Appendix I: WSLP WVA Assumption Document

USFWS

West Shore Lake Pontchartrain

Methodology and Assumptions for Determining Environmental Benefits

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WETLAND VALUE ASSESSMENT MODEL

The Wetland Value Assessment (WVA) model was developed under the Coastal Wetlands Planning, Protection, and Restoration program to determine benefits of proposed coastal wetland restoration projects. The WVA Swamp Community Model for Civil Works Version 2.0 (Swamp WVA) and the WVA Bottomland Hardwoods Community Model for Civil Works Version 1.2 (BLH WVA) models were used to assess direct and indirect impacts for WSLP project features proposed for construction. These models are approved for regional use on USACE Civil Works projects. Further information on this model may be obtained from the U.S. Army Corps of Engineers, New Orleans District, Regional Planning and Environmental Division South (Point of Contact: Patrick Smith, Phone: 504-862-1583).

The WVAs are similar to the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (HEP), in that habitat quality and quantity are measured for baseline conditions and predicted for future without-project and future with-project conditions. Instead of the species-based approach of HEP, each WVA model utilizes an assemblage of variables considered important to the suitability of that habitat type for supporting a diversity of fish and wildlife species. As with HEP, the WVA allows a numeric comparison of each future condition and provides a quantitative estimate of project-related impacts to fish and wildlife resources.

The WVA models operate under the assumption that optimal conditions for fish and wildlife habitat within a given coastal wetland type can be characterized, and that existing or predicted conditions can be compared to that optimum to provide an index of habitat quality. Habitat quality is estimated and expressed through the use of mathematical models developed specifically for each wetland type. Each model consists of: 1) a list of variables that are considered important in characterizing fish and wildlife habitat; 2) a Suitability Index graph for each variable, which defines the assumed relationship between habitat quality (Suitability Index) and different variable values; and 3) a mathematical formula that combines the Suitability Indices for each variable into a single value for wetland habitat quality, termed the Habitat Suitability Index (HSI). The WVA models assess the suitability of each habitat type for providing resting, foraging, breeding, and nursery habitat to a diverse assemblage of fish and wildlife species. This standardized, multi-species, habitat-based methodology facilitates the assessment of project-induced impacts on fish and wildlife resources.

HSI values are determined for each target year (TY). Target years, determined by the model user, represent significant changes in habitat quality or quantity that are expected during the 50-year project life, under future with-project (FWP) and future without-project (FWOP) conditions. In this study, target years of 0, 1, 5, 10, 40 and 50 are evaluated for the FWP and FWOP.

The product of an HSI value and the acreage of available habitat for a given target year is known as the Habitat Unit (HU). The HU is the basic unit for measuring project effects on fish and wildlife habitat. Future HUs change according to changes in habitat quality and/or quantity. Results are annualized over the project life to determine the Average Annual Habitat Units (AAHUs) available for each habitat type.

The change (increase or decrease) in AAHUs between FWP and FWOP scenarios provide a measure of anticipated impacts. A net gain in AAHUs indicates that the project is beneficial to the habitat being evaluated; a net loss of AAHUs indicates that the project is damaging to that habitat type. In determining future with-project conditions, all project-related direct (construction) impacts were assumed to occur in Target Year 1.

The Swamp WVA consists of seven variables:
1) stand structure;
2) stand maturity;
3) hydrology;
4) mean high salinity during the growing season;
5) size of contiguous forested area;
6) suitability and traversability of surrounding land use; and
7) disturbance.

The BLH WVA consists of seven variables:
1) tree species composition;
2) stand maturity;
3) understory/midstory;
4) hydrology;
5) size of contiguous forested area;
6) suitability and traversability of surrounding land uses; and
7) disturbance.

Changes in each variable are predicted for future without-project and future with-project scenarios over a 50-year project life.

For determining impacts for the WSLP levee system project (Project), the WVA methodology was selected as the most appropriate evaluation tool. Described below are the assumptions used to determine those swamp and BLH baseline, FWOP, and FWP projections for the proposed Project area.

General Assumptions

- Period of analysis is from 2020 (TY0) to 2070 (TY50).
- TY0 is baseline.
- Five different impact areas were considered Direct Levee footprint, Direct Access road footprints, Indirect Interior High, Indirect Interior Low, and Exterior impact areas.
- The latest (2018) USACE Civil Works versions of Swamp (v2.0) and BLH (v1.2) WVAs were used.
- The FWOP conditions from Louisiana Coastal Area (LCA) Convent Blind River assumed no net vertical accretion. We assume the same since the WSLP is adjacent to the LCA Convent Blind River area. From the LCA Convent Blind River Feasibility

Study – Page 5-35: "Existing conditions would persist, including no net vertical accretion of soil deposition and continued subsidence over the 50-year period of analysis."

- TYs for both FWOP and FWP include TY0, TY1, TY5, TY10, TY40 and TY50. TYs 1-10 are used to capture potential near term impacts resulting from Project construction and operation. TY 40 is used to capture changes due to relative sea level rise (RSLR). As seen in modeling for other projects (Messina, et al 2019 and ERDC 2016) impacts from RSLR are predicted to become discernable by 2060 or TY40.
- The WSLP levee system could create a financial incentive to develop in protected areas, including wetlands. Recent significant changes in the Federal flood insurance program (stemming from passage of the Biggert-Waters Flood Insurance Reform Act) will likely have the effect of establishing dramatically lower flood insurance rates in areas within 100-year or 1% levee systems relative to those without. This could create a significant financial incentive for development in protected areas, particularly as lower lying and less protected communities migrate to safer locations (as occurred after Hurricane Katrina, particularly in St. Bernard Parish). Though induced development may occur this evaluation does not assume it would. It is assumed that if post Project development does occur in wetlands, those impacts would be mitigated for by the developer or owner.

Assessing Current Habitat Type and Health of the Project Area

The WSLP Environmental team asked ERDC to utilize remote sensing techniques to identify and assess the current condition of bottomland hardwood (BLH) and swamp habitats within the WSLP levee system project area (Salstus and Suir, 2019). This effort provided baseline knowledge of the location and quality of these habitats for use in the environmental assessments of this project.

Two Geographic Information Systems (GIS) products generated in the ERDC GIS/RS Report that were used for WVA analysis:

1. Habitat Differentiation Raster: Habitats were distinguished using a variety of data sources including satellite imagery, LIDAR data, WVA field data, the National Land Cover Dataset (NLCD), and the USFWS National Wetland Inventory and a Maximum Likelihood Classification method. These data were used to determine the amount and spatial extent of habitat types for WVA variables and acreages. Swamp habitats were located mostly in interior regions interspersed with water while BLH habitat was primarily confined to the areas between swamp habitats and developed areas. This corroborated with field observations.
2. NDVI Classification: The Normalized Difference Vegetation Index (NDVI), a primary measure of condition, function, recovery, and sustainability with well-established correlations to photosynthetic activity, aboveground biomass, and leaf area, was used as a measure of primary productivity and plant vigor. The NDVI was calculated using WV3 satellite imagery collected in April 2019. These data were used to estimate the spatial extent of habitat types of different floristic qualities related to vegetation type and health. The analysis revealed that BLH habitat represented the highest mean NDVI values, followed closely by swamp and other vegetation habitats.

The project area was separated into three geographically distinct areas for evaluation based on the NDVI – East, Central, and West (Figure 1). The WVAs were split accordingly into these three sections: West, Central, and East and again separated by Direct (Direct Levee and Access Footprints), Indirect Interior (area between the levee alignment and the developed area), and Indirect Exterior (area outside of and adjacent to the levee system) areas (Figure 2). The HET used the ERDC GIS/RS Habitat Raster data for each area to determine all impact area acres for evaluation (Table 3). Table 1 is a list of all the WVAs based on area (West, Central, and East) and impact zone (Direct and Indirect). Table 2 indicates which plots were used in each location's impacts assessment (WVAs). Table 3 shows the acres used in each WVA based on the ERDC GIS/RS outputs applied to the project area.

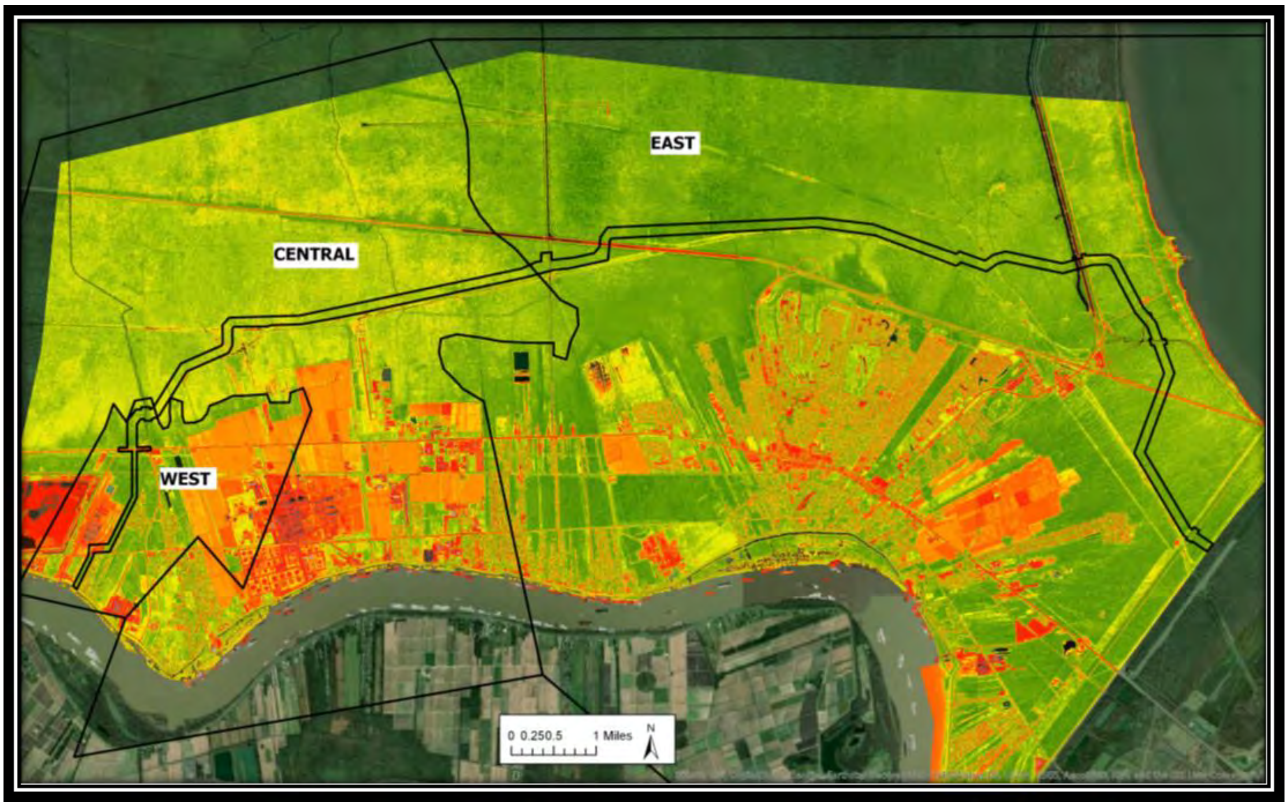

Figure 1. ERDC GIS/RS NDVI raster data with east, west, and central areas (Saltus and Suir, 2019).

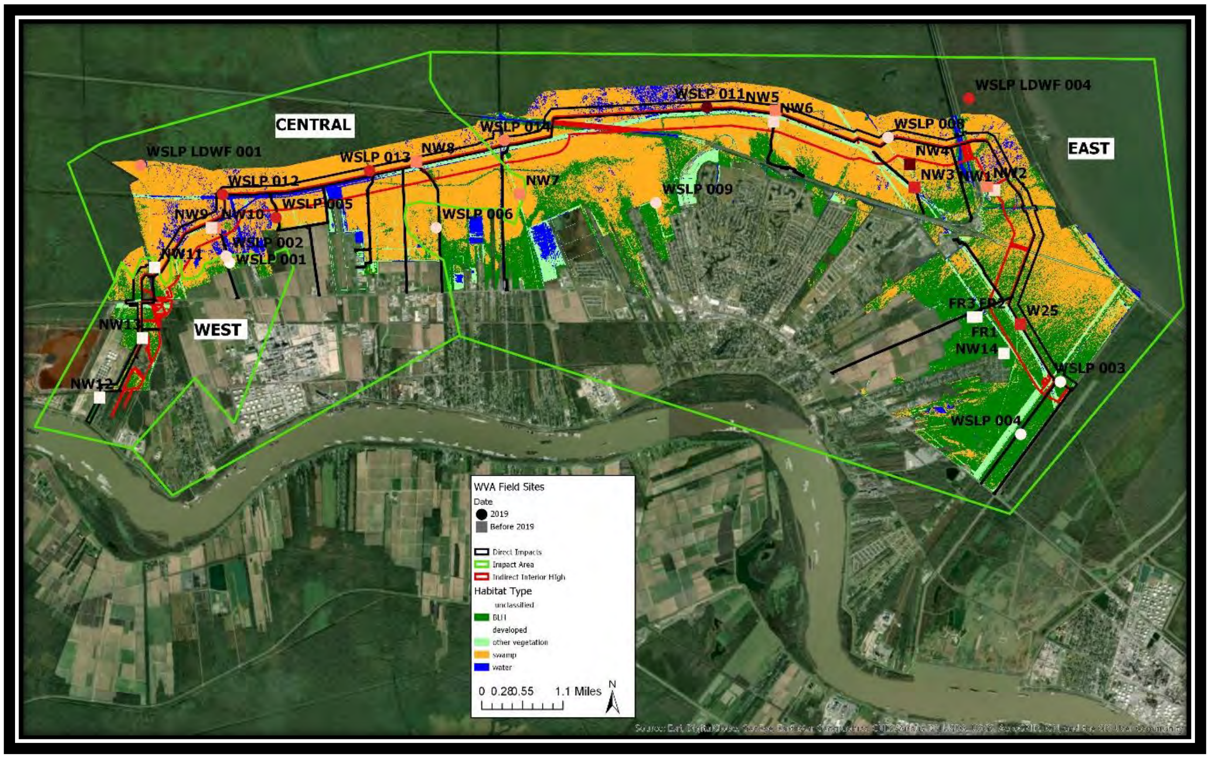

Figure 2. The 3 floristic quality sections: East, Central, and West are within the green polygons. Habitat types (swamp, BLH, etc) are shown for impact areas (Direct and Indirect) only. The Direct Levee and Access Road impact areas are shown in black. The Indirect Exterior impact area is from the north side of Direct Levee to the Exterior (mostly north) edge of habitat type. The Interior Indirect High impact area is shown in red. The Interior Indirect Low impact area is the remaining area between the red (Indirect High) and the developed area to the south. Wetland Value Assessment Plots from the Feasibility Study are shown as squares and from summer 2019 are shown as circles.

Table 1. List of each Wetland Value Assessment (WVA).

SWAMP		BOTTOMLAND HARDWOOD (BLH)
East Direct Levee Footprint		East Direct Levee Footprint
East Direct Access Footprint		East Direct Access Footprint
East Indirect Interior High		East Indirect Interior High
East Indirect Interior Low		East Indirect Interior Low
East Indirect Exterior		East Indirect Exterior
Central Direct Levee Footprint		Central Direct Levee Footprint
Central Direct Access Footprint		Central Direct Access Footprint
Central Indirect Interior High		Central Indirect Interior High
Central Indirect Interior Low		Central Indirect Interior Low
Central Indirect Exterior		Central Indirect Exterior
West Direct Levee Footprint		West Direct Levee Footprint
West Direct Access Footprint		West Direct Access Footprint
West Indirect Interior High		West Indirect Interior High
West Indirect Interior Low		West Indirect Interior Low
West Indirect Exterior		West Indirect Exterior

Table 2. Data from listed plots are used for baseline information in the Wetland Value Assessments.

Central	**Swamp Field Sites**						
Direct	WSLP 012	WSLP 013	NW8				
Indirect Inside High	NW9	NW10					
Indirect Exterior	WSLP LDWF 001						
East	**Swamp Field Sites**						
Direct	WSLP 008	WSLP 011	WSLP 014	W25	NW5		
Indirect Inside High	NW6						
Indirect Inside Low	WSLP 006	FR2	NW14	NW2	NW3	NW4	NW7
Indirect Exterior	WSLP LDWF 004	WSLP 015					
Central	**BLH Field Sites**						
Indirect Inside High	NW15						
Indirect Inside Low	WSLP 005						
East	**BLH Field Sites**						
Direct	WSLP 003						
Indirect Inside Low	WSLP 004	WSLP 009	FR1	FR3	NW17		

Table 3. Acres for all impact areas evaluated.

Eastern-All		
Area	Swamp	BLH
Direct Levee	676.5	149.3
Direct Access	31.6	8.9
Indirect High	1023.4	359.5
Indirect Low	3157.3	3311.5
Indirect Exterior	2102.0	539.6

Eastern-LDWF		
Area	Swamp	BLH
Direct Levee	130.1	1.5
Direct Access	0.0	0.0
Indirect High	5.5	0.0
Indirect Low	0.0	0.0
Indirect Exterior	449.3	2.4

Central-All		
Area	Swamp	BLH
Direct Levee	364.2	1.6
Direct Access	20.4	5.0
Indirect High	600.4	23.8
Indirect Low	1348.2	87.8
Indirect Exterior	1270.9	23.0

Central-LDWF		
Area	Swamp	BLH
Direct Levee	35.0	0.4
Direct Access	0.0	0.0
Indirect High	0.0	0.0
Indirect Low	0.0	0.0
Indirect Exterior	353.4	2.6

Western-All		
Area	Swamp	BLH
Direct Levee	47.1	66.6
Direct Access	2.4	1.3
Indirect High	98.4	125.0
Indirect Low	90.0	90.7
Indirect Exterior	82.6	103.7

Western-LDWF		
Area	Swamp	BLH
Direct Levee	4.9	0.1
Direct Access	0.0	0.0
Indirect High	0.0	0.0
Indirect Low	0.0	0.0
Indirect Exterior	4.9	0.3

Data Collected from Site Visits and CRMS Stations

Baseline data were collected from several field sites in March 2011, July and Dec 2013, and May, June, August and October 2019 for swamp and BLH habitat quality. In addition to field sites, data from Louisiana's Coastwide Reference Monitoring System (CRMS) stations CRMS0059 (Reserve) and CRMS5373 (Hope), such as hydrology and salinity, were also used (CPRA 2020). One tenth acre (37.2 ft radius) size plots were used for field sites. Parameters such as diameter at breast height (DBH), stand structure, and hydrology were taken at each field site. Sites were either directly on the proposed levee alignment or interior and exterior to the alignment (indirect). A total of 29 plots (14 BLH and 15 Swamp sites) representing habitat throughout the project area were used to develop baseline data. However, with each iteration of the WSLP more sites are taken, given large area and the difficulty accessing many of the remote sites we obtained as many plots as feasible. Ideally, many more plots would be preferred. See Figure 2 and Table 2 for plot locations and which areas they were used in the WVA.

The plots were labeled by health and/or stress level during site visits. These categories included: BLH Healthy, BLH Medium Stress, BLH Very Stressed, Swamp Healthy, Swamp Low Stress, Swamp Medium Stress, and Swamp Very Stressed. The naming convention used on the field notes and notes in the ingrowth spreadsheets included the following:

- H= healthy, LS=low stressed, MS= moderately stressed, VS=very stressed,
- BLH= bottomland hardwood, Sw=swamp
- Main= DBH measurements from the main trunk of any trees within a plot.
- Branched= DBH measurement from any branch other than main trunk.
- Stressed Topped = Trees that were topped and stressed; note that any tree indicated as topped was assumed to be stressed.
- Stump growth = any tree growth observed on a downed tree or stump.

In-growth spreadsheets

Ingrowth spreadsheets were used to predict tree growth for individual trees from plots. This spreadsheet grows individual tree DBH and field site basal area over time. All swamp plots were separated into cypress and other tree species groups while BLH plots maintained a single in-growth spreadsheet for each plot.

Outputs from each plot's in-growth spreadsheets including tree composition (BLH V1), stand structure (swamp V1), stand maturity (swamp and BLH V2), and understory/midstory (VLH V3) for each plot were developed individually then combined in the appropriate WVAs by area. See sections on Variables 1, 2, and 3 below.

A growth factor for cypress was used to project tree growth of typical cypress swamp. The growth factor is based on a regression ($Y=-0.512X-0.1$, $R^2=1$) based on literature growth rates for specific tree species (Visser and Sasser 1995), and Mr. Bern Wood (Southeastern Louisiana University - working with Dr. Gary Shaffer) during a February 2010 verbal communication with the USFWS (Angela Trahan, personal communication). Data from Mr. Bern Wood were collected from Maurepas Swamp Wildlife Management Area, a Wildlife Management Area in the Project Area and vicinity, study sites.

<u>Assumptions applied to all plots:</u>

- Initial and future relative sea level rise (RSLR) growth rates are presented in Table 4. Initial growth rates were based on dominant trees and site conditions of each plot. See V2 section for details on future growth rates.
- In-growth spreadsheets without mortality were used for plots designated as healthy or low stressed, while in-growth spreadsheets with mortality were used for medium or high stress sites.

<u>Assumptions applied to 2019 Plots for In-growth Spreadsheets:</u>

- Plots with several small trees to be grown in were entered as 0.1 or 0.5 inch DBH depending on field notes and/or measurements.

- Trees that were listed as less than 1 inch DBH were entered as 0.9 inch DBH.
- Each plot had notes on the condition of individual trees. Growth rates and life spans were adjusted based on field observations. Separate in-growth spreadsheets were used for each condition-plot combination and is referred to as a subplot:
  - Main sub-plots include the main (or only) trunk of all healthy looking trees. Growth rates were based on stand structure and habitat quality of the plot and vicinity. Main plots were grown for 50 years.
  - Stressed trees were grown in for 10 years then removed. This subplot growth rate was discounted 25% from the main subplot growth rate. (Equation used = Growth rate*1.25 if growth factor is negative, or GR * 0.75 if growth factor is positive)
  - Stressed and topped trees were grown in for 5 years then removed. This subplot growth rate was discounted 50% from the main subplot growth rate. (Equation used = Growth rate * 1.5 if growth factor is negative, GR*0.5 if growth factor is positive)
  - Branched trees were grown in for 10 years at the same growth rate as the main subplot, then removed. Note the largest branch or trunk was included in the Main sub-plot. It was assumed that the main trunk would out compete branched trees.
  - Growth on downed trees or stumps were grown in for 10 years then removed. This subplot growth rate was discounted 25% from the main subplot growth rate. (Equation used = Growth rate*1.25 if growth factor is negative, or GR * 0.75 if growth factor is positive)
- All main tree subplots were entered into the most recent in-growth spreadsheets which allows for growth with or without mortality. Branched, stressed, topped, or stump growth tree subplots were left in an older version of the ingrowth spreadsheet and allowed to die out as described above.
- Average DBH and basal area of each subplot was calculated and combined for each target year, and then averaged (by DBH and basal area) or summed (number of trees) by plot.

<u>Assumptions applied to 2013 Plots for In-growth Spreadsheets:</u>

- The 2013 plots were evaluated to determine if the site was considered healthy, low stressed, medium stressed, or very stressed based on recollection, review of data sheets and notes by 2013 field participants, and comparison to ERDC GIS/RS raster data.
- The 2013 data were put into the new in-growth spreadsheets and updated by using the sixth year (2013 to 2019) as TY1.

RSLR Assumptions

- Baseline inundations were determined using water depth estimates from the field and nearby CRMS stations. If no field data were available, St. John the Baptist Parish LIDAR data were used primarily for BLH.

- In accordance with the USACE EC-1165-2-212, RSLR was determined using the Lake Pontchartrain at West End USGS Gauge (gage number 85625) to determine base and future subsidence and sea level rise (SLR) levels and RSLR. 2070 Intermediate SLR was determined to be 0.85 feet NAVD88 and RSLR was determined to be 2.32 feet, North American Vertical Datum of 1988 (NAVD 88).
- Intermediate RSLR was assumed to be 2.32 feet. Future projections used 2.32 as a basis to rerun long term tidal simulations to compare FWP and FWOP.
- HEC-RAS 2D modeling (both with and without an intermediate RSLR) indicated there were minor project-induced hydrology changes (Figures 3 and 4).
- Intermediate RSLR rates were added to existing water depths and then incorporated into the regression to obtain a change in growth rates for trees at each site applied at TY40.
- Intermediate RSLR growth rates were calculated by using a correlation to the increased inundation due to SLR.
- In order to incorporate intermediate RSLR into the growth factor regression, the Service developed a simple spreadsheet in which the calculations are guided by the following assumptions:
    - 1) there is a direct/ linear correlation between water depth and tree growth suppression (y = -0.5125x - 0.1)
    - 2) the maximum growth reduction factor is -2.15 (a more significant reduction factor would signify extreme tree stress and would equate to short-term tree death
    - 3) the maximum growth reduction factor occurs at a total of 4 feet of inundation, beyond which extreme tree stress and death would occur in less than 10 years (based on personal observations)
        - Plots with a RSLR growth rate determined to be less than -2.4 based on the correlated calculations, were capped at a minimum of -2.4 growth rate.
        - A growth rate less than -2.4 produced errors and grew trees in reverse (shrinking rather than growing in DBH).
    - 4) the minimum growth reduction factor (-0.1) occurs in areas where there are optimum hydrologic conditions (i.e., sufficient soil moisture, but no inundation)
    - Example of stressed growth rates in the in growth spreadsheet - a growth rate of -1.69 for cypress are applied to cypress swamps considered to be highly degraded/stressed and likely to convert to marsh in 20-30 years.
    - Growth rates were assumed to slow severely as water levels increase with RSLR. Intermediate RSLR was used that predicted a 2.32 foot increase.
- A RSLR growth rate was applied at TY40 to all swamp and BLH sites predicted to become permanently inundated due to intermediate RSLR (Table 4).
- This RSLR regression growth correction factor was initially developed for swamp but was also applied to BLH habitats. If BLH became permanently flooded it was assumed the worst growth factor was applied to those sites. BLH sites that were predicted to remain dry (elevations at or above water levels for 50 years) maintained the same growth rate through TY50.

- The majority of initial swamp growth rates were either -0.1 or -0.3 depending on the dominant species. All the TY40-TY50 growth rates for swamp were from -1.5 to -2.4 (Table 4).

Table 4. Swamp and BLH growth factors used in the In-growth Spreadsheets. Existing water depth based on field observation, Future total water depth based on existing water depth plus USACE Intermediate Relative Sea Level Rise (The North American Vertical

Datum of 1988 or NAVD88). Growth factors based on stand composition and habitat quality. Future tree growth factors based on the future water depths.

SWAMP					
Plot Name	Existing Water Depth (feet)	Sea Level Rise (feet)	Future Total Water Depth (feet)	Initial Growth factor	Future (RSLR) Growth Factor (max -2.4)
FR2 cy	-2.5	2.32	-0.2	-0.10	-0.10
FR2 oth				-0.30	-0.30
NW1 cy	0.5	2.32	2.8	-0.10	-1.5
NW1 oth				1.10	
NW10 cy	1.5	2.32	3.8	-0.10	-2.1
NW10 oth				0.10	
NW14 cy	-2.5	2.32	-0.2	-0.10	0.0
NW14 oth				0.40	
NW2 cy	1.5	2.32	3.8	-0.10	-2.1
NW2 oth				-0.30	
NW3 cy	2.5	2.32	4.8	-0.10	-2.4
NW3 oth				0.30	
NW4 cy	3.5	2.32	5.8	-0.10	-2.4
NW4 oth				0.30	
NW5 cy	1.5	2.32	3.8	-0.10	-2.1
NW5 oth				0.30	
NW6 cy	0.5	2.32	2.8	-0.10	-1.5
NW6 oth				0.30	
NW7 cy	1.5	2.32	3.8	-0.10	-2.1
NW7 oth				0.30	
NW8 cy	1.5	2.32	3.8	-0.10	-2.1
NW8 oth				0.30	
NW9 cy	0.5	2.32	2.8	-0.10	-1.5
NW9 oth				-0.30	
W25 cy	2.5	2.32	4.8	-0.10	-2.4
W25 oth				0.30	
WSLP 006 cy	0.5	2.32	2.8	-0.10	-1.5
WSLP 006 oth				-0.30	
WSLP 008 cy	0.5	2.32	2.8	-0.10	-1.5
WSLP 008 oth				0.30	
WSLP 011 cy	3.5	2.32	5.8	-1.29	-2.4
WSLP 011 oth				-0.30	
WSLP 012 cy	2.5	2.32	4.8	-0.10	-2.4
WSLP 012 oth				-0.30	
WSLP 013 cy	2.5	2.32	4.8	-0.10	-2.4
WSLP 013 oth				0.30	
WSLP 014 cy	1.5	2.32	3.8	-0.10	-2.1
WSLP 014 oth				-0.30	
WSLP 015 cy	0.5	2.32	2.8	-0.10	-1.5
WSLP 015 oth				-0.30	
WSLP LDWF 001 cy	1.5	2.32	3.8	-0.10	-2.1
WSLP LDWF 001 oth				-0.30	
WSLP LDWF 004 cy	2.5	2.32	4.8	-0.10	-2.4
WSLP LDWF 004 oth	2.5	2.32	4.8	0.30	-2.4

Bottomland Hardwood					
Plot Name	Existing Water Depth (feet)	Sea Level Rise (feet)	Future Total Water Depth (feet)	Initial Growth factor	Future (RSLR) Growth Factor (max -2.4)
FR1	-2.1	2.32	0.2	-0.20	-0.6
FR3	-1.8	2.32	0.5	1.10	-0.4
NW11	-1.4	2.32	0.9	0.30	-0.6
NW12	-5.2	2.32	-2.9	1.10	1.1
NW13	-3.0	2.32	-0.7	-0.60	-0.6
NW15				0.10	0.1
NW16				0.10	0.1
NW17				0.10	0.1
WSLP 001	-1.7	2.32	0.6	0.30	-0.4
WSLP 002	0.5	2.32	2.8	-0.60	-1.5
WSLP 003	-2.5	2.32	-0.2	-0.30	-0.3
WSLP 004	-2.5	2.32	-0.2	-0.30	-0.3
WSLP 005 blh	2.5	2.32	4.8	-0.30	-2.4
WSLP 009 blh	0.5	2.32	2.8	-0.30	-1.5

WESTLAND VALUE ASSESSMENT

The WVA spreadsheet for Direct Levee and Access Footprint impacts FWP variables were left blank.

General Swamp V1 and V2 and BLH V1, V2, and V3

Site plots were used to determine these variables for all impact areas (Table 2). In the field, diameter at breast height (DBH) and other characteristics of the stand (species composition, canopy closure, mast productions, general stand health, etc…) were taken. These data were used to determine average DBH and basal area (BA), tree growth, and stand composition components for each area. In some cases a representative plot was not available. For these cases other impact area plots were used as a surrogate. Where representative plots were available, WVAs used information from plots within their impact area.

Swamp

- The same data for Direct Levee Footprint areas (from their respective location - west, central or east) were used for Direct Access Footprint areas.
- There were no swamp plots in the west. The HET used plots from the Central Area for the western swamp, based on proximity and CRMS data.
- There were no swamp plots available in the Central Indirect Interior Low. In this case Central Indirect Interior High was used, because of proximity and similarity of habitats condition.

BLH

- The Central area did not have many BLH impact area plots or acres of impact. The HET used the same central BLH plots (Inside Low) for all central impact areas.
- In the East and West Indirect areas, Indirect Interior Low was used the V1, V2, and V3 for Indirect Interior High.
- For the Exterior Impact Areas, the HET use the closest in proximity (direct in these cases) impact area information for the first three variables.

V1: Swamp V1 (Stand Structure) and BLH V1 (tree association)

Swamp Variable (V) 1 – Stand Structure

Stand structure (V1) data were collected from field site visits (2011, 2013, and 2019).

Swamp FWOP

Some areas have been hydrologically impacted by railroad tracks, roads, and berms created from logging and oil and gas activities. Many of these areas have few drainage outlets. The project area and vicinity was last logged in 1956. The height of logging was the 1920-1930s. Existing stands are currently around 70 years old. Even though regeneration has been observed and there are existing hydrologic restrictions we cannot assume much improvement into the future with an estimated 2.32 foot increase for intermediate RSLR. Therefore, the future conditions are expected to be lower than optimal at TY 50. Without the project (FWOP) we assume stand structure will drop by one class value starting in TY40 unless it is already at the lowest class value (class 1).

Swamp FWP

A V1 class reduction was applied to all Direct FWOP and Indirect FWOP/FWP scenarios at TY40 to represent RSLR impacts to project area hydrology.

HEC-RAS 2D modeling (both with and without an intermediate RSLR) indicated there were minor project-induced hydrology changes (figures 3 and 4, Agnew 2019). To minimize hydrology impacts to enclosed wetlands, the project includes features such as interior drainage canals, water control structures within the levee system and pumping stations. Proposed pumping stations would only operate during the threat of tropical storm events when floodgates are closed. Canals and drainage structures would be used to reduce impacts to hydrology and allow for connectivity between protected and unprotected areas.

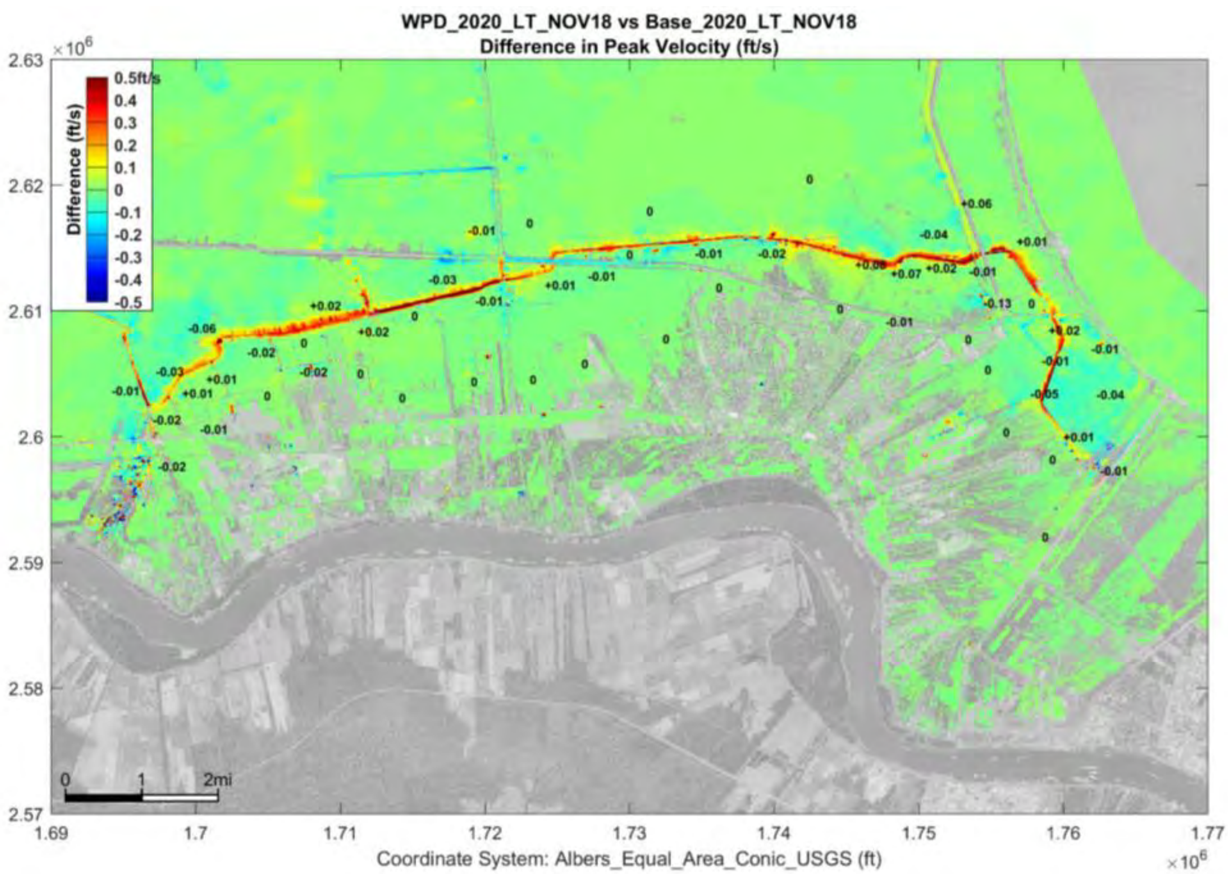

Figure 3. Maximum water velocity difference between West Shore Lake Pontchartrain with and without project for simulation set B1 (B1 is a simulation from November 1, 2018 to November 30, 2018 of observed tidal time-series for Average water surface elevation 0.55foot). Blues and yellows indicate areas of change due to the project while orange to dark indicate the levee alignment (Agnew, 2019).

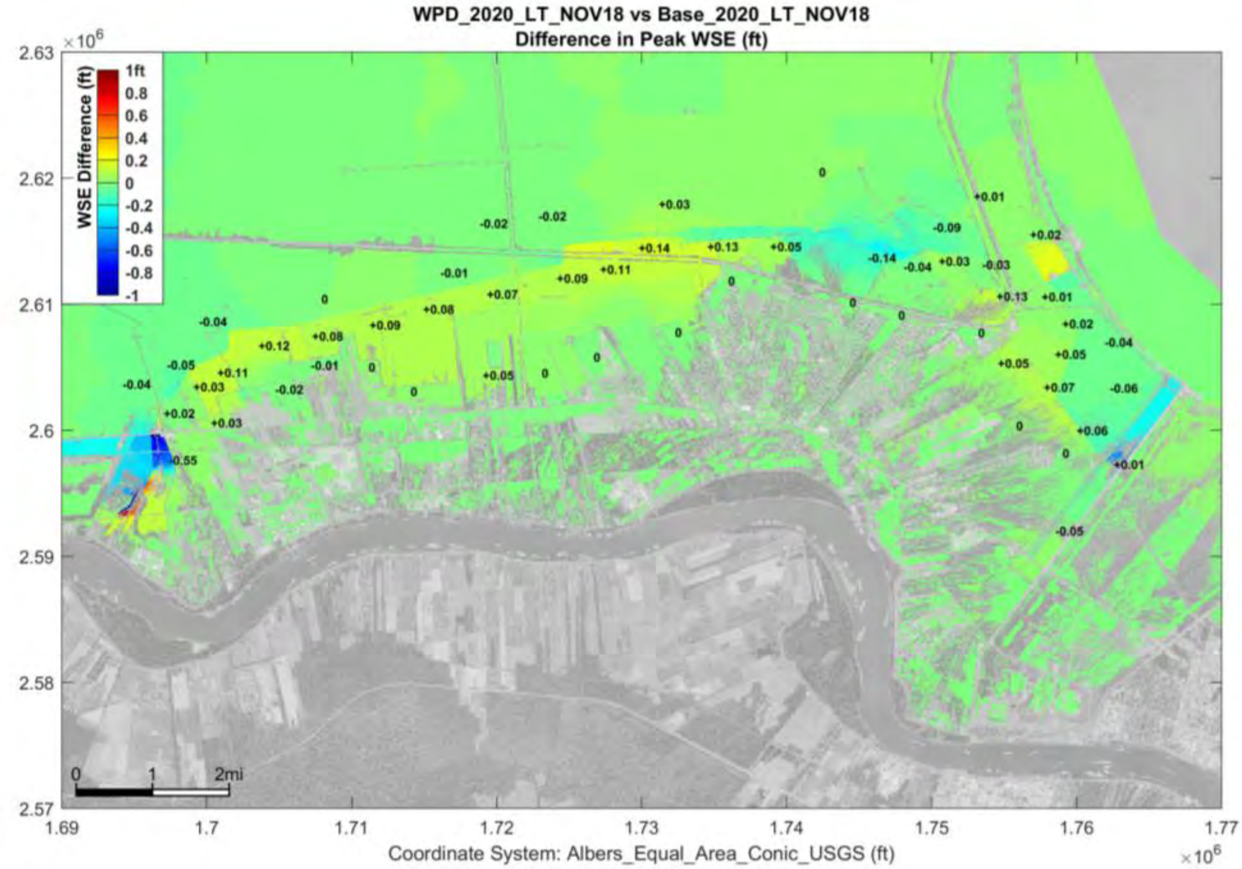

Figure 4. Maximum water surface elevation difference between West Shore Lake Pontchartrain with and without project for simulation set B1 (B1 is a simulation from November 1, 2018 to November 30, 2018 of observed tidal time-series for Average water surface elevation 0.55foot). Blues and yellows indicate areas of change due to the project while orange to dark indicate the levee alignment (Agnew, 2019).

Despite inclusion of project features to avoid hydrology impacts, the HEC-RAS modeling revealed that a slight increase in inundation occurred in some locations near the levee alignment (in the Indirect Exterior and Indirect Interior High areas). Increased water depth can reduce the transfer of oxygen to roots. Depth increases indicate a with-project reduction in water exchange which might lead to water quality deterioration. The combined effects of these changes to water movement might stress previously healthy swamps and result in a reduction in forest diversity and productivity (Krauss et. al. 2009). The reduction in forest diversity and productivity can be seen through a reduction of soft mast production and by limiting the development of stand structure (overstory, midstory, and understory) which are important for provide resting, foraging, breeding, nesting, and nursery habitat.

A Digital Elevation Model (DEM) created from LIDAR data was used to generate initial elevation conditions for the HEC-RAS hydrologic model. LIDAR data does not typically provide accurate estimates of ground elevations in turbid flooded wetlands, especially those with floating aquatic vegetation which is very common in the project area. Additionally, minor typography/bathymetry features which can effect hydrology, are sometimes not captured in LIDAR based DEMs. Thus the HET is concerned that the HEC-RAS hydrologic model may not accurately reflect restrictions in hydrologic surface-flow post-construction. Based on the DEM issues and associated modeling inaccuracies, and the HETs knowledge and experience associated with swamp habitats and the project area, the HET agreed that additional indirect impacts to Swamp habitats beyond what was indicated in the HEC-RAS 2D models are likely.

Portions of the Project Area swamps are presently severely inundated and stressed, though the Indirect High impact swamp areas were found on average to be fairly healthy. Areas containing swamp habitat with a stand structure (V1) with a Class 4 to Class 6 (Table 5), are susceptible to elevated stress levels due to restrictions in hydrologic surface-flow post-construction. Even though in FWP all Indirect Exterior and Indirect High impact swamp areas may experience changes in water movement, only the healthier Indirect High impact swamp areas were evaluated to have additional impacts beyond that indicated by hydrologic modeling results. This delayed response to the with-project hydrology changes was for Indirect High FWP starting at TY10 by dropping V1 one class level (Table 7). Indirect Exterior on average was already stressed thus not likely to add significant additional stress with the project. Indirect low was considered to be too far removed to have hydrologic impacts with the project.

See table 5 for reference to classes and Tables 6 and 7 for each impact area's class.

Table 5. Wetland Value Assessment Swamp Model Variable 1 – Stand Structure.

	Overstory		Scrub-shrub/ Midstory Cover		Herbaceous Cover
Class 1.	<33%				
Class 2.	≥33%<50%	and	<33%	and	<33%
Class 3.	≥33%<50%	and	≥33%	or	≥33%
			OR		
	≥50%<75%	and	<33%	and	<33%
Class 4.	≥50%<75%	and	≥33%	or	≥33%
			OR		
	≥75%	and	<33%	and	<33%
Class 5.	≥33%<50%	and	≥33%	and	≥33%
Class 6.	≥50%	and	≥33%	and	≥33%
			OR		
	≥75%	and	≥33%	or	≥33%

Table 6. V1 Stand Structure for Direct Levee and Access Footprint Swamp Impacts.

East and West Direct Levee and Access Footprints		
	FWOP Class	FWP Class
TY0	1	1
TY1	1	none
TY5	1	none
TY10	1	none
TY40	1	none
TY50	1	none

Central Direct Levee and Access Footprints		
	FWOP Class	FWP Class
TY0	3	3
TY1	3	none
TY5	3	none
TY10	3	none
TY40	2	none
TY50	2	none

Table 7. V1 Stand Structure for Indirect Swamp Impacts.

East and West Indirect High Inside		
	FWOP Class	FWP Class
TY0	6	6
TY1	6	6
TY5	6	6
TY10	6	5
TY40	5	4
TY50	5	4

Central Indirect High Inside		
	FWOP Class	FWP Class
TY0	4	4
TY1	4	4
TY5	4	4
TY10	4	3
TY40	3	2
TY50	3	2

East and West Indirect Low Inside		
	FWOP Class	FWP Class
TY0	6	6
TY1	6	6
TY5	6	6
TY10	6	6
TY40	5	5
TY50	5	5

Central Indirect Low Inside		
	FWOP Class	FWP Class
TY0	4	4
TY1	4	4
TY5	4	4
TY10	4	4
TY40	3	3
TY50	3	3

East Indirect Exterior		
	FWOP Class	FWP Class
TY0	2	2
TY1	2	2
TY5	2	2
TY10	2	2
TY40	1	1
TY50	1	1

Central and West Indirect Exterior		
	FWOP Class	FWP Class
TY0	3	3
TY1	3	3
TY5	3	3
TY10	3	3
TY40	2	2
TY50	2	2

BLH Variable V1 Tree Species Association

Wildlife species that utilize bottomland hardwoods depend heavily on mast, other edible seeds, and tree buds as primary sources of food. The basic assumptions for this variable are: 1) more production of mast (hard and/or soft) and other edible seeds is better than less production, and 2) because of its availability during late fall and winter and its high energy content, hard mast is more critical than soft mast, other edible seeds, and buds. Table 8 shows the class values based on tree species.

BLH Tree Species Association (V1) data were collected during field site visits for baseline estimates. Projections for each site were processed through the WVA Site-Ingrowth spreadsheets (see In-growth spreadsheet section). BLH Class remains the same for the project life FWOP and FWP (Table 9).

Table 8. BLH Variable V1 Tree Species Association Class descriptions.

Class 1:	Less than 25% of overstory canopy consists of mast or other edible-seed producing trees or more than 50% of soft mast present but no hard mast.
Class 2:	25% to 50% of overstory canopy consists of mast or other edible-seed producing trees, but hard mast producers constitute less than 10% of the canopy
Class 3:	25% to 50% of overstory canopy consists of mast or other edible-seed producing trees, and hard mast producers constitute more than 10% of the canopy.
Class 4:	Greater than 50% of overstory canopy consists of mast or other edible-seed producing trees, but hard mast producers constitute less than 20% of the canopy.
Class 5:	Greater than 50% of overstory canopy consists of mast or other edible-seed producing trees, and hard mast producers constitute more than 20% of the canopy.

Table 9. BLH Variable V1 Tree Species Association

	EAST	*CENTRAL*	*WEST*
Direct Levee and Access footprints	*Class 4*	*Class 5*	*Class 4*
Indirect High Inside	*Class 5*	*Class 5*	*Class 4*
Indirect Low Inside	*Class 5*	*Class 5*	*Class 4*
Indirect Exterior	*Class 5*	*Class 5*	*Class 4*

V2/V3: Swamp and BLH V2 (Stand Maturity) and BLH V3 (Understory/Midstory)

Swamp V2 - Stand Maturity

Stand maturity (V2) data was collected from all site visits for baseline estimates. Projections for each site was processed through the WVA Site-Ingrowth spreadsheets (Tables 10 and 11). See In-growth spreadsheets section for information on V2 assumptions.

Table 10. V1 and V2 Summary Tables for Central Swamp.

	CENTRAL DIRECT LEVEE FOOTPRINT SWAMP									
			Plots	WSLP 012	WSLP 013	NW8				
	AVERAGE	TOTAL	HEALTHY							
	TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
	DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
Cypress	18.0	592.2	18.8	666.7	18.9	758.2	16.6	20.4	23.7	1419.2
# Cy Trees	28.0		29.0		32.0		12.0		39.0	
Other	9.9	338.1	9.9	426.2	10.3	531.3	15.2	1390.3	15.6	1452.4
# O Trees	51.0		65.0		76.0		96.0		96.0	
	% Overstory	56.7								
	% Midstory	9.0								
	% Ground	24.0								
	CENTRAL INDIRECT INSIDE HIGH SWAMP									
				Plots	NW9	NW10				
	AVERAGE	TOTAL	LOW STRESS							
	TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
	DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
Cypress	22.5	297.2	23.9	333.0	25.4	370.8	33.7	640.1	34.9	681.8
# Cy Trees	10.0		10.0		10.0		10.0		10.0	
Other	12.7	188.8	13.2	225.2	13.9	267.3	15.2	777.5	15.6	999.4
# O Trees	18.0		20.0		22.0		52.0		70.0	
	% Overstory	59.5								
	% Midstory	42.5								
	% Ground	10.0								
	CENTRAL INDIRECT Exterior SWAMP									
				Plots	WSLP LDWF 001					
	AVERAGE	TOTAL	MED STRESSED							
	TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
	DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
Cypress	20.3	179.0	21.4	196.9	22.8	220.6	28.6	399.2	29.3	416.6
# Cy Trees	7.0		7.0		7.0		8.0		8.0	
Other	10.4	250.9	10.7	300.9	10.3	392.0	14.4	1263.2	14.7	1315.1
# O Trees	34.0		39.0		54.0		98.0		98.0	
	% Overstory	65.0								
	% Midstory	3.0								
	% Ground	6.0								

Table 11. V1 and V2 Summary Tables for East and West Swamp.

	EAST DIRECT LEVEE FOOTPRINT SWAMP									
		Plots	WSLP 008	WSLP 011	WSLP 014	W25	NW5			
	AVERAGE	TOTAL	HEALTHY							
	TY 1.0	91.0	TY 5.0		TY 10.0		TY 40.0		TY 50.0	
	DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
Cypress	17.9	234.8	19.2	259.1	20.5	286.4	16.2	553.0	18.5	595.4
# Cy Trees	10.9		10.7		10.5		23.9		23.5	
Other	9.2	274.8	9.6	363.2	9.8	435.8	13.9	1764.5	14.4	1600.6
# O Trees	52.9		64.1		72.6		152.2		130.4	
	% Overstory	32.6								
	% Midstory	37.0								
	% Ground	48.0								
	EAST INSIDE INDIRECT HIGH SWAMP									
				Plots	NW6					
	AVERAGE	TOTAL	LOW STRESS							
	TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
	DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
Cypress	29.7	97.0	31.1	106.3	32.5	115.8	40.6	180.4	41.9	192.0
# Cy Trees	2.0		2.0		2.0		2.0		2.0	
Other	13.8	105.8	13.1	133.4	14.5	158.8	17.3	578.6	18.6	658.4
# O Trees	8.0		11.0		11.0		31.0		31.0	
	% Overstory	73.0								
	% Midstory	40.0								
	% Ground	100.0								
	EAST INSIDE INDIRECT LOW SWAMP									
	Plots	WSLP 006	FR2	NW14	NW2	NW3	NW4	NW7		
	AVERAGE	TOTAL	MED STRESSED							
	TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
	DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
Cypress	16.4	418.6	15.0	490.5	14.7	574.5	19.1	1288.5	20.3	1433.2
# Cy Trees	23.0		30.0		36.0		53.0		53.0	
Other	12.6	668.3	12.9	820.9	12.0	1013.6	16.9	3164.8	18.1	3553.7
# O Trees	64.0		74.0		97.0		175.0		175.0	
	% Overstory	71.1								
	% Midstory	40.4								
	% Ground	36.2								
	EAST INDIRECT EXTERIOR SWAMP									
	Plots	WSLP LDWF 004	WSLP 015	CRMS5373						
	AVERAGE	TOTAL								
	TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
	DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
Cypress	32.8	431.2	33.3	474.7	34.6	526.9	38.3	954.9	24.4	821.1
# Cy Trees	35.0		36.0		36.0		42.0		21.0	
Other	24.0	484.8	25.2	557.5	26.1	640.5	27.7	1556.2	13.0	807.8
# O Trees	128.0		130.0		135.0		191.0		78.0	
	% Overstory	33.8								
	% Midstory	32.5								
	% Ground	16.9								

BLH Variables V2 - Stand Maturity and V3 - Understory/Midstory

Table 12. V1, V2, and V3 Summary Tables for BLH

EAST DIRECT LEVEE and ACCESS Footprint BLH									
			WSLP 003						10
AVERAGE	TOTAL	HEALTHY							
TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
13.1	190.4	13.0	214.6	12.3	254.2	12.4	882.6	14.7	1185.1
14.0		16.0		21.0		86.0		86.0	
% Overstory	80.0		Hard-mast	0.0					
% Midstory	35.0		Soft-mast	95.0					
% Ground	80.0		Non-mast	5.0					
			Class	4.0					
EAST INDIRECT INSIDE Low BLH									
			WSLP 004	WSLP 009 bl	FR1	FR3	NW16	NW17	
AVERAGE	TOTAL	HEALTHY							
TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
12.7	616.9	12.7	731.4	9.1	881.1	15.4	2727.1	17.9	3525.4
54.9		63.5		105.0		173.9		172.7	
% Overstory	69.2		Hard-mast	27.5					
% Midstory	44.0		Soft-mast	72.5					
% Ground	45.5		Non-mast	0.0					
			Class	5.0					
CENTRAL INDIRECT INSIDE LOW BLH									
									10
AVERAGE	TOTAL	HEALTHY							
TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
16.2	230.1	15.7	274.5	10.8	318.8	21.0	761.4	24.0	956.6
14.0		17.0		27.0		27.0		27.0	
% Overstory	61.7		Hard-mast	30.0					
% Midstory	10.0		Soft-mast	70.0					
% Ground	40.0		Non-mast	0.0					
			Class	5.0					

WEST DIRECT LEVEE and ACCESS Footprint BLH									
			NW11	NW12	NW13				
AVERAGE	TOTAL	HEALTHY							
TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
14.9	323.0	14.1	397.3	8.8	479.6	19.8	1379.3	22.5	1737.6
24.0		30.0		55.0		55.0		55.0	
% Overstory	72.0		Hard-mast	8.3					
% Midstory	72.7		Soft-mast	90.0					
% Ground	51.7		Non-mast	1.7					
			Class	4.0					
WEST INDIRECT INSIDE LOW BLH									
			WSLP 001	WSLP 002					
AVERAGE	TOTAL	HEALTHY							
TY 1.0		TY 5.0		TY 10.0		TY 40.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA	DBH	BA
9.0	65.2	9.2	80.1	8.6	111.8	12.8	1184.2	15.2	1599.6
13.8		16.0		24.7		127.0		124.0	
% Overstory	40.0		Hard-mast	5.0					
% Midstory	47.5		Soft-mast	94.0					
% Ground	60.0		Non-mast	1.0					
			Class	4.0					

V3/V4: Swamp V3 (Water regime) and BLH V4 Hydrology

The same information is used to calculate the SIs for Swamp V3 and BLH V4. These variables are somewhat interchangeably referred to as water regime or hydrology as they consider the flooding duration and amount of water flow or exchange in forested wetlands using eight categories (Table 15). For swamp the optimal water regime is assumed to be seasonal flooding with abundant and consistent riverine/tidal input and water flow-through (SI=1.0; Table 13). The optimal water regime for BLH is assumed to be temporary flooding with abundant and consistent riverine input and water flow-through (SI = 1.0; Table 14).

Table 13. Wetland Value Assessment Swamp Model Variable 3 – Water Regime.

		Flow/Exchange			
		High	Moderate	Low	None
Flooding Duration	Permanent	0.65	0.45	0.30	0.10
	Semi-Permanent	0.75	0.65	0.45	0.25
	Seasonal	1.00	0.85	0.70	0.50
	Temporary	0.9	0.75	0.65	0.40

Table 14. Wetland Value Assessment Bottomland Hardwood Model Variable 4 – Hydrology.

		Flow/Exchange			
		High	Moderate	Low	None
Flooding Duration	Temporary	1.00	0.85	0.70	0.50
	Seasonal	0.85	0.75	0.65	0.40
	Semi-Permanent	0.75	0.65	0.45	0.25
	Permanent/Dewatered	0.65	0.45	0.30	0.10

Each WVA subgroups was adjusted for water regime for baseline and future projections based on the data described in the proceeding section.

Data for determining Water Regime and Hydrology

The HET used ERDC RS/GIS data (Saltus and Suir, 2019), WVA field observations, and H&H model results (Agnew, 2019), and CRMS data from 2007 or 2012 to 2019 (CPRA, 2020) to estimate values for these variables. Table 15 shows the percent inundation for the period of analysis for each CRMS station used. CRMS0059 (Reserve) was inundated the entire period of analysis (2012-2019), while CRMS5373 (Hope) was inundated approximately 96% of the period of analysis (2007-2019). These are the two closest CRMS station but only CRMS0059 is within the project area. Both stations are located along waterways which would likely have more water flux than interior swamps. Based on field observation, there were some dry or low water level areas as well as completely inundated areas within the Project Area.

Table 15. CRMS0059 (Reserve) and CRMS 5373 (Hope) mean growing season salinity and inundation.

CRMS0059			
Year	Mean Salinity	Mean growing season salinity	Inundation
2012	0.33	0.26	1.00
2013	0.31	0.28	1.00
2014	0.18	0.14	1.00
2015	0.20	0.21	1.00
2016	0.11	0.09	1.00
2017	0.10	0.08	1.00
2018	0.12	0.12	1.00
2019	0.10	0.10	1.00

CRMS 5373			
Year	Mean Salinity	Mean growing season salinity	Inundation
2007	0.48	0.43	0.99
2008	0.30	0.30	0.87
2009	0.43	0.51	0.87
2010	0.26	0.26	0.98
2011	0.54	0.56	0.97
2012	0.26	0.20	0.97
2013	0.23	0.22	0.99
2014	0.19	0.16	0.96
2015	0.16	0.18	0.96
2016	0.14	0.13	0.98
2017	0.15	0.13	0.98
2018	0.16	0.17	0.95
2019	0.13	0.12	N/A

Swamp flood duration

Coastwide Reference Monitoring System (CRMS) CRMS0059 and CRMS5373 station data indicated flooded all or most of the time at the station sites. Based on U.S. Army Engineer Research and Development Center's (ERDC) Remotely Sensed Habitat Assessment and Geographic Information Systems (GIS) data (ERDC RS/GIS data), WVA field observations, hydrologic model results, and CRMS data from 2007 or 2012 to 2019, the level of inundation was determined to vary from dry to deep (3 feet or deeper).

Each plot was categorized into the following water levels: dry, low water (< 1 foot inundated), wet (1-2 feet inundated), moderate water (2-3 feet inundated), and deep (> 3 feet inundated) based on field site visits, CRMS data (Table 15), and ERDC RS/GIS data. Older data (e.g., field site data from 2011 and 2013) were reviewed and categorized based on notes and recollection. Floating aquatic vegetation was observed during field site visits.

WVA field site inundation levels were averaged to estimate sub-area flood duration values. For instance, sub-area central Indirect Interior High had two field sites: one with low water (valued at 1) and one that was wet (valued at 2). These two plots were combined and weighted (Table 16) for a final value of 1.5 which was assigned a semi-permanent duration on the Swamp V3 (Table 13). Most swamp plots were estimated to have semi-permanent to permanent flood durations (Table 18).

Average water levels were increased by 2.32 feet for each plot and recategorized by the same group ranges at TY40. For example, the addition of 2.32 feet increased the central Indirect Interior High plots to moderate water (value of 3) and deep water (value of 3) with a final weighted average of 3, or permanently flooded. This method corroborated our assumption that all swamp would become permanently flooded in the future. Future projections were applied to both FWOP and FWP.

There were no swamp plots in the western area. Central swamp hydrology information and assumptions were applied to the western swamp WVAs. This was based on the field and CRMS Station data, and geographic proximity.

Hydrologic impacts were captured in the WVA for two impact areas (Indirect Exterior and Indirect High) in the WVAs Swamp V3 Water Regime and Bottomland Hardwood V4 Hydrology variables. These variables consider the flooding duration and amount of water flow/exchange. Although the hydrologic modeling results indicated a slight with-project increase in inundation, the HET chose not to apply WVA impacts due to increased inundation.

<u>Swamp flow/exchange</u>

Field observations, CRMS data, LIDAR data (but see section xyz), aerial imagery, and knowledge of previous anthropogenic alterations, and H&H modeling indicate much of the area has highly restricted flow. The HET assumed that near the levee alignment (Indirect Exterior and Indirect High) there would be a reduction in water flow/exchange.

Flow/exchange were assumed to not change for all FWOP TYs and scenarios. Indirect Interior High and Indirect Exterior flow and exchange were decreased one level at TY1 to account for changes in hydrology in the vicinity of the levee system alignment (ex. Moderate to Low flow/exchange). With RSLR all areas will have Low flow/exchange in FWP (TY40/50) because there will be openings but the efficiency will be reduced due to high RSLR (0.3 HSI).

The HET assumed the flow/exchange variable was between moderate and low flows for much of the project area swamps based on these data. Indirect Interior High flow/exchange was assumed to be lower than Direct and Indirect Exterior areas because of an existing pipeline ROW that likely acts as a hydrologic barrier. Indirect Interior Low is decreased further because it is mostly higher ground with more development and canals, and is less influenced by tidal exchange (Figures 3 and 4).

Some of the areas were determined to be between values seen on Tables 13 and 14, a weighted SI value was given to represent these instances (Table 17). Sometimes the weighted plot values were between flow/exchange categories.

<u>BLH flow/exchange and flood duration</u>

BLH sites were mostly dry except in the central area where they were more inundated. Most BLH habitats may receive some standing water, but the water table is likely below the ground for much of the year. Water inputs come predominantly from rainfall and there was very limited water exchange from riverine and/or tidal inputs. Healthy BLH is typically in higher elevation and drain well.

Based on field observations, aerial imagery, CRMS data, and H&H modeling, BLH was given a low or moderate flow exchange and either temporary or seasonal flood duration (based on weighting above), except for the Central sites which were assumed to be permanently flooded (Table 18).

As in swamp, the 2.32 foot RSLR projection was added to existing ground elevation estimates, derived from LIDAR and field data. FWOP TY50 flood duration were increased, but the flow/exchanged were assumed to remain the same (Table 18). Flow/exchange for all subareas are assumed to decrease to low, except Direct impacts and Indirect Interior Low areas, for FWP TY1. Flow/exchange in the BLH east Indirect Low is hydrologically isolated by bayous, pipeline corridors, and canals. Therefore, BLH east was assumed to have minor project-related flow impacts and was reduced from moderate to 50/50% moderate/low to show a slight impact but not fully (Table 18).

Table 16. Weighted average of field plot water levels to determine flooding of each subarea for the West Shore Lake Pontchartrain Project.

	U	V			
	Value	# Plots		Swamp	BLH
3	1	x	Dry and Low Wet <0.5ft	Seasonal/Temp	Temp/Seasonal
4	2	y	Wet (1.5ft)	Semi-perm	Semi-perm
5	3	z	Mod Wet & Deep >2.5	Perm	Perm
6	Total	0			
	Weighted Avg	=((U3*V3)+(U4*V4)+(U5*V5))/V6			

Table 17. Suitability Index weighted between values from the Swamp V3 Water Regime or Bottomland Hardwood (BLH) V4 Hydrology values from the Swamp and BLH, respectively, Wetland Value Assessment. Used in the West Shore Lake Pontchartrain Project.

	Swamp	
50% Moderate 50% low	Temp	0.7
50% Moderate 50% low	Seasonal	0.775
50% Moderate 50% low	Semi perm	0.55
50% Moderate 50% low	Perm	0.375
75% Moderate 25% low	Semi-perm	0.6
75% Moderate 25% low	Permanent	0.425
	BLH	
50% Moderate 50% low	Temp	0.775
50% Moderate 50% low	Seasonal	0.7
50% Moderate 50% low	Semi perm	0.55
50% Moderate 50% low	Perm	0.375

Table 18. Swamp V3 Water Regime and Bottomland Hardwood V4 Hydrology values used for baseline conditions and future projections for the subareas of the West Shore Lake Pontchartrain project.

EAST									
		FWOP TY1		FWOP TY50		FWP TY1		FWP TY50	
Area	Habitat	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration
Ind- Exterior	Swamp	Moderate	Semi-Perm	Moderate	Perm	low	Semi-Perm	low	Perm
Direct	Swamp	Moderate	Semi-Perm	Moderate	Perm	0	Semi-Perm	0	0
Ind - High	Swamp	50 Mod/50 low	Temp	50 Mod/50 low	Perm	low	Temp	low	Perm
Ind - Low	Swamp	low	Semi-Perm	low	Perm	low	Semi-Perm	low	Perm
		FWOP TY1		FWOP TY50		FWP TY1		FWP TY50	
Area	Habitat	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration
Ind- Exterior	BLH	Moderate	Seasonal	Moderate	Semi-Perm	low	Seasonal	low	Semi-Perm
Direct	BLH	Moderate	Seasonal	Moderate	Seasonal	0	0	0	0
Ind - High	BLH	Moderate	Seasonal	Moderate	Perm	low	Seasonal	low	Perm
Ind - Low	BLH	Moderate	Seasonal	Moderate	semi-perm	50 Mod/50 low	Seasonal	50 Mod/50 low	semi-perm
CENTRAL									
		FWOP TY1		FWOP TY50		FWP TY1		FWP TY50	
Area	Habitat	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration
Ind- Exterior	Swamp	75% Moderate 25% low	Semi-perm	75% Moderate 25% low	Perm	low	Semi-perm	low	Perm
Direct	Swamp	75% Moderate 25% low	Permanent	75% Moderate 25% low	Perm	0	0	0	0
Ind - High	Swamp	50/50 Moderate Low	Semi-perm	50/50 Moderate Low	Perm	low	Semi-perm	low	Perm
Ind - Low	Swamp	50/50 Moderate Low	Permanent	50/50 Moderate Low	Perm	50/50 Moderate Low	Permanent	50/50 Moderate Low	Perm
		FWOP TY1		FWOP TY50		FWP TY1		FWP TY50	
Area	Habitat	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration
Ind- Exterior	BLH	75% Moderate 25% low	Permanent	75% Moderate 25% low	Permanent	low	Permanent	low	Permanent
Direct	BLH	75% Moderate 25% low	Permanent	75% Moderate 25% low	Permanent	0	0	0	0
Ind - High	BLH	50/50 Moderate Low	Permanent	50/50 Moderate Low	Permanent	low	Permanent	low	Permanent
Ind - Low	BLH	50/50 Moderate Low	Permanent	50/50 Moderate Low	Permanent	50/50 Moderate Low	Permanent	50/50 Moderate Low	Permanent
WEST									
		FWOP TY1		FWOP TY50		FWP TY1		FWP TY50	
Area	Habitat	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration
Ind- Exterior	Swamp	75% Moderate 25% low	Semi-perm	75% Moderate 25% low	Perm	low	Semi-perm	low	Perm
Direct	Swamp	75% Moderate 25% low	Permanent	75% Moderate 25% low	Perm	0	0	0	0
Ind - High	Swamp	50/50 Moderate Low	Semi-perm	50/50 Moderate Low	Perm	low	Semi-perm	low	Perm
Ind - Low	Swamp	50/50 Moderate Low	Permanent	50/50 Moderate Low	Perm	50/50 Moderate Low	Permanent	50/50 Moderate Low	Perm
		FWOP TY1		FWOP TY50		FWP TY1		FWP TY50	
Area	Habitat	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration	Flow/Exchange	Flood Duration
Ind- Exterior	BLH	Low	Temp	Low	Semi-perm	low	Temp	low	Semi-perm
Direct	BLH	Low	Temp	Low	Semi-perm	0	0	0	0
Ind - High	BLH	Low	Temp	Low	Semi-perm	low	Temp	low	Semi-perm
Ind - Low	BLH	Low	Temp	Low	Semi-perm	low	Temp	low	Semi-perm

Note: In addition to the potential impact to water exchange, the Service is concerned about reduced future water exchange due to Relative Sea Level Rise (RSLR) requiring increased structure closures.

As stated in the 2016 WSLP EIS "Hydrologic connectivity would be maintained to the extent practicable through water control structures except during closure for hurricanes or tropical storms. When the system is closed, pumps would operate on average for 1.7 storms per year, which equates to a closure of structures on average 8.5 days per year. This expected rate of closure would be the same regardless of the actual rate of RSLR as closure of the system is tied to tropical storm events and the elevation trigger would be adjusted as sea level rises. The risk reduction system is only authorized to address storm surge caused by hurricane and tropical storm events. It is not authorized to mitigate for or reduce impacts caused by higher day-to-day water levels brought about by increases in sea level rise. Rainfall events and high tides could still cause significant flooding of the swamps within the levee-enclosed area. All drainage features through the levee system were sized to match the existing gravity drainage system, and would mimic the existing drainage patterns when the system is not closed. Any operational changes implemented to address changing SLR conditions or for any other non-project-related purpose would be considered a separate project purpose requiring separate authorization, new NEPA documentation, and/or permit approvals."

The project is not authorized to close the system more often due to higher day-to-day flooding impacts caused by RSLR. Because WSLP is authorized this way, impact analysis to the WSLP project area forested wetlands were evaluated assuming structures would not be closed more often than allowed by the stated triggers. However, if the sponsor/operator sees a higher level of sea level rise and starts to see increased soil saturation/flooding in developed areas due to RSLR, they may want to change the operations to close the structures more frequently, such as at high tides. A change in operations would be considered a separate project purpose and authorization, and would require a new NEPA documentation and a permit approval for this operation change. With a change from the authorized operation, there may be an increase in frequency and duration of gate closures due to area-wide stage increases caused by RSLR thereby leading to potential substantial negative impacts to wetlands enclosed by the levee system not estimated for the current WVAs. If a change in operation due to RSLR is realized, at present, it is unknown how water levels within the system would be managed so there is a potential for substantial additional and unaccounted for indirect impacts to forested wetlands and fish and wildlife resources. Additional impacts would need to be evaluated and mitigated for if changes in structure operations changes occur.

If the proposed levee and/or operation of structures increases flood frequency and water depth the bald cypress swamp will become stressed which could result in a reduction in diversity and productivity (Krauss et. al. 2009). Increased water depth can also reduce the transfer of oxygen to roots. Over time, a stressed swamp could convert to marsh and/or open water. Reduced water exchange in the enclosed wetlands would lead to further water quality deterioration in the Lake Pontchartrain Basin by eliminating or reducing the filtering capacity of those wetlands. The potential wetland habitat impact to the largest remaining continuous forested wetlands in Louisiana would result in the reduction of resident fish and wildlife, reduced important wintering habitat for waterfowl and other migratory birds that use the Central and Mississippi Flyways, and reduced nursery habitat and detritus input important to the maintenance of estuarine-dependent fish and shellfish production.

V4: SWAMP V4 – Salinity

Baseline salinity estimates were based on nearby CRMS station salinities of recent years (2010-2019) to represent salinities after the Mississippi River Gulf Outlet (MRGO) was closed in 2009, the Inner Harbor Navigation Canal-Lake Borgne Surge Barrier (surge barrier) was closed in 2010, and the Seabrook floodgate complex was completed in 2012. Since these closures, salinities have been reduced in the Pontchartrain basin and the project area.

For swamp the WVA standard is to use the mean high growing season salinity, which is from March 1 through October 31. Data from CRMS0059 sites H01 and H02 at Reserve Relief Canal and CRMS5373 Hope Canal had a 0.42 parts per thousand (ppt) mean growing season salinity for all years from 2007-2019. Data for these two stations had a mean high growing season salinity of 0.35 ppt from 2010 – 2019. The highest salinities for all years is 1.3ppt and for 2010-2019 is 1.2ppt. See figures 5 and 6 for mean growing season (Note: this is not mean high growing season) salinities.

The HET used 0.4 ppt as the baseline salinity for swamp.

Future salinity

In the future, saltwater increases are expected due to continued land loss associated with RSLR. Modeling results from the Delta Management and Mid-Barataria Sediment Diversion projects were reviewed (Messina, et al 2019 and ERDC 2016) to better understand salinity dynamics in the project area and vicinity. Results indicated that salinities in Lake Pontchartrain would not increase by more than 0.5 ppt over the next 50 years. Since the project area is further inland than Lake Pontchartrain, it was assumed salinities within the project area would not increase by more than 0.5 ppt. This expected slight change in salinity is not likely to impact plant health.

The East area is closest to Lake Pontchartrain and was assumed to have the greater increase in salinity (an increase of 0.5ppt) while the areas further away (Central and West) were not likely to increase as much. The HET used 0.5ppt in the West and Central areas and 0.7ppt in the East for TY40 and TY50.

Figure 5. Mean growing season salinities for CRMS0059 (2012-2019) and CRMS5373 (2007-2019)

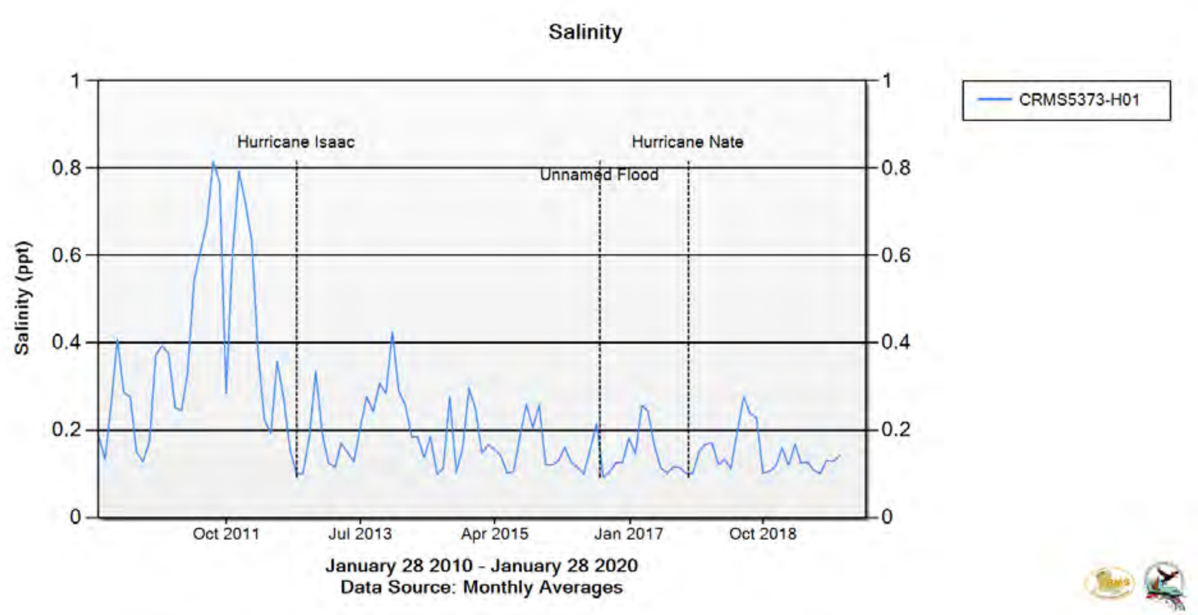

Figure 6. Monthly Average Salinity 2010-2019 for CRMS5373 (Hope).

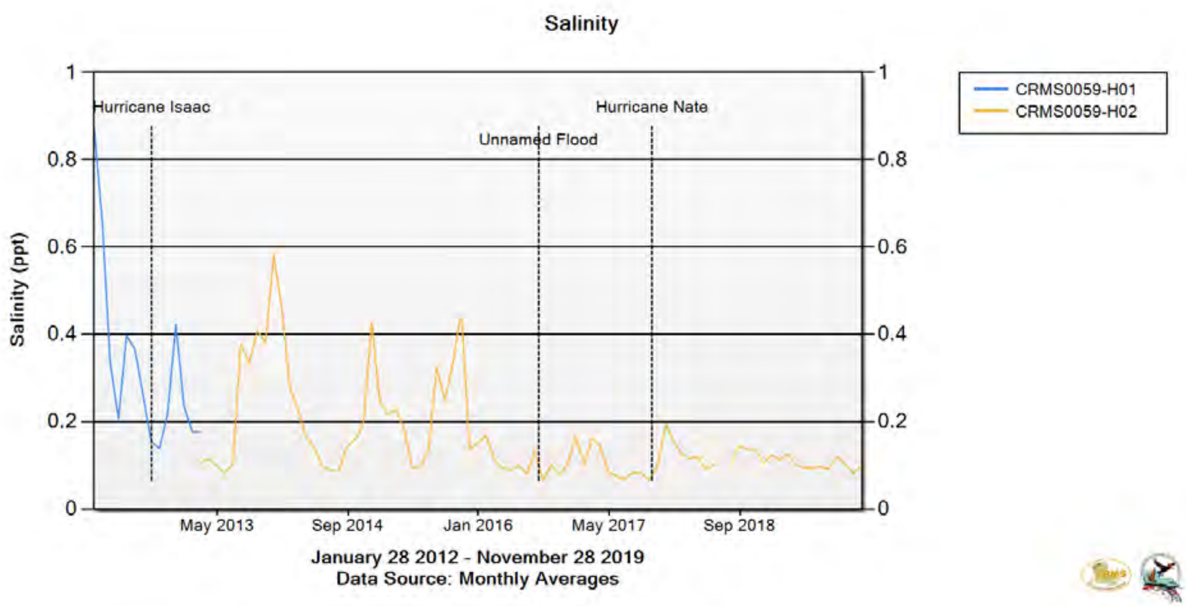

Figure 7. Monthly Average Salinity for CRMS0059 (Reserve).

V5: Size of Contiguous Forested Area

Although edge and diversity, which are dominant features of small forested tracts, are important for certain wildlife species, it is important to understand four concepts: 1) species which thrive in edge habitat are highly mobile and presently occur in substantial numbers, 2) because of forest fragmentation and ongoing timber harvesting by man, edge and diversity are quite available, 3) most species found in "edge" habitat are "generalists" in habitat use and are quite capable of existing in larger tracts, and 4) those species in greatest need of conservation are "specialists" in habitat use and require large forested tracts. Therefore, the basic assumption for this variable is that larger forested tracts are less common and offer higher quality habitat than smaller tracts. For this model, tracts greater than 500 acres in size are considered large enough to warrant being considered optimal. See Table 19.

Table 19. Size of Contiguous Forested Area.

Class 1.	0 to 5 acres
Class 2.	5.1 to 20 acres
Class 3.	20.1 to 100 acres
Class 4.	100.1 to 500 acres
Class 5.	> 500 acres

Note: Corridors less than 75 feet wide do not constitute a break in the forested area contiguity.

For this variable, Swamp and BLH were considered together as a large contiguous forest. The ERDC GIS/RS data, 2016 National Land Cover Database (NLCD) data, FWI, and available imagery were used to determine sizes of contiguous forested areas for each area evaluated. A weighted average was calculated for each impact area to determine their HSI for baseline, FWOP, and TY1-TY10 FWP (Table 20). The levee footprint changed to non-forested habitat for all FWP scenarios (Table 20). Access roads were considered to be too small to fit criteria since they were all a maximum of 40 feet wide.

Table 20. Habitat Suitability Index for baseline, and future projections of Size of Contiguous Forest Area.

FWOP (TY0, TY1, and TY50) and FWP (TY0) V5 HSI Table			FWP V5 HSI Table (TY1, TY50)		
	Impact area	HSI		Impact area	HSI
Area E	Footprint	0.99	Area E	Footprint	0.00
	Access Roads	0.99		Access Roads	0.00
	Indirect High	0.98		Indirect High	0.89
	Indirect Low	0.98		Indirect Low	0.97
	Indirect Out	0.98		Indirect Out	0.97
Area C	Footprint	1.00	Area C	Footprint	0.00
	Access Roads	0.99		Access Roads	0.00
	Indirect High	0.96		Indirect High	0.95
	Indirect Low	0.98		Indirect Low	0.98
	Indirect Out	1.00		Indirect Out	1.00
Area W	Footprint	0.94	Area W	Footprint	0.00
	Access Roads	0.92		Access Roads	0.00
	Indirect High	0.91		Indirect High	0.86
	Indirect Low	0.90		Indirect Low	0.88
	Indirect Out	0.87		Indirect Out	0.81

V6: Suitability and Traversability of Surrounding Land Uses

The 2016 National Land Cover Dataset (NLCD) was used to categorize surrounding land uses. Based on a 0.5 mile buffer of the levee alignment, access footprints, and all Indirect areas, Table 21 through Table 26 shows the percent of each land use seen in the buffer and calculates a weighted average of land use that is used for the Suitability Index (SI) for baseline, FWOP, and FWP conditions. Similar to V5, all Indirect impact FWP scenarios included the levee footprint as non-habitat.

In the FWOP it is expected that active agriculture and pasture hayfield areas will become more inundated because of RSLR (Table 18). As there is uncertainty regarding insurability of flood prone areas under the National Flood Insurance Program, future development of these areas is unlikely without the proposed levee system. With the levee alignment, it was assumed most of those areas would experience inundation relief and could be developed. This assumption is based on the Corps economics analysis that projects growth to occur in existing agricultural lands. Note this assumption applies to V6 (Land Use) and V7 (Disturbance) but are not the assumptions used to determine mitigation acreages.

Table 21. V6 - Suitability and Traversability of Surrounding Land Use for Direct East.

V6 East Direct Levee Footprint			
	FWOP TY0, TY1, TY50; FWP TY0		
Land use	**NLCD attributes**	**Acres**	**%**
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	7253.0	94.4
Abandoned ag	None	0.0	0.0
Pasture hayfields	Hay/pasture	0.0	0.0
Active ag	Cultivate Crops, Openwater	102.1	1.3
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	329.6	4.3
Total		7684.6	100.0

V6 East Direct Access Raod Footprint			
	FWOP TY0, TY1, TY50; FWP TY0		
Land use	**NLCD attributes**	**Acres**	**%**
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	7386.6	73.1
Abandoned ag	None	0.0	0.0
Pasture hayfields	Hay/pasture	219.1	2.2
Active ag	Cultivate Crops, Openwater	1002.1	9.9
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	1490.3	14.8
Total		10098.1	100.0

Table 22. V6 - Suitability and Traversability of Surrounding Land Use for Indirect East.

V6 East Indirect Inside High									
	FWOP TY0, TY1, TY50; FWP TY0			subtract levee		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%			Acres	%	Acres	%
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	3613.0	91.9		754.8	2858.2	72.7	2858.2	72.7
Abandoned ag	None	0.0	0.0			0.0	0.0	0.0	0.0
Pasture hayfields	Hay/pasture	26.7	0.7			808.6	20.6	0.0	0.0
Active ag	Cultivate Crops, Openwater	187.3	4.8		2.2	185.0	4.7	12.5	0.3
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	106.3	2.7		24.9	81.4	2.1	1062.6	27.0
Total		3933.3	100.0	Total	781.9	3933.3	100.0	3933.3	100.0

V6 East Indirect Inside Low									
	FWOP TY0, TY1, TY50; FWP TY0			subtract levee		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%			Acres	%	Acres	%
Bottomland hardwood	wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	6194.1	46.3		840.2	5353.9	40.0	5353.9	40.0
Abandoned ag	None	0.0	0.0			0.0	0.0	0.0	0.0
Pasture hayfields	Hay/pasture	696.1	5.2			1565.2	11.7	0.0	0.0
Active ag	Cultivate Crops, Openwater	1309.5	9.8		2.7	1306.8	9.8	115.6	0.9
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	5174.7	38.7		26.2	5148.4	38.5	7904.8	59.1
Total		13374.4	100.0	Total	869.1	13374.4	100.0	13374.4	100.0

V6 East Indirect Exterior									
	FWOP TY0, TY1, TY50; FWP TY0			subtract levee		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%			Acres	%	Acres	%
Bottomland hardwood	wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	6867.1	85.3		859.6	6007.6	74.6	6007.6	74.6
Abandoned ag	None	0.0	0.0			0.0	0.0	0.0	0.0
Pasture hayfields	Hay/pasture	1.1	0.0			889.4	11.1	0.0	0.0
Active ag	Cultivate Crops, Openwater	902.7	11.2		2.7	900.0	11.2	902.0	11.2
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	277.5	3.4		26.0	251.5	3.1	1138.9	14.2
Total		8048.5	100.0	Total	888.2	8048.5	100.0	8048.5	100.0

Table 23. V6 - Suitability and Traversability of Surrounding Land Use for Direct Central.

V6 Central Direct Levee Footprint			
		FWOP TY0, TY1, TY50; FWP TY0	
Land use	**NLCD attributes**	**Acres**	**%**
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	3921.0	97.1
Abandoned ag	None	0.0	0.0
Pasture hayfields	Hay/pasture	4.2	0.1
Active ag	Cultivate Crops, Openwater	15.6	0.4
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	96.7	2.4
Total		4037.6	100.0

V6 Central Direct Access Roads Footprint			
		FWOP TY0, TY1, TY50; FWP TY0	
Land use	**NLCD attributes**	**Acres**	**%**
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	4327.4	72.1
Abandoned ag	None	0	0
Pasture hayfields	Hay/pasture	231.2906336	3.9
Active ag	Cultivate Crops, Openwater	816.1890628	13.6
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	627.2	10.4
Total			6002.0

Table 24. V6 - Suitability and Traversability of Surrounding Land Use for Indirect Central.

V6 Central Indirect Inside High									
		FWOP TY0, TY1, TY50; FWP TY0		subtract		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%	levee		Acres	%	Acres	%
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	3613.0	91.9		477.3	3135.8	79.7	3135.8	79.7
Abandoned ag	None	0	0			0.0	0	0.0	0.0
Pasture hayfields	Hay/pasture	26.6874	0.7			510.0	13.0	0.0	0.0
Active ag	Cultivate Crops, Openwater	187.256	4.8			187.3	4.8	56.0	1.4
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	106.3	2.7		6.0	100.3	2.6	741.5	18.9
Total		3933.3	100	Total	483.3	3933.3	100.0	3933.3	100.0

V6 Central Indirect Inside Low									
		FWOP TY0, TY1, TY50; FWP TY0		subtract		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%	levee		Acres	%	Acres	%
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	3201.8	60.6		437.2	2764.6	52.3	2764.6	52.3
Abandoned ag	None	0.0	0.0			0.0	0.0	0.0	0.0
Pasture hayfields	Hay/pasture	242.6	4.6			680.1	12.9	0.0	0.0
Active ag	Cultivate Crops, Openwater	1010.3	19.1			1010.3	19.1	231.0	4.4
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	829.1	15.7		0.2	828.9	15.7	2288.3	43.3
Total		5283.9	100.0	Total	437.5	5283.9	100.0	5283.9	100.0

V6 Central Indirect Exterior									
		FWOP TY0, TY1, TY50; FWP TY0		subtract		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%	levee		Acres	%	Acres	%
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	4490.6	97.2		404.5	4086.1	88.5	4086.1	88.5
Abandoned ag	None	0.0	0.0			0.0	0.0	0.0	0.0
Pasture hayfields	Hay/pasture	4.0	0.1			416.3	9.0	0.0	0.0
Active ag	Cultivate Crops, Openwater	11.8	0.3			11.8	0.3	11.1	0.2
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	112.5	2.4		7.8	104.7	2.3	521.7	11.3
Total		4618.9	100.0	Total	412.3	4618.9	100.0	4618.9	100.0

Table 25. V6 - Suitability and Traversability of Surrounding Land Use for Direct West.

V6 West Direct Levee Footprint			
		FWOP TY0, TY1, TY50; FWP TY0	
Land use	**NLCD attributes**	**Acres**	**%**
Bottomland hardwood	wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	7253.0	94.4
Abandoned ag	None	0.0	0.0
Pasture hayfields	Hay/pasture	0.0	0.0
Active ag	Cultivate Crops, Openwater	102.1	1.3
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	329.6	4.3
Total		7684.6	100.0

V6 West Direct Access Raod Footprint			
		FWOP TY0, TY1, TY50; FWP TY0	
Land use	**NLCD attributes**	**Acres**	**%**
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	1600.1	59.9
Abandoned ag	None	0.0	0.0
Pasture hayfields	Hay/pasture	431.4	16.1
Active ag	Cultivate Crops, Openwater	79.6	3.0
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	561.5	21.0
Total		2672.7	100.0

Table 26. V6 - Suitability and Traversability of Surrounding Land Use for Indirect West.

V6 West Indirect Inside High									
		FWOP TY0, TY1, TY50; FWP TY0		subtract		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%	levee		Acres	%	Acres	%
Bottomland hardwood	wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	1321.0	57.4		141.0	1180.0	51.3	1180.0	51.3
Abandoned ag	None	0.0	0.0			0.0	0.0	0.0	0.0
Pasture hayfields	Hay/pasture	107.0	4.7		0.2	284.7	12.4	0.0	0.0
Active ag	Cultivate Crops, Openwater	236.4	10.3		9.6	226.8	9.9	66.7	2.9
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	635.6	27.6		27.1	608.5	26.5	1053.3	45.8
Total		2300.0	100.0	Total	177.9	2300.0	100.0	2300.0	100.0

V6 Westl Indirect Inside Low									
		FWOP TY0, TY1, TY50; FWP TY0		subtract		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%	levee		Acres	%	Acres	%
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	1,415.3	44.7		151.2	1,264.1	40.0	1,264.1	40.0
Abandoned ag	None	0.0	0.0			0.0	0.0	0.0	0.0
Pasture hayfields	Hay/pasture	145.7	4.6		0.2	319.1	10.1	0.0	0.0
Active ag	Cultivate Crops, Openwater	880.5	27.8		0.9	879.6	27.8	61.8	2.0
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	722.3	22.8		21.3	701.0	22.2	1,837.9	58.1
Total		3,163.8	100.0	Total	173.7	3,163.8	100.0	3,163.8	100.0

V6 West Indirect Exterior									
		FWOP TY0, TY1, TY50; FWP TY0		subtract		FWP TY1		FWP TY50	
Land use	NLCD attributes	Acres	%	levee		Acres	%	Acres	%
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	1389.7	73.1		147.7	1242.1	65.3	1242.1	65.3
Abandoned ag	None	0.0	0.0			0.0	0.0	0.0	0.0
Pasture hayfields	Hay/pasture	29.4	1.5		0.2	199.0	10.5	0.0	0.0
Active ag	Cultivate Crops, Openwater	44.3	2.3		0.9	43.4	2.3	38.7	2.0
Development	Barrren Land, Developed (high, medium, low intensity) developed open space	437.5	23.0		21.1	416.3	21.9	620.0	32.6
Total		1900.8	100.0	Total	169.9	1900.8	100.0	1900.8	100.0

V7: Disturbance

The effect of disturbance is a factor of the distance to, and the type of, disturbance. The ERDC GIS/RS data, 2016 National Land Cover Database (NLCD) data, FWI, and available imagery were used to classify the disturbance type such as highways, industrial areas, waterways, agriculture, homes, etc. See Table 27.

Similar to V5, Swamp and BLH were considered together as a large contiguous forest for V7. Each impact area was buffered and distance to disturbances were calculated with a weighted average to determine the resulting HSI (Table 28). Also similar to V5, the levee footprint was applied to the FWP condition to determine the HSI. Similar to V6, all ag land was assumed to become developed by TY40.

For Baseline (TY0), FWOP and FWP TY1, and FWOP TY50 the HET used the HSIs in Table 28. The HET assumed that FWOP TY40 and TY50 are similar to existing conditions for development projections, because of RSLR impacts. An assumption that agricultural land would become developed at FWP TY40 was applied here for reasons described in the V6 variable section (Table 28). This assumption is based on the Corps economics analysis that projects growth to occur in existing agricultural lands. Note this assumption applies to V6 (Land Use) and V7 (Disturbance) but are not the assumptions used to determine mitigation acreages.

Table 27. Variable V7 Disturbance of the Wetland Value Assessment Swamp and Bottomland Hardwood Model.

Variable V_7 Disturbance

The effect of disturbance is a factor of the distance to, and the type of, disturbance, hence both are incorporated in the SI formula.

Note: Linear and/or large project sites may be exposed to various types of disturbances at various distances. The SI for this variable should be weighted to account for those variances.

Distance Classes	Type Classes
Class 1. 0 to 50 ft.	**Class 1.** Constant/Major. (Major highways, industrial, commercial, major navigation.)
Class 2. 50.1 to 500 ft.	**Class 2.** Frequent/Moderate. (Residential development, moderately used roads, waterways commonly used by small to mid-sized boats).
Class 3. > 500 ft.	**Class 3.** Seasonal/Intermittent. (Agriculture, aquaculture.)
	Class 4. Insignificant. (Lightly Used roads and waterways, individual homes, levees, rights of way).

Suitability Indices for Distance/Type Class

		Type Class			
		1	2	3	4
Distance Class	1	.01	.26	.41	1
	2	.26	.50	.65	1
	3	1	1	1	1

Table 28. Variable V7 Disturbance Habitat Suitability Index (HSI) for the Wetland Value Assessment Swamp and Bottomland Hardwood Model for the West Shore Lake Pontchartrain Levee Project

Variable V7 Disturbance

FWOP (TY0, TY1, and TY50) and FWP (TY0) V7 HSI Table		
Area E	Levee Footprint	0.86
	Access Roads	0.79
	Indirect High	0.82
	Indirect Low	0.77
	Indirect Exterior	0.80
Area C	Levee Footprint	0.97
	Access Roads	0.88
	Indirect High	0.93
	Indirect Low	0.84
	Indirect Exterior	0.98
Area W	Levee Footprint	0.33
	Access Roads	0.82
	Indirect High	0.56
	Indirect Low	0.66
	Indirect Exterior	0.47

FWP (TY50) V7 HSI Table		
Area E	Levee Footprin	0.00
	Access Roads	0.00
	Indirect High	0.77
	Indirect Low	0.74
	Indirect Exteric	0.80
Area C	Levee Footprin	0.00
	Access Roads	0.00
	Indirect High	0.93
	Indirect Low	0.84
	Indirect Exteric	0.98
Area W	Levee Footprin	0.00
	Access Roads	0.00
	Indirect High	0.56
	Indirect Low	0.63
	Indirect Exteric	0.47

FWP (TY1) V7 HSI Table		
Area E	Levee Footprint	0.00
	Access Roads	0.00
	Indirect High	0.82
	Indirect Low	0.77
	Indirect Exterior	0.80
Area C	Levee Footprint	0.00
	Access Roads	0.00
	Indirect High	0.93
	Indirect Low	0.84
	Indirect Exterior	0.98
Area W	Levee Footprint	0.00
	Access Roads	0.00
	Indirect High	0.56
	Indirect Low	0.66
	Indirect Exterior	0.47

RESULTS

See Table 29 and 30 for a summary of resulting Annual Average Habitat Unit (AAHUs) and acres impacted for all Direct (Levee and Access Footprints) and Indirect (Exterior and Inside High and Low) swamp and bottomland hardwood (BLH) for the West Shore Lake Pontchartrain Project levee system. See Table 29 and 30 for the impacts specific to the Louisiana Department of Wildlife and Fisheries lands. Direct impacts for the entire levee system alignment and access roads is 1,142 acres of swamp and 233 acres of BLH resulting in -602 AAHUs for swamp and -163 AAHUs for BLH. Indirect impacts include 9,773 acres of swamp and 4,665 acres of BLH resulting in -549 AAHUs for swamp and -125 AAHUs for BLH based on the USACE Intermediate RSLR projections.

Table 29. Summary of all Direct and Indirect Annual Average Habitat Units (AAHUs) and acres impacted for swamp in the West Shore Lake Pontchartrain Project and the subset of Louisiana Department of Wildlife and Fisheries lands.

SWAMP	Acres	AAHUS
East Direct Levee Footprint	677	-329.67
East Direct Access Footprint	23	-11.04
East Indirect Interior High	1,016	-81.55
East Indirect Interior Low	3,142	-22.09
East Indirect Exterior	2,102	-102.96
Central Direct Levee Footprint	364	-218.80
Central Direct Access Footprint	24	-14.02
Central Indirect Interior High	594	-62.69
Central Indirect Interior Low	1,330	-9.52
Central Indirect Exterior	1,301	-61.04
West Direct Levee Footprint	47	-20.20
West Direct Access Footprint	3	-1.31
West Indirect Interior High	97	-7.55
West Indirect Interior Low	89	-0.89
West Indirect Exterior	83	-3.87

SWAMP	Acres	AAHUs
Direct	1,137	-595
Indirect Interior High	1,707	-152
Indirect Interior Low	4,561	-32
Indirect Exterior	3,486	-168
TOTAL	10,892	-947

LDWF	Acres	AAHUS
LDWF East Direct Levee Footprint	261	-127
LDWF East Direct Access Footprint	4	-2
LDWF East Indirect Interior High	203	-16
LDWF East Indirect Interior Low	128	-1
LDWF East Indirect Exterior	968	-47
LDWF Central Direct Levee Footprint	37	-22
LDWF Central Indirect Interior High	20	-2
LDWF Central Indirect Exterior	432	-20
LDWF West Direct Levee Footprint	10	-4
LDWF West Direct Access Footprint	1	0
LDWF West Indirect Interior High	17	-1
LDWF West Indirect Exterior	5	0

LDWF SWAMP	Acres	AAHUs
LDWF Direct	312	-156
LDWF Indirect Interior High	241	-20
LDWF Indirect Interior Low	128	-1
LDWF Indirect Exterior	1,405	-68
Total	2,087	-244

Table 30. Summary of all Direct and Indirect Annual Average Habitat Units (AAHUs) and acres impacted for Bottomland Hardwood in the West Shore Lake Pontchartrain Project and the subset of Louisiana Department of Wildlife and Fisheries lands.

BOTTOMLAND HARDWOOD (BLH)	Net Acres	AAHUS		BLH	Acres	AAHUs
East Direct Levee Footprint	149.3	-106.5		Direct	242	-169
East Direct Access Footprint	17.1	-12.1		Indirect Interior High	503	-24
East Indirect Interior High	357.3	-22.5		Indirect Interior Low	3,467	-70
East Indirect Interior Low	3296.9	-68.7		Indirect Exterior	666	-30
East Indirect Exterior	539.6	-28.4		Total	4,877	-293
Central Direct Levee Footprint	1.6	-1.3				
Central Direct Access Footprint	5.2	-3.9				
Central Indirect Interior High	21.9	-0.6				
Central Indirect Interior Low	79.3	-0.6				
Central Indirect Exterior	23.0	-0.9				
West Direct Levee Footprint	66.6	-44.0				
West Direct Access Footprint	2.0	-1.4				
West Indirect Interior High	123.5	-0.8				
West Indirect Interior Low	90.3	-0.7				
West Indirect Exterior	103.7	-0.6				
LDWF	Acres	AAHUS		LDWF BLH	Acres	AAHUs
LDWF East Direct Levee Footprint	92.6	-66.05				
LDWF East Direct Access Footprint	1.7	-1.20		LDWF Direct	101	-72
LDWF East Indirect Interior High	177.4	-11.18		LDWF Indirect Interior High	199	-11
LDWF East Indirect Interior Low	100.1	-2.09		LDWF Indirect Interior Low	100	-2
LDWF East Indirect Exterior	206.9	-10.9		LDWF Indirect Exterior	212.9	-11.1
				Total	613	-96
LDWF Central Direct Levee Footpri	0.5	-0.37				
LDWF Central Indirect Interior High	0.1	0.0				
LDWF Central Indirect Exterior	5.8	-0.2				
LDWF West Direct Levee Footprint	5.4	-3.54				
LDWF West Direct Access Footprint	0.8	-0.5				
LDWF West Indirect Interior High	21.9	-0.1				
LDWF West Indirect Exterior	0.2	0.0				

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Appendix II: Commercial Borrow Source Requirements

A Commercial Borrow Pit is defined to include borrow areas, access routes, office buildings, loading and unloading facilities, staging areas, etc. For a borrow pit to be considered a Commercial Borrow Pit for the WSLP Project, it must:

1. Have all appropriate federal, state, and local permits,
2. Have a current business license,
3. Submit a complete package with all information presented in sections 1-14 below. All documentation presented shall be current and up-to-date.

The Government will determine whether potential commercial borrow pits meet these requirements.

1 Right of Entry

A Right of Entry (ROE) form signed by the landowner(s) that covers the project duration shall be included in the package. If the proposed clay source Point-of-Contact (POC) is not the landowner, then the package shall include a document signed by the landowner(s) stating that the POC is acting as an agent of the landowner(s) and has the right to represent the landowner(s). The ROE must clearly state that the POC has the appropriate permissions and rights to remove borrow material from the proposed real estate interest.

2 Maps

The following maps shall be provided:

(1) A map of the general area giving detailed instructions on how to get to the Commercial Borrow Pit from the nearest major highway.

(2) A topographic map(s) (quadrangle) with a scale of 1:24,000 with the location of the Commercial Borrow Pit superimposed and the nearest town labeled on the map.

(3) A layout map of the Commercial Borrow Pit showing the dimensions of the proposed excavation areas within the site, locations of soil borings, and latitude/longitude points to reference property boundaries. The map shall show the location and dimensions of any haul road that exists or is to be constructed for its hauling operation. The map shall also show the location and dimensions of any drainage features, such as dikes.

3 Wetlands Determination

Package must include U.S. Army Corps of Engineers (USACE) Jurisdictional Wetland Determination (JD) letter and map. The Commercial Borrow Pit shall avoid jurisdictional wetlands, with an adequate buffer. If the Commercial Borrow Pit had impacts to jurisdictional wetlands, or there are plans for impacts to jurisdictional wetlands, a USACE Section 404 permit and/or Section 10 permit will be required. A Section 10/404 Permit does not constitute full environmental compliance for potential use as a Commercial Borrow Pit. A JD is valid, and considered current for five (5) years from the date of issuance.

4 Coastal Zone Management (CZM)

Package must include a Coastal Use Permit (CUP) Application, and a Letter of No Objection (LNO) or CUP from the Louisiana Department of Natural Resources in Louisiana, or the respective state agency for other states. A CUP Application, and CUP or LNO from the local agency must be provided when the state decides that it is a matter of Local Concern. A CUP is valid, and is considered current usually for two (2) years from the date of issuance.

5 Threatened & Endangered Species (T&E)

Package must include a consultant's report and a concurrence letter of "No Effect on T&E Species" from the U.S. Fish & Wildlife Service. The consultant's report must include a map of the studied area with the study area boundary defined by x-y coordinate system. T&E concurrence is valid, and considered current for one (1) year from the date of issuance.

6 Cultural Resource Report

Package must include a Phase I Cultural Resource Survey prepared by a professional cultural resource management (CRM) company that has staff who meet the Secretary of the Interior's Professional Qualifications Standards (http://www.nps.gov/history/local-law/arch_stnds_9.htm). The report must include a map of the studied area with the study area boundary defined by x-y coordinate system.

