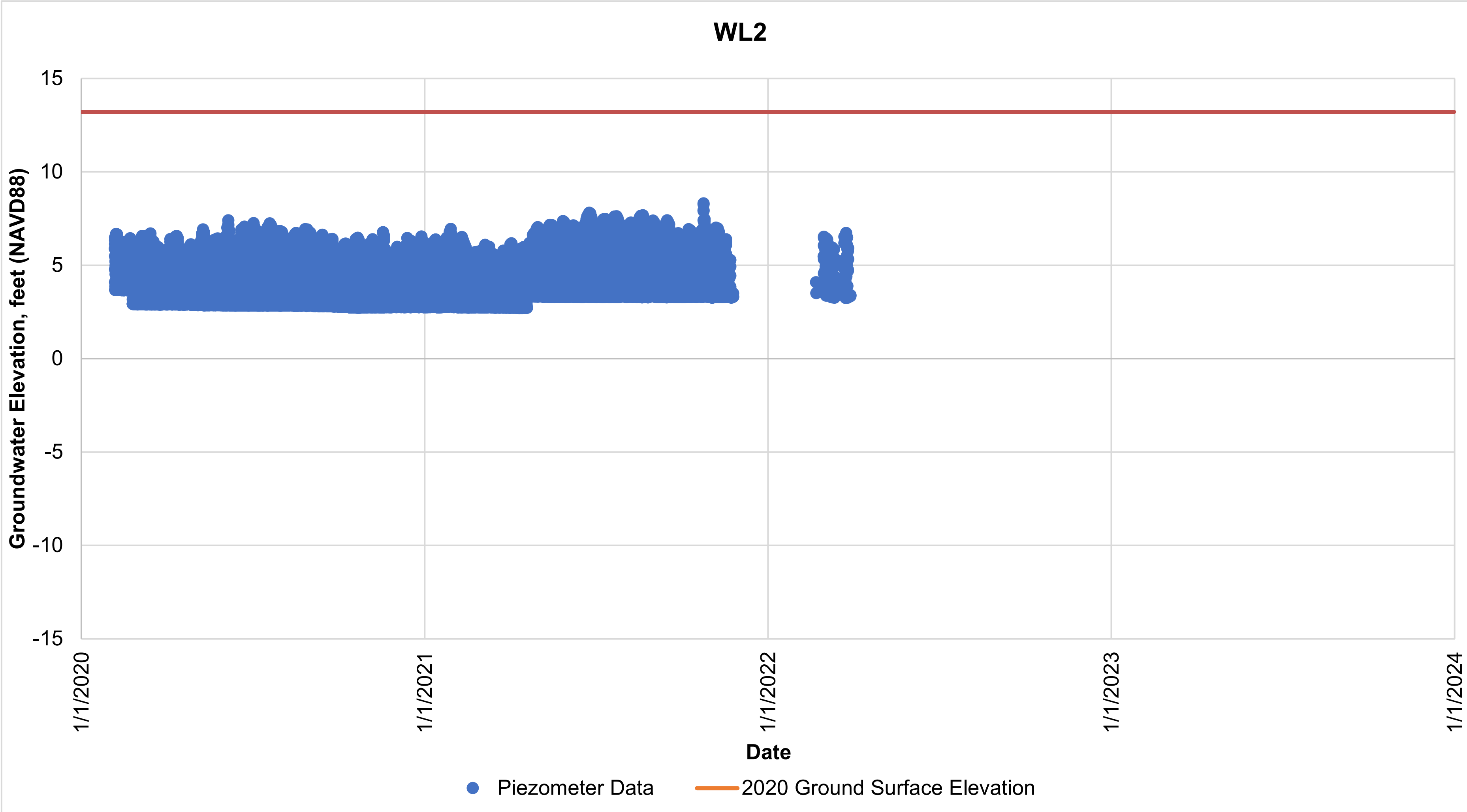
FIG. H-15

FIG. H-15



NOTES

1. Approximate Ground Surface Elevation = 13.21