7 Environmental Site Assessment

Package must include an Environmental Site Assessment (ESA) that shows a low risk of encountering Recognized Environmental Conditions (REC). The ESA must conform to ASTM E 1527 or ASTM E 2247 (if applicable) standards. The ESA must include a map of the studied area with the study area boundary defined by an x-y coordinate system. An ESA is valid, and considered current for six (6) months from the date of the report.

8 Soil Boring Analysis

Package must include a Geotechnical Report stamped and signed by a licensed civil engineer with a specialization in geotechnical engineering certifying that the proposed source contains suitable material meeting the specifications outlined below.

(1) The Geotechnical Report must consist of a summary and conclusion section in the main body of the report with any supporting data attached separately.

(2) Borrow borings must be spaced a maximum of 500 feet on-center, a maximum of 250 feet from the edge of the proposed excavation site(s), and be representative of the entire proposed source of materials. The licensed engineer's test plan must provide a comprehensive boring sampling must extend to at least five (5) feet below the bottom of the proposed excavation.

(3) All soil samples must be classified in accordance with the Unified Soil Classification system. See below for required soil testing. The supporting data attached to the geotechnical report shall be comprehensive and include as a minimum all field logs, soil sampling and testing results, and a detailed investigation location map with the location of the potential borrow source and all investigation locations superimposed. The soil investigation locations must include latitudes and longitudes for plotting purposes.

(4) The borrow material shall be of naturally occurring earth materials. Materials that are classified in accordance with ASTM D 2487 as CL or CH with less than 35% naturally occurring sand content are suitable for use as levee construction material. Materials classified as ML are suitable if blended to produce a material that classifies as CH or CL according to ASTM D 2487. Levee construction materials shall have a salinity content equal or less than 1,500 ppt. Allowable borrow material cannot have organic content greater than 12 percent by weight, as determined by ASTM D 2974, Method C.

9 Laboratory Tests

The following laboratory tests must be performed:

(1) Soil classification shall be performed in accordance with the Unified Soil Classification System and ASTM D 2487.

(2) Atterberg Limits Test shall be performed in accordance with ASTM D 4318.

(3) Determination of moisture content shall be performed in accordance with ASTM D 2216 or ASTM D 4643.

(4) Determination of organic content shall be performed in accordance with ASTM D 2974, Method C.

(5) Sand Content shall be determined by -200 wash in accordance with ASTM D 1140.

(6) Sodium content shall be determined by EPA 6010, CAS No. 7440-23-5.

Control compaction curves will be established in the future prior to embankment placement.

10 Test Procedures for Borings

The testing procedure for borings shall be as follows:

(1) A moisture content determination shall be made and recorded on all samples at every foot of sample.

(2) Soil classification shall be performed at every foot of sample.

(3) For (CH), (CL), and (ML) soils, Atterberg Limits and Organic Content Testing (ASTM D 2974, Method C), is required every 5 feet (minimum) and at every change in material type.

(4) Samples with moisture contents at 70% or higher or having a Liquid Limit of 70 or higher must be tested for organic content for that sample as well as for a sample 2 feet above and 2 feet below that sample.

(5) Sand content tests will be required for samples that classify as CL (with a PI greater than 10) and for all clay samples (CH and CL) with greater than 10% coarse grain materials estimated by visual classification for 2 or more consecutive feet.

(6) Sand content tests shall be limited to one test every 5 feet of sampling and shall conform to ASTM D 1140 (#200 sieve required).

(7) Sand content tests will be required for samples that classify as a ML, but limited to one test every 5 feet of sampling.

(8) One composite sodium content test will be required in each boring.

Laboratory testing shall be performed at a Corps of Engineers approved testing laboratory. An approved testing laboratory can be located at the following web site: https://mtc.erdc.dren.mil/searchvalidation.aspx.

If a borrow site within the Commercial Borrow Pit is within 1,500 feet of the Mississippi River Levee (MRL) or within 300 feet of a Hurricane Protection Levee (HPL), a permit from

the local levee district responsible for the O&M of the nearby MRL or HPL MUST be included. For additional information regarding this permit, please contact Amy Powell, Amy.E.Powell@usace.army.mil, (504) 862-2241 OR
Karen Oberlies, Karen.L.Oberlies@usace.army.mil, (504) 862-2313.

11 Borrow Area Management Plan

The package will include a plan for clearing, stripping, and excavating materials from the Commercial Borrow Pit, if necessary. In this plan, work areas, stockpile areas, etc, all will be clearly shown. The Commercial Borrow Pit shall not work or move material outside the boundaries of the approved limits of its borrow area. The Management Plan shall indicate in writing and show on its layout plans details of the following:

(1) A stockpile plan for cleared and stripped material and debris to include disposal areas.

(2) The locations for disposal of wasted material. Location of any haul roads.

(3) A plan for stockpiling embankment material before it is transported off site to include locations, stockpile heights, slopes, and limits.

(4) The proposed methods for draining and keeping borrow material dry, including any protection dikes constructed to alleviate drainage problems.

(5) A complete list of excavation and transportation equipment planned for use in its operations.

(6) A list of permits required and the issuing office.

12 Mitigation Requirements

The package must include a written plan and map that describes and shows any areas subject to laws or regulations (Clean Water Act Section 404, Rivers and Harbors Act Section 10, National Historical Preservation Act, Section 906 of WRDA 1986, HTRW, etc.) that hold jurisdiction within the Commercial Borrow Pit. Plan and maps must clearly show areas/resources being avoided, areas where any impacts were minimized, and areas where it has been determined that impacts are unavoidable. Resources include but are not limited to areas of cultural interest, bottomland hardwood forest, wetlands subject Section 404 of the Clean Water Act, Threatened and Endangered species including any habitat deemed critical by the U.S. Fish and Wildlife Service, and areas found to be hazardous, toxic, or to contain radioactive waste. The U.S. Army Corps of Engineers New Orleans District (CEMVN) Environmental Team Coordinator will determine the consequences of a proposed action on any resources identified on the property in question. Plan and maps will be reviewed as outlined in paragraph "Government Performed Environmental Assessment" below, including any mitigation deemed necessary. For mitigation related to unavoidable impacts to wetlands
or forested areas within the borrow pit boundaries, written proof shall be provided in the form of a letter from a mitigation bank showing compensatory mitigation has been completed as "in-kind" in the hydraulic basin.

13 Zoning Classification

Written evidence that the property intended for use as a Commercial Borrow Pit contains the proper zoning classification that will allow excavation and use it as a borrow area. This evidence shall consist of a letter from the local land zoning office stating the zoning classification of the Commercial Borrow Pit.

14 Environmental Protection Plan

In order to prevent, and to provide for abatement and control of any environmental pollution, the Commercial Borrow Pit shall comply with the Louisiana Pollution Discharge Elimination System (LPDES) General Permit requirements, all applicable Federal, State, and Local laws, and regulations as well as USACE regulations concerning environmental pollution control and abatement and any regulations referred to in the following paragraph. For hazardous wastes, materials, substances and chemicals applicable regulations shall include, but are not limited to, 29 CFR 1910.106, 29 CFR 1910.120, 40 CFR 260, 40 CFR 279, 40 CFR 355, 40 CFR 372- SUBPART D, 49 CFR 171 - 178 and EM 385-1-1, LAC 33:V, and LAC 33:VII.

The Commercial Borrow Pit must provide an established Environmental Pollution Control Plan/Environmental Protection Plan that includes:

1) Environmental Pollution Control Plan/Environmental Protection Plan for activities (such as painting, metal finishing, etc.) that involve hazardous chemicals, hazardous substances or hazardous materials, include in the plan a Hazard Communication Program and Safe Storage Plan. For activities that anticipate generation of hazardous wastes at the Commercial Borrow Pit, include in the plan a waste identification / determination and waste disposal plan. For activities that pose a risk of an oil or hazardous substance spill, include in the plan a Spill Reporting and Response Plan.
    a. Non-regulated debris disposal plan with best management practices to reduce or minimize impacts to the human environment
    b. Hazardous and regulated solid waste disposal plan in accordance with applicable laws and regulations. The Hazardous Waste Plan would include, but not necessarily be limited to the following:
        i. Hazardous waste shall be place in closed containers and shall be shielded adequately to prevent dispersion of the waste by wind or water.
        ii. Nonhazardous waste shall be stored in containers separate from hazardous waste storage areas.
        iii. All hazardous waste shall be transported by a licensed transporter in accordance with LAC 33:V and 49 CFR 171, Subchapter C.
        iv. All nonhazardous waste shall be transported in accordance with local regulations regarding waste transportation.
        v. The plan shall identify what types of hazardous and/or regulated solid wastes will be generated and shall list the hazards involved with each waste.
        vi. All laboratory testing for waste determinations shall be performed by a laboratory which has received accreditation from the Louisiana Department of Environmental Quality.
2) Procure applicable Federal, State, and Local regulations on pollution control.
3) Air Pollution Plan – plan for dust, smoke, and noise abatement
4) Water Pollution Plan – disposal plan of materials (wastes, effluents, trash, garbage, oil, grease, chemicals, etc…), erosion control, etc…
5) The Commercial Borrow Pit shall not pollute lakes, ditches, rivers, bayous, canals, groundwater, waterways, or reservoirs with materials harmful to water quality, fish, shellfish, or wildlife, or materials which may be a detriment to outdoor recreation.
6) No water flows will be altered as a result of Commercial Borrow Pit operation.
7) Land Pollution - disposal of debris, restoration of temporary construction sites, etc…
8) Prevention of Landscape Defacement Plan
9) Plan to record and preserve any historical and archeological finds
10) All pollution control facilities shall be maintained by the Commercial Borrow Pit
11) Assurance that all past and any future oil spill or chemical release that has

occurred at the Commercial Borrow Pit have been and will be reported to the National Response Center.

12) Training course(s) regarding the Environmental Protection Plan have been made available to all employees of the Commercial Borrow Pit.

Appendix III: Engineering Appendix

Enclosure

Updated Geotechnical Engineering Guidance for West Shore Lake Pontchartrain, St. Charles, St. John the Baptist, and St. James Parishes, Louisiana.

1. Purpose. The purpose of this memorandum is to provide revised Geotechnical design guidelines for levees and floodwalls for the West Shore Lake Pontchartrain project (WSLP). The guidelines in the subsequent paragraphs are intended to supplement the guidelines previously provided. Those original guidelines included the June 2012 HSDRRS Design Guidelines, specific memoranda for WSLP (e.g. Reference G below), published U.S. Army Corps of Engineers (USACE) Engineer Manuals (EM), to name a few. A draft version of this memorandum was drafted on 07 January 2022 and provided to all EORs. This memorandum signed by the USACE New Orleans District Levee Safety Officer (LSO) serves as the final documentation of the updated design guidance.

2. Background. After completing a number of draft levee, floodwall, and structure designs for WSLP, the need for increased design efficiency given the complexity of the project was quickly realized by all responsible parties. Two design summit meetings, attended by representatives from USACE, the levee sponsor (Coastal Protection and Restoration Authority (CPRA)), and A-E firms working on WSLP, took place on 13 and 20 April 2021. At these meetings, updated Geotechnical design criteria as well as revised hydraulic design elevations were discussed. This memorandum provides guidance concerning the main criteria revisions and clarifications agreed upon by CPRA and USACE, in conjunction with feedback and input from the A-E firms.

3. References. The following are attachments to this guidance.

a. Summary of Recommendations Discussed During WSLP Geotechnical Design Summit on April 20th, 2021, CPRA.

b. Strength and Compressibility Correlations for New Orleans Area Soils, Virginia Tech, 4 September 2011.

c. Sample Shear Strength Parameters – Initial, USACE dated 16 June 2020.

d. Sample Shear Strength Parameters – With Discarded Tests, USACE dated 25 June 2021.

e. Sample Consolidation Parameters, USACE dated 28 June 2021.

f. Typical Maintenance Berm Requirements, USACE dated 16 June 2021.

g. Geotechnical Engineering Recommendation for Embankment Design for West Shore Lake Pontchartrain, USACE

4. Revised Geotechnical Design Criteria.

a. Assess the Validity of Laboratory Strength Tests. The first update in guidance is to review and potentially revise soil properties from each Engineer of Record's (EOR) initial levee/floodwall design. Unconsolidated Undrained (UU) triaxial test results can significantly vary due to sample disturbance, anisotropy, and strain rate. Following the design summit meetings, CPRA developed a memo, dated 21 May 2021, discussing Geotechnical recommendations that resulted from these meetings (Reference A). This document introduces the idea of assessing UU triaxial compression test and Consolidation test results for data quality. Criteria for lab test assessment can be found in "Strength and Compressibility Correlations for New Orleans Area Soils," prepared by Brandon et al. and dated 4 September 2011 (Reference B). For UU triaxial test results that plot below the $s_u/\sigma_v'=0.22$ line, the sample quality should be assessed. Brandon et al. (2011) provides ranking criteria that can be used to assess sample quality. Keep in mind, the criteria in the Brandon et al. paper was established to select the most optimum lab test to develop soil property correlations. Therefore, a particular UU test may still be considered valid in soil design parameter selection even if it doesn't meet the criteria below. The research resulted in good correlations for CH soils but notable scatter for CL and CHO soils. Therefore, the focus of these correlations for soil property development should be on CH soils only. The EOR can use the ranking criteria as a reference point to gauge sample quality, however, engineering judgment should be used to determine which lab results are appropriate. A summary of UU criteria from Brandon et al. is provided below:

(1) Peak deviator stress ($\sigma_{d,peak}$) achieved at an axial strain (ε_a) less than or equal to about 5%. For this exercise, less than or equal to 8% could be assumed.

(2) Mohr's circles must have approximately equal diameters. Diameters should be within about a 10% difference.

(3) The water content (w%) and initial void ratio (e_o) of all three test specimens must be within about ±5% of each other. Use the formula for percent change between the smallest w%/e_o and the largest w%/e_o.

(4) The degree of saturation should be greater than or equal to 95%.

(5) The stress-strain curves should generally have a smooth appearance.

(6) The value of initial tangent modulus should be approximately equal between all test specimens.

According to the Brandon paper, (1) if a test result satisfies 4 or more of the criteria, assume the data is acceptable, (2) if the test result satisfies 2 or fewer of the criteria, assume the data is questionable and identify it as such on the shear strength data plot, and (3) if the test result satisfies 3 of the criteria, use engineering judgement to discern the test quality or flag it separately to indicate design intentions.

Additionally, the CPRA memo (Reference A) also includes correlations developed using site specific soil boring data for unit weight (γ) and e_o. Estimated values for these properties via these correlations shall be included and utilized in making the final soil property determinations.

See Reference C for an example of how UU tests might be selected for criteria assessment. An example of how a shear strength data plot might be updated following a criteria assessment and how unit weight correlations can be incorporated into soil parameters are provided in Reference D.

b. Reassess Consolidation Parameters. Consolidation parameters shall be reexamined to ensure general agreement between stress history and undrained shear strength. Preconsolidation Pressure, denoted as P_c and σ'_p herein, shall first be plotted with elevation using the results of the laboratory consolidation tests. In addition, an Overconsolidation ratio (OCR) plot shall be developed. To do this, Cone Penetration Test (CPT) data can be used to estimate σ'_p and in turn create a continuous profile of OCR using the definition of OCR shown in Equation 4.2.1.

$$OCR = \sigma'_p / \sigma'_v \tag{4.2.1}$$

Where σ'_v = Effective Vertical Stress

σ'_p = Preconsolidation Pressure

An estimate of σ'_p from CPT data can be established by using Equation 4.2.2:

$$\sigma'_p = 0.33(q_t - \sigma_{vo}) \tag{4.2.2}$$

Where q_t = CPT tip resistance corrected for pore water pressure

σ_{vo} = total vertical stress

OCR estimates using the P_c results from consolidation tests shall be converted to discrete points plotted on the OCR plot using Equation 4.2.1.

EORs shall review the Coefficient of Compressibility (C_c) and the Coefficient of Consolidation (C_v) correlations illustrated in Appendix C of Reference A. These correlations in conjunction with results from consolidation test shall be plotted for each design reach with elevation. Based on an assessment of soil layers and where the data plots with elevation, best estimates (e.g. mean or average) for C_c and C_v shall be determined for each soil layer. In addition, the 25th and 75th quartiles shall be established for C_v.

The original design guidelines (Reference G) required the used of the 25th quartile to establish C_v values in order to avoid (1) potential under-estimation of the time to achieve a design-specific degree of consolidation and (2) the potential impacts to the construction contracts due to that difference in time. Considering the plan for robust use of instrumentation as well as the incorporation of wick drains in several of the contract, updated guidance requires the use of best estimate value for both C_c and C_v for strength gain predictions. A plot of consolidation parameters with this updated guidance including an OCR plot and void ratio correlations is provided in Reference E as an example.

The quality of the P_c, OCR, and C_c estimates from consolidation tests should be evaluated. Criteria explained in Reference B (pages 66-85) may be used to assess the quality of the data. If questionable consolidation test results do not satisfactorily pass the criteria assessment, they can be flagged in the P_c and OCR plots and the final values for these properties determined for each stratum accordingly. The following Quality Control (QC) criteria for Consolidation Tests shall be validated before relying on any test results:

(1) Strain upon reloading to in-situ σ'v should be less than about 3%.

(2) Saturation should be greater than 95%.

(3) Depth of sample ≥ 5 ft.

(4) Percent difference between σ'p (Casagrande) and σ'p (Sowers) should be less than 25%.

(5) Well-defined break in the compression curve at transition from recompression to virgin compression (at σ'p).

(6) Time increment for each load is sufficient to reach End of Primary consolidation.

(7) Smooth and reasonable shape for time rate of consolidation curves (time curves) at each load increment.

c. Soil Property Review and Approval. EORs shall conduct a detailed reevaluation of all geotechnical and geologic data and ensure that an appropriate number of design reaches has been determined. All soil properties from the reassessment guidance in the previous paragraphs will be reviewed by USACE and CPRA during an updated 10% submittal from the EORs.

d. Embankment Design Guidance.

(1) In addition to the shear strength gain method described in USACE's memo titled,

“Geotechnical Engineering Recommendation for Embankment Design for West Shore Lake Pontchartrain” (Reference G), shear strength gain may also be estimated using Equation 4.4.1. To utilize this equation, preconsolidation pressure can be calculated at the end of each hold period, which will correlate to a design shear strength estimate for that stage of analysis. Either method of strength gain analysis is acceptable, therefore, the EOR is responsible for deciding which method is appropriate for its analyses and documenting its rationale accordingly in their final geotechnical report.

$$s_u = \sigma'_p \times 0.22 \quad (4.4.1)$$

(2) Geotechnical engineers should assume revisions to design grade and still water level (SWL) elevations based on revised hydraulic modelling. Refer to Table 4.4.1.

Updated Geotechnical Engineering Guidance for West Shore Lake Pontchartrain, St. Charles, St. John the Baptist, and St. James Parishes, Louisiana.

Table 4.4.1. Revised Hydraulic Design Elevations

Hydraulic Reach	Location		2027 SWL 100YR 90% NAVD88	2070 SWL 100YR 90% NAVD88	2027 Levee 100YR Construction Grade Elevation (ft. NAVD88)	FINAL 2070 Levee 100YR Design Elevation using Min Coastal Wave (2.5ft, 3.2 sec)	FINAL T-wall Elevations (ft. NAVD88)
R1	WSLP-113	CPRA	7.2	10.3	8.5	13.5	13.9
R2	WSLP-112		7.2	10.3	8.5	13.5	13.9
R3	WSLP-111		7.2	10.3	8.5	13.5	13.9
R4	WSLP-110/Hope		7.2	10.4	8.5	13.5	13.9
R5	WSLP-109		7.2	10.7	8.6	14	14.4
R6	WSLP-108/Miss B		7.3	11.2	8.6	14.5	14.9
R7	WSLP-107	Reserve	8.6	12.2	9.6	15.5	15.9
R8	WSLP-106		9.9	12.8	11.0	16	16.4
R9	WSLP-105	I-10	10.1	13	11.0	16	-
R10	WSLP-105/Perrilloux		10.2	13	11.0	16	16.4
R11	WSLP-105		10.2	13.1	11.0	16	-
R12	WSLP-104		10.6	13.3	11.5	16.5	-
R13	WSLP-104	I55 PS	11	13.7	12.0	17	17.4
R14	WSLP-103		12.1	14.6	13.9	17.5	17.9
R15	WSLP-102/Montz		12.2	14.6	13.9	17.5	17.9
R16	WSLP-101	I-10	11.5	14	12.5	17	-
R17	Prescott		11.5	14	12.5	17	17.4
BC1	Bonne Carre N		11.1	13.7	12.5	17	-
BC2	Bonne Carre M		11.2	13.8	12.0	17	-
BC3	Bonne Carre S		11.5	14	12.5	17	-
ST J1	St James		6.2	9.8	7.1	13	13.4

(3) No overbuild above the required levee crown elevations will be calculated for the 2027 levee design. The levee section will be designed to the 2027 design grade with an additional 6” allowance for post construction settlement while turfing requirements are met. In other words, the final Construction Grade for 2027 shown in Table 4.4.1 is the

required design grade plus 6 inches. The predicted length of time the WSLP earthen embankments will remain above the required grade for the 1% (100 yr) Annual Exceedance Probability will vary reach by reach based on the final construction grade and foundation conditions. USACE will utilize instrumentation data (piezometers and settlement gages) acquired during construction to either validate or revised the predicted settlement curves and reassess the likely time the earthen embankments will remain above the 1% grade.

(4) A hypothetical levee design shall be performed for the 2070 Project Grade. The 2070 levee design will not incorporate overbuild but shall utilize conservative assumptions about shear strength gains in 2070 based on anticipated overburden. The intent of this design is to (1) establish the required length and strength of any geotextile required for the 2070 levee and (2) ensure that the location of the interior drainage canal is appropriately set at a safe and stable distance from the 2070 levee. Any geotextile required for the 2070 levee shall be incorporated into the final 2027 plans and specification even if the 2027 levee design indicates less reinforcement is required. Likewise, centerline offset of the interior drainage canal in the 2027 plans and specifications shall be based on the 2070 levee design. This is to ensure that the WSLP levee can be safely raised through the 50-year life of the project. Seepage analyses do not need to be performed for the 2070 levee design.

(5) Levee section geometry should be revised in slope stability and seepage calculations to replicate assumed subsurface conditions immediately following construction of the sand working platform placed to El. +3.0. EORs will assume for every foot of sand built above the mudline, a foot of sand will be placed below the mudline (Reference A). The thickness of the sand shall never be assumed to be less than 3 feet thick, i.e., existing mudlines higher than El. 0.0 will assume sand to El. -3.0. Because compaction of sand placed below the water surface will not take place, a friction angle of 25° and unit weight of 110 pcf should be used for the soil properties of this portion of the levee section.

(6) For wick drain and staged construction (i.e., predicting gains in shear strength) analyses, EOR shall assume maximum construction times in the project specific design guidance. Each project will have its own maximum construction duration requirements.

(7) The details of the maintenance berm have been updated (Reference F) with accompanying memo include.

5. <u>Slope Stability Factors of Safety</u>. Slope stability Factors of Safety (FOS) were revised based on updated USACE guidance according to Draft version of EM 1110-2-1913, “Evaluation, Design, and Construction of Levees.” FOS for critical failure cases

are summarized in Table 4.5.1 below. Note, the failure surfaces for all S-Case analyses should be non-optimized in an effort to avoid infinite-slope failures in the slip surface.

Table 4.5.1: WSLP Stability Factors Of Safety (FOS) for Levee Embankment Design

COMPONENT	ANALYSIS TYPE		PREVIOUS DESIGN GUIDANCE, MINIMUM FOS	UPDATED DESIGN GUIDANCE, MINIMUM FOS
Levee Embankment	**Deep-Seated Global Stability (Spencer Method)**	Design Hurricane (SWL)	1.50	1.40
		Water at Project Grade	1.40	1.30
		Low Water (hurricane condition)	1.40	1.30
		Low Water (non-hurricane condition) S-case, non-optimized	1.40	1.30
		Design Hurricane (SWL) w/ dry PS borrow pit	N/A	N/A
		Water at Construction Grade	1.20	1.20
		Water at Interim Construction Grade (levees designed with staged construction)	1.50	1.30
	Deep-Seated Global Stability (Design Check with Janbu's Method)	Design Hurricane (SWL)	1.30	1.30
		Water at Project Grade	1.20	1.20
		Low Water (hurricane condition)	1.30	1.20
		Low Water (non-hurricane condition) S-case, non-optimized	1.30	1.20
		Design Hurricane (SWL) w/ dry PS borrow pit	N/A	N/A
		Water at Interim Construction Grade	1.30	1.20

6. Levee Design Alternative Assessment Using Wick Drains. After soil properties are reviewed and finalized, the first step of the Geotechnical engineering design process will be an assessment of the cost effectiveness of utilizing wick drains during embankment construction. This wick drain design is considered preliminary and will only be used to assess this alternative by approximating costs and the viability of wick drains as an alternative.

a. The first step of the wick drain cost assessment will be to incorporate the updated design guidance discussed above, in addition to all previously supplied design guidance (Reference G), to develop a levee section without wick drains. Only critical slope stability load cases that typically govern the required levee section, specifically Still Water and Low Water Levels, will be assessed in this alternative evaluation. Additionally, only the Entry/Exit search method in Slope/W will be utilized for the preliminary design. Seepage analyses do not need be performed for this alternative assessment.

b. An additional preliminary levee section will be developed following the same updated design guidance discussed above utilizing wick drains to potentially reduce the required overbuild and levee footprint. For this analysis, assume wick drains will be installed across the entire sand working platform. Note, the sand working platform should be identified as the sand placed above the existing ground surface elevation. The most efficient drain spacing shall be determined by the EOR; however, 3-foot spacing is a good starting point for analysis. The depth of the wick drains shall be based on the elevation of soil layers where the most settlement is expected and critical slope stability failure surfaces may occur. The depth of wick drains shall be no deeper than the top of the Pleistocene. Wick drain inclusions will potentially reduce the levee footprint by expediting consolidation and shear strength gain. When modelling shear strength gain in Slope/W, careful consideration should be given to the number and placement of verticals. At a minimum, the recommended number of verticals is 5. Shear Strength gain should be applied to one vertical placed at the centerline of the levee and two additional verticals placed at the edge of the sand working platform. Existing, virgin conditions should be modelled with two additional verticals placed at a distance in which the consolidating influence from the wick drains is negligible (preliminary analyses indicate this is within 1 to 3 feet of the wick drain/sand platform edge). A ground surface settlement line query in Settle3 should be used to help determine this point. Additional verticals may be used at the A-E’s discretion. Horizontal wicks will be placed the full width of the sand base and will daylight out the landside toe to facilitate drainage. Horizontal wicks will be spaced 6’ on center in the direction parallel to the levee centerline. See Table 4.6.1 for recommended soil and wick drain properties to be utilized in this design alternative.

c. Once both preliminary levee sections have been developed, these sections shall be submitted to USACE, as the 15% design submittal, for evaluation of costs and viability for final design. USACE will coordinate the final decision on the wick drain alternative with the EORs and CPRA. The EOR should perform all required analyses for the alternative (i.e. with or without wick drains) agreed upon by USACE and CPRA. The alternative not selected should be documented with stability plates in an appendix in the final Geotechnical report.

Updated Geotechnical Engineering Guidance for West Shore Lake Pontchartrain, St. Charles, St. John the Baptist, and St. James Parishes, Louisiana.

Table 4.6.1: Recommended Values for Wick Drain Properties

WICK DRAIN PROPERTIES	RECOMMENDED VALUES
Cross Section Shape	Circular or Strip
Circular Diameter	0.216 feet
Strip Width and Thickness	0.33 feet and 0.01 feet, respectively
Drain Spacing, Preload Boundary	3 feet
Drain Spacing, Beyond Preload Boundary	6 feet
Drain Length	Varies.
Drain Pattern	Triangular
Smear Zone, ratio of diameter of smear zone to diameter of drain	3
Smear Zone, ratio of undisturbed to smear zone permeability	4
Horizontal Flow, C_h/C_v	1.5

7. Slope Stability Factors of Safety for T-Walls. Slope stability FOS have been revised and are summarized in Table 4.7.1. below.

Table 4.7.1.: WSLP Deep-Seated Global Stability FOS for T-wall Design

COMPONENT	ANALYSIS TYPE		PREVIOUS DESIGN GUIDANCE, MINIMUM FOS	UPDATED DESIGN GUIDANCE, MINIMUM FOS
T-WALL	**Deep-Seated Global Stability (Spencer Method)**	SWL	1.50	1.40
		TOW	1.40	1.30
		LWL	1.40	1.30
	Deep-Seated Global Stability (Design Check with Janbu's Method)	SWL	1.30	1.30
		TOW	1.20	1.20
		LWL	1.30	1.20

8. T-Wall Design Consistency. To promote consistency across T-wall designs in WSLP, the following design criteria will be followed:

a. The T-wall design procedure should be coordinated between the Geotechnical and Structural team members. The design may involve multiple iterations to design T-wall foundations to ensure Settlement Induced Bending Moments (SIBM) and Unbalanced Loads (UBL) do not exceed allowable pile capacities or lead to an overstressed pile foundation.

b. Preloads with wick drains will be incorporated into T-wall designs with the goal of inducing as much consolidation settlement at the critical T-wall SIBM locations such that pile downdrag and SIBM criteria are met for the anticipated 2070 levee elevations). At the 65% submittal, the duration of preloads shall be included so that the anticipated overall construction duration can be assessed. Special consideration should be taken with the preload to not induce settlement at sensitive structures such as pipelines.

c. Each preload will have a 100-foot transition area where the wick drain spacing will be doubled beyond the wick drains required for the T-wall design described above.

d. Tie-in berms will be required for stability purposes at the location of each T-wall transition as embankment levee transitions into T-wall. The shape and dimensions of the tie-in berms will be governed by slope stability analyses in the “parallel to centerline” and “perpendicular to centerline” cross section directions. The need for geotextile reinforcement parallel to the centerline shall also be evaluated. Mass stability analyses may be used to consider three-dimensional effects of the levee crown for the required berm parallel to the centerline.

e. To reduce the potential for differential settlement between T-wall monoliths, T-wall monoliths should be designed with equivalent base slab (i.e. no step-down approach) and pile tip elevations. The base slab between T-wall monoliths and an adjacent drainage structure, pump station, etc. may vary.

9. <u>Maintenance Berms.</u> Maintenance berms are to be included in the design of the WSLP system to provide the non-Federal Sponsor with a maintainable area above the tidal water elevation to keep unwanted vegetation away from the levee toe.

a. These maintenance berms are not to be considered in the overall factors of safety of the levee stability with regard to hurricane and storm damage risk reduction. These berms will be required to meet a local stability factor of safety of 1.2, for both short-term and long-term conditions.

b. In addition, these berms are to be modelled as semi-compacted fill as shown on the drawing (Reference F). The semi-compacted fill properties are based on those shown in the HSDRRS Design Guidelines and shall have a unit weight of 110 pcf, friction angle of zero degrees, and a cohesion of 400 psf.

10. USACE Point of Contact for this memorandum is Richard J. Varuso, Ph.D., P.E., Chief, Geotechnical Branch.

MEMORANDUM

May 21, 2021

SUBJECT: Summary of Recommendations Discussed During WSLP Geotechnical Design Summit on April 20th, 2021.

The geologic soil profile for the WSLP project generally consist of Marsh, Swamp and Riverine deposits. The Holocene deposits generally consist of organic clay (CHO) to peat (PT) layers near the ground surface underlain by low-plasticity clay (CL) to low-plasticity silt (ML) layers and high-plasticity clay (CH) layers. The Pleistocene deposits generally consist of stiff CH to stiff CL soils with seams of ML and layers of silty sand (SM) to poorly-graded sand (SP). Appendix A presents a fence diagram which identifies the soil classifications along the WSLP project. CH soils were not included in the profile to provide clarity. The thickness of the Holocene region generally decreases along the project alignment from East (WSLP-101) to West (WSLP-110). Undrained shear strength estimates for WSLP are based on data from CPTs, undrained unconsolidated (UU) triaxial tests and unconfined compression (UC) tests. The shear strengths in the Holocene region will govern the embankment design, therefore, it is crucial to QA/QC and refine the CPT and laboratory data for the soils in this region. This memo is intended to provide discussion and possible solutions to some of the issues brought up in the design phase of WSLP.

Undrained Shear Strength Data

For normally consolidated CH soils, s_u/σ_v'=0.22 can provide reliable estimates of undrained shear strength. Brandon et al. (2011) in *Strength and Compressibility Correlations for New Orleans Area Soils* found an average s_u/σ_v' ratio of 0.28 for New Orleans area soils based on DSS tests. For UU triaxial test results that plot below the s_u/σ_v'=0.22 line, the sample quality should be assessed. Brandon et al. (2011) provides a ranking criteria that can be used to assess sample quality. UU triaxial test results can significantly vary due to sample disturbance, anisotropy, and strain rate. The Engineer of Record (EOR) can use the ranking criteria as a reference point to gauge sample quality, however, engineering judgment should be used to determine which lab results are appropriate.

Determining the appropriate design shear strength lines in CL and CHO/PT soils are more difficult due to the challenges of simulating the in-situ conditions in the lab. The Brandon et al. (2011) ranking criteria was found to not favor CL and CHO/PT soils due to the lack of repeatability in the three-point UU triaxial tests. WSLP-101 provides examples of test results from CL and CHO test samples that were not repeatable. For soil samples identified as CL, there may be a significant presence of silt particles. The visual classifications of soil samples for WSLP identified a significant amount of silt/sand lenses throughout the project, which is verified by the CPT results. Brandon et al. (2014) in *Soil Strength and Slope Stability* provides the following excerpt regarding UU triaxial tests on low-plasticity silts:

> Nonplastic silts often exhibit undrained friction angles considerably greater than zero (Bishop and Eldin, 1950; Nash, 1953; Penman, 1953). Golder and Skempton (1948) explained that this behavior results from the dilatant properties of silt, which causes cavitation and loss of saturation during

testing. Attempts to use UU triaxial tests to characterize silts often produce strength results showing considerable scatter because cavitation may occur in some tests and not in others (Torrey, 1982; Arel and Önalp, 2012). It is not recommended to use UU triaxial tests to determine strength parameters for nonplastic silts.

Due to the difficulties of testing low-plasticity soils in the lab, the EOR may rely on the CPT data, which provides a repeatable in-situ measurement of tip resistance.

Consolidation Correlations

To develop site-specific consolidation correlations for the WSLP dataset, the sample quality of each consolidation test was assessed and assigned a quality designation (Good, OK, and Questionable) using The Brandon et al. (2011) ranking criteria (see Appendix B). The dataset used for this memo includes data from each WSLP project reach and the data from the River Reintroduction into Maurepas Swamp Project. The Good and OK quality test results were used to develop the correlations.

The dataset for WSLP was subdivided based on soil type and depositional age. A summary of the dataset is presented below in Table 1. The soil types were grouped into high-plasticity clays (CH), low-plasticity clays (CL), and organic clays (CHO). The depositional ages were grouped into Holocene and Pleistocene deposits.

Table 1: Summary of the WSLP dataset and the sample quality designations.

Soil Type	**Quality**			**Total**
	Good	**OK**	**Questionable**	
Holocene CH	20	27	18	65
Pleistocene CH	12	32	21	65
All CH	32	59	39	130
Holocene CL	4	10	11	25
Pleistocene CL	2	11	8	21
All CL	6	21	19	46
Holocene CHO	10	8	4	22
Pleistocene CHO	0	1	0	1
All CHO	10	9	4	23

Site-specific correlations were developed to estimate compression index (C_c), coefficient of consolidation (c_v), void ratio (e_o) and total unit weight (γ) using the natural water content (w_n). Correlations with liquid limit (LL) were also developed for c_v. The correlation figures can be found in Appendix C. In the USACE Embankment Design Memo, the Brandon et al. (2011) C_c - w_n correlations and the NAVFAC c_v – LL correlation were recommended. This memo provides a comparison between the recommended correlations and the developed site-specific correlations. Ultimately, it is up to the EOR to determine the suitability of these correlations. Table 2 below summarizes the list of the correlations that generally agree with the WSLP lab results.

Table 2: Summary of correlations.

Soil Type	Correlations	Reference
Holocene CH	$C_c = 0.017*w_n - 0.299$	Brandon et al. (2011)
Pleistocene CH	$C_c = 0.0161*w_n - 0.1467$	CPRA
Holocene CL	$C_c = 0.0125*w_n - 0.1657$	CPRA
Pleistocene CL	$C_c = 0.017*w_n - 0.299$	Brandon et al. (2011)
Holocene CHO	$C_c = 0.012*w_n + 0.137$	Brandon et al. (2011)
CH	$c_v = 0.35*\exp(-0.042*w_n)$	Brandon et al. (2011)
	$c_v = 9809.9*LL^{-2.847}$	NAVFAC
CL	$c_v = 1.51*\exp(-0.055*w_n)$	CPRA
	$c_v = 9809.9*LL^{-2.847}$	NAVFAC
CHO	$c_v = 0.0022*\exp(0.011*w_n)$	Brandon et al. (2011)
	$c_v = 9809.9*LL^{-2.847}$	NAVFAC
All Soil Types	$\gamma = -23.87*\ln(w_n) + 200.43$	CPRA
	$e_o = 0.0261*w_n + 0.0635$	CPRA

Consolidation Design Parameters

Due to limited consolidation data, the developed site-specific correlations can augment data gaps in the design soil profiles to capture soil characteristics not tested in the lab. The w_n correlations can provide continuous estimates of C_c, e_o, c_v and γ in the design soil profiles. The w_n correlations results were satisfactory for each consolidation parameter except for c_v. For this reason, the *LL* correlation should also be included in the design profile.

Each soil type requires its own correlation and can be plotted separately. Due to insufficient test data on ML and SM soils, site-specific correlations were not developed. The presence of these soil types will influence consolidation behavior and should be considered. This can be done by assigning typical values of C_c and c_v for these soil types. The EOR should determine the appropriate values for these soil types. If the EOR identifies questionable lab data, the sample quality can be assessed using the Brandon et al. (2011) ranking criteria. The EOR can then determine whether a test result is appropriate.

Stress History

The design values for stress history should be a function of the design undrained shear strength. To maintain consistency between these design parameters, the design preconsolidation pressure can be calculated using the following relationship;

$$\sigma'_{p,design} = {}^{s_{u,design}}/_{0.22} \tag{1}$$

Furthermore, the design undrained shear strength can be verified in the preconsolidation design profile using Good and OK quality consolidation data. Using Eq. 1, the strength gain calculations can be translated from the Settle3D consolidation model for a given time step. When inputting design values in Settle3D, the preconsolidation pressure should be inputted instead of OCR. The preconsolidation pressure design profile should also include correlations from the CPTs. The following equation can be used to plot the preconsolidation pressure using CPT data.

$$\sigma_p' = \alpha(q_t - \sigma_{vo}) \quad (2)$$

where α is typically 0.33 for clays

The soft near-surface CHO/PT layers also exhibit high variability in lab testing. During construction, these organic layers will undergo horizontal displacement, remolding and immediate settlement. Upon loading, the characteristics of these organic soils will change significantly. The CPT data for these soils also exhibits significant scatter, likely due to the presence of wood and roots. For past HSDRRS levee projects with similar subsurface conditions and construction techniques, the EOR assigned higher undrained shear strength values to mimic the immediate change in soil characteristics. The depth and magnitude of the assumed strength gain during construction is dependent on the type of loading and engineering judgment.

Design Soil Profiles

Examples of shear strength and consolidation design profiles for WSLP reaches are included in Appendix D. These examples include the recommendations presented in this memo. It is up to the EOR to interpret the data and to choose appropriate design values.

Pile Foundations

The pile foundation design will be significantly influenced by the Pleistocene soils. There is uncertainty in the characteristics of the Pleistocene soils at the depth of the proposed pile tips due to limited CPT data. CPTs were sounded into the Pleistocene but were terminated at relatively shallow depths. When comparing the UU triaxial test data to the CPT data, there is significant scatter in the lab data. In the consolidation design profile, the CPT results generally agree with the Good and OK quality consolidation test results. Due to the lack of data in the deeper portions of the Pleistocene and the scatter observed in the UU triaxial test results, the pile capacities and required pile lengths should not be finalized until pile load tests are performed for the WSLP project. Appendix E presents a fence diagram which contains the proposed pile tip elevations and the location of the pile load tests along WSLP which we understand are subject to change as the design progresses.

Other Recommendations

To maintain consistency for these types of levee projects, the modeling procedures should be standardized.

Settle3D Model

1. The levee embankment should be modeled using the "Embankment Cross Section Designer" feature. This allows for the levee load to be inputted using x, y coordinates. This feature can be accessed through the following path: Load -> Add Embankment (Cross_Section).
2. Strength gain should be captured in the design immediately after sand base construction. The projected production rate for the placement of embankment fill can be assumed as 2,400-CY per day for two working crews. The production schedule is based on a 5-day workweek. The cubic yards of fill can be converted to embankment height after the levee geometry is determined. The model should include two-month load stages until the levee embankment is complete.
3. The recompression coefficient of consolidation (c_{vr}) should be at least equal to c_v.

SlopeW Model

1. A good rule of thumb for modeling the sand core; for every foot of sand placed above the mudline, a foot of sand can be assumed to be below the mudline.
2. Wider and thicker sand core dimensions may help increase the slope stability FOS.

<u>Points of Contact</u>

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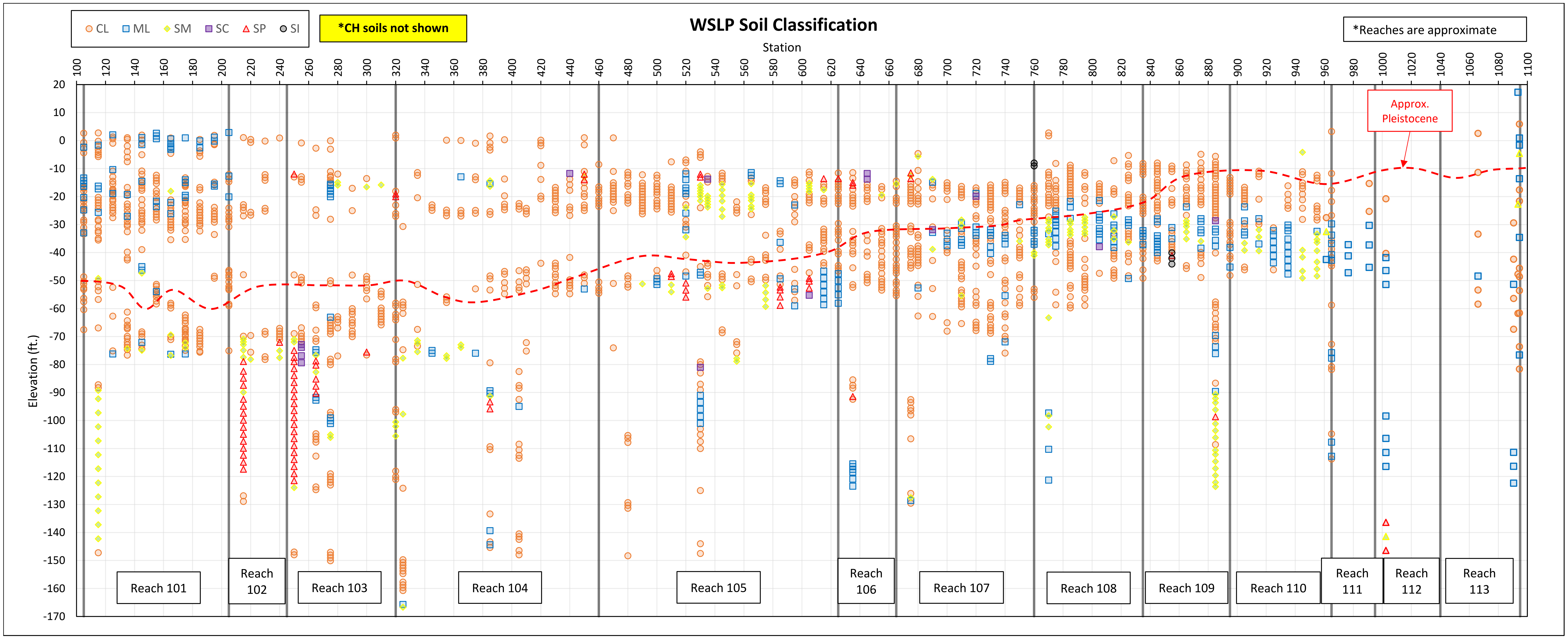
Appendix A: WSLP Soil Classifications



WSLP Soil Classification
CL
ML
SM
SC
SP
SI
*CH soils not shown
*Reaches are approximate
Station
Elevation (ft.)
Approx. Pleistocene
Reach 101
Reach 102
Reach 103
Reach 104
Reach 105
Reach 106
Reach 107
Reach 108
Reach 109
Reach 110
Reach 111
Reach 112
Reach 113

Appendix B: Brandon et al. (2011) Ranking Criteria

UU Triaxial Test Ranking Criteria:

- Peak deviator stress ($\sigma_{d,\ peak}$) achieved at an axial strain (ε_a) less than or equal to about 5%.
- Mohr's circles must have approximately equal diameters.
- The water content (w_n) and initial void ratio (e_o) of all three test specimens must be within about ±5% of each other.
- The degree of saturation should be greater than or equal to 95%.
- The stress-strain curves should generally have a smooth appearance.
- The value of initial tangent modulus should be approximately equal between all test specimens.

Rank	Number of criteria met	Designation
1	0 to 2	Questionable
2	2 or 3	Questionable
3	3 or 4	OK
4	4 or 5	OK or Good
5	5 or 6	Good

Consolidation Test Ranking Criteria:

- Strain upon reloading to in-situ vertical effective stress (σ'_v) less than about 3%.
- Saturation ≥ 95%.
- Depth of sample ≥ 5 ft.
- Percent difference between σ'_P (Casagrande) and σ'_P (Sowers) ≤ 25%.
- Well-defined break in the compression curve at transition from recompression to virgin compression (at σ'_P).
- Time increment for each load is sufficient to reach End of Primary (EOP) consolidation.
- Smooth and reasonable shape for time rate of consolidation curves (time curves) at each load increment.

Rank	Number of criteria met	Designation
1	0 to 3	Questionable
2	3 or 4	Questionable
3	4 or 5	OK
4	5 or 6	OK or Good
5	6 or 7	Good

Appendix C: Consolidation Correlations

All WSLP Data

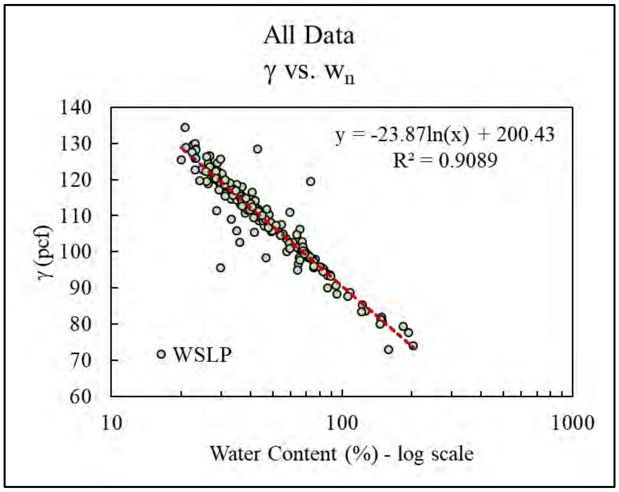


Figure 1: WSLP correlation for total unit weight (γ) and water content (w_n) using all consolidation tests.

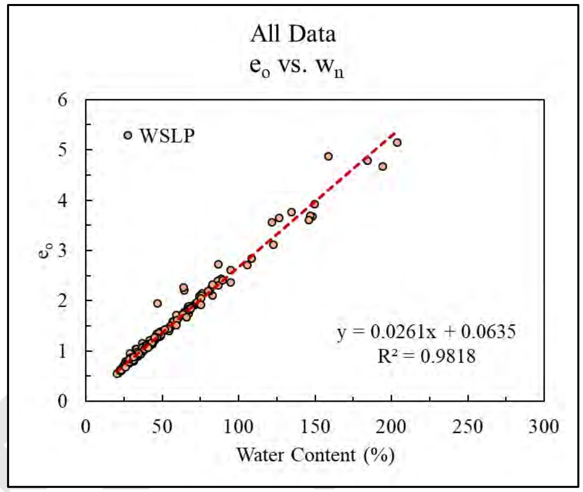


Figure 2: WSLP correlation for initial void ratio (e_o) and water content (w_n) using all consolidation tests.

CH Correlations

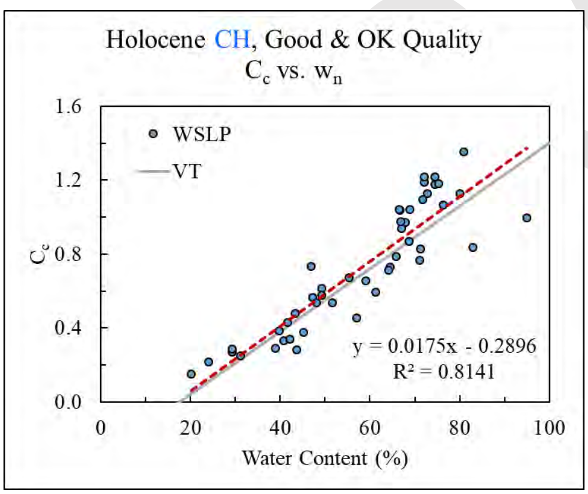


Figure 3: WSLP correlation for compression index (C_c) and water content (w_n) for Holocene CH of Good & OK quality.

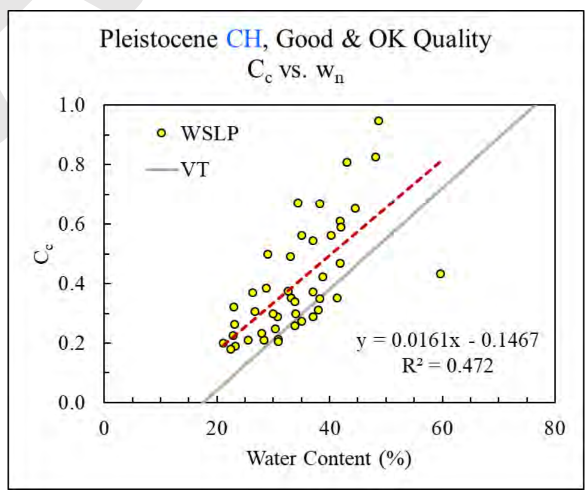


Figure 4: WSLP correlation for compression index (C_c) and water content (w_n) for Pleistocene CH of Good & OK quality.

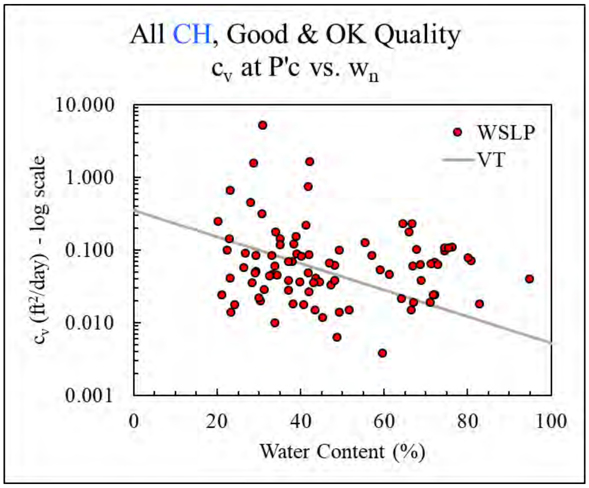


Figure 5: WSLP correlation for coefficient of consolidation (c_v) and water content (w_n) for Holocene and Pleistocene CH of Good & OK quality. c_v was taken at the preconsolidation stress.

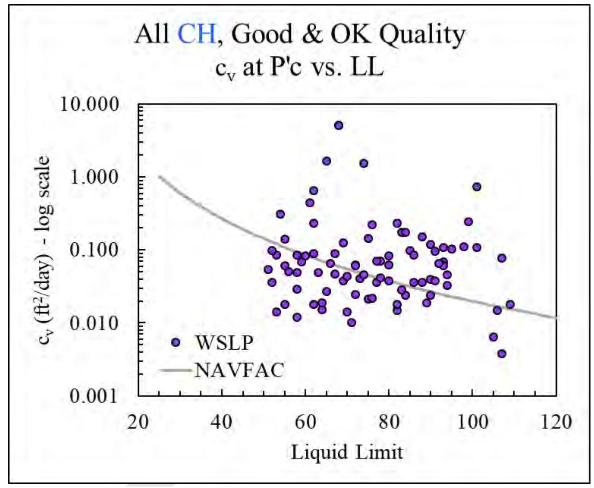


Figure 6: WSLP correlation for coefficient of consolidation (c_v) and liquid limit (LL) for Holocene and Pleistocene CH of Good & OK quality. c_v was taken at the preconsolidation stress.

CL Correlations

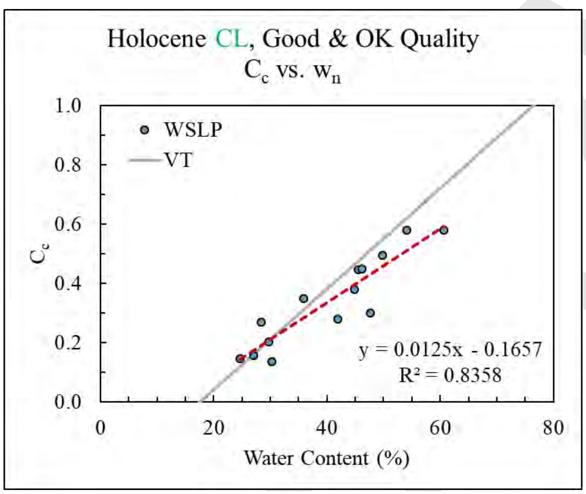


Figure 7: WSLP correlation for compression index (C_c) and water content (w_n) for Holocene CL of Good & OK quality.

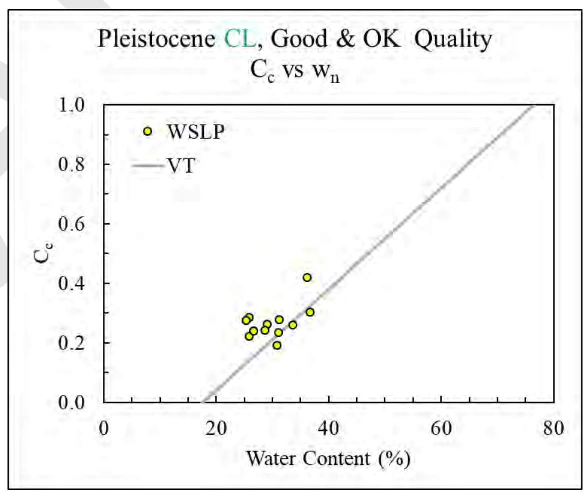


Figure 8: WSLP correlation for compression index (C_c) and water content (w_n) for Pleistocene CL of Good & OK quality.

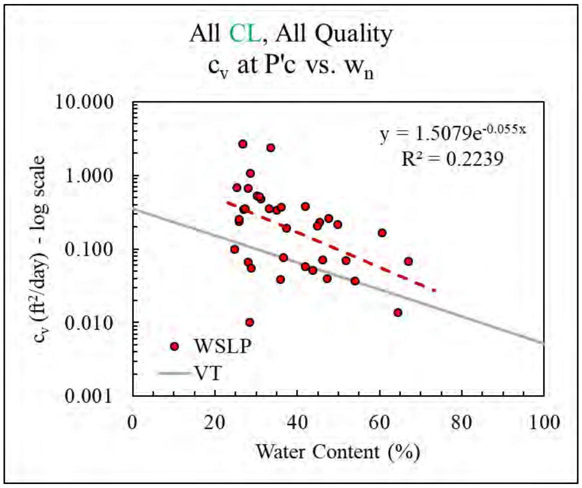


Figure 9: WSLP correlation for coefficient of consolidation (c_v) and water content (w_n) for Holocene and Pleistocene CL of all quality. c_v was taken at the preconsolidation stress.

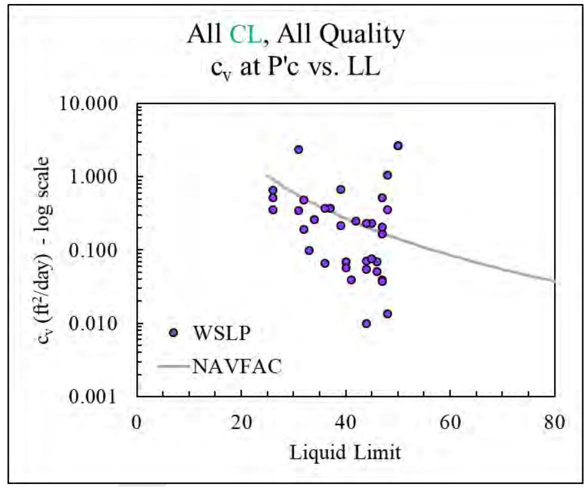


Figure 10: WSLP correlation for coefficient of consolidation (c_v) and liquid limit (LL) for Holocene and Pleistocene CL of all quality. c_v was taken at the preconsolidation stress.

CHO Correlations

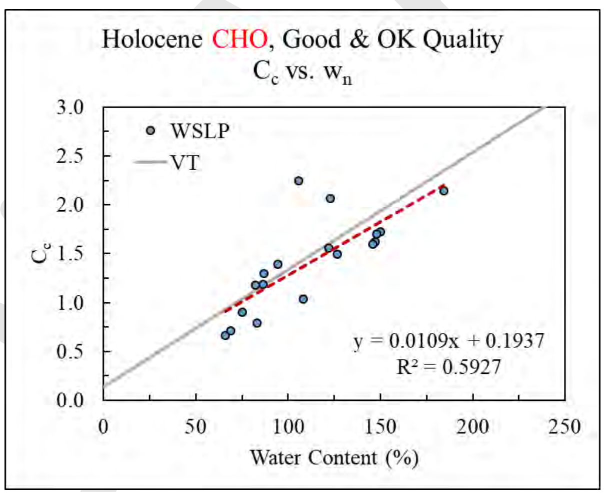


Figure 11: WSLP correlation for compression index (C_c) and water content (w_n) for Holocene CHO of Good & OK quality.

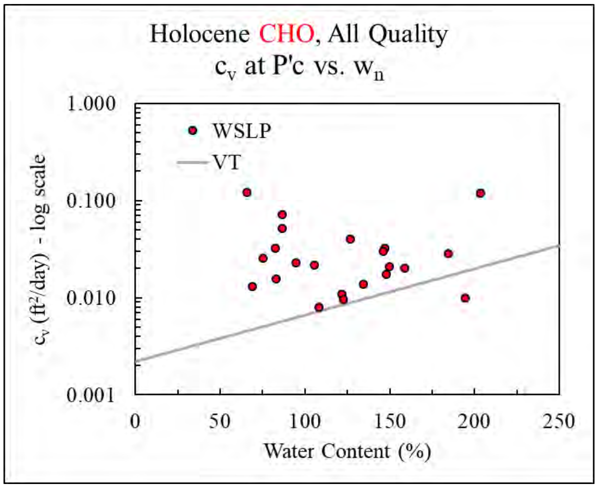


Figure 12: WSLP correlation for coefficient of consolidation (c_v) and water content (w_n) for Holocene CHO of all quality. c_v was taken at the preconsolidation stress.

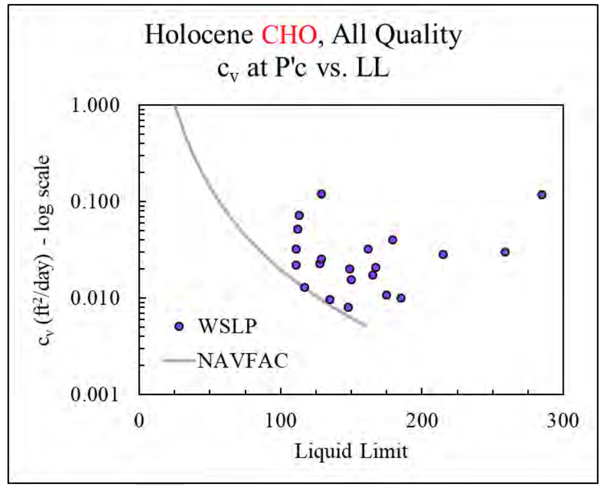
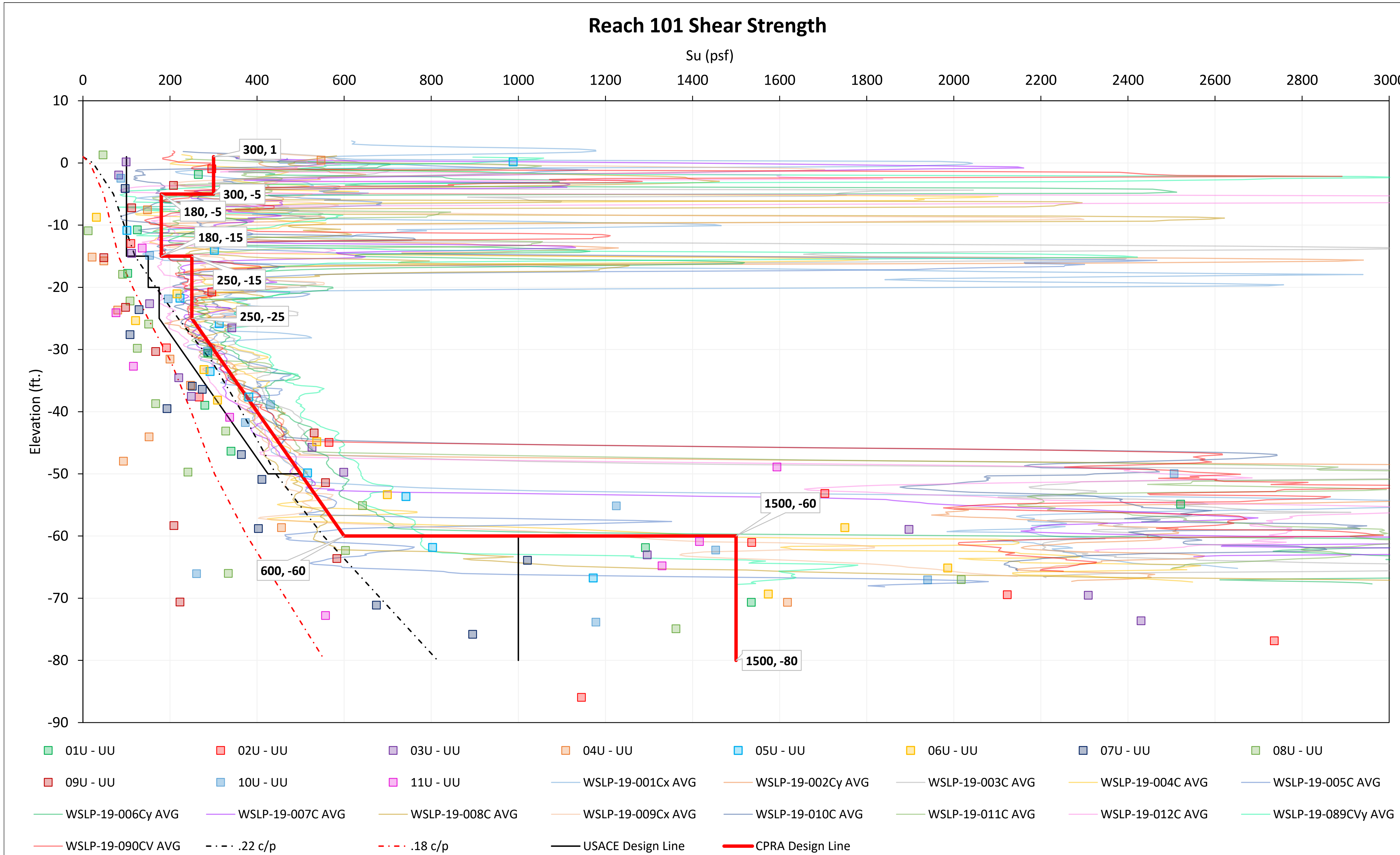
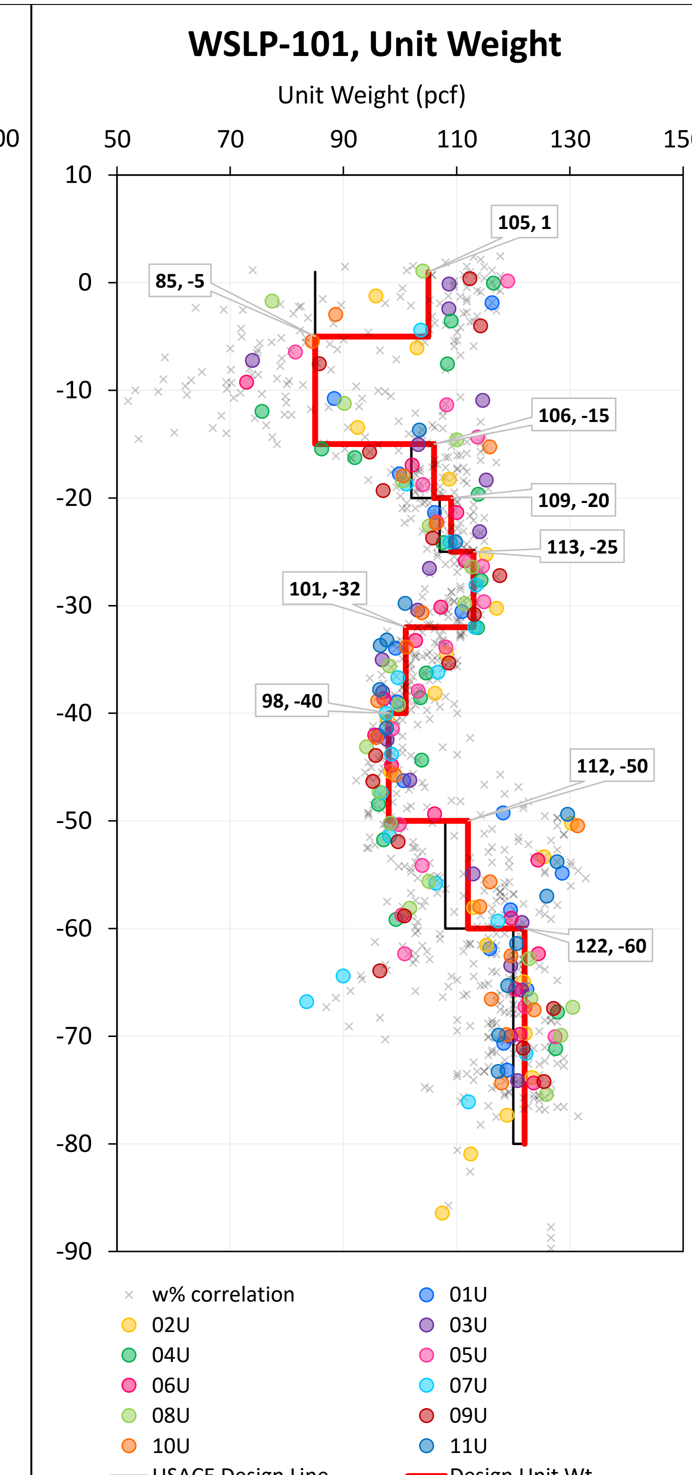


Figure 13: WSLP correlation for coefficient of consolidation (c_v) and liquid limit (LL) for Holocene CHO of all quality. c_v was taken at the preconsolidation stress.

Appendix D: Design Soil Profiles

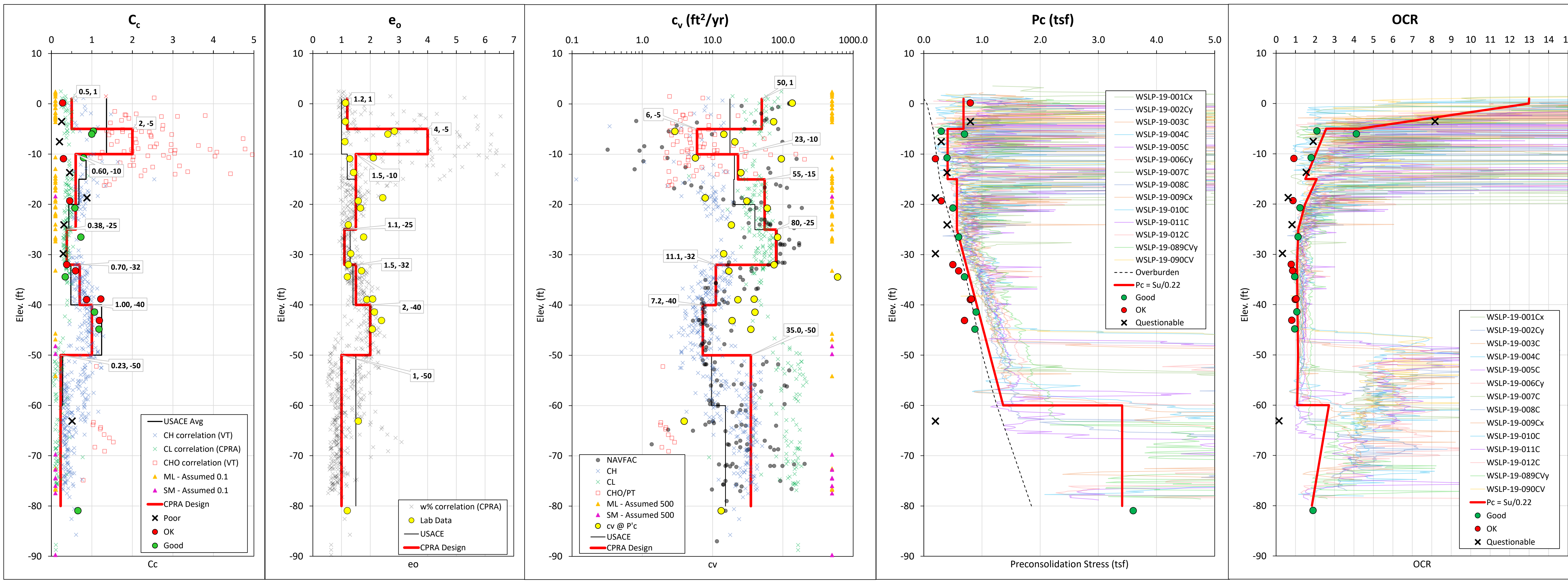


Reach 101 Shear Strength
Su (psf)
Elevation (ft.)
300, 1
300, -5
180, -5
180, -15
250, -15
250, -25
600, -60
1500, -60
1500, -80
01U - UU
02U - UU
03U - UU
04U - UU
05U - UU
06U - UU
07U - UU
08U - UU
09U - UU
10U - UU
11U - UU
WSLP-19-001Cx AVG
WSLP-19-002Cy AVG
WSLP-19-003C AVG
WSLP-19-004C AVG
WSLP-19-005C AVG
WSLP-19-006Cy AVG
WSLP-19-007C AVG
WSLP-19-008C AVG
WSLP-19-009Cx AVG
WSLP-19-010C AVG
WSLP-19-011C AVG
WSLP-19-012C AVG
WSLP-19-089CVy AVG
WSLP-19-090CV AVG
.22 c/p
.18 c/p
USACE Design Line
CPRA Design Line

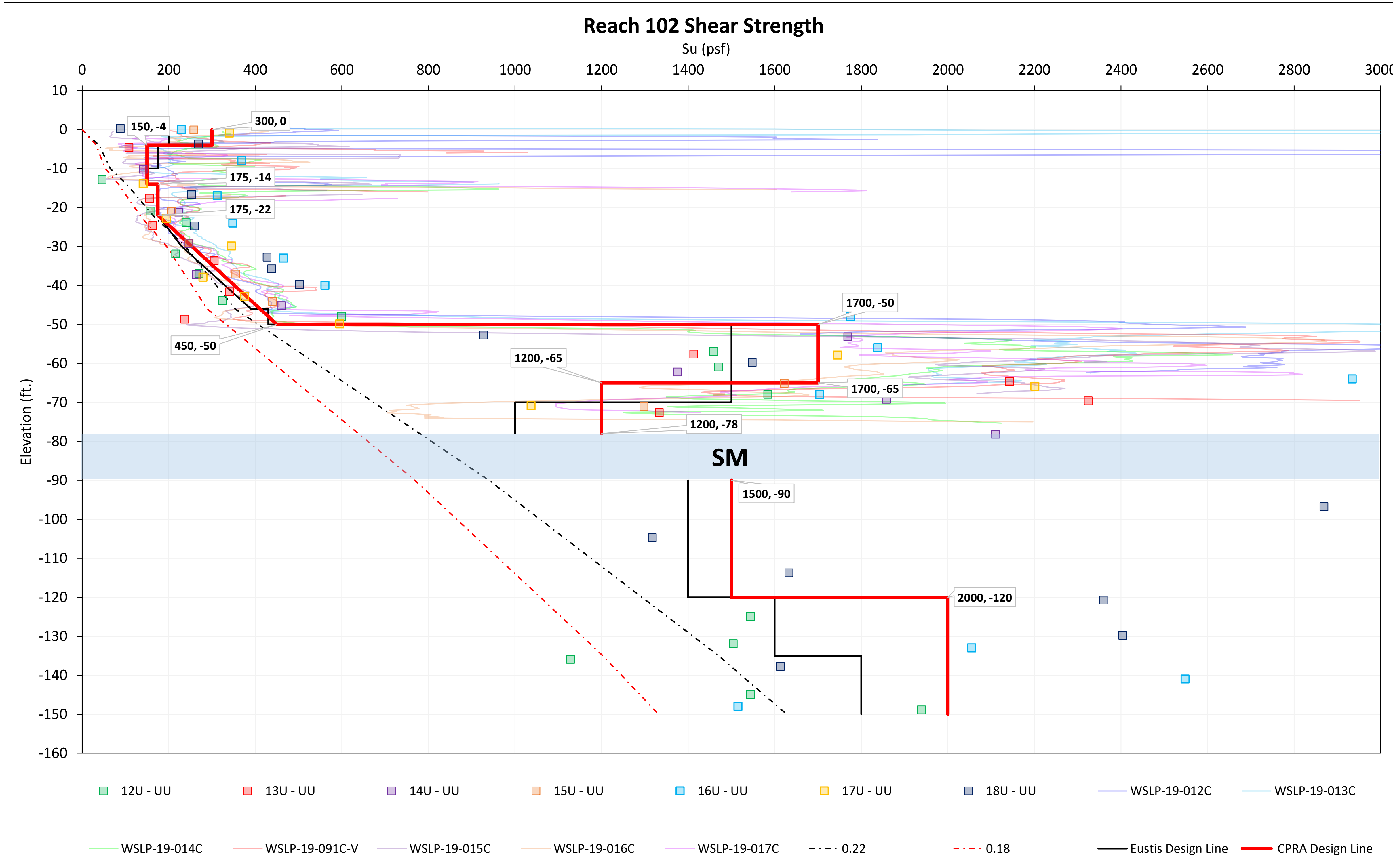


WSLP-101, Unit Weight
Unit Weight (pcf)
105, 1
85, -5
106, -15
109, -20
113, -25
101, -32
98, -40
112, -50
122, -60
w% correlation
01U
02U
03U
04U
05U
06U
07U
08U
09U
10U
11U
USACE Design Line
Design Unit Wt

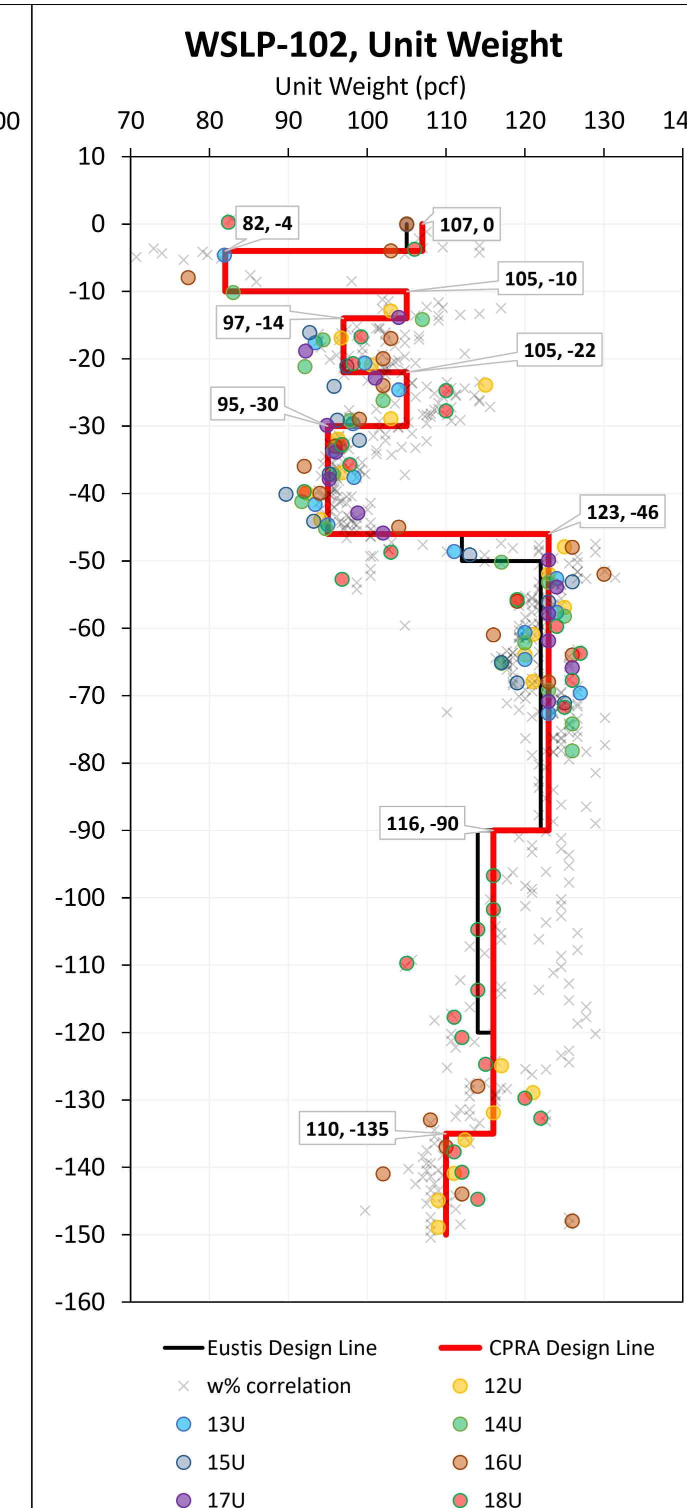
WSLP-101



Cc
Elev. (ft)
0.5, 1
2, -5
0.60, -10
0.38, -25
0.70, -32
1.00, -40
0.23, -50
USACE Avg
CH correlation (VT)
CL correlation (CPRA)
CHO correlation (VT)
ML - Assumed 0.1
SM - Assumed 0.1
CPRA Design
Poor
OK
Good
Cc
eo
1.2, 1
4, -5
1.5, -10
1.1, -25
1.5, -32
2, -40
1, -50
w% correlation (CPRA)
Lab Data
USACE
CPRA Design
eo
cv (ft²/yr)
50, 1
6, -5
23, -10
55, -15
80, -25
11.1, -32
7.2, -40
35.0, -50
NAVFAC
CH
CL
CHO/PT
ML - Assumed 500
SM - Assumed 500
cv @ P'c
USACE
CPRA Design
cv
Pc (tsf)
WSLP-19-001Cx
WSLP-19-002Cy
WSLP-19-003C
WSLP-19-004C
WSLP-19-005C
WSLP-19-006Cy
WSLP-19-007C
WSLP-19-008C
WSLP-19-009Cx
WSLP-19-010C
WSLP-19-011C
WSLP-19-012C
WSLP-19-089CVy
WSLP-19-090CV
Overburden
Pc = Su/0.22
Good
OK
Questionable
Preconsolidation Stress (tsf)
OCR
WSLP-19-001Cx
WSLP-19-002Cy
WSLP-19-003C
WSLP-19-004C
WSLP-19-005C
WSLP-19-006Cy
WSLP-19-007C
WSLP-19-008C
WSLP-19-009Cx
WSLP-19-010C
WSLP-19-011C
WSLP-19-012C
WSLP-19-089CVy
WSLP-19-090CV
Pc = Su/0.22
Good
OK
Questionable
OCR

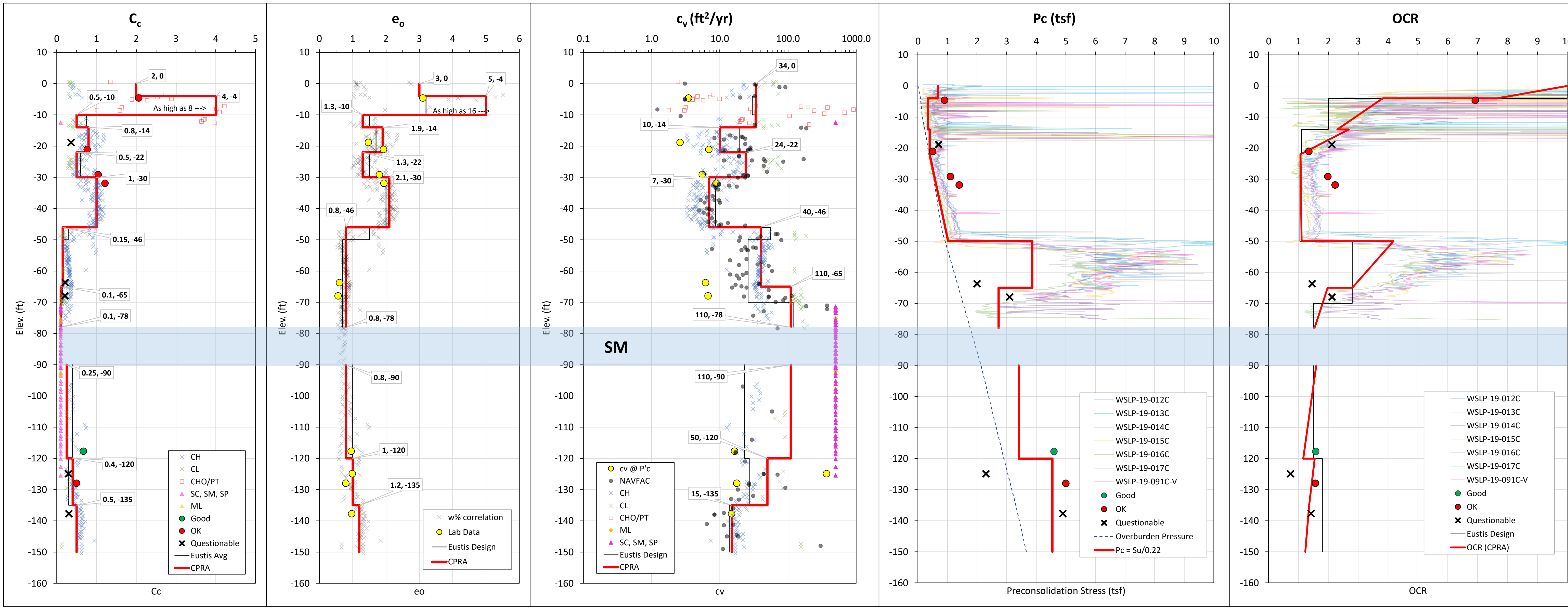


Reach 102 Shear Strength
Su (psf)
Elevation (ft.)
150, -4
300, 0
175, -14
175, -22
450, -50
1700, -50
1200, -65
1700, -65
1200, -78
SM
1500, -90
2000, -120
12U - UU
13U - UU
14U - UU
15U - UU
16U - UU
17U - UU
18U - UU
WSLP-19-012C
WSLP-19-013C
WSLP-19-014C
WSLP-19-091C-V
WSLP-19-015C
WSLP-19-016C
WSLP-19-017C
0.22
0.18
Eustis Design Line
CPRA Design Line

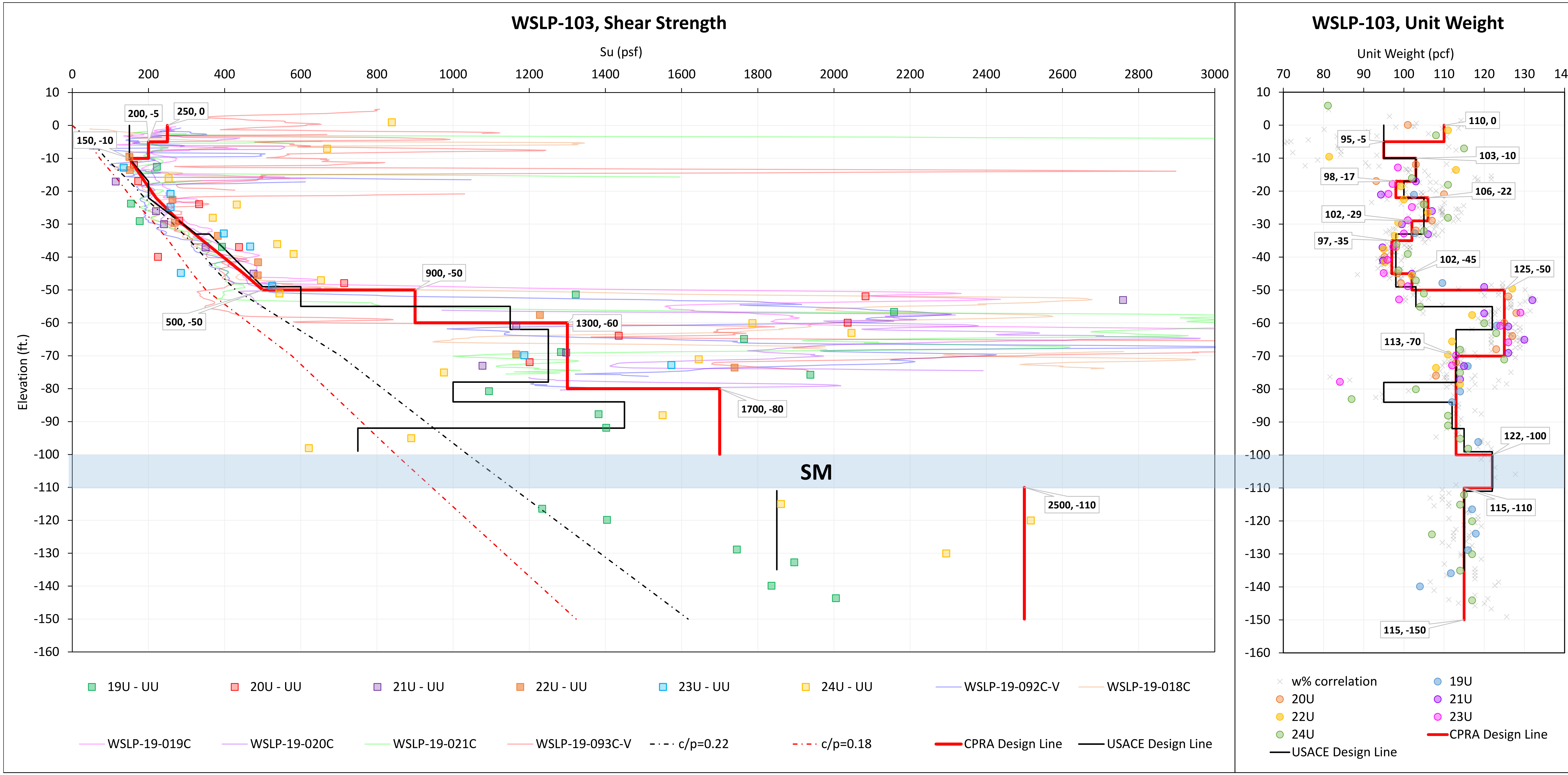


WSLP-102, Unit Weight
Unit Weight (pcf)
82, -4
107, 0
105, -10
97, -14
105, -22
95, -30
123, -46
116, -90
110, -135
Eustis Design Line
CPRA Design Line
w% correlation
12U
13U
14U
15U
16U
17U
18U

WSLP-102

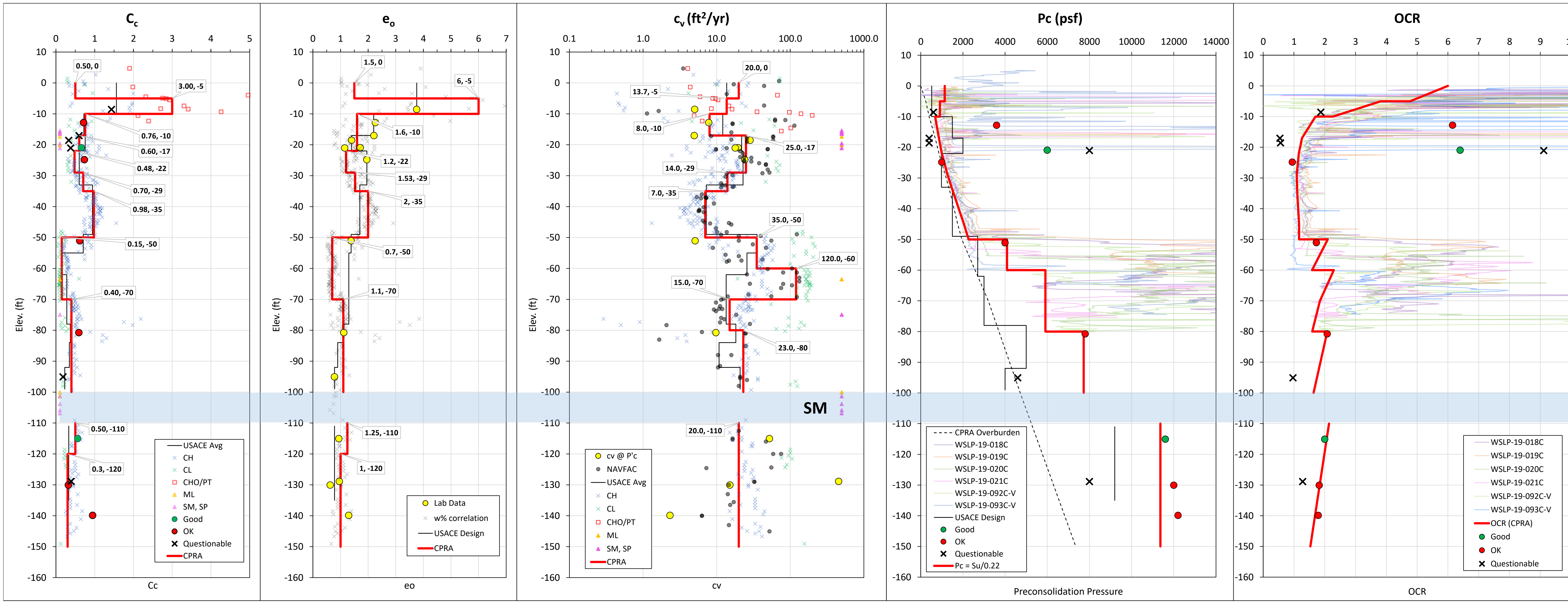


Cc
Elev. (ft)
2, 0
0.5, -10
4, -4
As high as 8 --->
0.8, -14
0.5, -22
1, -30
0.15, -46
0.1, -65
0.1, -78
0.25, -90
0.4, -120
0.5, -135
CH
CL
CHO/PT
SC, SM, SP
ML
Good
OK
Questionable
Eustis Avg
CPRA
Cc
eo
3, 0
5, -4
1.3, -10
As high as 16 --->
1.9, -14
1.3, -22
2.1, -30
0.8, -46
0.8, -78
0.8, -90
1, -120
1.2, -135
w% correlation
Lab Data
Eustis Design
CPRA
eo
cv (ft²/yr)
34, 0
10, -14
24, -22
7, -30
40, -46
110, -65
110, -78
SM
110, -90
50, -120
15, -135
cv @ P'c
NAVFAC
CH
CL
CHO/PT
ML
SC, SM, SP
Eustis Design
CPRA
cv
Pc (tsf)
WSLP-19-012C
WSLP-19-013C
WSLP-19-014C
WSLP-19-015C
WSLP-19-016C
WSLP-19-017C
WSLP-19-091C-V
Good
OK
Questionable
Overburden Pressure
Pc = Su/0.22
Preconsolidation Stress (tsf)
OCR
WSLP-19-012C
WSLP-19-013C
WSLP-19-014C
WSLP-19-015C
WSLP-19-016C
WSLP-19-017C
WSLP-19-091C-V
Good
OK
Questionable
Eustis Design
OCR (CPRA)
OCR

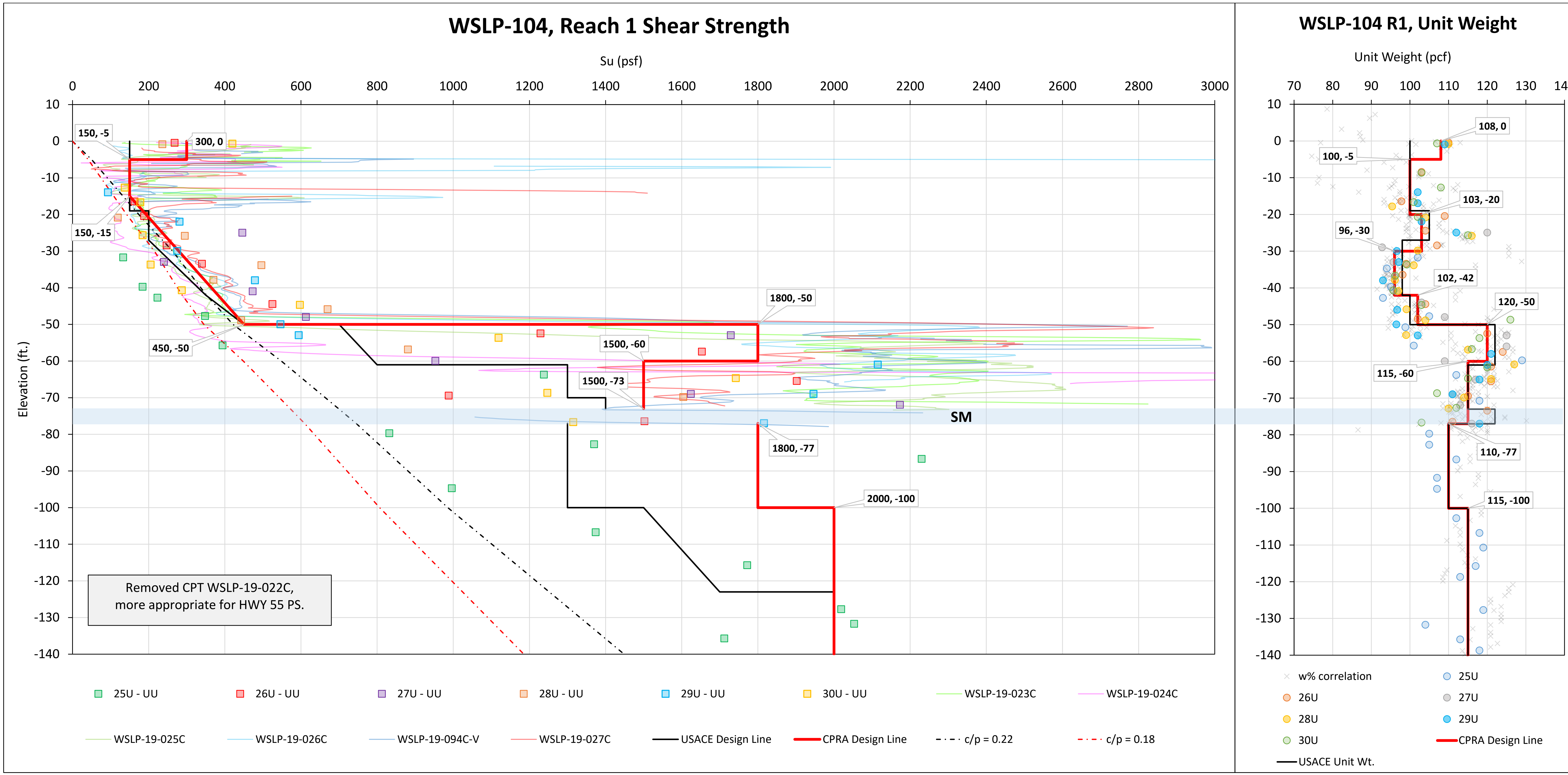


WSLP-103, Shear Strength
Su (psf)
Elevation (ft.)
200, -5
250, 0
150, -10
900, -50
500, -50
1300, -60
1700, -80
SM
2500, -110
19U - UU
20U - UU
21U - UU
22U - UU
23U - UU
24U - UU
WSLP-19-092C-V
WSLP-19-018C
WSLP-19-019C
WSLP-19-020C
WSLP-19-021C
WSLP-19-093C-V
c/p=0.22
c/p=0.18
CPRA Design Line
USACE Design Line
WSLP-103, Unit Weight
Unit Weight (pcf)
110, 0
95, -5
103, -10
98, -17
106, -22
102, -29
97, -35
102, -45
125, -50
113, -70
122, -100
115, -110
115, -150
w% correlation
19U
20U
21U
22U
23U
24U
CPRA Design Line
USACE Design Line

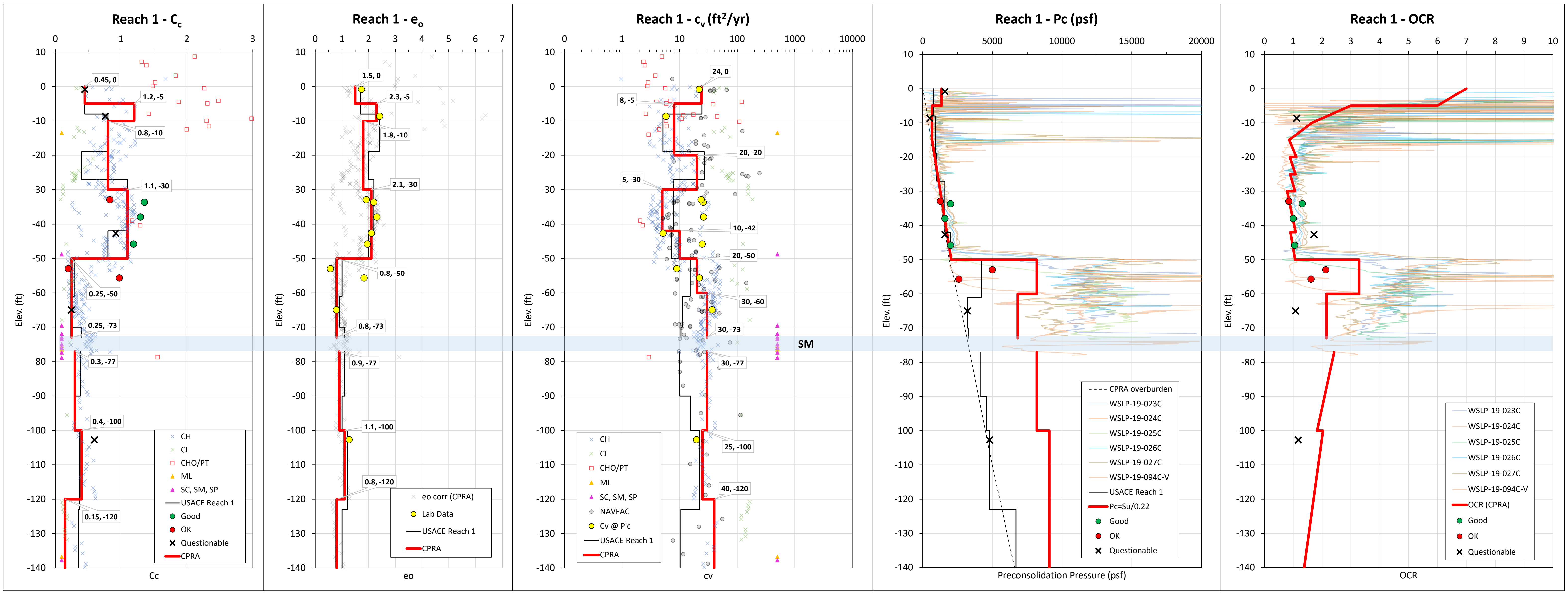
WSLP-103

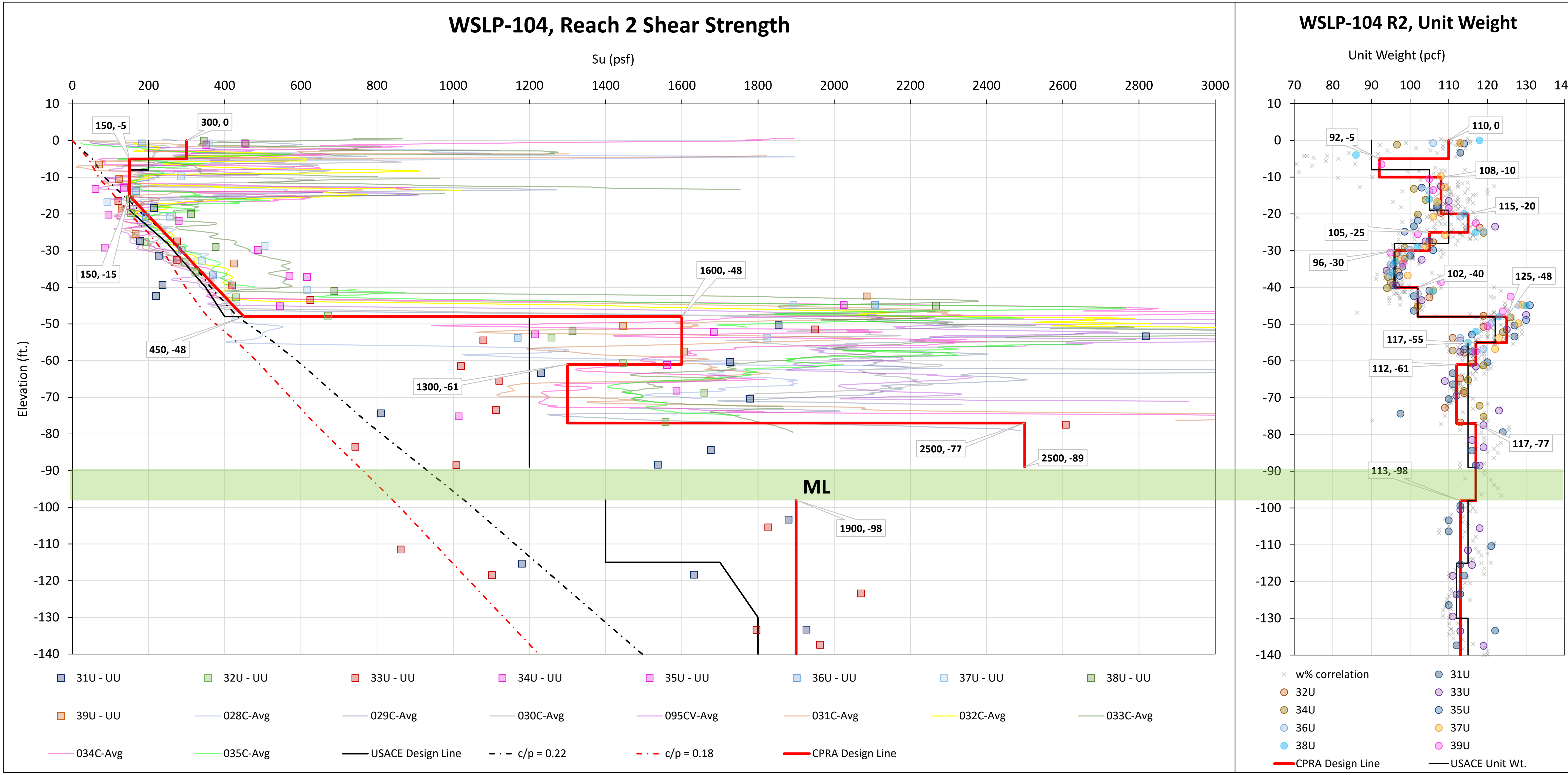


Cc
eo
cv (ft2/yr)
Pc (psf)
OCR
Elev. (ft)
SM
0.50, 0
3.00, -5
0.76, -10
0.60, -17
0.48, -22
0.70, -29
0.98, -35
0.15, -50
0.40, -70
0.50, -110
0.3, -120
USACE Avg
CH
CL
CHO/PT
ML
SM, SP
Good
OK
Questionable
CPRA
1.5, 0
6, -5
1.6, -10
1.2, -22
1.53, -29
2, -35
0.7, -50
1.1, -70
1.25, -110
1, -120
Lab Data
w% correlation
USACE Design
20.0, 0
13.7, -5
8.0, -10
25.0, -17
14.0, -29
7.0, -35
35.0, -50
120.0, -60
15.0, -70
23.0, -80
20.0, -110
cv @ P'c
NAVFAC
cv
CPRA Overburden
WSLP-19-018C
WSLP-19-019C
WSLP-19-020C
WSLP-19-021C
WSLP-19-092C-V
WSLP-19-093C-V
Pc = Su/0.22
Preconsolidation Pressure
OCR (CPRA)

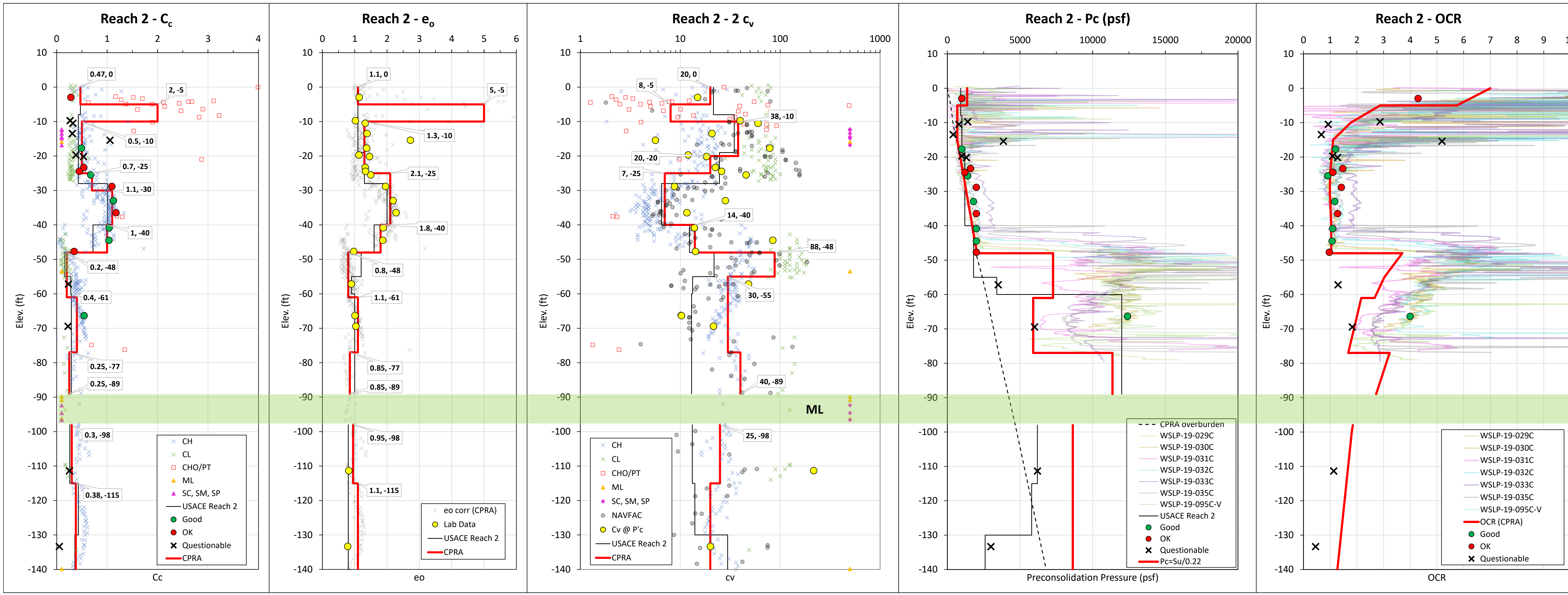

WSLP-104, Reach 1 Shear Strength
Su (psf)
Elevation (ft.)
150, -5
300, 0
150, -15
450, -50
1800, -50
1500, -60
1500, -73
SM
1800, -77
2000, -100
Removed CPT WSLP-19-022C, more appropriate for HWY 55 PS.
25U - UU
26U - UU
27U - UU
28U - UU
29U - UU
30U - UU
WSLP-19-023C
WSLP-19-024C
WSLP-19-025C
WSLP-19-026C
WSLP-19-094C-V
WSLP-19-027C
USACE Design Line
CPRA Design Line
c/p = 0.22
c/p = 0.18
WSLP-104 R1, Unit Weight
Unit Weight (pcf)
108, 0
100, -5
103, -20
96, -30
102, -42
120, -50
115, -60
110, -77
115, -100
w% correlation
25U
26U
27U
28U
29U
30U
CPRA Design Line
USACE Unit Wt.