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
WL2

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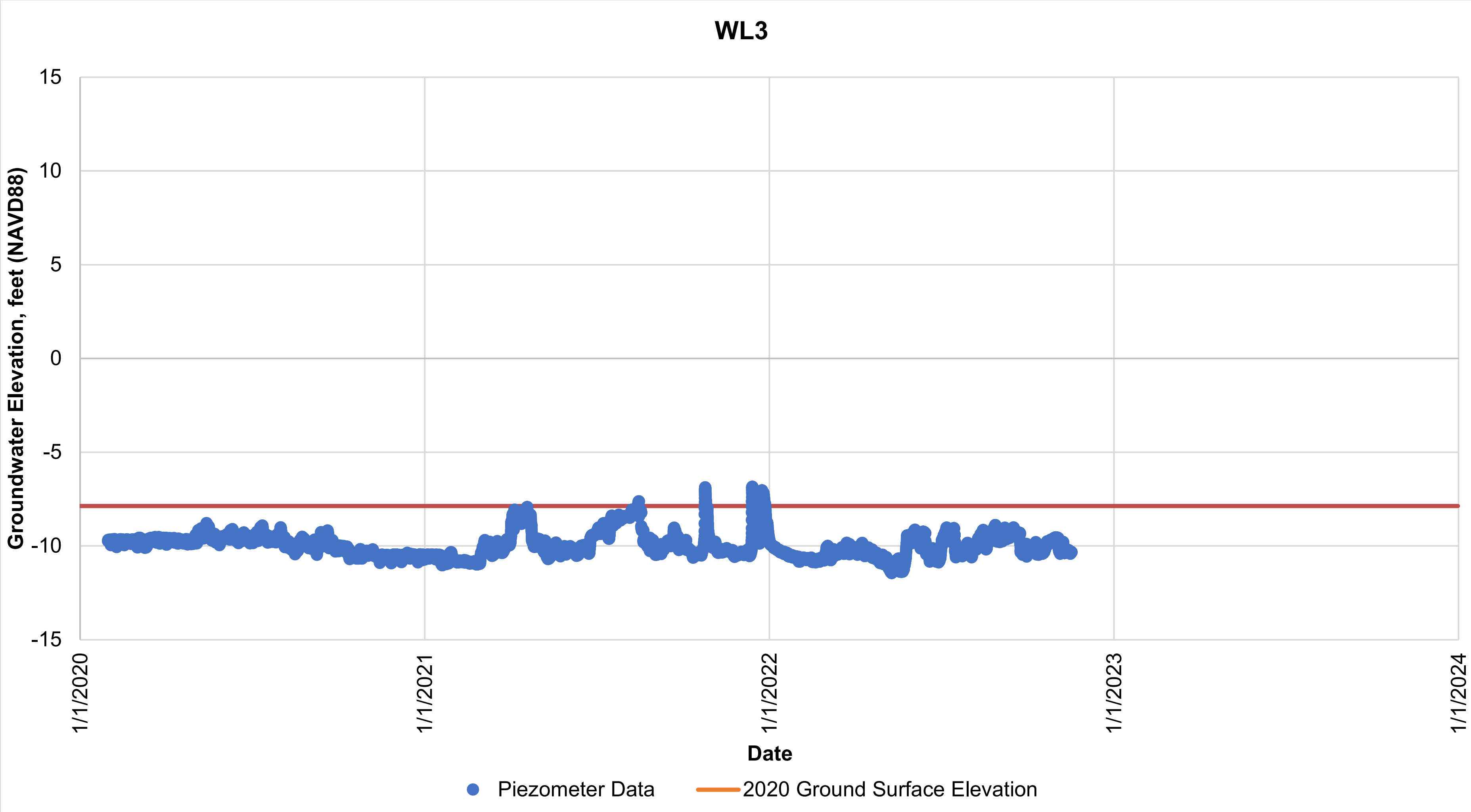
FIG. H-16

FIG. H-16

Piezometer Data (WL 1-4).xlsx 7/27/2023



NOTES

1. Approximate Ground Surface Elevation = -7.87
2. Data Received From Westervelt Ecological Services on June 19, 2023.

FIG. H-17

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
WL3

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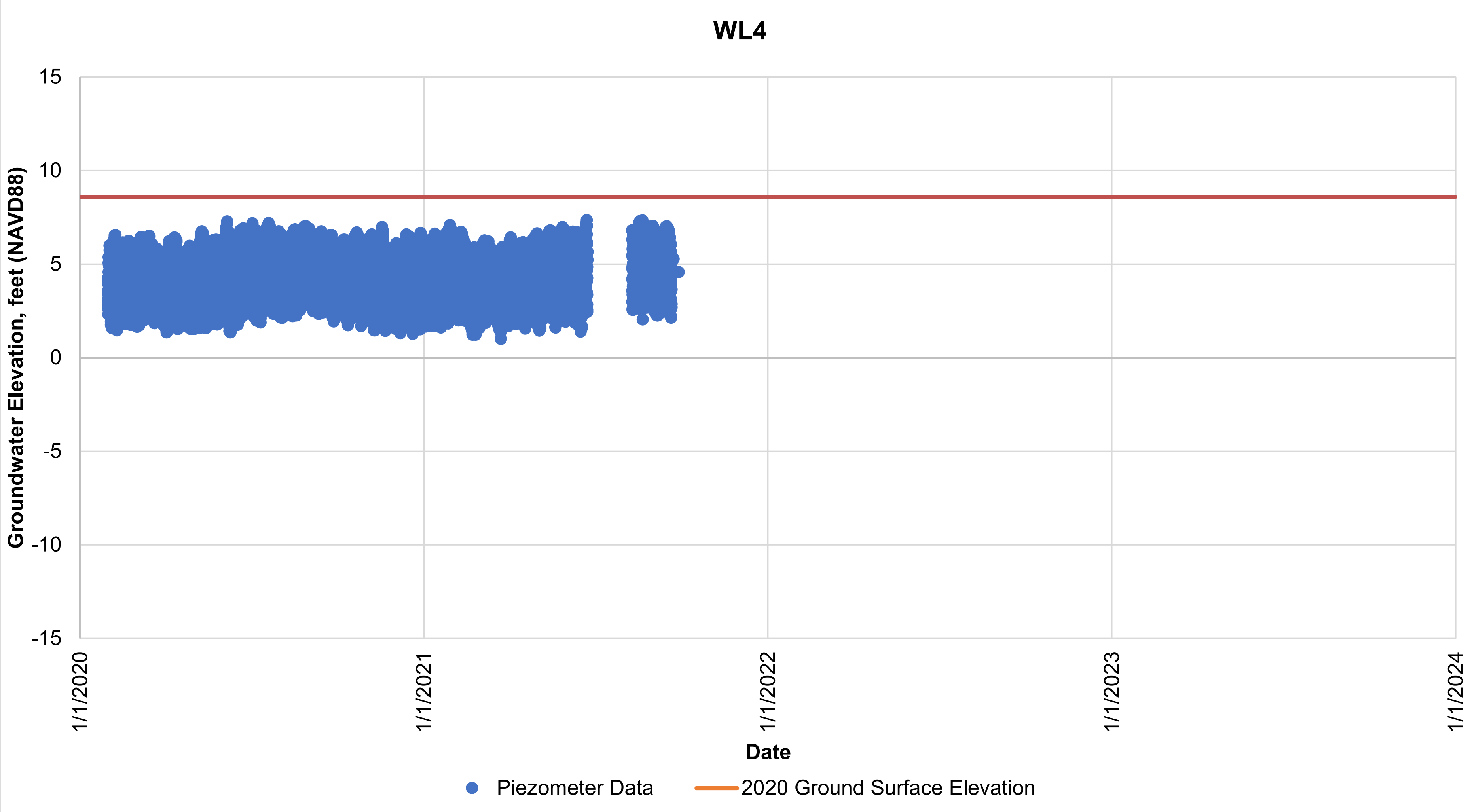
FIG. H-17