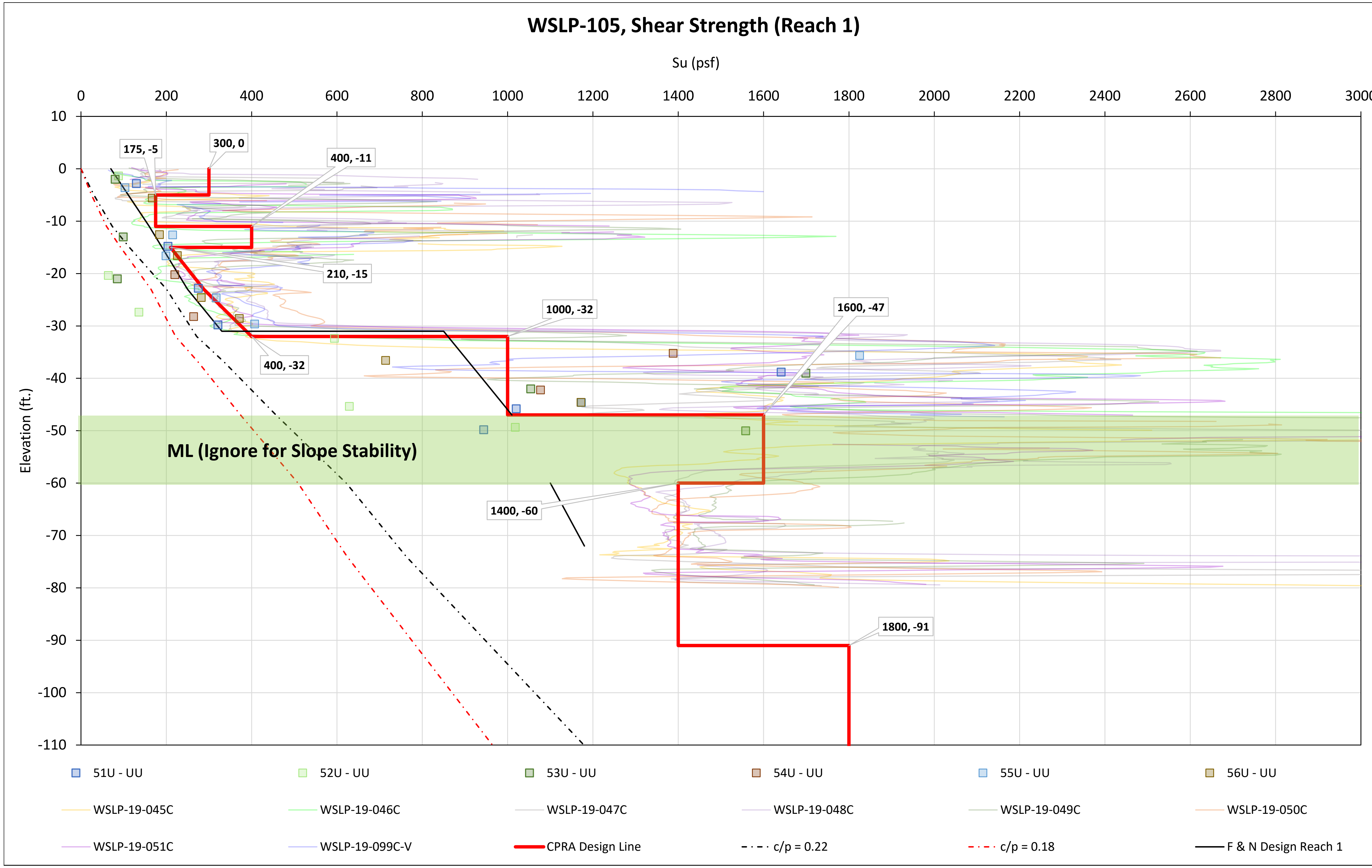
WSLP-104, Reach 1

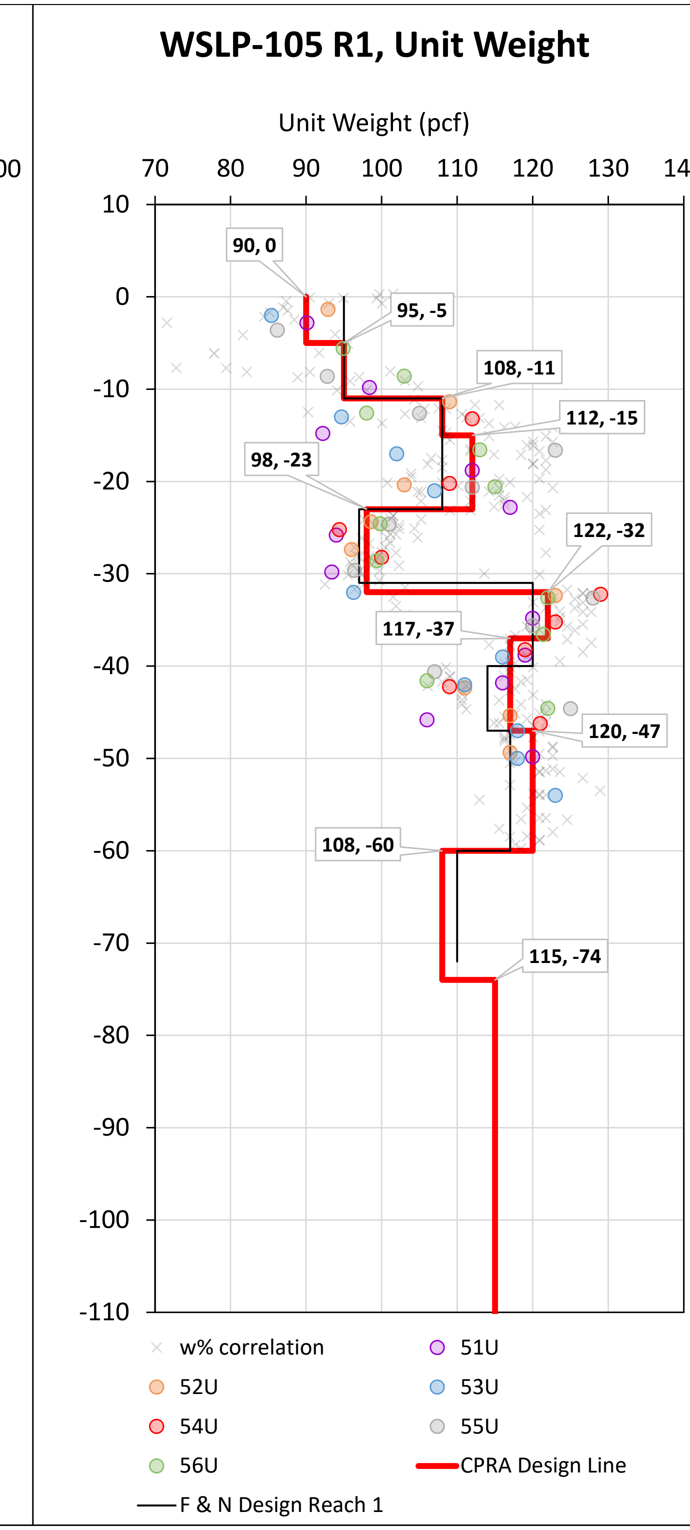



WSLP-104, Reach 2 Shear Strength
Su (psf)
Elevation (ft.)
150, -5
300, 0
150, -15
1600, -48
450, -48
1300, -61
2500, -77
2500, -89
1900, -98
ML
31U - UU
32U - UU
33U - UU
34U - UU
35U - UU
36U - UU
37U - UU
38U - UU
39U - UU
028C-Avg
029C-Avg
030C-Avg
095CV-Avg
031C-Avg
032C-Avg
033C-Avg
034C-Avg
035C-Avg
USACE Design Line
c/p = 0.22
c/p = 0.18
CPRA Design Line
WSLP-104 R2, Unit Weight
Unit Weight (pcf)
92, -5
110, 0
108, -10
115, -20
105, -25
96, -30
102, -40
125, -48
117, -55
112, -61
117, -77
113, -98
w% correlation
31U
32U
33U
34U
35U
36U
37U
38U
39U
CPRA Design Line
USACE Unit Wt.

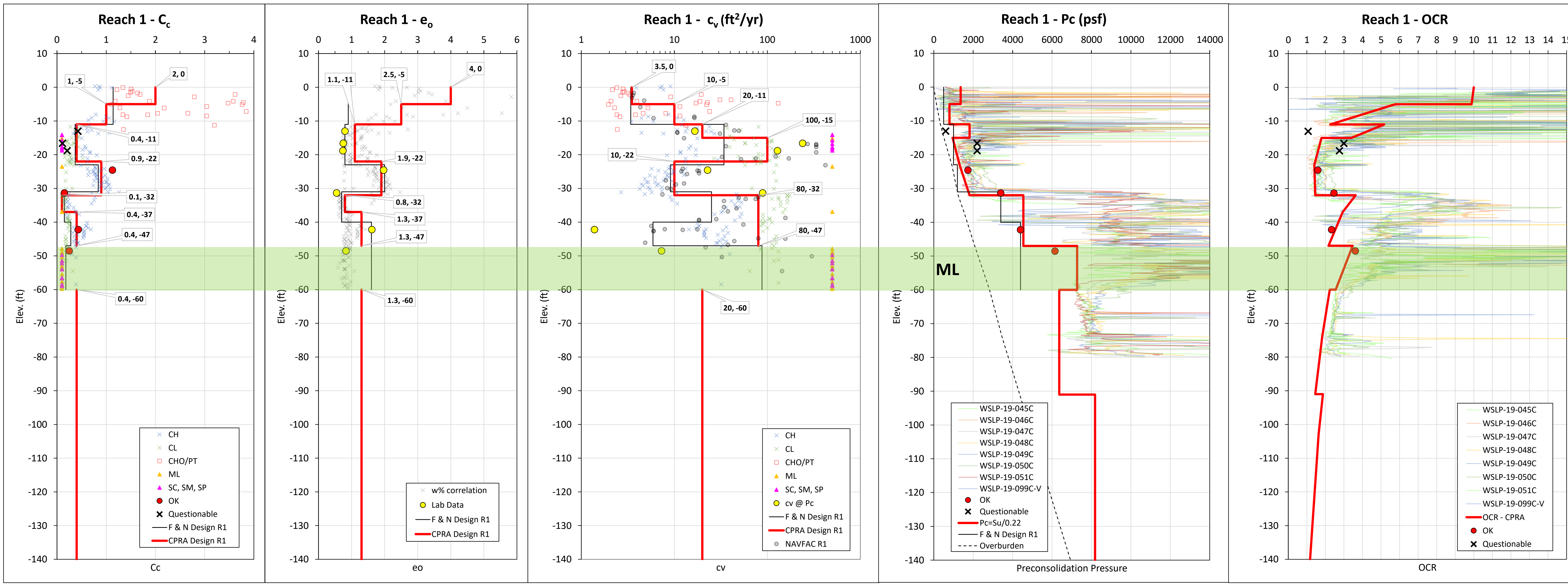
WSLP-104, Reach 2

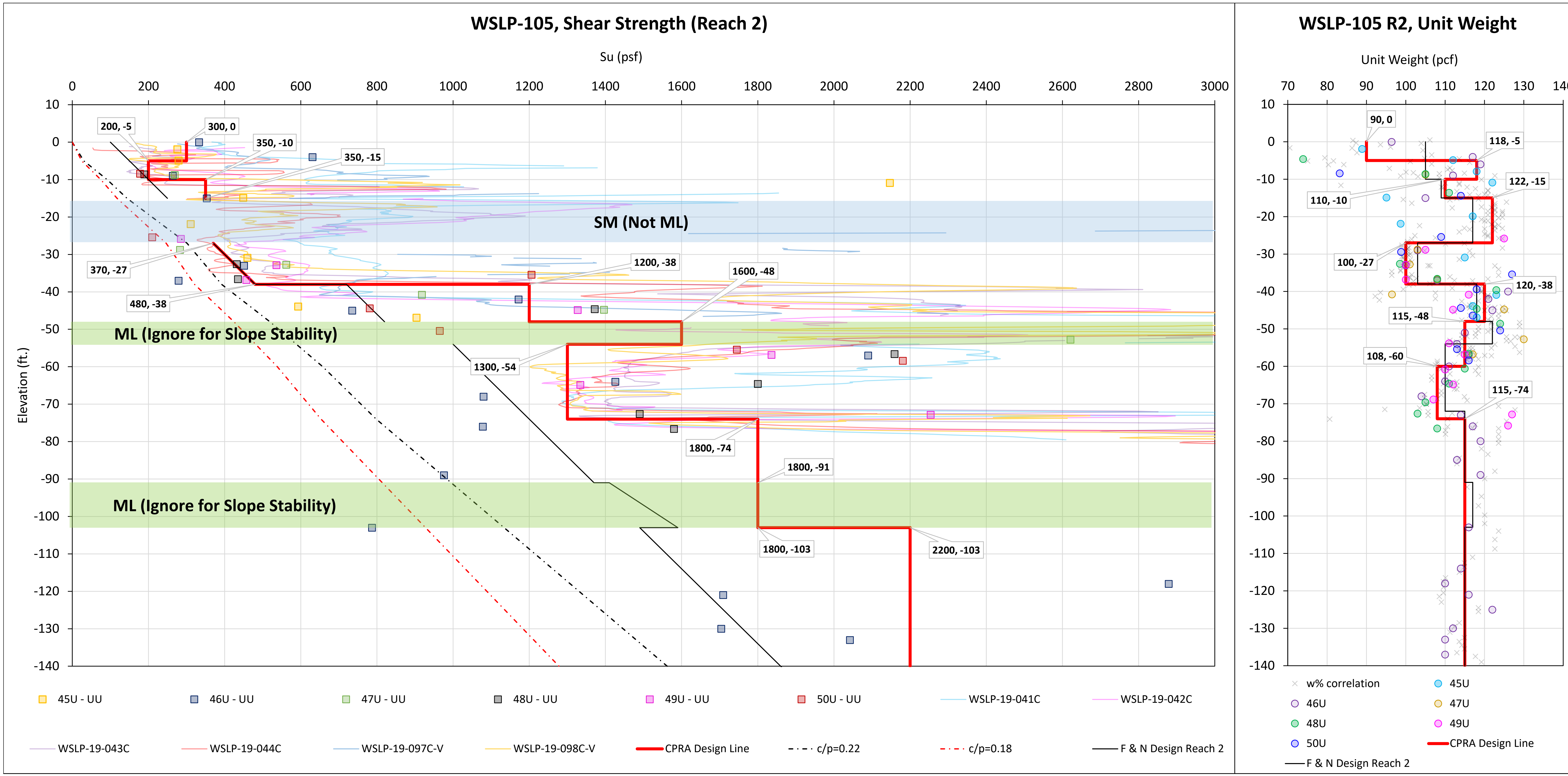



WSLP-105, Shear Strength (Reach 1)
Su (psf)
Elevation (ft.)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
175, -5
300, 0
400, -11
210, -15
1000, -32
400, -32
1600, -47
ML (Ignore for Slope Stability)
1400, -60
1800, -91
51U - UU
52U - UU
53U - UU
54U - UU
55U - UU
56U - UU
WSLP-19-045C
WSLP-19-046C
WSLP-19-047C
WSLP-19-048C
WSLP-19-049C
WSLP-19-050C
WSLP-19-051C
WSLP-19-099C-V
CPRA Design Line
c/p = 0.22
c/p = 0.18
F & N Design Reach 1

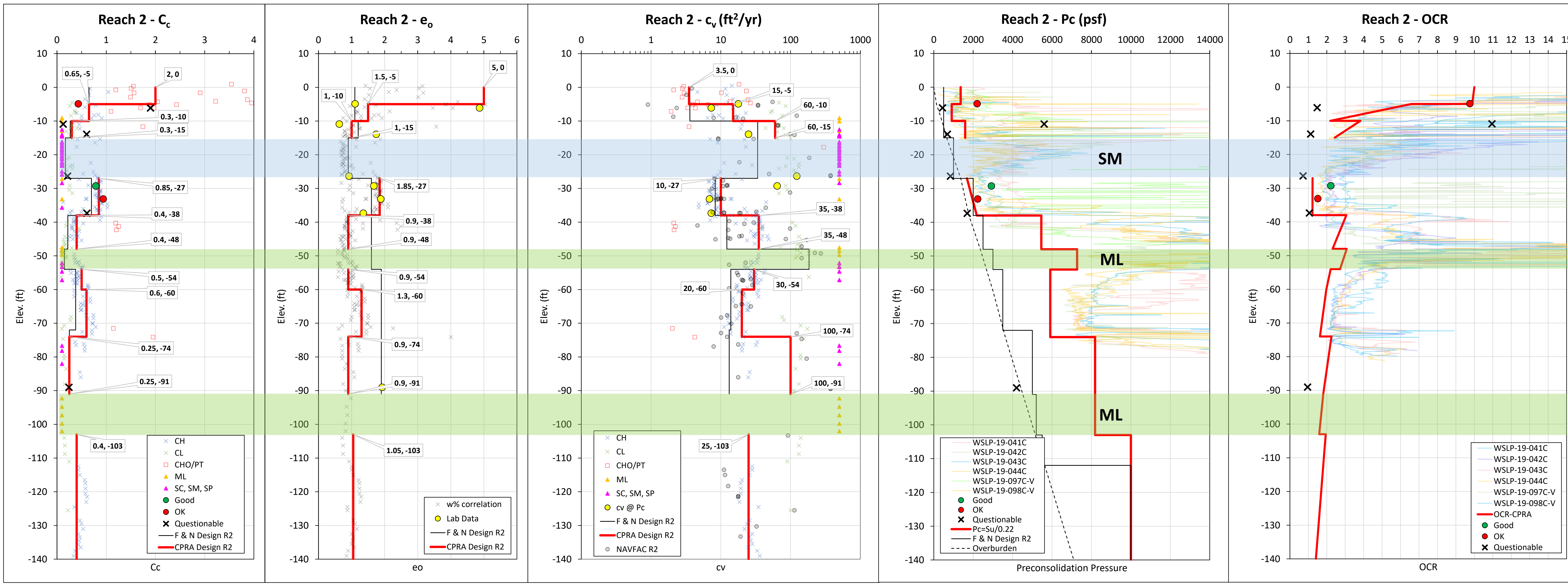

WSLP-105 R1, Unit Weight
Unit Weight (pcf)
70
80
90
100
110
120
130
140
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
90, 0
95, -5
108, -11
112, -15
98, -23
122, -32
117, -37
120, -47
108, -60
115, -74
w% correlation
51U
52U
53U
54U
55U
56U
CPRA Design Line
F & N Design Reach 1

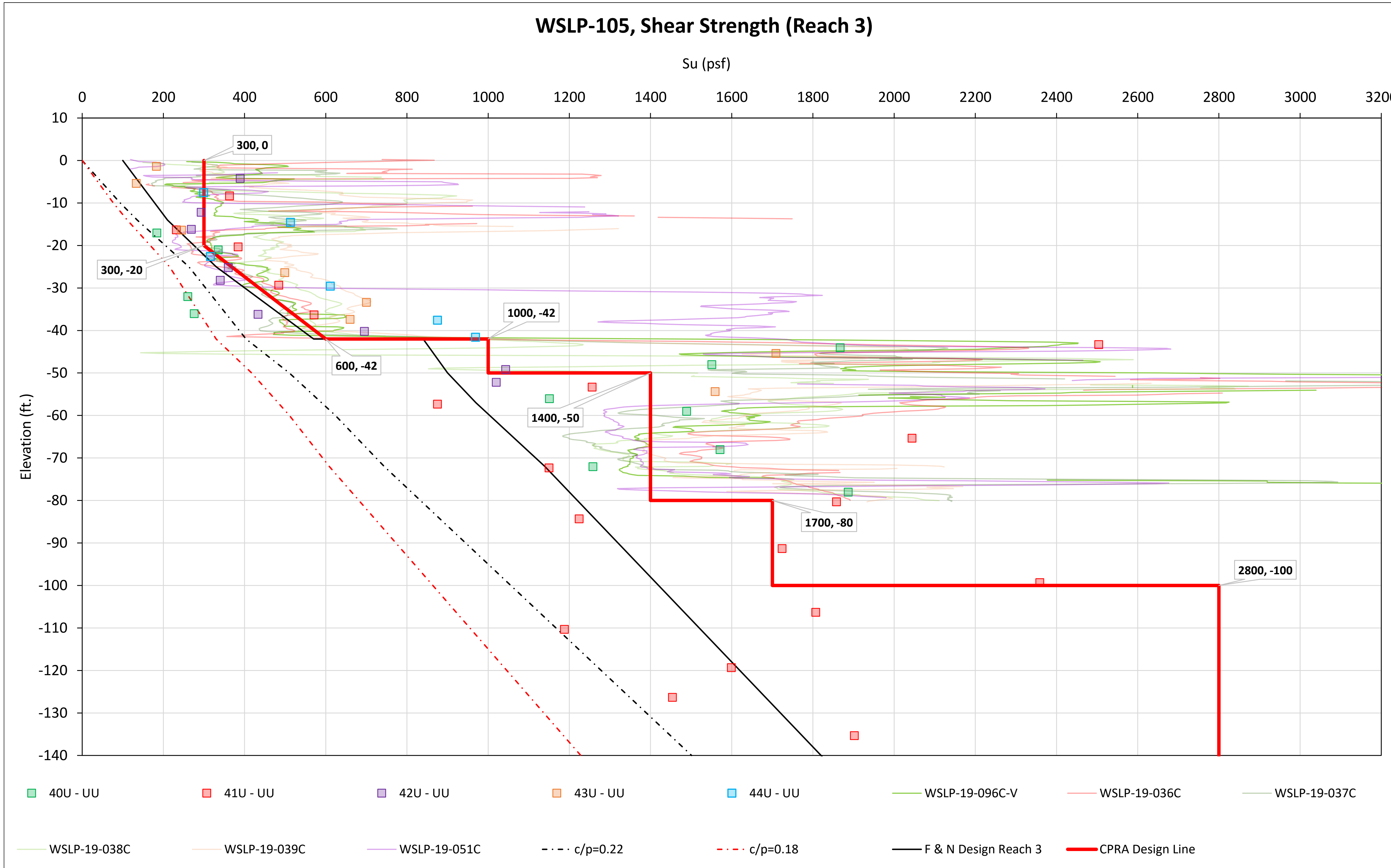
WSLP-105, Reach 1

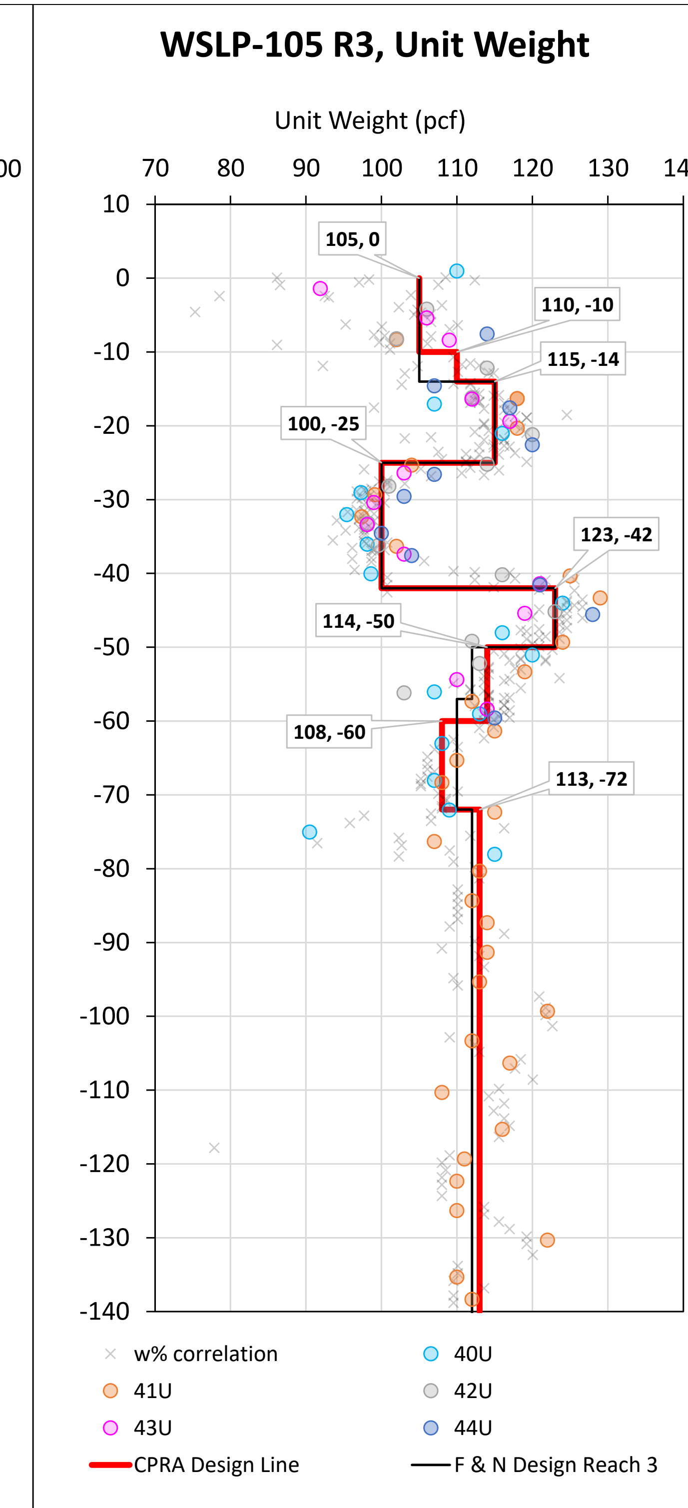



WSLP-105, Shear Strength (Reach 2)
Su (psf)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
Elevation (ft.)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
200, -5
300, 0
350, -10
350, -15
SM (Not ML)
370, -27
1200, -38
1600, -48
480, -38
ML (Ignore for Slope Stability)
1300, -54
1800, -74
1800, -91
ML (Ignore for Slope Stability)
1800, -103
2200, -103
45U - UU
46U - UU
47U - UU
48U - UU
49U - UU
50U - UU
WSLP-19-041C
WSLP-19-042C
WSLP-19-043C
WSLP-19-044C
WSLP-19-097C-V
WSLP-19-098C-V
CPRA Design Line
c/p=0.22
c/p=0.18
F & N Design Reach 2
WSLP-105 R2, Unit Weight
Unit Weight (pcf)
70
80
90
100
110
120
130
140
90, 0
118, -5
122, -15
110, -10
100, -27
120, -38
115, -48
108, -60
115, -74
w% correlation
45U
46U
47U
48U
49U
50U
CPRA Design Line
F & N Design Reach 2

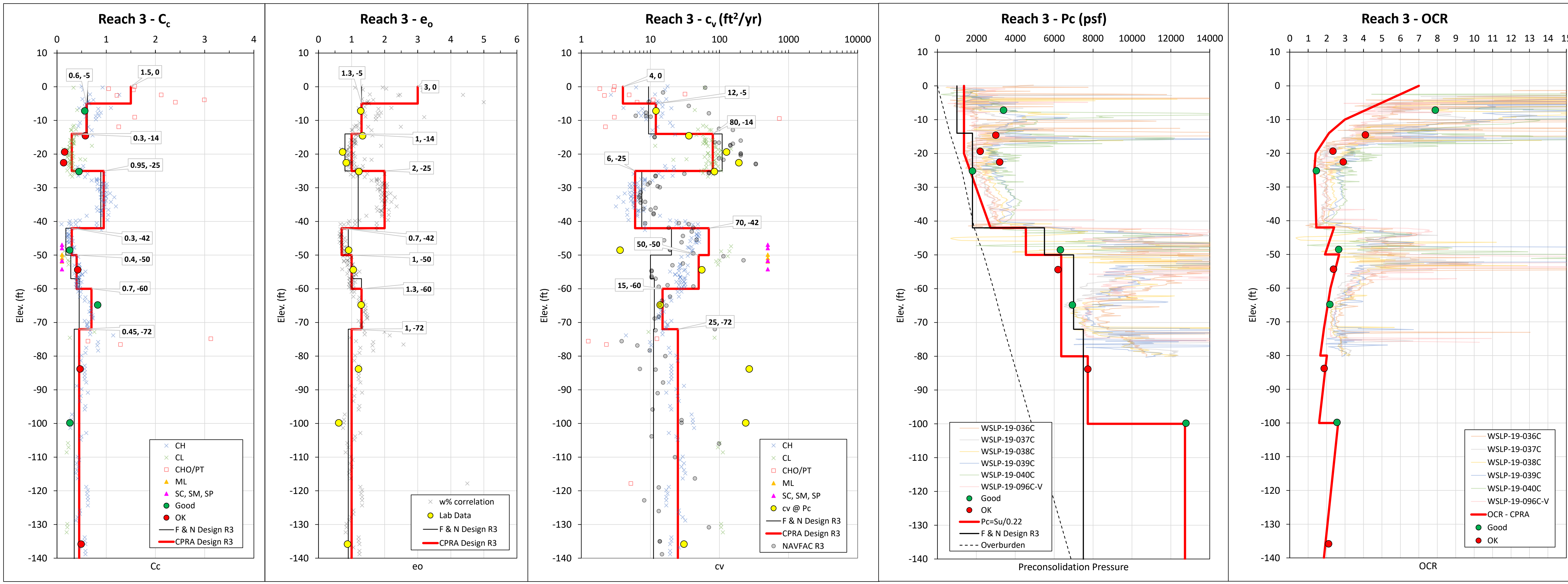
WSLP-105, Reach 2

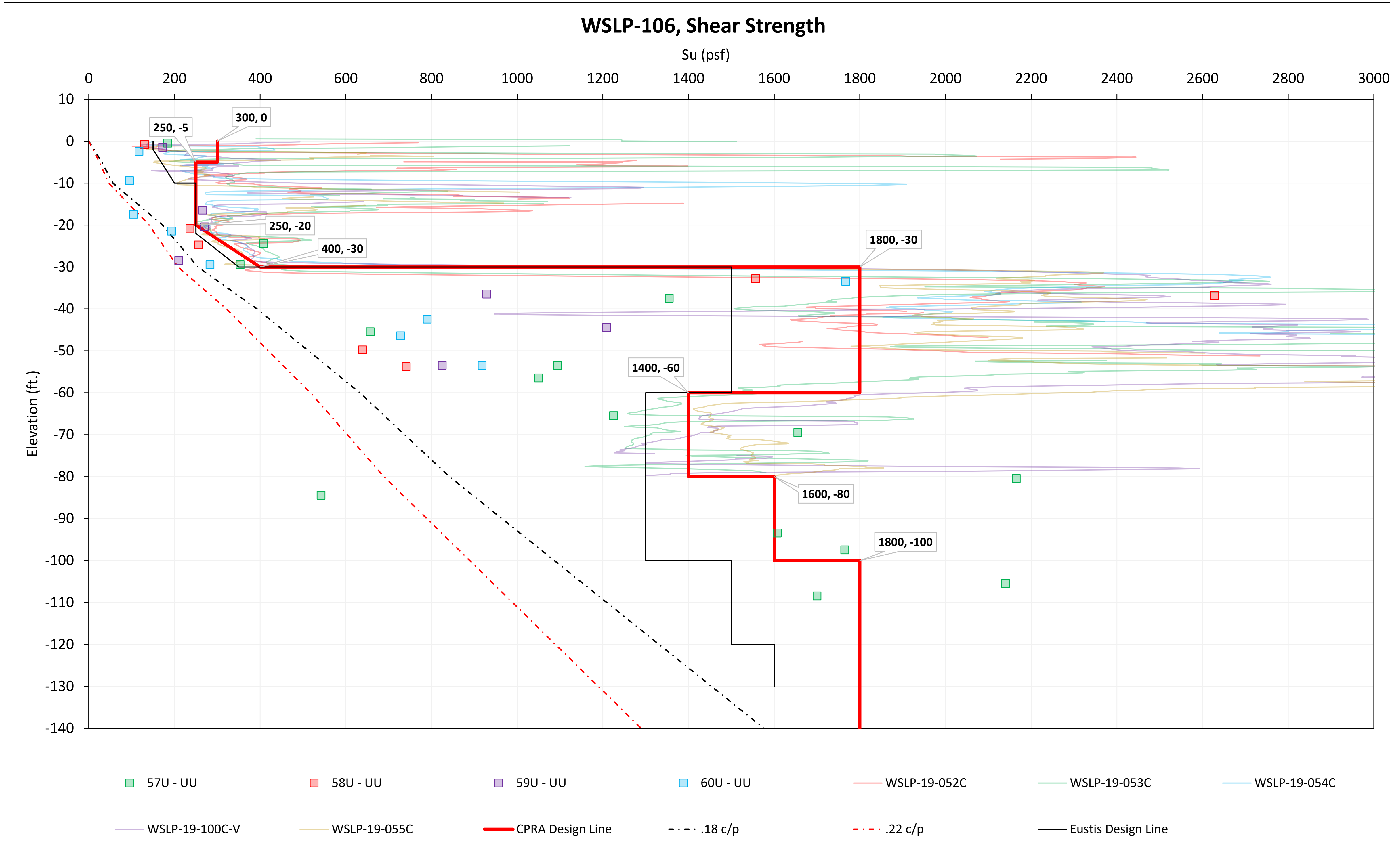



WSLP-105, Shear Strength (Reach 3)
Su (psf)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
Elevation (ft.)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
300, 0
300, -20
600, -42
1000, -42
1400, -50
1700, -80
2800, -100
40U - UU
41U - UU
42U - UU
43U - UU
44U - UU
WSLP-19-096C-V
WSLP-19-036C
WSLP-19-037C
WSLP-19-038C
WSLP-19-039C
WSLP-19-051C
c/p=0.22
c/p=0.18
F & N Design Reach 3
CPRA Design Line

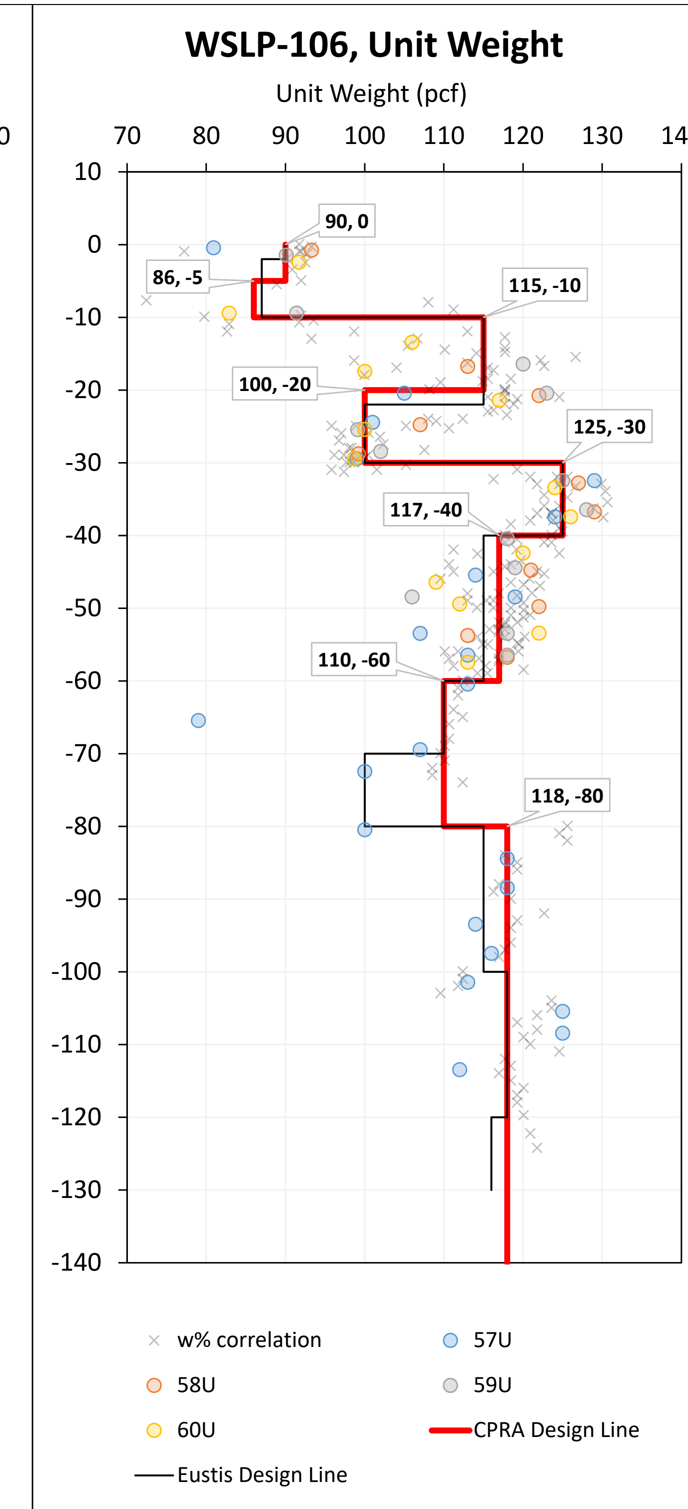

WSLP-105 R3, Unit Weight
Unit Weight (pcf)
70
80
90
100
110
120
130
140
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
105, 0
110, -10
115, -14
100, -25
123, -42
114, -50
108, -60
113, -72
w% correlation
40U
41U
42U
43U
44U
CPRA Design Line
F & N Design Reach 3

WSLP-105, Reach 3



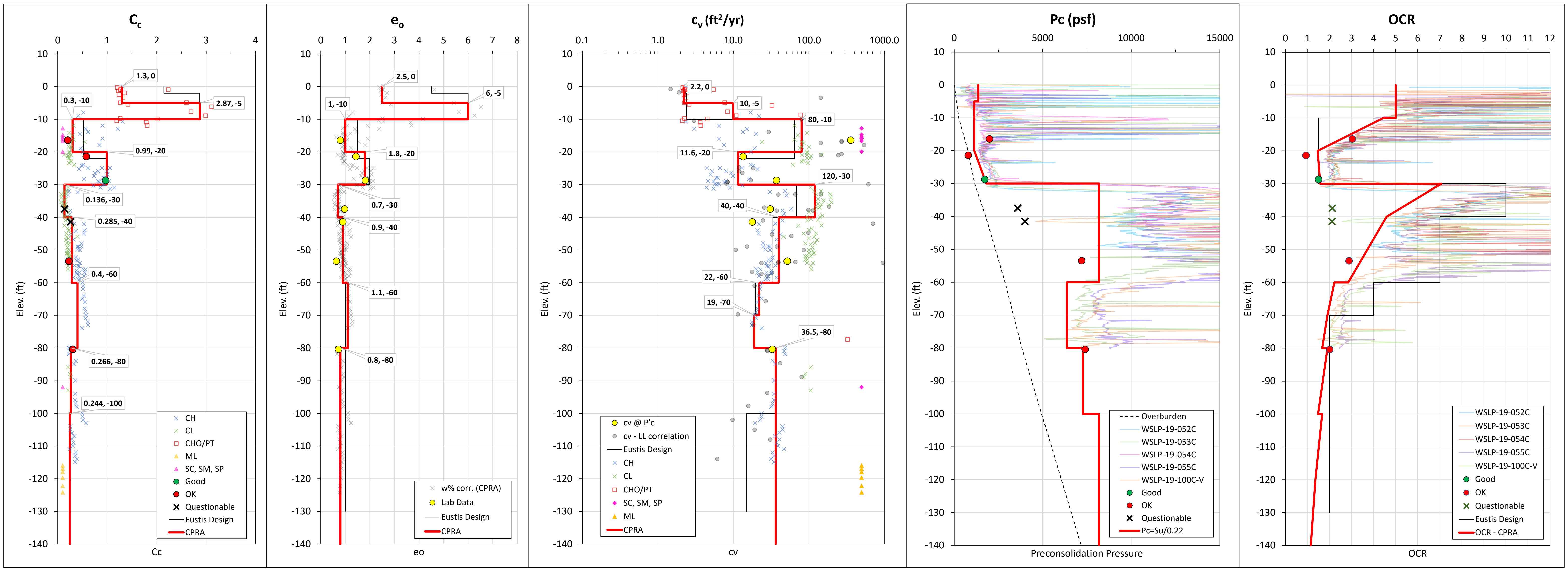


WSLP-106, Shear Strength
Su (psf)
Elevation (ft.)
250, -5
300, 0
250, -20
400, -30
1800, -30
1400, -60
1600, -80
1800, -100
57U - UU
58U - UU
59U - UU
60U - UU
WSLP-19-052C
WSLP-19-053C
WSLP-19-054C
WSLP-19-100C-V
WSLP-19-055C
CPRA Design Line
.18 c/p
.22 c/p
Eustis Design Line

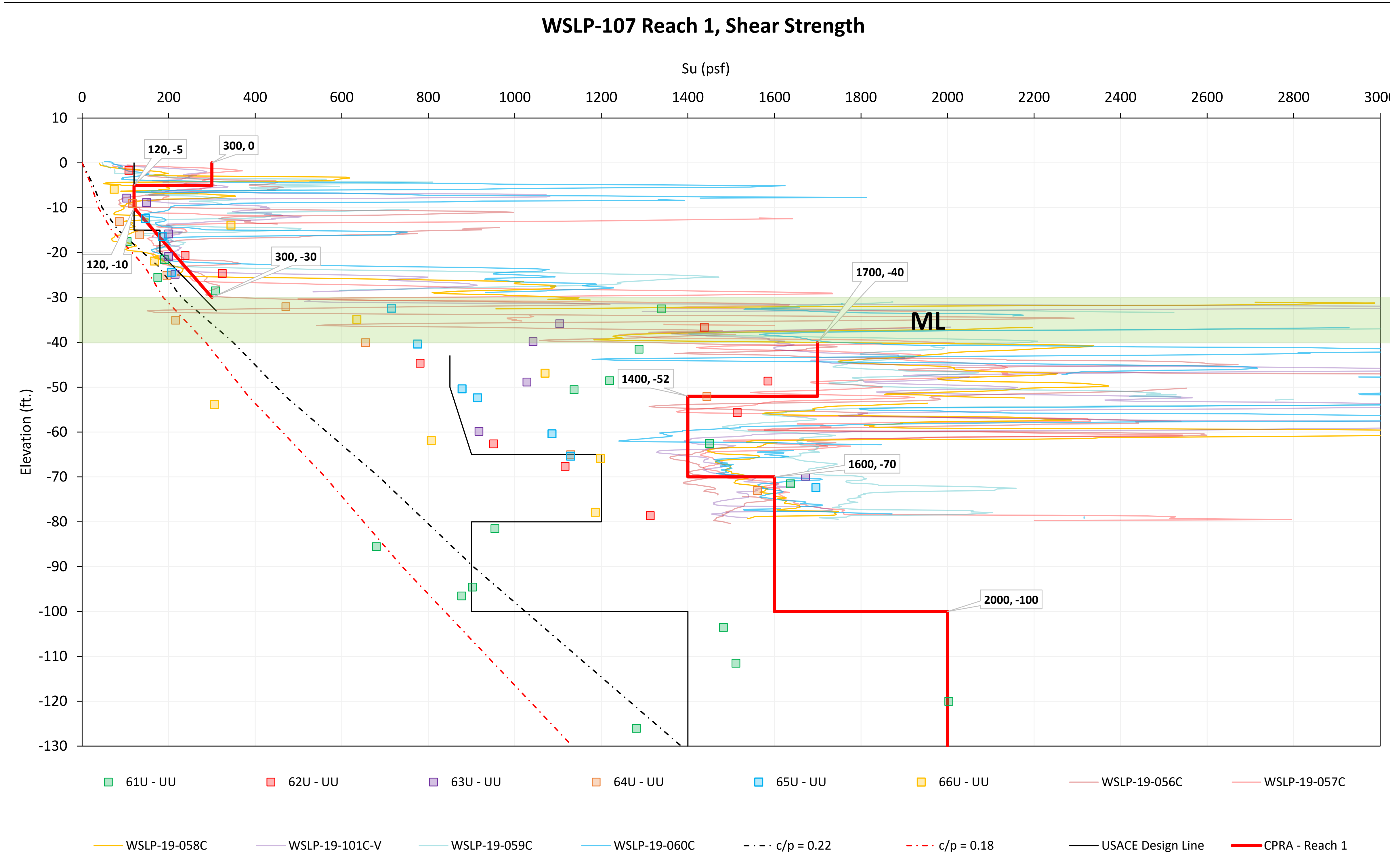


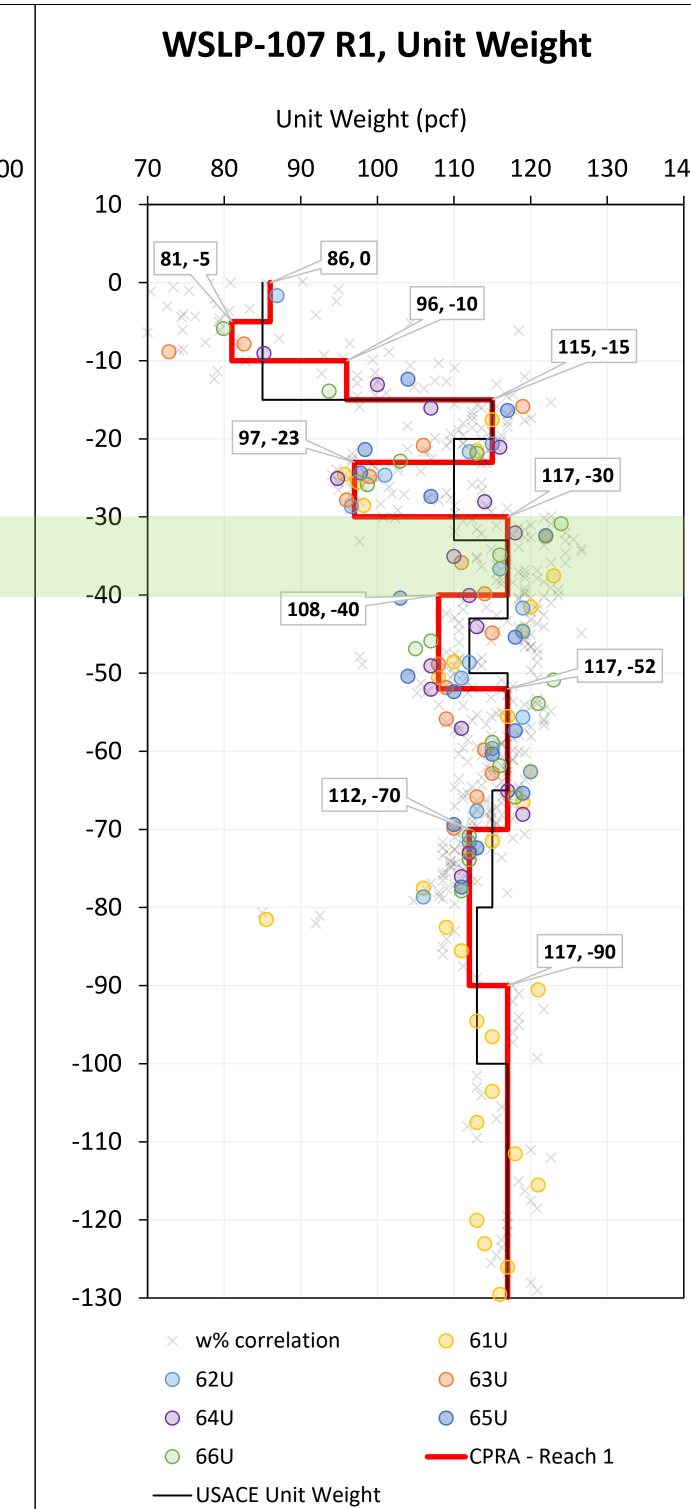
WSLP-106, Unit Weight
Unit Weight (pcf)
90, 0
86, -5
115, -10
100, -20
125, -30
117, -40
110, -60
118, -80
w% correlation
57U
58U
59U
60U
CPRA Design Line
Eustis Design Line

WSLP-106

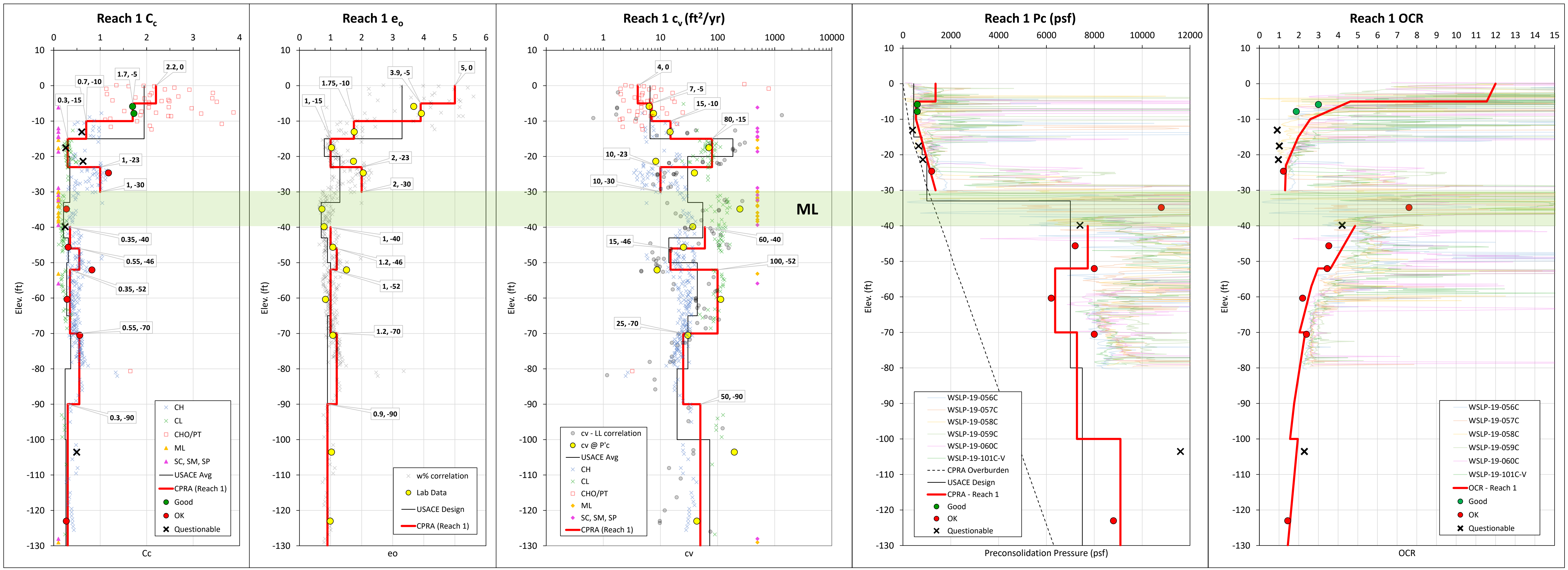


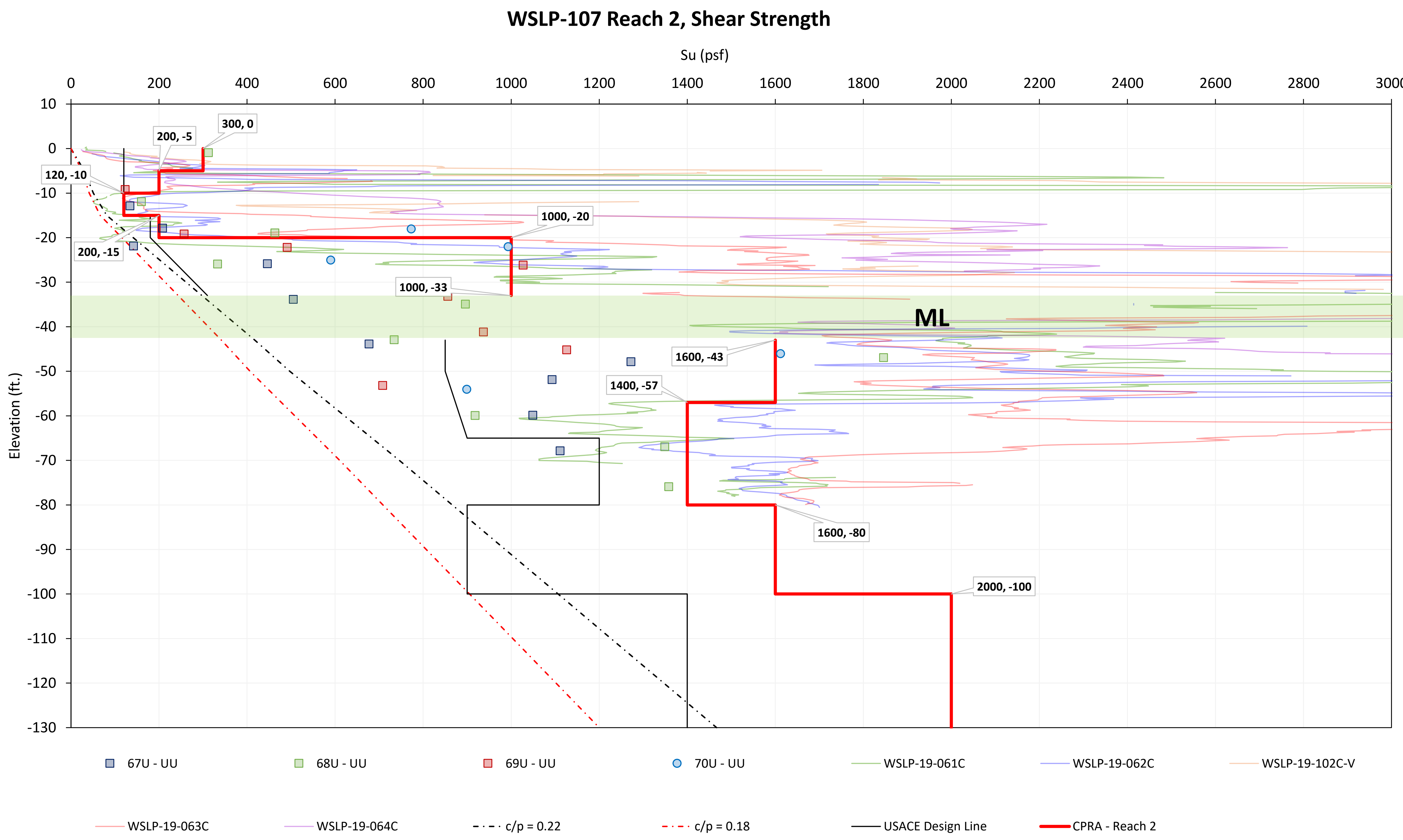
Cc
eo
cv (ft²/yr)
Pc (psf)
OCR
Elev. (ft)
Cc
eo
cv
Preconsolidation Pressure
OCR
CH
CL
CHO/PT
ML
SC, SM, SP
Good
OK
Questionable
Eustis Design
CPRA
w% corr. (CPRA)
Lab Data
cv @ P'c
cv - LL correlation
Overburden
WSLP-19-052C
WSLP-19-053C
WSLP-19-054C
WSLP-19-055C
WSLP-19-100C-V
Pc=Su/0.22
OCR - CPRA


WSLP-107 Reach 1, Shear Strength
Su (psf)
Elevation (ft.)
120, -5
300, 0
120, -10
300, -30
1700, -40
ML
1400, -52
1600, -70
2000, -100
61U - UU
62U - UU
63U - UU
64U - UU
65U - UU
66U - UU
WSLP-19-056C
WSLP-19-057C
WSLP-19-058C
WSLP-19-101C-V
WSLP-19-059C
WSLP-19-060C
c/p = 0.22
c/p = 0.18
USACE Design Line
CPRA - Reach 1

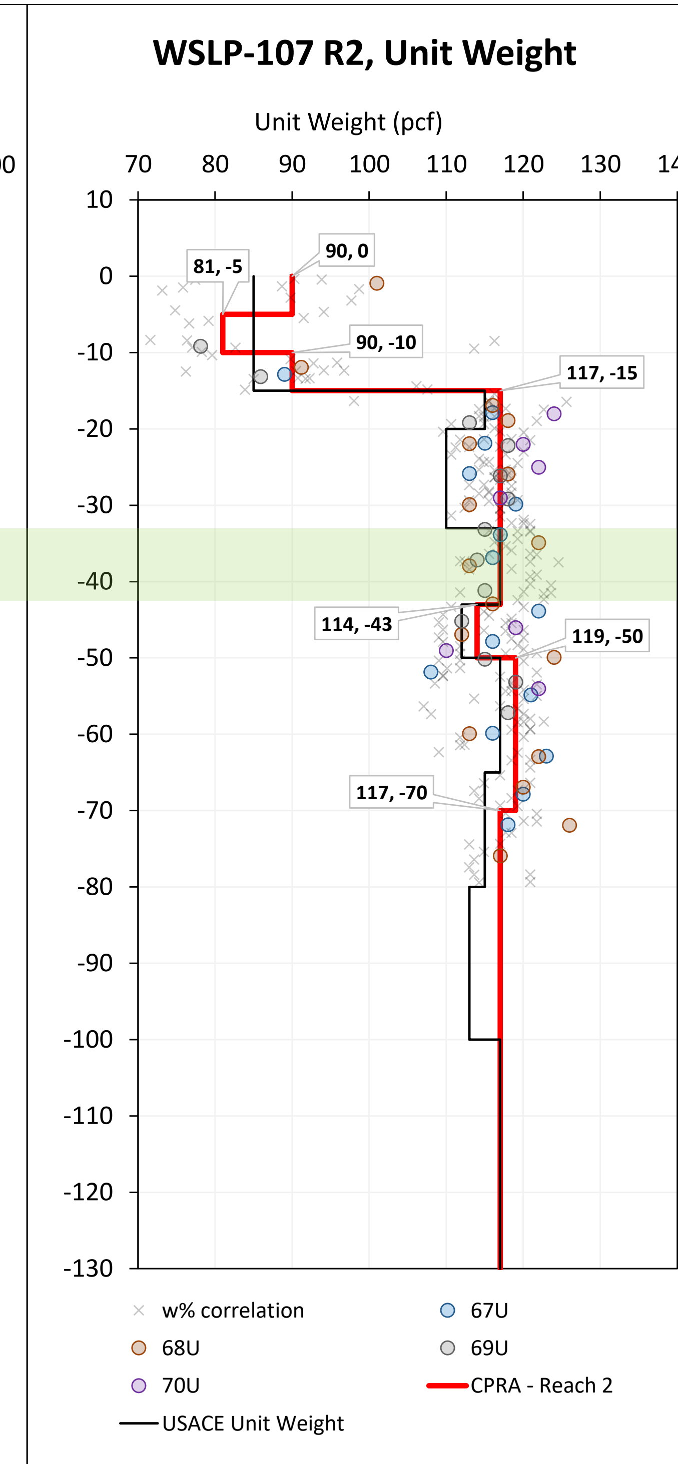

WSLP-107 R1, Unit Weight
Unit Weight (pcf)
81, -5
86, 0
96, -10
115, -15
97, -23
117, -30
108, -40
117, -52
112, -70
117, -90
w% correlation
61U
62U
63U
64U
65U
66U
CPRA - Reach 1
USACE Unit Weight

WSLP-107, Reach 1



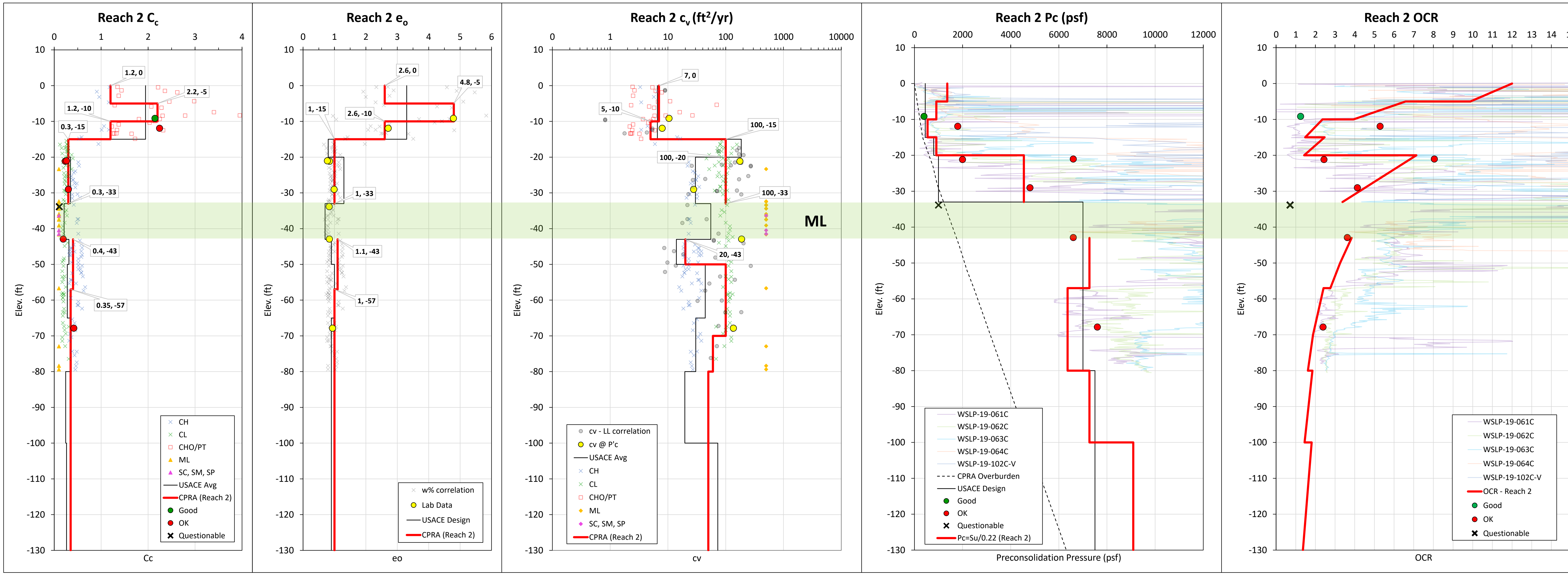


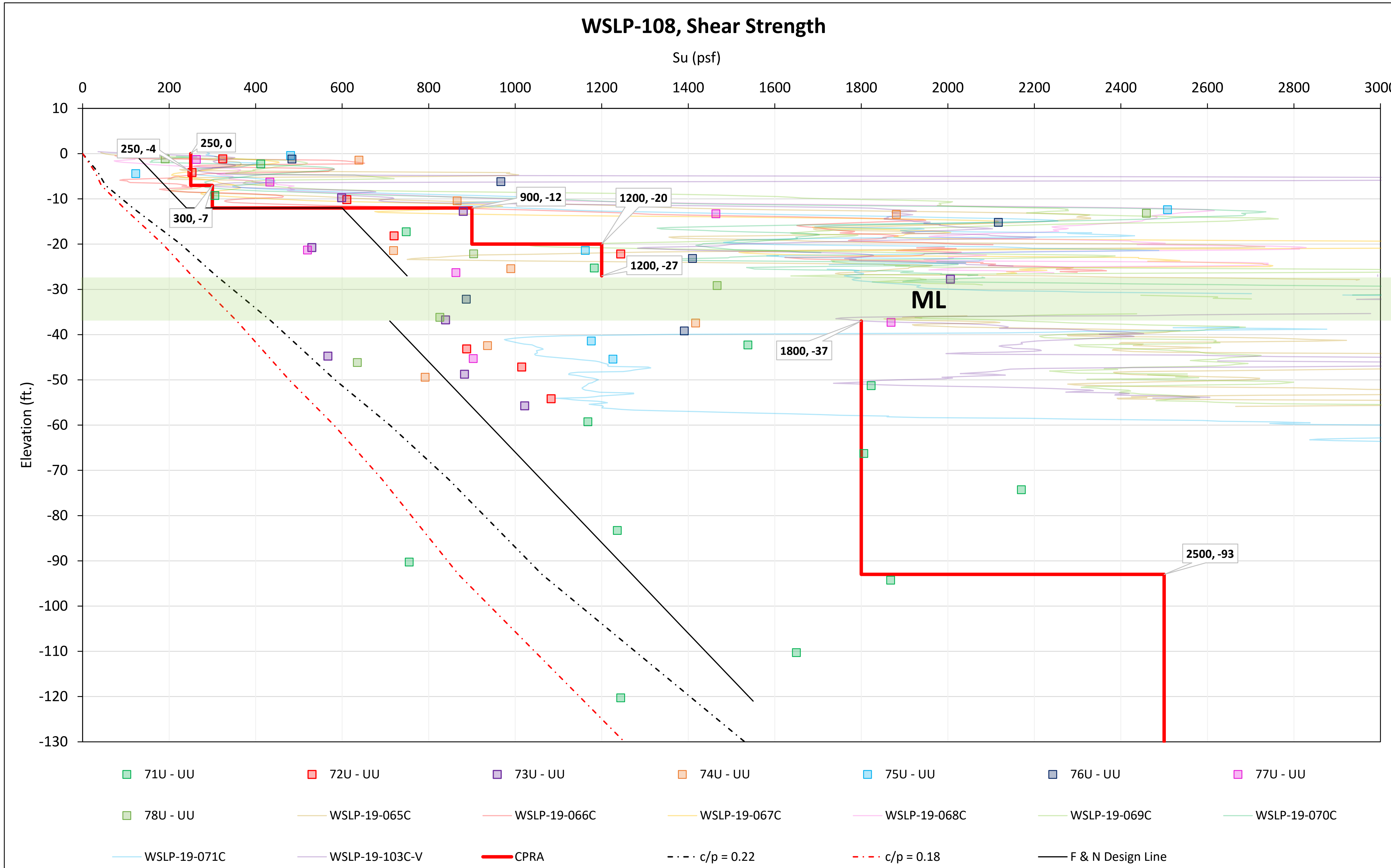
WSLP-107 Reach 2, Shear Strength
Su (psf)
Elevation (ft.)
ML
300, 0
200, -5
120, -10
200, -15
1000, -20
1000, -33
1600, -43
1400, -57
1600, -80
2000, -100
67U - UU
68U - UU
69U - UU
70U - UU
WSLP-19-061C
WSLP-19-062C
WSLP-19-102C-V
WSLP-19-063C
WSLP-19-064C
c/p = 0.22
c/p = 0.18
USACE Design Line
CPRA - Reach 2



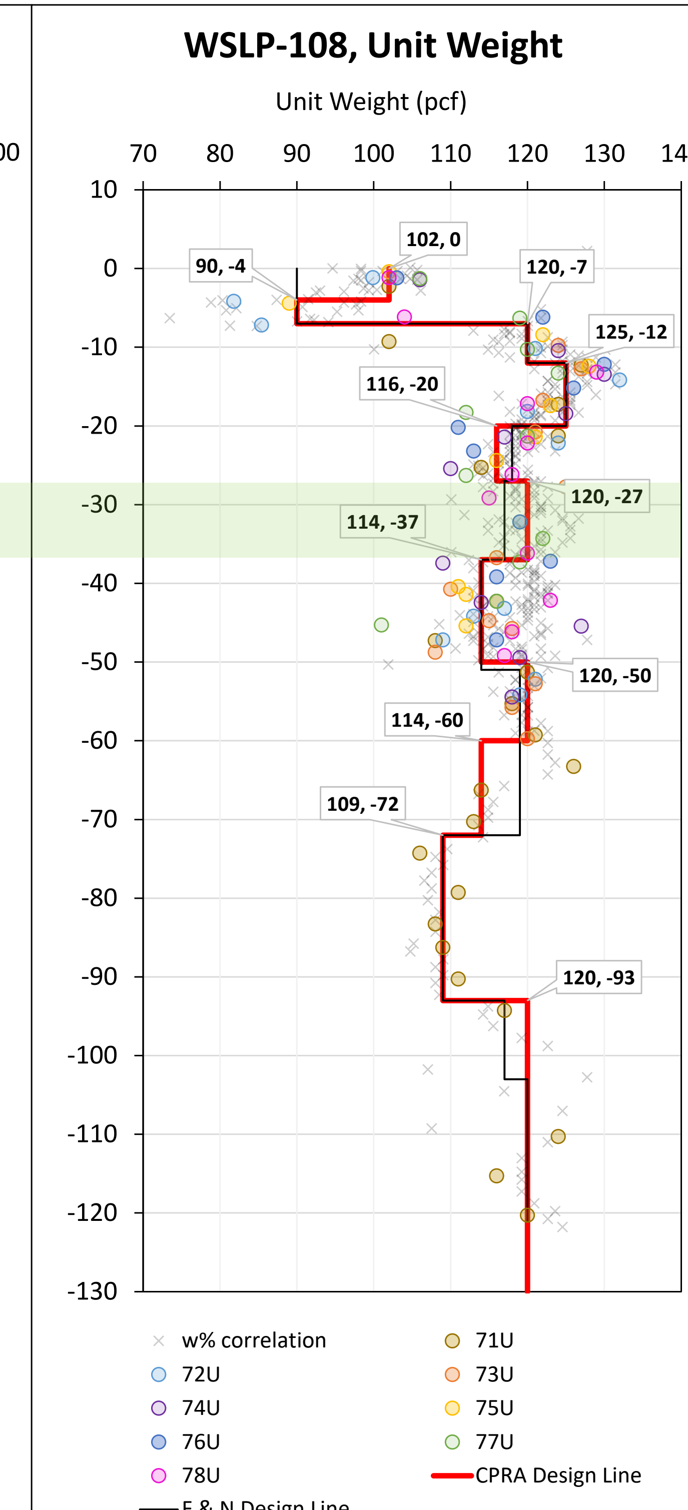
WSLP-107 R2, Unit Weight
Unit Weight (pcf)
90, 0
81, -5
90, -10
117, -15
114, -43
119, -50
117, -70
w% correlation
67U
68U
69U
70U
CPRA - Reach 2
USACE Unit Weight

WSLP-107, Reach 2



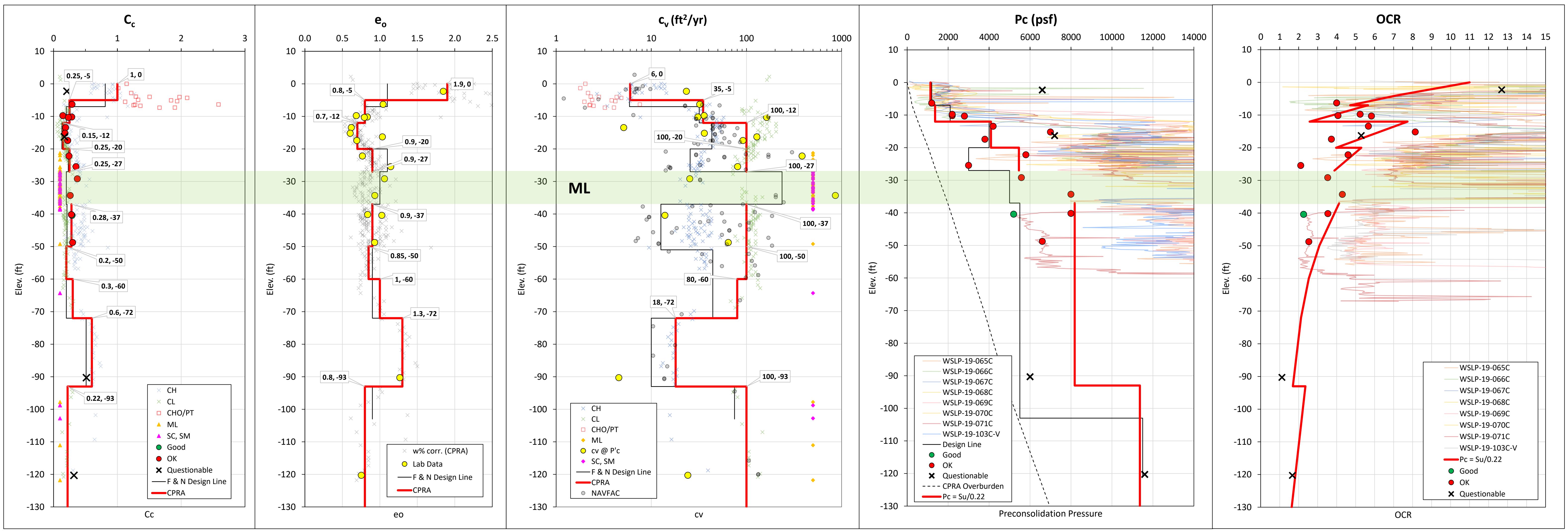


WSLP-108, Shear Strength
Su (psf)
Elevation (ft.)
250, -4
250, 0
300, -7
900, -12
1200, -20
1200, -27
1800, -37
2500, -93
ML
71U - UU
72U - UU
73U - UU
74U - UU
75U - UU
76U - UU
77U - UU
78U - UU
WSLP-19-065C
WSLP-19-066C
WSLP-19-067C
WSLP-19-068C
WSLP-19-069C
WSLP-19-070C
WSLP-19-071C
WSLP-19-103C-V
CPRA
c/p = 0.22
c/p = 0.18
F & N Design Line

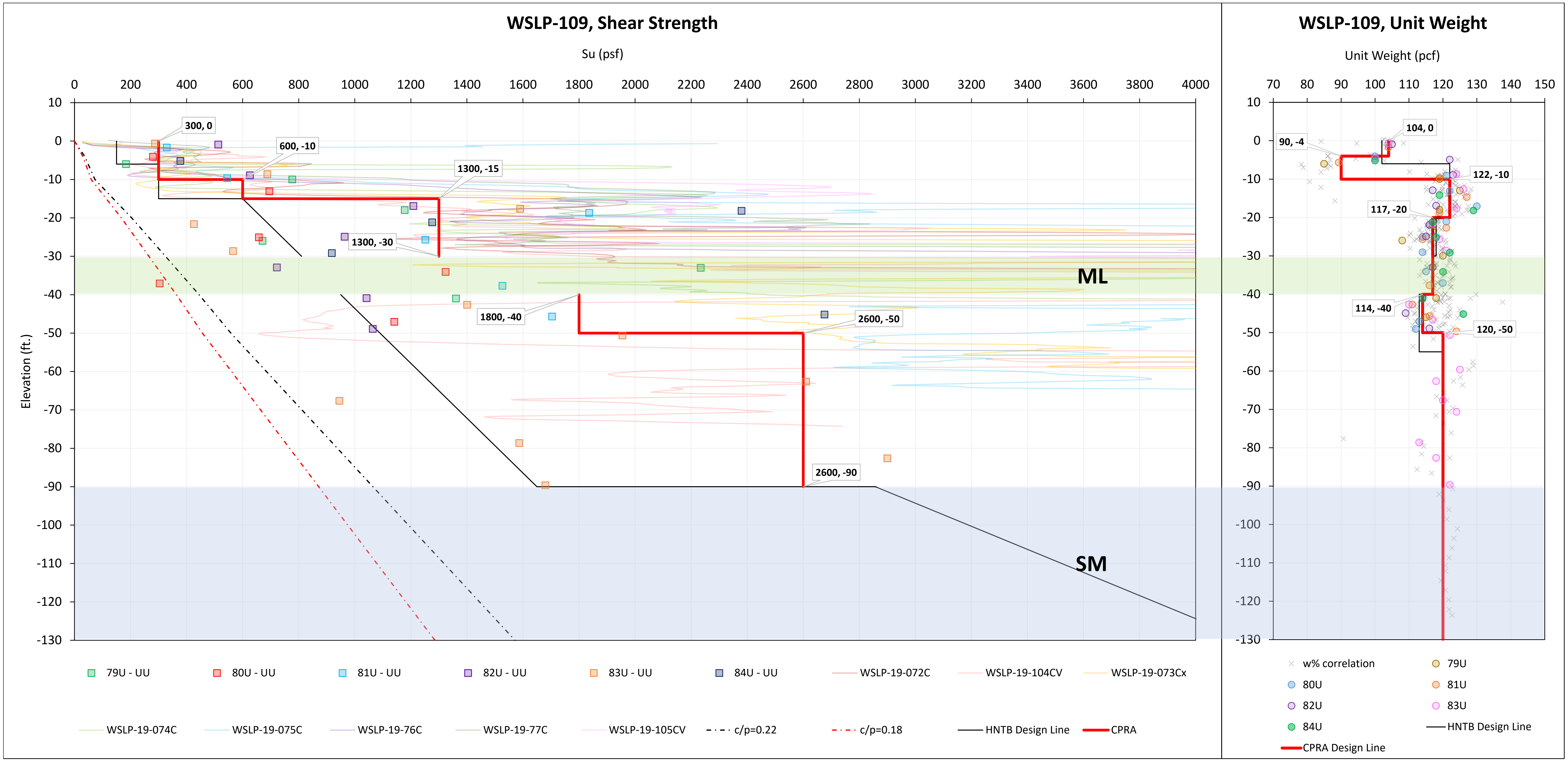


WSLP-108, Unit Weight
Unit Weight (pcf)
90, -4
102, 0
120, -7
125, -12
116, -20
120, -27
114, -37
120, -50
114, -60
109, -72
120, -93
w% correlation
71U
72U
73U
74U
75U
76U
77U
78U
CPRA Design Line
F & N Design Line

WSLP-108

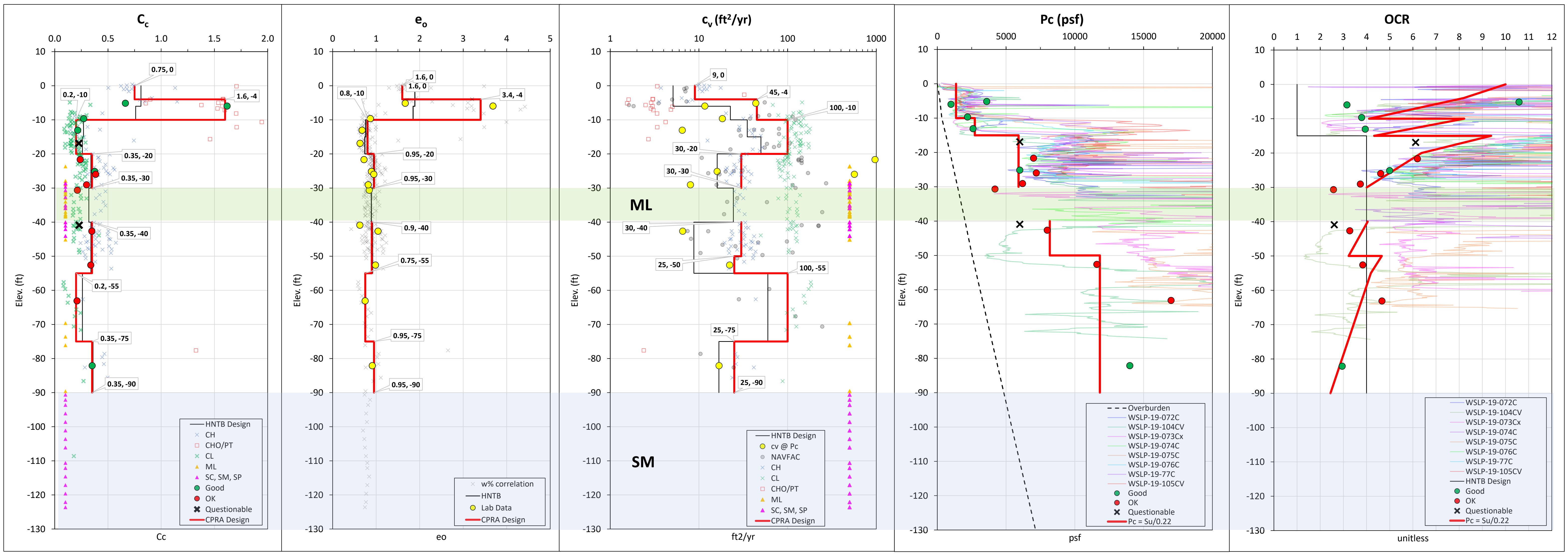


Cc
0
1
2
3
Elev. (ft)
0.25, -5
1, 0
0.15, -12
0.25, -20
0.25, -27
0.28, -37
0.2, -50
0.3, -60
0.6, -72
0.22, -93
CH
CL
CHO/PT
ML
SC, SM
Good
OK
Questionable
F & N Design Line
CPRA
Cc
eo
0.0
0.5
1.0
1.5
2.0
2.5
0.8, -5
1.9, 0
0.7, -12
0.9, -20
0.9, -27
0.9, -37
0.85, -50
1, -60
1.3, -72
0.8, -93
w% corr. (CPRA)
Lab Data
F & N Design Line
CPRA
eo
cv (ft²/yr)
1
10
100
1000
6, 0
35, -5
100, -12
100, -20
100, -27
ML
100, -37
100, -50
80, -60
18, -72
100, -93
CH
CL
CHO/PT
ML
cv @ P'c
SC, SM
F & N Design Line
CPRA
NAVFAC
cv
Pc (psf)
0
2000
4000
6000
8000
10000
12000
14000
WSLP-19-065C
WSLP-19-066C
WSLP-19-067C
WSLP-19-068C
WSLP-19-069C
WSLP-19-070C
WSLP-19-071C
WSLP-19-103C-V
Design Line
Good
OK
Questionable
CPRA Overburden
Pc = Su/0.22
Preconsolidation Pressure
OCR
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
WSLP-19-065C
WSLP-19-066C
WSLP-19-067C
WSLP-19-068C
WSLP-19-069C
WSLP-19-070C
WSLP-19-071C
WSLP-19-103C-V
Pc = Su/0.22
Good
OK
Questionable
OCR
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130

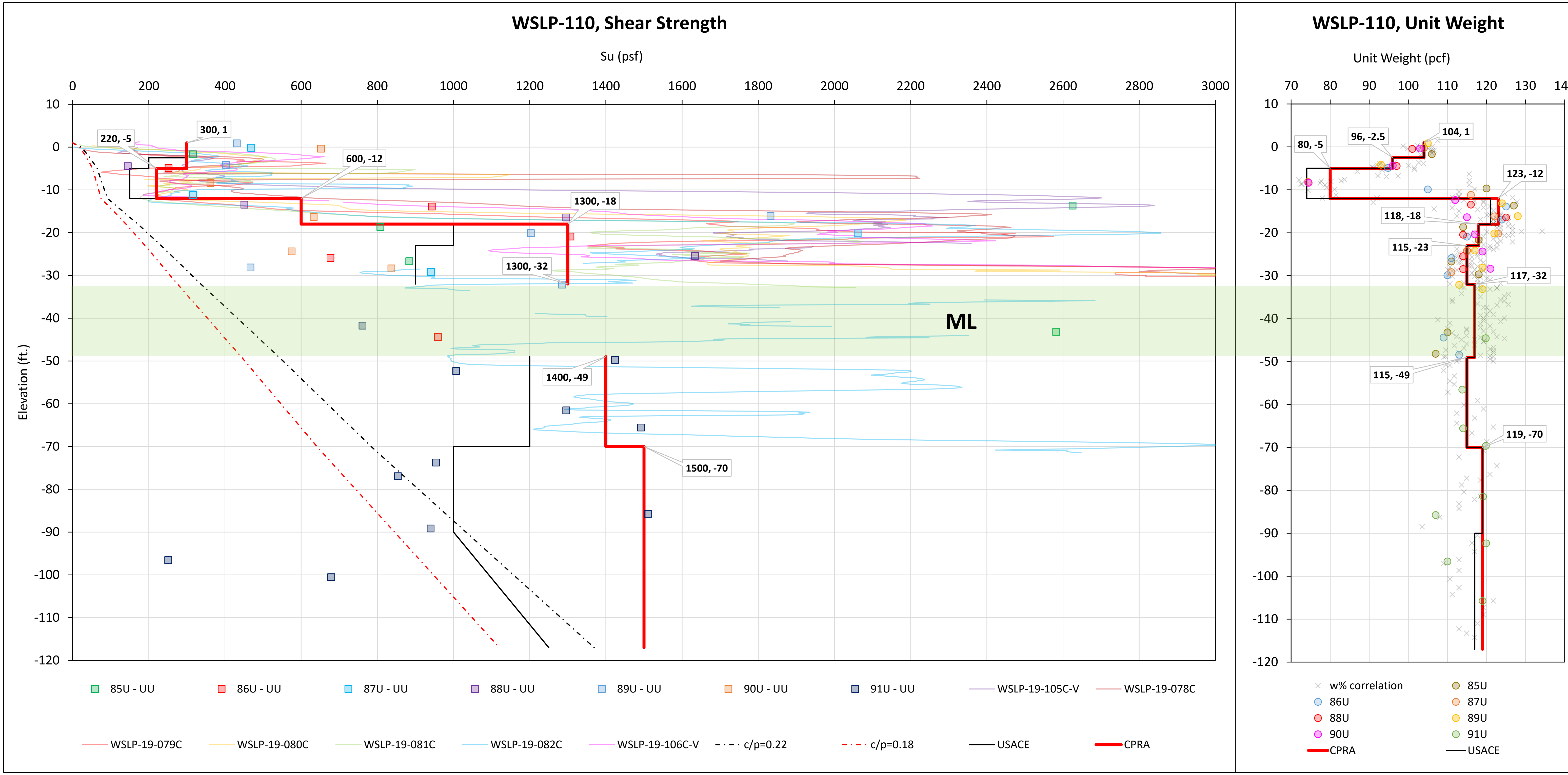


WSLP-109, Shear Strength
Su (psf)
Elevation (ft.)
300, 0
600, -10
1300, -15
1300, -30
1800, -40
2600, -50
2600, -90
ML
SM
79U - UU
80U - UU
81U - UU
82U - UU
83U - UU
84U - UU
WSLP-19-072C
WSLP-19-104CV
WSLP-19-073Cx
WSLP-19-074C
WSLP-19-075C
WSLP-19-76C
WSLP-19-77C
WSLP-19-105CV
c/p=0.22
c/p=0.18
HNTB Design Line
CPRA
WSLP-109, Unit Weight
Unit Weight (pcf)
104, 0
90, -4
122, -10
117, -20
114, -40
120, -50
w% correlation
79U
80U
81U
82U
83U
84U
HNTB Design Line
CPRA Design Line

WSLP-109

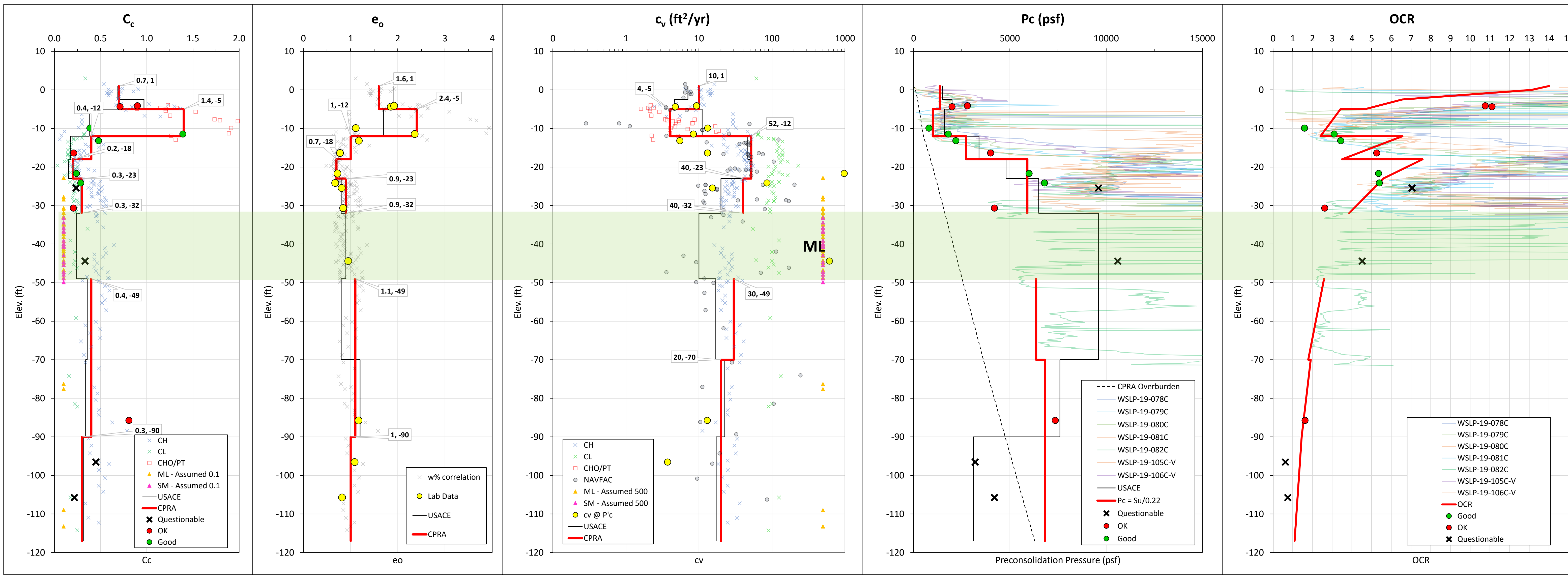


Cc
eo
cv (ft2/yr)
Pc (psf)
OCR
Elev. (ft)
ML
SM
HNTB Design
CH
CHO/PT
CL
ML
SC, SM, SP
Good
OK
Questionable
CPRA Design
w% correlation
HNTB
Lab Data
cv @ Pc
NAVFAC
Overburden
WSLP-19-072C
WSLP-19-104CV
WSLP-19-073Cx
WSLP-19-074C
WSLP-19-075C
WSLP-19-076C
WSLP-19-77C
WSLP-19-105CV
Pc = Su/0.22
ft2/yr
psf
unitless



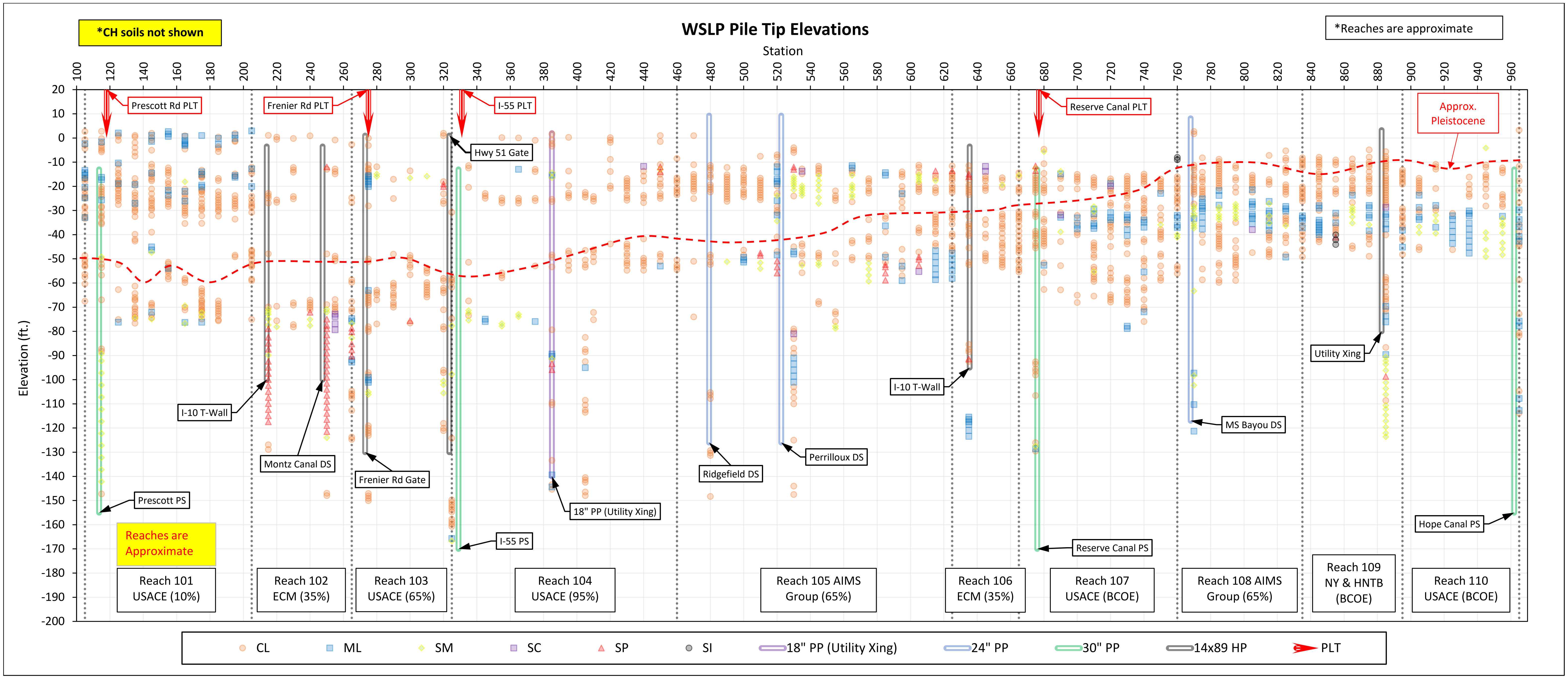
WSLP-110, Shear Strength
Su (psf)
Elevation (ft.)
220, -5
300, 1
600, -12
1300, -18
1300, -32
1400, -49
1500, -70
ML
85U - UU
86U - UU
87U - UU
88U - UU
89U - UU
90U - UU
91U - UU
WSLP-19-105C-V
WSLP-19-078C
WSLP-19-079C
WSLP-19-080C
WSLP-19-081C
WSLP-19-082C
WSLP-19-106C-V
c/p=0.22
c/p=0.18
USACE
CPRA
WSLP-110, Unit Weight
Unit Weight (pcf)
80, -5
96, -2.5
104, 1
123, -12
118, -18
115, -23
117, -32
115, -49
119, -70
w% correlation
85U
86U
87U
88U
89U
90U
91U
CPRA
USACE

WSLP-110



Cc
Elev. (ft)
0.7, 1
1.4, -5
0.4, -12
0.2, -18
0.3, -23
0.3, -32
0.4, -49
0.3, -90
CH
CL
CHO/PT
ML - Assumed 0.1
SM - Assumed 0.1
USACE
CPRA
Questionable
OK
Good
eo
1.6, 1
2.4, -5
1, -12
0.7, -18
0.9, -23
0.9, -32
1.1, -49
1, -90
w% correlation
Lab Data
USACE
CPRA
cv (ft2/yr)
cv
10, 1
4, -5
52, -12
40, -23
40, -32
30, -49
20, -70
ML
CH
CL
CHO/PT
NAVFAC
ML - Assumed 500
SM - Assumed 500
cv @ P'c
USACE
CPRA
Pc (psf)
Preconsolidation Pressure (psf)
CPRA Overburden
WSLP-19-078C
WSLP-19-079C
WSLP-19-080C
WSLP-19-081C
WSLP-19-082C
WSLP-19-105C-V
WSLP-19-106C-V
USACE
Pc = Su/0.22
Questionable
OK
Good
OCR
WSLP-19-078C
WSLP-19-079C
WSLP-19-080C
WSLP-19-081C
WSLP-19-082C
WSLP-19-105C-V
WSLP-19-106C-V
OCR
Good
OK
Questionable

Appendix E: WSLP Pile Foundations



*CH soils not shown
WSLP Pile Tip Elevations
*Reaches are approximate
Station
Elevation (ft.)
Prescott Rd PLT
Frenier Rd PLT
I-55 PLT
Reserve Canal PLT
Approx. Pleistocene
Hwy 51 Gate
I-10 T-Wall
Montz Canal DS
Frenier Rd Gate
Prescott PS
18" PP (Utility Xing)
I-55 PS
Ridgefield DS
Perrilloux DS
I-10 T-Wall
MS Bayou DS
Utility Xing
Reserve Canal PS
Hope Canal PS
Reaches are Approximate
Reach 101 USACE (10%)
Reach 102 ECM (35%)
Reach 103 USACE (65%)
Reach 104 USACE (95%)
Reach 105 AIMS Group (65%)
Reach 106 ECM (35%)
Reach 107 USACE (BCOE)
Reach 108 AIMS Group (65%)
Reach 109 NY & HNTB (BCOE)
Reach 110 USACE (BCOE)
CL
ML
SM
SC
SP
SI
18" PP (Utility Xing)
24" PP
30" PP
14x89 HP
PLT

Strength and Compressibility Correlations for New Orleans Area Soils

Report submitted to the

New Orleans District

U. S. Army Corps of Engineers

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Virginia Tech

Blacksburg, Virginia

September 4, 2011

Reference b

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Introduction

In 2005, Hurricane Katrina made landfall in Louisiana and inundated parts of the city of New Orleans. In the aftermath of Hurricane Katrina, the United States Army Corps of Engineers (USACE) began an unprecedented subsurface exploration and testing program as part of a reconstruction and upgrading of the hurricane protection system. This effort has taxed the capacity of area geotechnical testing firms, as well as testing firms outside of the New Orleans area. Using the data collected from the reconstruction effort, along with the pre-Katrina data available in the soils reports for projects in the New Orleans area, correlations for compressibility and strength for area soils has been investigated.