Piezometer Data (WL 1-4).xlsx 7/27/2023



NOTES

1. Approximate Ground Surface Elevation = 8.59
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
WL4

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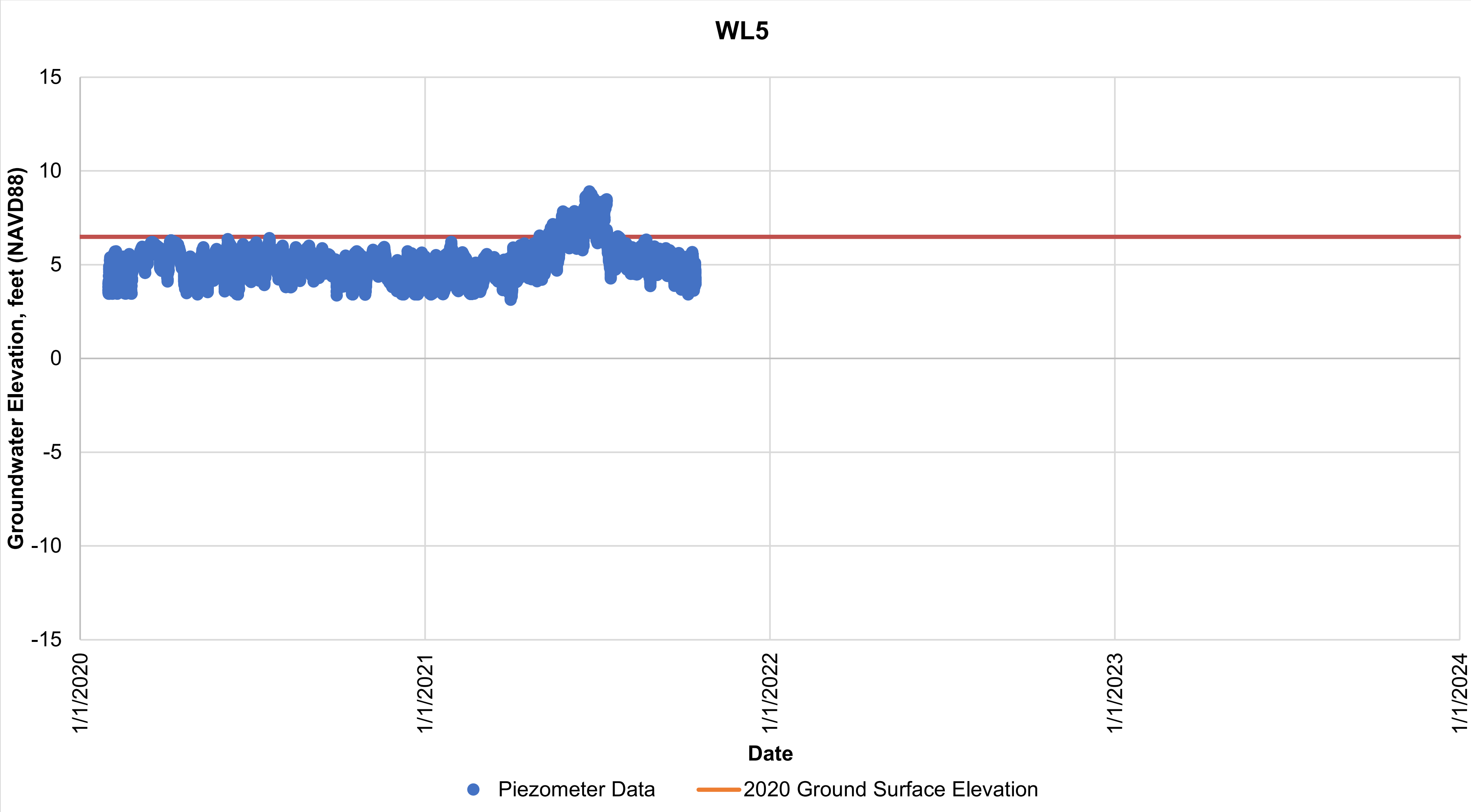
FIG. H-18

FIG. H-18



NOTES

1. Approximate Ground Surface Elevation = 6.49
2. Data Received From Westervelt Ecological Services on June 19, 2023.

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
WL5

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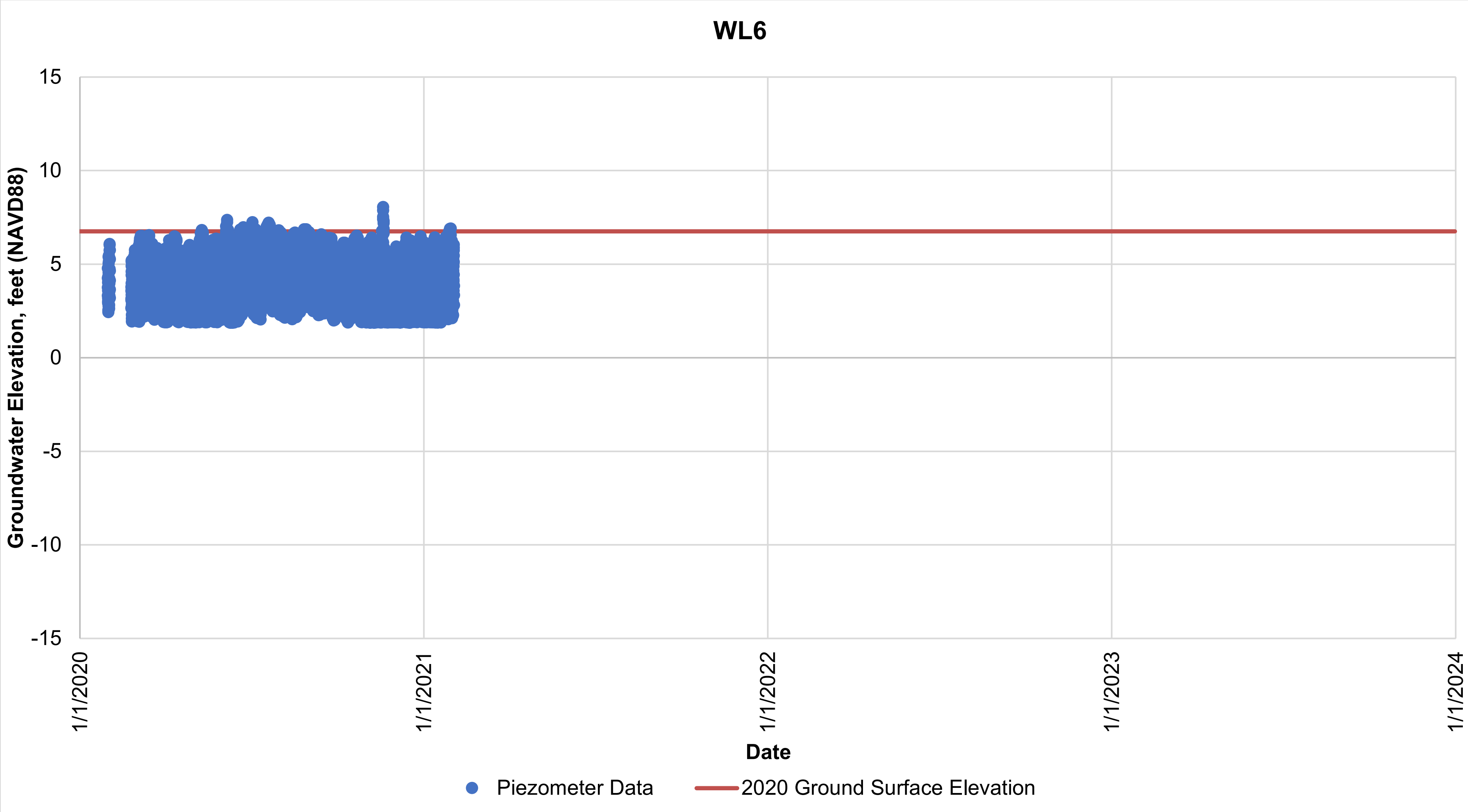
FIG. H-19

FIG. H-19

Piezometer Data (WL 5-8).xlsx 7/27/2023



NOTES

1. Approximate Ground Surface Elevation = 6.75
2. Data Received From Westervelt Ecological Services on June 19, 2023.

FIG. H-20

Little Egbert Multi-Benefit Project
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PIEZOMETRIC DATA
WL6