The laboratory testing program included Unconsolidated-Undrained (UU or Q) triaxial compression tests, Consolidated-Undrained (CU or R) triaxial compression tests, Consolidated-Drained Direct Shear (DS) tests, Consolidated-Undrained Direct Simple Shear (DSS) tests, and consolidation tests.

Owing to the large numbers of UU triaxial and consolidation tests, a database was created using a subset of the test results by analysis of seven different task orders. The task orders used in this study were Lake Cataouatche/Westwego to Harvey Canal (TO 02), Jefferson Lakefront (TO 03), Algiers Canal (TO 04), St. Charles Parish (TO 09 and TO 17), Inner Harbor Navigational Canal (TO 41), New Orleans to Venice (TO 55), and LPV145/146 (TO 63). For the direct simple shear tests, the CU triaxial tests, the direct simple shear tests, and the direct shear tests; all test reports that were available, both pre-Katrina and post-Katrina, were assessed.

A major effort was placed on individually assessing each test report so that test results only of the highest quality were considered in the development of the correlations. The individual test reports were ranked on a scale of one to five, with five being the highest quality possible. The ranking system was a semi-quantitative procedure that addressed sample disturbance, equipment errors, errors in conducting the test, data reduction errors, etc.

The correlations developed for the New Orleans area soils were primarily focused on strength and compressibility parameters based on the soil index parameters. The strength correlations involved both drained and undrained strength parameters. The UU triaxial, CU triaxial, and DSS tests provided undrained strength parameters. Drained strength parameters were provided by DS tests and CU triaxial tests. The consolidation tests provided the majority of the compressibility parameters, while the UU triaxial tests provided some additional information regarding soil modulus.

Table 1 shows the test type along with the number of tests conducted where data was readily available and the number of tests examined and evaluated for this report.

Table 1 Summary of tests performed and ranked.

Test Type	No. of Test Series Performed	No. of Test Series Evaluated
UU Triaxial	26,105	3,232
CU Triaxial	191	120
CU DSS	273	273
CD DS	387	387
Consolidation	3550	406

Calculation of Vertical Effective Stress

Knowledge of the vertical effective stress (σ_v') at the location of each of the laboratory test specimens was very important in the assessment of the test results. The vertical effective stress was needed to determine if the correct consolidation stresses were applied in the case of CU triaxial, DS, and DSS tests; and for calculating undrained strength ratio values.

Due to the large volume of test results analyzed, determining the stress required a considerable effort. A sequence of calculations was used to estimate the in situ σ_v' based on standard input parameters obtained from the boring logs.

The depth of the static water table was determined by examination of the individual boring logs. Above the water table, the pore pressure was assumed to be zero. The format of the New Orleans District boring logs contains a sheet entitled "Summary of Laboratory Test Results." This sheet contains a listing of the soil water content vs. depth at roughly 1 foot increments. The summary also includes calculated values of degree of saturation when laboratory tests were conducted on individual test specimens. The water contents reported on this sheet were used for the determination of the unit weight.

The unit weights of the soil layers were calculated using the following equation with consideration also being given to measured unit weights for the test specimens:

$$\gamma = \frac{\gamma_w (e + G_s)}{1 + e} = \frac{\gamma_w \left(\frac{G_s w}{S} + G_s \right)}{1 + \frac{G_s w}{S}}$$

where: e = void ratio

G_s = specific gravity of soil solids

w = water content

S = degree of saturation

The water contents (w) were obtained from the boring logs and the summary sheets. The value of specific gravity (G_s) was assumed based on the water content. If the water content was greater than 200%, the soil was likely highly organic (PT), and G_s = 2.55 was used. If w was between 100% and 200%, G_s = 2.6 was used. If w was less than 100%, G_s = 2.65 was used. The degree of saturation (S%) was assumed to be 90% above the water table and 100% below the water table.

The correlations examined in this report are separated into strength correlations and compressibility correlations. The strength correlations are further subdivided into undrained strength parameters and drained strength parameters. Within each section, each lab test is briefly described along with the individual ranking criteria.

Strength Correlations

The strength tests were assessed for both drained and undrained strength parameters. Undrained strength parameters are important for the soils in the New Orleans area because most of the soils were classified as high plasticity clays (CH), organic clays (CHO), and peats (PT). Considering that the majority of these materials are normally consolidated to slightly over-consolidated, the undrained shear strength of these materials is often used in design.

The undrained strength parameters included in this report are the undrained shear strength (s_u) and the undrained strength ratio (USR), defined as s_u/σ_v'. The effective stress or drained friction angle (ϕ') was the main drained strength parameter analyzed in this study.

UU Triaxial Compression Tests

The Unconsolidated Undrained (UU) triaxial compression test has historically been the most common test to measure the undrained shear strength of soil in New Orleans District practice. In the past, this test was normally conducted following the procedures given in Appendix X of EM 1110-2-1906. More recently, the test has been conducted in accordance with ASTM D2850.

Over 26,000 UU triaxial compression test series have been conducted since Hurricane Katrina. Of these, a subset of 3,232 tests has been reviewed to obtain correlations for s_u and initial tangent modulus (E_i) values. Although E_i is a measure of soil compressibility, it normally has been considered proportional to the undrained shear strength, thus it is included in the strength assessment section of this report. Approximately 500 UU test results were assessed for each of the seven task orders analyzed. In TO 09, only 269 UU tests were conducted, and all tests were assessed.

Each UU triaxial compression test report was examined individually and assigned a rank from 1 to 5, with 5 denoting the highest quality test. The ranking system consists of both quantitative and qualitative criteria. For a ranking of 5 (best), the following criteria must be generally satisfied:

- Peak deviator stress ($\sigma_{d,peak}$) achieved at an axial strain (ε_a) less than or equal to about 5%.
- Mohr's circles must have approximately equal diameters.
- The water content (w_n) and initial void ratio (e_o) of all three test specimens must be within about ±5% of each other.
- The degree of saturation should be greater than or equal to 95%.
- The stress-strain curves should generally have a smooth appearance.
- The value of initial tangent modulus should be approximately equal between all test specimens.

If 1 or 2 requirements listed above were not satisfied, a rank of 4 was assigned. If 2 or 3 requirements were not satisfied, a rank of 3 was assigned. If 3 to 4 requirements were not satisfied, a rank of 2 was assigned. For a test to receive a ranking of 1 (worst), four or more of the criteria listed above were not satisfied. Table 2 shows the ranking of all tests assessed to date. In cases where the test was at the borderline between two ranks, a qualitative judgment was made.

Table 2 Summary of UU triaxial test series results by ranking.

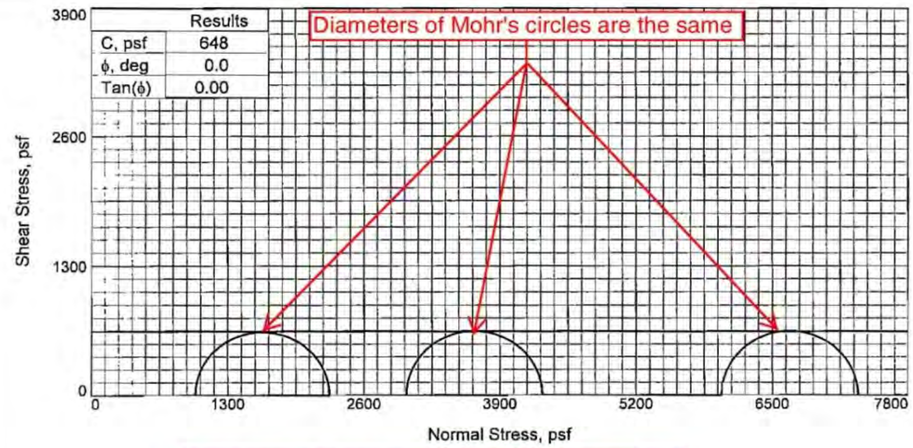
Ranking	Number of UU Triaxial test series
1	14
2	658
3	1414
4	915
5	241

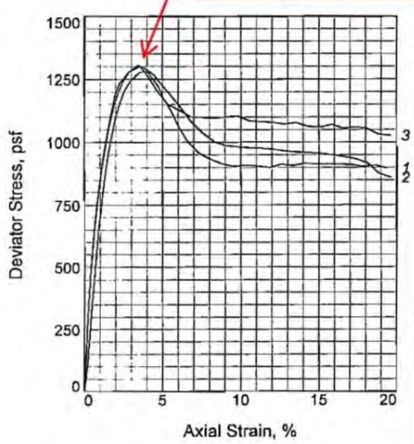
In order to demonstrate the differences between the relative ranks, Figure 1, Figure 2, and Figure 3 are provided to show rankings of 5, 3, and 1, respectively. The figures are annotated to indicate the pertinent features that controlled the ranking.

Table 3 shows the number of tests of each ranking categorized by material type. Few tests had the lowest rating (1), and the majority of the tests were ranked 3. There seemed to be no well-defined trend of test quality vs. soil type, although proportionally fewer CL soils were given the top ranking of 5.

Table 3 Number of test series for each ranking categorized by material type.

Ranking	CH	CHO	CL	PT
1	1 (0.1%)	1 (0.5%)	12 (1.9%)	0 (0%)
2	321(14.7%)	41 (19.1%)	250 (38.8%)	36 (20.0%)
3	934(42.7%)	87 (40.5%)	313 (48.6%)	80 (43.8%)
4	735 (33.6%)	68 (31.6%)	62 (9.6%)	50 (26.7%)
5	195(8.9%)	18 (8.4%)	7 (1.1%)	21 (11.2%)





	Sample No.	1	2	3
Initial	Water Content, %	62.2	63.0	62.2
	Dry Density, pcf	63.2	62.8	63.0
	Saturation, %	99.9	100.1	99.3
	Void Ratio	1.7067	1.7252	1.7165
	Diameter, in.	1.390	1.392	1.392
	Height, in.	3.117	3.118	3.121
At Test	Water Content, %	62.2	63.0	62.2
	Dry Density, pcf	63.2	62.8	63.0
	Saturation, %	99.9	100.1	99.3
	Void Ratio	1.7067	1.7252	1.7165
	Diameter, in.	1.390	1.392	1.392
	Height, in.	3.117	3.118	3.121
	Strain rate, %/min.	1.00	1.00	1.00
	Back Pressure, psi	0.00	0.00	0.00
	Cell Pressure, psi	6.88	20.88	41.77
	Fail. Stress, psf	1280	1300	1305
	Strain, %	3.9	3.5	3.5
	Ult. Stress, psf	904	954	1095
	Strain, %			
	σ_1 Failure, psf	2270	4307	7320
	σ_3 Failure, psf	990	3006	6015

Type of Test:
Unconsolidated Undrained
Sample Type: UNDISTRUBED
Description: M GR CH4 W/ LNS ML

LL= 93 **PL=** 24 **PI=** 69
Assumed Specific Gravity= 2.74
Remarks:

Figure _______

Client: U.S. Army Corps of Engineers

Project: USACE - NOV 1, 2, 5, 9 & 10
Plaquemines, La.
Source of Sample: NOV-09-7FU **Depth:** 37.7
Sample Number: 11C
Proj. No.: 0022-0055 **Date Sampled:** 8/26/2008

TRIAXIAL SHEAR TEST REPORT
FFEBJV, LLC

Tested By: VF/AW **Checked By:** TB

Figure 1 Example of UU triaxial test with "5" ranking.

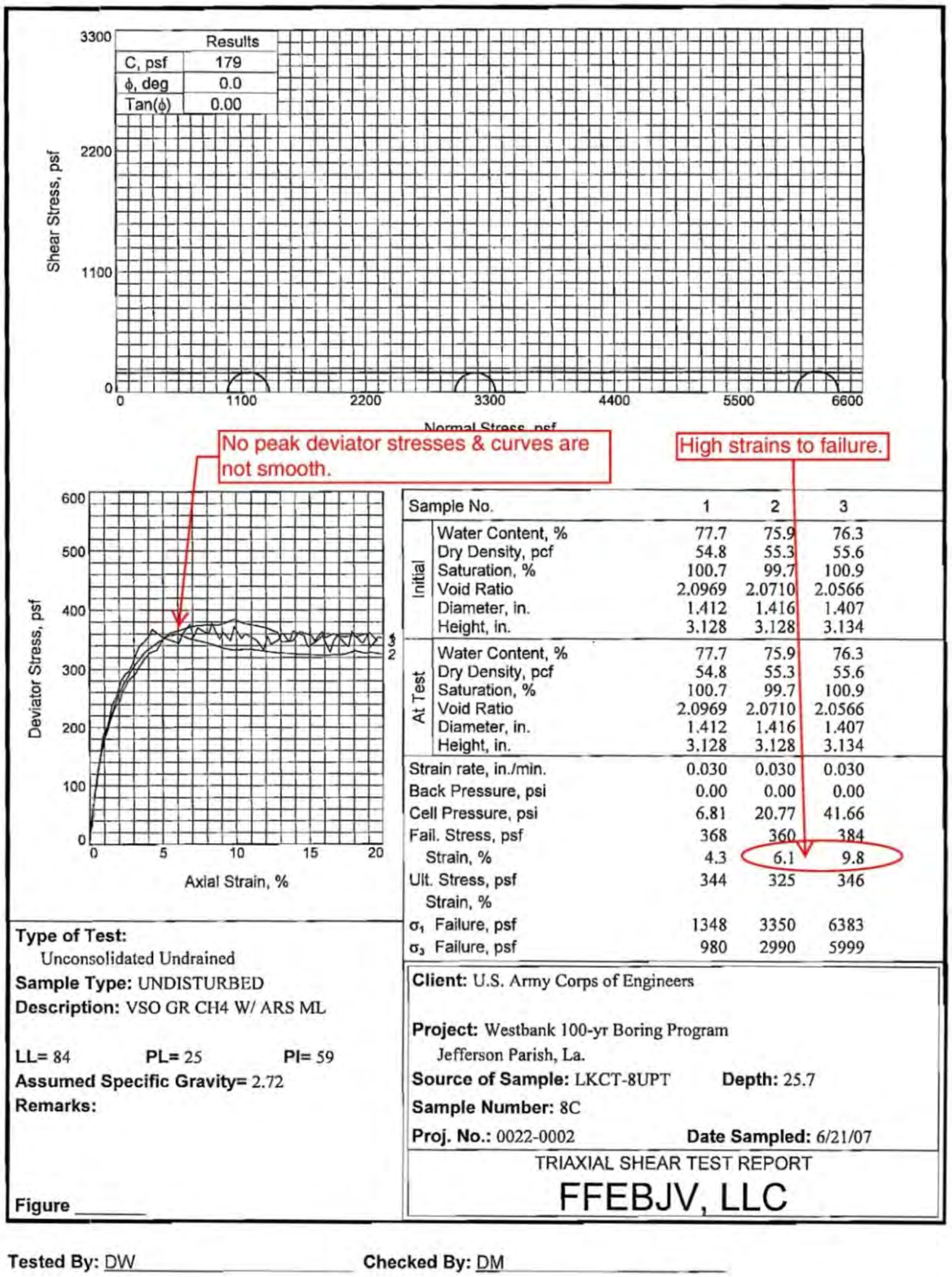
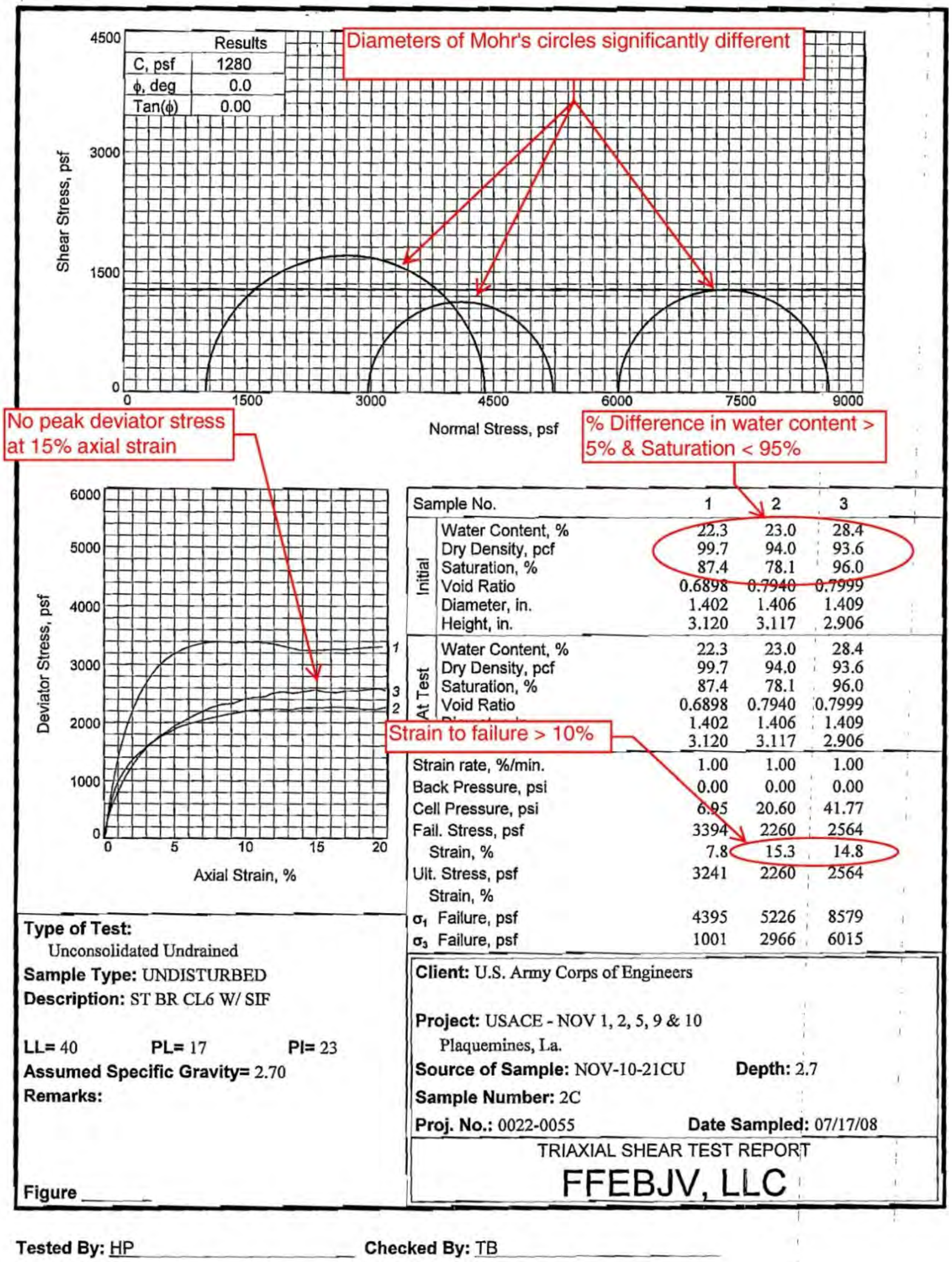


Figure 2   Example of UU triaxial test with “3” ranking.



Sample No.		1	2	3
Initial	Water Content, %	22.3	23.0	28.4
	Dry Density, pcf	99.7	94.0	93.6
	Saturation, %	87.4	78.1	96.0
	Void Ratio	0.6898	0.7940	0.7999
	Diameter, in.	1.402	1.406	1.409
	Height, in.	3.120	3.117	2.906
At Test	Water Content, %	22.3	23.0	28.4
	Dry Density, pcf	99.7	94.0	93.6
	Saturation, %	87.4	78.1	96.0
	Void Ratio	0.6898	0.7940	0.7999
	Diameter, in.	1.402	1.406	1.409
	Height, in.	3.120	3.117	2.906
Strain rate, %/min.		1.00	1.00	1.00
Back Pressure, psi		0.00	0.00	0.00
Cell Pressure, psi		6.95	20.60	41.77
Fail. Stress, psf		3394	2260	2564
Strain, %		7.8	15.3	14.8
Ult. Stress, psf		3241	2260	2564
Strain, %				
σ_1 Failure, psf		4395	5226	8579
σ_3 Failure, psf		1001	2966	6015

Type of Test:
Unconsolidated Undrained
Sample Type: UNDISTURBED
Description: ST BR CL6 W/ SIF

LL= 40 **PL=** 17 **PI=** 23
Assumed Specific Gravity= 2.70
Remarks:

Figure ____

Client: U.S. Army Corps of Engineers

Project: USACE - NOV 1, 2, 5, 9 & 10
Plaquemines, La.
Source of Sample: NOV-10-21CU **Depth:** 2.7
Sample Number: 2C
Proj. No.: 0022-0055 **Date Sampled:** 07/17/08

TRIAXIAL SHEAR TEST REPORT
FFEBJV, LLC

Tested By: HP **Checked By:** TB

Figure 3 Example of UU triaxial test with "1" ranking.

Undrained Strength Ratio

The undrained strength ratio, or USR, is defined as the undrained shear strength divided by the vertical effective stress. A considerable effort was expended in estimating the in situ vertical effective stress to increase the accuracy of calculating this ratio. Whenever possible, the original boring logs and field boring reports were examined along with the laboratory test reports.

Figure 4 shows the measured undrained strength plotted versus the vertical effective stress for soils that classified as CL, CH, CHO, or PT by the New Orleans District classification system. Only soils that ranked 4 or 5 were included in this plot. For this plot, it was assumed that all soils were normally consolidated in situ, and a linear relationship could be used to define the undrained strength ratio. Figure 4 shows that there is a general trend of increasing USR, which is the slope of the best-fit linear trend line, with increasing plasticity and with increasing organic content.

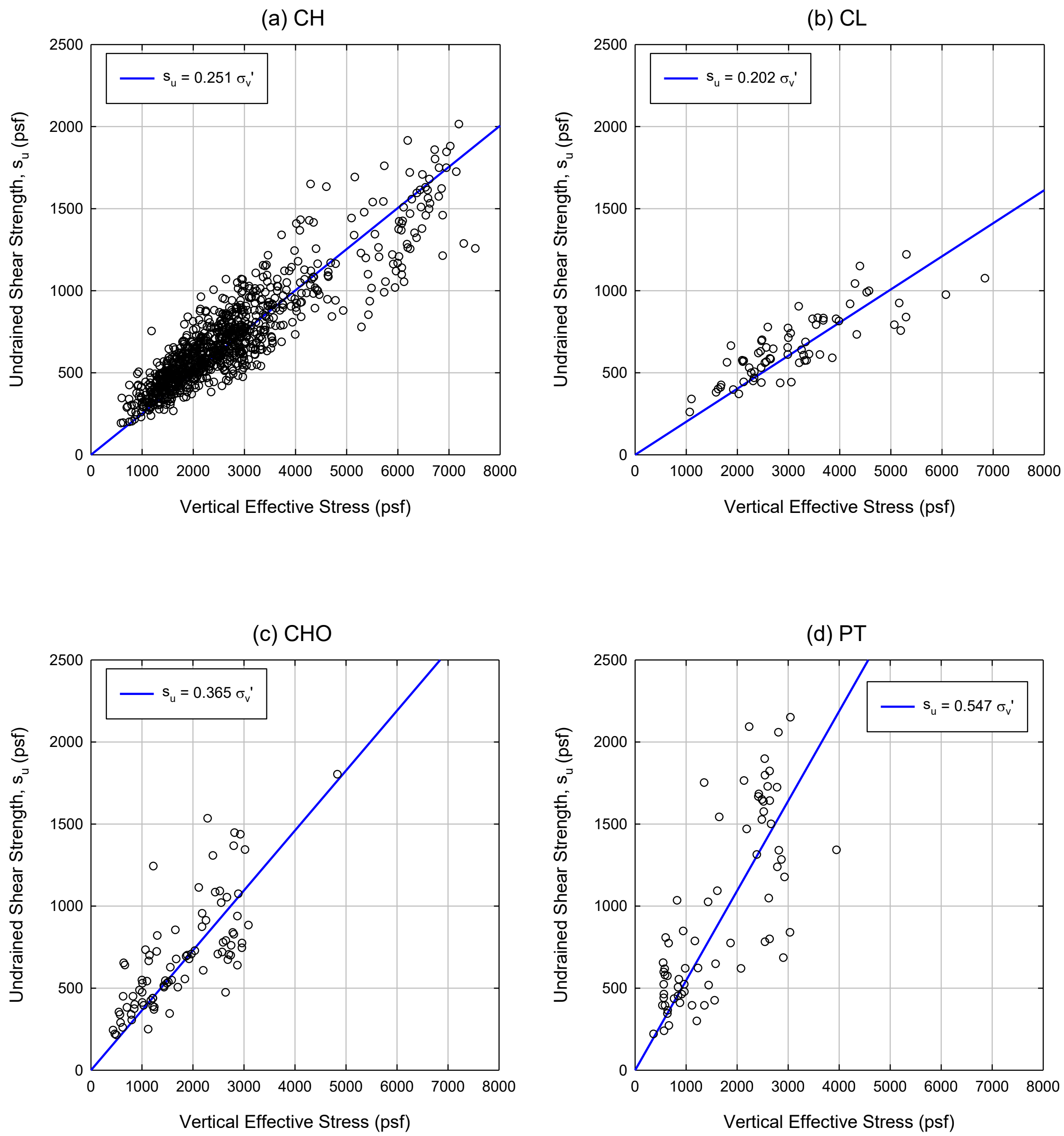


Figure 4 Plot of undrained shear strength versus vertical effective stress for CL, CH, CHO, and PT soils.

Skempton (1957) proposed a correlation between plasticity index and the USR based on a combination of field vane shear tests and unconfined compression test data, and this relationship is shown in Figure 5. It was recognized by Bjerrum (1972) that the undrained shear strength determined from the field vane shear test needs to be corrected due to anisotropy and strain rate effects when it is used for slope stability and bearing capacity analysis. The shear strength determined with the vane shear test in the field is reduced by a correction factor (α or μ), with the correction factor being a function of the plasticity index value of the soil. As the plasticity index increases, the value of the correction factor decreases. Skempton's correlation evidently does not include such a correction, since he proposed it 15 years prior to the introduction of Bjerrum's correction factor.

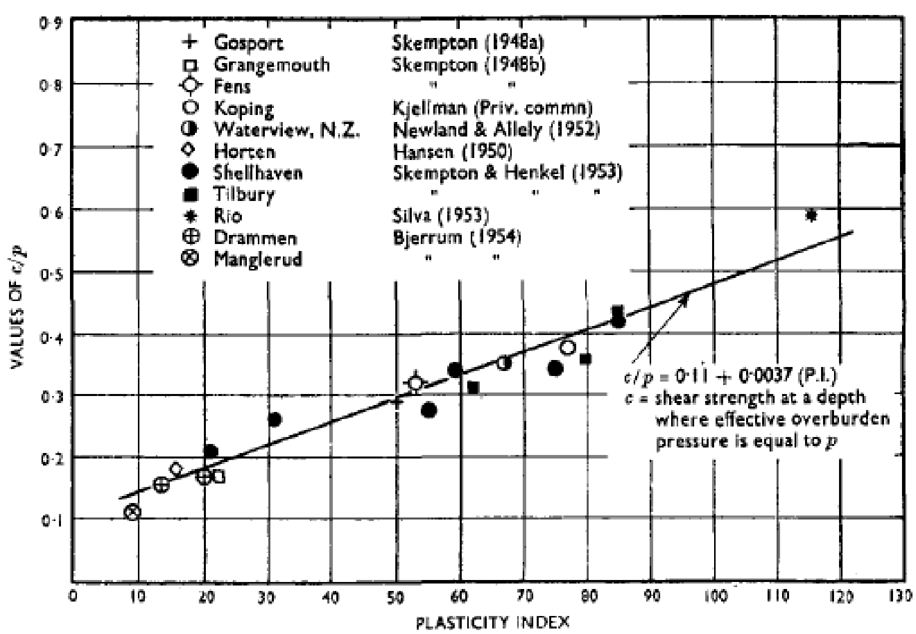


Figure 5 Skempton's correlation between USR and plasticity index (Skempton, 1957).

It is important to consider how Skempton developed this correlation. Each data point shown in the figure is not the result of an individual test, but represents the average plasticity index and best-fit USR for complete borings or multiple borings in uniform materials at a specific site. In order to document how this correlation was developed, Skempton's sources were examined. Figure 6 shows how the USR was determined for one point in Figure 5, the Horten clay from Hansen (1950). Figure 6 shows the results of about 30 vane shear tests conducted over a depth of about 90 ft. These data were interpreted to indicate an undrained strength ratio of 0.18, and that was plotted on Skempton's chart against the average PI of 16.

Figure 7 shows Skempton's correlation plotted with all CL and CH clays ranked 4 or 5 and the best-fit line. Figure 8 shows Skempton's correlation plotted against CHO and PT soils ranked 4 or 5 and the best-fit line.

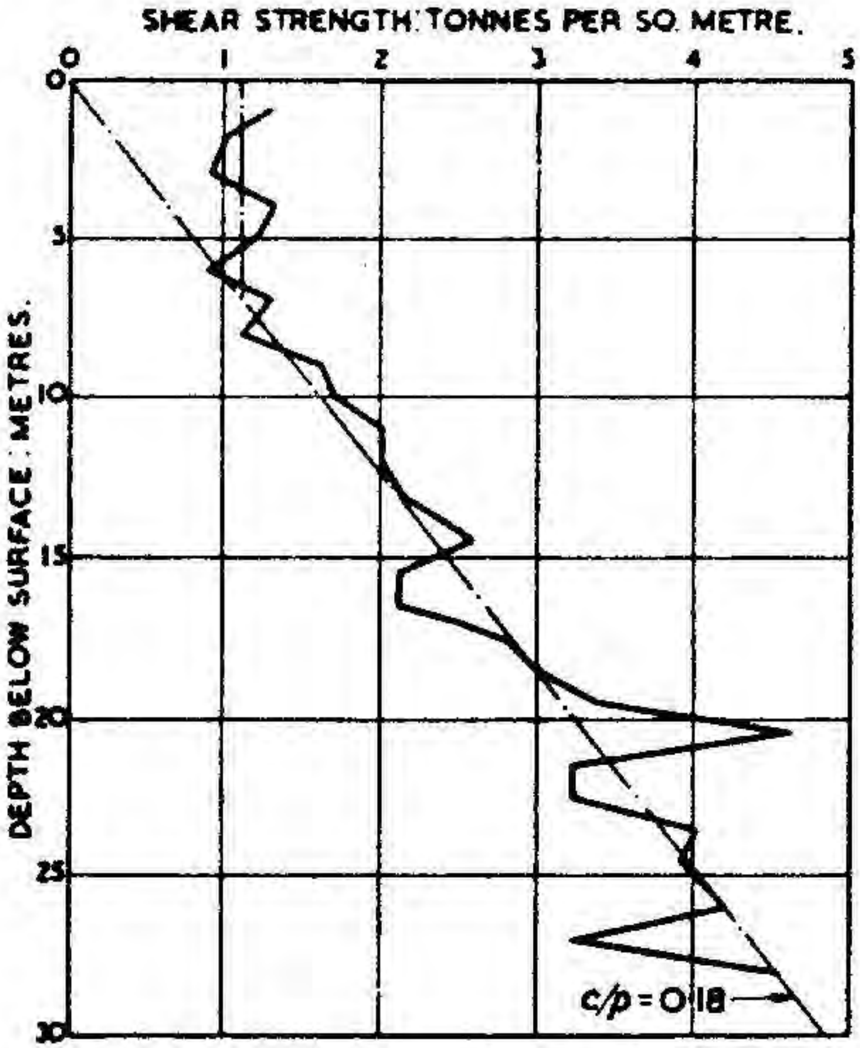


Figure 6   Determination of USR in Horten clay from Hansen (1950).

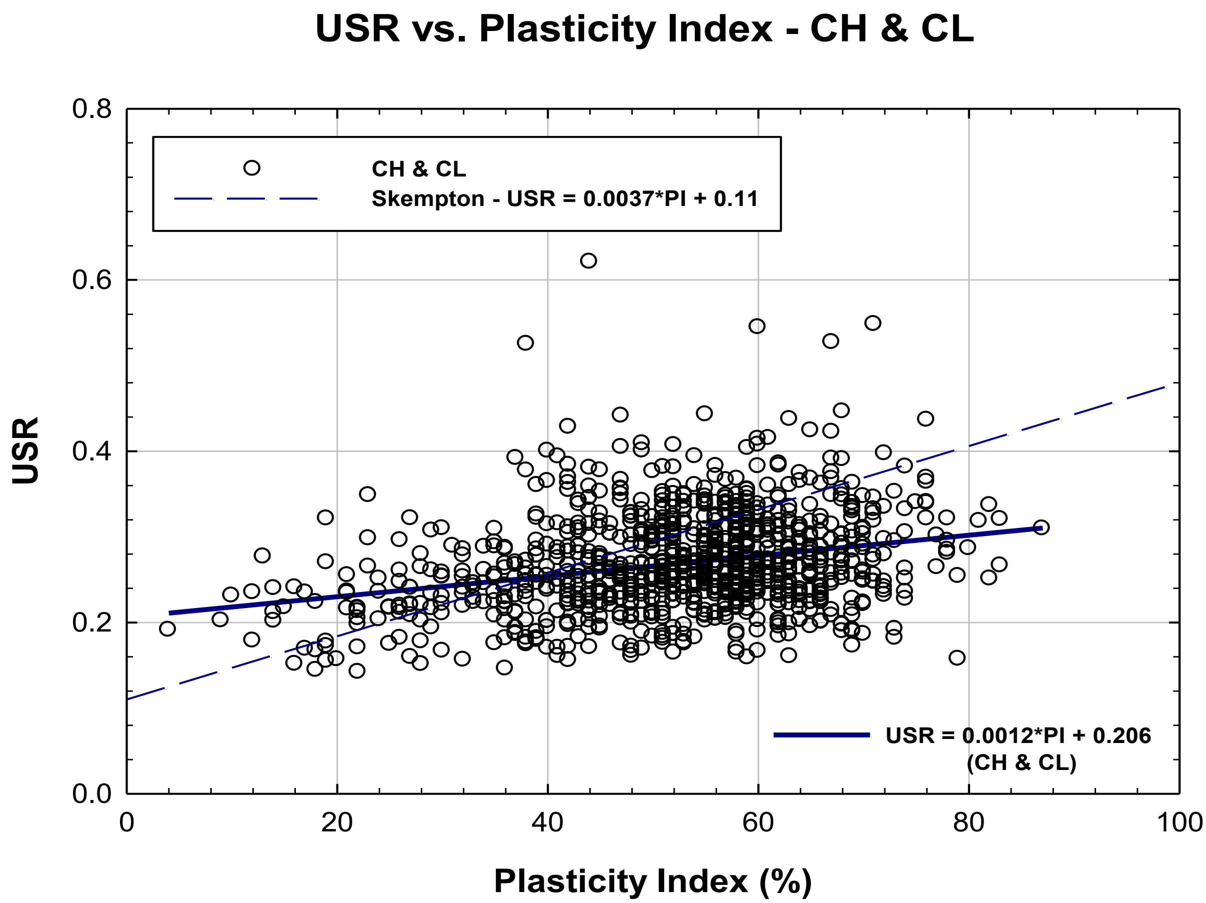


Figure 7 USR versus plasticity index for CH and CL soils ranked 4 or 5.

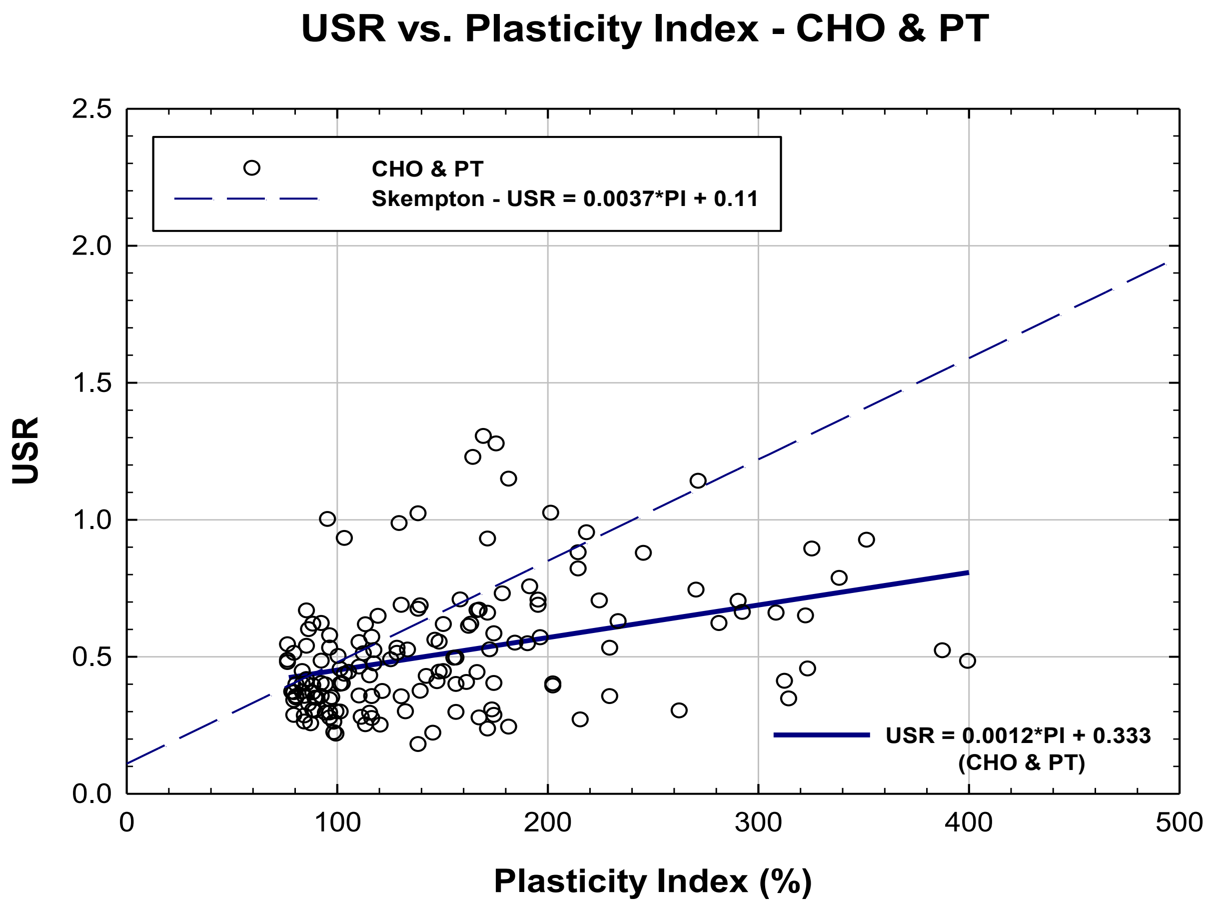


Figure 8 USR versus plasticity index for CHO and PT soils ranked 4 or 5.

As evident from the figures, considerable scatter exists in the laboratory test results. In order to reduce the amount of scatter, an averaging approach similar to Skempton's was applied. Since New Orleans area soils are often stratified, it is inaccurate to apply an average USR or plasticity index for an entire boring. Instead, the results from the individual test specimens were grouped together based on New Orleans District classification symbol, and the average USR and plasticity index were computed. Table 4 shows the number of test series, the average plasticity index, and the average USR for each classification. Figure 9 is a plot of the average USR versus average plasticity index for all classifications. As indicated by the plot, the average procedure removes much of the scatter, and the results are distilled into nine data points which can be accurately described by the following equation:

$$USR_{UU} = 0.0022\ PI + 0.169$$

Table 4 Average PI, USR, and number of test results of each New Orleans District classification.

Material	PI	USR	N
CH4	59	0.277	705
CH3	44	0.267	152
CH2	35	0.244	68
CL6	28	0.225	34
CL4	18	0.211	35
CHOA	93	0.410	60
CHOB	121	0.400	17
CHOC	132	0.480	9
PT	210	0.620	71

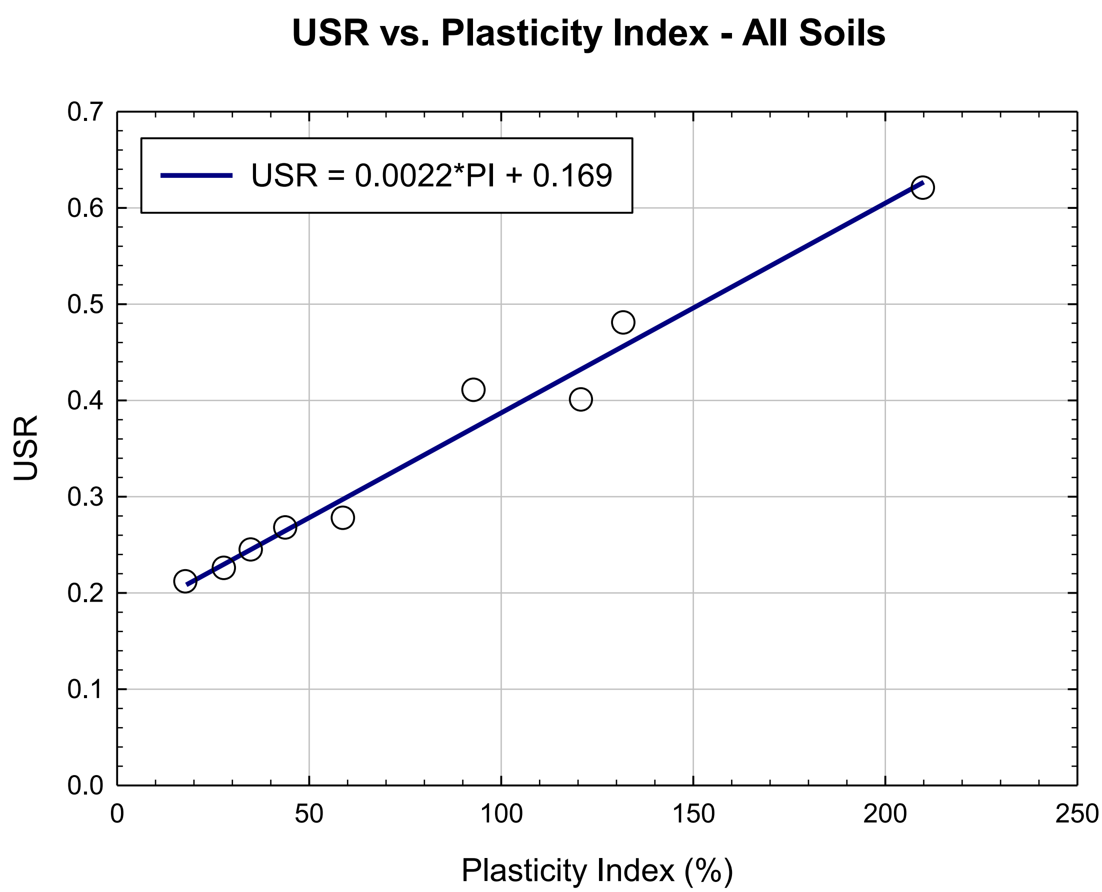


Figure 9 Average USR versus average plasticity index for all soil types.

If only the data points for PI values less than 80 are used, the equation becomes:

$$USR_{UU} = 0.0017\ PI + 0.181$$

There have been other correlations of USR versus plasticity index for clayey soils determined for other types of tests, including the CU triaxial compression test and the CU direct simple shear test. One such set of correlations was presented by Ladd (1991). Figure 10 shows Ladd's correlations for the direct simple shear tests along with the average USR values for CL and CH soils determined based on the UU test data. The plot was developed for CL and CH soils because they have the same range of PI values as shown in Ladd's original correlation. At PI values lower than about 30, the average USR determined from UU triaxial tests is lower than the Ladd's DSS trend. At higher PI values, the UU USR appears to be significantly higher.

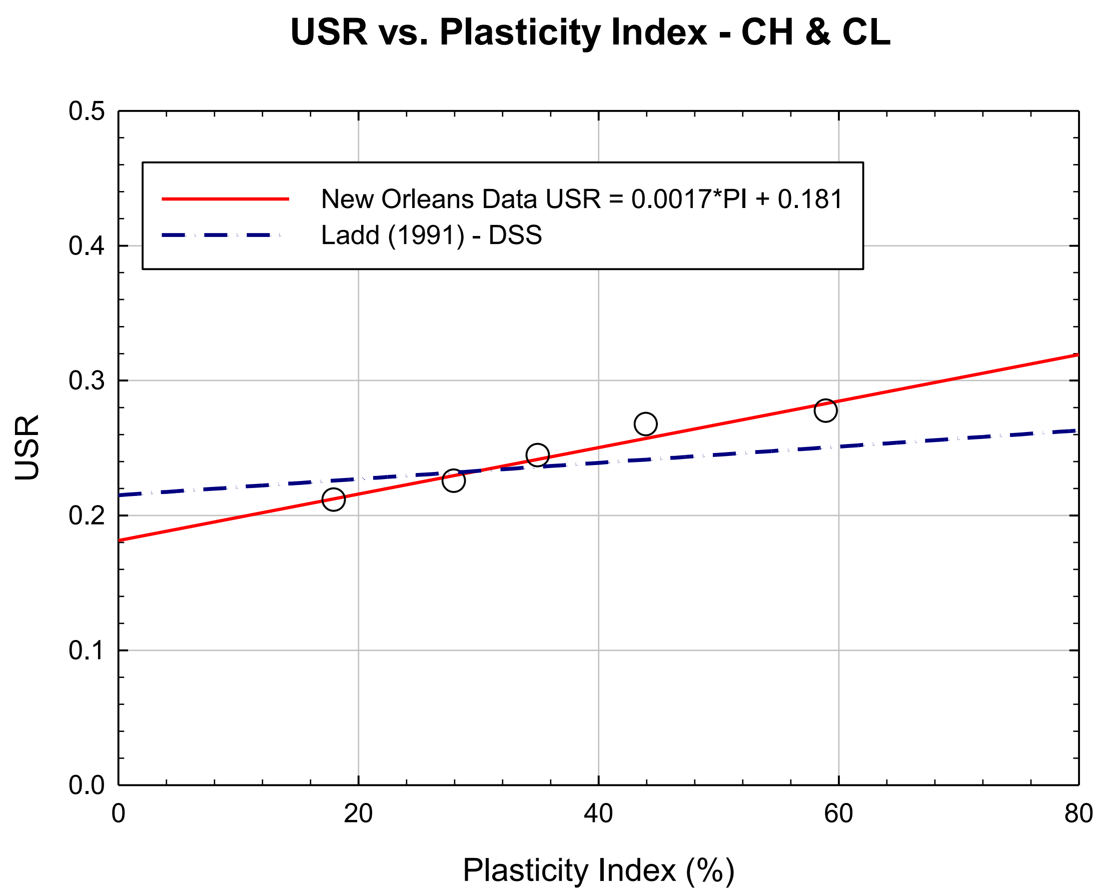


Figure 10 Comparison of USR versus plasticity index for UU triaxial tests and Ladd's DSS correlation.

Another correlation that has been used in geotechnical engineering practice is USR versus liquid limit. Hansbo (1957) proposed the following relationship:

$$USR = 0.0045 \cdot LL$$

where: LL = liquid limit.

Larsson (1980) analyzed the Hansbo data, as well as other published undrained strength ratio data derived from field vane shear test results. Figure 11 is a plot of Hansbo's correlation with other data sources collected by Larsson.

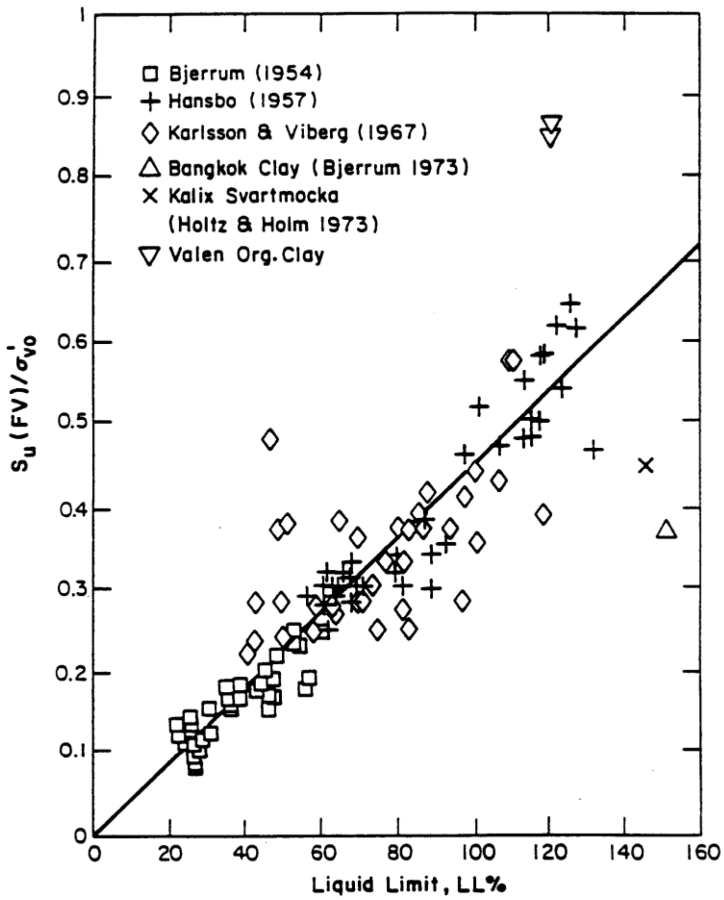


Figure 11 Data analyzed by Larsson (1980) in determining relationship between USR and liquid limit.

Figure 12 shows the USR versus liquid limit for CL and CH soils ranked 4 or 5, the best-fit line, as well as the Hansbo's correlation. As evident from the plot, the Hansbo correlation does not accurately reflect the UU test results. For the majority of the data points, the Hansbo correlation would overpredict the undrained strength ratio.

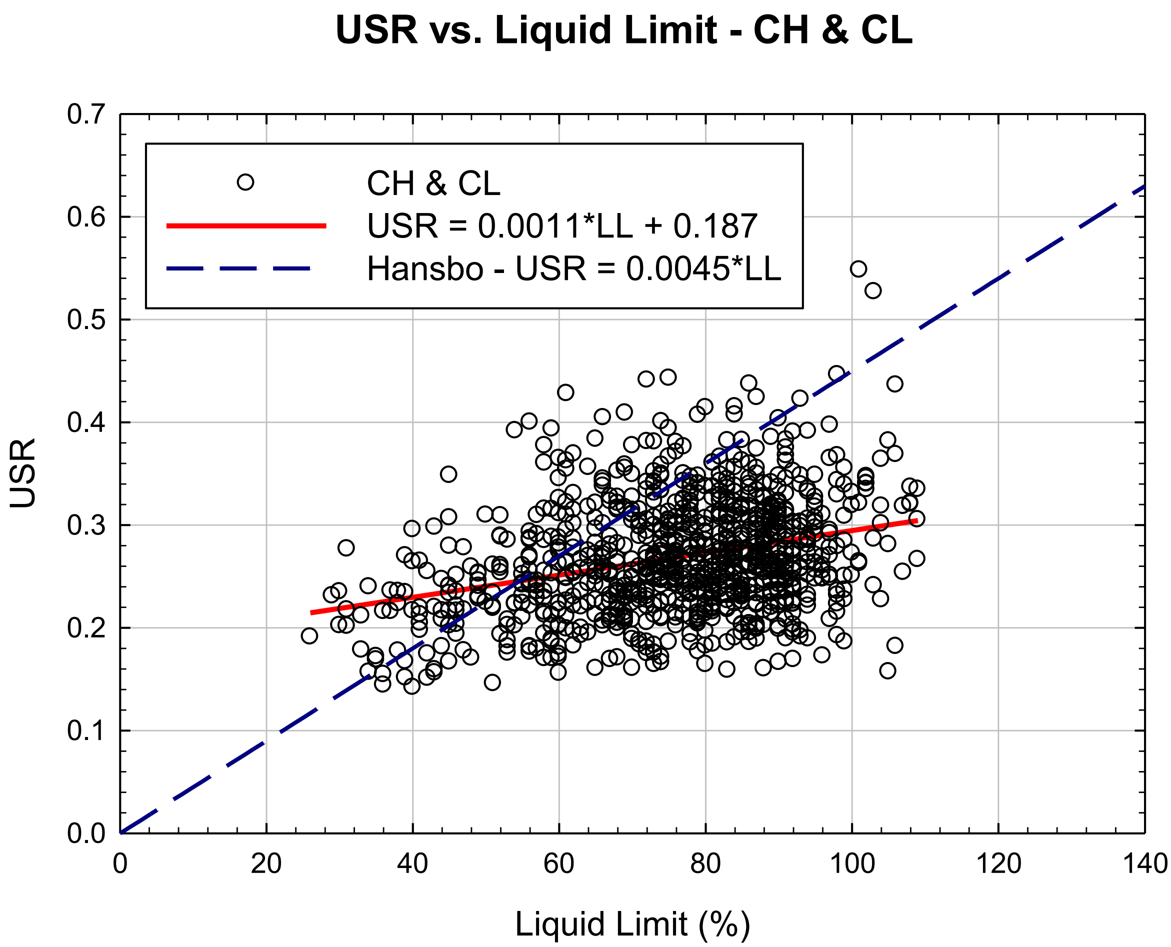


Figure 12 USR versus liquid limit for CL and CH soils ranked 4 or 5.

The original Hansbo correlation was developed for soils with liquid limit values less than 160. It is extrapolated in Figure 13 to allow a comparison for the New Orleans soils classified as CHO and PT. Again, the Hansbo correlation over-estimates the USR to a considerable degree for the organic soils.

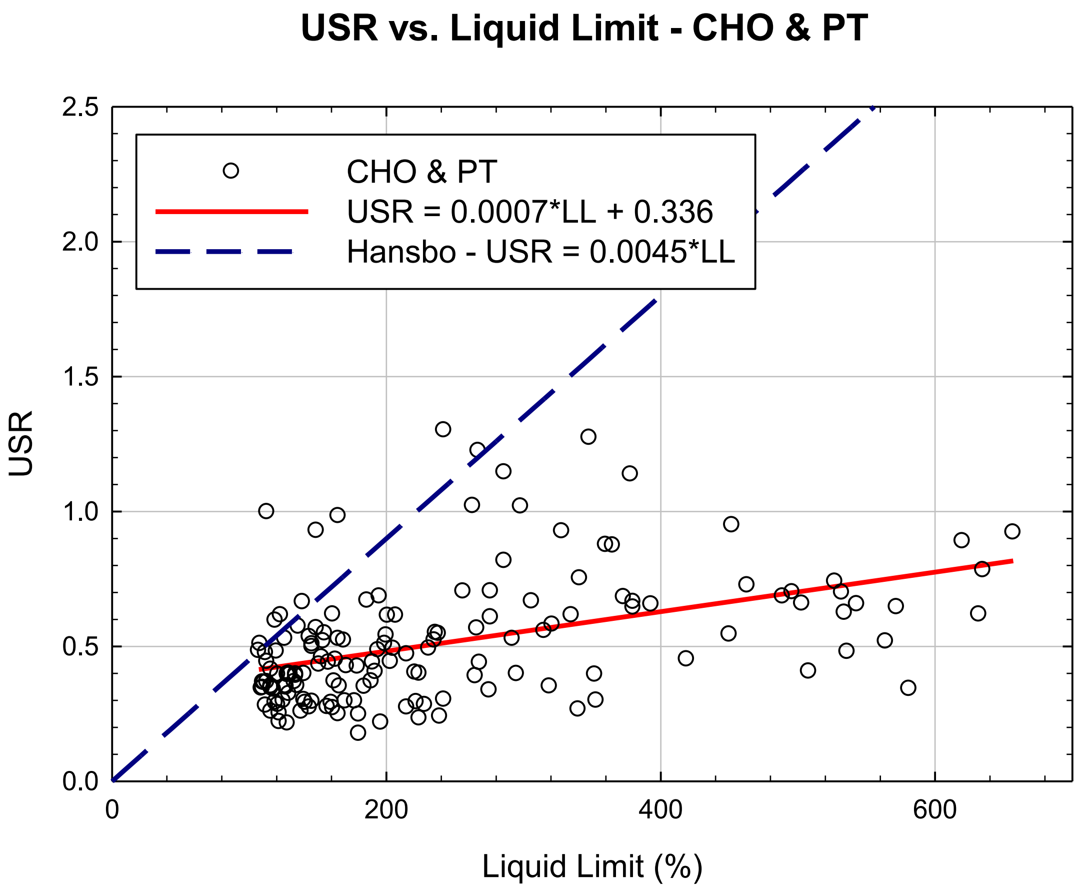


Figure 13 USR versus liquid limit fom UU triaxial tests for all CHO and PT soils ranked 4 or 5.

In order to reduce the scatter from these results, the average USR and liquid limit of each material classification symbol was determined in the same manner as done earlier for the correlation based on PI. Table 5 shows the average liquid limit, USR, and the number of test series in each classification; and these data are plotted in Figure 14. As evident from the figure, the averaged data appear to show a linear trend, but the slope of the line is considerably different than that suggested by Hansbo.

Table 5 Average LL, USR, and number of test series of each New Orleans District classification symbol.

Material	LL	USR	N
CH4	85	0.277	705
CH3	65	0.267	152
CH2	55	0.244	68
CL6	45	0.225	34
CL4	37	0.211	35
CHOA	129	0.410	60
CHOB	169	0.400	17
CHOC	193	0.480	9
PT	356	0.620	71

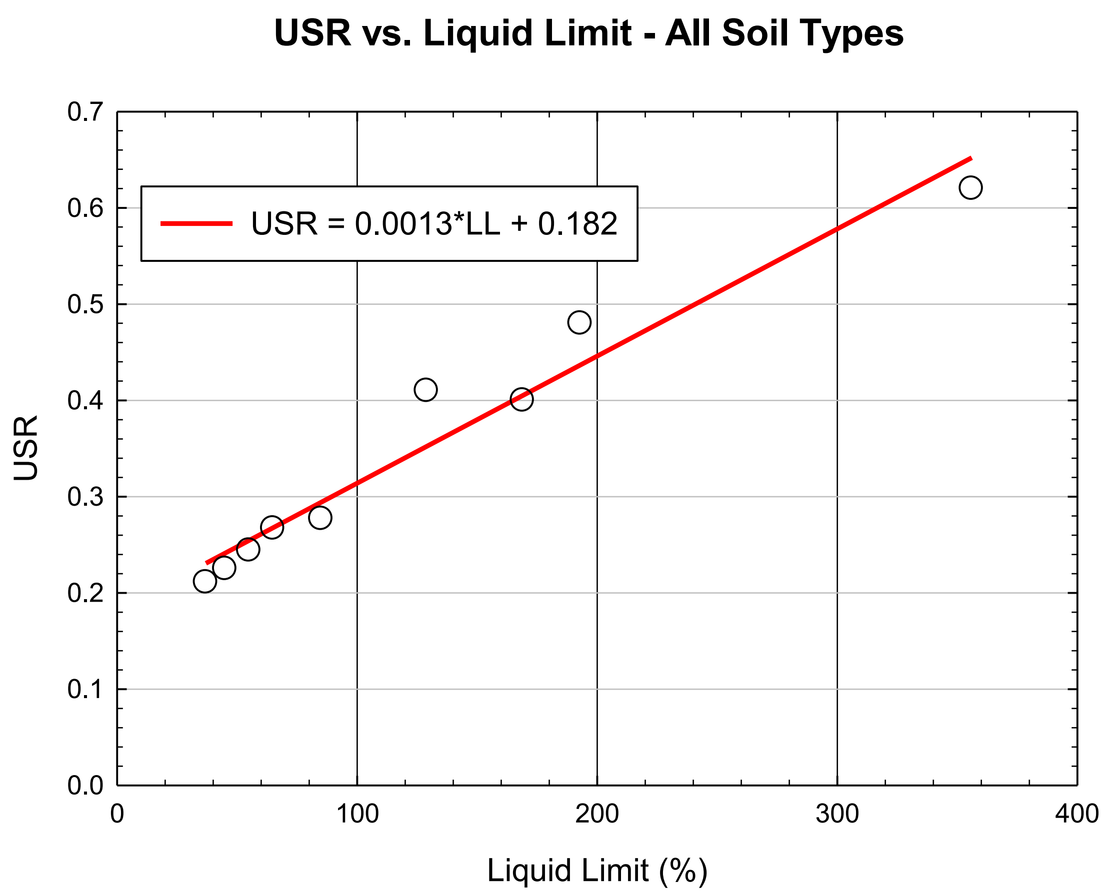
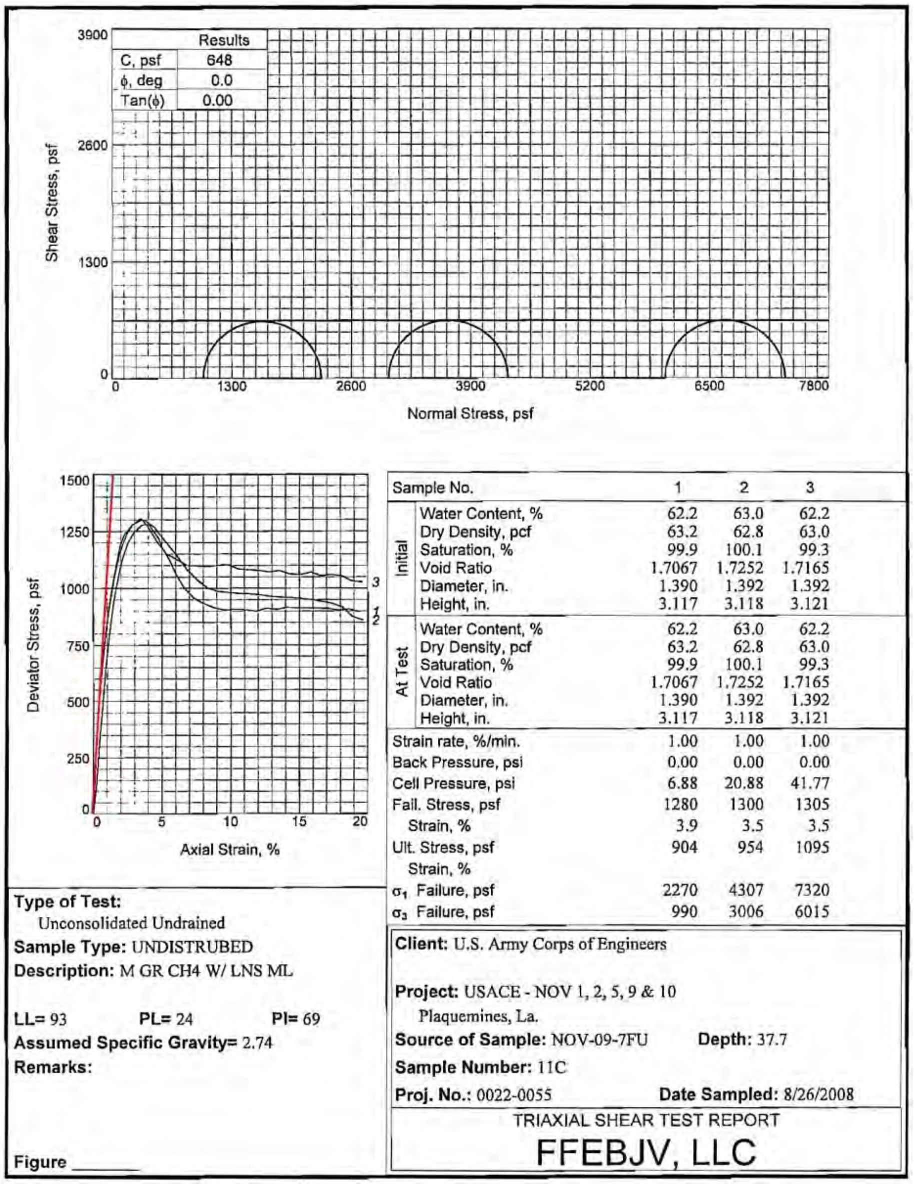


Figure 14 USR versus liquid limit from UU triaxial tests for averaged for New Orleans District soil classification symbols.

Initial Tangent Modulus

The initial tangent modulus, E_i, is defined as the initial slope of the stress-strain curve. An example of the determination of E_i is shown in Figure 15 on the stress-strain plot of a UU test report. For this research, the PDF of the test report was used to determine E_i. The portion of the stress-strain curve was magnified on the screen, and the line was drawn using a mouse. The appropriate values of stress and strain were scaled off of the drawing, and E_i was calculated.

According to Duncan and Buchignani (1976) and Mayne and Swanson (1981), E_i increases as s_u increases. Duncan and Buchignani show that the ratio of E_i/s_u decreases as plasticity index increases. Their analysis was based on field data, and presumably was not affected by sample disturbance. Mayne and Swanson show the ratio E_i/s_u decreases as the compression index, C_c, increases. Their data was based on consolidated undrained triaxial tests.



Sample No.		1	2	3
Initial	Water Content, %	62.2	63.0	62.2
	Dry Density, pcf	63.2	62.8	63.0
	Saturation, %	99.9	100.1	99.3
	Void Ratio	1.7067	1.7252	1.7165
	Diameter, in.	1.390	1.392	1.392
	Height, in.	3.117	3.118	3.121
At Test	Water Content, %	62.2	63.0	62.2
	Dry Density, pcf	63.2	62.8	63.0
	Saturation, %	99.9	100.1	99.3
	Void Ratio	1.7067	1.7252	1.7165
	Diameter, in.	1.390	1.392	1.392
	Height, in.	3.117	3.118	3.121
Strain rate, %/min.		1.00	1.00	1.00
Back Pressure, psi		0.00	0.00	0.00
Cell Pressure, psi		6.88	20.88	41.77
Fail. Stress, psf		1280	1300	1305
Strain, %		3.9	3.5	3.5
Ult. Stress, psf		904	954	1095
Strain, %				
σ_1 Failure, psf		2270	4307	7320
σ_3 Failure, psf		990	3006	6015

Type of Test: Unconsolidated Undrained
Sample Type: UNDISTRUBED
Description: M GR CH4 W/ LNS ML
LL= 93 **PL=** 24 **PI=** 69
Assumed Specific Gravity= 2.74
Remarks:

Figure ______

Client: U.S. Army Corps of Engineers
Project: USACE - NOV 1, 2, 5, 9 & 10 Plaquemines, La.
Source of Sample: NOV-09-7FU **Depth:** 37.7
Sample Number: 11C
Proj. No.: 0022-0055 **Date Sampled:** 8/26/2008

TRIAXIAL SHEAR TEST REPORT
FFEBJV, LLC

Figure 15 Plot showing E_i on stress-strain plot.

Only UU test results that were ranked 4 or 5 were included in the analysis of initial tangent modulus. Figure 16 shows the relationship between E_i and s_u for CL, CH, CHO, and PT determined in this investigation. There is not a significant difference of the slopes of the best fit trend lines for the CL, CH, and CHO soils. For these soils, the initial tangent modulus is about $110 \cdot s_u$ to $150 \cdot s_u$. It is clear that the PT soils had a much lower modulus than the other soils, and the initial tangent modulus is only about $55 \cdot s_u$.

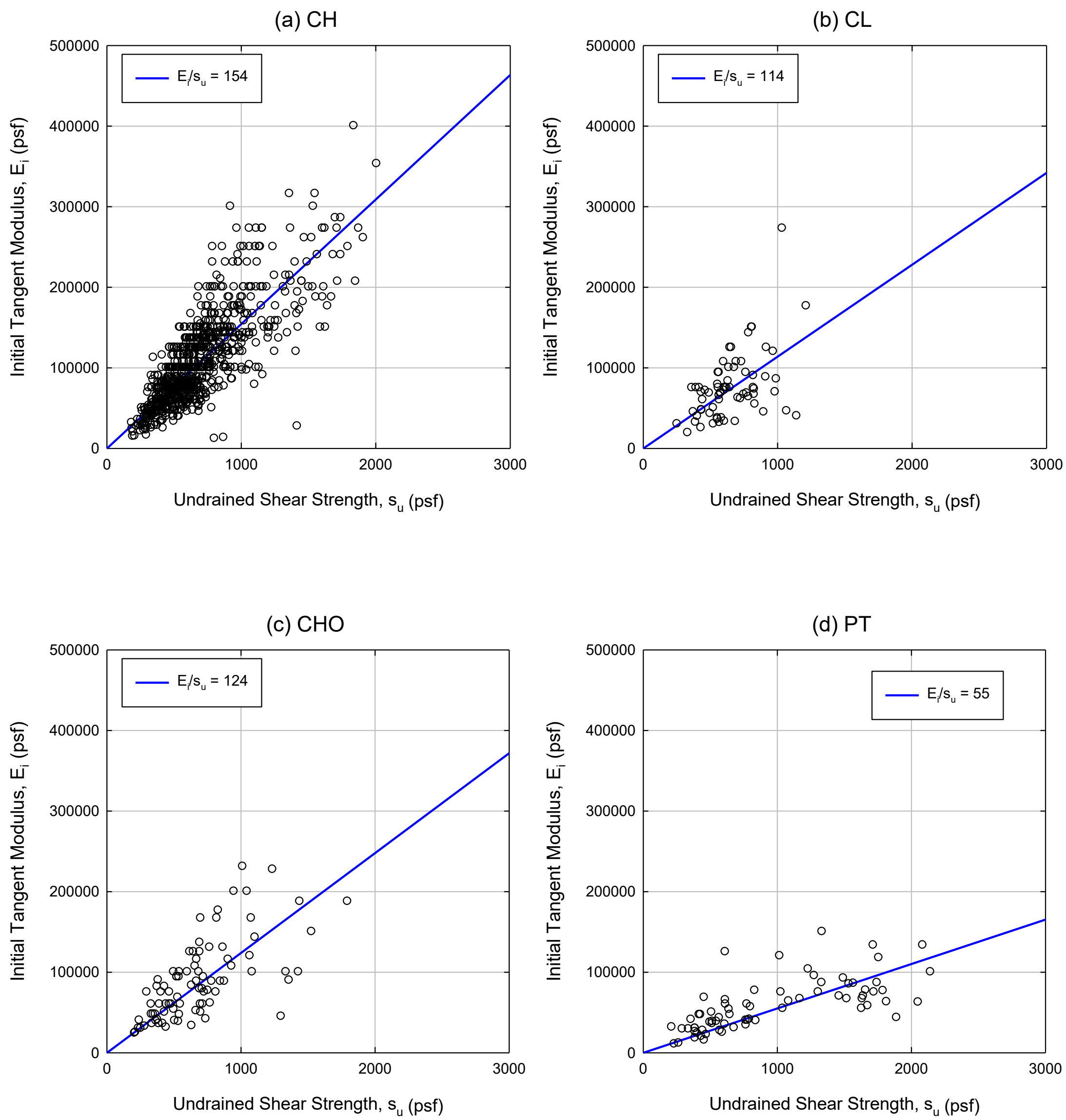


Figure 16 Relationship between E_i and s_u for all materials.

Duncan and Buchignani report that E_i from UU tests is frequently only one-half or one-third as large as the in situ modulus, thus these values may be significantly smaller than appropriate design values.

There was not a strong correlation between E_i/s_u and plasticity index or any other index property for the CL and CH soils. However, there were relationships between E_i/s_u and water content, and E_i/s_u and liquid limit for CHO and PT soils. Figure 17 shows the empirical relationship determined between E_i/s_u and natural water content. For the curve shown on the figure, the ratio of the initial tangent modulus to the undrained shear strength can be approximated as:

$$E_i/s_u = 4791 \times w^{-0.787}$$

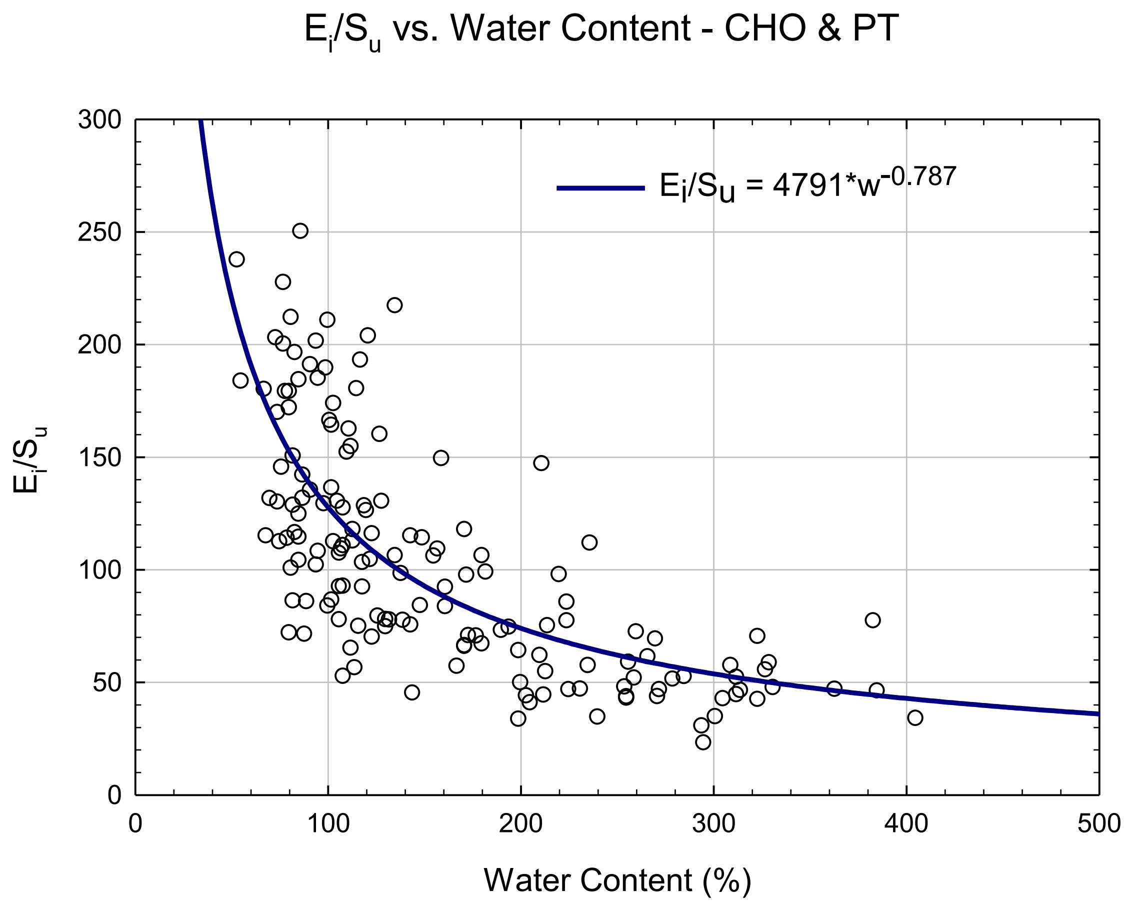


Figure 17 Calculated regression between E_i/s_u and water content for materials classified as CHO and PT.

Figure 18 shows a similar relationship between E_i/s_u and liquid limit determined for CHO and PT soils. For the curve shown on the figure, the ratio of the initial tangent modulus to the undrained shear strength can be approximated as:

$$E_i/s_u = 8213 \times LL^{-0.834}$$

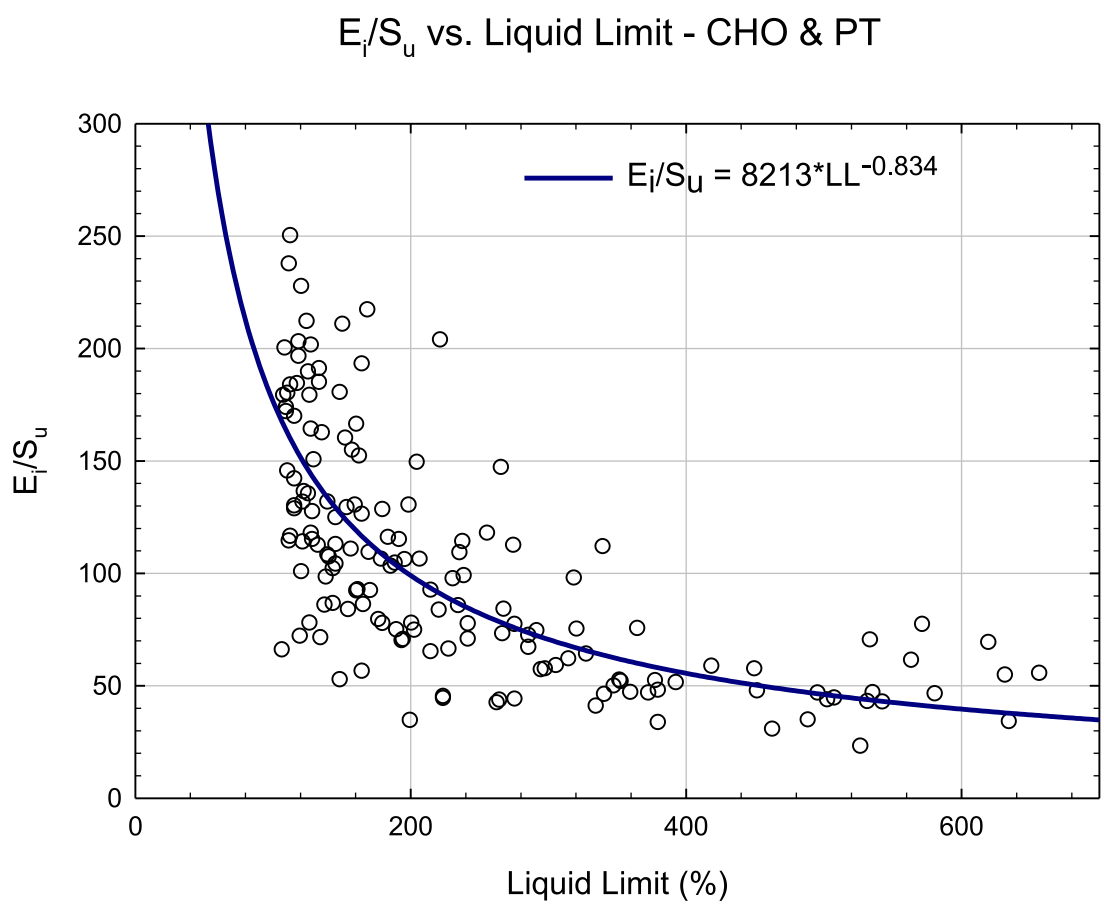


Figure 18 Calculated regression between E_i/s_u and liquid limit for materials classified as CHO and PT.

Consolidated Undrained Triaxial Compression Tests

Consolidated Undrained triaxial compression tests are conducted on both undisturbed and remolded soil samples in geotechnical engineering practice primarily to determine the drained or effective shear strength parameters c′ and ϕ′. The test results can also be used to determine undrained (or total) shear strength parameters in special cases. In general, the CU tests examined as part of this study were conducted according to ASTM D4767

For the New Orleans area data, the drained shear strength parameters were determined based on the effective stress circles corresponding to the peak deviator stress, $\sigma_{d,peak}$. In the case of over-consolidated or dilative (often silty) soils, the pore pressure may decrease or even became negative prior to achieving the $\sigma_{d,peak}$. For these tests, different failure criteria, such as the maximum principal stress ratio $(\sigma_1'/\sigma_3')_{max}$ or PSR_{max}, or Skempton's (1954) pore pressure parameter $\bar{A}$ at failure ($\bar{A}_f$) equal to zero, would have been more appropriate (Brandon et al. 2005). However, the test reports did not provide sufficient information to use these other failure criteria.

For the purpose of this study, CU tests from both pre-Katrina soil reports and post-Katrina projects were used. Each CU triaxial compression test result was examined individually and assigned a ranking from 1 to 5, with 5 being the highest quality. For a ranking of 5 (best), the following criteria must be generally satisfied:

- The peak deviator stress occurred at axial strains less that 15%.
- The back pressure used was at least 60 psi.
- End of Primary (EOP) consolidation is achieved for each effective consolidation stress. Note: consolidation curves were not provided with all test reports.

- The effective consolidation stress was greater than the in situ vertical effective stress.
- The tests specimens exhibited relatively smooth stress-strain curves, indicating reasonable deviator force resolution.
- The effective stress envelopes were approximately linear.
- The initial values of p and p’ for the stress paths were approximately equal, and correctly reflected the consolidation stress.
- The specimen property data were consistent.
- Index property values (Atterberg limits, etc.) were available.

If the CU test came from a pre-Katrina soils report, then the legibility of the test report was also considered.. The reproductions of several of the older test reports were not legible in many cases. For a test to receive a ranking of 1 (worst), 6 or more of the criteria listed above were not satisfied. If 1 to 2 requirements were not satisfied, a rank of 4 was assigned. If 2 to 3 requirements were not satisfied, a rank of 3 was assigned. If 3 to 5 requirements were not satisfied, a rank of 2 was assigned.

In the following sections, examples of each criterion are shown for actual test results.

Strain at peak deviator stress

Achieving a peak deviator stress at modest strains, for both CU and UU triaxial tests, is often an indication of a test specimen with low disturbance. Figure 19 shows the stress-strain curve for Sample 6D from Boring WWHC-37UPT where a peak deviator stress was achieved at strains less than about 6%, indicating high quality test specimens. Figure 20 shows the stress-strain curves for Sample 9C from Boring WWHC-45UFT, where the deviator stress was still increasing at 15% axial strain. It is likely that these test specimens were highly disturbed.

It should be noted that overconsolidated clays and silts that have a tendency for dilation can show strain hardening during undrained shear. This is usually accompanied by a decrease in pore pressure during shear. When evaluating the CU tests for this report, the pore pressure response was also taken into account.

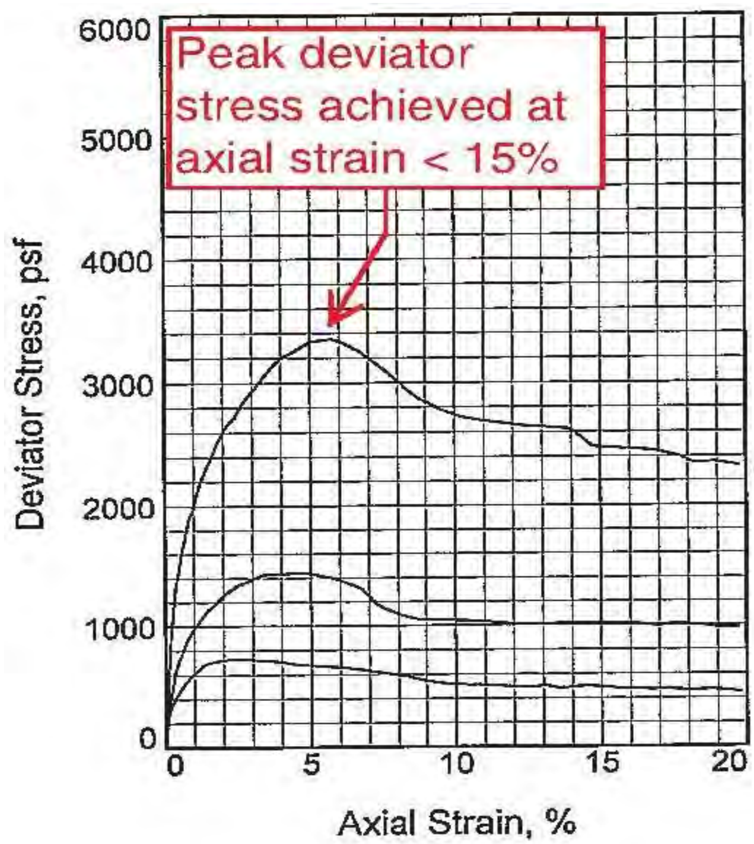


Figure 19 Stress-strain curve where the peak deviator stress was achieved at an axial strain less than 6% (Sample 6D from Boring WWHC-37UPT).

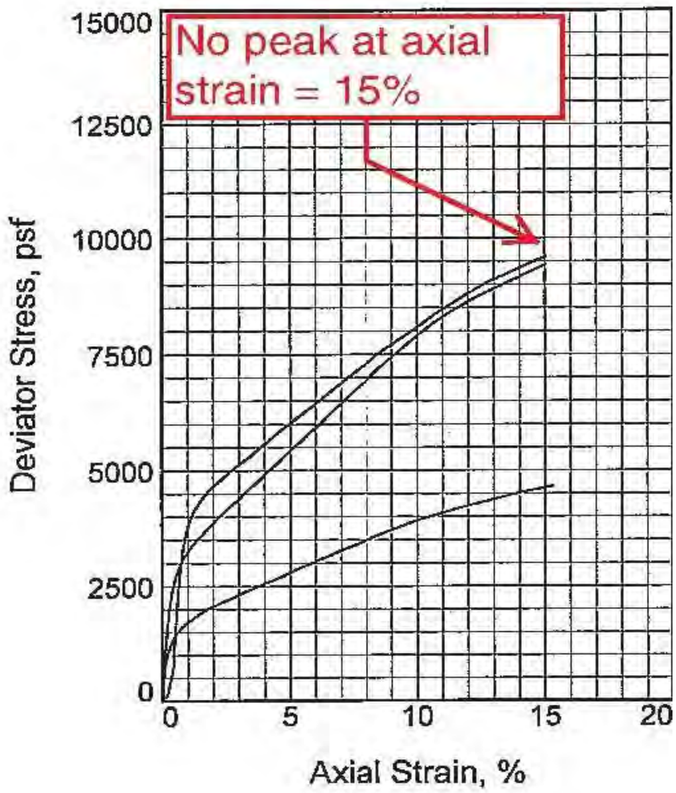


Figure 20 Stress-strain curve where a peak deviator stress was not achieved at 15% axial strain, indicating likely disturbance (Sample 9C from Boring WWHC-45UFT).

Backpressure greater than 60 psi

The magnitude of the back pressure can often be important in CU triaxial test results. Some test reports showed that very modest back pressures were used. The accompanying stress paths and pore pressure responses indicated that the samples and/or pore pressure boards were not fully saturated prior to shear. It is especially important that dilative soils are tested with a high back pressure (greater than 60 psi). If the net change in pore pressure is below zero, then the sample would be losing saturation during shear as air came out of solution during shear.

End of primary consolidation

In the CU triaxial test, full consolidation (*end of primary* or *EOP*) should be achieved before the specimen is sheared. In the case that full consolidation is not achieved, the remaining excess pore pressures will cause a reduction in effective stress after the drainage valve is closed. Figure 21 shows triaxial consolidation plots where EOP was achieved for Sample 8D from Boring WWHC-52UCL. Figure 22 shows consolidation plots from Sample 6B (Boring LKCT-30UPT) where it is clear that end of primary consolidation was not achieved.

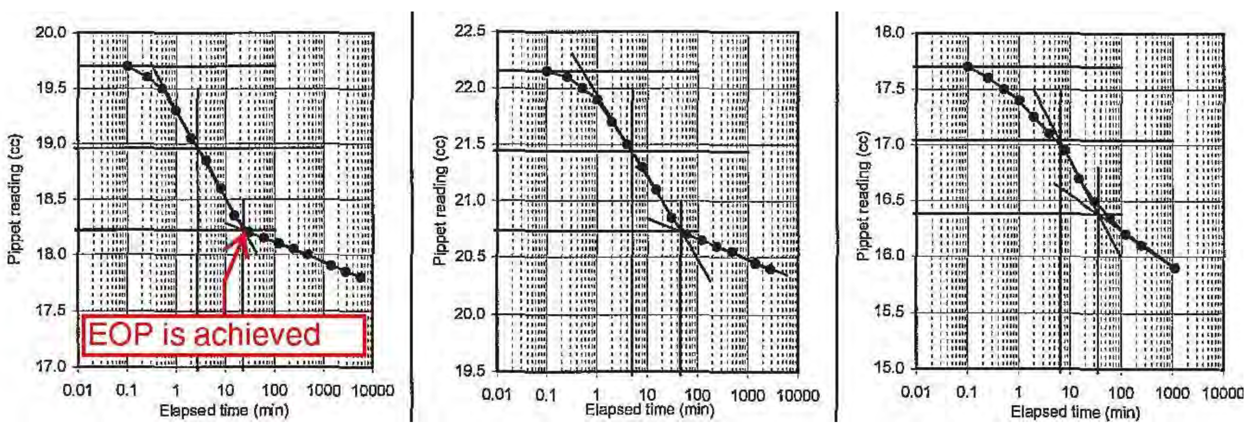


Figure 21 CU triaxial consolidation plots where EOP is achieved.

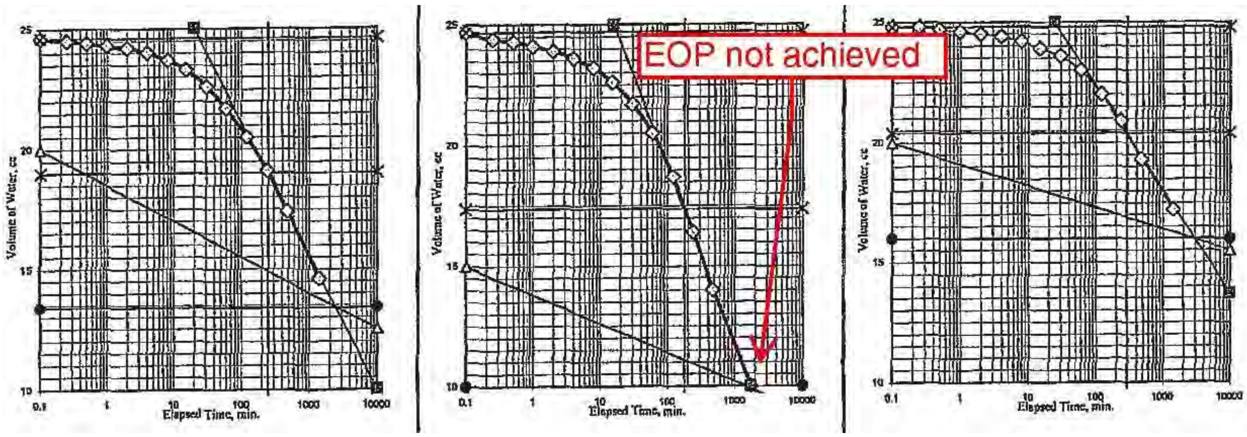


Figure 22 CU triaxial consolidation plots where EOP is not achieved.

Effective Consolidation Stress Greater than In Situ Effective Stress

In order to correctly interpret CU triaxial tests results for both effective and total stress strength parameters, it is necessary to reconcile the field effective stress with the laboratory consolidation stress. If the laboratory consolidation stress is less than the field effective stress, then the laboratory sample has a higher OCR than the soil in situ. If the soil in the field is normally consolidated, which is most often the case for New Orleans area soils, then laboratory consolidation stresses equal to or greater than the field vertical effective stress should produce test specimens that are essentially normally consolidated.

Shape of Stress-strain Curves

The smoothness of the stress strain curves often reflects the suitability of the resolution of the deviator force load cell. If the stress-strain curve is erratic, the load cell may not have enough resolution to accurately determine the deviator force applied to the test specimen. For most of the effective stresses used in the available CU triaxial tests, a load cell capacity of 100 lbs would be appropriate.

Linearity of Effective Stress Envelope

Ideally, the Mohr's circles at failure should form a linear failure envelope. There are many justifiable reasons why individual test points may deviate from a linear relationship. However, a significant deviation in the linearity of the envelope increases the difficulty in obtaining a single value of the effective stress friction angle. In many cases, a non-linear envelope was probably the result of a bad test as opposed to true soil behavior.

Comparison of Initial Values of p and p'

The initial values of the stress path points p and p' can provide useful information regarding both the saturation and consolidation state of the triaxial test specimen. If a test specimen is thoroughly back pressure saturated and has been fully consolidated, the total and effective stress paths should both start from the isotropic consolidation pressure. Closing the drainage value prior to undrained shear should not change the value of p'. If the test specimen was not sufficiently saturated, the pore pressure in the test specimen will start to decrease when the drainage valve is closed, prior to the application of shear stress. This causes the initial value of p' to plot to the right of the initial value of p.

If full consolidation is not achieved, residual excess pore pressures are still within the test specimen. When the drainage valve is closed, the measured pore pressures will increase over time, and the value of p' will plot to the left of the value of p. Figure 23 shows an example of this problem for CU triaxial tests conducted on Sample 6B from boring LKCT-30UPT.

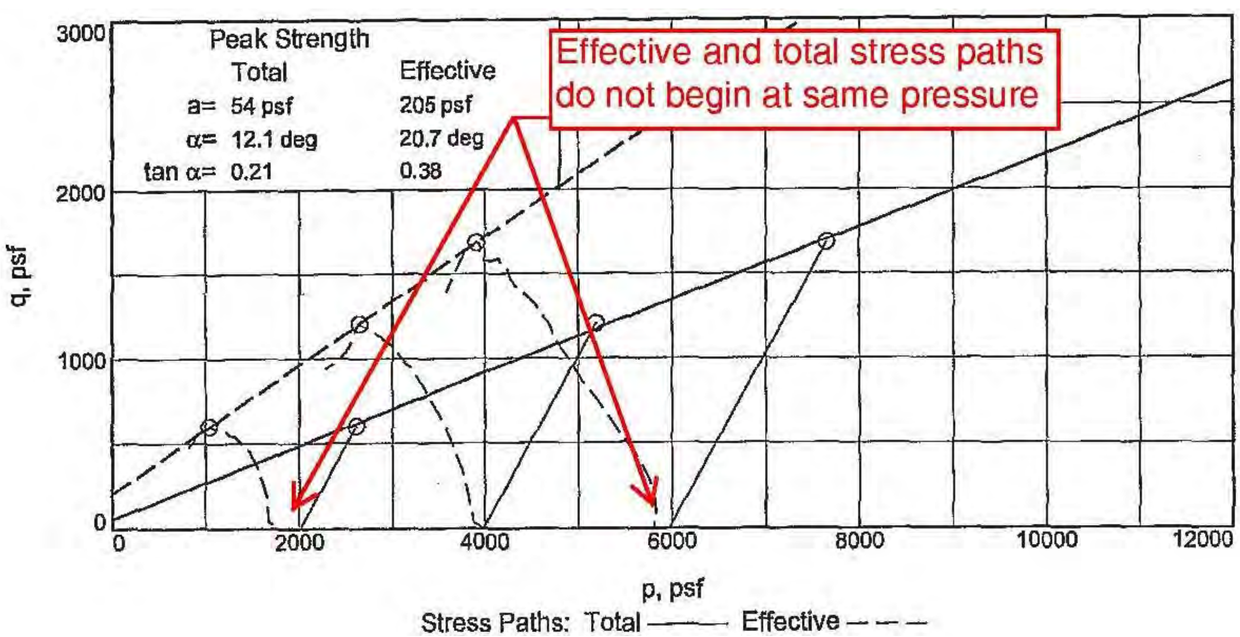


Figure 23 Example of effective and total stress path with different initial values.

In addition to the stated criteria, some tests were omitted from further consideration if significant negative pore pressures were developed during shear. This normally occurred when the test specimens were ML soils. As an example, Figure 24 shows tests result for two CU triaxial tests on Sample 7B from Boring PW05NF-15U. For these test specimens, the pore pressures decreased to about -7500 psf below the back pressure during shear. As this was occurring, air would be coming out of solution, and the test specimens would be losing saturation.

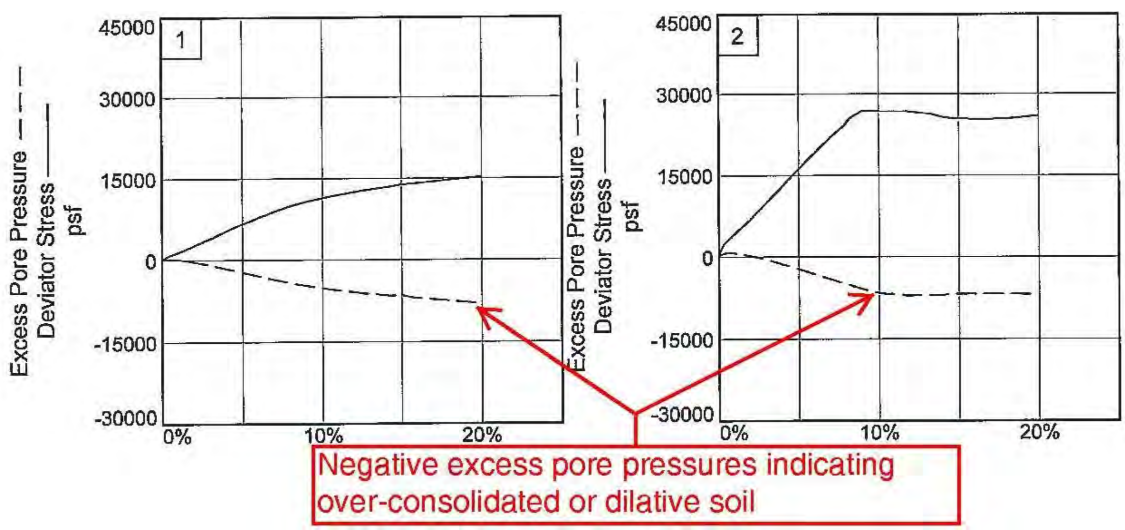


Figure 24 Stress-strain curves for dilative test specimens.

Consolidated-Drained Direct Shear Test

Consolidated-drained direct shear tests were conducted New Orleans area soils both pre-Katrina and post-Katrina. The post-Katrina tests were conducted by FFEB JV. The pre-Katrina tests were conducted by a variety of labs. There was no significant difference in the shear strength parameters obtained for these two data sets; therefore, they were combined in the subsequent correlations.

Each direct shear test report was individually examined and generally assessed according to the criteria listed below.

- End of Primary (EOP) consolidation is achieved.
- The effective vertical consolidation stress was greater than the in situ vertical effective stress.
- The tests specimens exhibited relatively smooth stress-displacement curves, indicating reasonable shear force resolution.
- The effective stress envelopes were approximately linear.
- The specimen property data were consistent.
- Index property values (Atterberg limits, etc.) were available.

Instead of formally ranking the test results on a 1 to 5 scale as done with the CU tests, the tests that were obviously problematic were omitted from the data set.

Effective Stress Strength Parameter Interpretation

CU triaxial tests and CD direct shear tests are most often used to determine drained or effective stress strength parameters, c′ and ϕ'.

In the case of normally consolidated soils, the effective stress cohesion (c') is equal to zero. There have been many attempts to correlate the drained friction angle to soil index properties, such as plasticity index. Figure 25 shows a common correlation proposed by Bjerrum and Simons (1960). This correlation was developed from the results of CU triaxial test results. Figure 26 shows a similar correlation developed by Hadjidakis and Sherman (1962) based on the results of direct shear test results specifically for Mississippi Valley soils.

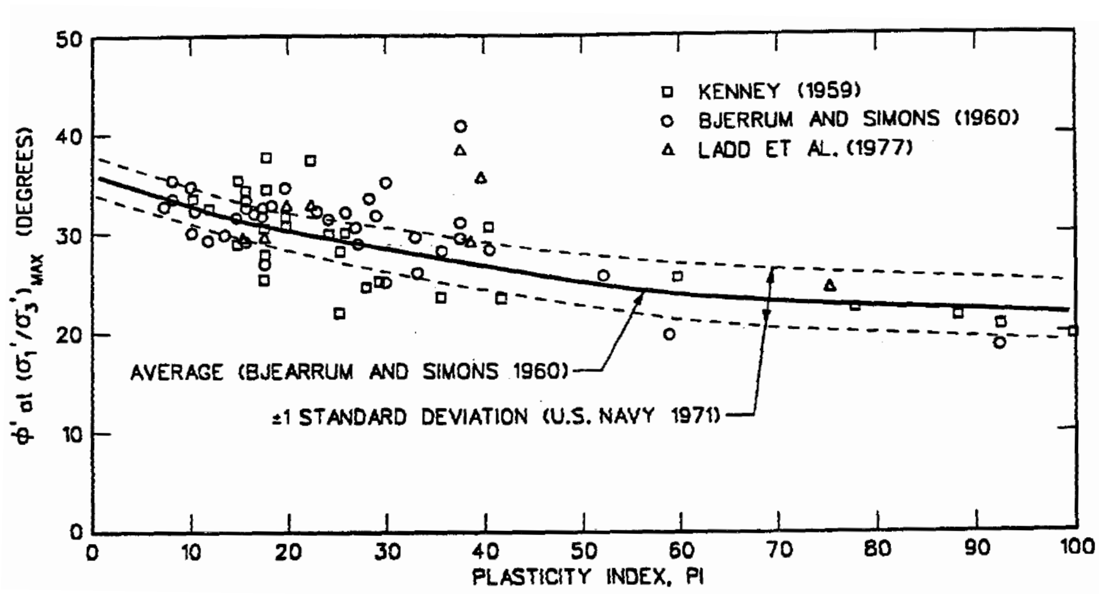


Figure 25 Typical relationship between drained friction angle and plasticity index (after Bjerrum and Simons, 1960).