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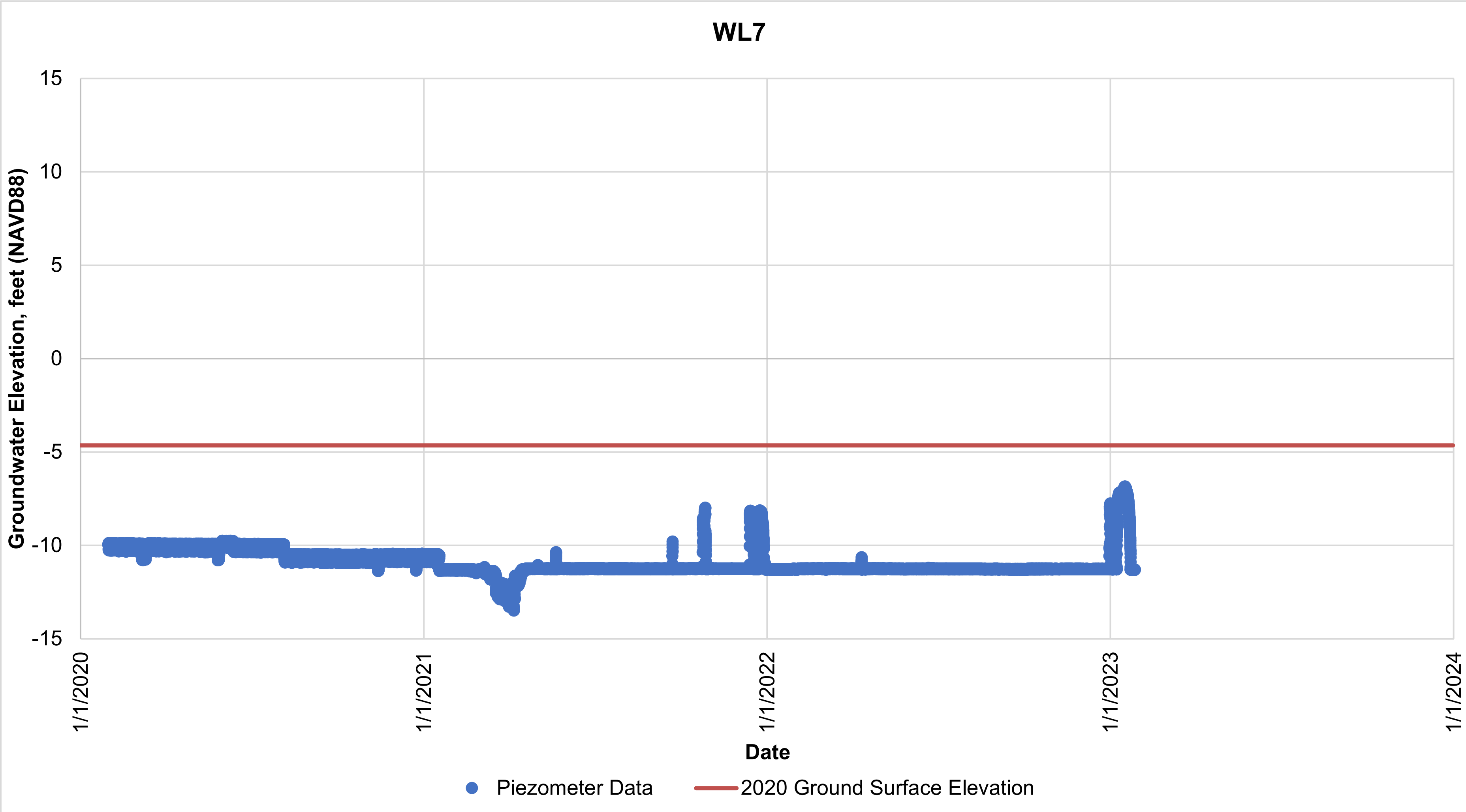
FIG. H-20