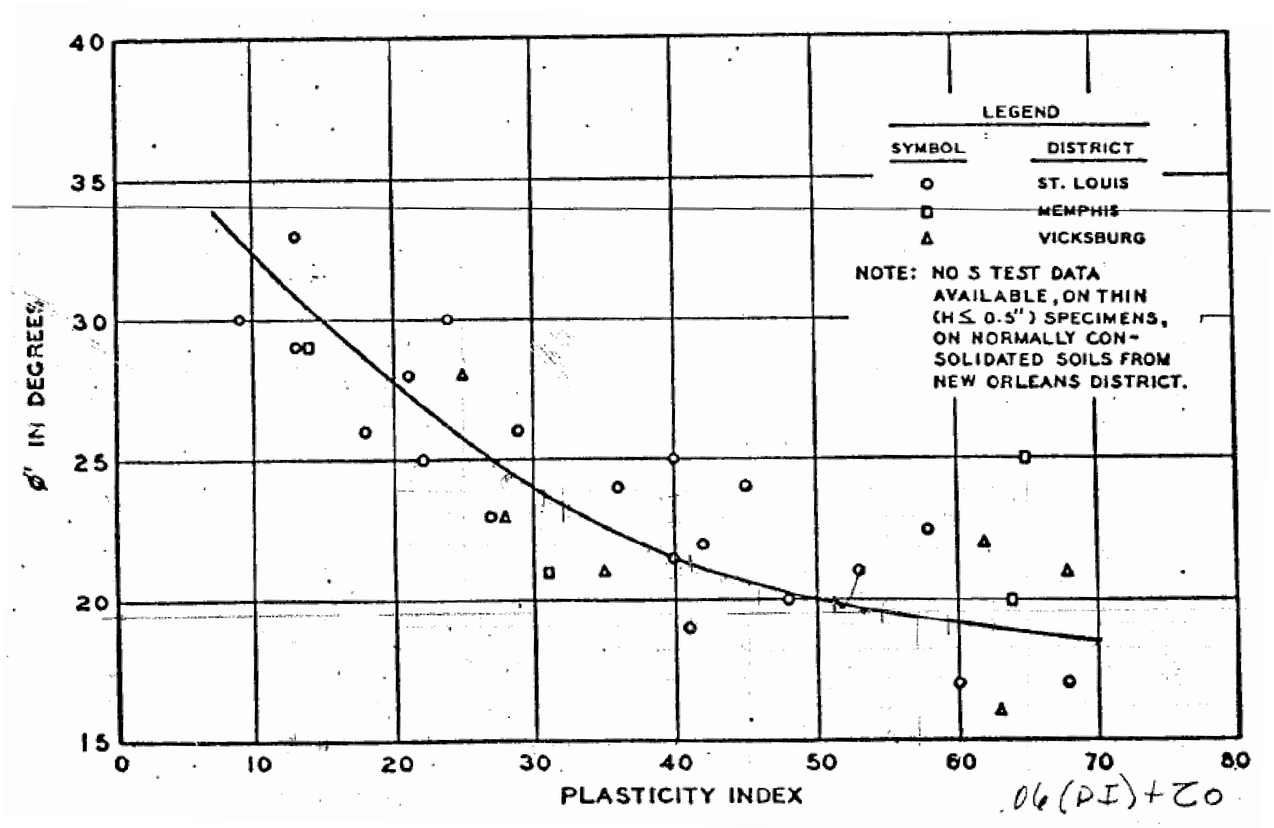


Figure 26 Correlation between drained friction angle and plasticity index for normally consolidated Mississippi Valley soils (Hadjidakis and Sherman, 1962).

In this study, the drained friction angle used in the correlation was obtained only considering the tests conducted in a series where the laboratory consolidation stress was equal to or in excess of the in situ vertical effective stress. If the soil was normally consolidated in situ, then these test results should provide the normally consolidated friction angle, with the effective stress cohesion being equal to zero. Only triaxial tests that were ranked 3 or above were considered in the analysis. This resulted in 85 CU triaxial test being considered. For the fine-grained soils, 222 direct shear test series were considered. Most of these test series consisted of three individual tests.

Figure 27 shows the relationship between the drained friction angle and plasticity index for both the CU triaxial and CD direct shear data set. It is evident that the CU triaxial tests result in a much higher value of friction angle than the direct shear test. This has been observed by other researchers (Hvorslev 1960, Saada and Townsend 1981, Kulhawy and Mayne 1990), and has been attributed to the progressive failure effects occurring in direct shear tests.

Based on the relationships shown on the plots, the effective stress friction angle can be estimated for triaxial tests by the following equation:

$$\phi'_{trx} = 27.6 + 17.2 \cdot e^{-0.045 \cdot PI}$$

Similarly, the effective stress friction angle can be estimated for the direct shear test by an equation of similar format:

$$\phi'_{ds} = 17.6 + 19.5 \cdot e^{-0.028 \cdot PI}$$

The relationship provided by Sherman and Hadjidakis (1962) appears to underpredict the drained friction angle for both direct shear and triaxial tests.

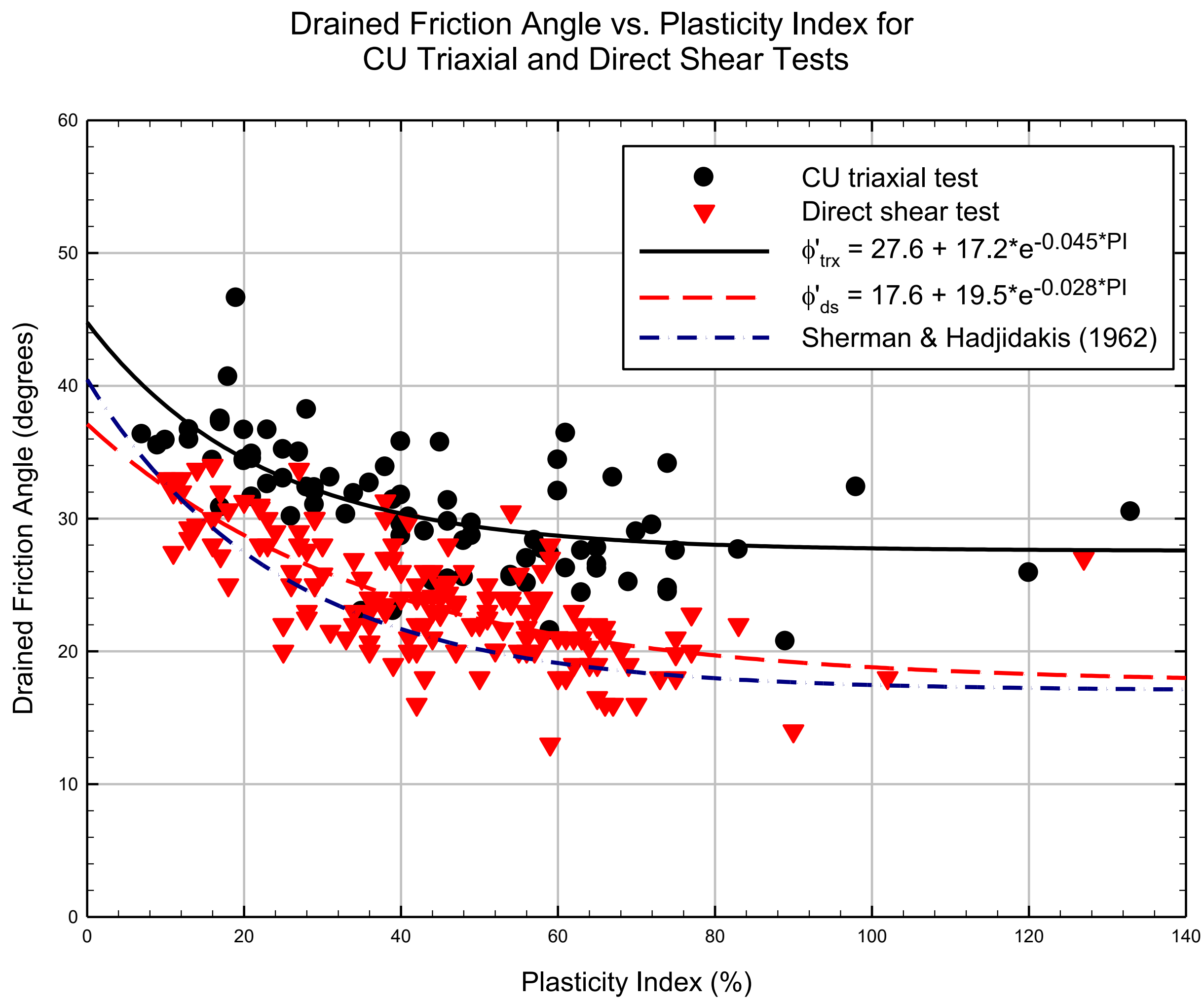


Figure 27 Relationship between drained friction angle with plasticity index for CU triaxial tests and direct shear tests.

The correlation of friction angle with liquid limit appeared to be equally as accurate as that for the plasticity index. Shown in Figure 28 are the correlations for both the CU triaxial test and the direct shear test. The formats of the equations are the same as for the PI correlations.

$$\phi'_{trx} = 28.0 + 64.3 \cdot e^{-0.058 \cdot LL}$$

$$\phi'_{ds} = 20.7 + 36.5 \cdot e^{-0.040 \cdot LL}$$

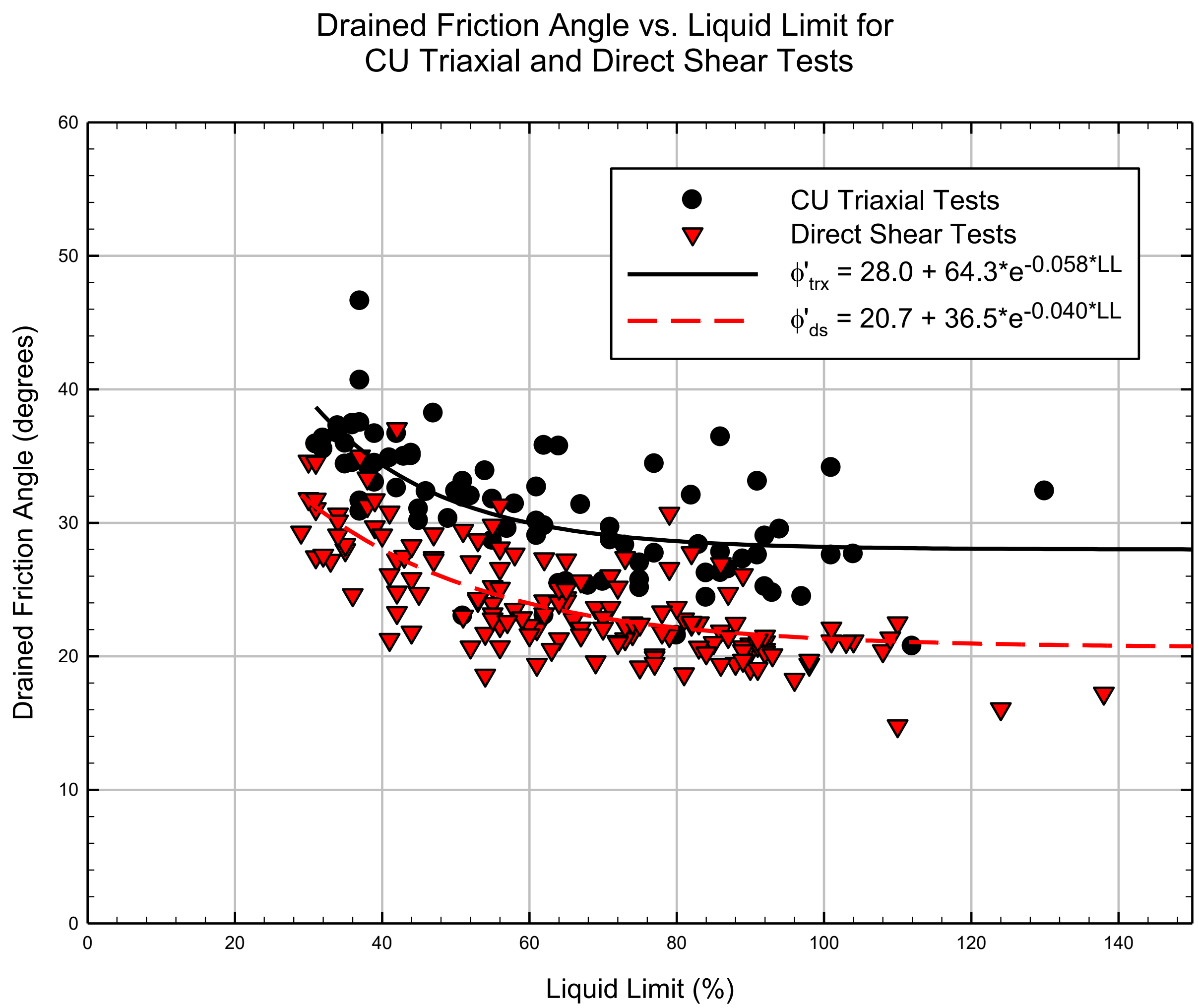


Figure 28 Relationship between drained friction angle and liquid limit for CU triaxial tests and direct shear tests.

Other correlations with effective stress friction angle and index properties were explored, but these two correlations appeared to exhibit the least scatter.

For design purposes, it is useful to look at the average measured friction angles for the different New Orleans District soil classification symbols. Table 6 shows the results for CU triaxial tests. The friction angle values reported for CHO and PT soils should be regarded as preliminary since only few tests were conducted.

Table 6 Summary of drained friction angle for fine-grained soils for CU triaxial tests.

Soil Type	# of tests	Friction Angle (deg)			Standard Deviation
		Maximum	Minimum	Average	
CH	49	36.42	21.55	28.78	3.68
CHO	4	32.37	20.74	27.38	5.20
CL	30	46.60	30.14	35.26	3.31
PT	2	42.20	32.05	37.12	7.18

Table 7 shows similar data for direct shear tests. While the measured friction angles are considerably lower than those measured for the CU triaxial tests, the standard deviations are about the same.

For design purposes, it is conservative to use a friction angle that is one standard deviation below the average. By using this value, there is only a 16% probability that the actual value realized in the field will be lower.

Table 7 Summary of drained friction angle for all soils for direct shear tests.

Soil Type	# of tests	Friction Angle (deg)			Standard Deviation
		Maximum	Minimum	Average	
CH	148	33.26	14.79	22.66	3.24
CL	50	37.04	20.00	29.45	3.70
ML	42	41.03	27.29	33.24	2.25
CHO	2	33.18	26.47	29.83	4.75
SC	4	34.99	31.63	32.80	1.50
SM	109	38.35	23.32	33.03	2.37
SP	32	39.35	30.63	34.22	2.12

CU Tests for Undrained Strength Parameters

CU triaxial tests are not normally recommended for determining undrained strength parameters for design (Duncan and Wright 2005). In some special cases, CU triaxial tests can be used to determine undrained strength for rapid drawdown analysis of earth dams, but those advanced analyses should rely on laboratory test results and not correlations.

The CU triaxial tests conducted in the New Orleans area are useful to examine if the area soils will normalize in a manner consistent with the SHANSEP method (Ladd and Foott 1974). This will be discussed in the section dealing with direct simple shear tests procedures and results.

Consolidated Undrained Direct Simple Shear Tests

Few consolidated undrained DSS tests were conducted prior to Hurricane Katrina. Since Hurricane Katrina, DSS tests were conducted as part of the IPET investigation and on several task orders related to Task Force Hope, Task Force Guardian, and new MVN construction.

The ASTM specification for the DSS test (D6528) is actually for conducting a drained test. The shearing process takes place under constant volume, and the change in normal stress required to maintain a constant value condition is inferred as the pore pressure. The specimen is given free access to water during the consolidation and shearing process. The test specimen is not back pressure saturated.

Conducting the test requires about the same technical prowess of conducting an incremental stress consolidation test, with only a little more effort required for specimen setup. The test is essentially an incremental stress consolidation test, with the specimen being sheared after full consolidation at the last desired stress increment. It normally takes about 7 to 14 days to conduct a DSS test depending on the soil type, the consolidation characteristics of the soil, and the final desired consolidation stress.

The ranking criteria for the DSS test contain some of the same elements of the CU triaxial test. The criteria used are listed below:

- The peak deviator stress should occur at shear strains less than 15%.
- End of Primary (EOP) consolidation should have been achieved.
- The effective consolidation stress should be greater than the in situ vertical effective stress.
- The tests specimens should exhibit relatively smooth stress-strain curves, indicating reasonable deviator force resolution.
- The specimen property data should be consistent.
- Index property values (Atterberg limits, etc.) should be available.

Direct Simple Shear Test Details

Current US geotechnical engineering practice has adopted ASTM D6528 as the standard practice for the DSS test. If this specification is followed, the test report includes the following information:

Specimen property data

- Soil description and visual classification
- Specimen height and diameter
- Average water content of trimmings
- Initial specimen water content, void ratio, density, and degree of saturation
- Preshear void ratio

Consolidation information

- Table of consolidation results
- Consolidation curves
- Time for 95% consolidation (t_{95}) for maximum stress increment

Shear information

- Shear strain rate
- Table of shear strain, shear stress, normal stress, pore pressure, axial strain, and shear modulus

The plots that are normally included with a DSS test are:

- Shear stress versus shear strain
- Shear stress versus normal stress
- Induced pore pressure versus shear strain
- Axial strain versus shear strain
- Logarithm of shear modulus versus logarithm of shear strain

Several additional elements should be checked in the test report before DSS test results can be used with confidence for shear strength interpretation:

1. Compare the specimen consolidation stress and preconsolidation pressure with the in situ stress. It is necessary that the OCR of the laboratory specimen be the same as in the field for the data to be valid.
2. Check the shearing strain rate. D6528 is vague in this regard. The strain rate should be based on the last consolidation increment, whereby the time to failure should be less than $2 \cdot t_{90}$. However, the standard also states that "much of the existing data and practical experience have been developed using a shear strain

rate of 5% per hour." Many labs use a default value of 5% per hour.

3. The vertical strain tolerance should be less than 0.05%, as required from the ASTM specifications. If this value is exceeded, the results may be invalid.
4. Examine the vertical axial strain when the test specimen has been reloaded to the field vertical stress. The lower the vertical strain, the less disturbance incurred by the test specimen.

Normalization of New Orleans Area Soils

In order to interpret the undrained shear strength from DSS tests, the "normalization" procedure outlined in the SHANSEP procedure (Ladd and Foott 1974) was adopted. In order for a soil to normalize, it must have relatively the same stress-strain response and shear strength, for a given value of overconsolidation ratio, when normalized by the consolidation stress. Ladd and Foott called this the *Normalized Soil Parameter* (NSP) concept.

Ladd and Foot suggest the following procedure to determine if a soil normalizes:

> "Consolidate samples to approximately 1.5 times, 2.5 times, and 4 times the *in situ* $\sigma_v'_m$ ($\sigma_v'_m$ = preconsolidation pressure) and measure $s_u/\sigma_v'_c$ ($\sigma_v'_c$ = vertical effective consolidation stress in the laboratory). A clay exhibiting normalized behavior will yield a constant value of $s_u/\sigma_v'_c$,

at least at the two higher stresses. If $s_u/\sigma_v'_c$ varies consistently with stress, the NSP concept does not apply to the clay."

This approach was adopted, when possible, in this report to see if the New Orleans area soils normalize.

Laboratory DSS Test Data Analyzed

Various sources of test results were available to assess the normalization characteristics of New Orleans area soils. The following sources of data were analyzed:

(1) Twenty-five (25) direct simple shear test results conducted by Geotesting Express on samples from the 17^{th} St. Outfall Canal.

(2) One hundred and eighty-two (182) direct simple shear test series conducted by FFEB JV.

(3) Twenty-eight (28) direct simple shear test series conducted by Terracon for projects located in two different areas of New Orleans.

(4) Thirty-eight direct simple shear tests (38) conducted at Virginia Tech from four New Orleans locations.

Each of these tests was examined for procedural errors (poor initial saturation, incomplete consolidation, incorrect stresses, etc.) that would invalidate the data. A primary assessment benchmark of the test data was to see if the test results normalized to the point where an accurate undrained strength ratio could be determined. In this manner, a complete test series would provide one value of undrained strength ratio. For the DSS tests, plots similar to Figure 29 were generated for each test series to assess the normalization. For the ideal case, shown as the left-most plot, all tests in the series provide the same undrained strength ratio. This would represent a case of no disturbance and perfect normalization. If the test specimens are disturbed but normalize nonetheless, the test results would appear as shown on the center plot. If the soil samples do not normalize, the test data would plot as shown in the right-most figure. The undrained strength ratios were only considered for test specimens that normalize.

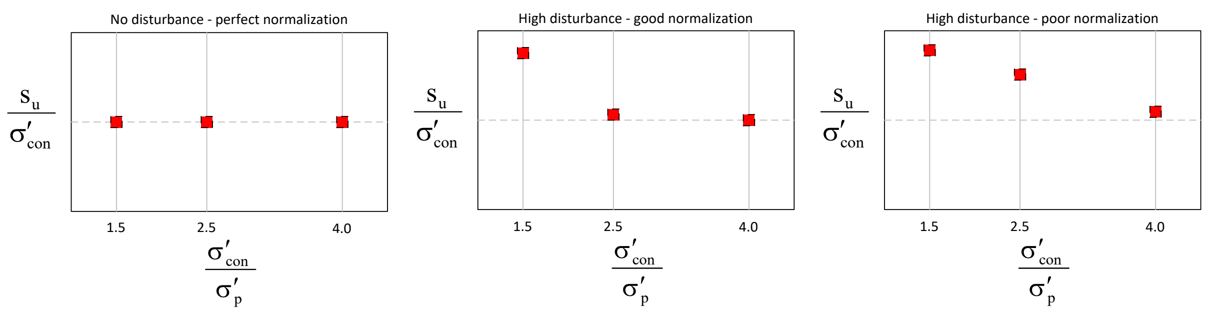


Figure 29 Hypothetical plots of undrained strength ratio versus stress ratio to determine degree of disturbance and normalization.

Ladd and Foott did not provide any guidance regarding a quantitative assessment of what constitutes normalization. They state that the resulting normalized shear strength must be "constant," at least for the highest two consolidation stresses for a three-stress test series.

For the purpose of this research, two different thresholds for "constant" were adopted. In order for a sample to be judged to exhibit normalized behavior, the undrained strength ratio for the two highest stresses had to be within ±5% or ±10% of the mean value for the two highest consolidation stresses.

It was not possible to assess all tests using the ±5% or ±10% criterion. Many test specimens were tested at only one value of vertical consolidation stress, and therefore only one stress ratio value was available. Therefore, it was not possible to determine if the soil normalized. In many cases, three tests may have been conducted from a sample, but the first two may have been tested at consolidation pressures lower than the in situ vertical effective stress. The majority of the tests conducted by the FFEB lab were suitable for assessment. Shown in Table 8 is the number of DSS tests that were deemed to have been sufficiently normalized. In all, only about 32% of the DSS samples appear to have exhibited normalized behavior using the ±5% threshold value. If the threshold is relaxed to ±10%, 66% of the samples normalize.

Table 8 Normalization of DSS test samples for New Orleans area projects assuming that the undrained shear strength for the two highest consolidation stress are within 5% of the mean value.

Laboratory	Total DSS Tests	Samples w/more than two tests	% Normalized Samples 5% Threshold	% Normalized Samples 10% Threshold
FFEB	182	60	27	60
Virginia Tech	38	9	33	78
Geotesting Express	25	10	60	90
Terracon	28	3	0	0

The DSS data obtained in New Orleans area testing allows Ladd's DSS USR correlation to be examined. Shown in Figure 30 are the DSS undrained strength ratios as a function of PI for all data that met the ±10% threshold. The average undrained strength ratio was 0.28, with a standard deviation of 0.033. Ladd's results showed the undrained strength ratio increasing with increasing PI, and his proposed relationship is shown as the dashed red line on the plot. For the New Orleans area soils, the undrained strength ratio appears to be reasonably constant for the range of PI values reported. The Ladd relationship represents a lower bound to the measured test data.

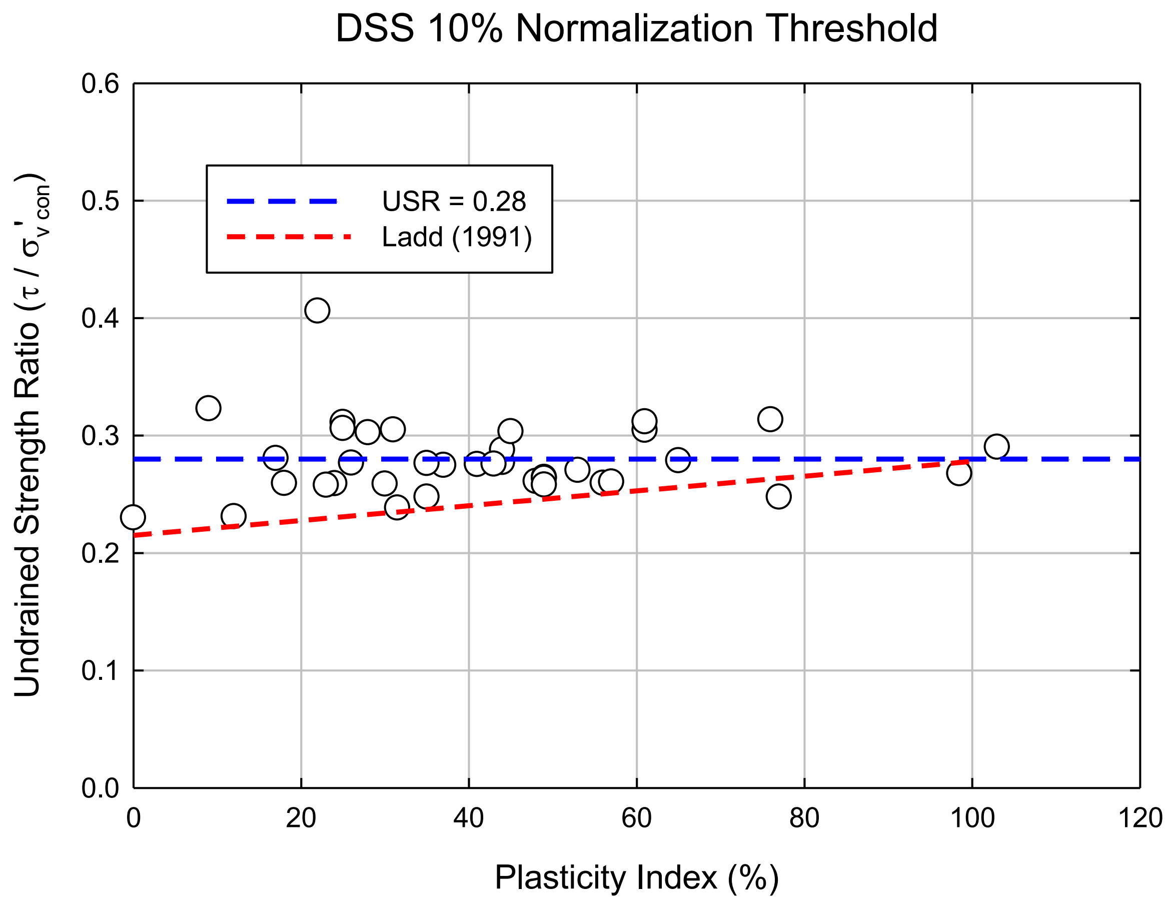


Figure 30 Undrained strength ratio as a function of PI for DSS tests where the samples met the ±10% normalization threshold.

The same average undrained ratio was calculated for the tests which met the ±5% threshold. A plot of the test results is presented in Figure 31. Even with the more stringent acceptance criterion, the undrained strength ratio does not appear to increase with increasing PI.

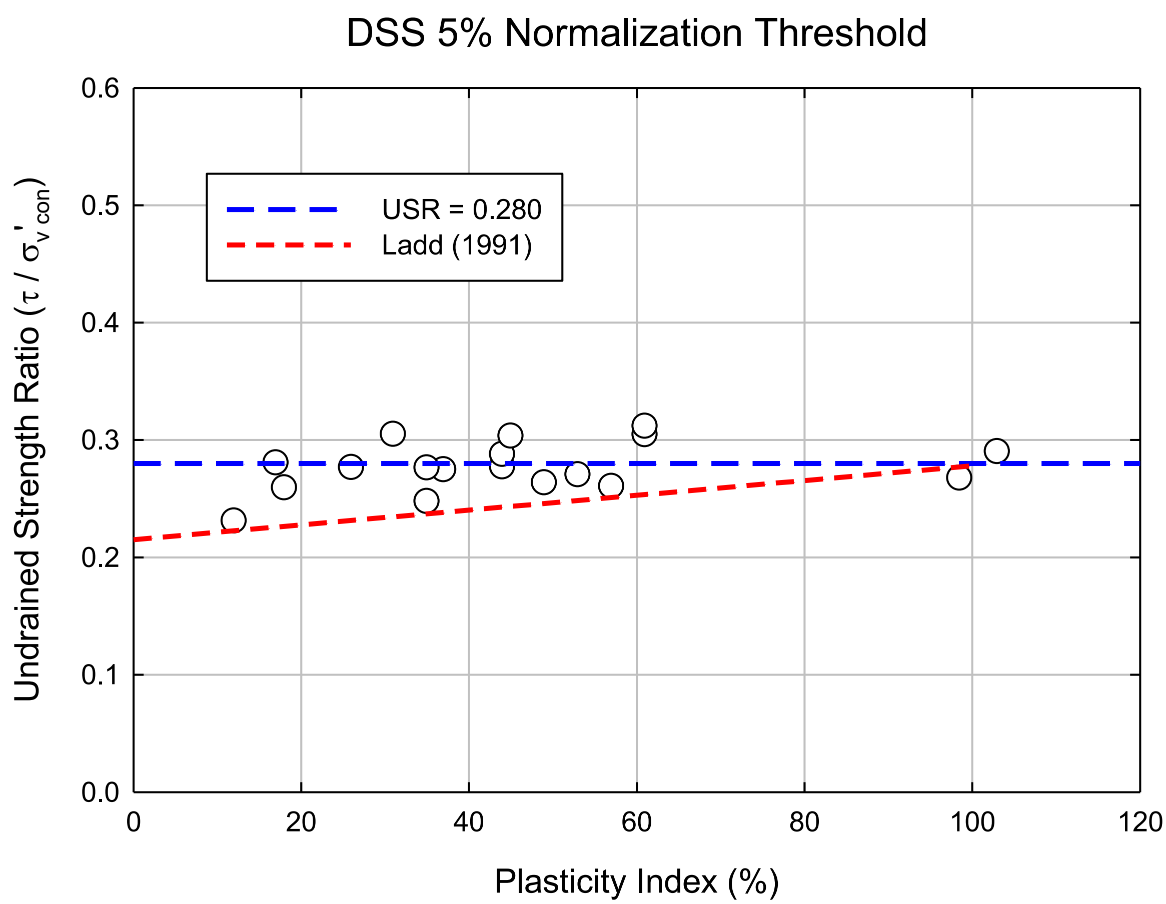


Figure 31 Undrained strength ratio as a function of PI for DSS tests where the samples met the ±5% normalization threshold.

It is useful to compare the undrained strength ratio determined for the DSS and the UU triaxial test as a function of the plasticity index (PI). Shown in Figure 32 is the linear undrained strength ratio relationship determined for the averaged UU test results for CL and CH soils presented earlier plotted with the average USR for the DSS tests of 0.28. For PI values less than about 60, the USR determined from UU triaxial tests is less than that determined from DSS tests. For PI values greater than 60, it appears that UU tests would produce a higher USR than DSS tests. It should be noted that there is considerable scatter in both the UU and DSS test results, so these values would only be approximate.

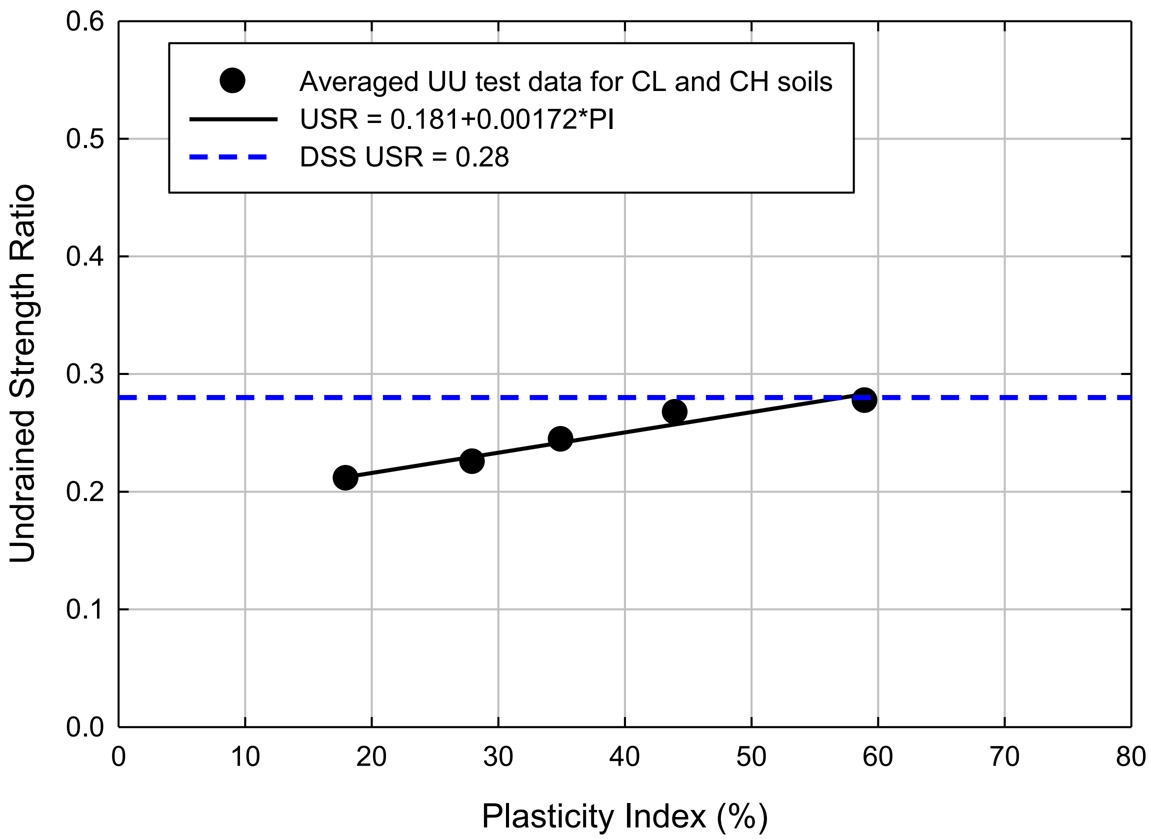


Figure 32 USR determined for UU triaxial tests and DSS tests for CL and CH soils as a function of PI.

Laboratory CU Triaxial Test Data Analyzed

The CU triaxial test data discussed earlier was also assessed for undrained strength ratio. Only post-Katrina CU tests were examined. In addition to applying the rating procedure described earlier, the CU triaxial data were also scrutinized for normalization. Plots similar to that shown in Figure 29 were generated for the CU triaxial test data.

Shown in Table 9 are the normalization results from the CU triaxial compression tests conducted by the FFEB lab. Eighty-four test series of 3-point envelopes were judged to be of good enough quality for assessment. Only about 29% of the samples exhibited normalized behavior when using the 5% threshold and 57% normalized using the 10% threshold. These percentages are similar to that obtained with the DSS test specimens. Many of the Isotropically Consolidated Undrained (ICU) triaxial compressions tests were plagued with the same problems regarding the selection of the consolidation stresses that occurred in the DSS tests.

Table 9 Normalization of ICU triaxial compression test samples for New Orleans area projects.

Laboratory	Total ICU TC Test Series	% Normalized Samples 5% Threshold	% Normalized Samples 10% Threshold
FFEB	84	29%	57%

Shown in Figure 33 are the test results that were judged to be of acceptable quality and that exhibited normalized behavior using the ±10% criterion. Plotted with the data is the constant linear relationship for CK_oU triaxial tests proposed by Ladd (1991). The test results show a relatively constant undrained strength ratio of about 0.32 for plasticity index values greater than about 50. For plasticity index values less than 50, the undrained strength ratio increases with decreasing plasticity index. The solid blue line shown on the plot is an equation fit to the data having the following form:

$$USR_{CU} = 0.30 + 0.624 \cdot e^{-0.061 \cdot PI}$$

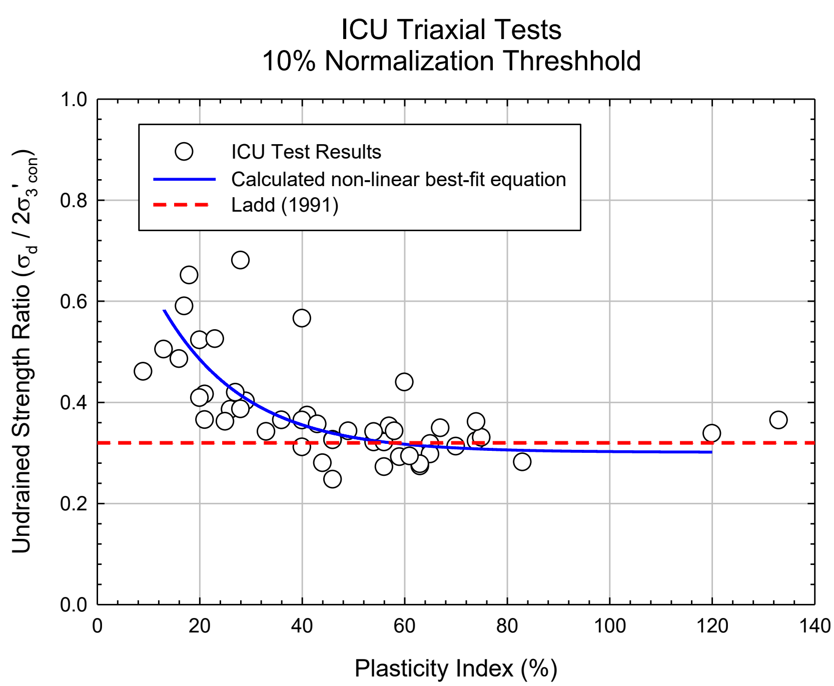


Figure 33 Undrained strength ratio as a function of PI for ICU triaxial tests where the samples met the ±10% normalization threshold.

Ladd's value of 0.32 serves as an adequate lower-bound for the undrained strength ratio for the CU triaxial tests, but is conservative for PI values less than 50. Figure 34 shows similar data plotted for the CU triaxial tests using the normalization threshold of ±5%. The general trends are the same. It should be noted that the undrained strength ratio determined from CU triaxial tests is normally too high to be used for design (Duncan and Wright 2005).

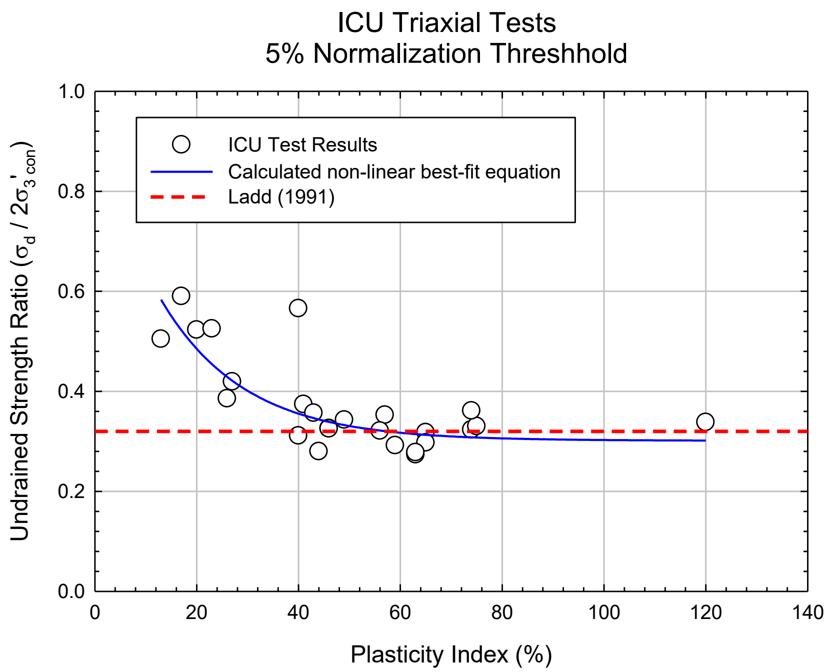


Figure 34 Undrained strength ratio as a function of PI for ICU triaxial tests where the samples met the ±5% normalization threshold.

Compressibility Correlations

Consolidation tests are used to simulate one-dimensional compression of a soil deposit in the field. The laboratory test specimens are loaded and monitored to determine several parameters used to characterize a soil's compressibility with respect to time and stress magnitude. For the New Orleans area test results assessed, the consolidation tests were run in accordance with ASTM D2435. The test procedure involves loading a nominally one-inch-tall undisturbed sample on its vertical axis while it is restrained in the horizontal direction by a stiff ring. Depending on the testing method, each load increment is applied for a specific time period or until the completion of primary consolidation. The test results normally include the following parameters which were analyzed in this study: preconsolidation pressure (P_p' or σ_p'), compression index (C_c), recompression index (C_r), coefficient of consolidation (c_v), and coefficient of secondary compression (c_α).

Consolidation Test Ranking System

There were approximately 50 consolidation tests each from seven different task orders assessed for this report. The task orders were chosen based on their size, the generally high quality of the test results submitted, and their geographic diversity within the New Orleans area. The test ranking system was developed based on qualitative and quantitative criteria. The ranking system progresses from 1 to 5 in increasing quality. It was difficult to have a strict quantitative ranking system, as the ranking required a considerable amount of qualitative individual judgment. For example, lean clays, organic clays, and peats tend to have generally lower quality test results and were given some leniency in the rating system. This leniency does not allow erroneous data to be included with good data but it simply allows these problematic soils to be evaluated and analyzed for any useful information.

For a ranking of 5 (best), the following criteria must be generally be satisfied.

- Strain upon reloading to in situ vertical effective stress (σ'_v) less than about 3%
- Saturation ≥ 95%
- Depth of sample ≥ 5 ft
- % Difference between P_p'(Casagrande) and P_p' (Sowers) ≤ 25%
- Well-defined break in the compression curve at transition from recompression to virgin compression (at P_p').
- Time increment for each load is sufficient to reach End of Primary (EOP) consolidation
- Smooth and reasonable shape for time rate of consolidation curves (time curves) at each load increment

For a ranking of 1 (worst), four or more of the criteria listed above were not satisfied. If 1 to 2 requirements were not satisfied, a rank of 4 was assigned. If 2 to 3 requirements were not satisfied, a rank of 3 was assigned. If 3 to 4 requirements were not satisfied, a rank of 2 was assigned.

In order to demonstrate the differences between the relative ranks, Examples 1, 2, and 3 are provided to show Rankings of 5, 3, and 1, respectively. The rating system is explained in detail below, with examples and explanations of each criterion.

Strain at σ_v'

Lunne et al. (1999) proposed using the vertical strain incurred as the sample is reloaded to the field vertical effective stress as measure of disturbance in a sample. Table 10 shows the scale developed by Lunne et al. to indicate varying levels of quality for an "undisturbed" sample. An axial strain threshold of 3% was used in this study.

Table 10 Criteria proposed by Lunne et al. (1999) to quantify sample disturbance in consolidation tests.

Overconsolidation Ratio	Axial Strain			
	Very Good to Excellent	Good to Fair	Poor	Very Poor
1-2	<0.04	0.04-0.07	0.07-0.14	>0.14
2-4	<0.03	0.03-0.05	0.05-0.10	>0.10

Figure 35 shows a high quality compression curve for a consolidation test conducted on Sample 8B from Boring ACE-14CU. When the sample was reloaded back to the in situ effective stress, only 2.4% vertical strain had been achieved. Figure 36 shows a compression curve from Sample 8B taken from Boring ACE-01CU indicating possible significant disturbance. When the test specimen was reloaded back to the in situ effective stress, a vertical strain of 12.7% had been achieved.

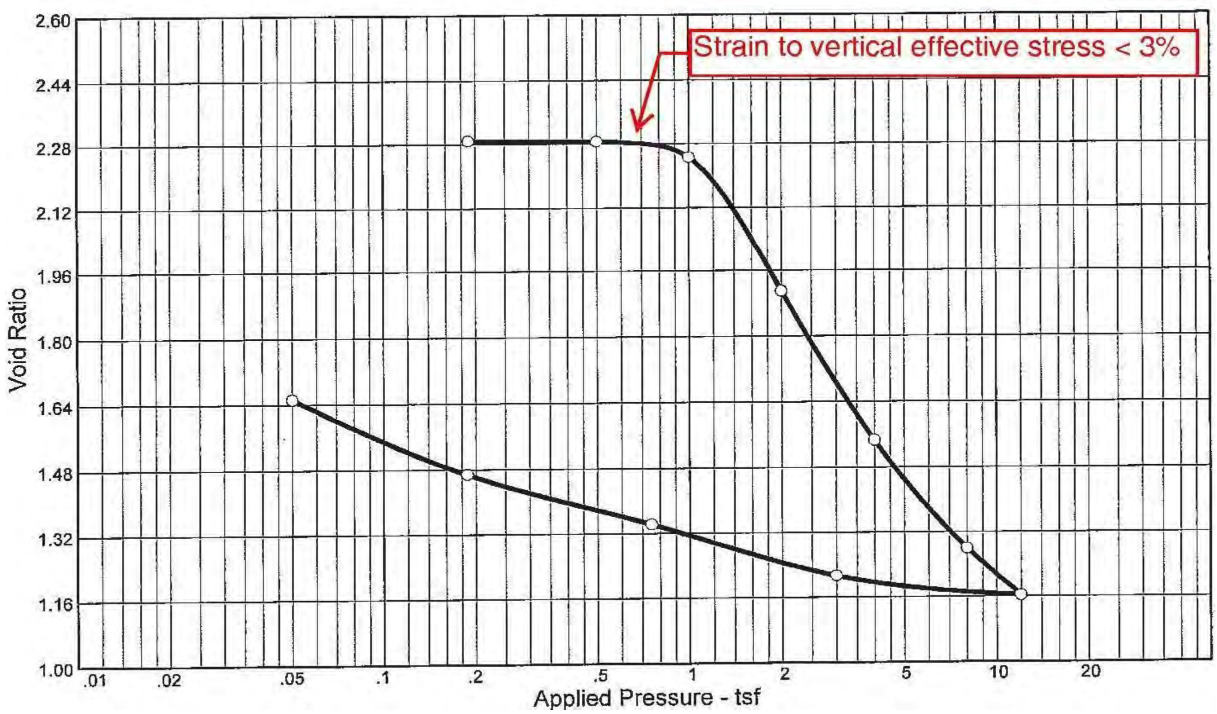


Figure 35 Example of compression curve satisfying the axial strain criterion (ACE-14CU Sample 8B).

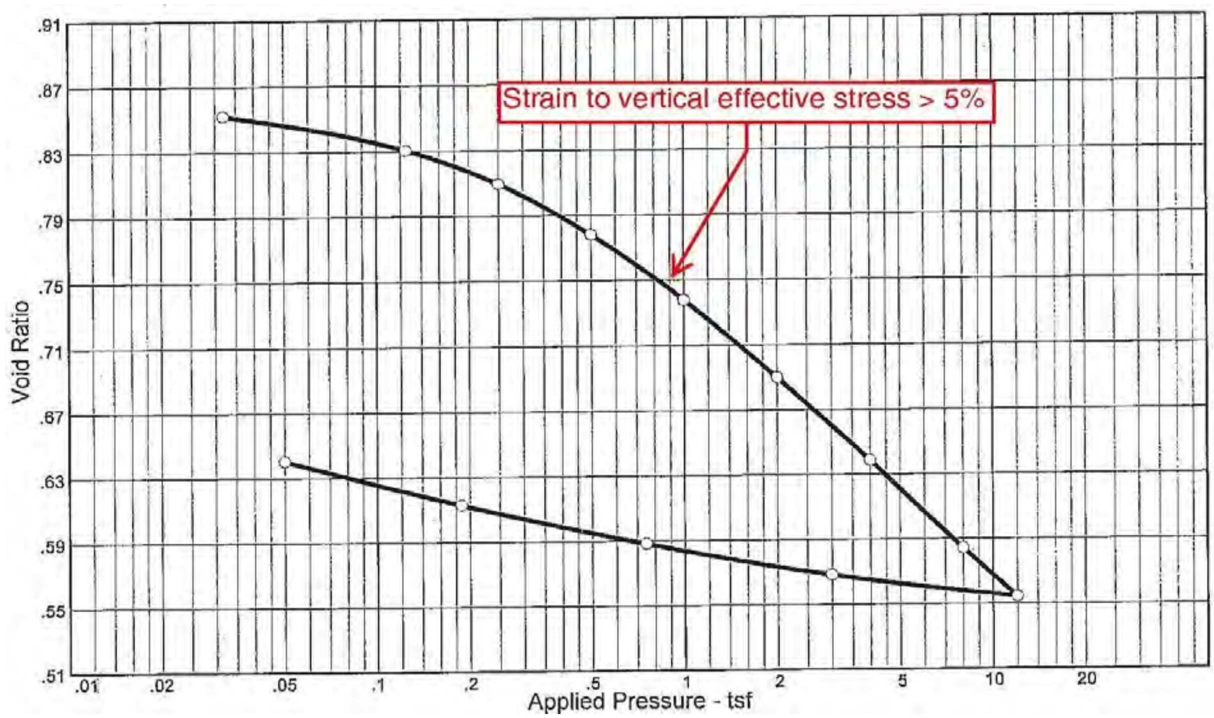


Figure 36 Example of compression curve exceeding the axial strain criterion (Sample 8B taken from Boring ACE-01CU).

Degree of Saturation

It is normally a prerequisite that consolidation test specimens are fully saturated. This requirement is used since Terzaghi's vertical consolidation theory was developed assuming the soil is fully saturated with an incompressible liquid. ASTM D2435 cautions that the c_v determination will be sensitive to the degree of saturation of the test specimen. Ducasse et al. (1986) note that c_v can be more than 10 times less for saturated soils than for partially saturated soils.

Depth of Sample > 5 ft

The depth criterion was implemented due to the fact that samples taken at shallow depths would normally have a lower degree of saturation. They are also more susceptible to disturbance due to the low confining stresses in the soil.

Percent difference between P_p'(Casagrande) and P_p'(Sowers) < 25%

The preconsolidation pressure was determined both using the well-known Casagrande procedure and the less-common Sowers (1970) procedure. The specific application of the Sowers procedure varies depending on the type of soil being tested. For low to moderate plasticity over-consolidated (OC) clay, Sowers recommended constructing tangent lines from the recompression and virgin compression zones and defining P_p' as their intersection. For sensitive clays or soils with a flocculated structure, Sowers recommended constructing a horizontal line from the initial void ratio (e_o) and a tangent line from the virgin compression zone and defining P_p' as their intersection.

Leonards (1962) showed that recompression curve for undisturbed, normally-consolidated clay should be nearly horizontal. In this study, Sowers' method for sensitive and flocculated clays was used. A comparison of the values was used as a means to quantitatively assess the repeatability of P_p'.

Figure 37 shows a compression curve for Sample 14C taken from Boring NOV10-23CU. The preconsolidation pressure determined using Casagrande's procedure is 1.20 tsf, and the preconsolidation pressure determined using Sowers' procedure is 1.08 tsf, which represents a difference of 10.0%. This difference indicates a test of reasonably high quality. The calculation of the vertical effective stress at the sample location indicates an underconsolidated test specimen, which does not appear likely at this site.

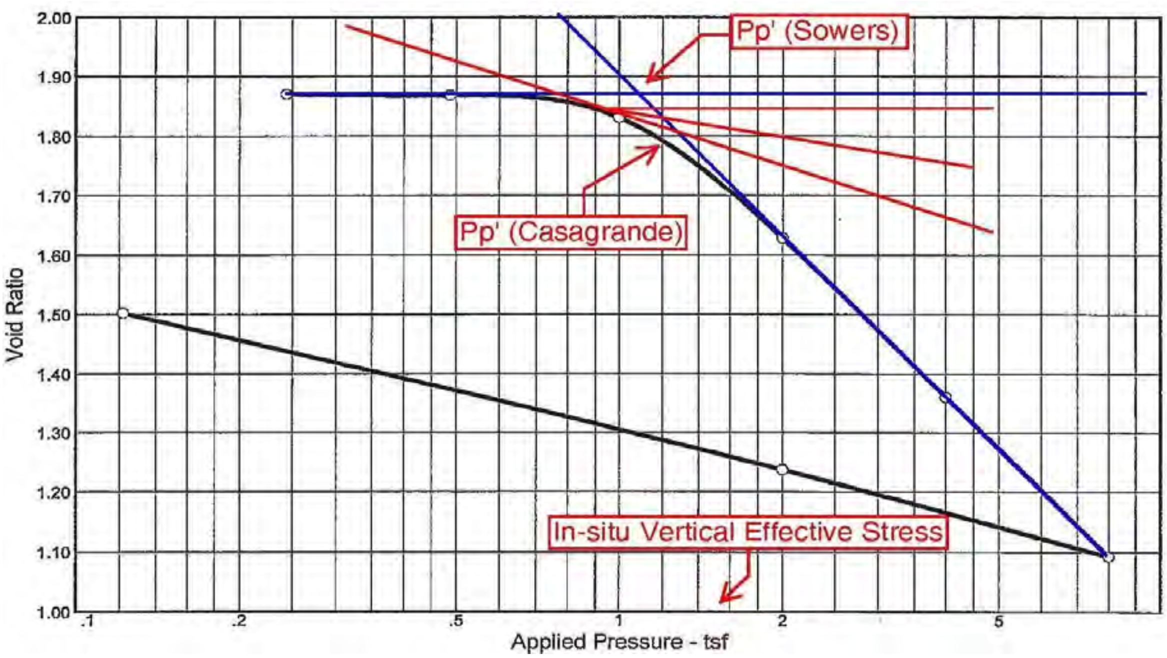


Figure 37 Determination of preconsolidation pressure with Casagrande's and Sowers' method.

Transition from recompression to virgin compression

A sharp transition from recompression to virgin compression, which is often called a well-defined point of maximum curvature, is the most immediately apparent of the ranking criteria upon visual observation of the test results. A numerical determination for this criterion is not easily implemented, therefore judgment is required. In most cases, the presence of a sharp break at P_p' indicates a high quality test. However, the lack of a sharp break is not always indicative of a low quality test, because silty test specimens may not exhibit a well-defined break (Becker et al. 1987).

Figure 38 shows a high quality test on Sample 9B taken from Boring JLF-23PU. Figure 39 shows a medium to low quality test on Sample 9D from Boring NOV10-28PU which could still be used in further analysis. Figure 40 shows a compression curve for Sample 6B taken from Boring IHNC-07-23PU with no distinguishable transition from recompression to virgin compression.

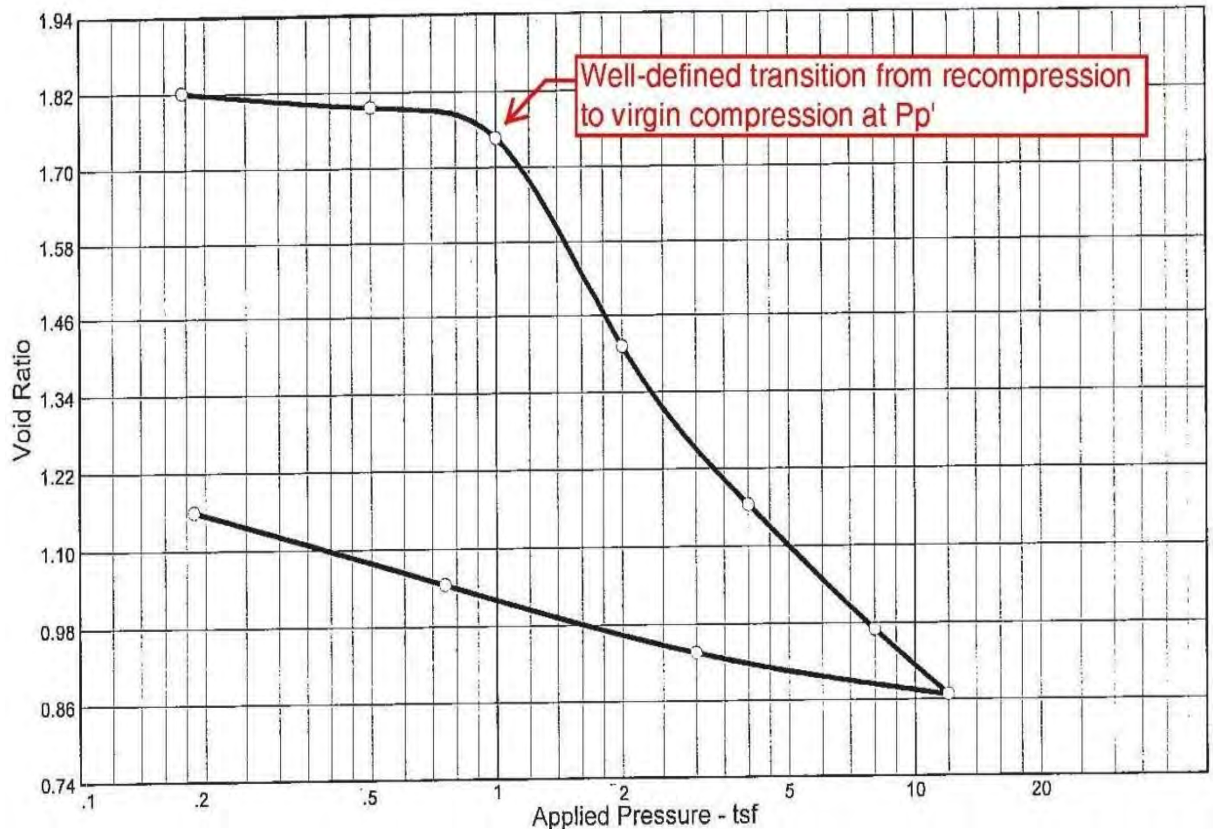


Figure 38 Compression curve with distinct transition from recompression to virgin compression at P_p' (Sample 9B from Boring JLF-23PU).

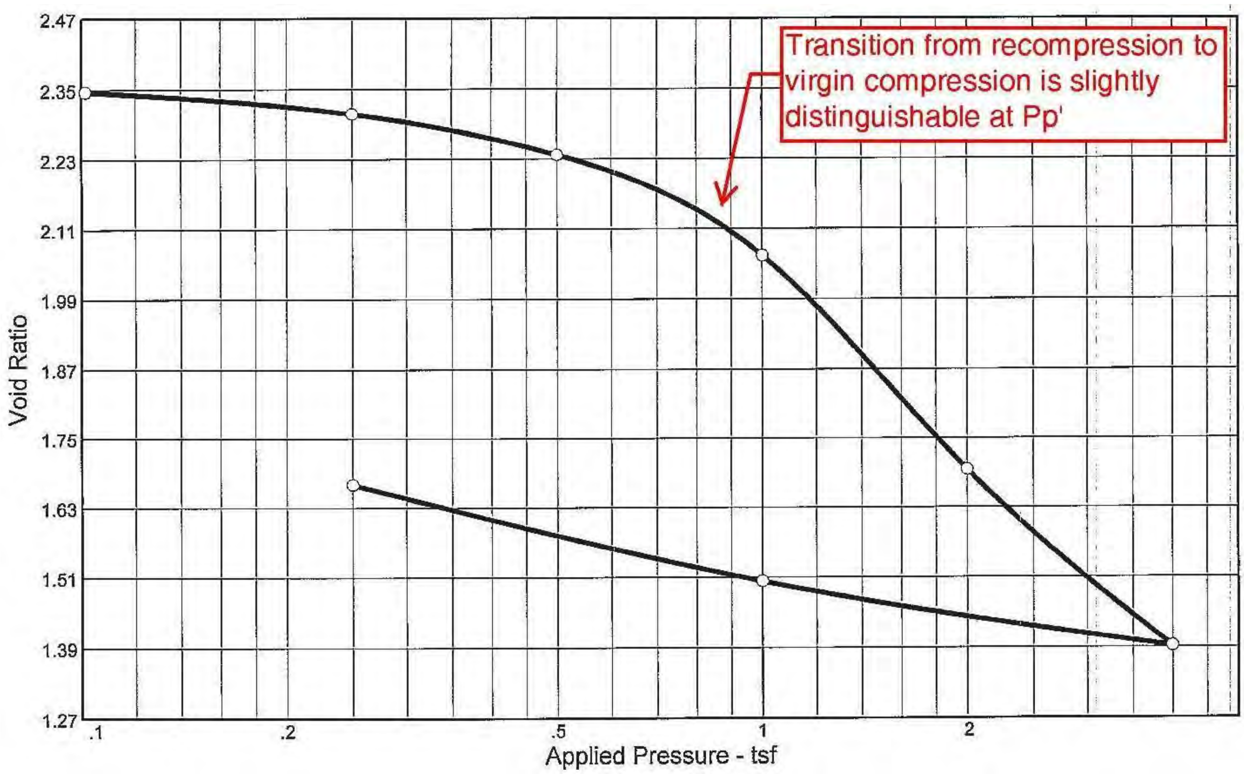


Figure 39 Compression curve with smooth transition from recompression to virgin compression at P_p' (Sample 9D from Boring NOV10-28PU).

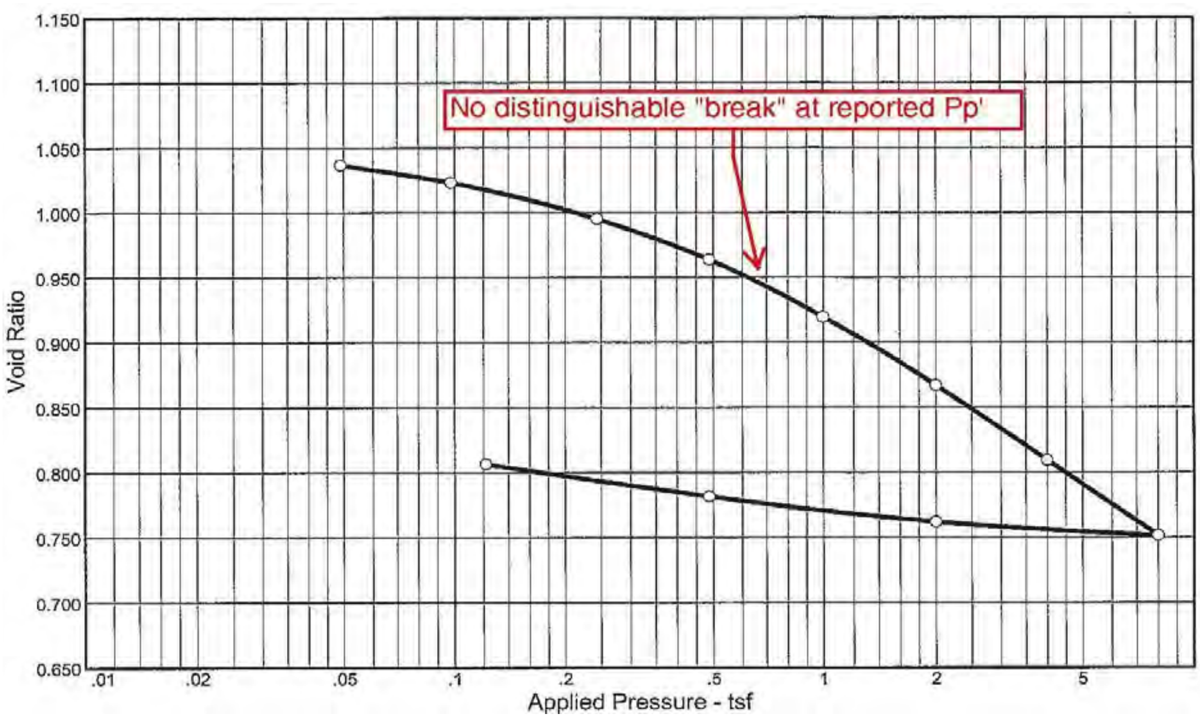


Figure 40 Compression curve indicating no distinguishable break in curve at P_p' (Sample 6B from Boring IHNC-07-23PU).

End of Primary Consolidation Achieved

The length of the time increment for each load increment affects both the compression curve and the time rate of consolidation parameters. ASTM D2435 suggests that the compression curve be constructed with the void ratios or strains at EOP. Some soils do not reach EOP after 24 hours, in which case larger time increments should be used. The choice of the time increment can greatly affect the calculation of the parameters c_v and c_α.

The parameter c_α is the slope of the time curve during secondary compression. This parameter is normally calculated automatically for each load increment by the software which creates the test summary. The software uses the last few points of the curve to calculate an approximate slope. If EOP is not achieved, then c_α is calculated for a portion of the curve which is typically steeper, thus overestimating c_α.

The Casagrande procedure for determining c_v is also affected by the choice of the time increment because this method uses this same slope to determine the time to EOP or 100% consolidation (t_{100}). Figure 41 and Figure 42 show time curves for Sample 6D taken from Boring JLF-03FU. Figure 41 shows a time curve which has reached EOP. Figure 42 shows a time curve which has not reached EOP. When EOP is not reached, it is obvious by looking at these figures that the calculated parameters are inaccurate.

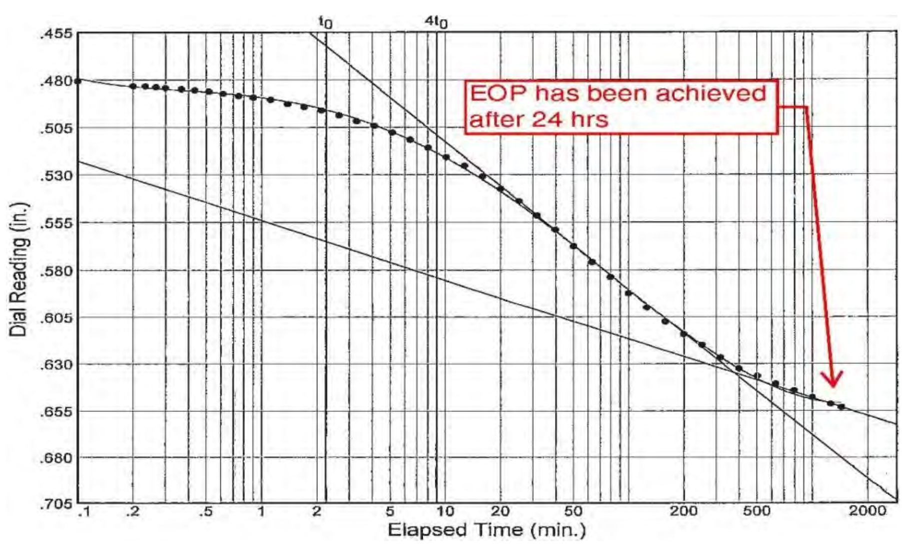


Figure 41 Time curve for load increment where EOP was achieved (Sample 6D taken from Boring JLF-03FU).

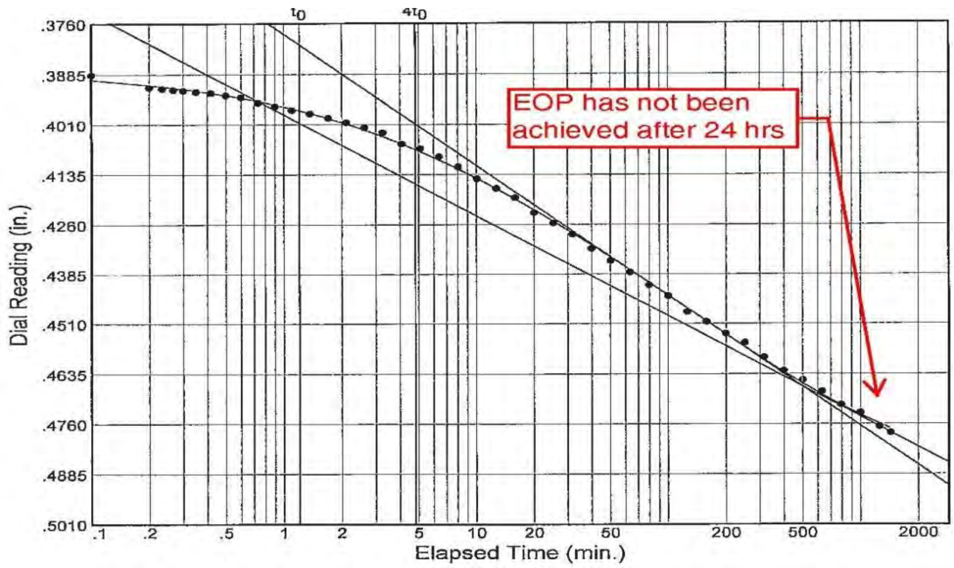


Figure 42 Time curve for load increment where EOP was not achieved (Sample 6D taken from Boring JLF-03FU).

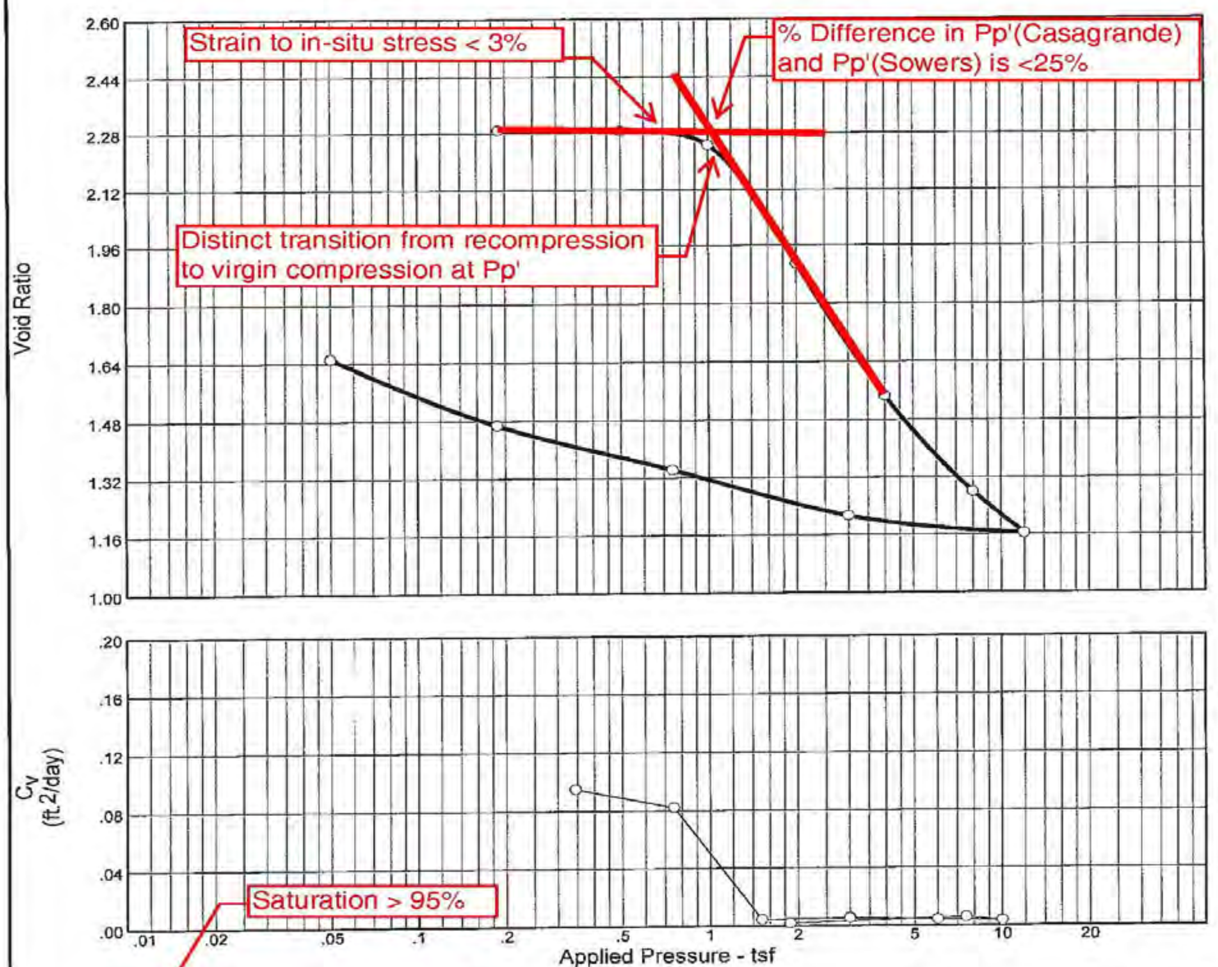
Smooth and correct shape for time curves at each load increment

Ideally, the displacement curves should exhibit a smooth S-shaped curve when plotted against the logarithm of time to ensure that the time rate of consolidation parameters can be accurately calculated. The organic clays and peats often have time curves which do not exhibit the expected shape in either the recompression or virgin compression range.

Example Consolidation Test Rankings

Shown in the following figures are examples of the ranking procedure for different tests. Figure 43 shows a compression curve that was ranked "5", and Figure 44 shows a time curve that was ranked "5." Figure 45 shows a compression curve that was ranked "3", and Figure 46 shows a time curve that was ranked “3.” Figure 47 shows a compression curve that was ranked “1”, and Figure 48 shows a time curve that was ranked “1.”

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
96.7 %	81.5 %	52.1	76	45	2.74	1.13	1.29	2.308

MATERIAL DESCRIPTION	USCS	AASHTO
M DGR CH4 W/ SIF, TR-O	CH4	

Project No. 0022-0004 **Client:** U.S. Army Corps of Engineers

Depth > 5 ft

Project: Algiers 100-yr Boring Program
Jefferson, Orleans & Plaquemines Parishes, LA

Source: ACE-14CU **Sample No.:** 8B **Elev./Depth:** 28.8

Specific gravity is assumed

Tested by: TB
Calculated by: WJY
Checked by: RNE

FFEBJV, LLC
St Rose, LA

Figure

Figure 43 Example of compression curve with "5" ranking.

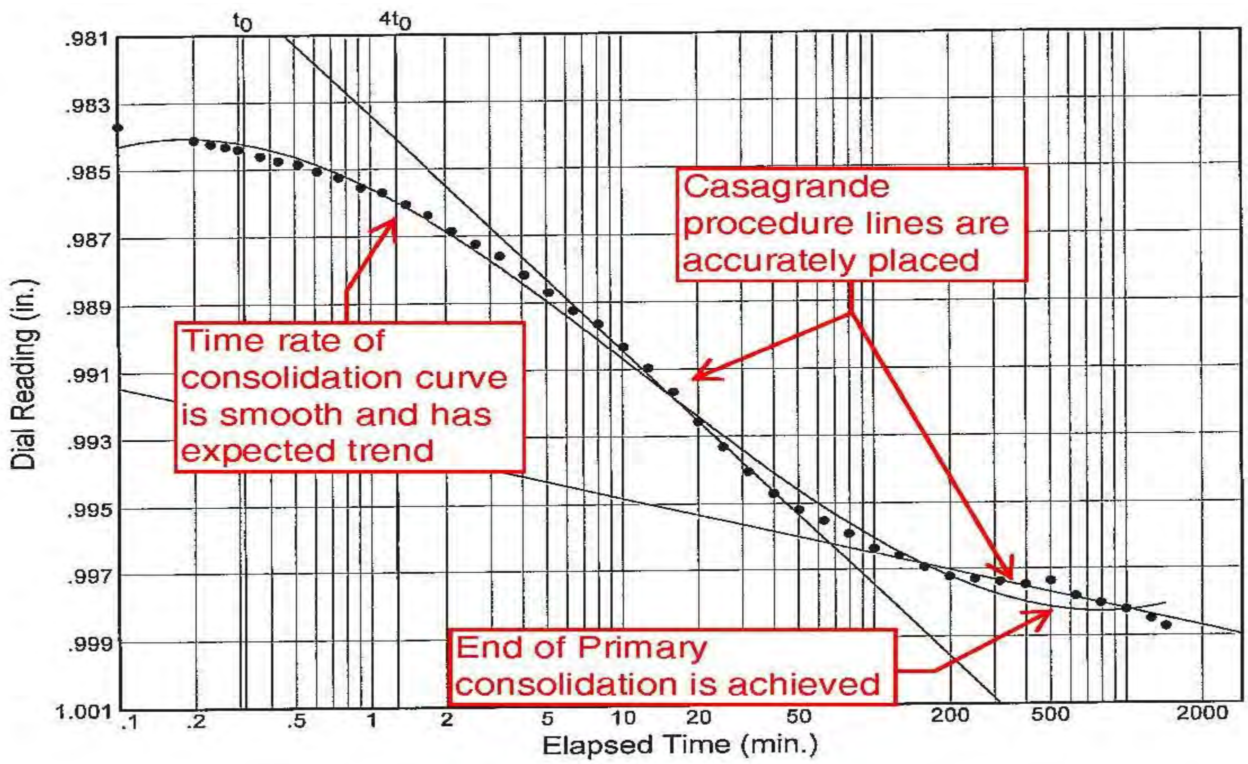
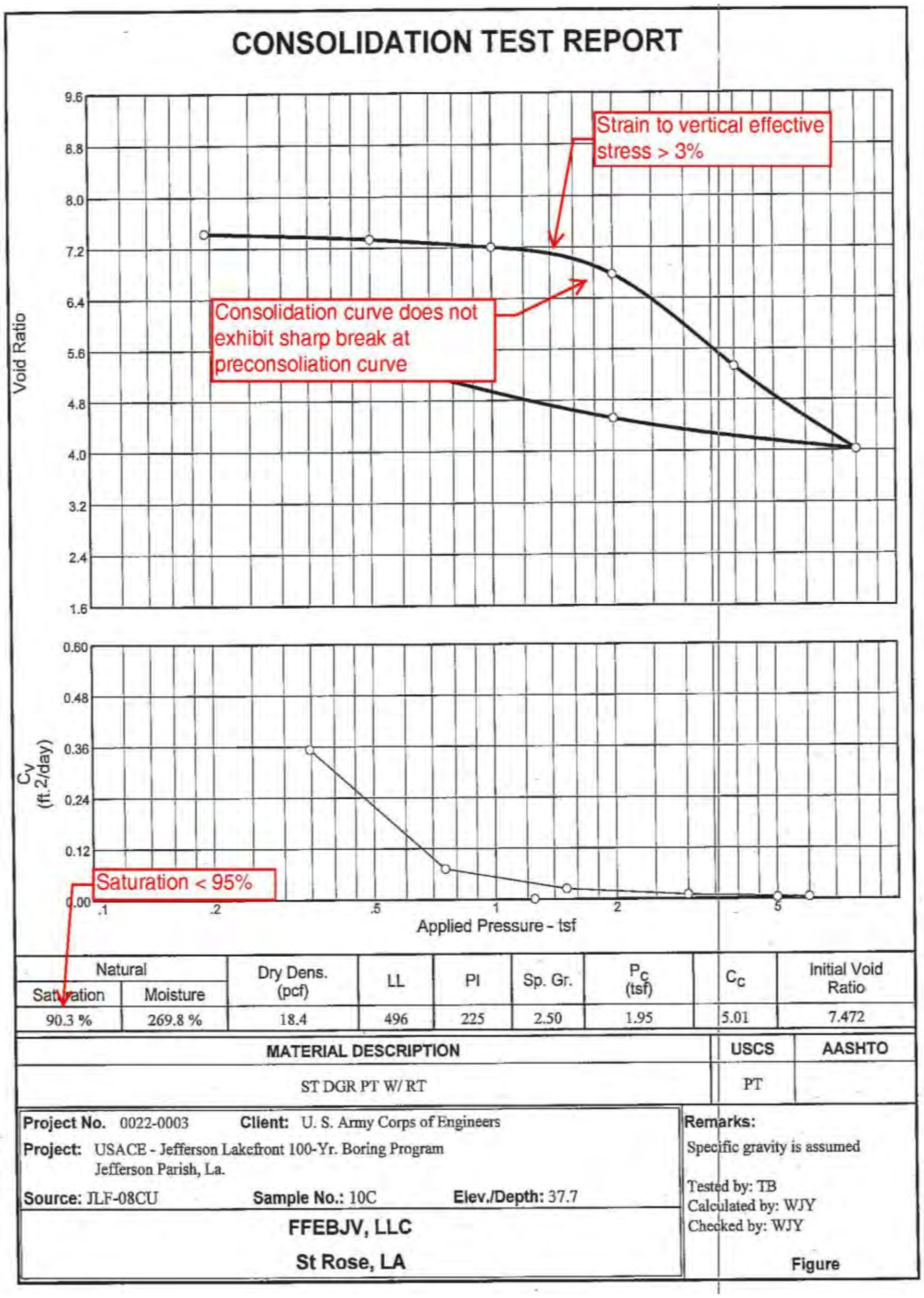


Figure 44 Example of time curve with "5" ranking.



Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
90.3 %	269.8 %	18.4	496	225	2.50	1.95	5.01	7.472

MATERIAL DESCRIPTION	USCS	AASHTO
ST DGR PT W/ RT	PT	

Project No. 0022-0003 **Client:** U. S. Army Corps of Engineers
Project: USACE - Jefferson Lakefront 100-Yr. Boring Program
Jefferson Parish, La.
Source: JLF-08CU **Sample No.:** 10C **Elev./Depth:** 37.7

FFEBJV, LLC
St Rose, LA

Remarks:
Specific gravity is assumed

Tested by: TB
Calculated by: WJY
Checked by: WJY

Figure

Figure 45 Example of compression curve with "3" ranking.

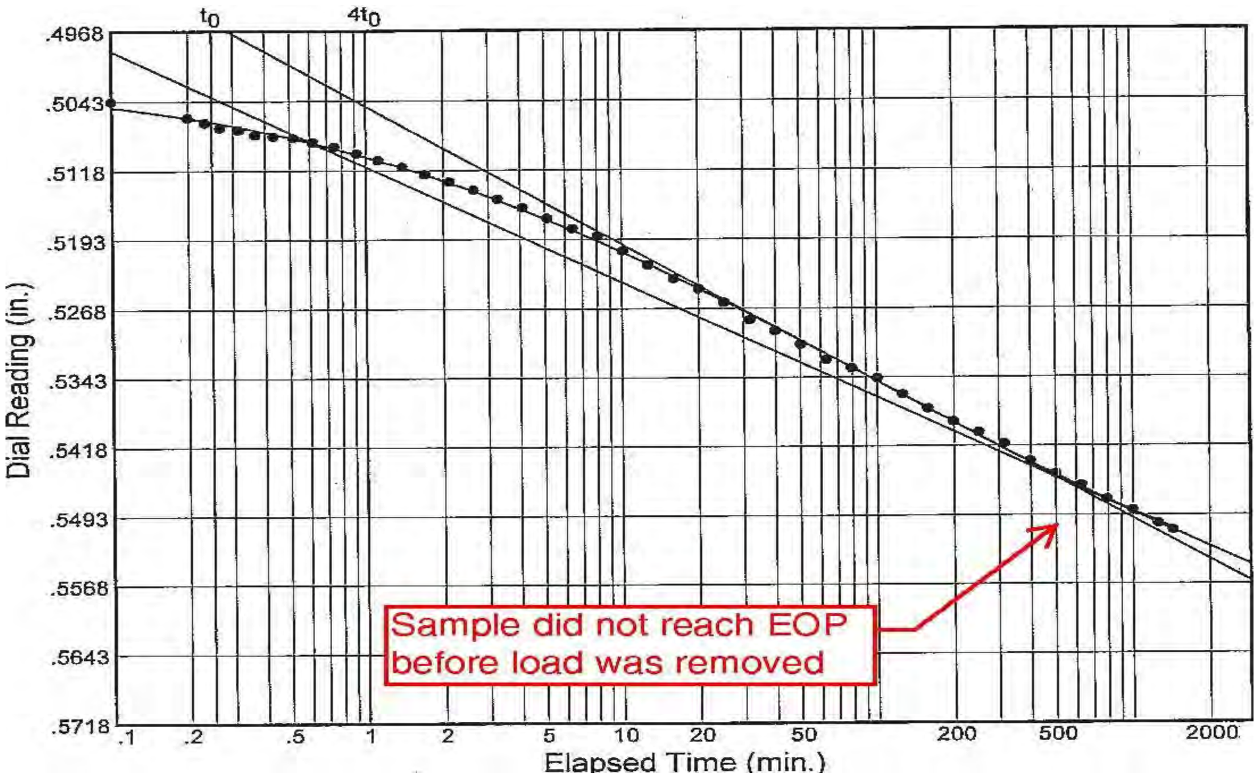


Figure 46 Example of time curve with "3" ranking.

Figure 47 Example of compression curve with "1" ranking.

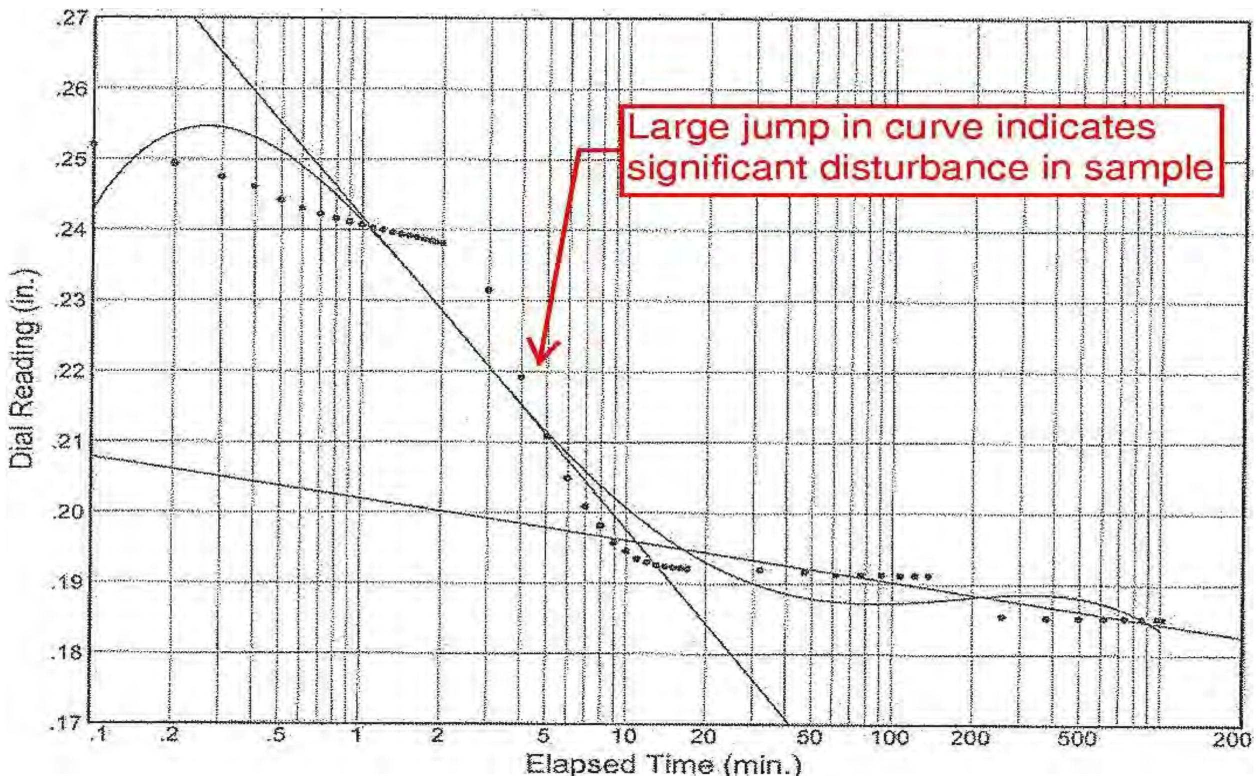


Figure 48 Example of time curve with "1" ranking.

Consolidation Tests Assessed

Correlations were developed using consolidation test results from eight task orders at seven different locations in the New Orleans area. The correlations were divided into two categories based on magnitude of settlement parameters and time rate of settlement parameters. In all cases, only tests ranked "3" or higher were used in the correlations.

Table 11 shows the number of tests analyzed and the ranking distributions for each soil type. Table 12 shows the number of tests analyzed from each task order and the number of tests ranked “3” or higher for each soil type. Task orders 9 and 17 are from approximately the same geographical area so they were combined in Table 12.

Table 11 Number of tests analyzed and ranking distribution for each soil type.

Soil Type	No. of Tests	No. in Ranking Categories				
		5	4	3	2	1
CH	241	16	119	88	18	0
CL	62	0	8	19	34	1
CHO	30	0	19	11	0	0
PT	73	4	35	23	9	2
Σ	406	20	181	141	61	3
% of Total		4.9%	44.6%	34.7%	15.0%	0.7%

Table 12 Number of tests analyzed and ranked “3” or higher for each task order.

Task Order	Soil Types							
	No. of Tests Analyzed				No. Ranked 3 or Higher			
	CH	CL	CHO	PT	CH	CL	CHO	PT
2	57	6	11	26	57	2	11	22
3	41	3	0	22	39	1	0	21
4	25	23	1	1	22	10	1	1
9 & 17	28	4	0	7	27	2	0	2
41	30	3	5	6	27	3	5	6
55	19	16	10	6	18	7	10	6
63	41	3	3	3	36	2	3	3

Soils that were classified as CHO and PT were typically distinguished from the other soil types by approximate boundaries at in situ water content (w_n) > 120%, liquid limit (LL) > 100%, plasticity index (PI) > 90%, and dry unit weight (γ_d) < 50 pcf. Results from the organic and inorganic soils were plotted separately in the majority of the correlations. In most cases, well-known correlations were plotted along with the data collected in this study.

Magnitude of Settlement Parameters

C_c and C_r are the main parameters associated with calculation of the magnitude of settlement. Table 13 shows published correlations of these parameters for various soil index parameters. The existing correlations were plotted along with regression equations developed in this study to determine their appropriateness for use with the New Orleans area soils.

In a report by the U.S. Army Corps of Engineers Waterways Experiment Station (USACE WES), Sherman and Hadjidakis (1962) developed correlations for fine-grained alluvial soils from the Mississippi River Valley. Equations 1 and 2 were developed as part of their report for the USACE which relates w_n to C_c for New Orleans soils with OCR $\leq$ 1.5 and OCR > 1.5.

Equation 3 was developed by Deubert (1982) from an assessment of over 1,000 consolidation test results on New Orleans area clays. Mesri and Ajlouni (2007) found that the compression index was related to the initial water content by a factor of 100 (Equation 4). Nishida (1956) developed the formula in Equation 5 for C_c as a function of initial water content (w_o) which he assumed to be equal to the natural water content, w_n. Nishida (1956) also developed Equation 6 for C_c as a function of e_o. However, this formula was developed assuming the soil grains were uniform rigid spheres. Hough (1957) developed Equations 7 and 8 for C_c as a function of e_o for fine-grained inorganic and organic soils, respectively. Elnaggar and Krizek (1970) developed Equation 9 for compression ratio ($C_{\varepsilon c}$) as a function of e_o. They recommended only using this equation for inorganic soils with $e_o \leq 2$.

Terzaghi and Peck's (1967) formula for C_c as a function of LL is shown in Equation 10. Their formula was based on Equation 11, created by Skempton (1944) for remolded soils. Terzaghi and Peck (1967) assumed that C_c for undisturbed soils was about 30% greater than that of C_c for remolded soils. Sherman and Hadjidakis (1962) also developed a correlation for C_c as a function of LL for Mississippi Valley soils, which is shown as Equation 12. Deubert (1982) developed Equations 13 and 14 relating C_c to LL and PI, respectively, from over 1,000 consolidation test results for New Orleans area clays. Correlations developed by Kulhawy and Mayne (1990) relating C_c and C_r to PI are included as Equations 15 and 16.

Table 13 Published correlations of C_c and C_r.

Eq. #	Equation	Notes	Reference
1	$C_c = 0.0259 \cdot w_n - 0.553$	OCR ≤ 1.5	Sherman and Hadjidakis (1962)
2	$C_c = 0.01038 \cdot w_n - 0.043$	OCR > 1.5	Sherman and Hadjidakis (1962)
3	$C_c = 0.014 \cdot w_n - 0.12$		Deubert (1982)
4	$C_c = w_n/100$		Mesri and Ajlouni (2007)
5	$C_c = 0.54 \cdot (2.6 \cdot w - 0.35)$	w in decimal form	Nishida (1956)
6	$C_c = 1.15 \cdot (e_o - 0.35)$		Nishida (1956)
7	$C_c = 0.29 \cdot (e_o - 0.27)$	Inorganic	Hough (1957)
8	$C_c = 0.35 \cdot (e_o - 0.50)$	Organic	Hough (1957)
9	$C_{\varepsilon c} = 0.156 \cdot e_o + 0.0107$	inorganic soils with $e_o \leq 2$	Elnaggar and Krizek (1970)
10	$C_c = 0.009 \cdot (LL - 10\%)$		Terzaghi and Peck's (1967)
11	$C_c = 0.007 \cdot (LL - 10\%)$		Skempton (1944)
12	$C_c = 0.011 \cdot (LL - 16\%)$		Sherman and Hadjidakis (1962)
13	$C_c = 0.009 \cdot LL - 0.10$		Deubert (1982)
14	$C_c = 0.010 \cdot PI - 0.06$		Deubert (1982)
15	$C_c = PI/73$		Kulhawy and Mayne (1990)
16	$C_r = PI/385$		Kulhawy and Mayne (1990)

According to Holtz and Kovacs (1981), C_r can be assumed as 5% to 10% of C_c. Leonards (1976) notes that that C_r values between 0.015 and 0.035 are the most common. Leonards (1976) further states that $C_r < 0.005$ and $C_r > 0.05$ are not common and should be re-examined. Figure 49 shows a plot of C_r as a function of C_c with lines following Holtz and Kovacs' recommendation along with actual test results. A simple regression analysis on all of the data show that C_r is approximately 20% of C_c for New Orleans area soils, in contrast to the recommendation by Holtz and Kovacs that C_r is 5% to 10% of C_c. Additionally, it is apparent that C_r can greatly exceed the upper limit of 0.035 recommended by Leonards (1976).

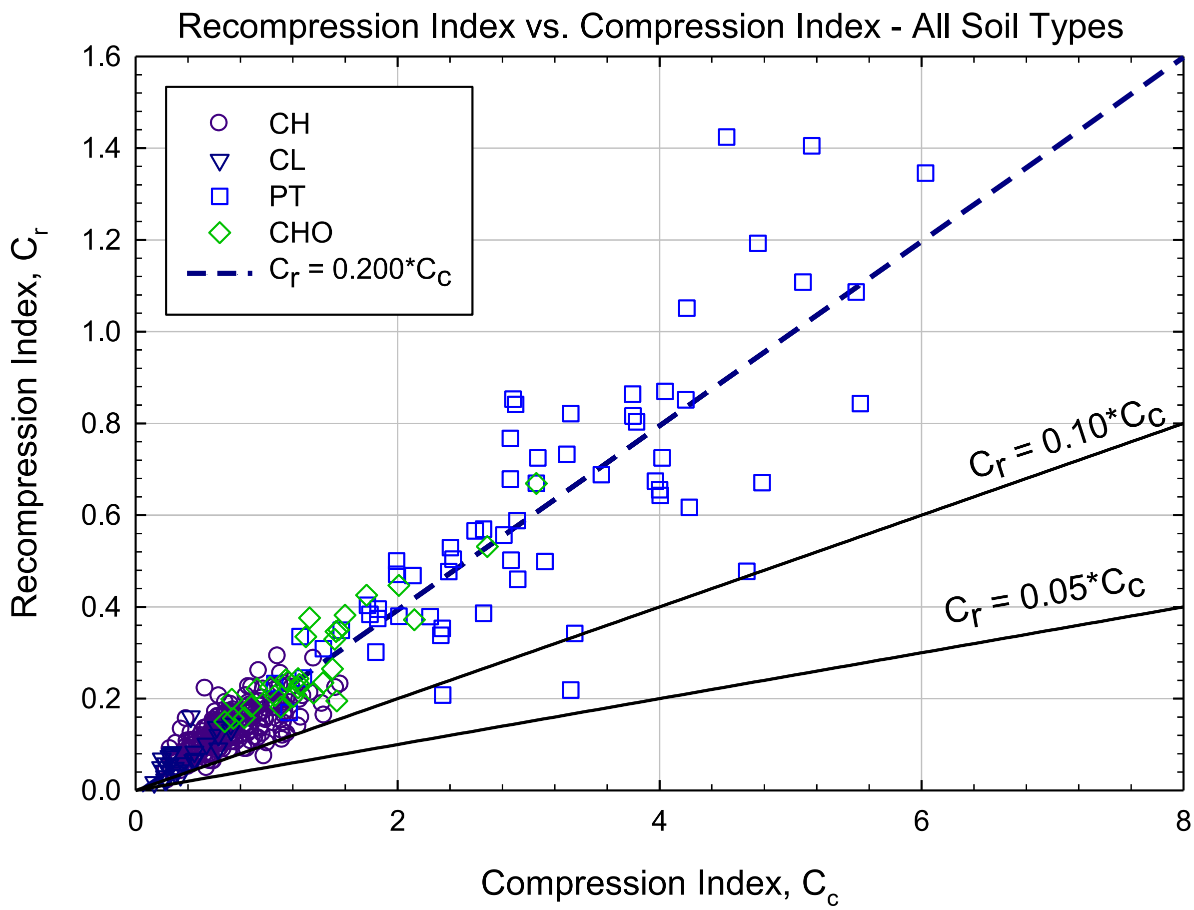


Figure 49 Recompression index vs. compression index for all soil types ranked 3 to 5.

Consolidation Test Correlation Plots

Due to the fact that the values of C_c and C_r can vary greatly depending on soil type, in this report, they generally have been assessed separately for organic (CHO and PT) and inorganic (CH and CL) soils.

Figure 50 and Figure 51 show plots of C_c as a function of w_n for inorganic clays (CH and CL) and organic soils (CHO and PT), respectively. Plotted with the data are the relevant published correlations listed in Table 13. Based on the test data, it seems that the Sherman and Hadjidakis (1962) correlation overpredicts the compression index. For the inorganic clays (Figure 50), the equations proposed by Nishida (1956) and Deubert (1982) fit the data reasonably well. For the organic clays (Figure 51) the Nishida (1956) equation provides an adequate fit to the data.

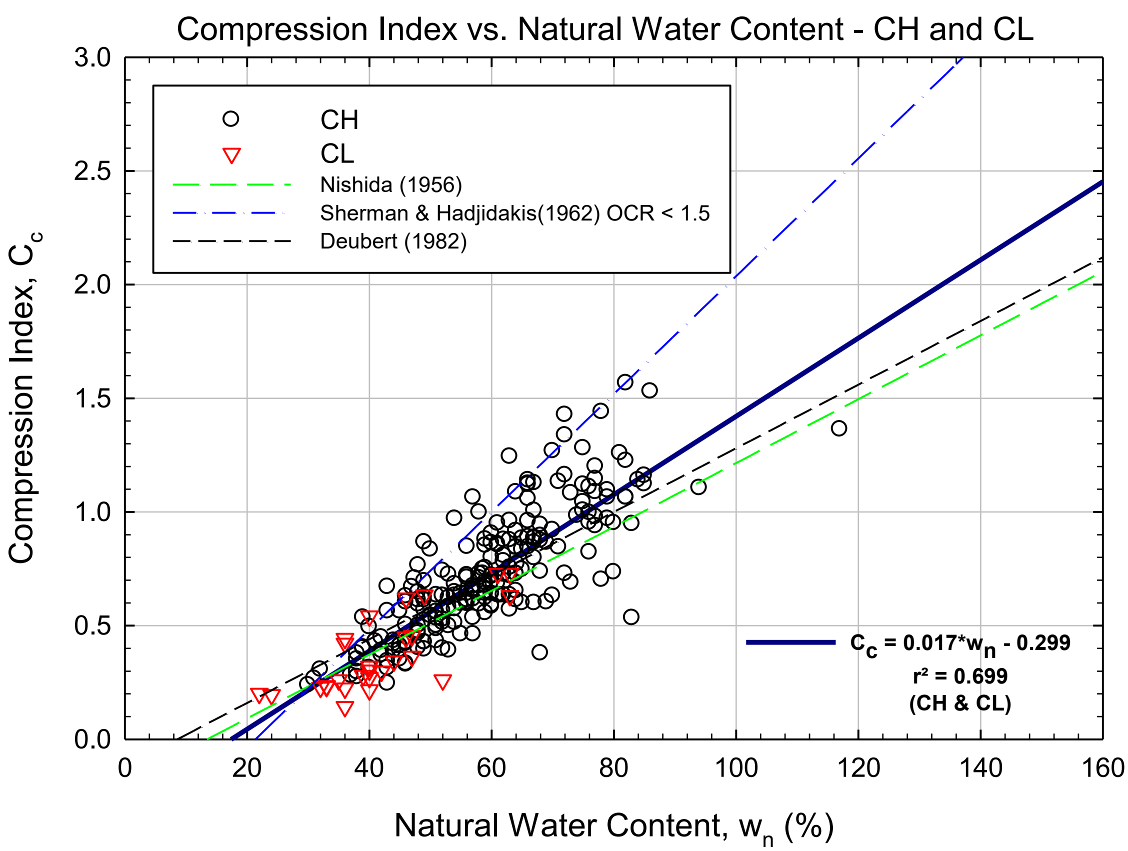


Figure 50 Compression index versus natural water content for CH and CL soils.

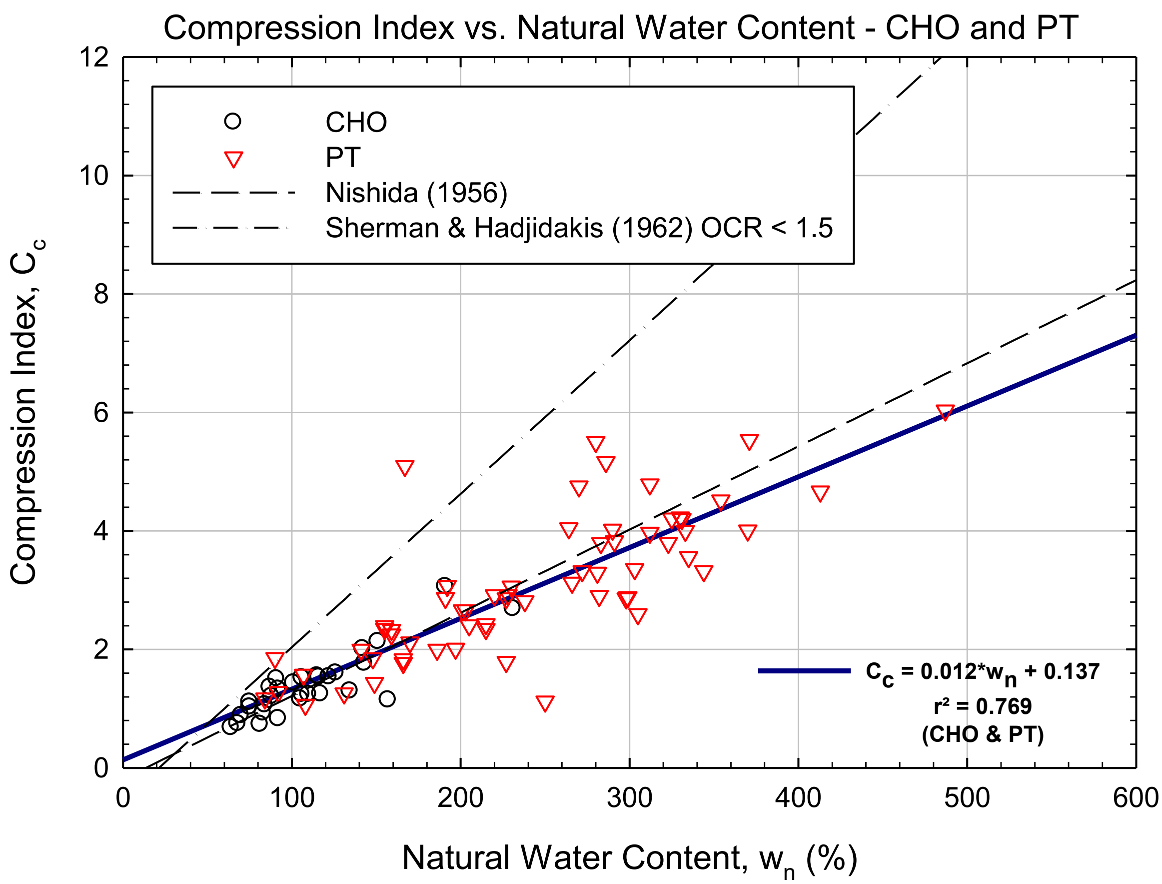


Figure 51 Compression index versus natural water content for CHO and PT soils.

Best-fit linear regression lines were calculated for both the organic and inorganic clays. For the CL and CH soils, the equation for compression index is:

$$C_c = 0.017 \cdot w_n - 0.299$$

with w_n expressed as a percentage.

For CHO and PT soils, the calculated equation is:

$$C_c = 0.012 \cdot w_n + 0.137$$

Mesri et al. (1997) showed that there is an approximate linear relationship between the logarithm of compression index and the logarithm of water content, with the compression index being approximately equal to the decimal value of the water content. This plot is shown for the New Orleans data in Figure 52. However, this correlation is not as accurate as the previous correlations presented for water content which incorporate an intercept into the linear relationship.

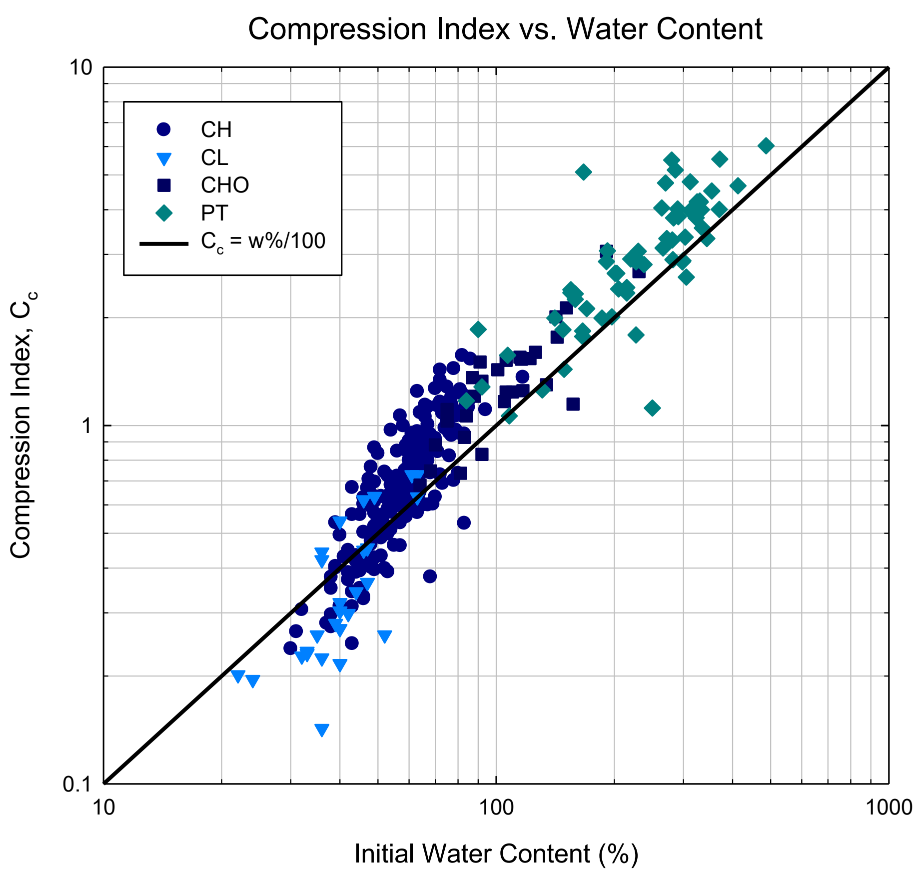


Figure 52 Log-log plot of compression index and water content for all soil types.

Figure 53 and Figure 54 show plots of C_c as a function of e_o for inorganic clays and organic soils, respectively. Also shown on the plots are the published correlations from Nishida (1956) and Hough (1957), along with a best-fit line calculated for the data set. It is apparent that the Nishida correlation overestimates C_c and the Hough correlation underestimates C_c.

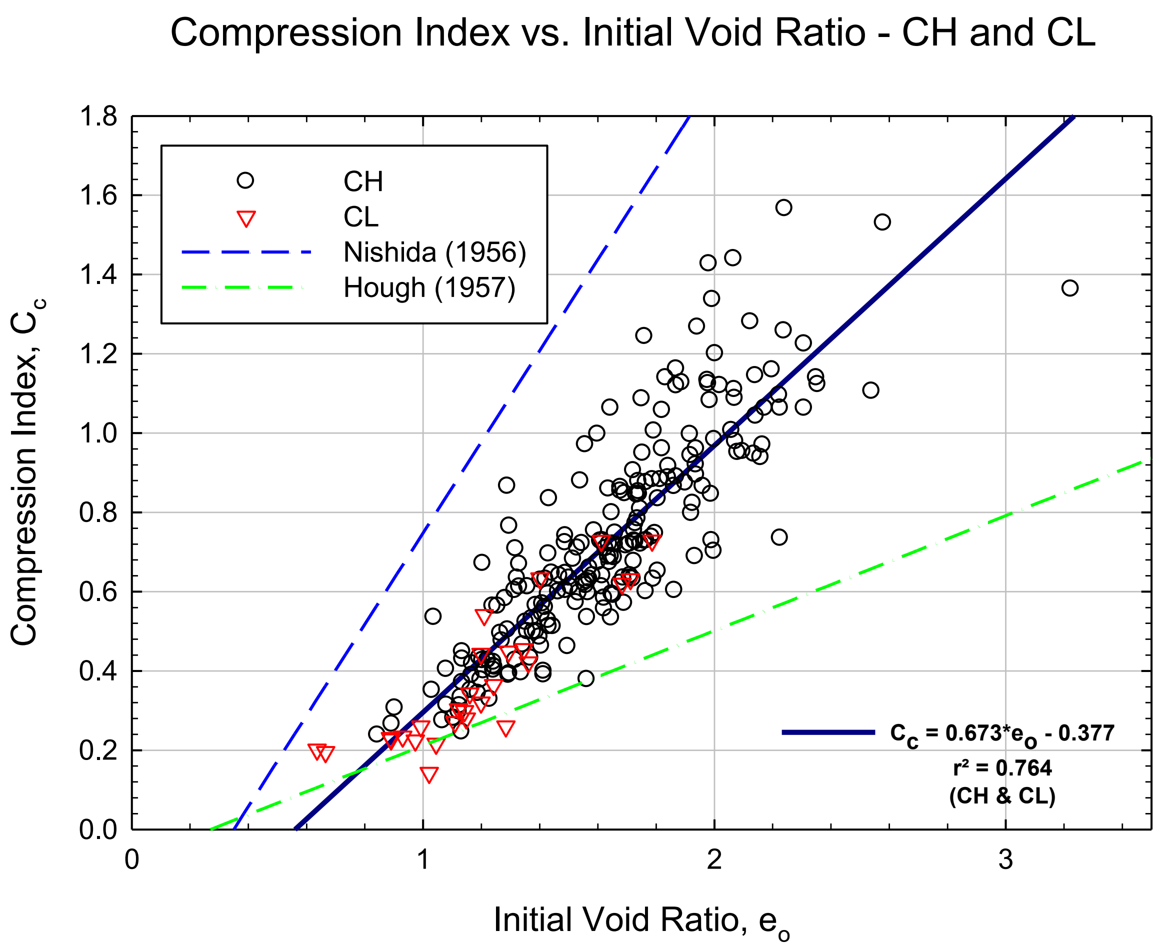


Figure 53 Compression index vs. initial void ratio for CH and CL soils.

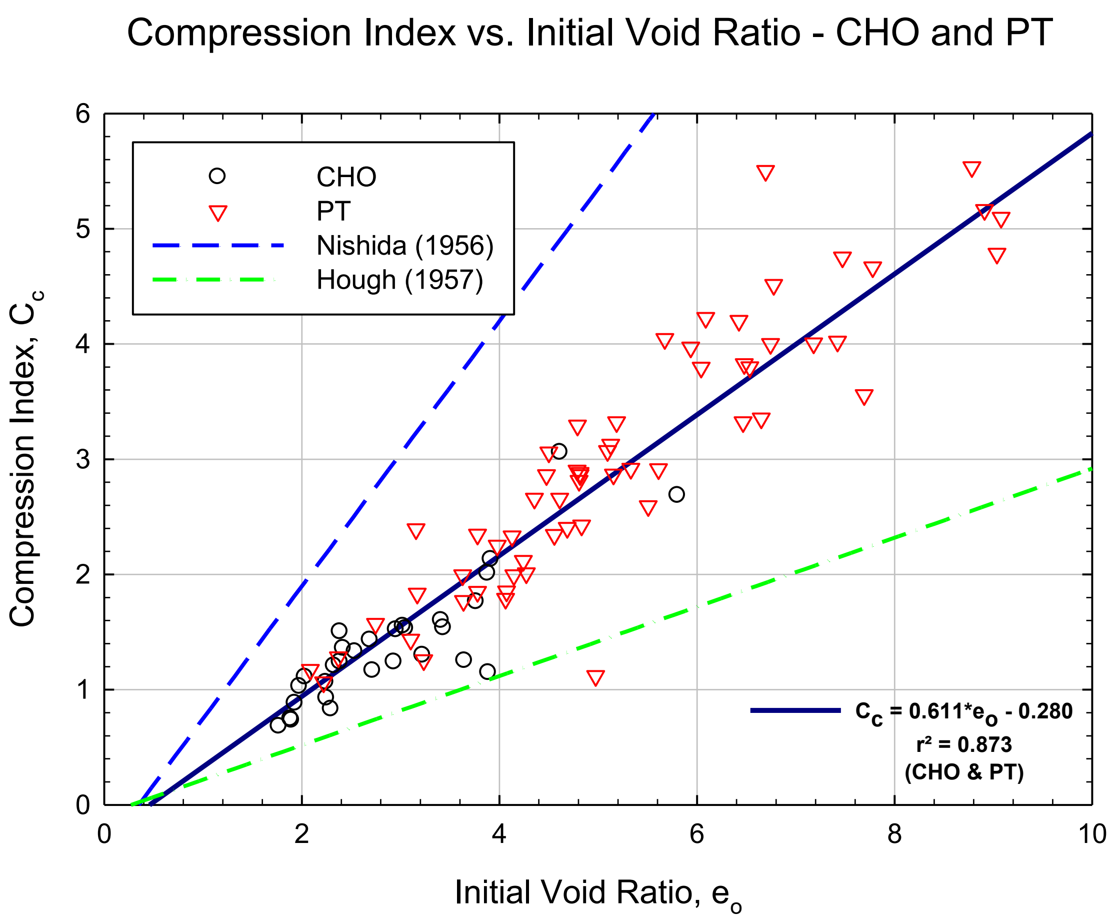


Figure 54 Compression index vs. initial void ratio for CHO and PT soils.

For the CL and CH soils, the equation for compression index as a function of void ratio is:

$$C_c = 0.673 \cdot e_o - 0.377$$

For CHO and PT soils, the calculated equation is:

$$C_c = 0.611 \cdot e_o - 0.280$$

The correlation proposed by Elnaggar and Krizek (1970) expressed the compression ratio ($C_{\varepsilon c}$) as a function of the initial void ratio. Values of the compression ratio were not supplied as part of the consolidation test reports, but could readily be calculated with the information input during the test evaluations. Shown in Figure 55 is the compression ratio determined for CH and CL soils as a function of the initial void ratio. As evident from the figure, the Elnaggar and Krizek (1970) correlation is virtually identical to the best-fit line calculated for the data set. Figure 56 shows the results from the organic soils, and the Elnaggar and Krizek (1970) correlation did not fare as well in predicting the compression ratio. This is not unexpected since Elnaggar and Krizek state that their correlation is best applied to inorganic soils with initial void ratios less than 1.5.

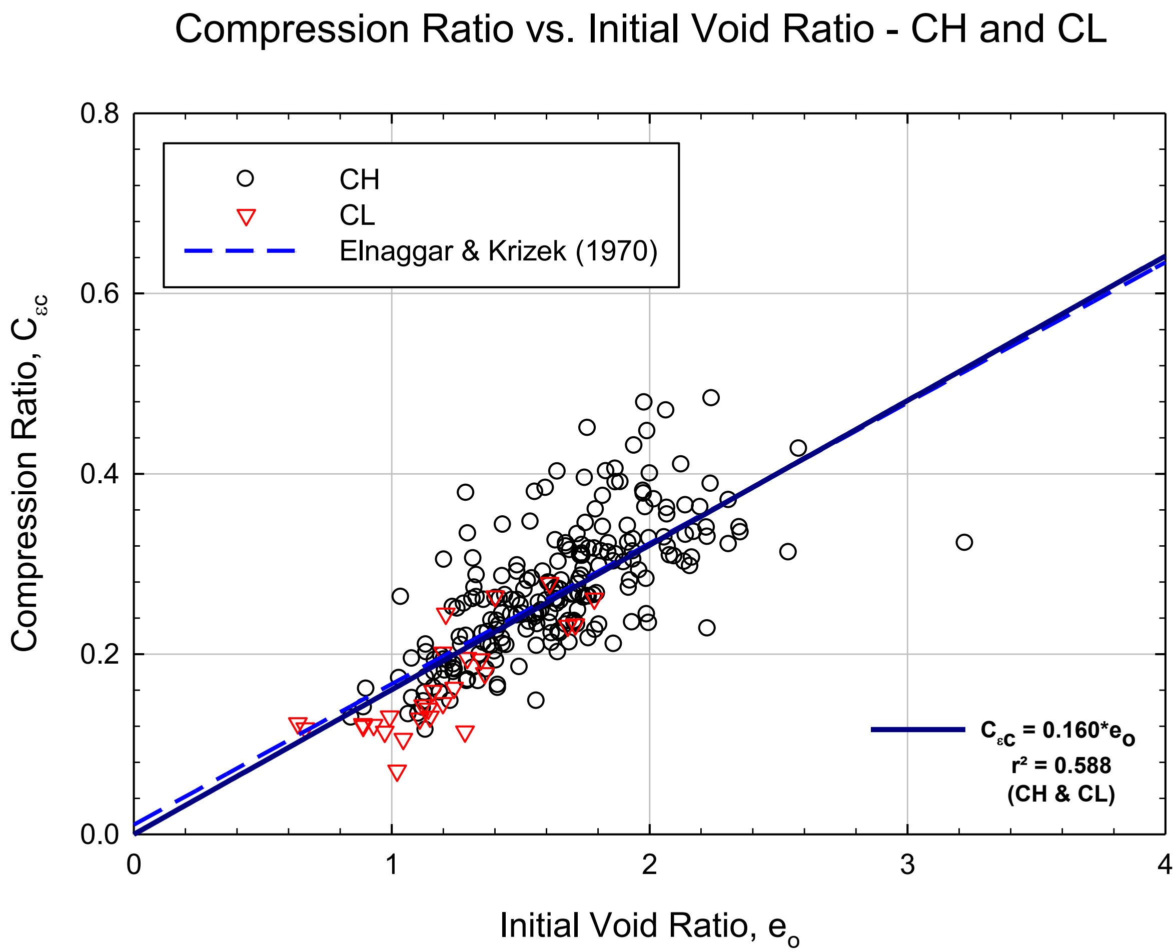


Figure 55 Compression ratio versus initial void ratio for CH and CL soils.

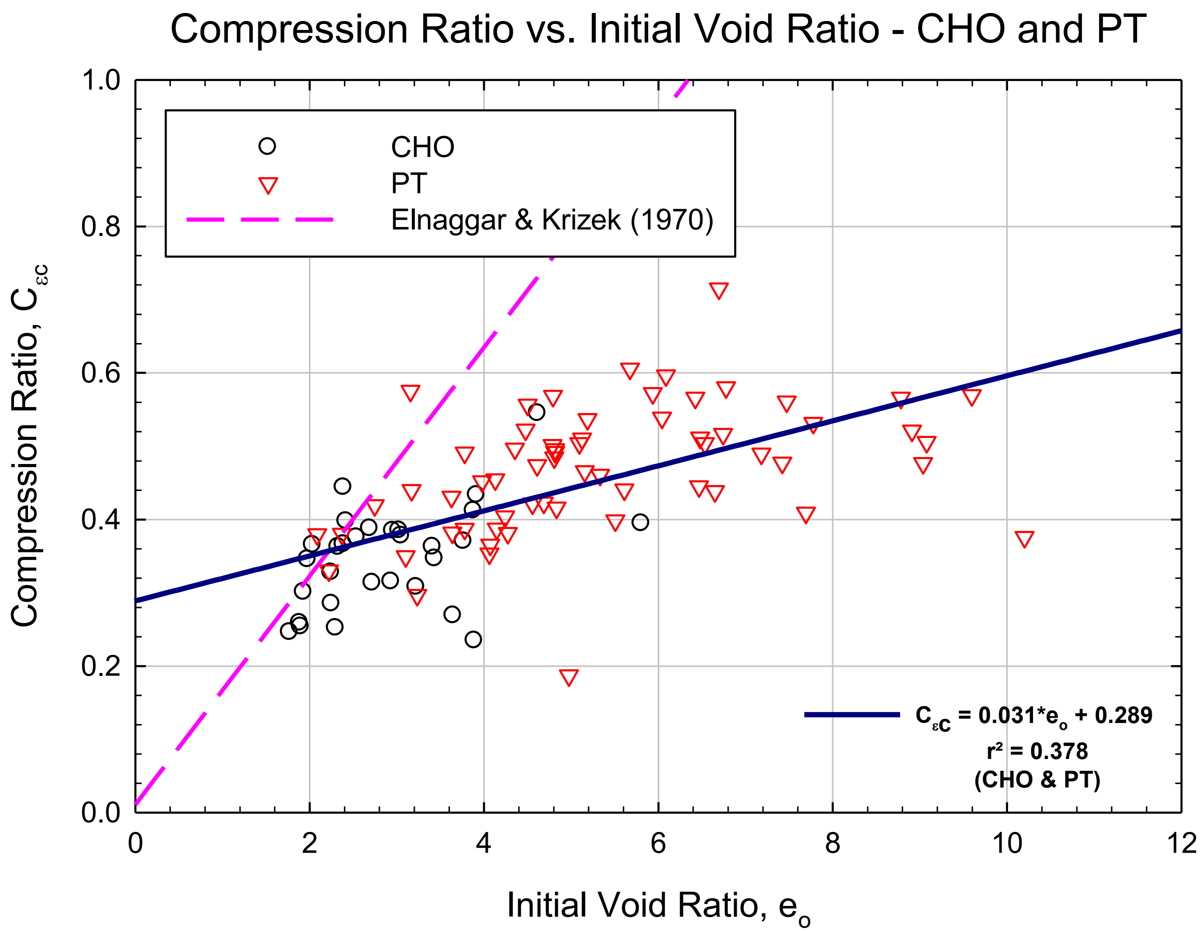


Figure 56 Compression ratio versus initial void ratio for CHO and PT soils.

If statistically valid relationships exist for compression index as a function of both water content and initial void ratio, then it can be expected that valid relationships would also exist for correlations of compression index to dry unit weight or dry density. The dry density of a soil is a function of the void ratio and specific gravity of soils. Likewise, the void ratio of a saturated soil is a function of the water content and specific gravity.

Plotted in Figure 57 is the compression index versus dry unit weight for CH and CL soils. An exponential decay function best fits the data, and can be written as follows:

$$C_c = 8 \cdot e^{-0.038\gamma_d}$$

with γ_d given in units of pounds per cubic ft.

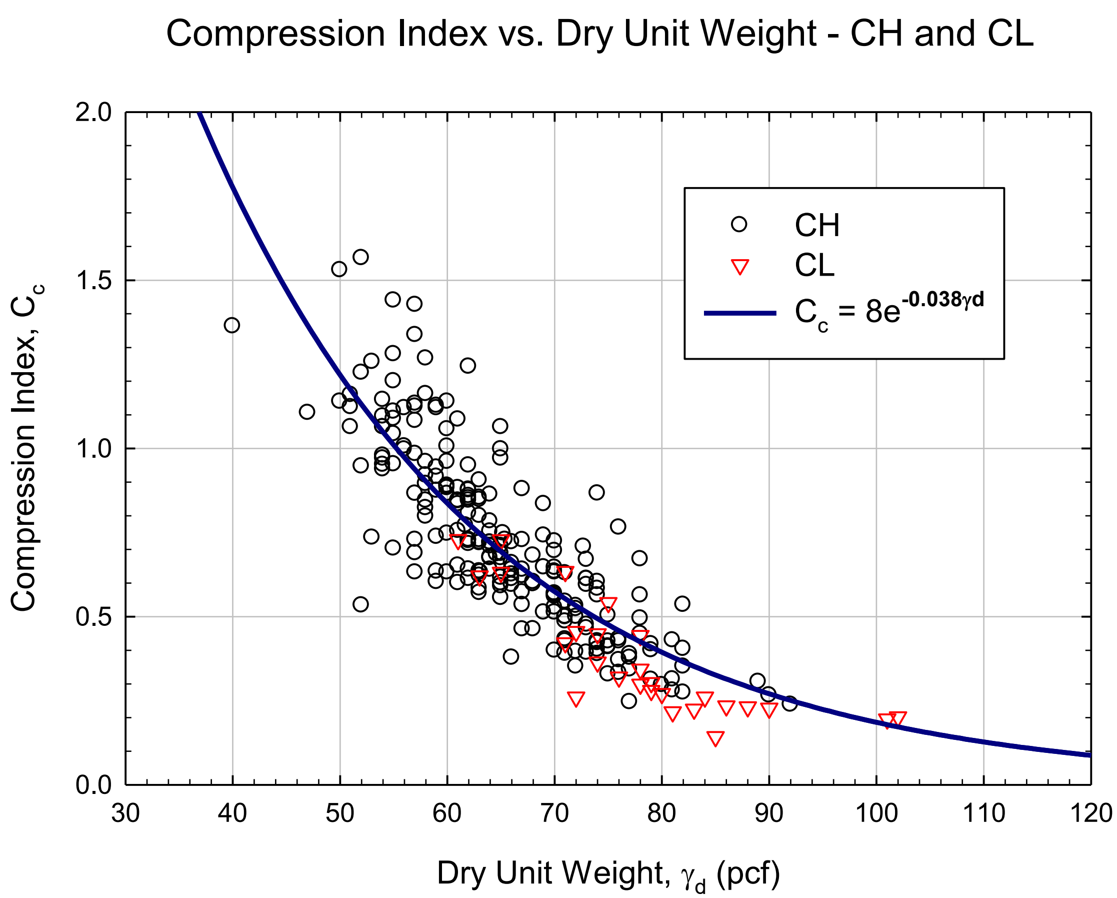


Figure 57 Compression index versus dry unit weight for CH and CL soils.

A similar equation can be developed for the organic soils. Figure 58 shows a plot of compression index versus dry unit weight for the CHO and PT soils in the database.

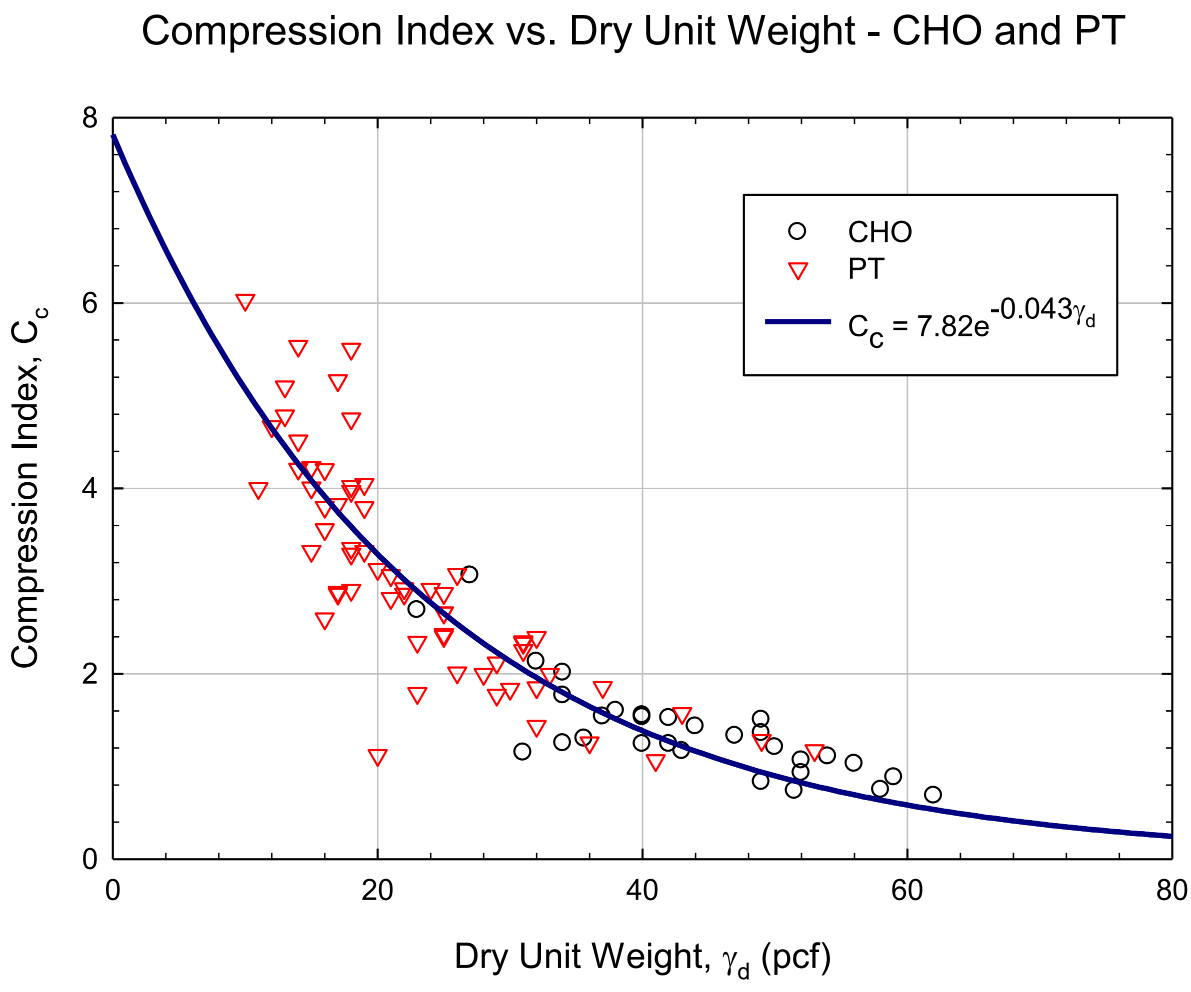


Figure 58 Compression index versus dry unit weight for CHO and PT soils.

The equation for the organic soils can be written as follows:

$$C_c = 7.82 \cdot e^{-0.043\gamma_d}$$

with γ_d given in units of pounds per cubic ft.

The remaining published correlations given in Table 13 are based on the plasticity characteristics of the soil. Figure 59 is a plot of C_c versus LL for CL and CH soils, along with the relevant correlations from Table 13.

Skempton's (1944) correlation was developed for remolded clays; therefore it is reasonable that the equation underestimates C_c for this data set for all soil types. The Terzaghi and Peck (1967) correlation and the Deubert (1982) correlation are nearly identical. These correlations and the Sherman and Hadjidakis (1962) correlation follow the general trend of the data; however, a great deal of scatter exists in the data set, and it is difficult to discern a strong linear trend.

Separate linear equations for calculated for the CL and CH soils, and these are given below:

$$\text{CH} \quad C_c = 0.0085\ (LL + 9.5)$$

$$\text{CL} \quad C_c = 0.018\ (LL - 19.6)$$

Figure 60 shows similar results for the CHO and PT soils. Again, there appears to be no strong linear trends of C_c with LL. The calculated linear relationship was:

$$\text{CHO and PT} \quad C_c = 0.0.0067\ (LL + 95)$$

However, the calculated relationship does not appear to be a significant improvement over the published relationships shown on the plot. It seems that correlations of C_c with LL are only approximate at best.

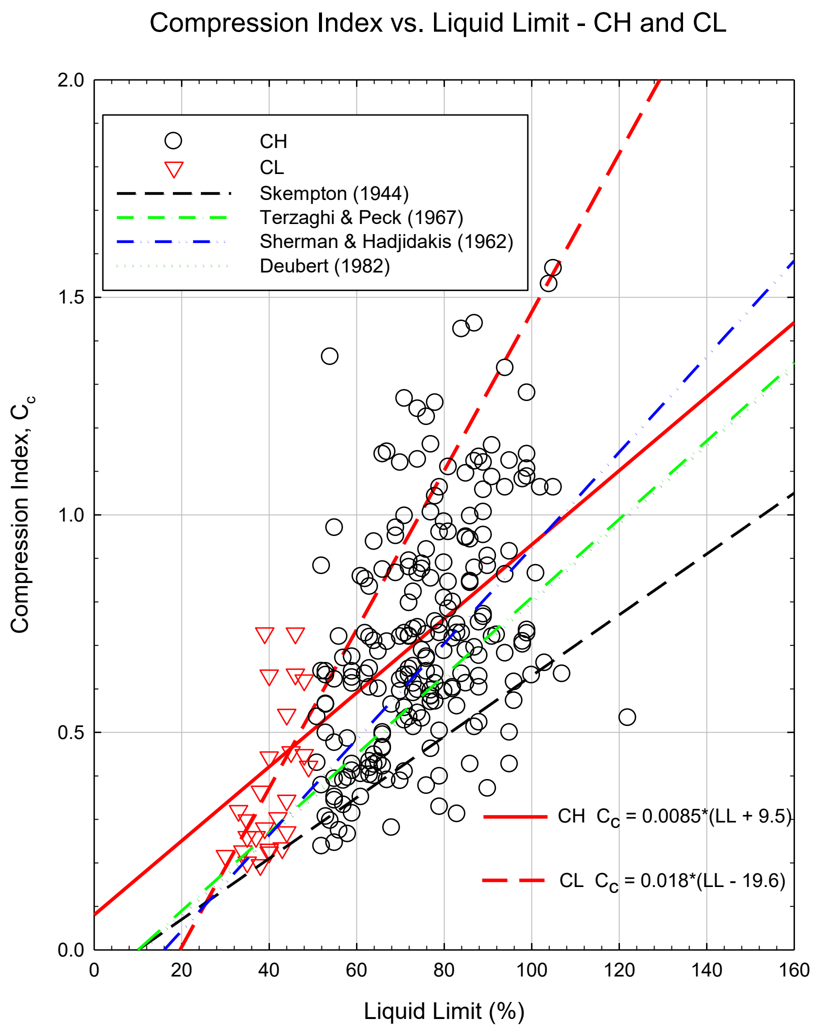


Figure 59 Compression index as a function of liquid limit for CH and CL soils.

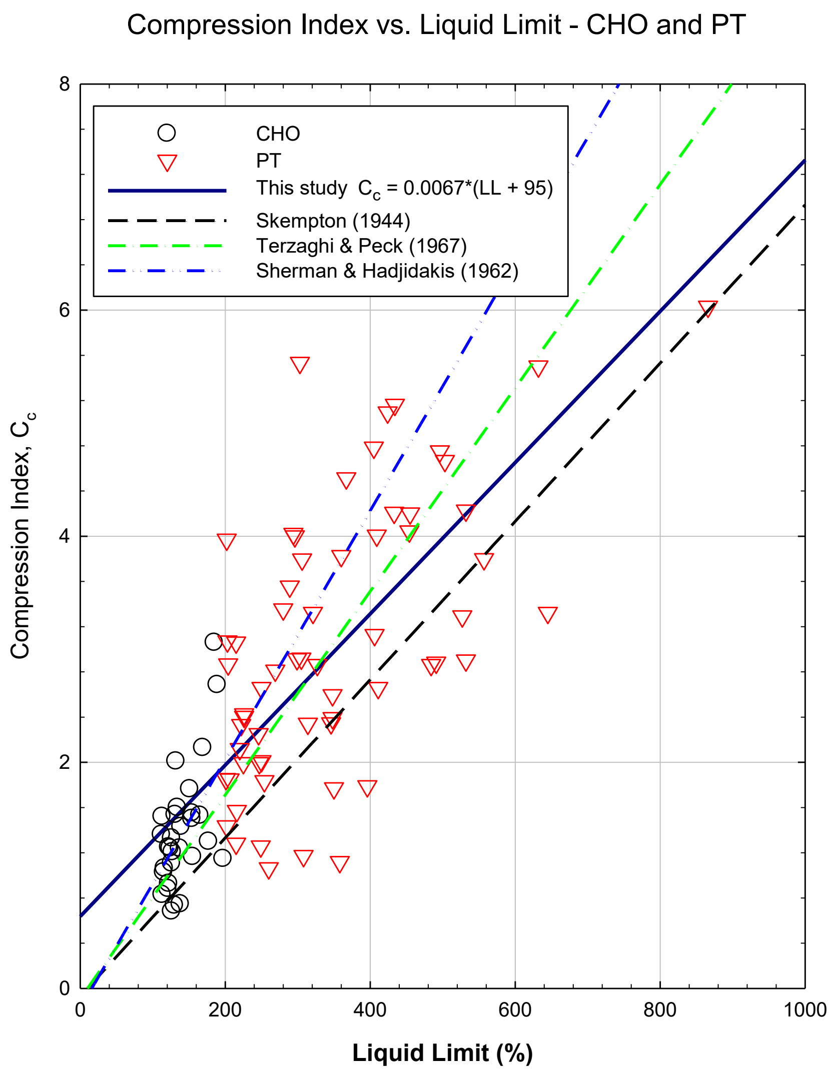


Figure 60 Compression index as a function of liquid limit for CHO and PT soils.

Kulhawy and Mayne (1990) provide correlations for C_c and C_r as a function of the plasticity index. For the New Orleans data collection, these correlations appeared to have even more scatter than the correlations based on liquid limit, and those plots are not included in this report.

Time Rate of Settlement Parameters

Soil parameters used for time rate of settlement calculations are the coefficient of consolidation (c_v) and the coefficient of secondary compression (c_α).

There are many different methods available to calculate the coefficient of consolidation. ASTM D2435 presents Casagrande's log time method and Taylor's square root of time method as acceptable alternatives, and these two methods are used the most in geotechnical engineering practice. Both of these methods were also used for consolidation tests conducted as part of New Orleans area practice. For this study, only Casagrande's method was used for the calculation of c_v.

A specific soil does not have a single unique value of c_v. The value of c_v depends on the stress applied to the soil, and if the soil is undergoing virgin compression or recompression. For this study, the values of c_v were calculated for the first stress in excess of the preconsolidation pressure.

An example of the reasoning behind this assessment is shown in Figure 61. Four tests from borings of close proximity, and approximately the same specimen depth and soil classification, were used to determine values of c_v. The average P_p' value is also plotted on the figure as a reference.

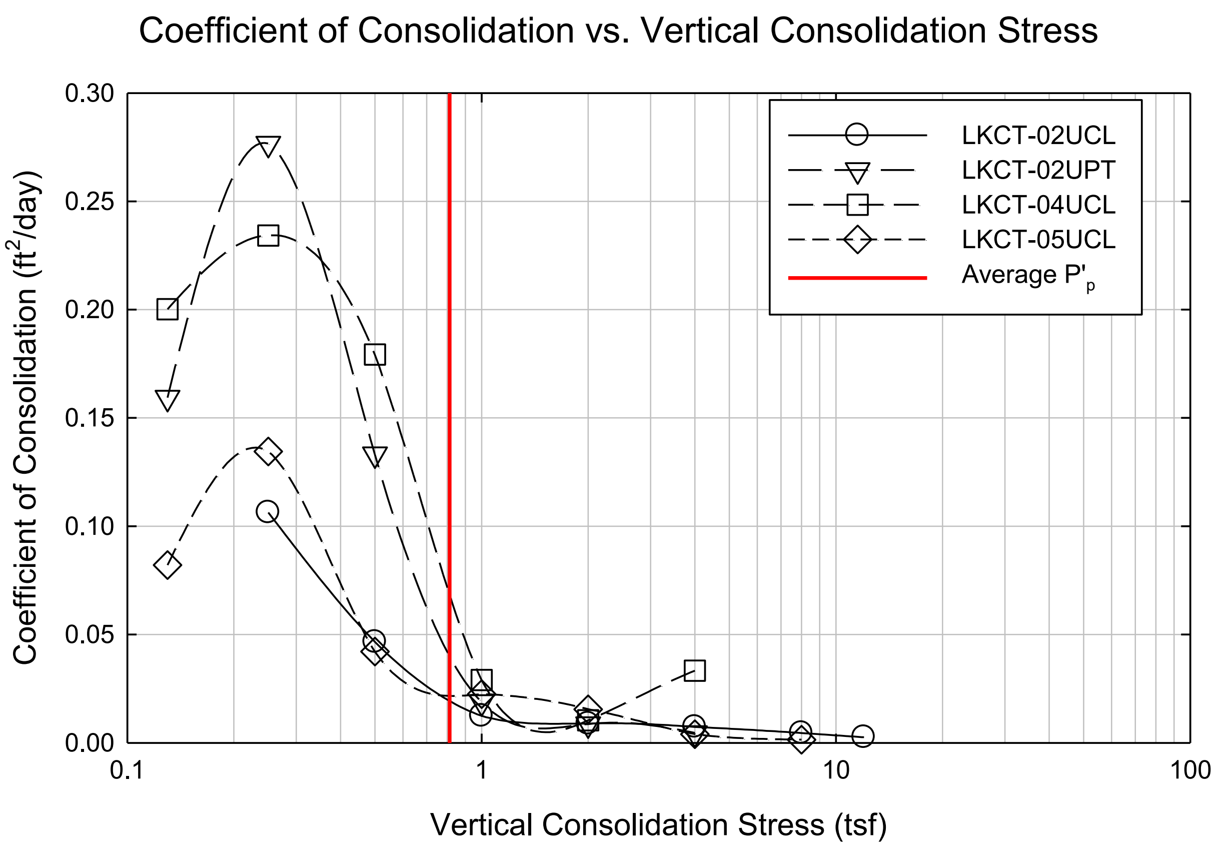


Figure 61 Coefficient of consolidation vs. vertical effective stress for four test specimens taken from nearby borings.

While the c_v values were highly variable for loads less than the preconsolidation pressure, similar values were calculated for loads greater than the preconsolidation pressure. In addition, the value of the coefficient of consolidation at loads immediately greater than the preconsolidation pressure often has the most engineering significance for time rate of settlement calculations.

There is some confusion in the geotechnical literature about the definition of the *coefficient of secondary compression* or *secondary compression index*, c_α. Historically, c_α was defined as the change in void ratio over a tenfold increase in time in the secondary compression portion of the time curve. More recent references define c_α as the change in decimal strain over a tenfold increase in time. This second definition is sometimes, but not consistently, written as $c_{\varepsilon\alpha}$ or $c_{\alpha\varepsilon}$ to distinguish it from the first definition. The values are related by the initial void ratio by the equation:

$$c_{\varepsilon a} = \frac{c_\alpha}{1 + e_o}$$

The value of $c_{\varepsilon\alpha}$ was calculated for the same four test specimens used for the c_v determination in the previous figure. Figure 62 shows the $c_{\varepsilon\alpha}$ values plotted against the consolidation stresses. In contrast to the c_v values, the $c_{\varepsilon\alpha}$ values exhibit a great deal of variation at stresses greater than the preconsolidation stress. There is a limit to the precision available for in the determination of $c_{\varepsilon\alpha}$. The slope of the secondary compression curve had to be scaled by hand from the time plots, and it was difficult to obtain a precision greater than about 0.001. The variation in the $c_{\varepsilon\alpha}$ values was also evident in the plots constructed for examining correlations.

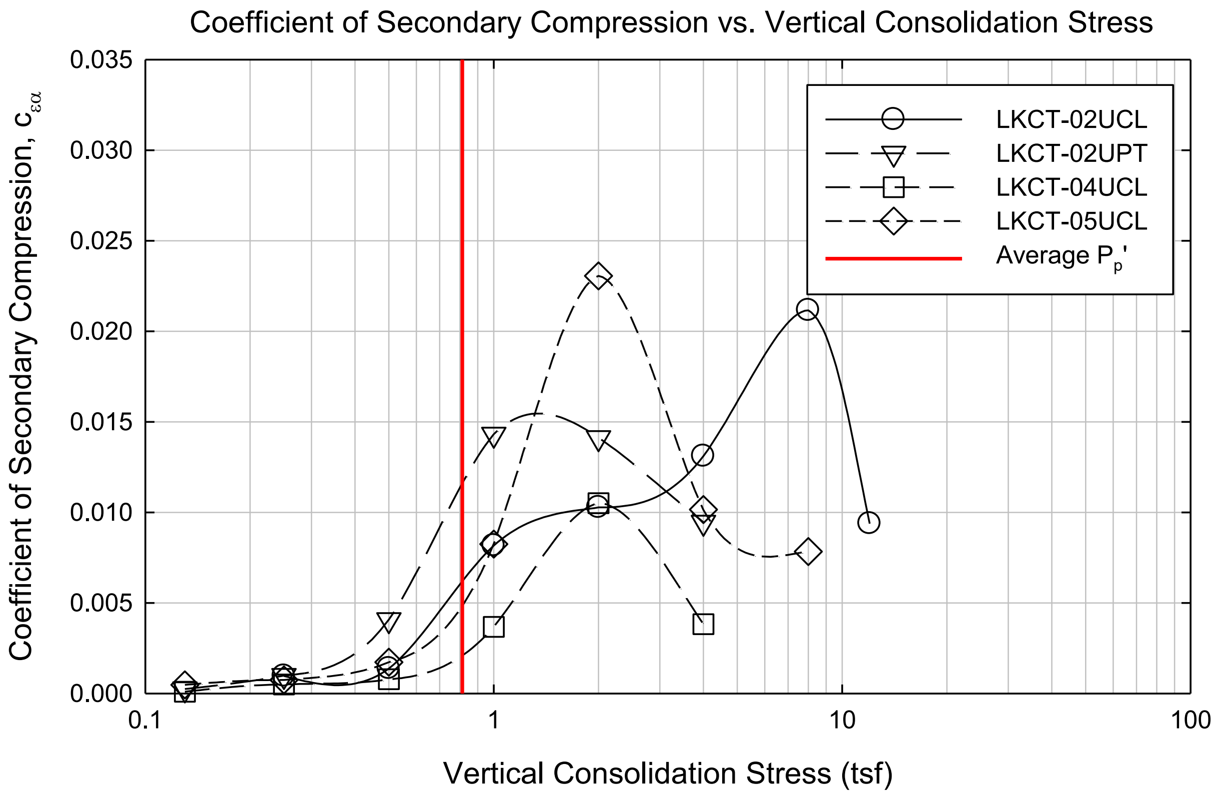


Figure 62 Coefficient of secondary compression versus consolidation stress for four test specimens taken from nearby borings.

Even with the effort expended in culling the poor test results from the database and calculating the soil parameters by hand, there was much scatter in the time rate parameters. In many cases, it was difficult to discern any trends of c_v or $c_{\varepsilon\alpha}$ with soil index properties.

For example, Figure 63 shows a plot of the logarithm of c_v versus initial water content for CL and CH soils. If a regression analysis is performed, an equation is calculated predicting a decrease in coefficient of consolidation with increasing water content. Figure 64 shows a similar plot for the CHO and PT soils. For these data, c_v increases with increasing water content. Similar inconsistencies were encountered with attempts at correlations between c_v and other index properties (e.g. LL, PI, etc.).

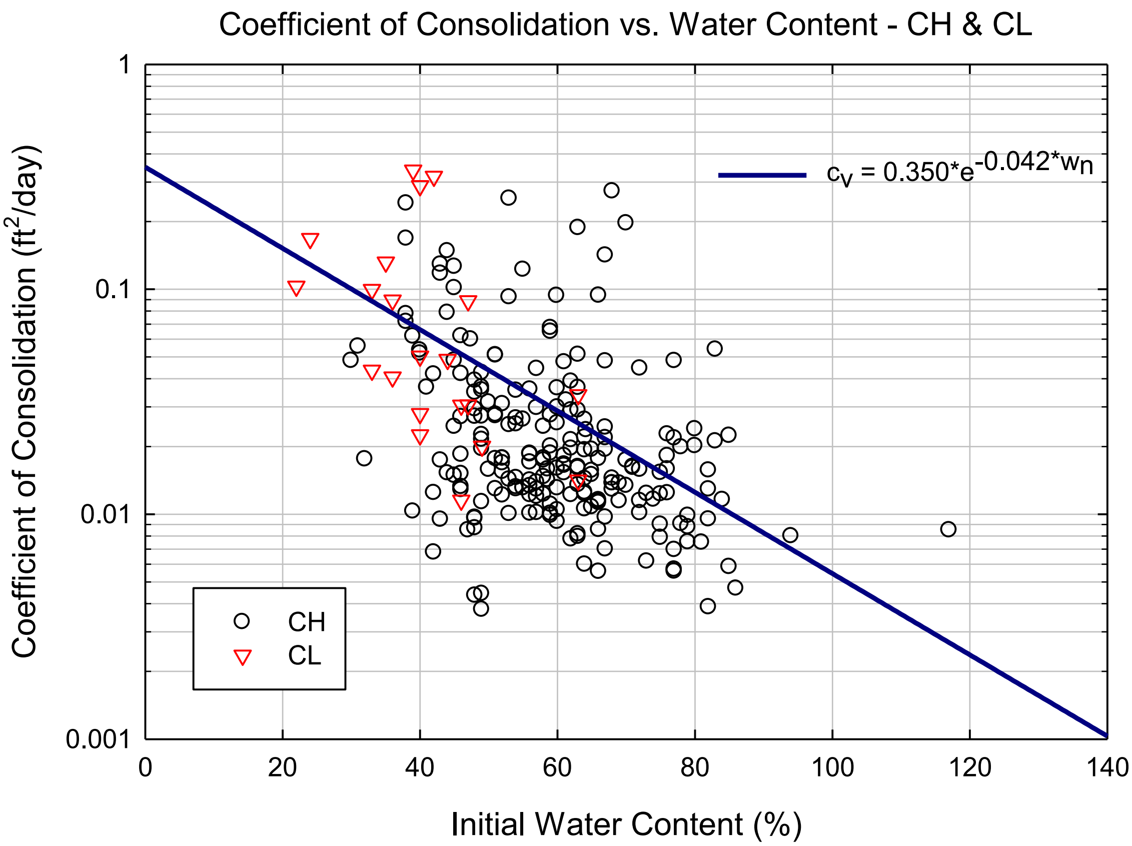


Figure 63 Coefficient of consolidation versus water content for CH and CL soils.

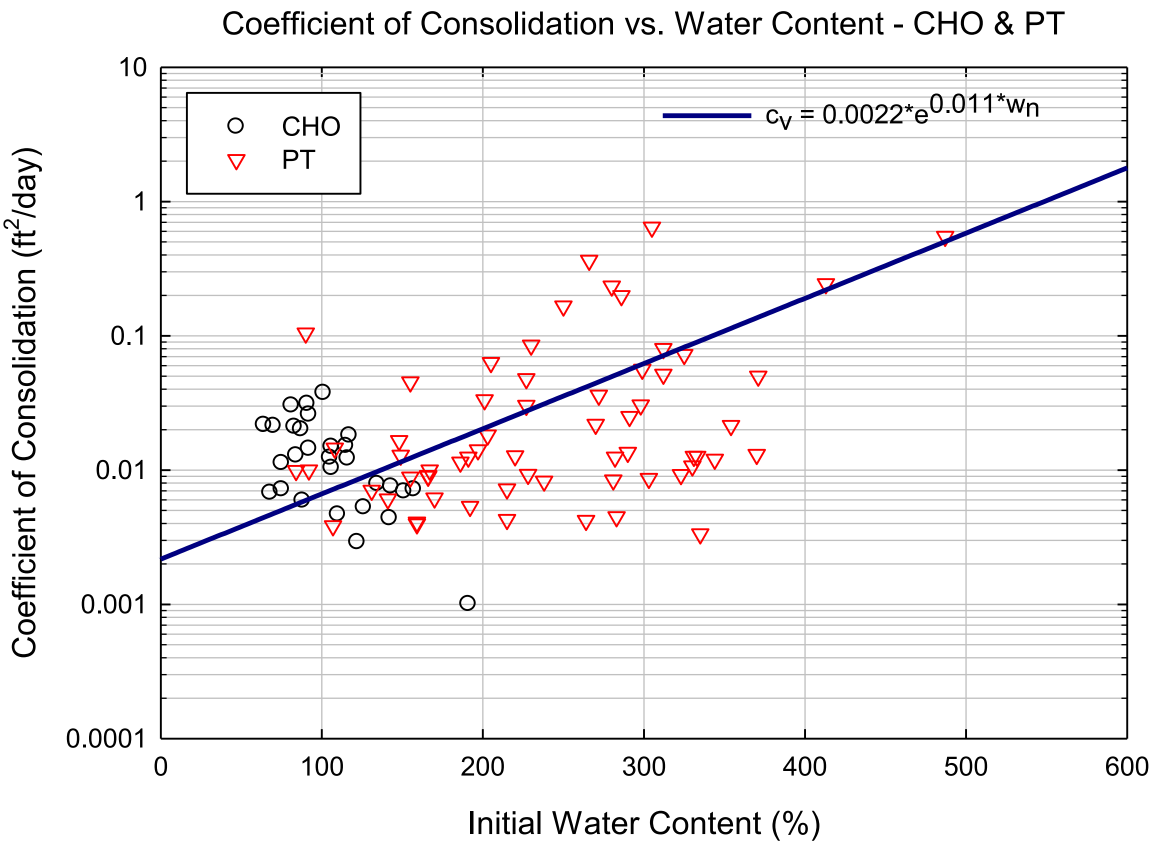


Figure 64 Coefficient of consolidation versus water content for CHO and PT soils.

G. Mesri has done considerable research in the past 30 years investigating the ratio of C_α to C_c. Mesri and Godlewski (1977) found that this ratio was relatively constant for a given soil type. Mesri and Castro (1987) reported that the value of the ratio is about 0.04 for inorganic clays, 0.05 for organic clays, and 0.06 for peats.

A plot of C_α vs. C_c is provided in Figure 65, along with guidelines showing the different ratios. The bulk of the data are bounded by

C_α/C_c values ranging from 0.01 to 0.07, although it is not possible to discern specific values for the different soil types. The average value for New Orleans area soils is about 0.04.

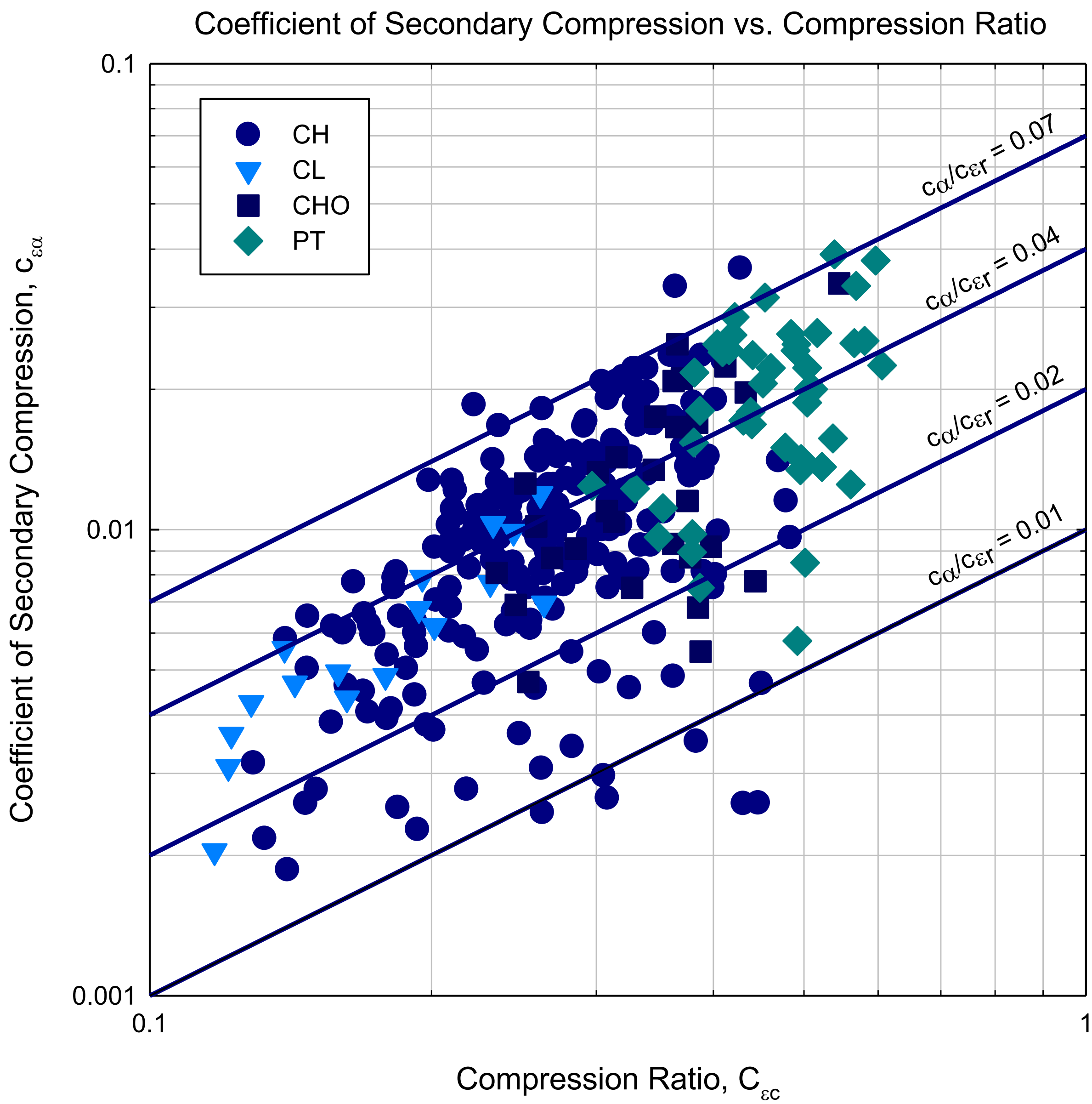


Figure 65 Coefficient of secondary compression vs. compression ratio for all soil types.

Summary and Conclusions

The geotechnical exploration, field testing, and laboratory testing that has been conducted in the New Orleans area since Hurricane Katrina is unprecedented in geotechnical engineering history. The combination of high quality samples along with modern testing techniques has resulted in a database of soil property data that allows examination of existing soil correlations and development of new correlations.

An important element of this study was the assessment of the test data for quality prior to using the results in correlation development. A ranking system was developed for each test type, and test reports were individually reviewed and ranked on a scale from 1 to 5. Owing to the large number of UU and consolidation tests, only a representative subset of the data was reviewed. For the CU triaxial, CD direct shear, and CU direct simple shear tests; all test reports were reviewed.

For the purpose of this study, the New Orleans area soils were considered to be normally consolidated. The main impact of this assumption is that the undrained strengths are characterized by a single value of undrained strength ratio for a given soil type and test type.

Undrained Shear Strength – Unconsolidated Undrained Triaxial Tests

The average undrained strength ratios shown in Table 14, as a function of soil type, were determined from UU triaxial tests.

Table 14 Undrained strength ratios as a function of soil classification determined from UU triaxial tests.

Soil Classification	Undrained strength ratio
CL	0.202
CH	0.251
CHO	0.365
PT	0.547

For all soil types, the undrained strength ratio for UU triaxial tests can be estimated from the following equation:

$$USR_{UU} = 0.0022PI + 0.169$$

If the PI is less than 80, increased accuracy of the estimate can be obtained by using the equation below:

$$USR_{UU} = 0.0017PI + 0.181$$

Undrained Shear Strength – Direct Simple Shear Tests

The direct simple shear tests were assessed both on test quality and if the soil exhibited normalized shear strength properties. Only tests that exhibited a significant degree of normalization were considered. Based on the DSS test results, the undrained strength ratio was found to be a constant regardless of the value of PI.

$$USR_{DSS} = 0.28$$

For PI values less than about 60, the undrained strength ratio from UU triaxial tests, on average, will be less than that determined from DSS tests.

Undrained Shear Strength – Consolidated Undrained Triaxial Tests

The CU triaxial tests results were assessed in the same manner as the DSS tests in regards to undrained shear strengths. Only samples that exhibited a significant degree of normalization were considered in the correlations. Based on the test results, the following equation was developed for CU triaxial tests:

$$USR_{CU} = 0.30 + 0.624 \cdot e^{-0.061 \cdot PI}$$

It should be noted that undrained shear strengths from CU triaxial tests are normally considered to be unconservative for general engineering applications (Duncan and Wright 2005).

Effective Stress Friction Angle – Consolidated Undrained Triaxial Tests and Direct Shear Tests

CU triaxial tests and CD direct shear tests were reviewed to provide values of the effective stress friction angle for normally consolidated conditions. The consolidation stresses were compared to the in situ effective stresses to ensure that the test specimens were normally consolidated at failure. An effective stress cohesion equal to zero was assumed in the data reduction.

In general, the CU triaxial provided a friction angle about four to ten degrees greater than the direct shear test, with this difference increasing with increasing PI. This difference is expected since progressive failure issues can impact direct shear test results to a much greater degree than triaxial test results. In addition, alluvial, lacustrine, and riverine soils are often weakest when sheared on horizontal planes owing to the orientation of the layering.

The following empirical equation was developed to calculate the friction angle as a function of PI for triaxial shear:

$$\phi'_{trx} = 27.6 + 17.2 \cdot e^{-0.045 \cdot PI}$$

Similarly, the effective stress friction angle can be calculated for the direct shear test by an equation of similar format:

$$\phi'_{ds} = 17.6 + 19.5 \cdot e^{-0.028 \cdot PI}$$

For design purposes, it is useful to look at the average measured friction angles for the triaxial test as a function of the New Orleans District soil classification symbol. Table 15 shows the results for the New Orleans area CU triaxial tests. The friction angle values reported for CHO and PT soils should be regarded as preliminary since only a few test series were conducted.

Table 15 Summary of drained friction angle for all soils for CU triaxial tests.

Soil Type	# of tests	Friction Angle (deg)			Standard Deviation
		Maximum	Minimum	Average	
CH	49	36.42	21.55	28.78	3.68
CHO	4	32.37	20.74	27.38	5.20
CL	30	46.60	30.14	35.26	3.31
PT	2	42.20	32.05	37.12	7.18

For design purposes, it is normally conservative to use a friction angle that is one standard deviation below the average. By using this value, there is only a 16% probability that the actual value realized in the field will be lower.

Compressibility Correlations

Many different correlations have been developed for estimating the compression index of cohesive soils. The correlations based on initial water content, initial void ratio, and initial dry density all have approximately the same accuracy owing to the numerical connection between these soil index parameters. The calculated relationship between compression index and initial water content is given in Table 16 below.

Table 16 Compression index as a function of in situ water content (in percent).

Soil Type	Empirical Relationship
CL and CH	$C_c = 0.017 \cdot w_n - 0.299$
CHO and PT	$C_c = 0.012 \cdot w_n + 0.137$

The ratio of the recompression to the compression index for New Orleans soils is about 0.2. This is slightly higher than generic values reported in the geotechnical literature.

The correlations for compression index based on plasticity characteristics, such as LL and PI, exhibited a greater degree of scatter than does related to water content or density. Correlations of this sort are not recommended.

No useful correlations were found for the coefficient of consolidation (c_v) or the secondary compression index ($c_{\varepsilon\alpha}$ or c_α). Mesri and Castro (1987) have reported that the ratio c_α/C_c is constant for a given soil type, but that was not found to be the case for New Orleans area soils. The lack of viable correlations for c_v and c_α is understandable since the parameters are not constant for a given soil. The value of both parameters varies as a function of applied effective stress.

Although the parameters were consistently determined for effective stresses slightly in excess of the in situ vertical effective stress, this did not serve to remove the variability to a degree were accurate correlations were possible.

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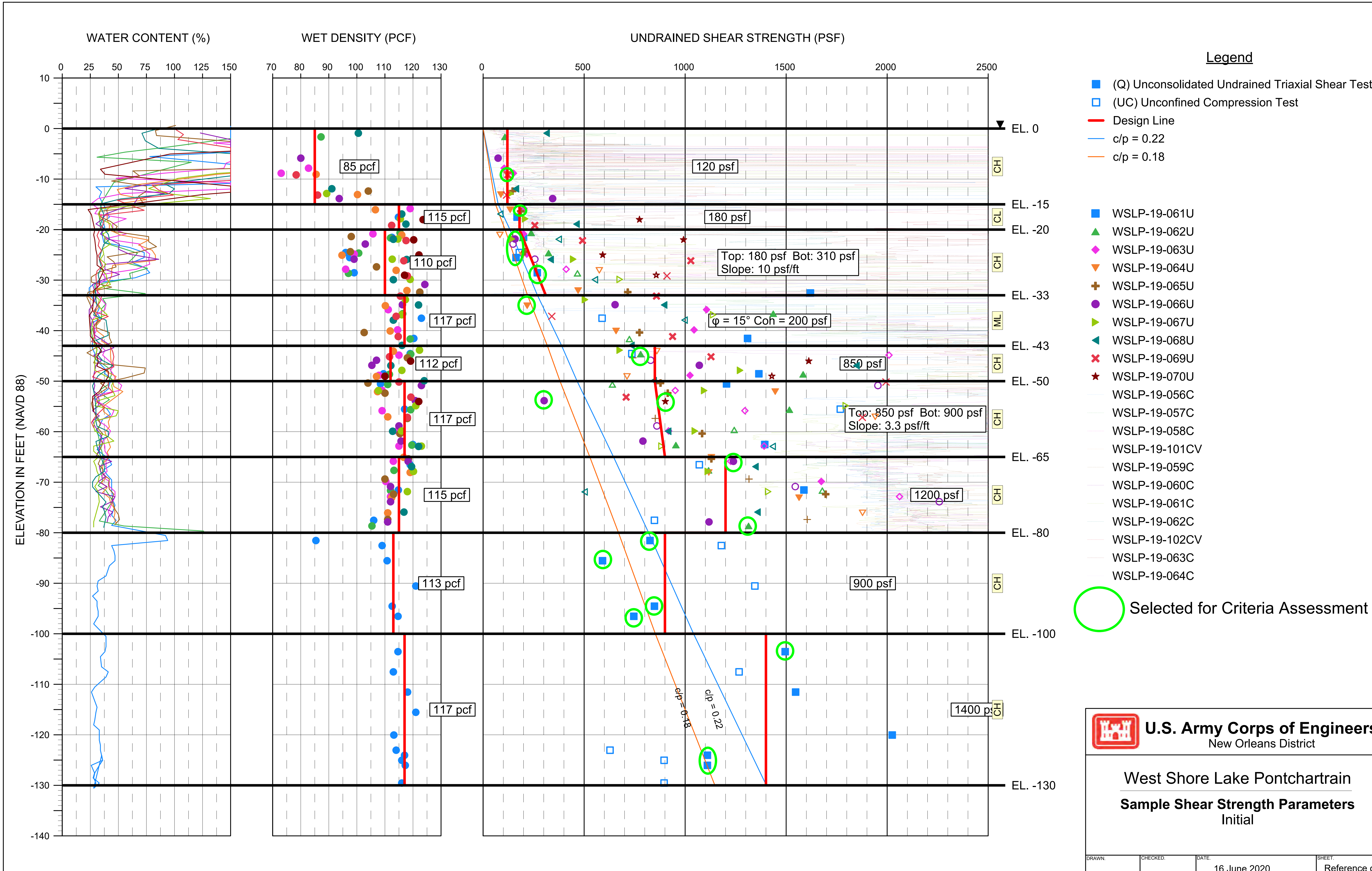
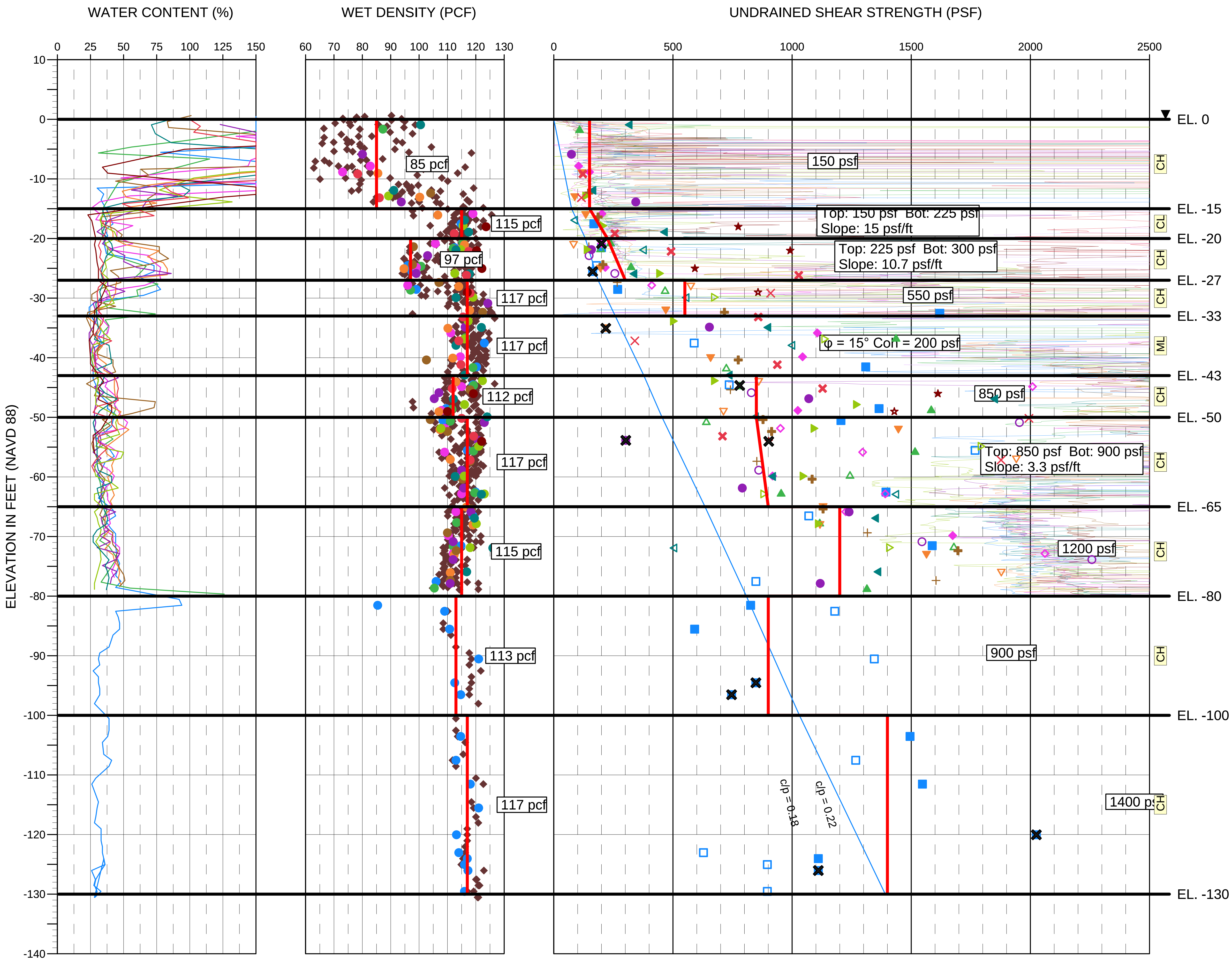


WATER CONTENT (%)
WET DENSITY (PCF)
UNDRAINED SHEAR STRENGTH (PSF)
ELEVATION IN FEET (NAVD 88)
85 pcf
115 pcf
110 pcf
117 pcf
112 pcf
117 pcf
115 pcf
113 pcf
117 pcf
120 psf
180 psf
Top: 180 psf Bot: 310 psf
Slope: 10 psf/ft
φ = 15° Coh = 200 psf
850 psf
Top: 850 psf Bot: 900 psf
Slope: 3.3 psf/ft
1200 psf
900 psf
1400 psf
c/p = 0.18
c/p = 0.22
EL. 0
EL. -15
EL. -20
EL. -33
EL. -43
EL. -50
EL. -65
EL. -80
EL. -100
EL. -130
CH
CL
CH
ML
CH
CH
CH
CH
CH
Legend
(Q) Unconsolidated Undrained Triaxial Shear Test
(UC) Unconfined Compression Test
Design Line
c/p = 0.22
c/p = 0.18
WSLP-19-061U
WSLP-19-062U
WSLP-19-063U
WSLP-19-064U
WSLP-19-065U
WSLP-19-066U
WSLP-19-067U
WSLP-19-068U
WSLP-19-069U
WSLP-19-070U
WSLP-19-056C
WSLP-19-057C
WSLP-19-058C
WSLP-19-101CV
WSLP-19-059C
WSLP-19-060C
WSLP-19-061C
WSLP-19-062C
WSLP-19-102CV
WSLP-19-063C
WSLP-19-064C
Selected for Criteria Assessment
U.S. Army Corps of Engineers
New Orleans District
West Shore Lake Pontchartrain
Sample Shear Strength Parameters
Initial
DRAWN.
CHECKED.
DATE.
16 June 2020
SHEET.
Reference c



Legend

- (Q) Unconsolidated Undrained Triaxial Shear Test
- (UC) Unconfined Compression Test
- In Situ Design Line
- c/p = 0.22
- Discarded Tests
- WSLP-19-061U
- WSLP-19-062U
- WSLP-19-063U
- WSLP-19-064U
- WSLP-19-065U
- WSLP-19-066U
- WSLP-19-067U
- WSLP-19-068U
- WSLP-19-069U
- WSLP-19-070U
- WSLP-19-056C
- WSLP-19-057C
- WSLP-19-058C
- WSLP-19-101CV
- WSLP-19-059C
- WSLP-19-060C
- WSLP-19-061C
- WSLP-19-062C
- WSLP-19-102CV
- WSLP-19-063C
- WSLP-19-064C
- Wet Density Correlations

NOTES:
1. Wet Density correlations are based upon a w% relationship developed by CPRA using WSLP laboratory test data.

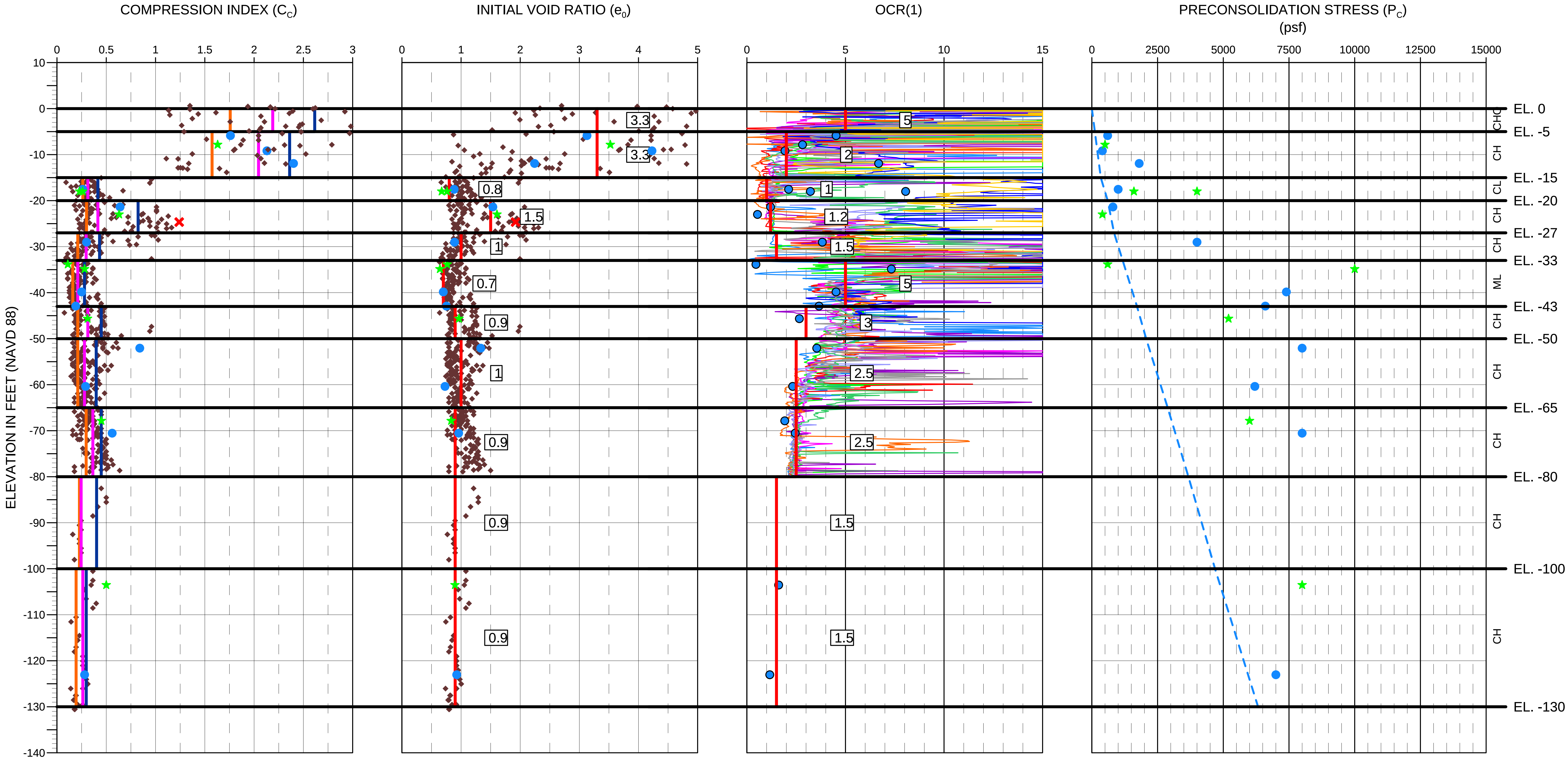
U.S. Army Corps of Engineers
New Orleans District

West Shore Lake Pontchartrain

Soil Parameter Design Line
Reach 107
STA. 326+00 to 411+00

DRAWN.	CHECKED.	DATE.	SHEET.
K.A.N.	C.M.R.	25 June 2021	Figure 01

Reference d



Legend

- Lab Data
- Design Line
- Effective Stress
- Correlations
- C_c Lab Data Adjusted
- C_c Lab Data Outlier (removed)
- C_c First Quartile
- C_c Median
- C_c Third Quartile
- WSLP-19-056C
- WSLP-19-057C
- WSLP-19-058C
- WSLP-19-059C
- WSLP-19-060C
- WSLP-19-061C
- WSLP-19-062C
- WSLP-19-063C
- WSLP-19-064C
- WSLP-19-0101C-V
- WSLP-19-0102C-V

NOTES:

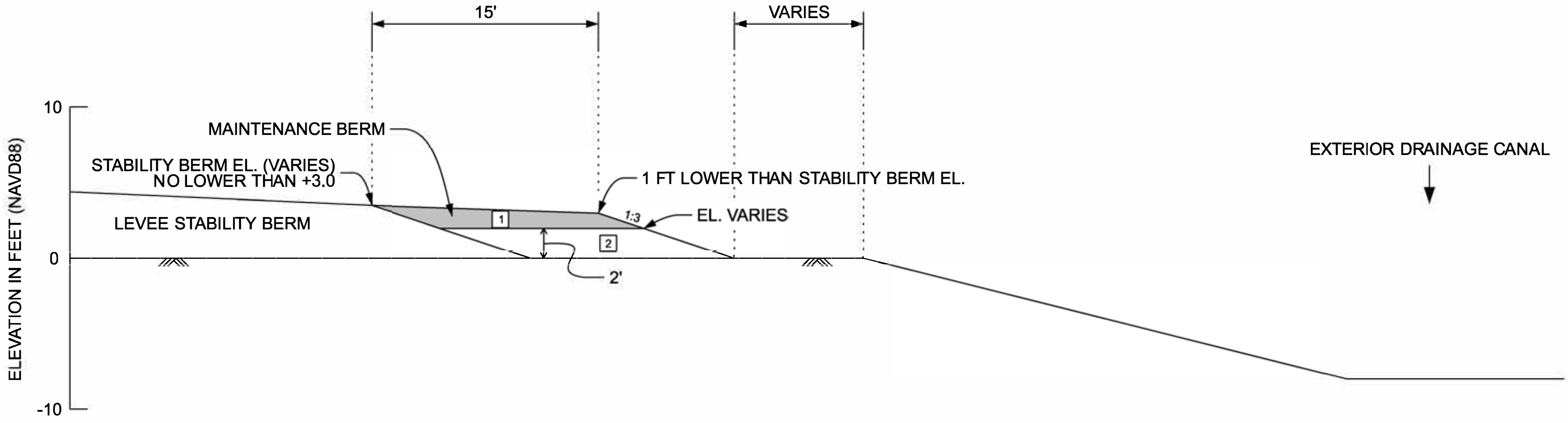
1. C_c correlations were based on w% equations taken from the Strength and Compressibility Correlations for New Orleans Area Soils report (2011 September 4).
2. C_c correlations for the upper two strata utilized the CHO/PT water content correlation. Samples not classified as organic material were discarded in these two strata.
3. Adjusted lab tests were adjusted based on the Casagrande method and/or moved to better match the soil type to the design stratum and decrease scatter in the data.
4. E_0 correlations were based upon an equation developed by CPRA through a thorough analysis of laboratory test data taken for the WSLP project.

U.S. Army Corps of Engineers
New Orleans District

West Shore Lake Pontchartrain

Consolidation Design Parameters
Reach 107
STA. 326+00 to 411+00

DRAWN.	CHECKED.	DATE.	SHEET.
K.A.N.	C.M.R.	28 June 2021	Figure 01



REGION NUMBER	SOIL DESCRIPTION	UNIT WEIGHT IN PCF	COHESION IN PSF
1	COMPACTED CLAY FILL	115	600
2	UNCOMPACTED CLAY FILL	100	200

NOTES:

1. FACTOR OF SAFETY FOR STABILITY OF THE MAINTENANCE BERM INTO THE DRAINAGE CANAL SHALL BE AT LEAST 1.20 UTILIZING SPENCER'S METHOD.

2. THE PURPOSE OF THE MAINTENANCE BERM IS TO ESTABLISH A 15-FT VEGETATION FREE ZONE THAT CAN BE MAINTAINED BY THE LEVEE SPONSOR.

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT

TYPICAL MAINTENANCE BERM REQUIREMENTS

WEST SHORE LAKE PONTCHARTRAIN (WSLP)
HURRICANE AND STORM DAMAGE RISK REDUCTION SYSTEM PROJECT
ST. CHARLES, ST. JOHN THE BAPTIST, AND ST. JAMES PARISHES, LOUISIANA

DRAWN BY: J.L.S.	APPROVED BY: R.J.V.	DATE: 24 FEB 2022	Reference f

CEMVN-EDG

MEMORANDUM FOR RECORD

SUBJECT: **Geotechnical Engineering Recommendation for Embankment Design for West Shore Lake Pontchartrain, St. Charles, St. John the Baptist, and St. James Parishes, Louisiana.**

1. The West Shore Lake Pontchartrain (WSLP) project is a hurricane and storm damage risk reduction levee system that spans approximately 18.5 miles and includes 4 pump stations and multiple drainage structures. The project is expected to be completed at the end of 2023 and it is located in St. Charles, St. John the Baptist, and St. James Parishes, Louisiana.

2. The WSLP alignment exists in a swamp environment where the foundation soils consist of very soft to soft organic clay, clay, and silty clay. The upper soil layers consists largely of clay material with high moisture content in the range of 75% to greater than 150%, low shear strengths in the range of 100psf to 200psf, and the potential for large amounts of consolidation. Undrained shear strength of foundation soils such as these have been shown to increase with consolidation, much of which is likely to occur during construction. Estimating strength gains during the construction of the WSLP levees will enable these levee to be constructed with a reduced overall levee section footprint, thereby saving costs due to reduced borrow and right-of-way requirements as well as minimizing the impacts to the environment. The purpose of this memorandum is to provide design guidelines for earthen levees that supplements the requirements of the HSDRRS Design Guidelines and ensures a consistent approach for considering gains in shear strength during construction in order to achieve a more efficient final levee cross section for WSLP. This guidance should be applied throughout the design of WSLP.

3. **Settlement Approach**: Primary consolidation settlement is largely controlled by a combination of compressibility and permeability. Compressibility describes the potential for soil to decrease in volume under a given load. Assuming Terzaghi's theory of consolidation settlement, the compression index, Cc, can be used to calculate the total amount of settlement in normally-consolidated soil. Permeability controls the rate at which water is expelled from soil and thus the rate of compression at which a soil layer takes place, described by the coefficient of consolidation, or Cv. Before consolidation settlement is estimated, an in-depth review and analysis of consolidation parameters should take place.
    a. The first step to developing a settlement model entails an in-depth review of consolidation test results. Consolidation tests have been performed at different depths and in different soil types for each contract reach of WSLP. For each of these consolidation tests, the graphical method developed by Casagrande in 1936 should be used to determine the Preconsolidation Pressure (Pc) on the consolidation curve found on the e-log(p) curve or data

sheet. The Cc should be estimated as the slope of the virgin compression line on the e-log(p) curve. The Cv should be estimated as the rate of consolidation at the Pc loading. See Figure 1 for an example of this method for determining these variables. The consolidation process is accompanied by a decrease in void ratio which can lead to a decrease in Cv. Because of this, the change in Cv at different anticipated loadings should be investigated. See Figure 2 as an example of this check of change of Cv during loading. To assess the sensitivity of overburden pressure on Cv, the anticipated load due to the first proposed stage of embankment construction was added to the Pc loading before interpreting Cv. In Figure 2, the red data points represent Cv at the Pc loading and the green dots assume additional loading from Pc plus stage 1 loading. From this plot, it was determined that there is little variation in Cv based on overburden and that Cv can be assumed to be constant throughout the consolidation process. If necessary, the Boussinesq, Westergaard, or a simplified stress distribution approach can be used to verify Cv consistency during loading.

b. Next, consolidation parameter plots should be developed by plotting preconsolidation stress (Pc), initial void ratio (e_o), Cc, and Cv from consolidation test results, see Figure 5. Since primary consolidation and addressing time-rate of settlement in the normally-consolidated clays encountered along the WSLP alignment relies primarily on Cc and Cv, additional analyses of these parameters is required. In addition to plotting Cc and Cv results from each consolidation test report, the geotechnical engineer may plot Liquid Limit and/or water content correlations to provide more data and help select soil design parameters. Cv correlations can be found in NAVFAC DM 7.01, Figure 4, dated 1 September 1986 and is included as Figure 3. Cc correlations can be found in “Correlation of Compression Index and Soil Properties of New Orleans Area Clays,” Table 16, dated 04 September 2011 and is included as Figure 4.

c. Once consolidation test and correlation data are plotted, this data may need to be adjusted/moved and outliers removed based upon soil classification and engineering judgment. Ultimately, it is more important to graphically show the data in the correct soil stratum from which it was tested than the elevation of the sample so that it can be appropriately considered in the final soil design parameter selection. For example, if the Cc test result for a soil sample classified as Clay is located in a layer classified as Organic Clay in the Consolidation Parameters, this Cc data point should be moved/removed from the Organic Clay layer. Designers may also want to ignore Cc correlations if there is high scatter. To address scatter and uncertainty in laboratory test results and uncertainty in the resulting settlement estimate, descriptive statistics should be used to determine a lower bound, upper bound, and best estimate design line for Cv and Cc parameters. Designers will begin by using the first and third quartile (equivalent to the 25th and 75th percentiles) of the laboratory test results and correlations as the lower and upper bound soil design parameters, and the median of the data set as the best estimate design line. However, engineering judgment should be applied to selecting design lines that result in logical upper and lower bound parameters. The rationale for the final selection of the upper and lower bound parameters shall be documented in the final design report. A sample plot of consolidation parameters are included as Figure 5.

d. A settlement sensitivity analysis shall be performed using the lower bound, best estimate, and upper bound Cc and Cv design lines. Consequently, 4 settlement models should be analyzed for each geotechnical design reach. These settlement models should be modelled with the upper bound consolidation parameters, the best estimate consolidation parameters, the lower bound consolidation parameters, and the lower bound Cv and best estimate Cc parameters. Settlement estimates will be incorporated into project Plans and Specifications (P&S) as a range of possible required wait times between construction lifts and give an indication of uncertainty in settlement estimates. The upper bound consolidation parameters will produce the largest settlement estimates and will be used to provide information in the P&S concerning potential settlement during and after construction. The best estimate consolidation parameters shall be used to assess the required levee overbuild and determine the final construction grade. Additional information concerning overbuild assumptions is provided in Paragraph 6. The lower bound consolidation parameters will produce the smallest settlement estimate. This settlement model will also be used to provide information in the P&S concerning settlement during and after construction. To predict strength gain, the median Cc and the lower bound Cv design lines should be modelled in order to increase the probability that the expected strength gains are realized in a time frame that does not create an excessively long construction duration. Deviations from this approach shall be approved by USACE and documented in the final design report.

4. **Strength Gain Method**: The following process shall be used to evaluate expected gains in shear strength of normally-consolidated clays and includes some sample calculations and graphic for illustrative purposes. Alternate approaches to strength gain analyses or variations to what is proposed in this memorandum shall be approved by USACE before application to WSLP levee designs. Prior to beginning strength gain analyses, the levee should be analyzed using the existing conditions soil design parameters. This proposed levee cross section should be presented to USACE after the 10% submittal and before the 35% submittal to coordinate the strength gain process. If the levee section design is feasible and practicable

without strength gain, USACE may direct engineering design based off the existing conditions soil design parameters.

a. Because strength gain depends on the applied load, a levee cross section and construction sequence must first be assumed. For a general starting point in analyzing an assumed levee section, the overbuild height, needed to achieve the final construction grade, may be assumed to be 30% of the difference between the hydraulic design grade elevation and the existing ground surface elevation. Next, a slope stability analysis using Spencer's Method shall be used to design the assumed levee cross section by establishing a FS = 1.10 for the Low Water Hurricane Case (e.g. failure toward the flood side) and a FS = 1.20 for the Design Water Surface Elevation (Still Water Elevation, e.g. failure toward the land side) case while utilizing the existing-conditions soil design parameters. Note, this assumes that once Spencer's Method analyses are revised with the soil design parameters from strength gain, factors of safety will increase to comply with Hurricane and Storm Damage Risk Reduction System (HSDRRS) Design Guidelines.

b. After the initial levee cross section has been estimated, a settlement model should be developed utilizing a construction sequence that assumes this cross section will be the final constructed levee. See Paragraph 5 for more detail.

c. The first step in determining shear strength gain is to calculate the existing-conditions soil design parameters using soil boring and Cone Penetration Test (CPT) data. Next, the preconsolidation pressure should be calculated with depth for each soil design reach with no proposed levee present. Preconsolidation pressure can be calculated by an industry-accepted definition defined by Equation (1).

$$\sigma'_p = \sigma'_v \times OCR \qquad (1)$$

Where σ'_p = preconsolidation pressure, σ'_v = effective vertical stress, and OCR is the overconsolidation ratio.

The OCR shall be assumed to be 1 in normally-consolidated clays above the Pleistocene. Thus, initial stress conditions can be computed by calculating effective vertical stress. This can be performed by hand-calculations or through computer software capable of performing a 2-dimensional settlement analysis such as Rocscience's Settle3D software.

d. Next, induced stress with depth due to the staged construction loading should be determined at the centerline where strength gain will be analyzed. This step can be performed through a software capable of performing 2-dimensional settlement analysis (e.g. Rocscience's Settle3D software using the Boussinesq Method). This process assumes three vertical lines for soil design parameters (one centerline and one at each levee toe). See paragraph 9 for more details.

e. After the construction sequence is modelled in the settlement software and time-rate consolidation parameters are used to predict the amount of settlement induced during construction, the settlement software can be used to predict the change in effective vertical stress at the end of construction. Knowing the initial effective vertical stress and the final effective vertical stress, a change in effective vertical stress (delta stress) can be computed at the top and bottom of each soil layer. This delta stress can be used to compute the gain in shear strength at the top and bottom of each soil layer.

f. A relationship between undrained shear strength and preconsolidation pressure was proposed by Mesri in "A Reevaluation of $S_{u\ (mob)}=0.22\ \sigma'_p$ Using Laboratory Shear Tests," (1989) and by Jamiliokowski et al in "New Developments in Field and Laboratory Testing of Soils," (1985), as shown in Equation 2:

$$s_u = 0.22 \times \sigma'_p \qquad (2)$$

Where s_u = undrained shear strength.

Thus, this relationship predicts $s_u/\sigma'_p = 0.22$. According to a report titled, "Applicability of SHANSEP in New Orleans Area Projects" prepared by Virginia Polytechnic Institute and State University for USACE, New Orleans District dated 1 January 2011, the ratio of s_u/σ'_p has tested to be as large as 0.28 for New Orleans area soils. See Figure 6 for more detail. Guidance included in this memorandum recommends using a ratio of 0.22 for calculating strength gains in order to increase the likelihood that the anticipated gains in shear strength are achieved and to reduce the probability of slope instability/failure during construction. Since the OCR is defined as the ratio of preconsolidation pressure to effective vertical stress, Equation (2) can be rewritten as shown in Equation (3).

$$s_u/\sigma'_v = 0.22 \times OCR \qquad (3)$$

As discussed previously in this memorandum, OCR should be considered to be equal to 1 in all soils that will be analyzed for gain in shear strength. Thus, utilizing the relationship between undrained shear strength and effective vertical stress, shear strength gain should be calculated by Equation (4).

$$s_{u'} = \Delta\sigma'_{v} \times 0.22 \qquad (4)$$

Where $s_{u'}$ = gain in shear strength and $\Delta\sigma'_{v}$ = the change in effective vertical stress due to the embankment load of the levee.

g. Gains in shear strength shall then be calculated at the top and bottom of each layer and added to the existing-conditions soil design parameters. An example calculation of this method is tabulated in Figure 7. The Spencer's Method slope stability model for the initial cross section shall be revised with the strength gain design parameters. The results of these revised stability analyses should be compared to HSDRRS Design Guidelines for slope stability (i.e. Table 3.1 in the June 2012 version). If any modifications are required to be made to the stability berms, the Spencer Method analyses should be revised to meet HSDRRS Design Guidelines. For example, if strength gain parameters are used to analyze slope stability and the resulting factor of safety is too low, stability berms should be increased until the factor of safety is adequate. At this point, the construction sequence and settlement model should be updated to reflect the new levee design and the iterative steps described in Paragraphs 4.a. through 4.g. should be revisited. The final levee embankment footprint analyzed in the settlement software and the final levee embankment analyzed in Spencer Method stability software should agree.

h. Gain in shear strength should only be applied in normally-consolidated soil above the assumed Pleistocene layer.

i. Due to the significant influence strength gain from construction will have upon the overall levee design and to reduce the risk of the need for design modifications during construction, the lower bound Cv design line shall be used when determining change in effective vertical stress in the foundation during construction staging. Additionally, the median, best estimate Cc design line should be used when determining change in effective vertical stress.

j. Each construction stage should be analyzed for slope stability and meet HSDRRS Design Guidelines for slope stability. It may be necessary to apply the strength gain principles detailed in this memo to these intermediate lifts.

Additionally, these strength gain principles should be applied to future lifts to the 2070 design grade.

5. **Construction Sequencing**: Construction sequencing shall be developed such that a required hold time is specified at certain construction stages in order to achieve the gain in shear strength required by design. The induced load from staged construction directly influences the amount of gain in shear strength seen at the end of construction, thus the construction sequence plays a vital part of the overall design and the following should be assumed and taken into consideration:
    a. The planned construction duration from the first lift to the last lift should be less than 2 years.
    b. The design overbuild and construction sequence should be balanced such that there is neither an excessive amount of overbuild nor an unnecessary delay in construction.
    c. Designers may assume that construction will progress at an approximate rate of 1,000 to 2,000 in-place cubic yards per day. See Figure 8 for an example staged construction sequence to utilize as a starting point.
    d. Each stage in the construction sequence must be checked for and meet HSDRRS Design Guidelines for slope stability.
    e. The final construction sequence must be approved by Pierre Hingle x2738 in CEMVN-CD-E.

6. **Strength Gain Validation during Construction:** Staged construction involves the risk of a stability failure because it involves strengthening the foundation soils in order to obtain design objectives. A deep-seated slope stability failure of levee embankments during construction must be avoided because the consequences of this action are weaker, remolded strengths of foundation soils and a repair section that is much larger with increased environmental impacts. This could lead to WSLP impacts such as delays in construction, levee realignment, or a change to a T-wall for hurricane risk reduction in the affected vicinity. For these reasons, strength gain during construction and embankment stability will be validated by instrumentation such as piezometers, inclinometers, settlement sensors, settlement plates, and CPTs. Based on the results of the instrumentation program, design may need to be modified as construction progresses. An instrumentation plan and CPT location plan will be developed for each contract reach before construction begins. To validate shear strength gain during construction, the following methodology should be followed:
    a. The first validation that will be performed during construction will be by measuring pore water pressure using vibrating wire (VW) piezometers installed at varying depths below the existing ground surface. Based on Terzaghi's one-dimensional theory of consolidation, after the embankment

load is placed on the soil and consolidation begins, the additional load is carried by pore water. As a result, excess pore water pressure is developed. As drainage in the subsoils follows, the pore water pressure will begin to return to hydrostatic conditions and the excess pore water pressure will decrease. Consequently, the effective stress of the soil will increase by the same amount that the pore water pressure decreases. Piezometers will be used to measure the pore water pressure before construction, immediately after the embankment is constructed to a required stage, and during a specified hold period. Utilizing this data, percent consolidation, or degree of consolidation can be estimated.

b. Before construction, the settlement software should be used, along with the best estimate Cv and Cc, to estimate the degree of consolidation required to induce effective vertical stress and in turn the necessary strength gain to continue with the next stage of levee embankment construction.

c. During construction, piezometer readings will be utilized to estimate degree of consolidation during the hold periods. Degree of consolidation can be defined by Equation 5.

$$U = 1 - (u_e/u_{eo}) \qquad (5)$$

Where U = degree of consolidation, u_e = the current excess pore water pressure and u_{eo} = the initial excess pore water pressure at the time of load application.

d. Thus, before construction begins, target degrees of consolidation should be identified for each stage of embankment construction. These targets of degree of consolidation will be validated in the field before progressing to the next stage of embankment construction. Figure 10 provides an example graph showing the degree of consolidation needed per layer to achieve estimated strength gain prior to progressing to Stage 2 construction.

e. The second validation that will be performed during construction will be through validating settlement. For each lift that utilizes strength gain, the settlement software should be used, along with the best estimate Cv and Cc parameters, to estimate the consolidation settlement required to induce effective vertical stress and in turn the necessary strength gain required to continue with the next stage of levee embankment construction. Settlement sensors and settlement plates will be used to validate that predicted settlement has occurred in the field. Thus, before construction begins, target settlements should be identified for each stage. These targets of settlement will be evaluated in the field before progressing to the next stage of embankment construction.

f. Additionally, prior to construction, due to uncertainty in the parameters, the lower bound, best estimate, and upper bound Cv parameters and best estimate Cc parameters should be used to produce a plot that shows a range of settlements vs. time during construction. This plot will be used to inform construction representatives regarding hold times. Figure 9 provides an example graph that shows the best estimate and potential range of time for estimated settlement to take place. In this example, settlement analyses estimate approximately 4.5 feet of settlement will occur prior to inducing enough strength gain to progress from Stage 1 construction to Stage 2 construction. By varying the Cv, an estimate of the hold time required to induce 4.5 feet of settlement can be approximated.

g. The third validation that will be performed during construction will be through CPTs. CPTs were previously performed throughout the WSLP alignment. Before progressing to the next stage of embankment construction, validation CPTs will be performed at various locations of existing CPTs for each contract reach of WSLP. Validation CPTs will be compared to existing CPTs performed at the same location to confirm that shear strength gain has taken place.

h. As described in Section 6, strength gain validation will be three-fold. Settlement monitoring, piezometers, and CPTs will all be used to validate shear strength gain. Due to uncertainties in soil conditions, soil compressibility and gains in shear strength, and uncertainties involved in instrumentation and settlement analyses, engineering judgment will need to be applied to the interpretation of the results of the field monitoring program to inform construction progress.

i. In addition to monitoring shear strength gain, inclinometers will be used to measure lateral deformations to address embankment stability.

7. **Levee Overbuild**: Lateral spread, shrinkage, primary consolidation, and required levee design life should be taken into consideration when determining levee overbuild. Total settlement will include the cumulative total of primary consolidation, lateral spread, and shrinkage.

    a. The best estimate Cc and Cv design lines should be used when analyzing primary consolidation after construction to determine a levee overbuild.

    b. For the first 10 years post-construction, embankment shrinkage should be estimated as 2% of the levee height. Note, MVN-EDG historically considered shrinkage to be 10% of the embankment material added, but since construction sequencing, intermediate lifts, and compaction requirements are being considered, CEMNVN-EDG justifiably recommends reducing this to 2%.

c. Lateral spread should be estimated as 20% of primary consolidation settlement. Note, MVN-EDG has historically considered lateral spread to be as much as 25% of the foundation settlement, but since a sand base will be constructed and construction sequencing and intermediate lifts are being incorporated, CEMVN-EDG justifiably recommends reducing this to 20%.
d. Levee crown elevation must remain above design grade for at least 5 years following the end of construction.

8. Slope stability analyses for WSLP will be analyzed using 3 'verticals', or locations where strength gains will be applied, (i.e. land side berm toe, centerline, and flood side berm toe). Therefore, shear strength gain will be estimated at one location, the levee centerline. Although foundation soils at and beyond the toe of the berms technically will experience slight changes in effective vertical stress and thus slight gains in strength, CEMVN-EDG recommends conservatively ignoring this slight gain in strength by having the vertical representing the existing-conditions design parameters be located at the toe of the berm at the flood side and land side of the levee. A profile view of a typical levee section is included as Figure 11 to identify the location of the 3 verticals that CEMVN-EDG will use for WSLP.

9. CEMVN-EDG performed a sensitivity check to see the difference in using 7 verticals as opposed to the 3 ultimately recommend in this memo. Figure 12 plots the induced stress (which is directly correlated to strength gain) at a depth of 10 feet due to an embankment load. The graph is identified with the locations of the "3 verticals" in black and the locations of the "7 verticals" in blue. The "7 verticals" interpolate between points along the induced stress/strength gain line fairly well, staying below the strength gain line throughout. By comparison, the "3 verticals" interpolates between verticals in a way that overestimates strength gain near the levee centerline and underestimates near the berm toe. However, in slope stability, an increase in the shear strength of foundation soils near the toe generally improves factor of safety more than increasing shear strength at the levee centerline. CEMVN-EDG performed sensitivity checks of slope stability analyses using "7 verticals" and "3 verticals." These analyses indicated that performing slope stability analyses with 3 verticals would result in a lower factor of safety. Additionally, utilizing 3 verticals results in a reduction in shear strength gain calculations and a reduction in overall design work. All things considered, CEMVN-EDG considers 3 verticals to be an appropriate design method. However,

increasing the number of verticals should be performed if design objectives require it.

10. This procedure for estimating the gain in undrained shear strength should be used throughout WSLP. Application of this procedure to other projects should not be used without first consulting CEMVN-EDG.

11. CEMVN-EDG points of contact are Mr. Leeland Richard, PE, x2397, Mr. Chad Rachel, PE, x2120, Mr. Craig Baldwin, x2983, Mr. Hashim Alrahahleh, x1565 and Mr. Kenneth Naka, x2902.