NOTES

1. Approximate Ground Surface Elevation = -4.64
2. Data Received From Westervelt Ecological Services on June 19, 2023.

FIG. H21

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
WL7

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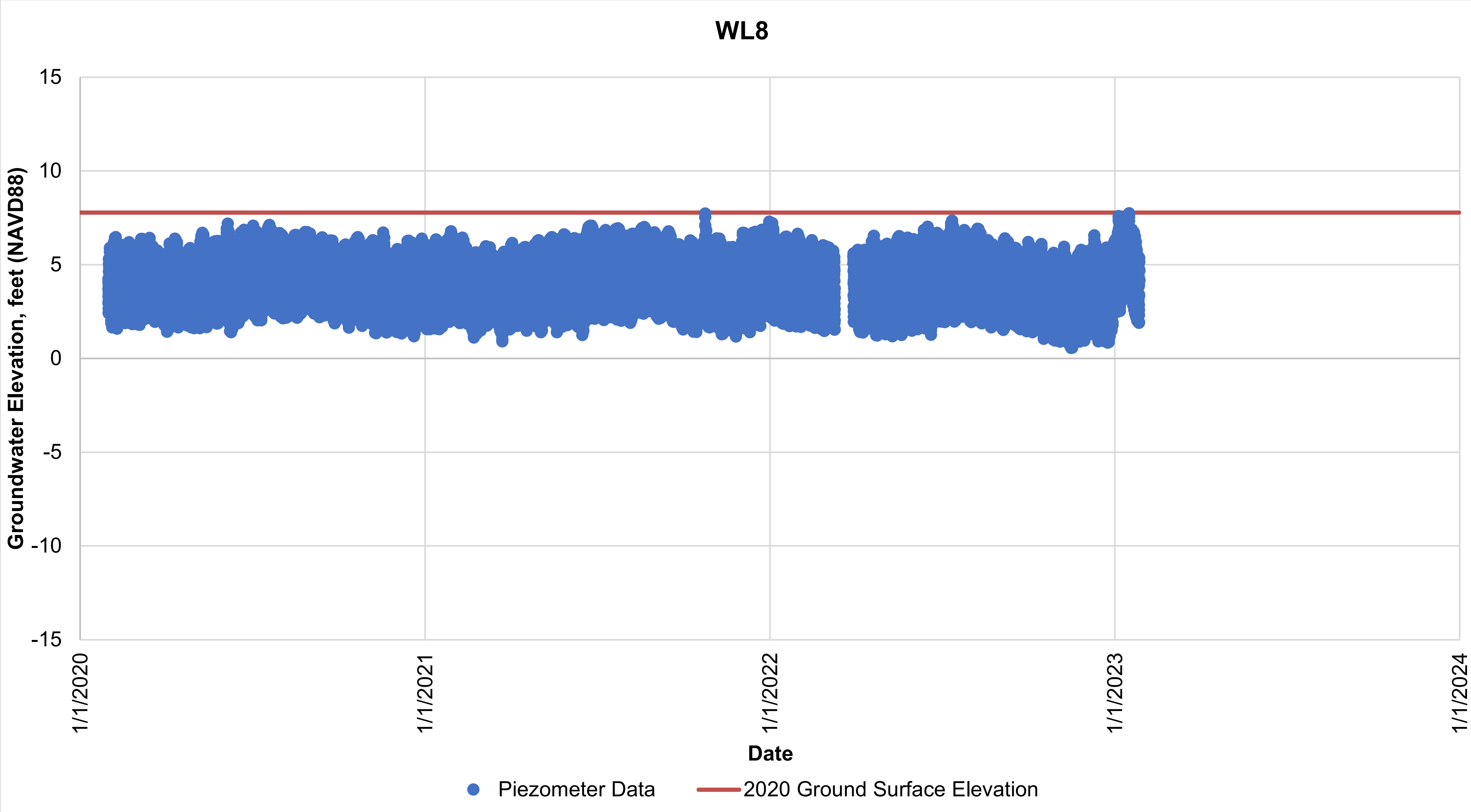
FIG. H-21

Piezometer Data (WL 5-8).xlsx 7/27/2023



NOTES

1. Approximate Ground Surface Elevation = 7.78
2. Data Received From Westervelt Ecological Services on June 19, 2023.

FIG. H22

Little Egbert Multi-Benefit Project
Solano County, California

PIEZOMETRIC DATA
WL8

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FIG. H-22

IMPORTANT INFORMATION

Important Information

About Your Geotechnical Report

Attachment to and part of Report: 110214/90703R02
Date: July 27, 2023
To: Mr. Mark Young
Westervelt Ecological Serivces, LLC

Important Information About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the GBA, Silver Spring, Maryland