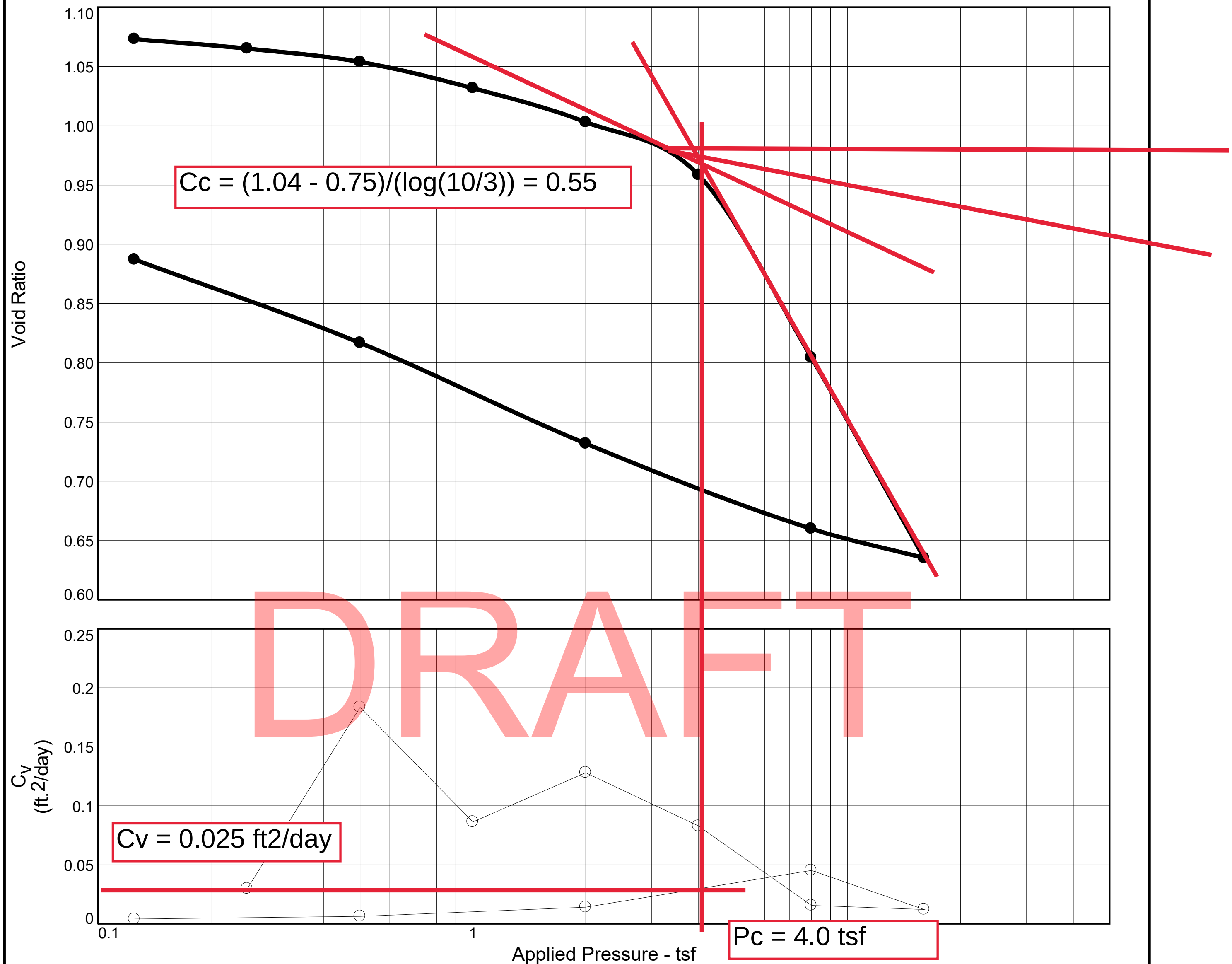
Figures
1 to 12

JEAN S. VOSSEN, P.E.
Chief, Engineering Division
New Orleans District, USACE

WSLP - Embankment Design Memo - Figure 1

Choosing Lab Cv based upon Pc Example

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	P_c (tsf)	C_c	Initial Void Ratio
Saturation	Moisture							
100.0 %	40.2 %	80.8	60	41	2.67	4.0	0.56	1.073

MATERIAL DESCRIPTION	USCS	AASHTO
ST GR CH3 W/ ARS & LNS ML, SL	CH3	

Project No. 24073 **Client:** U.S. ARMY CORPS OF ENGINEERS, NEW ORLEANS,

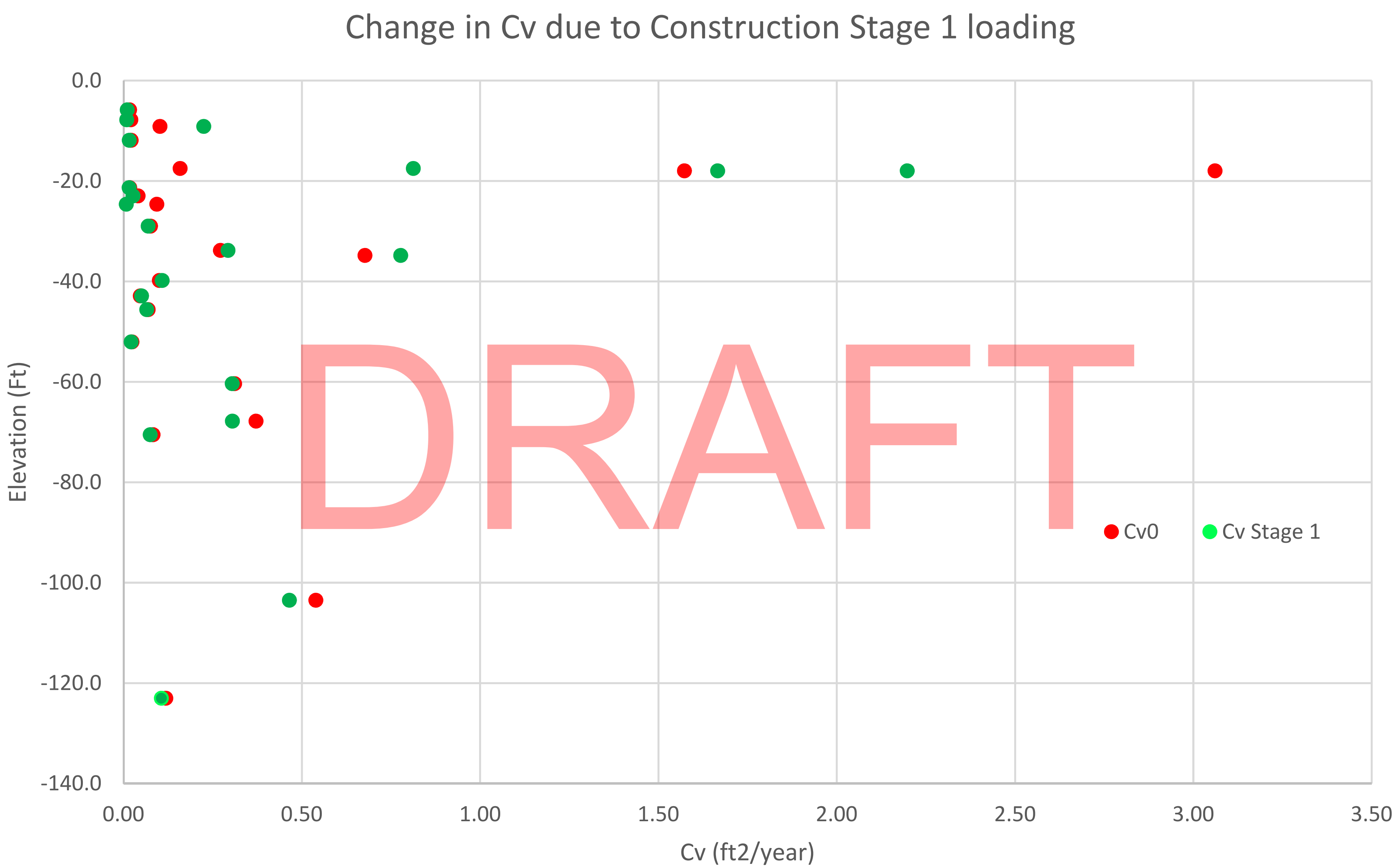
Project: U.S. ARMY CORPS OF ENGINEERS
WEST SHORE LAKE PONTCHARTRAIN (WSLP) HURRICANE AND STORM DAMAGE

Source of Sample: WSLP-19-061U **Depth:** 71 **Sample Number:** 20B

Remarks:

Figure

WSLP - Embankment Design Memo - Figure 2



Cv Correlation from LL. Figure 4 from NAVFAC Soil Mechanics Design Manual 7.01

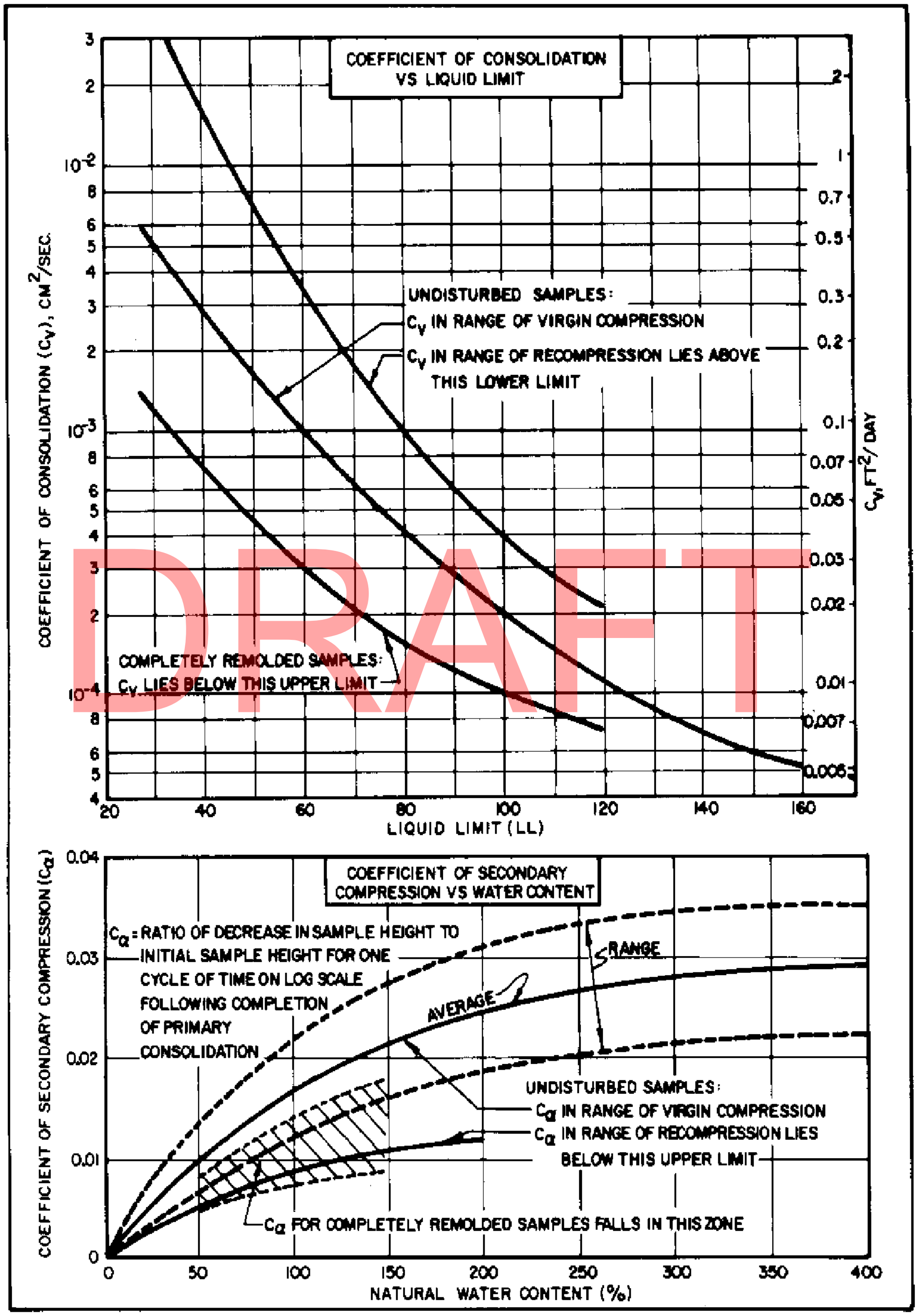


FIGURE 4
Approximate Correlations for Consolidation Characteristics
of Silts and Clays

Cc correlation from water content. Table 16 from the Strength and Compressibility Correlations for New Orleans Area Soils report.

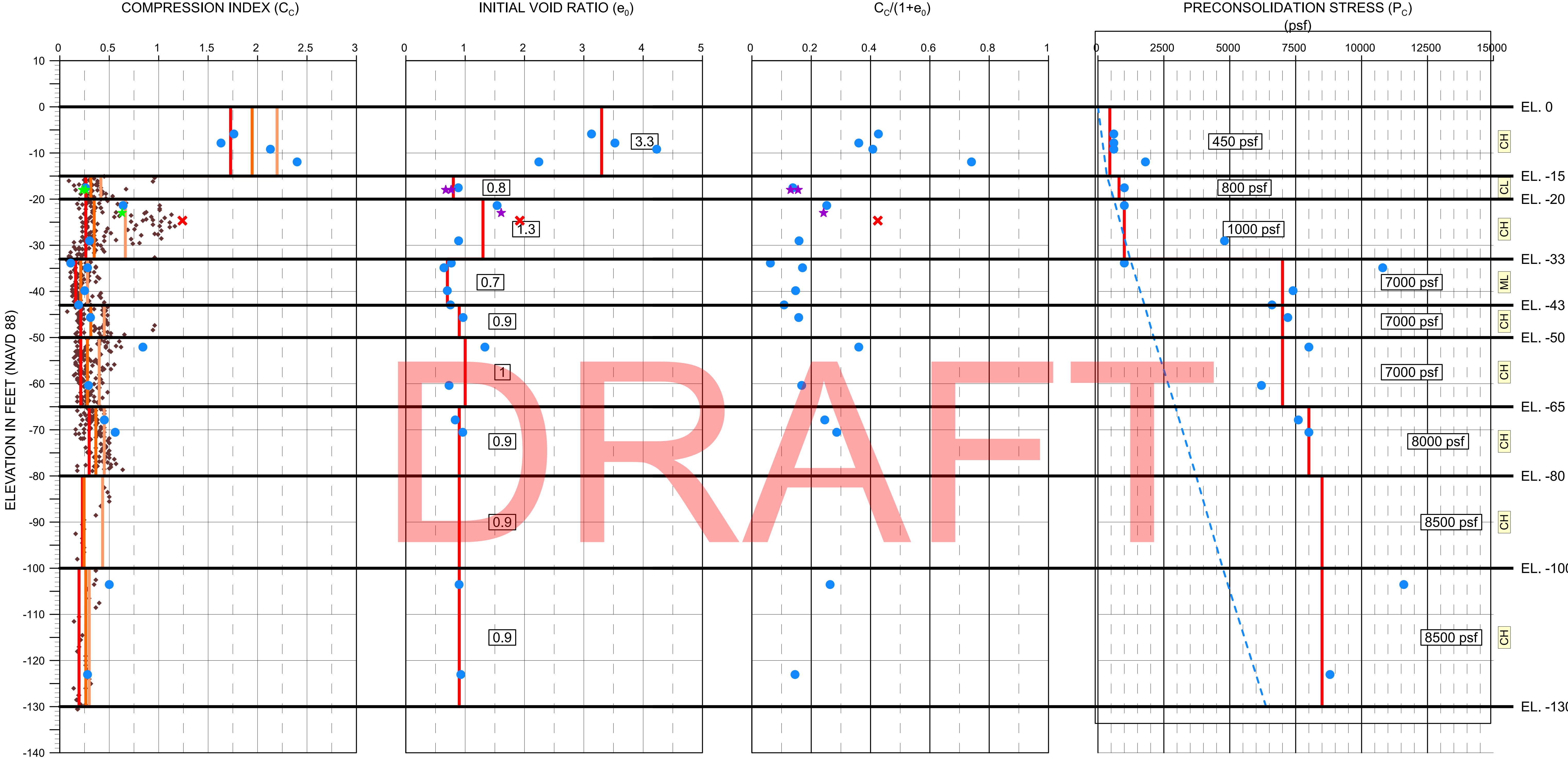
Table 16 Compression index as a function of in situ water content (in percent).

Soil Type	Empirical Relationship
CL and CH	$C_c = 0.017 \cdot w_n - 0.299$
CHO and PT	$C_c = 0.012 \cdot w_n + 0.137$

The ratio of the recompression to the compression index for New Orleans soils is about 0.2. This is slightly higher than generic values reported in the geotechnical literature.

WSLP - Embankment Design Memo - Figure 5 (Sheet1/2)

Consolidation Parameters



Legend

- Lab Data
- Design Line
- Effective Stress
- Cc Correlations
- CC Lab Data Adjusted
- CC Lab Data Outlier (removed)
- Cc First Quartile
- Cc Median
- Cc Third Quartile

NOTES:

1. Cc correlations were based on CH and CL w% correlations from the Strength and Compressibilit of New Orleans Soils report (2011 September 4).
2. Cc correlations for layer 1 were not included due to high scatter.
3. Adjusted lab tests were moved to better match the soil type to the design stratum and decrease scatter in the data.

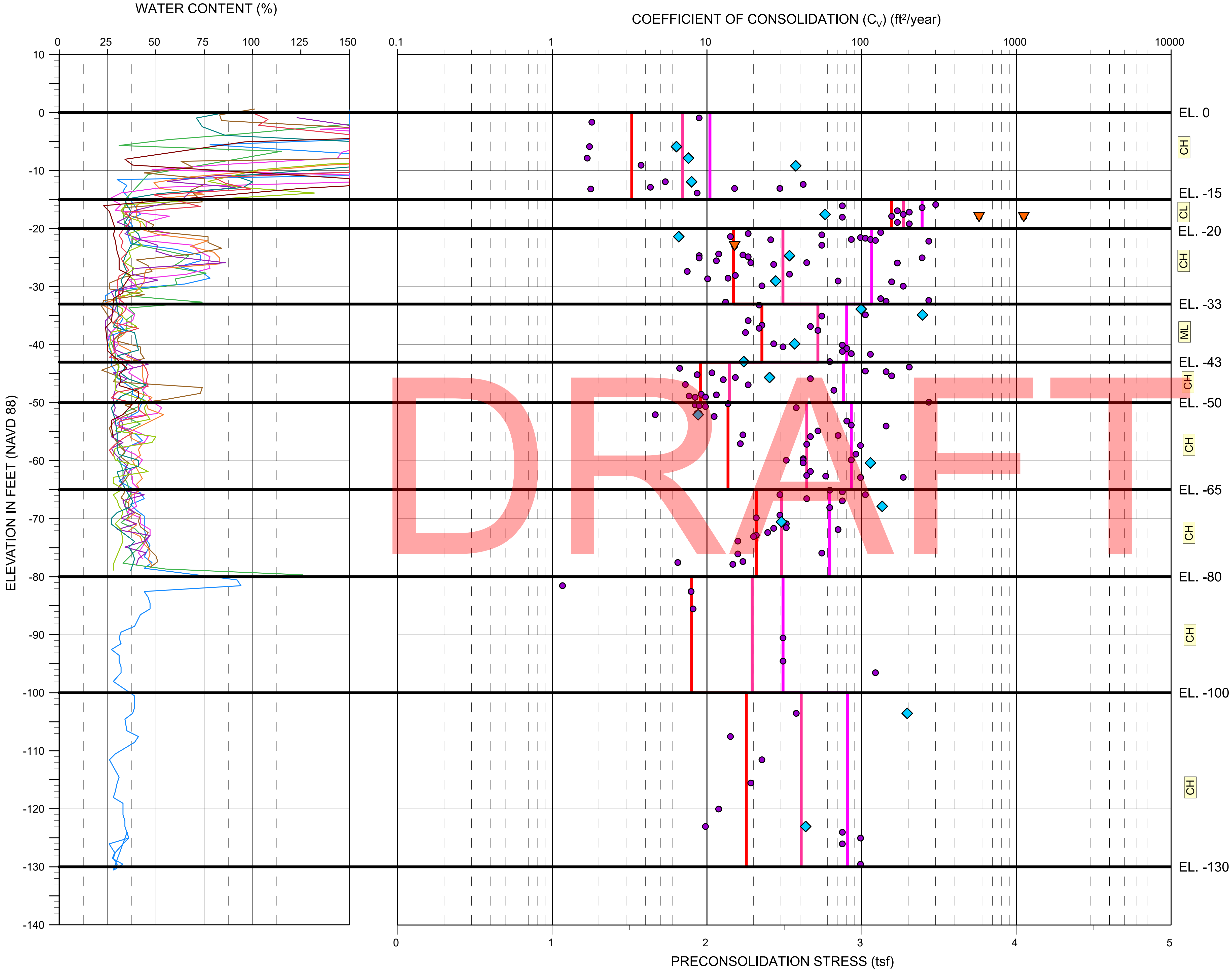
U.S. Army Corps of Engineers
New Orleans District

West Shore Lake Pontchartrain

Embankment Design Memo - Attachment 4
Consolidation Parameters from Reach 107b

DRAWN.	CHECKED.	DATE.	SHEET.
K.A.N.	K.A.N.	22 March 2020	Sheet (1/2)

WSLP - Embankment Design Memo - Figure 5 (Sheet2/2) Cv Design Line



Legend

- Cv from LL Correlation
- Cv Lab Tests Adjusted
- Cv Lab Tests
- Cv First Quartile
- Cv Median
- Cv Third Quartile

NOTES:

1. Adjusted lab tests were moved to better match the soil type to the design stratum and decrease scatter in the data.
2. Correlations were taken from the NAVFAC LL Cv correlation graph.

U.S. Army Corps of Engineers
New Orleans District

West Shore Lake Pontchartrain

Embankment Design Memo - Attachment 4
Cv Design Parameters from Reach 107b

DRAWN.	CHECKED.	DATE.	SHEET.
K.A.N.	K.A.N.	22 April 2020	Sheet (2/2)

Undrained Strength Ratios for New Orleans Area Soils

A key element in the application of SHANSEP is the determination of the undrained strength ratio to be used to calculate the shear strength distribution. The range of values for normally consolidated clays often cited by Prof. Ladd was presented earlier in Figure 22.

The data obtained in New Orleans area testing allows these published values to be examined. Shown in Figure 35 are the DSS undrained strength ratios as a function of PI for all data that met the ±10% threshold. The average undrained strength ratio was 0.28, with a standard deviation of 0.033. Ladd's[28] results showed the undrained strength ratio increasing with increasing PI, and his proposed relationship is shown as the dashed red line on the plot. For the New Orleans area soils, the undrained strength ratio appears to be reasonably constant for the range of PI values reported. The Ladd relationship represents a lower bound to the measured test data.

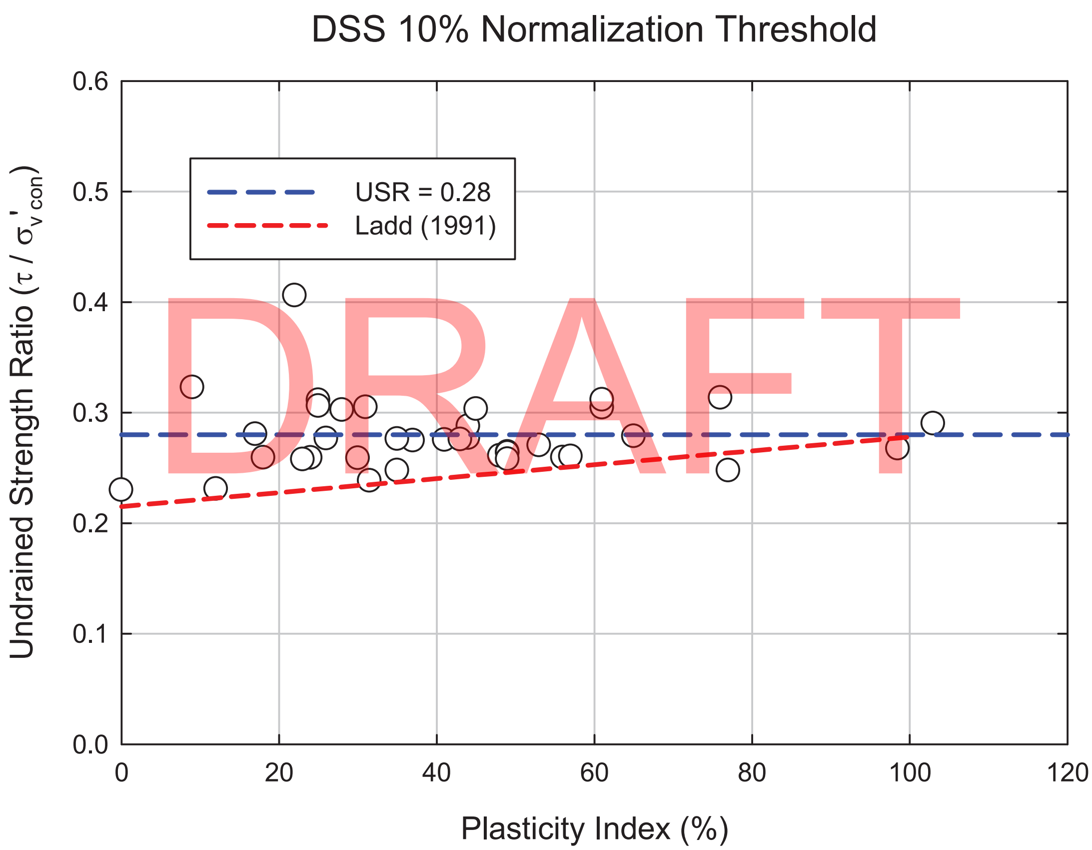


Figure 35 Undrained strength ratio as a function of PI for DSS tests where the samples met the ±10% normalization threshold.

The same average undrained ratio was calculated for the tests which met the ±5% threshold. A plot of the test results is presented in Figure 36. Even with the more stringent acceptance criterion, the undrained strength ratio does not appear to increase with increasing PI.

WSLP - Embankment Design Memo - Figure 7

Example of Strength Gain Calculations

Pre-consolidation Stress for 2020 (End of Construction)			Elevation	ΔP	Strength Gain (ΔP * 0.22) (psf)
Location:	**Levee Centerline**				
Depth (ft)	Pre-consolidation Stress (ksf) Existing Condition	Pre-consolidation Stress (ksf) End of construction			
0	0.00339	1.4909	0	1.48751	327.2522
15	0.34388	0.365504	-15	0.021624	4.75728
20	0.610895	0.619516	-20	0.008621	1.89662
33	1.31259	2.31867	-33	1.00608	221.3376

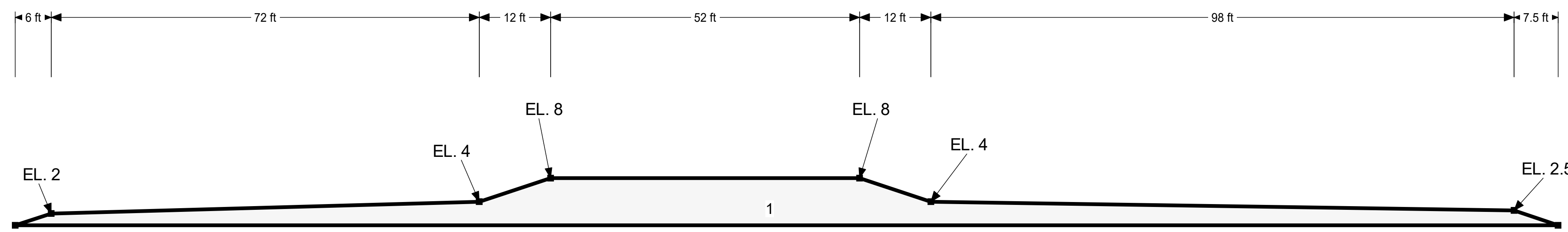
Original Strength (psf)	
Top Su	**Bot Su**
120	120
180	180
180	310

Increased Centerline Strength (psf)	
Top Su	**Bot Su**
447	125
185	182
182	531

WSLP - Embankment Design Memo - Figure 8

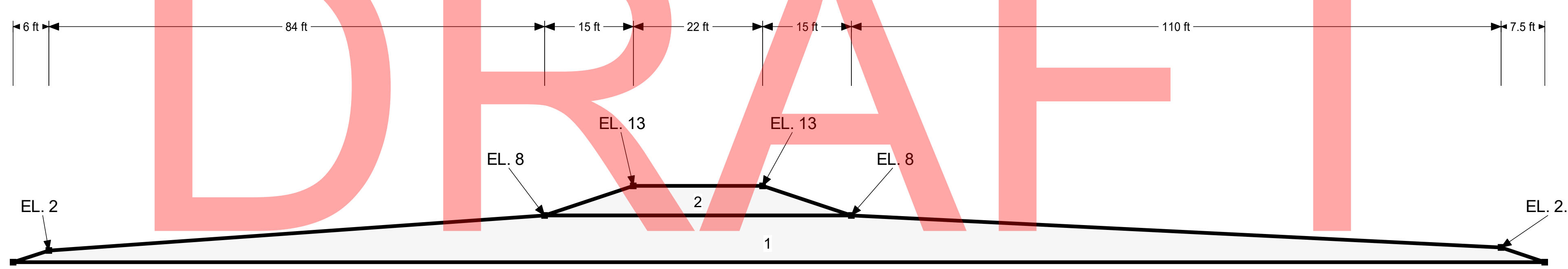
Example Staged Construction Sequencing

Stage 1 - Hold 45 Weeks



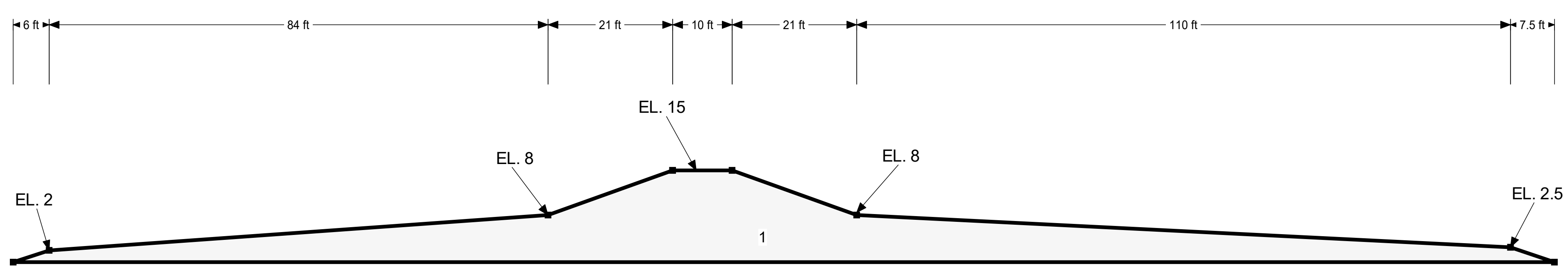
Area: 1109.9 ft^2

Stage 2 - Hold 20 Weeks



Area: 1613.9 ft^2

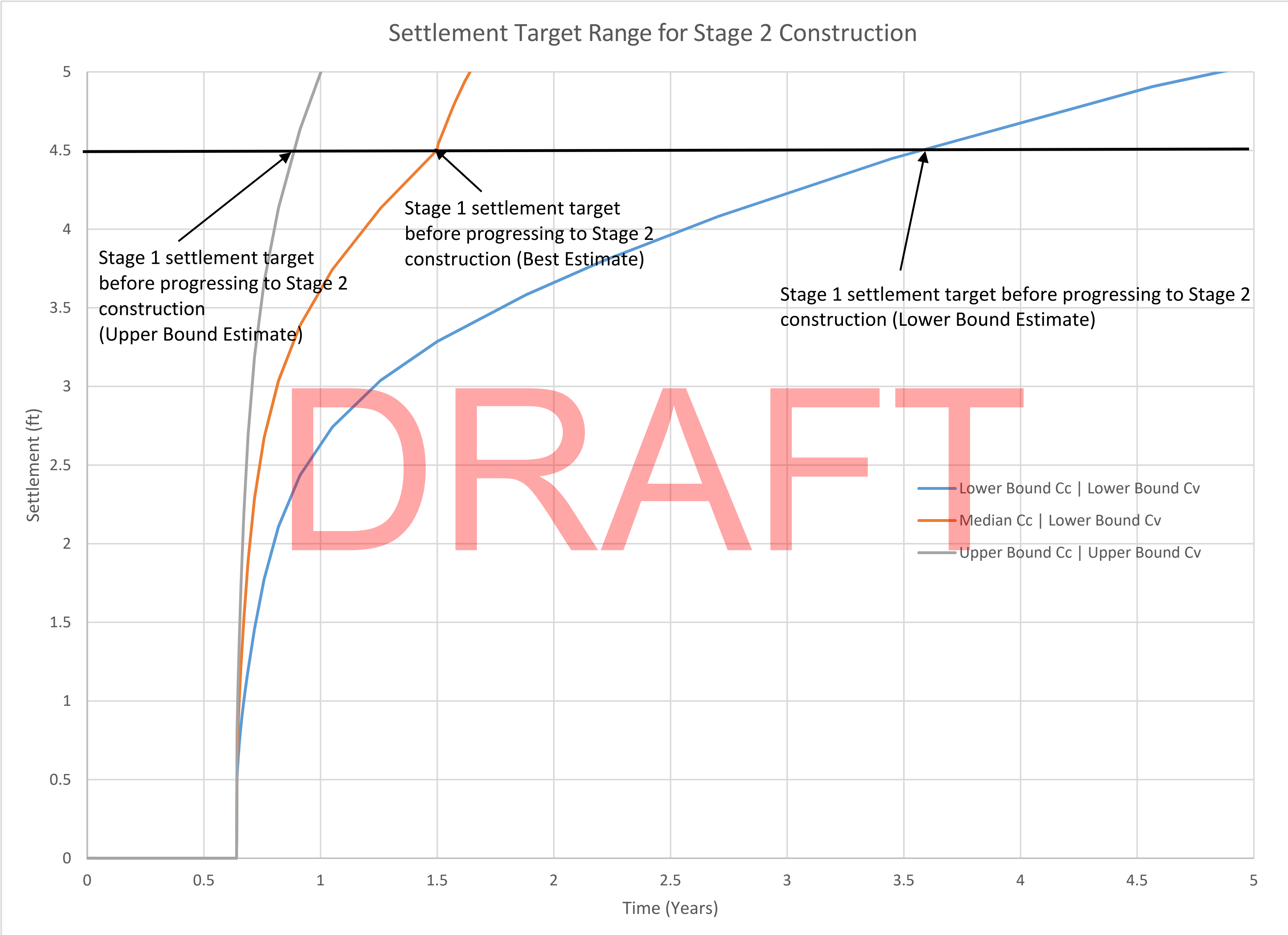
Stage 3 - End of Construction



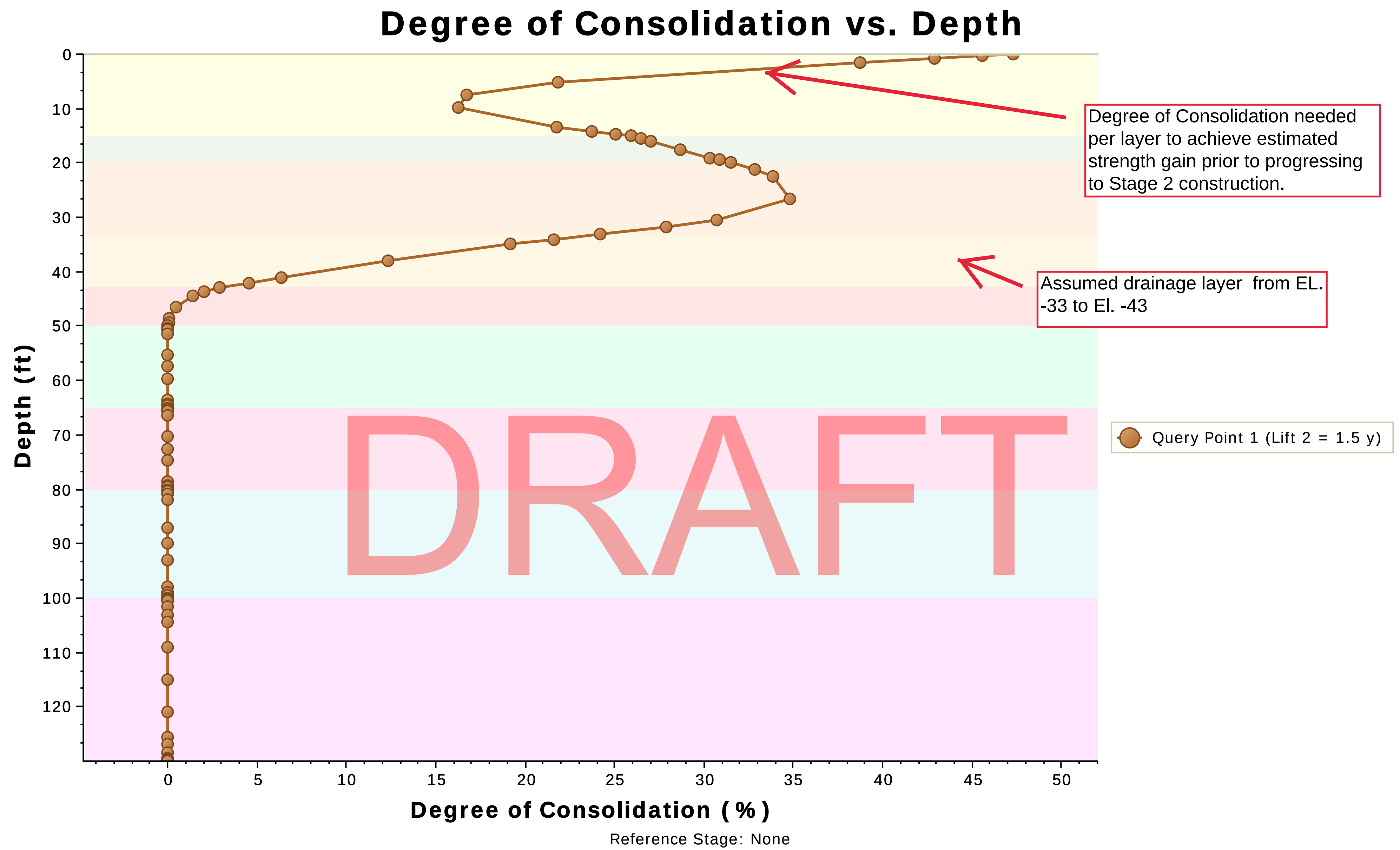
Area: 1661.4 ft^2

WSLP - Embankment Design Memo - Figure 9

Example: Best guess and Potential Range of Time for Stage 1 Hold Time



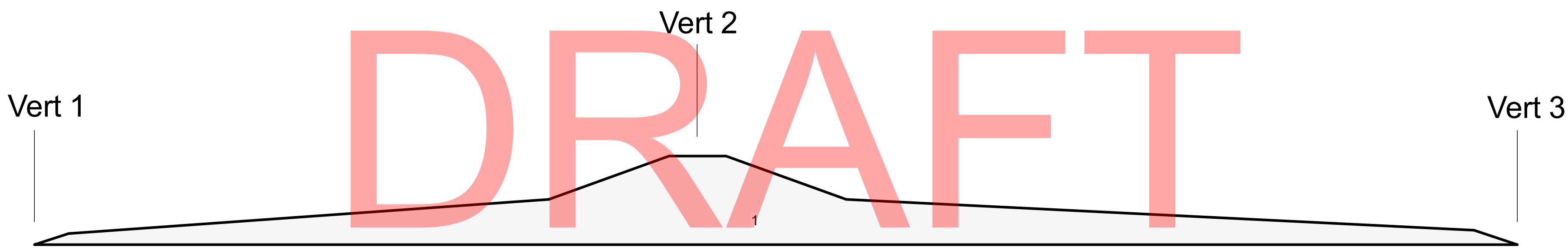
WSLP - Embankment Design Memo - Figure 10
Example Degree of Consolidation



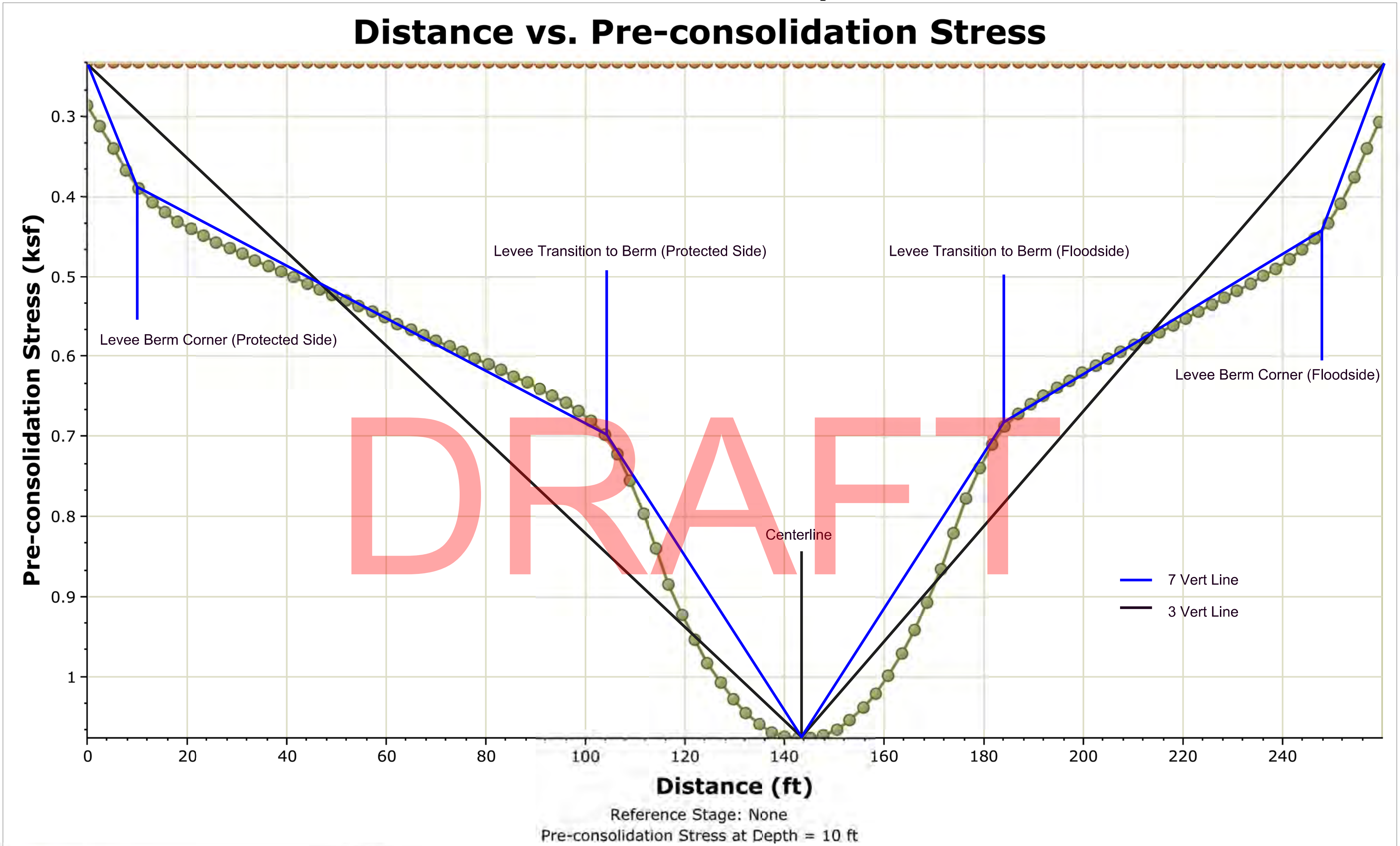
SETTLE3 5.001	Project	WSLP - Reach 107b - Settlement	
	Analysis Description		
	Drawn By	Kenneth Naka	Company: USACE MVN
	Date	10/24/2019, 12:56:21 PM	File Name: WSLP 107b - Settlement - Cc Median.s3z

WSLP - Embankment Design Memo - Figure 11

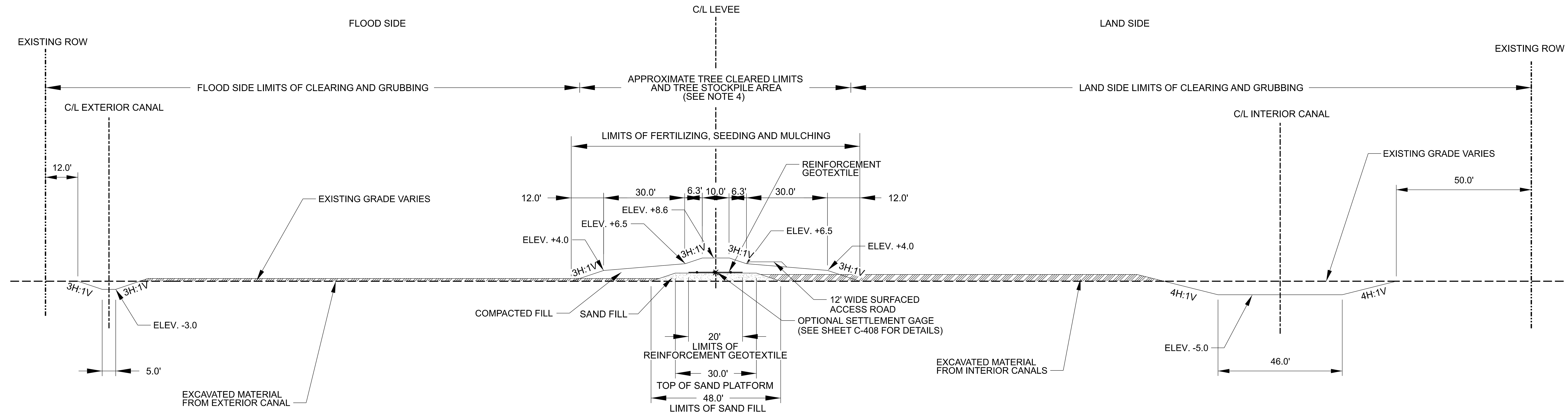
3 Verticals Example



DRAFT



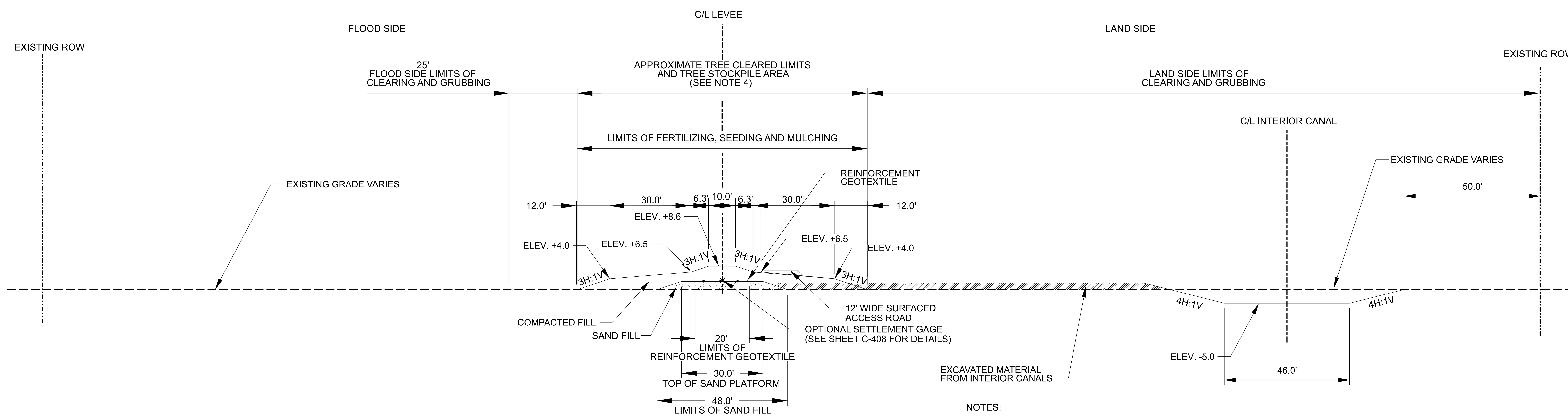
SETTLE3D 4.013	Project	WSLP - Contract 07 - Hydraulic Reach 3 - 2020 Settlement	
	Analysis Description		
	Drawn By	Kenneth Naka	Company: USACE MVN
	Date	10/24/2019, 12:56:21 PM	File Name: WSLP_107_HR3_Settlement.s3z



TYPICAL SECTION 108-1 - WEST

LEVEE CONSTRUCTION TO EL +8.6'
B/L STA. 318+50 TO 319+73.41
C/L STA. 318+48.87 TO 319+72.88

0 20' 40'
SCALE: 1"=20'



TYPICAL SECTION 108-1 - WEST

LEVEE CONSTRUCTION TO EL +8.6'
B/L STA. 247+50 TO 318+50
C/L STA. 247+50 TO 318+48.87

0 20' 40'
SCALE: 1"=20'

NOTES:

1. UNCOMPACTED FILL EXCAVATED FROM THE INTERIOR AND EXTERIOR CANALS SHALL BE SPREAD FROM LANDSIDE CANAL LIMITS TO THE FLOOD SIDE CANAL LIMITS, BUT NOT BELOW THE WORKING SAND PLATFORM, PRIOR TO LEVEE CONSTRUCTION.
2. SAND FILL SHALL BE PLACED TO ELEVATION +3.0' FOR A WORKING PLATFORM AT THE BASE OF THE LEVEE, BELOW THE REINFORCEMENT GEOTEXTILE.
3. EXCAVATED MATERIAL FROM THE INTERIOR AND EXTERIOR CANALS SHALL BE SPREAD BEFORE THE ADDITION OF THE SAND BASE. CANAL EXCAVATION CAN BE CONCURRENT WITH THE SAND PLACEMENT, BUT NOT IN ADVANCE OF 500 FEET OF SAND PLACEMENT.
4. TREES PREVIOUSLY CLEARED AND STOCKPILED ON SITE SHALL BE REMOVED BY THE CONTRACTOR.
5. ALL TREES SHALL BE CUT SUCH THAT THE REMAINING STUMPS STAY WITHIN THE SAND BASE. TO AVOID CONSTRUCTION EQUIPMENT ISSUES AND ENSURE PROPER COMPACTION, ANY REMAINING TREE STUMPS LOCATED BETWEEN THE EDGES OF SAND BASE AND THE TOE OF THE LEVEE STABILITY BERM SHALL BE REMOVED.
6. THE FIRST AND EACH SUCCESSIVE LAYER OF COMPACTED FILL MATERIAL SHALL BE COMPACTED TO AT LEAST 90% OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D 698 (STANDARD PROCTOR TEST) AT A MOISTURE CONTENT WITHIN THE LIMITS OF +5% TO -3% OF OPTIMUM MOISTURE CONTENT DETERMINED FROM ASTM D 698.

US Army Corps of Engineers®

NOT FOR CONSTRUCTION

MARK	DESCRIPTION	DATE

DESIGNED BY:
DRAWN BY: RMH
CHECKED BY: LJP
SUBMITTED BY: LJP
SIZE: ANSI D
ISSUE DATE: JUNE 2022
SOLICITATION NO.: YXXXXXXXXXXX
CONTRACT NO.: ZXXXXXXXXXXX
FILE NUMBER: H-8-48310
FILE NAME: H-8-48304_C-303.dgn

U.S. ARMY CORPS OF ENGINEERS
NEW ORLEANS DISTRICT
7400 LEAKE AVE.
NEW ORLEANS LA 70118

AIMS GROUP INC.
CONSULTING ENGINEERS
4421 ZENITH AVE.
METAIRIE, LA 70001

WEST SHORE LAKE PONTCHARTRAIN, LA
HURRICANE AND STORM DAMAGE RISK REDUCTION PROJECT
WSLP - 108

TYPICAL SECTIONS
ST JOHN THE BAPTIST PARISH, LA

SHEET ID
C-301

95%

Appendix IV: Representative species tables

Annex A: Representative bird species

Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Little blue heron	*Egretta caerulea*	Northern harrier	*Circus hudsonius*
Great blue heron	*Ardea herodias*	Sedge wren	*Cistothorus stellaris*
Green-backed heron	*Butorides virescens*	Greater yellowlegs	*Tringa melanoleuca*
Yellow-crowned night heron	*Nyctanassa violacea*	Eastern screech owl	*Megascops asio*
Black-crowned night heron	*Nycticorax nycticorax*	Mississippi kite	*Ictinia mississippiensis*
Great egret	*Ardea alba*	Red-tailed hawk	*Buteo jamaicensis*
Snowy egret	*Egretta thula*	Red-bellied woodpecker	*Melanerpes carolinus*
Cattle egret	*Bubulcus ibis*	Pileated woodpecker	*Dryocopus pileatus*
Reddish egret	*Egretta rufescens*	Barred Owl	*Strix varia*
Tricolor Heron	*Egretta tricolor*	Turkey Vulture	*Cathartes aura*
White ibis	*Eudocimus albus*	House Wren	*Troglodytes aedon*
Roseate spoonbill	*Platalea ajaja*	Prothonotary Warbler	*Protonotaria citrea*
White-faced ibis	*Plegadis chihi*	Wood duck	*Aix sponsa*
Killdeer	*Charadrius vociferus*	Hooded-merganser	*Lophodytes cucullatus*
American avocet	*Recurvirostra americana*	Canada goose	*Branta canadensis*
Black-necked stilt	*Himantopus mexicanus*	Blue-winged teal	*Spatula discors*
Herring gull	*Larus argentatus*	Mallard	*Anas platyrhynchos*
Laughing gull	*Leucophaeus atricilla*	Black-bellied whistling duck	*Dendrocygna autumnalis*
Boat-tailed grackle	*Quiscalus major*	Gadwall	*Mareca strepera*
Red-winged blackbird	*Agelaius phoeniceus*	American wigeon	*Mareca americana*
Anhinga	*Anhinga anhinga*	American coot	*Fulica americana*

Annex B: Representative mammal species (adapted from LCA Blind River Final SEIS).

Common Name	Scientific Name
Beaver	Castor Canadensis
Bobcat	Felis rufus
Cotton Mouse	Peromyscus gossypinus
Cotton Rat	Sigmodon hispidus
Coyote	Canis latrans
Eastern Cottontail	Sylvilagus floridanus
Eastern Harvest Mouse	Reithrodontomys humilis
Eastern Spotted Skunk	Spilogale putorius
Feral Hog	Sus scrofa
Fox Squirrel	Sciurus niger
Golden mouse	Ochrotomys nuttalli
Gray Fox	Urocyon cinereoargenteus
Gray Squirrel	Sciurus carolinensis
House Mouse	Mus musculus
Least Shrew	Cryptotis parva
Long-tailed Weasel	Mustela frenata
Marsh Rice Rat	Oryzomys palustris
Mink	Mustela vison
Muskrat	Ondatra zibethicus
Nine-banded Armadillo	Dasypus novemcinctus
Nutria	myocastor coypus
Old World Rats	Rattus spp.
Raccoon	Procyon lotor
Red Fox	Vulpes vulpes
River Otter Southern Flying Squirrel	Lutra canadensis
Southern Short-tailed Shrew	Glaucomys volans
Striped Skunk	Blarina carolinensis
Swamp Rabbit	Mephitis mephitis
Virginia Opossum	Didelphis virginiana
West Indian Manatee	Trichechus manatus

Annex C: Herpetofauna: Table indicating reptiles and amphibians likely to occur in project area vicinity (Michon, pers. comm. 2019).

Common Name	Scientific Name	Common Name	Scientific Name
Western Lesser Siren	*Siren intermedia nettingi*	Red-eared Slider	*Trachemys scripta elegans*
Central Newt	*Notophthalmus viridescens louisianensis*	Gulf Coast Box Turtle	*Terrapene carolina major*
Marbled Salamander	*Ambystoma opacum*	Midland Smooth Softshell	*Apalone mutica*
Three-toed Amphiuma	*Amphiuma tridactylum*	Gulf Coast Spiny Softshell	*Apalone spinifera aspera*
Valentine's Southern Dusky Salamander	*Desmognathus valentinei*	Mediterranean Gecko	*Hemidactylus turcicus (I)*
Four-toed Salamander	*Hemidactylium scutatum*	Northern Green Anole	*Anolis carolinensis carolinensis*
Western Dwarf Salamander	*Eurycea paludicola*	Little Brown Skink	*Scincella lateralis*
Fowler's Toad	*Bufo fowleri*	Common Five-lined Skink	*Plestiodon fasciatus*
East Texas Toad	*Bufo velatus*	Broad-headed Skink	*Plestiodon laticeps*
Gulf Coast Toad	*Bufo nebulifer*	Mississippi Ring-necked Snake	*Diadophis punctatus stictogenys*
Blanchard's Cricket Frog	*Acris blanchardi*	Western Mud Snake	*Farancia abacura*
Spring Peeper	*Pseudacris crucifer*	Eastern Hog-nosed Snake	*Heterodon platirhinos*
Cajun Chorus Frog	*Pseudacris fouquettei*	Pine Woods Snake	*Rhadinaea flavilata*
Cope's Gray Tree Frog	*Hyla chrysoscelis*	Midland Brown Snake	*Storeria dekayi wrightorum*
Western Bird-voiced Tree Frog	*Hyla avivoca avivoca*	Southern Red-bellied Snake	*Storeria occipitomaculata obscura*
Green Tree Frog	*Hyla cinerea*	Rough Earth Snake	*Haldea striatula*
Squirrel Tree Frog	*Hyla squirella*	Delta Glossy Swamp Snake	*Liodytes rigida deltae*
Eastern Narrow-mouthed Toad	*Gastrophryne carolinensis*	Graham's Crawfish Snake	*Regina grahamii*
Coastal Plains Leopard Frog	*Rana sphenocephala utricularius*	Mississippi Green Water Snake	*Nerodia cyclopion*
Bronze Frog	*Rana clamitans clamitans*	Northern Diamond-backed Water Snake	*Nerodia rhombifer rhombifer*
American Bull Frog	*Rana catesbeiana*	Yellow-bellied Water Snake	*Nerodia erythrogaster flavigaster*
Pig Frog	*Rana grylio*	Broad-banded Water Snake	*Nerodia fasciata confluens*
American Alligator	*Alligator mississippiensis*	Orange-striped Ribbon Snake	*Thamnophis proximus proximus*
Common Snapping Turtle	*Chelydra serpentina*	Eastern Garter Snake	*Thamnophis sirtalis sirtalis*
Alligator Snapping Turtle	*Macrochelys temminckii*	Northern Rough green Snake	*Opheodrys aestivus aestivus*
Mississippi Mud Turtle	*Kinosternon subrubrum hippocrepis*	Black-masked Racer	*Coluber constrictor latrunculus*
Stinkpot	*Sternotherus odoratus*	Gray Rat Snake	*Pantherophis spiloides*
Eastern Chicken Turtle	*Deirochelys reticularia reticularia*	Western Milk Snake	*Lampropeltis gentilis*
Mississippi Map Turtle	*Graptemys pseudogeographica kohnii*	Eastern Black King Snake	*Lampropeltis nigra*
Ouachita Map Turtle	*Graptemys ouachitensis*	Eastern Copperhead	*Agkistrodon contortrix*
Southern Painted Turtle	*Chrysemys dorsalis*	Northern Cottonmouth	*Agkistrodon piscivorus*
River Cooter	*Pseudemys concinna*	Timber Rattlesnale	*Crotalus horridus*

Annex D: Representative fishes adapted from LCA Blind River Final SEIS and Kelso and others (2005).

Common Name	**Scientific Name**
skipjack herring	*Alosa chrysochloris*
black bullhead	*Ameiurus melas*
bowfin	*Amia calva*
American eel	*Anguilla rostrata*
freshwater drum	*Aplodinotus grunniens*
gulf menhaden	*Brevoortia patronus*
common carp	*Cyprinus carpio*
American gizzard shad	*Dorosoma cepedianum*
threadfin shad	*Dorosaoma petenense*
golden topminnow	*Fundulus chrysotus*
blue catfish	*Ictalurus furcatus*
channel catfish	*Ictalurus punctatus*
bigmouth buffalo	*Ictiobus cyprinellus*
spotted gar	*Lepisosteus oculatus*
longnose gar	*Lepisosteus osseus*
warmouth	*Lepomis gulosus*
orangespotted sunfish	*Lepomis humilis*
bluegill	*Lepomis macrochirus*
longear sunfish	*Lepomis megalotis*
redear sunfish	*Lepomis microlophus*
spotted bass	*Micropterus punctulatus*
largemouth bass	*Micropterus salmoides*
yellow bass	*Morone mississippiensis*
striped mullet	*Mugil cephalus*
black crappie	*Pomoxis nigromaculatus*
white crappie	*Pomoxis annularis*
blacktail shiner	*Cyprinella venusta*
western mosquitofish	*Gambusia affinis*
sailfin molly	*Poecilia latipinna*

Annex E: Representative plant species list adapted from Individual Environmental Report 36 and LCA Blind River Final SEIS.

Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
Alligator weed	*Alternanthera philoxeroides*	Peppergrass	*Lepidium* spp.
American elm	*Ulmus americana*	Peppervine	*Ampelopsis arborea*
American sycamore	*Platanus occidentalis*	Pickerelweed	*Pontederia rotundifolia*
Bald cypress	*Taxodium distichum*	Pignut hickory	*Carya glabra*
Bedstraw	*Galium* spp.	Pigweed	*Amaranthus spp*
Bermuda grass	*Cynodon dactylon*	Planertree	*Planera aquatica*
Black willow	*Salix nigra*	Ragweed	*Ambrosia* spp.
Boxelder	*Acer negundo*	Red maple	*Acer rubrum*
Bushy beardgrass	*Andropogon glomeratus*	Red mulberry	*Morus rubra*
Buttonbush	*Cephalanthus occidentalis*	Smooth cordgrass	*Spartina alterniflora*
Carpetweed	*Mollugo verticillata*	Southern waterhemp	*Amaranthus* spp.
Cedar elm	*Ulmus crassifolia*	Spiny thistle	*Cirsium horridulum*
Chinese tallow tree	*Sapium sebiferum*	Sugarberry	*Celtis laevigata*
Cocklebur	*Xanthium* spp.	Sweetgum	*Liquidambar styraciflua*
Coffeeweed	*Sesbania* spp.	Three-corner grass	*Schoenoplectus americanus*
Common persimmon	*Diospyros virginiana*	Vervain	*Verbena* spp.
Dallis grass	*Paspalum dilatatum*	Water hyacinth	*Eichhornia crassipes*
Delta duck potato	*Sagittaria platyphylla*	Water Oak	*Quercus nigra*
Floating water primrose	*Ludwigia peploides*	Water pennywort	*Hydrocotyle umbellata*
Goldenrod	*Solidago* spp.	Water tupelo/tupelogum	*Nyssa aquatica*
Green ash	*fraxinus pennsylvanica*	Wire grass	*Spartina patens*
Honey locust	*Gleditsia triacanthos*	Woolly croton	*Croton capitatus*
Ironweed	*Vernonia* spp.	Wood sorrel	*Oxalis* spp.
Marshhay cordgrass	*Spartina patens*	Yankeeweed	*Eupatorium compositifolium*
Mock bishopweed	*Ptilimnium macrospermum*	Water milfoil	*Myriophyllum* spp.
Mosquito fern	*Azolla caroliniana*	Coontail	*Ceratophyllum demursum*
Nuttall oak	*Quercus nuttallii*	Souther pondweeds	*Potamogeton* spp.
		Dwarf Palmetto	*Sabal minor*

Appendix V: Hydrology Appendix

WEST SHORE LAKE PONTCHARTRAIN – TIDAL SIMULATIONS OF WITH AND WITHOUT PROJET

1. BACKGROUND

Additional HEC-RAS simulations were conducted to incorporate the final West Shore Lake Pontchartrain (WSLP) Interior Drainage Design to address environmental related questions. This addendum provides information relating to tidal modeling of with- and without-project conditions. The WSLP project relies on seven drainage structures to provide drainage and tidal exchange for the new polder. The drainage structure locations and dimensions are provided in Figure 1. Figure 1 also shows the final design alignment that was presented in the WSLP Interior Drainage Hydraulic Design Analysis dated April 2022, which was selected for construction and evaluated in the model runs for this effort. The purpose of the additional modeling is to estimate the effects of the project on volumetric exchange and velocities during normal day-to-day (non-storm) tidal conditions. Previous modeling focused on low frequency design storm events.

Several alternatives have been considered throughout the design process prior to arriving at the final design. For additional context, the following scenarios shown below illustrate how the design has transformed throughout the process:

Structures	Alternative 5: November 2019	Alternative D3: November 2021	Final Design: April 2022
Hope Canal	3 16x16ft @-10ft	3 10x10 @-5ft	3 10x10 @-5ft
MS Bayou	4 14x14ft @-8ft	4 10x10 @-5ft	4 10x10 @-5ft
Reserve	Alt 4 = 4 16x16ft @-10ft	5 10x10 @-5ft	**2000 cfs PS** 1 16x16 @-10ft 1 16x16 Nav Gate @-10ft
Perriloux	2 14x14 @-8ft	None	4 10x10 @-5ft
Ridgefield	2 14x14 @-8ft	2 10x10 @-5ft	None
I55	5 16x16ft @-10ft	5 10x10 @-5ft	**2000 cfs PS** 2 16x16 @-10ft
Montz North	None	None	None
Montz South	4 14x14ft @-8ft	4 10x10 @-5ft	4 10x10 @-5ft
Prescott	1 16x16ft @-10ft	1 10x10 @-5ft	2 10x10 @-5ft
Interior Canal	~80ft wide 30ft bottom width @-8ft 1:3 side slopes		~86ft wide 46ft bottom width @-5ft 1:4 side slopes
Exterior Canal			~35ft wide 5ft bottom width @-3ft 1:3 side slopes Limited to 300ft from drainage structures Hope canal exterior canal extends to first pipeline crossing
Interior Canal Weir Pipeline Crossing			~90ft wide w/ invert @-1ft

2. HEC-RAS MODELING

Month long tidal simulations were conducted for both with and without-project geometries for 5 different scenarios:

Simulation Set	Simulation Time Period	Water Level (ft NAVD88)*	Notes
A1	SEP-01-2019 to SEP- 30-2019	Average water surface elevation 1.0ft.	Tidal time-series
A2	SEP-01-2019 to SEP- 30-2019	Average water surface elevation 2.0ft	Tidal time-series +1.0ft
B1	NOV-01-2018 to NOV- 30-2018	Average water surface elevation 0.55ft.	Tidal time-series
B2	NOV-01-2018 to NOV- 30-2018	Average water surface elevation 1.55ft.	Tidal time-series +1.0ft
B3	NOV-01-2018 to NOV- 30-2018	Average water surface elevation 2.55ft.	Tidal time-series +2.0ft
*A1 and B1 values were determined from CRMS averaged data. The subsequent simulations build off these initial water levels.			

Tidal data (ft. NAVD88) was acquired from the National Oceanic and Atmospheric Administration (NOAA) Tides & Currents for the simulated time periods at the Bay Waveland Yacht Club gage in Mississippi (8747437). Predicted tidal data was used compared to verified data. The predicted data in combination with the specific precipitation and wind data provides an accurate depiction of event conditions for the area of interest. Verified tidal data is specific to the Bay Waveland location.

The wind data was obtained from ADCIRC hindcasts of Hurricane Isaac. The precipitation data came from Atlas 14 for the design events and the gridded data is from the National Weather Service (NWS) for the storm hindcasts. For the terrain, high resolution LiDAR data was obtained from St. John the Baptist Parish GIS office for the entire parish. The HEC-RAS full model development is outlined in the WSLP Interior Drainage Hydraulic Design Analysis main report (April 2022) under Section 4.

Simulation set A1 is a tidal, wind and rainfall simulation for the month of September 2019. HEC-RAS 6.3.1 was used which allows the use of gridded precipitation and wind. For this particular time period, the average stage at the tidal boundary is 1.0ft NAVD88. Simulation set A2 is the same as A1, except the water level at the boundary is increased by 1.0ft. These simulations are meant to estimate impacts of the project for a typical range of water levels that occur during non-storm conditions. Figure 2 displays the boundary condition tidal signal applied to the eastern edge of the model domain for simulation set A1.

Simulation set B1 is a simulation of the month of November 2018 using observed water levels at the boundary, observed gridded wind forcing and observed gridded rainfall forcing. The without-project simulation from set B1 was validated with the modeled results water level time-series. This validation provides increased confidence in the overall findings of the evaluation. Simulation set B2 is the same as B1, except the tidal boundary condition is increased by 1.0ft. Simulation set B3 is also the same as B1, except the tidal boundary condition is increased by

2.0ft. Simulation sets B1, B2, and B3 are meant to represent realistic conditions with rain, wind, and tides impacting the project. This time period was chosen because it includes a characteristic cold front and also a period of low water levels. Figure 3 displays the tidal boundary condition applied in simulation set B1. Figure 4 displays a snapshot of the observed gridded rainfall time-series applied in simulation set B1. Figure 5 displays a snapshot of the gridded wind applied in the modeling.

Both simulation sets A and B utilize the gridded wind and rainfall capabilities of HEC-RAS 6.3.1.

Simulation set B1 provided an opportunity to validate the modeling output. At first, the simulation was completed without rainfall. In order for the model to match observed water levels, it was necessary to add precipitation boundary forcing. Rainfall has less of an impact on water levels in the open water areas, or areas that are well connected to Lake Maurepas and Lake Pontchartrain. Figure 6 displays the CRMS gages used to validate the model results for the without-project run of simulation set B1. The model results and observations are compared in Figure 7 to Figure 16. It is important to note the accuracy of the datum of observed water levels can be on average a difference of 0.1 to 0.6 ft. One gage of particular interest is gage CRMS0059-H02, since it is located within the project polder. At this location, it was extremely important to add rainfall to the model in order to match observations. Also note at the CRMS0059-H02 location, there is not a strong tidal signal. At this location, it appears that rainfall causes an increased water level in the swamp that tends to dampen out the tidal signal from Lake Maurepas.

Simulation Set A1 Results

In order to evaluate the volumetric exchange between the polder for with and without project conditions, a flux output line was drawn along the interior of the entire project alignment. The project alignment is shown in Figure 1 as the thick red line. The total flow or “flux” across the boundary was extracted from each simulation. Figure 17 displays the total flow through the boundary for simulation set A1 for with and without project conditions. It should be noted that positive flow is flow leaving the polder. The comparison shows the project has very little impact on total volumetric exchange throughout the simulation. Figure 18 displays the total accumulated volume of flow through the flux boundary over the course of the simulation. Figure 18 suggests that the total volumetric exchange between the polder interior and exterior during a strong tidal oscillation is minor compared to the flow produced by rainfall. The model captures rainfall runoff into Lake Maurepas from the Amite and Comite Rivers, which can elevate and backflow the WSLP polder. There is very little difference in the total volume exchange between with and without project.

Simulation Set A2 Results

Figure 19 and Figure 20 display the total flow and volume exchange for simulation set A2. For the higher water level, there is more volumetric exchange. The increase in exchange from simulation set A1 is due to the higher starting water surface elevation, which allows more water to flow in and out of the polder area. Figure 20 shows there is very little difference in total volume exchanged between with and without project conditions. The drainage structures provide adequate exchange between the interior and exterior. The drainage structures are designed to adequately handle a low frequency rainfall event (10YR), where a tremendous amount of volume is generated within the polder. For example, the volume generated during a 2-day 10YR precipitation event is nearly 15,000 acre-ft according to previous simulations. The volume generated during rainfall events appears to be significantly higher when compared to the volume exchanged during tides.

Simulation Set B1 Results

Figure 21 and Figure 22 display the flow time-series and total volume exchange for simulation set B1. The results of this set of simulations show again how the addition of rainfall dominates the flow and volume exchange between the polder and exterior. The results show that the additional rainfall causes a strong net positive flow leaving the polder. The rainfall totals for November 2018 are approximately 8 inches. For drought periods without rain, volume exchange from tides would become higher.

Simulation Set B2 & B3 Results

Figure 23 through Figure 26 display the flow time-series and total volume exchange for simulation set B2 and B3. The higher starting water surface elevation does not have a tremendous effect of the total volumetric exchange between the polder interior and exterior. The results also show a strong net positive volume leaving the polder for the entire month of November. The results also show very little difference between with and without project conditions.

Velocity & Water Surface Elevation Results

Difference in maximum water velocity results for A1, A2, B1, B2, and B3 simulations are provided in Figure 27 to Figure 31. The velocity comparison shows the difference for with-project minus without-project conditions. A value of zero will result if no velocity data exists in either the with- or without-project condition.

The HEC-RAS Mapper maximum velocity results layer showed visual instabilities that do not depict the true model results. Reducing the computational time step may reduce the number of instabilities in the visualizations; however, the amount of time to compute the runs would be infeasible. Therefore, the results shown are taken from a peak velocity time step surrounding the WSLP alignment. Simulation set A1 & A2 velocity results were taken at a peak velocity time step of SEP-22-2019 00:00:00. Simulation set B1, B2, & B3 velocity results were taken at a peak velocity time step of NOV-13-2018 00:00:00.

Difference in maximum water surface elevation results for A1, A2, B1, B2, and B3 are provided in Figure 32 to Figure 36. The water surface elevation comparison shows the difference for with-project minus without-project conditions. The without project terrain elevation will result if no water surface elevation data exists for either the with- or without-project condition.

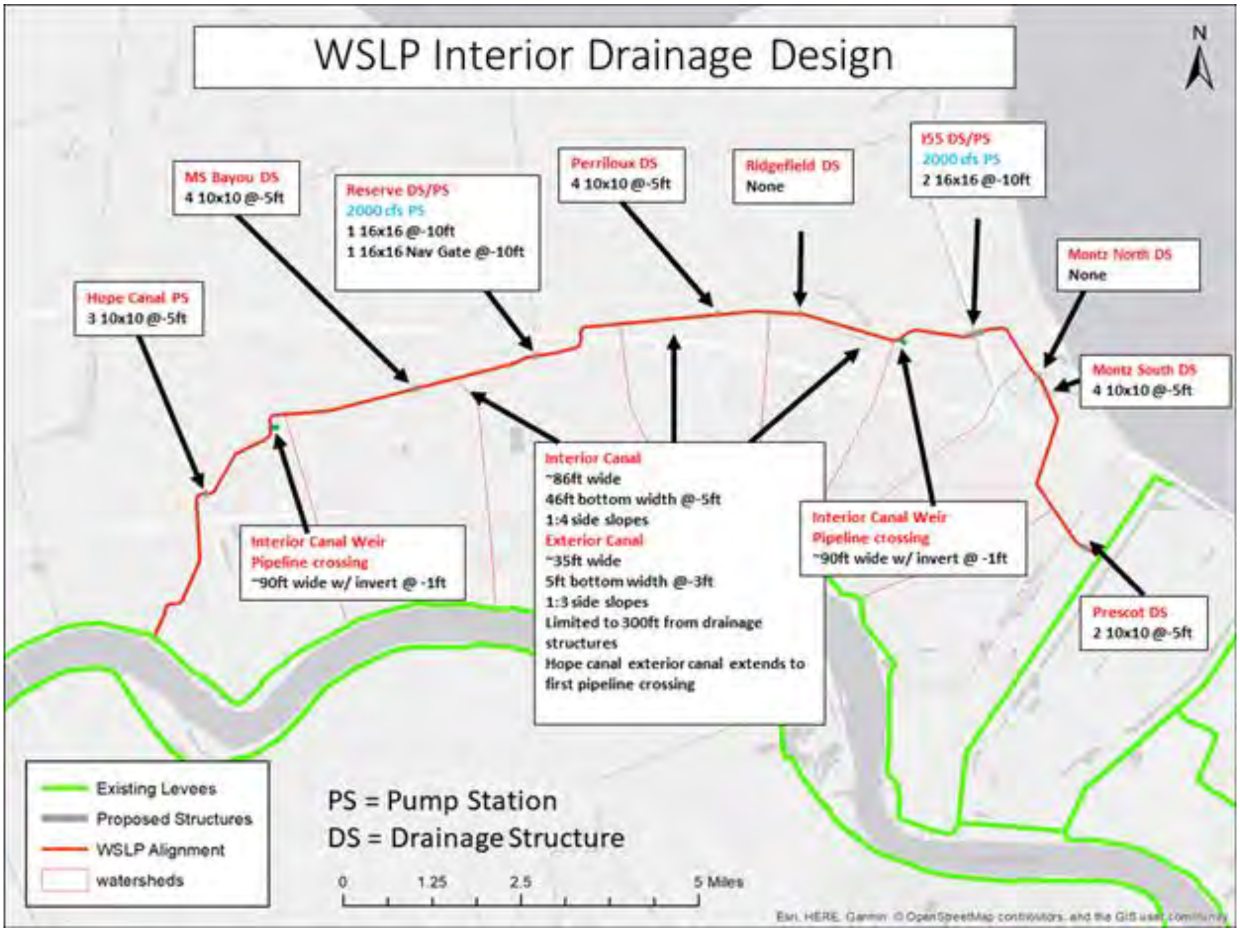


Figure 1 - Structures for the final WSLP Interior Drainage Design.

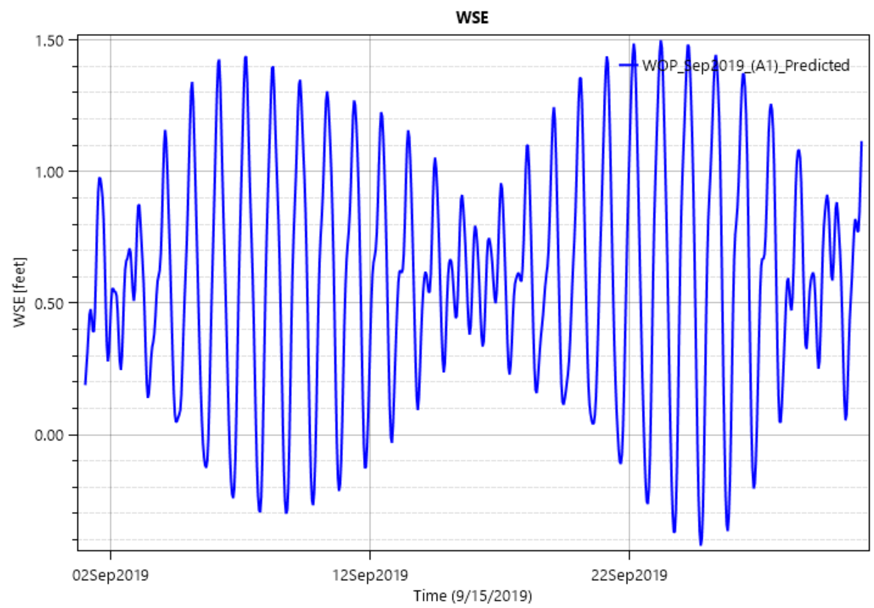


Figure 2 - Synthetic/Predicted water level time-series for tidal boundary condition for simulation set A1

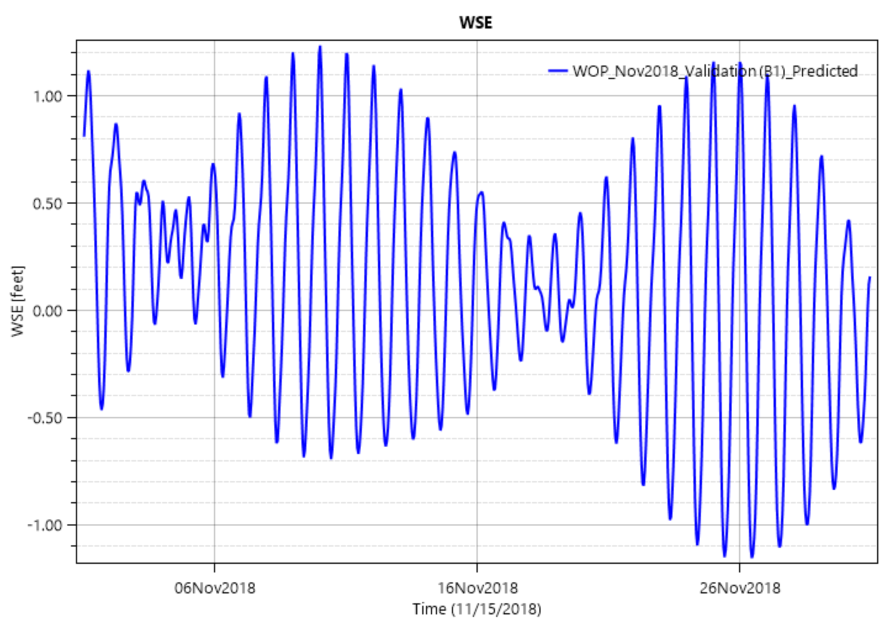


Figure 3 - Synthetic/Predicted water level time-series for tidal boundary condition for simulation set B1

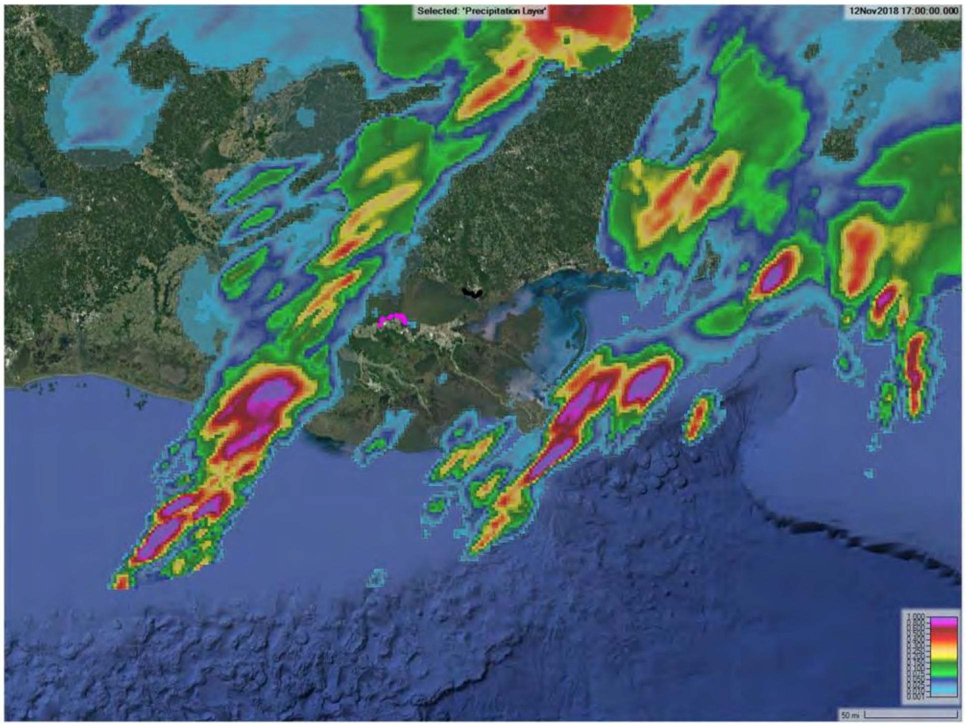


Figure 4 - Observed gridded rainfall for simulation set B1 @ 12NOV2018 17:00

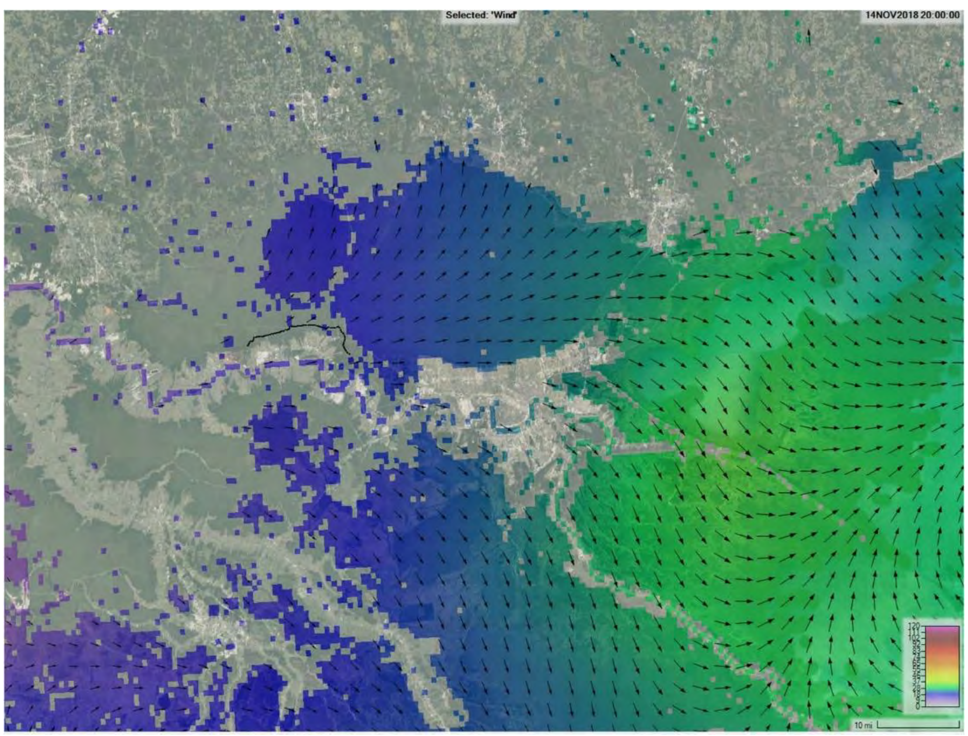


Figure 5 - Observed gridded wind forcing for simulation set B1 @ 14NOV2018 20:00

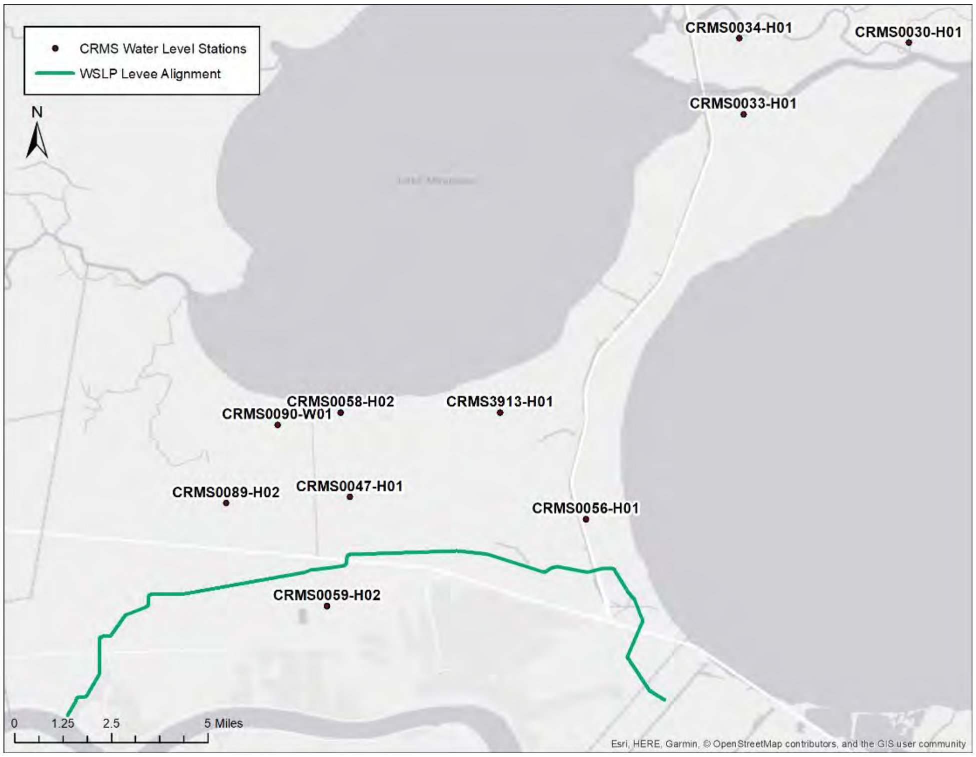


Figure 6 - CRMS water level gages used in model validation

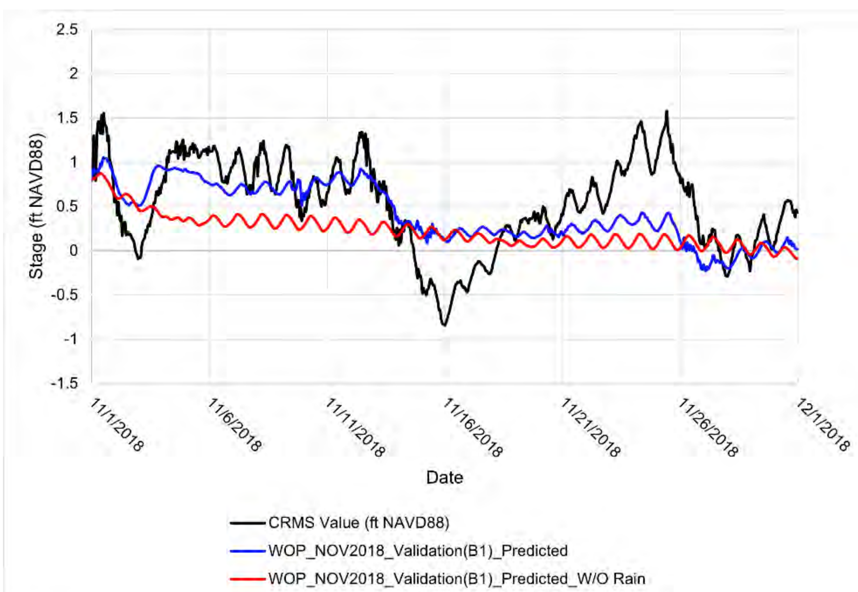


Figure 7 - Modeled vs observed water levels at CRMS0030-H01. Horizontal axis is day in November 2018.

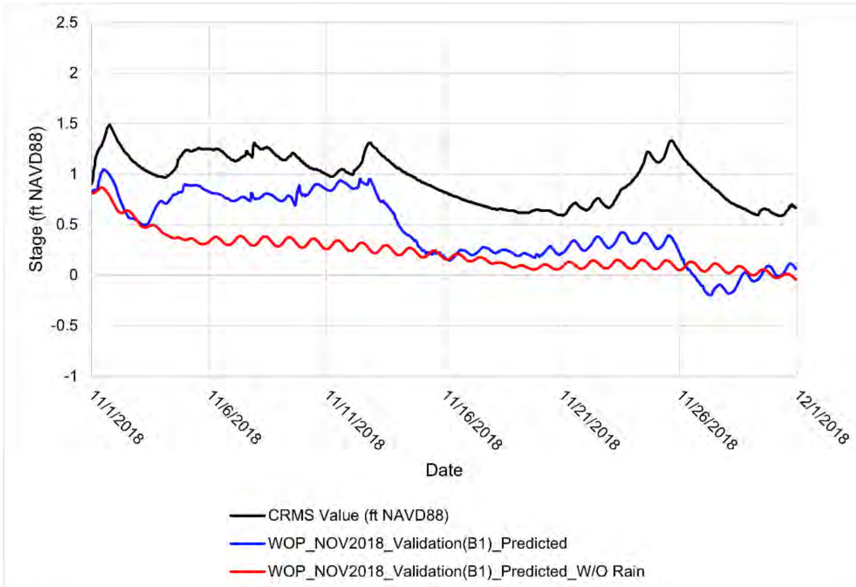


Figure 8 - Modeled vs observed water levels at CRMS0033-H01. Horizontal axis is day in November 2018.

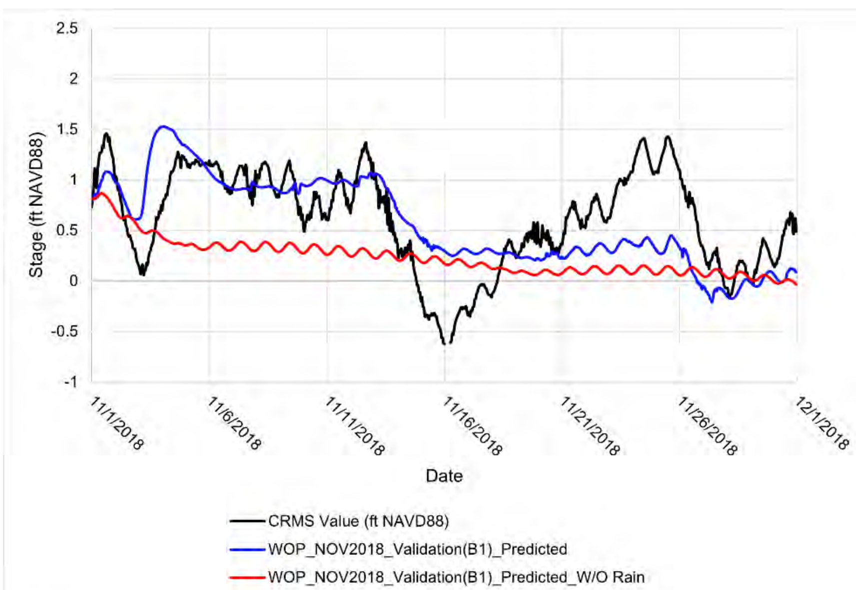


Figure 9 - Modeled vs observed water levels at CRMS0034-H01. Horizontal axis is day in November 2018.

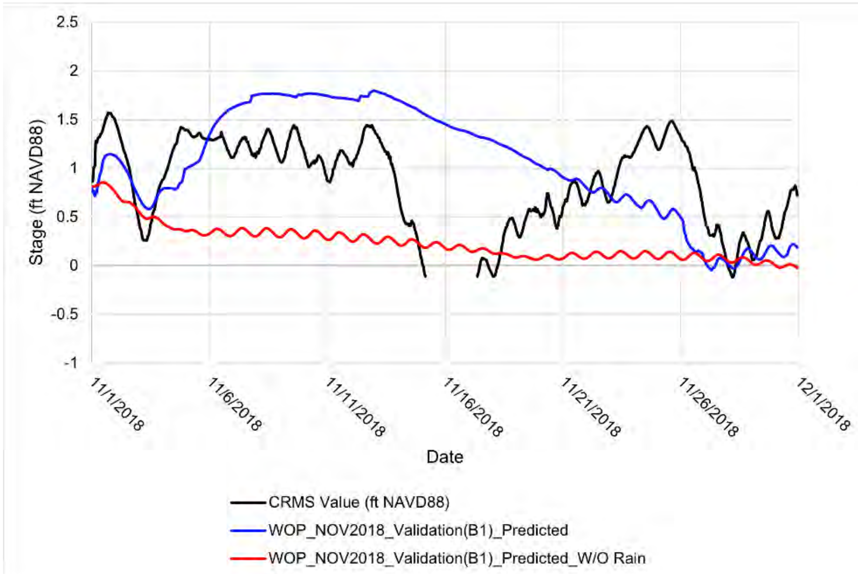


Figure 10 - Modeled vs observed water levels at CRMS0047-H01. Horizontal axis is day in November 2018.

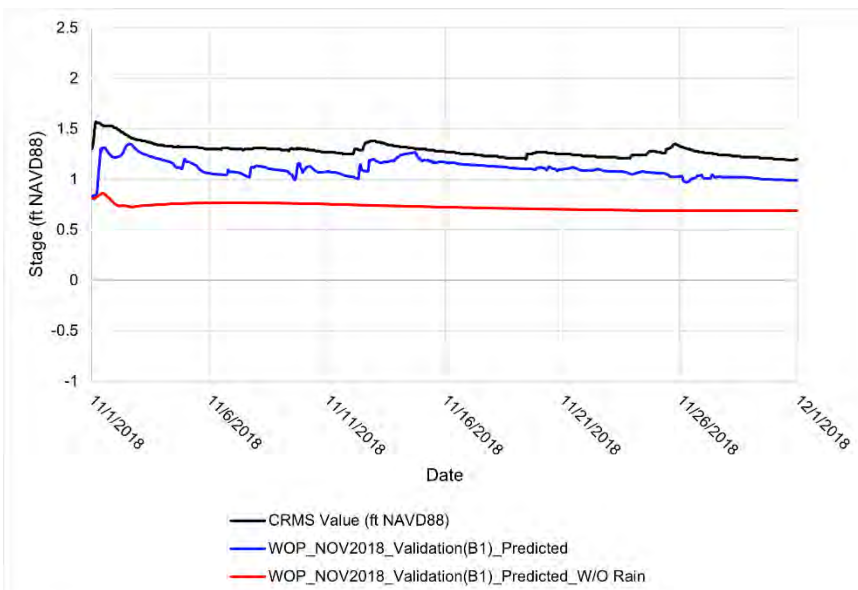


Figure 11 - Modeled vs observed water levels at CRMS0056-H01. Horizontal axis is day in November 2018.

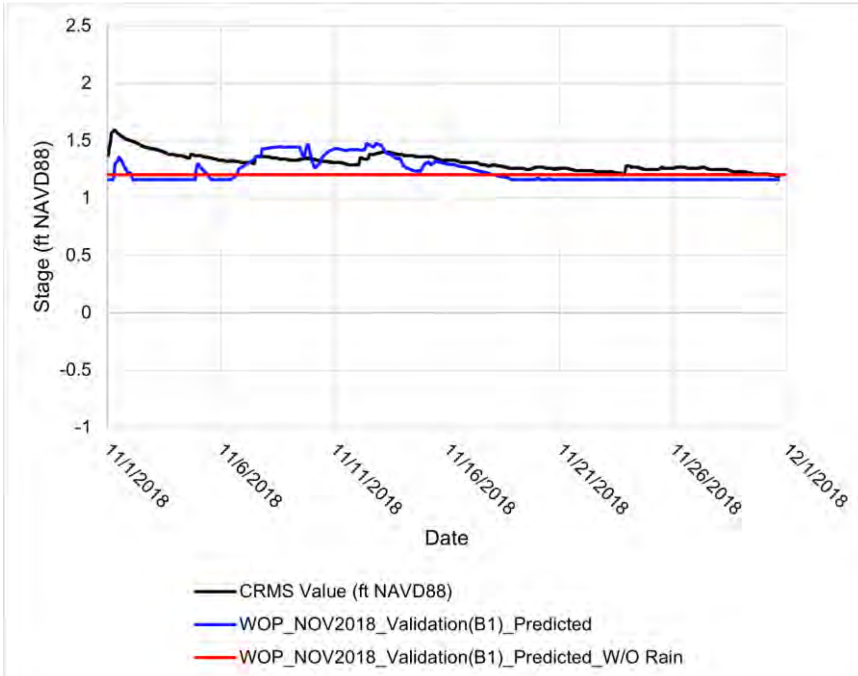


Figure 12 - Modeled vs observed water levels at CRMS0058-H02. Horizontal axis is day in November 2018.

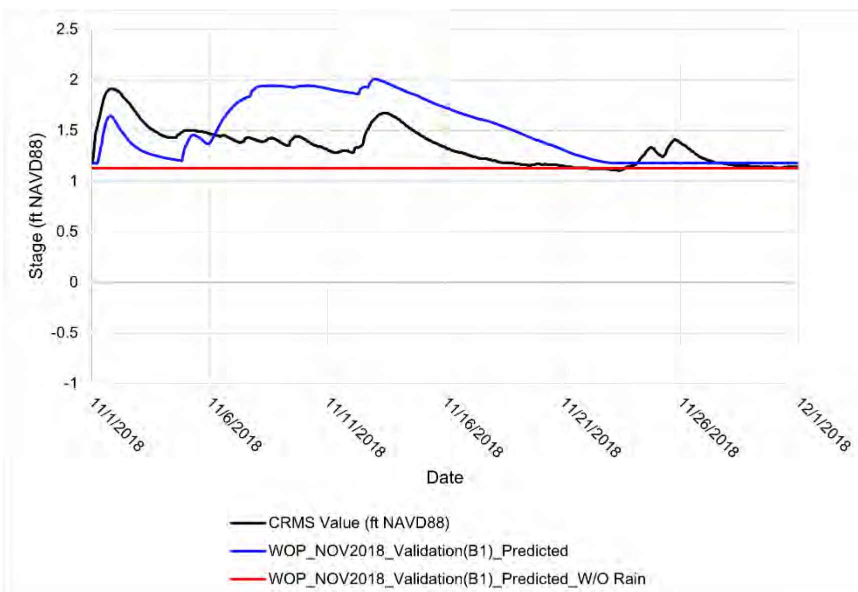


Figure 13 - Modeled vs observed water levels at CRMS0059-H02. Horizontal axis is day in November 2018.

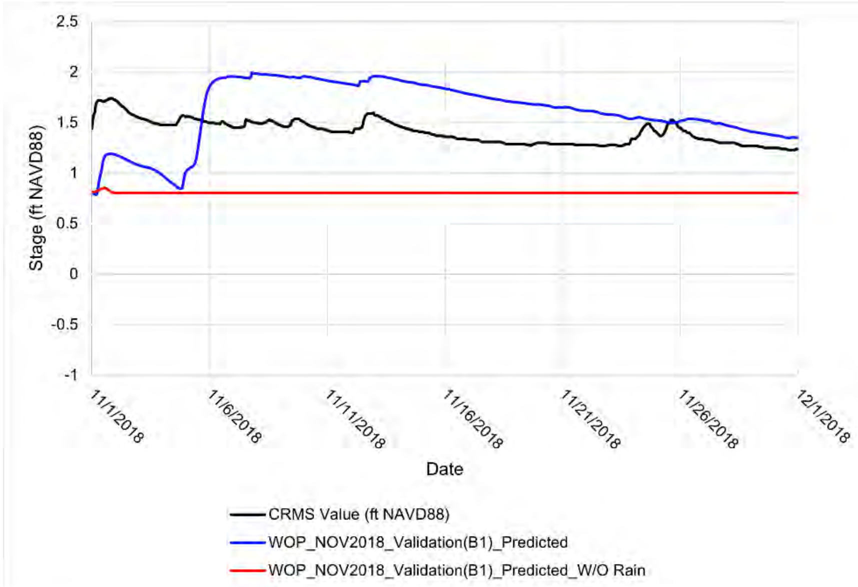


Figure 14 - Modeled vs observed water levels at CRMS0089-H02. Horizontal axis is day in November 2018.

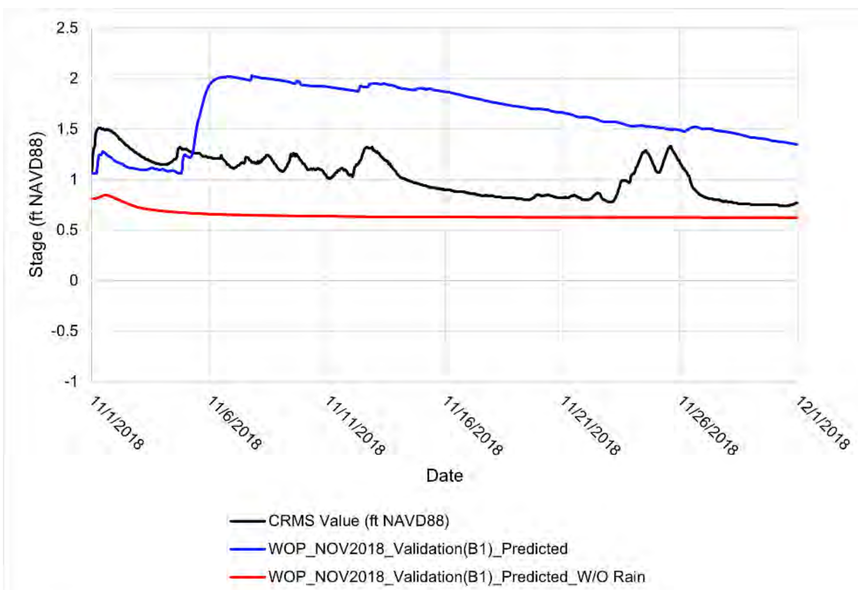


Figure 15 - Modeled vs observed water levels at CRMS0090-W01. Horizontal axis is day in November 2018.

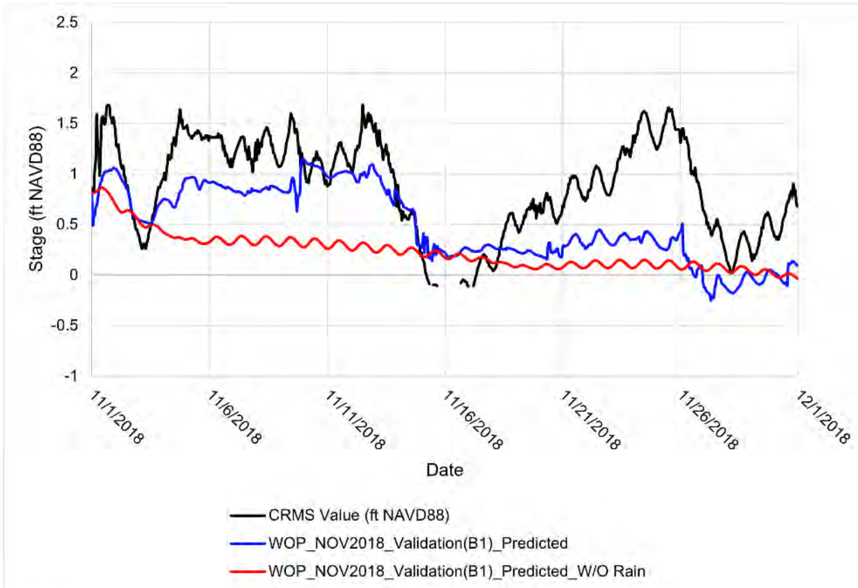


Figure 16 - Modeled vs observed water levels at CRMS3913-H01. Horizontal axis is day in November 2018.

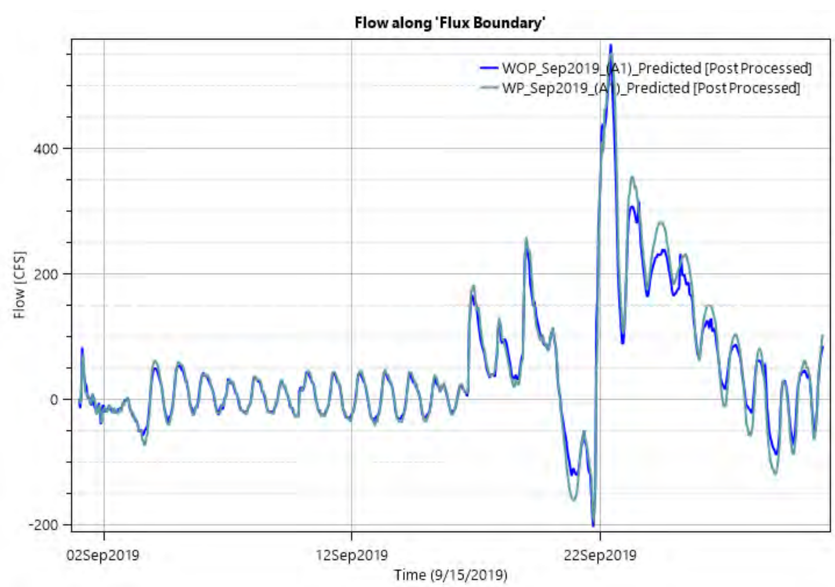


Figure 17 - Flow through flux boundary for with and without project (Simulation A1)

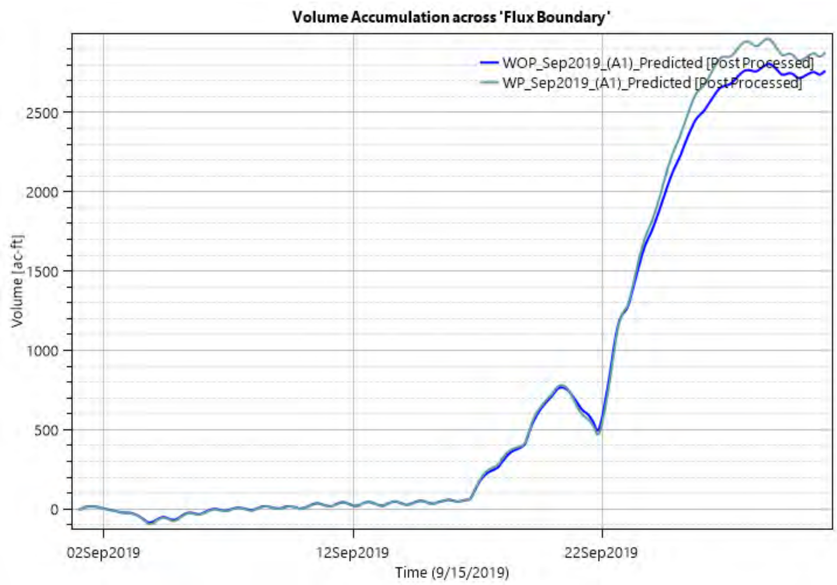


Figure 18 - Total accumulated volume through flux boundary for with and without project (Simulation A1)

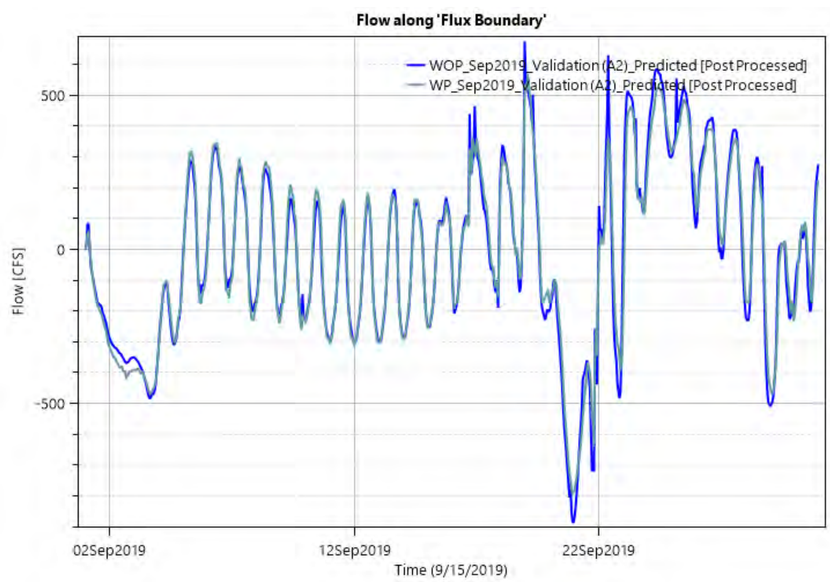


Figure 19 - Flow through flux boundary for with and without project (Simulation A2)

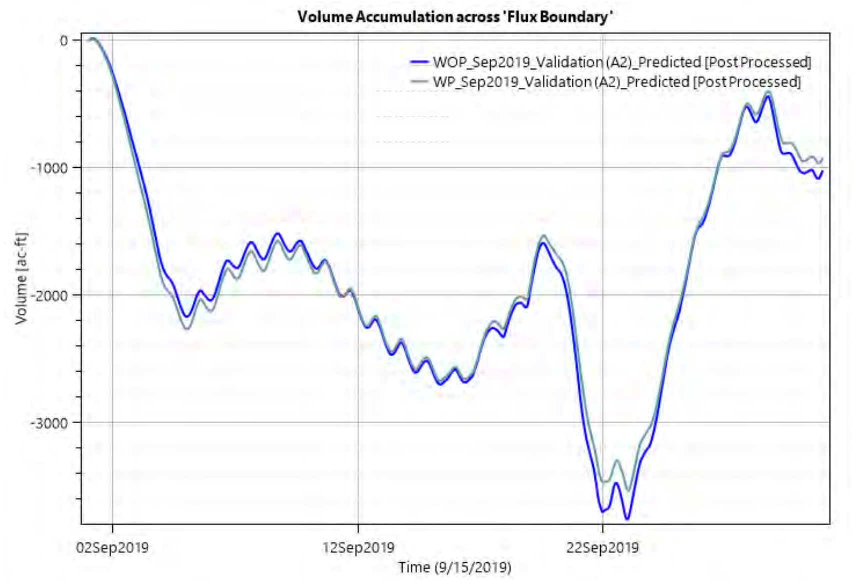


Figure 20 - Total accumulated volume through flux boundary for with and without project (Simulation A2)

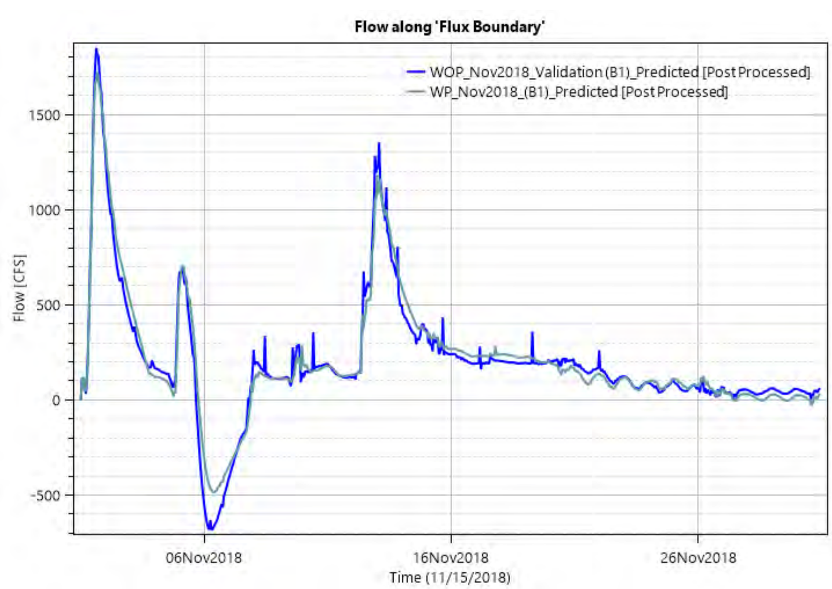


Figure 21 - Flow through flux boundary for with and without project (Simulation B1)

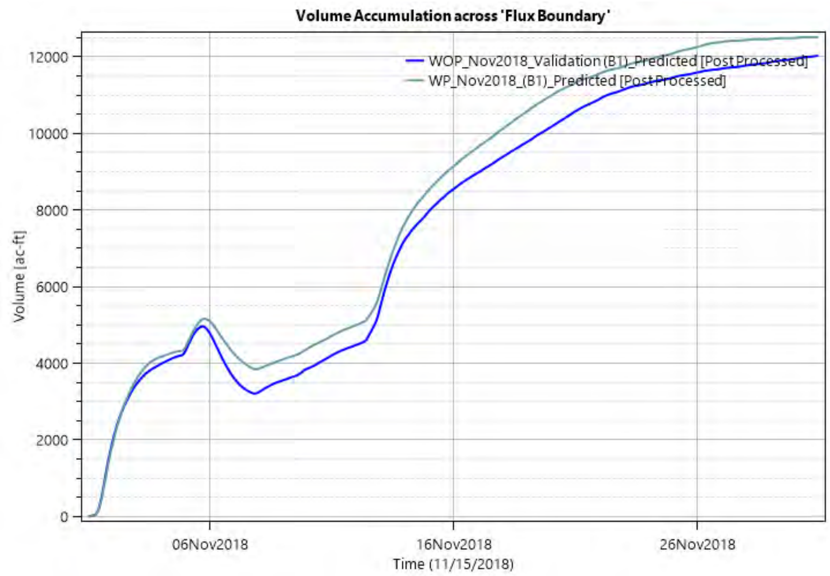


Figure 22 - Total accumulated volume through flux boundary for with and without project (Simulation B1)

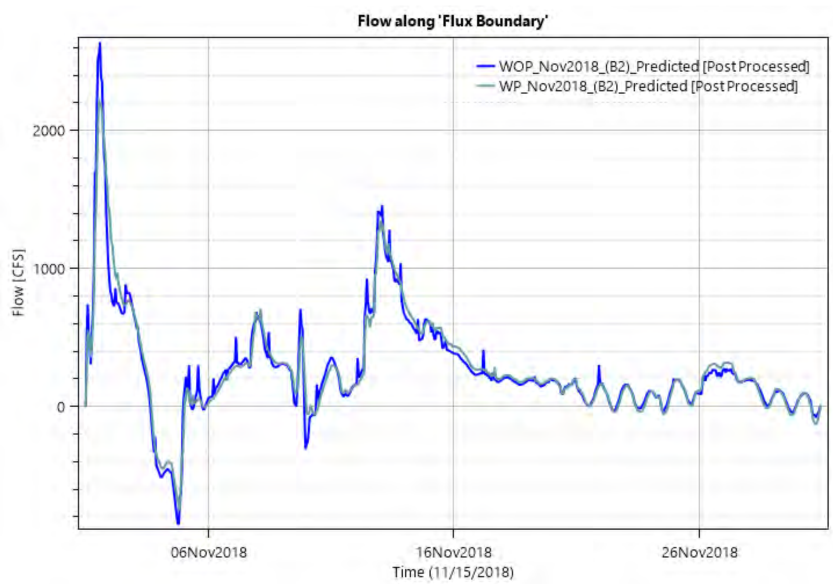


Figure 23 - Flow along flux boundary for with and without project (Simulation B2)

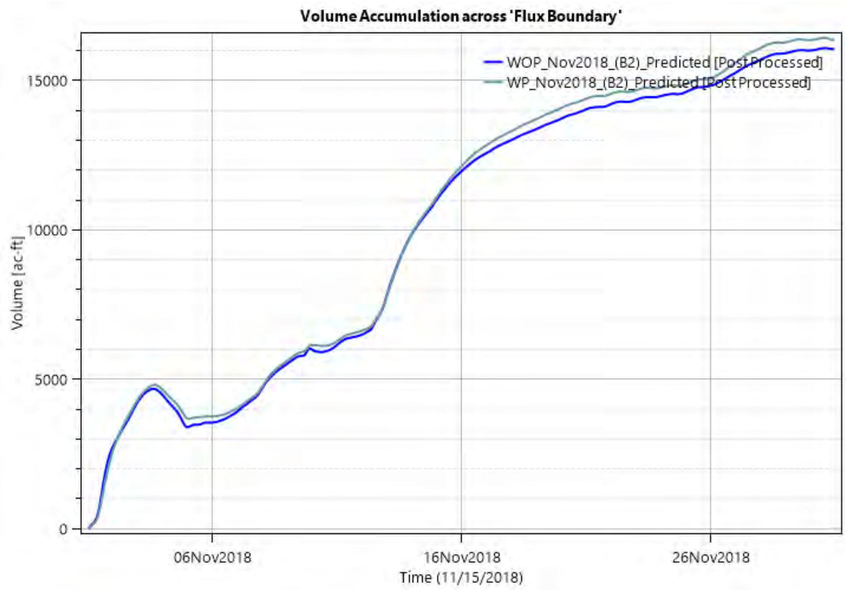


Figure 24 - Total accumulated volume through flux boundary for with and without project (Simulation B2)

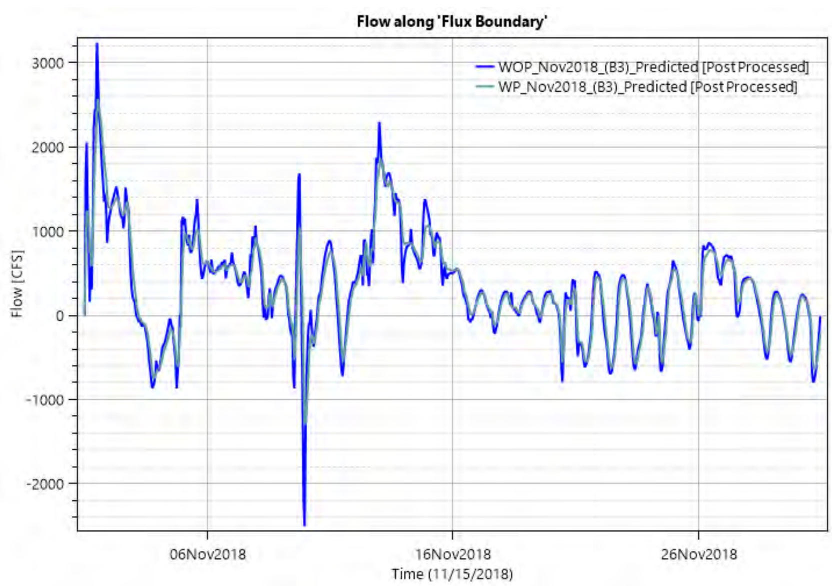


Figure 25 - Flow along flux boundary for with and without project (Simulation B3)

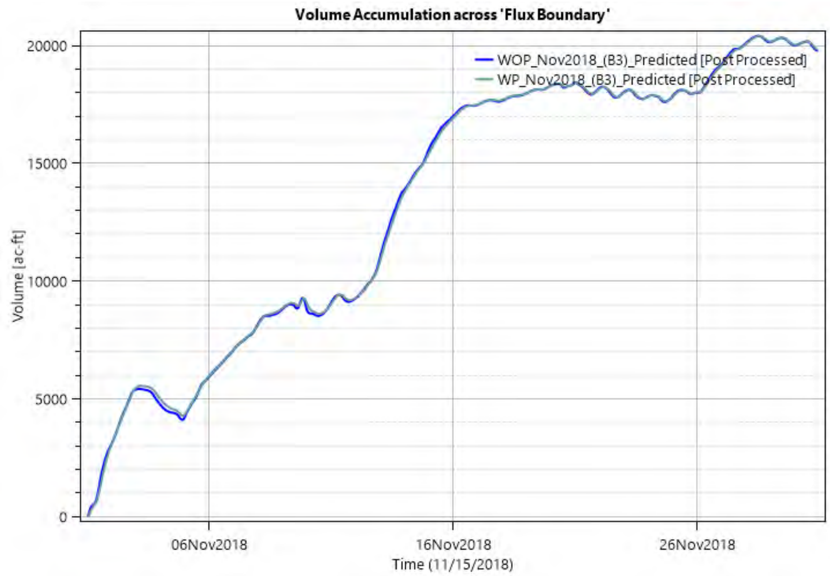


Figure 26 - Total accumulated volume through flux boundary for with and without project (Simulation B3)

Figure 27 - Maximum water velocity difference (with-project minus without-project) for simulation set A1

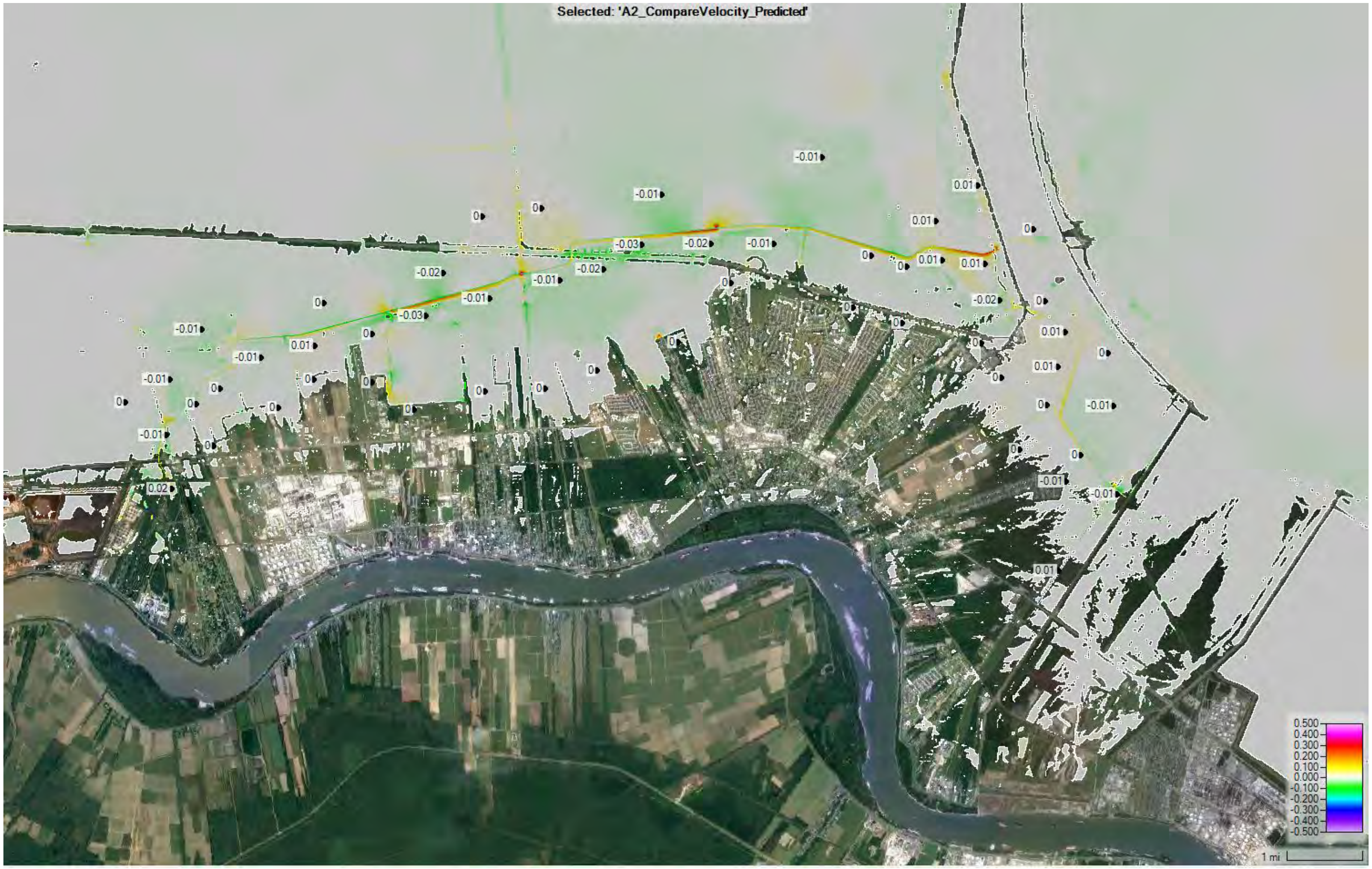


Figure 28 - Maximum water velocity difference (with-project minus without-project) for simulation set A2

Figure 29 - Maximum water velocity difference (with-project minus without-project) for simulation set B1

Figure 30 - Maximum water velocity difference (with-project minus without-project) for simulation set B2

Figure 31 - Maximum water velocity difference (with-project minus without-project) for simulation set B3

Figure 32 - Maximum water surface elevation difference (with-project minus without-project) for simulation set A1

Figure 33 - Maximum water surface elevation difference (with-project minus without-project) for simulation set A2

Figure 34 - Maximum water surface elevation difference (with-project minus without-project) for simulation set B1

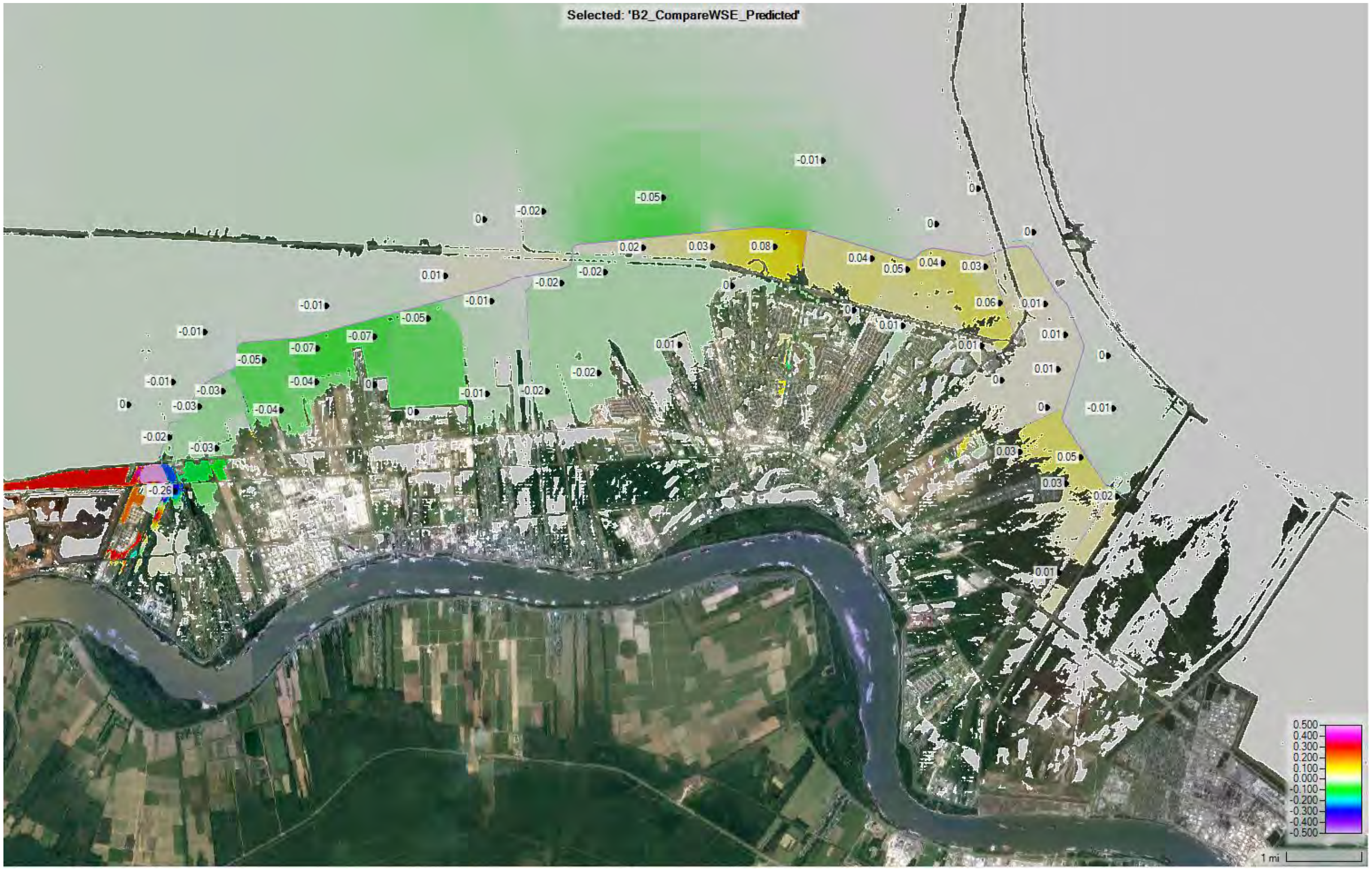


Figure 35 - Maximum water surface elevation difference (with-project minus without-project) for simulation set B2

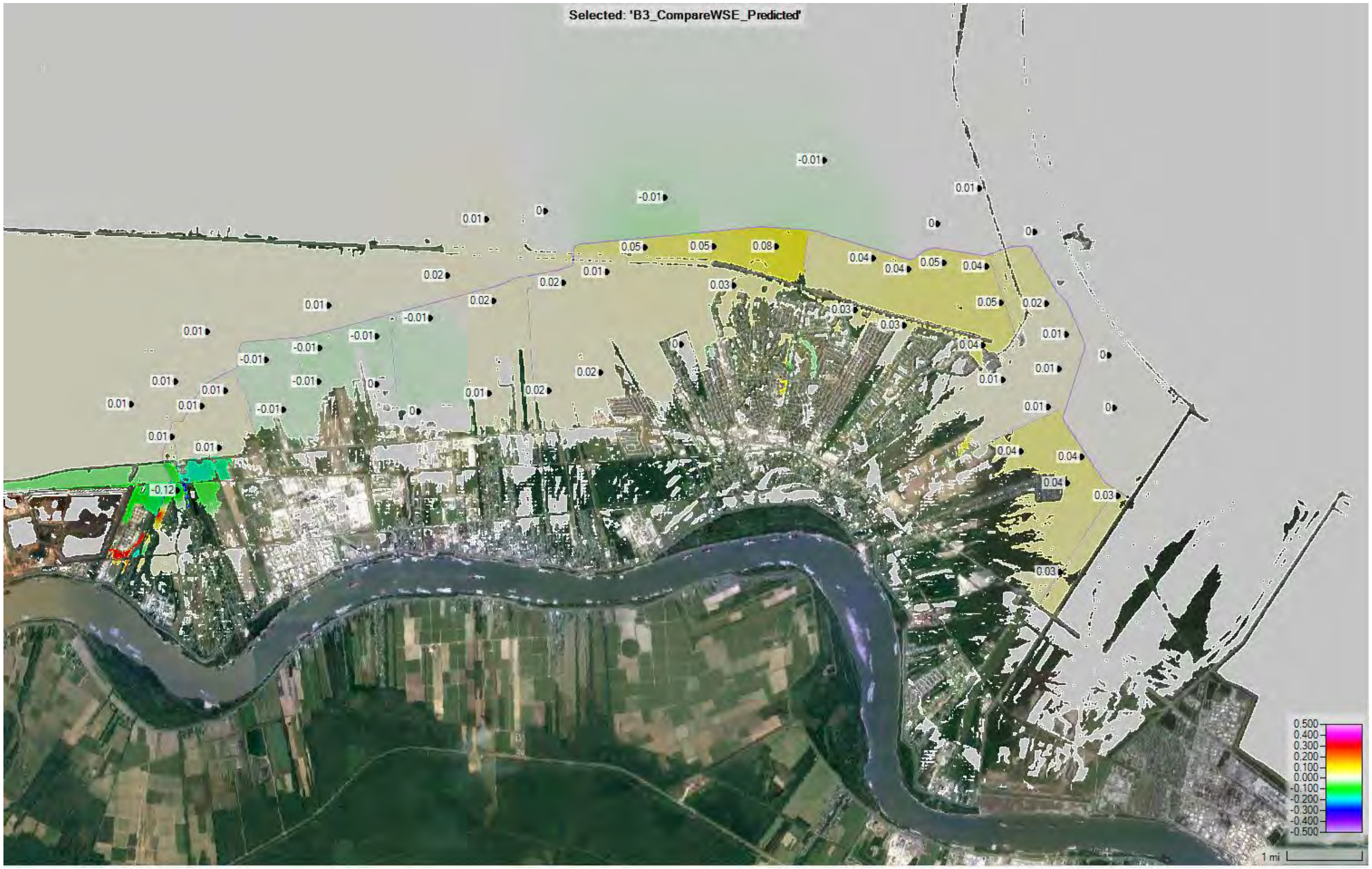


Figure 36 - Maximum water surface elevation difference (with-project minus without-project) for simulation set B3

Appendix VI: Environmental Consequences Supplemental Document

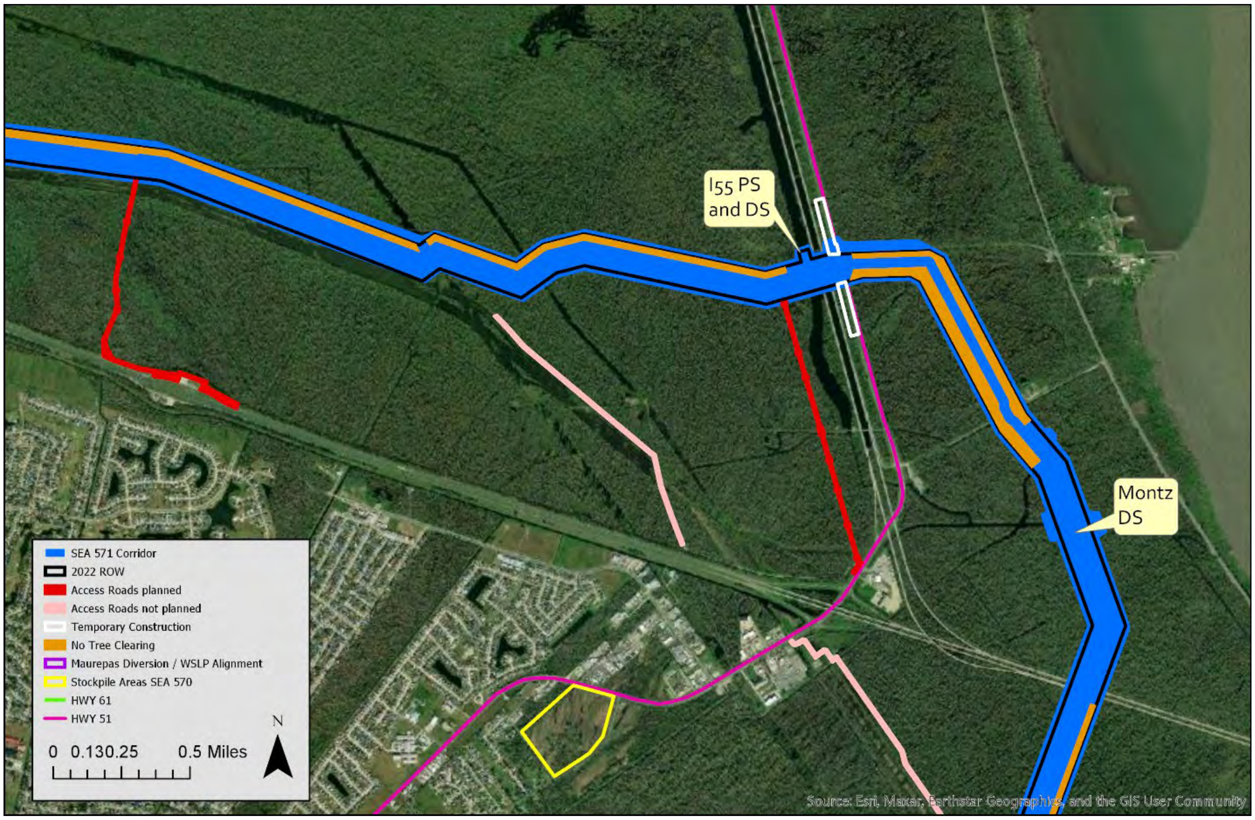
Direct Impacts

No tree clearing areas

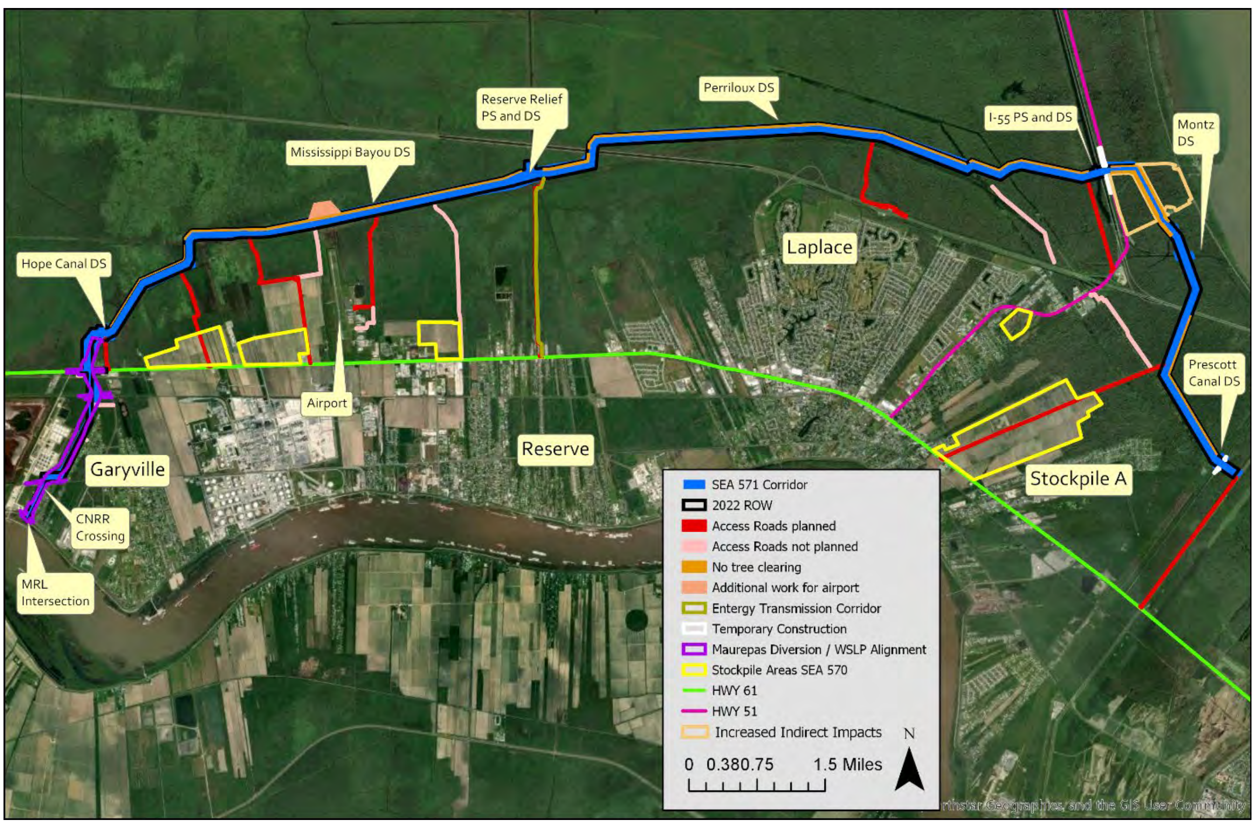
No tree clearing areas would be established to construct the levee system. These areas are within the 2022 levee system right of way, but construction of the levee system to the height for a 1% chance of exceedance storm surge in year 2027 would not require impacting the entire right-of-way. A total of approximately 235.2 acres of swamp and 25.0 acres of BLH would not be cleared based on polygons provided by USACE NOD Engineering and the Suir and Saltus remote sensing data. The total reduction in AAHUs associated with this was estimated by calculating the number of acres by habitat and impacts area (from the SEA 571) and then multiplying it by the corresponding AAHU/acre from each impact area and habitat type calculated for the SEA 571 WVA analysis.

SEA 571 Changes in impacts from No Tree Clearing Areas - Overall				
Habitat Area	Habitat Type	Acres	AAHU/ac	Total AAHUs
East	Swamp	160.70	0.49	78.25
West	Swamp	0.08	0.43	0.03
Central	Swamp	74.46	0.60	44.76
East	BLH	24.66	0.71	17.59
West	BLH	0.00	0.66	0.00
Central	BLH	0.35	0.81	0.29

SEA 571 Changes in impacts from No Tree Clearing Areas - LDWF property				
Habitat Area	Habitat Type	Acres	AAHU/ac	Total AAHUs
East	Swamp	56.59	0.49	27.56
West	Swamp	0.08	0.43	0.03
Central	Swamp	5.17	0.60	3.11
East	BLH	16.74	0.71	11.94
West	BLH	0.00	0.66	0.00
Central	BLH	0.08	0.81	0.06



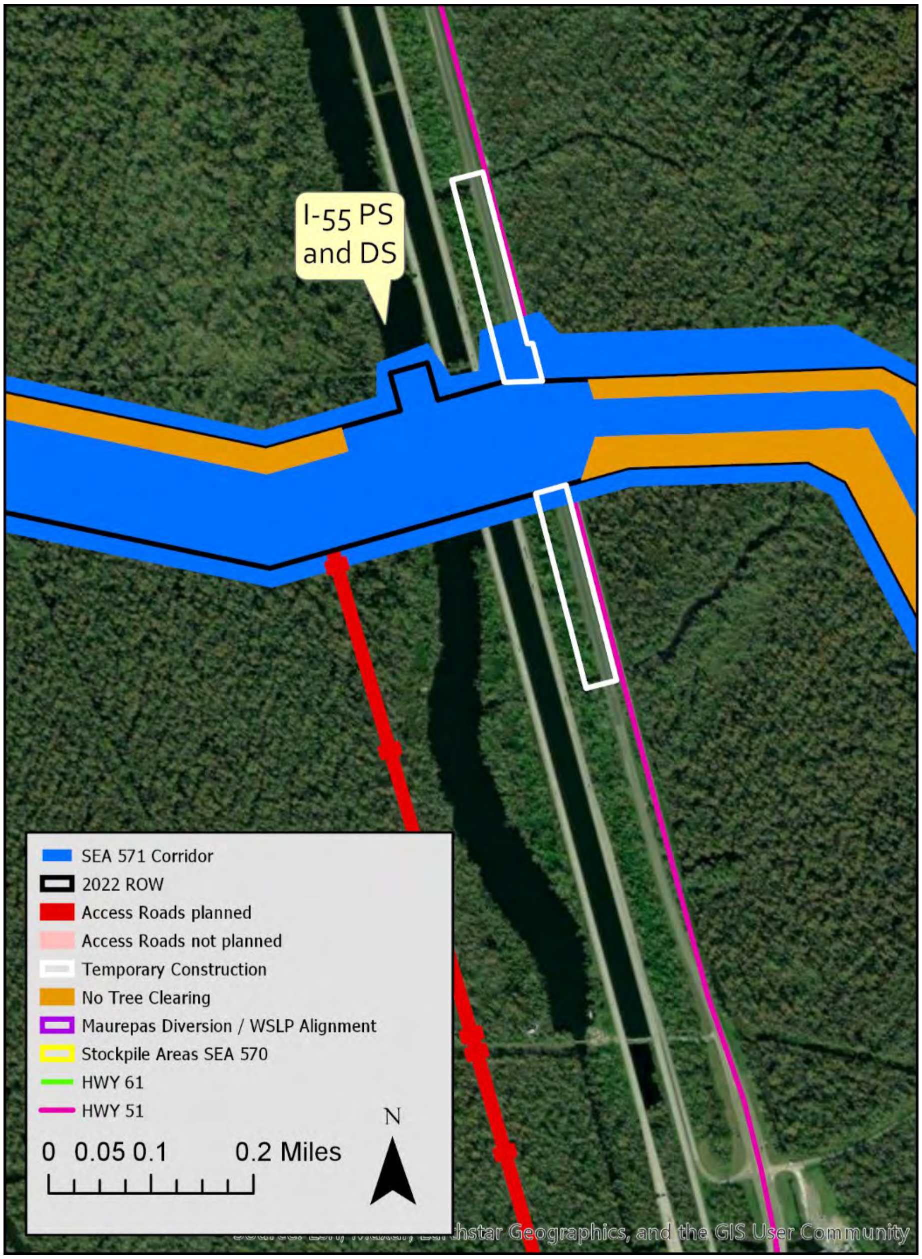
I55 PS and DS
Montz DS
SEA 571 Corridor
2022 ROW
Access Roads planned
Access Roads not planned
Temporary Construction
No Tree Clearing
Maurepas Diversion / WSLP Alignment
Stockpile Areas SEA 570
HWY 61
HWY 51
0 0.130.25 0.5 Miles
N
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community



Reserve Relief PS and DS
Perriloux DS
I-55 PS and DS
Montz DS
Mississippi Bayou DS
Laplace
Hope Canal DS
Airport
Prescott Canal DS
Reserve
Garyville
Stockpile A
CNRR Crossing
MRL Intersection
SEA 571 Corridor
2022 ROW
Access Roads planned
Access Roads not planned
No tree clearing
Additional work for airport
Entergy Transmission Corridor
Temporary Construction
Maurepas Diversion / WSLP Alignment
Stockpile Areas SEA 570
HWY 61
HWY 51
Increased Indirect Impacts
0 0.380.75 1.5 Miles
N

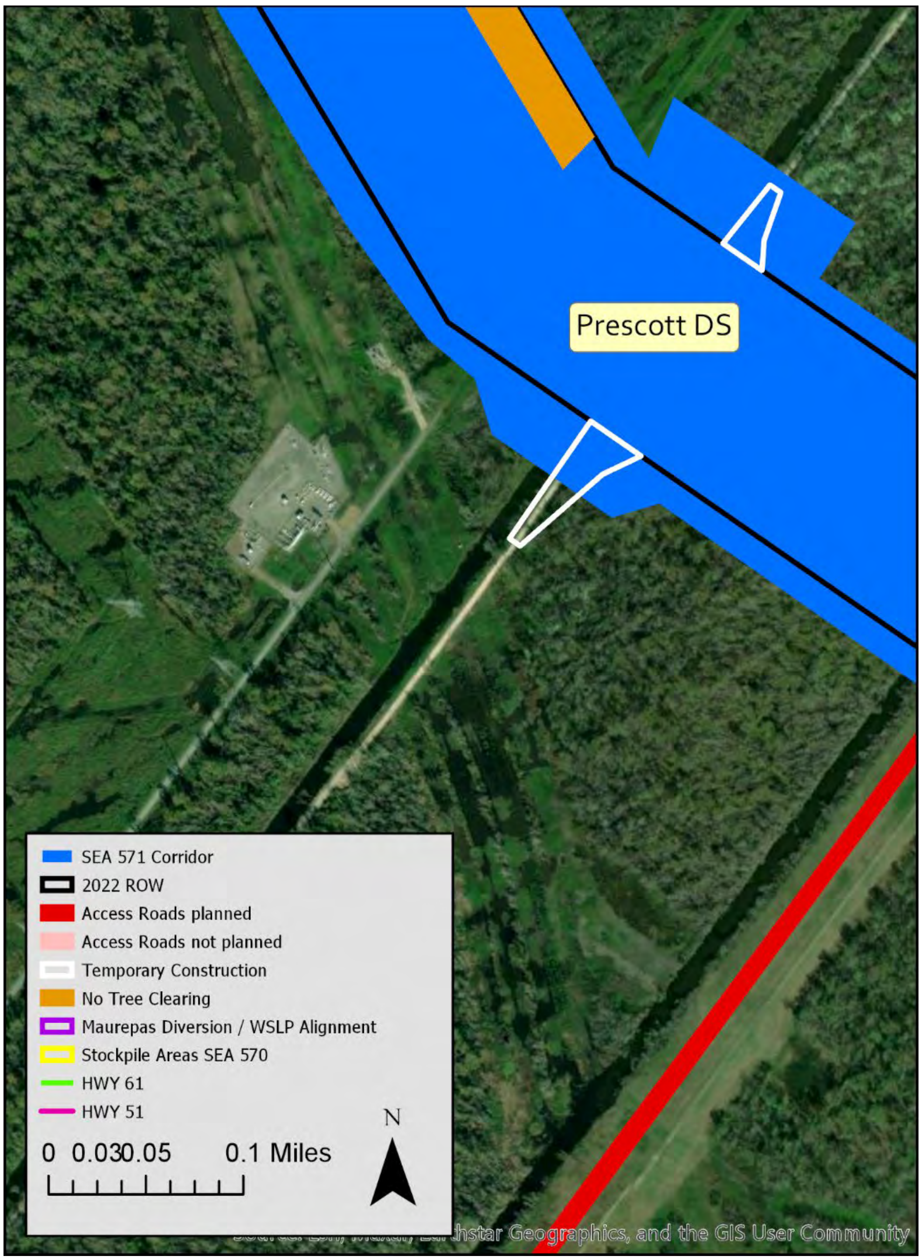
Temporary bypass roads near the I-55 pump station and drainage structures

An additional ~1.2 acres of swamp and ~4.1 acres of BLH would be impacted outside of the SEA 571 corridor to construct a temporary bypass road near the I-55 pump station and drainage structure. All of these impacts would be on LDWF property and within the eastern habitat area. These impacts would be considered permanent, because it is not likely the area would be able to return to existing conditions due to the degraded nature of the site and low regeneration rates. There would be a total of -0.6 and -2.9 AAHUs of impacts to swamp and BLH habitats, respectively.



Temporary construction activities near the Prescott Canal Drainage structure

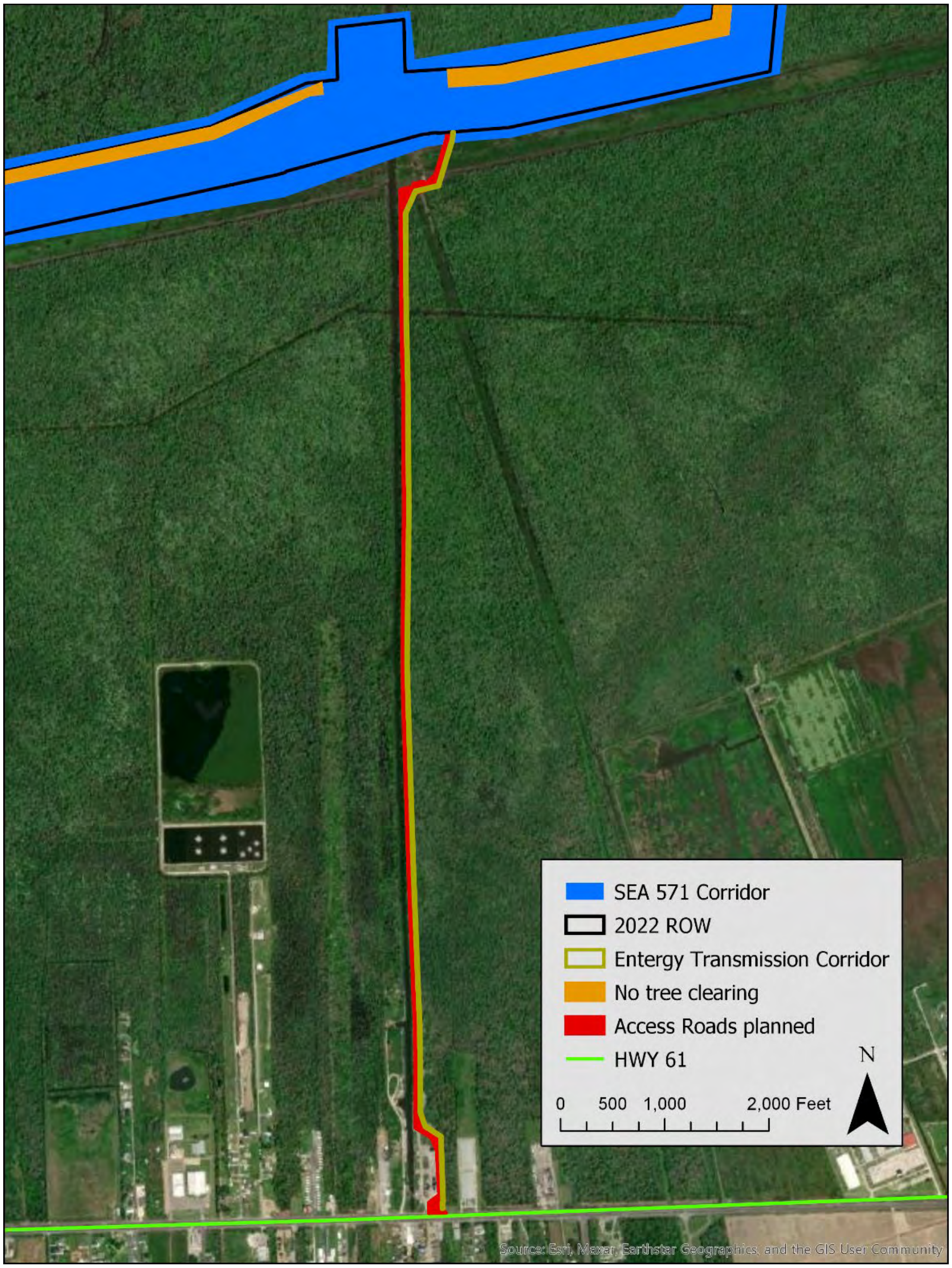
An additional ~0.16 acres of swamp and ~0.87 acres of BLH would be impacted outside of the SEA 571 corridor for temporary construction activities near the Prescott Canal drainage structure. None of these impacts would be on LDWF property. All impacts would be within the eastern habitat area. These impacts would be considered permanent, because it is not likely the area would be able to return to existing conditions due to the degraded nature of the site and low regeneration rates. There would be a total of -0.08 and -0.62 AAHUs of impacts to swamp and BLH habitats, respectively.



Power transmission corridor for the Reserve Relief pump station

An additional ~2.4 acres of swamp and ~1.76 acres of BLH would be impacted outside of the SEA 571 corridor to construct a power transmission corridor along the Reserve Relief canal access road. None of these impacts would be on LDWF property. Impacts would be within the eastern and central habitat areas. There would be a total of -1.25 and -1.32 AAHUs of impacts to swamp and BLH habitats, respectively.

SEA 571A Power Transmission Corridor for the Reserve Relief pump station				
Habitat Area	Habitat Type	Acres	AAHU/ac	Total AAHUs
East	Swamp	1.44	0.49	0.70
Central	Swamp	0.92	0.60	0.55
East	BLH	1.12	0.71	0.80
Central	BLH	0.64	0.8125	0.52



Levee system re-alignment to accommodate a proposed runway extension for the Port of South Louisiana's Executive Regional Airport in Reserve, Louisiana (Figure above)

An additional ~29.07 acres of swamp and < ~0.01 acres of BLH would be impacted outside of the SEA 571 corridor to construct a power transmission corridor along the Reserve Relief canal access road. None of these impacts would be on LDWF property. Impacts would be within the central habitat areas. There would be a total of -17.47 and -0.005 AAHUs of impacts to swamp and BLH habitats, respectively.

Indirect Impacts

Additional H&H model runs were run to assess for additional indirect impacts associated with changes in the levee system such as removal of the exterior drainage canal, design changes to the interior drainage canal, and design changes to drainage structures. Indirect impacts to wetlands were found to be similar to those described in SEA 571, except for an approximately 245 acres near I-55 where the H&H model report suggested there would be additional hydrologic impacts beyond what was assessed in SEA 571 (Appendix V). These 245 acres would be spread across the Indirect impacts interior low, indirect impacts interior high, and exterior impacts area as described in the SEA 571 (Table below). In addition, approximately 30 acres of this area would be new indirect impact acres on the exterior of the levee system (Table below). Approximately 89 acres would be on LDWF property (Table below). The AAHU/ac for each habitat type and area combination was used to calculate the number of AAHUs to be removed from the SEA 571 WVAs.

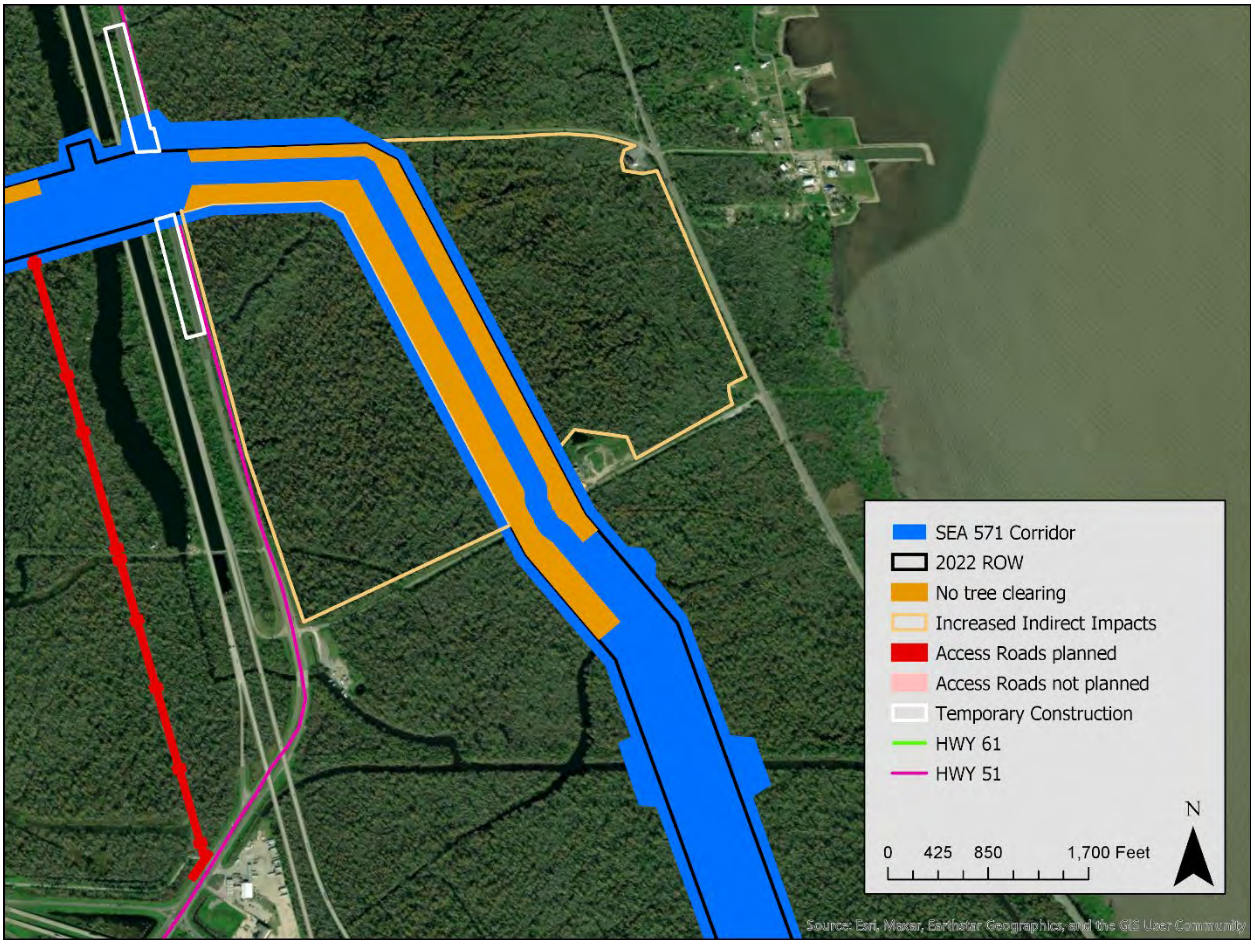
Increased Indirect Impacts within SEA 571 assessed areas Acres and AAHUs removed from WVAs			
SEA 571 impact area	Habitat	Acres	SEA 571 AAHUs
Indirect Inside Low East	BLH	8.57	0.18
Indirect Inside High East	BLH	17.71	1.12
Exterior east	BLH	6.89	0.36
LDWF - Indirect Inside Low East	BLH	8.57	0.18
LDWF - Indirect Inside High East	BLH	15.17	0.96
Indirect Inside Low East	Swamp	13.64	0.10
Indirect Inside High East	Swamp	87.94	7.10
Exterior east	Swamp	79.93	3.93
LDWF - Indirect Inside Low East	Swamp	13.64	0.10
LDWF - Indirect Inside High East	Swamp	51.98	4.20

Increased water levels as compared to the SEA 571 condition were assumed to reduce growth rates, basal area, and stand structure for swamp habitats within the 245 acre increased indirect impacts areas. For BLH habitats, it was expected to reduce average dbh. From TY10 – TY50 basal area and average dbh from the SEA 571 WVAs were reduced by 15% for each TY for both BLH and swamp to account for this. In addition to this, stand structure was reduced for the increased. The table below is a summary of the results by area and habitat type for the increased indirect impacts area.

Increased Indirect Impact Areas Additional negative impacts			
Impact area	Habitat	Acres	AAHUs
Indirect Inside East Increased Indirect Impacts	BLH	26.29	-3.11
Indirect Outside East Increased Indirect Impacts	BLH	18.01	-4.42
LDWF - Insider East Increased Indirect Impacts	BLH	23.74	-2.81
Indirect Inside East Increased Indirect Impacts	Swamp	101.58	-8.77

Indirect Outside East Increased Indirect Impacts	Swamp	99.14	-4.91
LDWF - Insider East Increased Indirect Impacts	Swamp	65.62	-5.67

Figure 34 - Maximum water surface elevation difference (with-project minus without-project) for simulation set B1



SEA 571 Corridor
2022 ROW
No tree clearing
Increased Indirect Impacts
Access Roads planned
Access Roads not planned
Temporary Construction
HWY 61
HWY 51
N
0 425 850 1,700 Feet
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

Appendix VII: Agency Coordination

Annex A: Department of Environmental Quality, Water Quality Certificate

From:	Elizabeth Hill
To:	Gunning, Kristin T MVN
Subject:	[Non-DoD Source] FW: Pre-filing for West Shore Lake Pontchartrain Post-Design Summit EA
Date:	Thursday, April 6, 2023 9:58:35 AM
Attachments:	Project Narrative_WSLP Post-Design Summit.pdf 2022 ROW.kmz

The proposed design changes within the SEA 571 ROW have been reviewed. LDEQ, Water Permits Division has no objections to the modifications as proposed. The administrative record has been updated to reflect these modifications. Water Quality Certification WQC 200512-01 remain valid for the project as proposed. No further action is required.

From: Gunning, Kristin T MVN <Kristin.T.Gunning@usace.army.mil>
Sent: Monday, March 20, 2023 11:19 AM
To: Jace Hood <Jace.Hood@la.gov>
Subject: Pre-filing for West Shore Lake Pontchartrain Post-Design Summit EA

Good morning,

I am working on a new EA for the West Shore Lake Pontchartrain project and am reaching out to see if a new Water Quality Certification is required. The scope of this new EA doesn't differ much from the previously authorized EA (WQC 200512-01/CER20200003) so I'm not sure what, if any additional information is required. Attached you can find a detailed project description and kmzs for the proposed project area.

In summary, the Proposed Action would include modifications to the structural alignment of the levee system in St. John the Baptist and St. Charles Parishes, Louisiana described in SEA 571. The majority of changes would be within the SEA 571 construction ROW corridor, except for 4 locations:

- Temporary bypass road near the I-55 pump station and drainage structures
- Temporary construction activities near the Prescott Canal Drainage structure.
- Power transmission corridor for the Reserve Relief Pump Station
- Levee system re-alignment to accommodate a proposed runway extension for the Port of South Louisiana's Executive Regional Airport in Reserve, Louisiana. Overall, less acres would be needed.

Design changes within the SEA 571 ROW being considered include levee system design, drainage canal designs and locations, drainage structure design, size, and location, pump station design, number, and locations, and inclusion of additional structures.

Thanks,

Kristin Gunning
Biologist, Environmental Studies Section

Regional Environmental Planning Division, South
USACE, New Orleans District

JOHN BEL EDWARDS
GOVERNOR

CHUCK CARR BROWN, PH.D.
SECRETARY

State of Louisiana

DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL SERVICES

MAY 15 2020

Mr. Patrick Smith
US Army Corps of Engineers, New Orleans District
Regional Planning and Environment Division, South
CEMVN-PDS-C
7400 Leake Avenue
New Orleans, LA 70118
Attn: Patrick Smith

AI No.: 101235
Activity No.: CER20200003

RE: West Shore Lake Pontchartrain and Storm Damage Risk Reduction Structural Alignment Surveys and Borings Investigation (SEA # 570, 571, and 2016 WSLP EIS)
Water Quality Certification WQC 200512-01
St. Charles and St. John the Baptist Parishes

Dear Mr. Smith:

The Louisiana Department of Environmental Quality, Water Permits Division (LDEQ), has reviewed the application to clear, grade, excavate, and place fill to construct and maintain a levee system, West Shore Lake Pontchartrain and Storm Damage Risk Reduction Levee System, including but not limited to surveys, borings, investigations, borrow pits, access roads, drainage canals, gates, and pumping systems for the eastern parts of St. John the Baptist and St. Charles Parishes.

Based on the information provided in the application and the additional information included in Supplemental Environmental Assessments (SEA) #570, #571, and the West Shore Lake Pontchartrain Environmental Impact Statement (2016 WSLP EIS), LDEQ determined that the requirements for a Water Quality Certification have been met. LDEQ concludes that the discharge of fill will not violate water quality standards as provided for in LAC 33:IX.Chapter 11. Therefore, LDEQ hereby issues the US Army Corps of Engineers, New Orleans District Water Quality Certification, WQC 200512-01.

Should you have any questions concerning any part of this certification, please contact Elizabeth Hill at (225) 219-3225 or by email at elizabeth.hill@la.gov. Please reference Agency Interest (AI) number 101235 and Water Quality Certification 200512-01 on all future correspondence to this Department to ensure all correspondence regarding this project is properly filed into the Department's Electronic Document Management System.

Sincerely,

Scott Guilliams
Administrator
Water Permits Division

c: IO-W

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NEW ORLEANS DISTRICT
7400 LEAKE AVE
NEW ORLEANS LA 70118-3651

Regional Planning and
Environmental Division South
New Orleans Environmental Branch

Scott Guilliams
Louisiana Dept. of Env. Quality
Administrator of Water Permits Div.
P.O. Box 4313
Baton Rouge, LA 70821-4313

5 May 2020

Dear Mr. Guilliams:

Pursuant to Section 401 of the Clean Water Act, the U.S. Army Corps of Engineers, New Orleans District requests water quality certification for Draft Supplemental Environmental Assessment (SEA) #571 West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Levee System St. Charles and St. John the Baptist Parishes, Louisiana. SEA #571 evaluates the potential impacts of altering the levee alignment footprint as described in the West Shore Lake Pontchartrain Environmental Impact Statement (2016 WSLP EIS) as well as adding to and modifying the associated levee alignment features described in the 2016 WSLP EIS and SEA 570. Features being considered for modification include pumping stations, drainage structures, the borrow plan, and access roads, as well as the addition of a sand placement plan and a spoil bank gapping plan, and the option for the Non-Federal Sponsor to design and build part of the Wes Shore Lake Pontchartrain levee system.

Two water quality certificates related to this Project were previously issued (WQC 140428-01/CER 20140004; WQC 190424-02/CER20190002).

Please review the enclosed document. If questions arise, please contact Patrick Smith at 504-862-1583, or by email at Patrick.W.Smith@usace.army.mil.

Sincerely,

Encl

Marshall K. Harper
Chief, Environmental Planning Branch

APPLICATION FOR DEPARTMENT OF THE ARMY PERMIT (33 CFR 325)	OMB APPROVAL NO. 0710-003 Expires October 1996

Public reporting burden for this collection of information is estimated to average 5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Service Directorate of Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0710-0003), Washington, DC 20503. Please DO NOT RETURN your form to either of those addresses. Completed applications must be submitted to the District Engineer having jurisdiction over the location of the proposed activity.

PRIVACY ACT STATEMENT

Authority: 33 USC 401, Section 10; 1413, Section 404. Principal Purpose: These laws require permits authorizing activities in, or affecting, navigable waters of the United States, the discharge of dredged of fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. Routine Uses: Information provided on this form will be used in evaluating the application or a permit. Disclosure: Disclosure of requested information is voluntary. If information is not provided, however, the permit application cannot be processed nor can a permit be issued.

One set of original drawings or good reproducible copies which show the location and character of the proposed activity must be attached to this application (see sample drawings and instructions) and be submitted to the District Engineer having jurisdiction over the location of the proposed activity. An application that is not completed in full will be returned.

(ITEMS 1 THRU 4 TO BE FILLED BY THE CORPS)

1. APPLICATION NO.	2. FIELD OFFICE CODE	3. DATE RECEIVED	4. DATE APPLICATION COMPLETED

(ITEMS BELOW TO BE FILLED BY APPLICANT)

5. APPLICANT'S NAME US Army Corps of Engineers, New Orleans District	*8. AUTHORIZED AGENT'S NAME AND TITLE (an agent is not required)* Same as Applicant
6. APPLICANT'S ADDRESS Regional Planning and Environment Division, South CEMVN-PDS-C 7400 Leake Avenue New Orleans, LA 70118 ATTN: Patrick Smith *Email (preferred if possible):Patrick.W.Smith@usace.army.mil*	***9. AGENT'S ADDRESS***
7. APPLICANT'S PHONE NOS. W/AREA CODE	*10. AGENT'S PHONE NOS. W/AREA CODE*
a. Residence ***b. Business*** (504) 862-1583	*a. Residence* *b. Business*

11. STATEMENT OF AUTHORIZATION

____

APPLICANT'S SIGNATURE *DATE:* 5 May 2020

NAME, LOCATION AND DESCRIPTION OF PROJECT OR ACTIVITY

12. PROJECT NAME OR TITLE (see instructions)

West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Structural Alignment Surveys and Borings Investigations

13. NAME OF WATERBODY, IF KNOWN (if applicable)	*14. PROJECT STREET ADDRESS (if applicable)*
15. LOCATION OF PROJECT St. John the Baptist and St. Charles — Louisiana *PARISH* — *STATE*	

16. OTHER LOCATION DESCRIPTIONS, IF KNOWN, (see instructions)

The location of the proposed action is primarily in agricultural lands, and swamp and bottomland hardwoods habitats near the communities of Montz in St. Charles Parish, and Laplace, Reserve, and Grayville in St. John the Baptist Parish, Louisiana.

17. DIRECTIONS TO THE SITE

18. Nature of Activity (Description of project, include all features.)
The Proposed Action would include modifications to the structural alignment of the levee system in St. John the Baptist and St. Charles Parishes, Louisiana described in the 2016 WSLP EIS, and modifications to features described in SEA 570. The modifications proposed herein would be in a similar location with similar features as described in the 2016 WSLP EIS and SEA 570. Nowhere within the proposed action levee system alignment/footprint would there be a 100% overlap with the 2016 WSLP EIS levee system alignment/footprint. This is due to an increase in the levee footprint where the results of field investigations and advanced engineering and design have found it necessary, and a shift in the entire levee system to accommodate for the recent installation of a new pipeline. The levee system would be between approximately 20 – 100 feet wider from the upper guide levee of the BCS to near the crossing at Hwy 61 where it would decrease to approximately the same width as described in the 2016 WSLP EIS. The proposed action also includes additional ROW for pump station construction. Approximately 30-40% of the current levee system ROW is co-located with the 2016 WSLP EIS levee system ROW (Figure 1).

A hypothetical corridor representing the maximum size of the levee system is shown in Figure 1. The corridor indicates the location extent within which the levee system could occur. This corridor would allow for slight shifts in alignment during further engineering and design, and during construction of the levee system. The exact location of the levee system ROW could shift slightly within the corridor, but no less than approximately 30% of it would be co-located with the 2016 WSLP EIS. Additionally, the levee system ROW would not exceed the size of the hypothetical corridor.

There are four shifts, other than the increase in size and slight shift due to installation of a new pipeline that are being considered. Three shifts that could aid in the constructability, improve the engineering, and decrease the utility relocations needed for the alignment are being considered (Figure 2). A fourth shift would accommodate CPRA's River Reintroduction into Maurepas Swamp Project.

Other parts of the proposed action described in this section include:
1. Updated borrow plan
2. Modifications to access roads
3. Addition of new access roads
4. Sand placement plan
5. Updated drainage structure design
6. Addition of new drainage structures
7. Updated pump station design
8. Addition of new pump stations
9. Updated transportation plan
10. Potential for the NFS to design and build the western section of the levee system
11. Potential to alter existing spoil banks in the Project Area and vicinity

Borrow Plan
In addition to sources mentioned in the 2016 WSLP EIS, borrow materials (clay and sand) used to construct the levee system could be obtained from within the stockpile areas described in SEA 570, or it could be obtained from permitted commercial sources. Any material purchased from a commercial source would be currently licensed by the Parish (if in Louisiana) or State (if in Mississippi) entity.

Access Roads
All access roads described in SEA #570, as well as Access Road P, Q, and S, which is located within the Bonnet Carré Spillway (BCS) upper guide levee berm, could be used for temporary construction and/or permanent access from Hwy 51 or Hwy 61 to the levee system ROW (Figure 1). Further engineering and design of some access roads discussed in SEA 570 indicate a larger ROW would be required for features such as additional width around corners and to allow for culverts for cross drainage. Construction of permanent access roads could be either improvements to existing roads or construction of new roads. Access roads located along existing roadways would be improved primarily through placement of geotextile fabric, sand and rock to provide an approximately 30 foot drivable width for a two-way haul access road within an approximately 40 foot wide ROW along straight sections from Hwy 61 or Hwy 51 to the levee ROW. As discussed in SEA 570, a 60-foot road width would be allowed, if needed, for access roads within underground transmission and utility ROWs to allow for protection features such as pipelines. Construction of new access roads would require clearing and grubbing in addition to material placement. Additional ROW of approximately 0.1 acres would be needed for the installation of each culvert. More ROW than previously described in SEA 570 would be allowed around bends, corners, and at intersections with public roads to facilitate safe traffic. Some features may be constructed such as traffic lights or wider shoulders and turn lanes where access roads intersect main roads, such as Hwy 61. Coordination with Louisiana Department of Transportation and Development (LA DOTD) and the US Federal Highway Administration (FHWA) is ongoing to determine the best methods and features for safe intersections while minimizing environmental impacts to the extent practicable. The total increase in impact area for access road construction beyond what was described in SEA #570, would be approximately 19 acres. The majority of these impacts would be to forested wetlands (swamp and BLH), and existing roads.

Sand Base Placement
Sand would be used to construct an approximately 70 foot to 100 foot wide sand base within the levee alignment ROW. The material would be back dumped and spread by a bull dozer in order to force soft material outward from the levee section. Any displaced soft material formed by construction of the sand base would remain within the alignment ROW, but removed from the levee design section. Sand would be placed until it has reached the minimum elevation of approximately 3 feet NAVD88.

Levees and Floodwalls
Levee and floodwall system would be built to USACE Hurricane and Storm Damage Risk Reduction System standards in a similar location with similar features and crown elevations as described in the 2016 WSLP EIS. As such, typical cross sections provided in this document are still representative. The ROW width would be between 20 and 100 feet wider and four re-alignments (Figures 1 and 2) would increase its length by about 0.5 miles (18.27 miles in the 2016 WSLP EIS to 18.8 miles including the proposed action). Slight deviations in location of the Proposed Action levee system (i.e., Hypothetical corridor in Figure 1) would be allowed, but the maximum ROW size increase would be limited to approximately 0.5 miles longer and approximately 150 additional acres (Figures 1 and 2).
An approximately 10 foot wide surfaced road would be constructed on the levee crown, floodside berm, or protected side berm for inspection vehicles. Where levee transitions to a floodwall, a 10 foot wide surfaced road would be provided along the protected side of the floodwall. Bridges would be constructed on either the floodside or protected side of the station at the drainage structures and pump station crossings for maintenance access.

Drainage Canals
Interior and exterior drainage canals would be located parallel to the earthen levee section for the majority of the levee system ROW. These canals would be built to the approximate dimensions described in the 2016 WSLP EIS, but would be shifted to parallel the levee system alignment. Both canals would be built within the limits of the hypothetical ROW shown in Figure 1. Where the interior canal intersects pipeline crossings, the depth of the canal would be restricted. The interior drainage canal would widen to 100 feet and would be shallow enough to avoid impacts to pipelines. Any material excavated for canal construction and deemed unsuitable for levee construction could be spread evenly along the project length between the levee and the interior drainage canal.

Western Section
The western section, as described in this section, refers to the levee system from the Hope Canal pump station to the Mississippi River Levee (MRL; Figures 1 and 2). The Louisiana Coastal Protection and Restoration Authority (CPRA) could design and construct some or part of the levee system components of the western section of the levee system; however, the USACE would determine the final alignment of this section. Design and location of the western section of the levee system may be co-located with the eastern guide levee of CPRA's River Reintroduction into Maurepas Swamp Project. The earthen levee sections between these stations would be from approximately 300 feet up to 600 feet wide. As the total length and width of levee would be approximately the same whether or not it is aligned to provide for the potential future construction of the River Reintroduction into Maurepas Swamp Project, no additional cost would be incurred by the Federal government. This portion of the project would include a highway ramp at US Highway 61 constructed to an elevation of approximately 16 feet NAVD88. Two lanes of traffic would be maintained in either direction during construction of the ramp. This would require widening the existing highway to maintain two lanes of traffic in either direction. Swing type floodgates would be provided at the Kansas City Southern and Canadian National Railway crossings. A swing type floodgate would also be located across LA Highway 44.

Additional Gates and T-wall Features
The levee system would also require construction of T-walls across pipeline corridors. These locations would be slightly shifted due to the levee system alignment changes. A 10 foot wide access road would run along the land side of the T-walls across the pipeline corridors that would include additional sand and crushed stone to reduce pressures for maintenance vehicles crossing the pipelines. As described in the 2016 WSLP EIS, T-walls would also be located below the three interstate crossings to include the western I-10 crossing, I-55 crossing, and the eastern I-10 crossing. A surfaced access road would only be provided below the eastern I-10 crossing. There would be no bridge crossing at the western I-10 crossing and the I-55 crossing because of insufficient height clearance requirements.

Drainage Structures and Pumping Stations
Additional drainage structures and pumping stations would be considered. Updated sluice gate designs to the Hope Canal, Mississippi, Reserve Relief Canal, Perriloux Canal, Ridgefield, and Montz South are shown in Table 1. A new drainage structure with a 16 feet wide by 16 foot wide sluice gate is proposed where the levee system crosses Prescott Canal. A new sluice gate at the Canadian National Railroad is also being considered that would be approximately 5 feet wide x 5 feet high. An 18 foot wide bridge would be constructed across the structure to carry maintenance and inspection vehicles.

Two new pump stations could be constructed at Prescott Canal and Interstate 55. Pump capacities being considered at these and updated pump station capacities for the four pump stations included in the 2016 WSLP EIS are shown in Table 1.

Table 1: Pumping station and Drainage Structures

Station Name	Number of 16 x 16 foot drainage structures	Pump capacity
Canadian National Railroad	1*	No pumps
Hope Canal	2	400-800 cfs
Mississippi Bayou	2	No pumps
Reserve Relief Canal	1	1200-2000 cfs
Perriloux	1	No pumps
Ridgefield	1	800 cfs
I-55 Canal	5	1200-2000 cfs
Montz North Canal**	1	No pumps
Montz South Canal	1	800 cfs
Prescott Canal	1	400-800 cfs

*drainage structure would be 5 x 5 feet
**under consideration; may not be necessary

Pump station complexes would include a pump station, the size of which would depend on the capacity (Table 1), with an adjacent drainage structure within an existing canal. These structures would tie into the levee system with T-walls on either side of the pump station/drainage structure complex. All pumps would be driven by diesel engines. Several fuel tanks would be located at each station with enough fuel to run the station for five days. A water well would be located at each station to provide potable water for drinking, showers, sprinkler system, and to lubricate the pumps. A surface parking area would also be provided at each station. In order to construct the structures within the existing canals without impeding existing canal flows, a temporary bypass channel would be constructed at each structure site with dimensions that would allow for the same flow capacity as the existing canal. In addition to the sluice gate at Reserve Relief Canal, an adjacent navigable gate would be constructed within the canal to allow for the passage of recreational boats.

Staff gages would be provided at the flood side and protected side of the pump stations and drainage structures. The drainage structures would remain open at all times except when they would be closed for tropical storm events. Closure for tropical storm events would be the same as described in the 2016 WSLP EIS. The amount of time the gates would remain closed would depend on a given storm's characteristics such as forward speed, rainfall, and storm track which impact water levels, and could remain closed for approximately 8.5 days on average. The days per year of system closure would vary by year and be dictated by tropical storm activity.

Estimated Quantities and Transportation Plans
As stated in the 2016 WSLP EIS, approximately 9,000,000 cubic yards of material would be needed for construction. Approximately 2,000,000 cubic yards of sand would be used to construct the sand base described in Section 2.2.3. Approximately 7,000,000 cubic yards of clay would be used to provide approximately 3,500,000 million cubic yards of in-place compacted clay necessary for levee system construction described in 2.2.4. These materials would be truck hauled to the levee alignment ROW with on-road dump trucks. It is estimated that 750,000 truckloads of sand and clay would be required for levee construction, utilizing triaxle and tandem dump trucks. Primary routes for clay fill would be via the BCS to Hwy 61, to the closest off-road access road as described in Section 1. Commercial sand suppliers are generally located on the flood side of the MRL and transportation routes are expected to be from LA Highway 626 to Hwy 61 and from Hwy 61 to the closest designated off-road access road to the levee system ROW. Commercial clay sources may be utilized but exact pit locations are not currently known. Traffic control plans would be implemented for all construction-related transportation to minimize impacts to existing traffic patterns and would rely upon use of highways to the extent practicable.

Pump stations, T-Walls, floodgates, and drainage structure construction would require use of a variety of commercial vehicles to bring materials, including but not limited to formwork, concrete, structural steel, engines, pumps, fuel, supplies, building materials and foundation piles. The types of vehicles could include, but may not be limited to, concrete mix trucks, flatbed trailers, freight trucks, service trucks, fuel trucks, as well as lowboy trailers to transport cranes, backhoes, forklifts, excavators, and bulldozers. Routes to the construction site would generally be from commercial manufactures and suppliers. Likely routes would be from a combination of I-10, I-55, Louisiana Highway 628, Hwy 51 or Louisiana Highway 3188 to Hwy 61 to the access roads described in Section 2.2.2. The estimated number of delivery trips for this portion of the construction is 4,000.

Staging Locations and Plans
Stockpile areas described in SEA #570, or within the immediate vicinity of access roads. In general, such staging areas would be approximately 200 feet x 200 feet. Any staging areas utilized outside of the levee system ROW would be limited to existing developed sites and would avoid impacts to cultural, recreational, socioeconomic, farmland, environmental justice, and wetlands and other environmentally sensitive areas.

Alterations in Spoil Banks
Gapping of existing spoil banks would be considered within the vicinity of the levee system and other project features, as shown in Figure 1, if such gapping would be necessary or desirable to facilitate drainage and/or maintain existing water flows within the project area. These gappings would be performed to maintain existing hydrology and would not have net negative impacts to vegetation resources. Any impacts to other resources would be minimized to the maximum extent practicable. Coordination with resource agencies regarding potential spoil bank gapping plans has occurred and would continue.

19. Project Purpose (Describe the reason or purpose of the project, (see instruction.)
The purpose of the proposed action is to construct a more effective Hurricane Storm Damage Risk Reduction System (HSDRRS) for the eastern parts of St. John the Baptist and St. Charles Parishes, Louisiana. Advanced engineering design and investigations of the West Shore Lake Pontchartrain Environmental Impact Statement's (2016 WSLP EIS) levee alignment indicate that sections of the levee need to be widened and shifted. Additionally, it is likely that the Bonnet Carré Spillway (BCS) would not have enough suitable clay borrow material for construction. The use of the five stockpile and staging areas described in Supplemental Environmental Assessment #570, West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Structural Alignment Surveys and Borings Investigations St. Charles and St. John the Baptist Parishes, Louisiana (SEA 570) as borrow sources and the use of licensed commercial borrow sources would provide enough additional borrow for construction. Other feature and plan changes being considered are described above in Section 18.

USE BLOCKS 20-22 IF DREDGED AND/OR FILL MATERIAL IS TO BE DISCHARGED

20. Reason(s) for Discharge
To modify and construct levees and berms of the WSLP Project HSDRRS.

21. Type(s) of Material Being Discharged and the Amount of Each Type in Cubic Yards.
Total amount (9,000,000 cubic yards) is unchanged from the 2016 WSLP EIS.
Sand – Approximately 2,000,000 cubic yards would be used for a sand base.
Clay – Approximately 7,000,000 cubic yards would be used for levee system ROW

22. Surface Area in Acres of Wetlands or Other Waters Filled (see instructions)
Approximately 66 acres of forested wetlands

23. Is Any Portion of the Work Already Complete? Yes _____ No __X__ IF YES, DESCRIBE THE COMPLETED WORK

24. Addresses of Adjoining Property Owners, Lessees, Etc., Whose Property Adjoins the Waterbody (If more than can be entered here, please attach a supplemental list.

25. List of Other Certifications or Approvals/Denials Received from other Federal, State or Local Agencies for Work Described in This Application.

AGENCY	***TYPE APPROVAL***	***IDENTIFICATION NO.***	***DATE APPLIED***	***DATE APPROVED***	***DATE DENIED***
LDNR -	Coastal Zone Consistency	C20140059 mod04	Review in process - To the best of my knowledge the proposed activity described in my permit application complies with and will be conducted in a manner that is consistent with the LA Coastal management Program.		
USACE	CWA Section 404(b)(1)		23 April 2020	ongoing	
USFWS	Endangered Species Act		24 March 2020	25 March 2020	
SHPO	Section 106			ongoing	

*Would include but is not restricted to zoning, building, and flood plain permits.

26. Application is hereby made for a permit or permits to authorize the work described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent of the applicant.

_________________________________ ___5 May 2020______ ____________________________________ ____________________
SIGNATURE OF APPLICANT *DATE* *SIGNATURE OF AGENT* *DATE*

The application must be signed by the person who desires to undertake the proposed activity (applicant) or it may be signed by a duly authorized agent if the statement in block 11 has been filled out and signed.

18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department or agency The United States knowingly and willfully falsifies, conceals, or covers up by any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statement or entry, shall be fined not more than $10,000 or imprisoned not more than five years, or both.

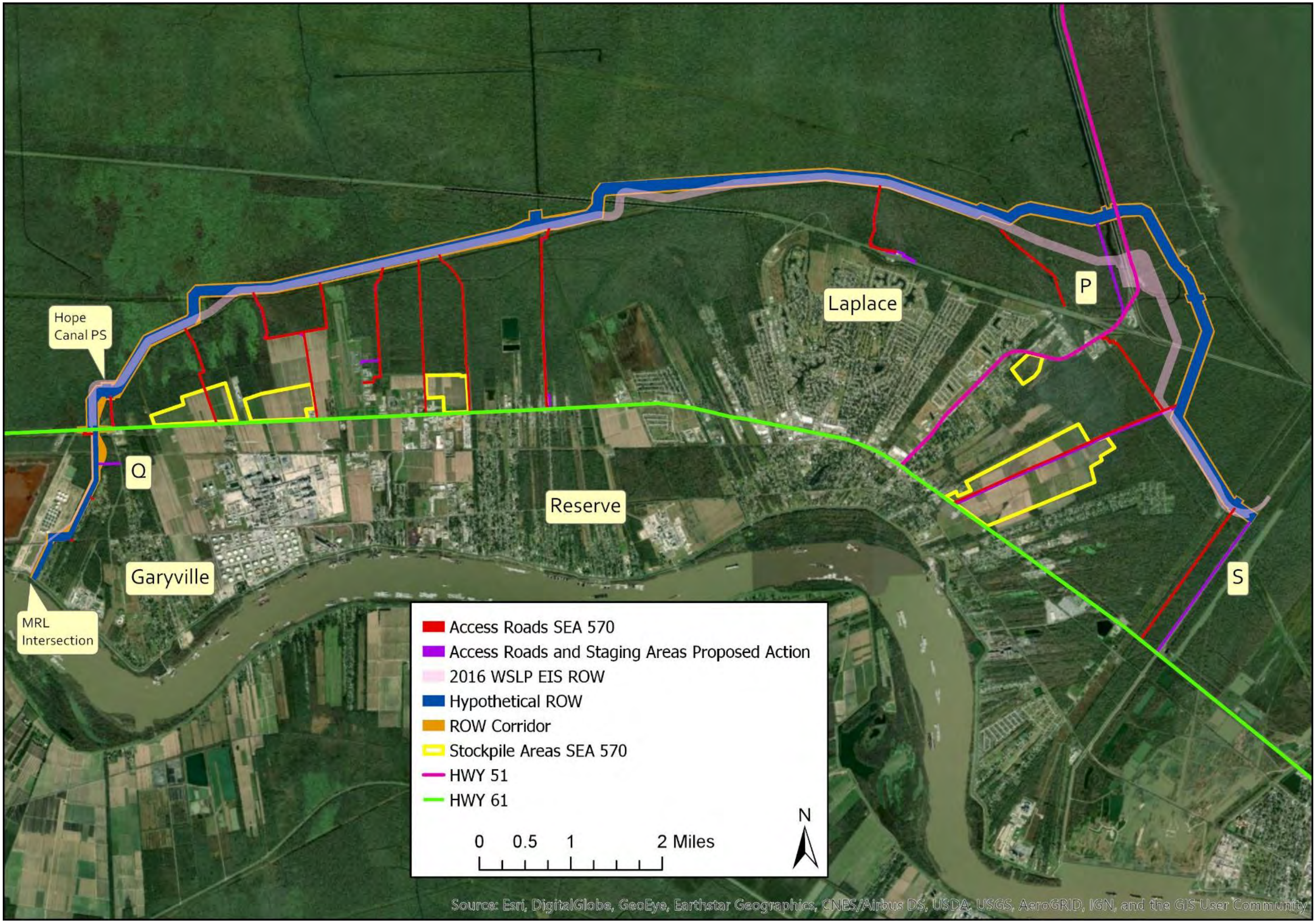


Figure 1: Map showing the Proposed Action. Access Roads that were not identified in SEA 570 are labeled P, Q, and S. Hypothetical ROW represents the proposed action's maximum levee system ROW size.

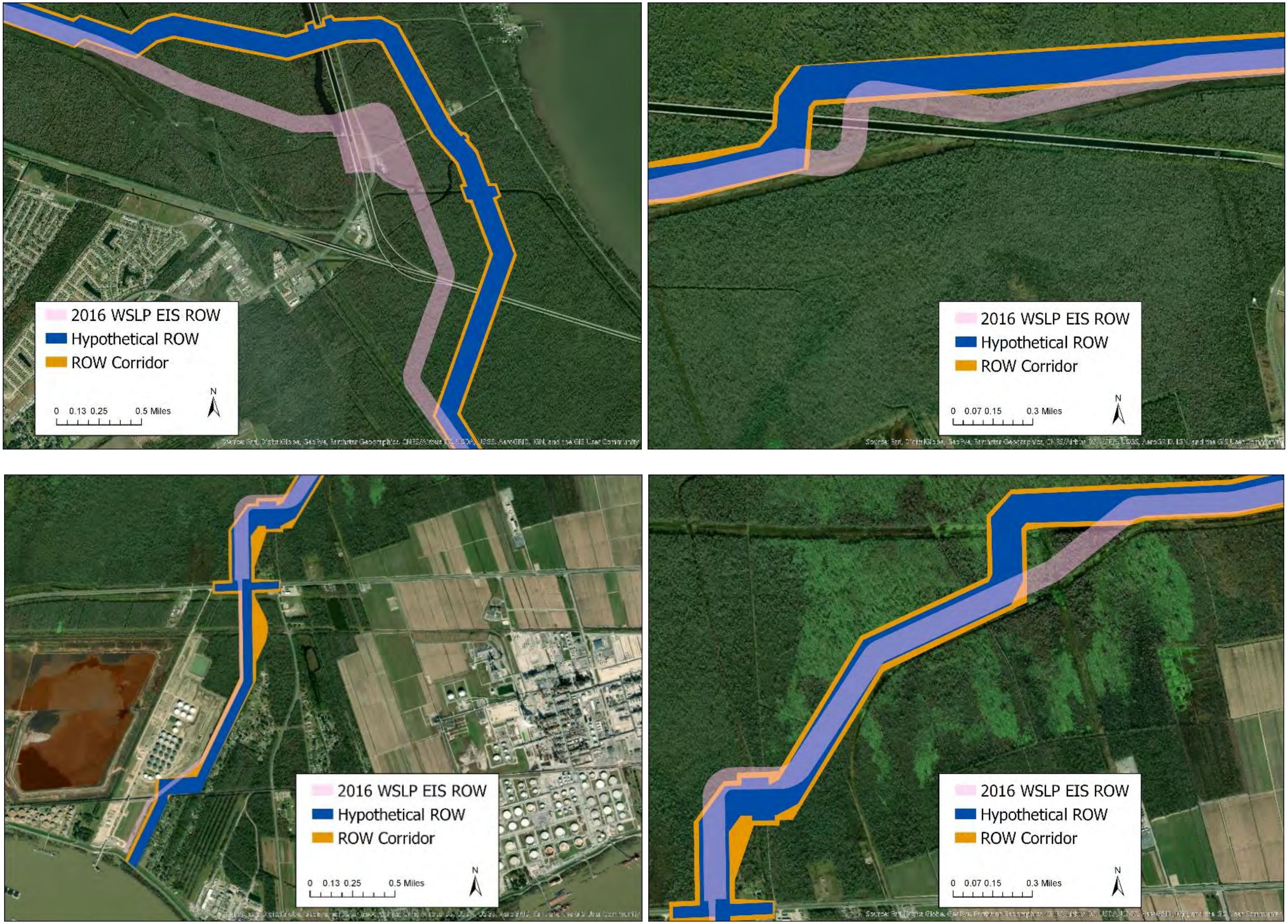


Figure 2. Areas with potential levee system shifts. Clockwise from top left: I-55 and I-10 interchange (pump station ROW increases at Montz north and south, and I-55 can be seen), second I-10 crossing, large transmission corridor crossing, and western section (pump station ROW increase at Hope Canal can be seen).

Annex B: Final 404(b)(1) determination

The following short form 404(b)(1) evaluation follows the format designed by the Office of the Chief of Engineers (OCE). As a measure to avoid unnecessary paperwork and to streamline regulation procedures while fulfilling the spirit and intent of environmental statutes, New Orleans District is using this format for all proposed project elements requiring 404 evaluation, but involving no adverse significant impacts.

PROJECT TITLE West Shore Lake Pontchartrain, Hurricane Protection System, St. John the Baptist and St. Charles Parish, Louisiana

PROJECT DESCRIPTION The Project Area is located within St. John the Baptist and St. Charles Parishes in southeastern Louisiana, between the Mississippi River and Lakes Maurepas and Pontchartrain. The towns of Montz, Laplace, Reserve, and Garyville are communities found within the Project Area. The Project Area occupies a portion of one of the oldest delta complexes in the Mississippi River Deltaic Plain. It is in the lower Mississippi River alluvial plain in the Pontchartrain Basin and includes residential and commercial developments south of Interstate 10 (I-10). West of Laplace, a majority of the developed areas in the Project Area are found between U.S. Highway 61 (US-61) and the Mississippi River levee. Much of the undeveloped area consists of forested wetlands, including swamp and bottomland hardwood forests. The State of Louisiana's Maurepas Swamp Wildlife Management Area (MSWMA) lies north of I-10, within the Project Area.

The Proposed Action would include modifications to the WSLP levee system in St. John the Baptist and St. Charles Parishes, Louisiana described in the 2016 WSLP EIS, SEA 570, and SEA 571 (Figure 1). The majority of changes would be within the SEA 571 construction ROW corridor, except for 4 locations (Figure 2).

1. Temporary bypass road near the I-55 pump station and drainage structures
2. Temporary construction activities near the Prescott Canal Drainage structure.
3. Power transmission corridor for the Reserve Relief Pumping Station
4. Levee system re-alignment to accommodate a proposed runway extension for the Port of South Louisiana's Executive Regional Airport in Reserve, Louisiana. Overall, less acres would be needed.

All other design changes being considered would occur within the SEA 571 construction ROW corridor:

1. Levee system design
2. Drainage canal designs and locations
3. Drainage structure design, size, and location
4. Pump station design, number, and locations
5. Additional structures

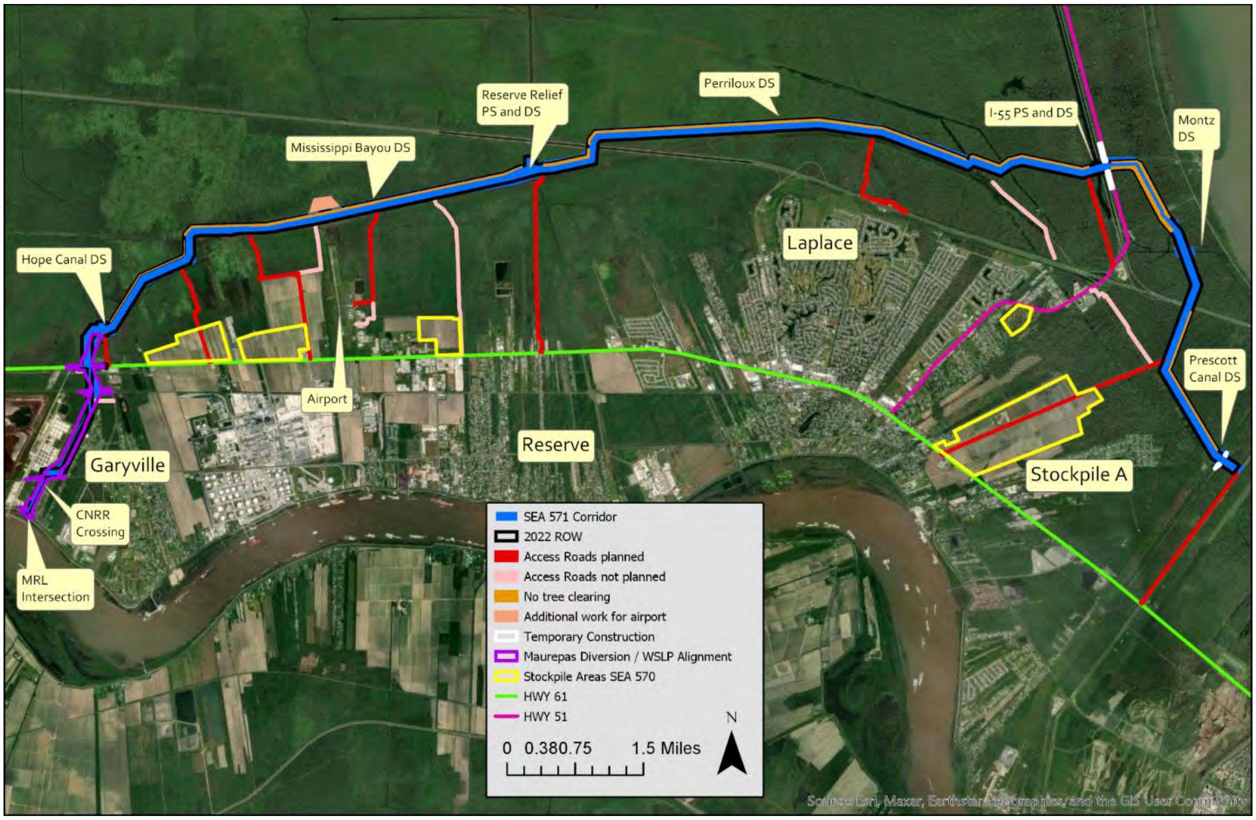


Figure 1. Proposed Action within St. John the Baptist and St. Charles Parish, Louisiana

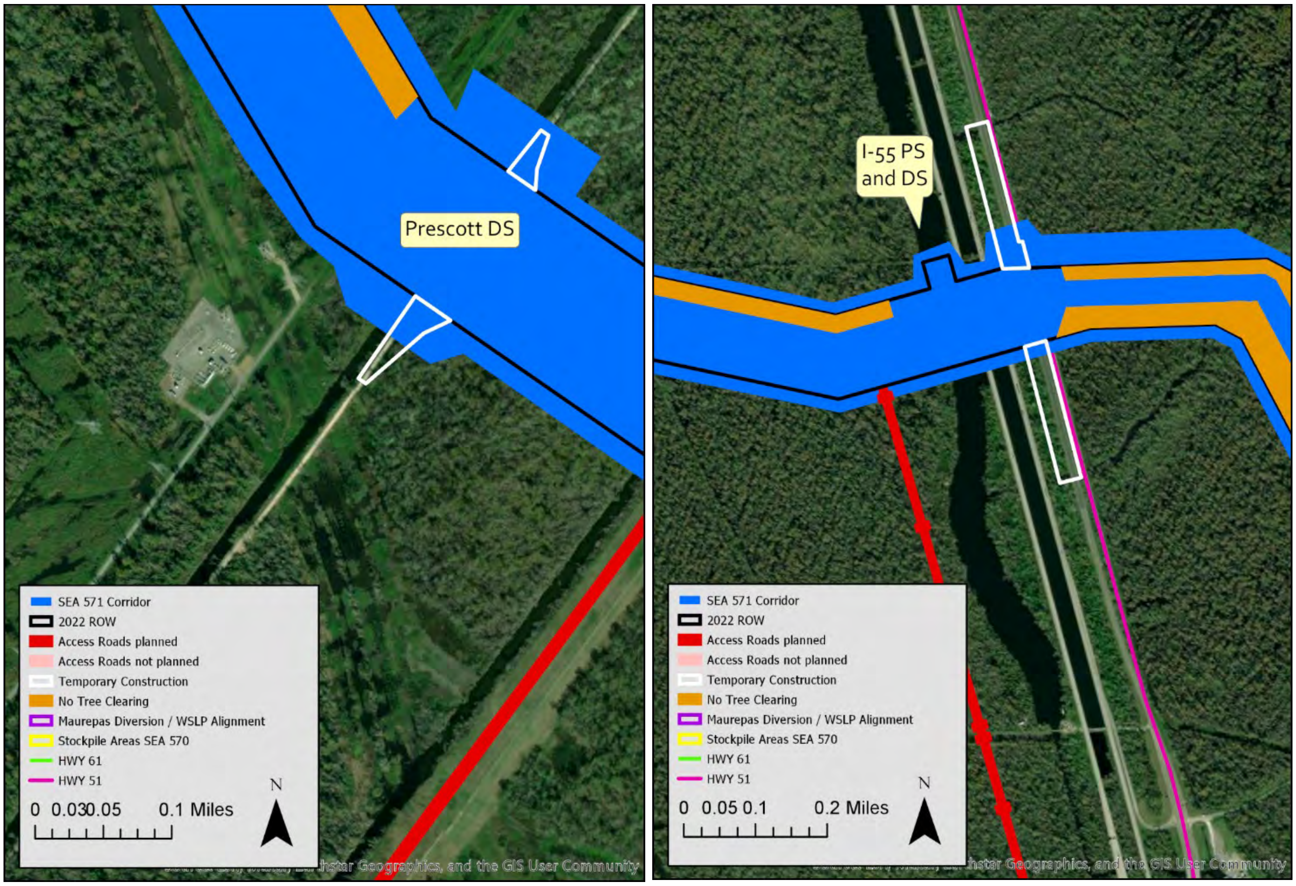


Figure 2. Areas with temporary staging and access roads outside of the SEA 571 ROW

Design Summit

All design changes considered herein were based on results of a design summit that was held in 2021 to examine all aspects of the project to reduce the cost while still providing the authorized 1% exceedance risk reduction. Preliminary cost estimates of these levee system as described in the 2016 EIS and SEA 571 exceeded Project funds. The design summit was the kickoff for design changes that are being considered in this SEA. New field data were incorporated into updated, more precise Hydraulic and Hydrologic models. Results of hydraulic re-designs lowered the required system heights and reduced the required pumping capacities. Additionally, levee re-designs included use of wick drains and staged construction to reduce levee embankment.

In summary the entire system was optimized to reduce costs while maintaining the same level of risk reduction. Levees would not be designed with overbuild to attempt to remain above the updated hydraulic design grades but would be designed at the year 2027 design grade with an additional 6 inches above the design grade. The year 2027 was selected as it is the anticipated completion of the system for turnover to the Non-Federal Sponsor. Subsequent levee lifts would require raising the design grades to account for future sea level rise and ground subsidence. In addition, these future lifts would account for standard wave overtopping and construction settlement.

Construction Details

Levees System The levee system will be designed to the 2027 design grade with an additional 6 inches allowance for post-construction settlement. The predicted length of time the WSLP earthen embankments will remain above the required grade for the 1% (100 yr) Annual Exceedance Probability will vary reach by reach based on the final construction grade and foundation conditions. USACE will utilize instrumentation data (piezometers and settlement gages) acquired during construction to either validate or revise the predicted settlement curves and reassess the likely time the earthen embankments will remain above the 1% grade. Revised hydraulic design elevations are show in Table 1. Borrow sources described in SEA 571 will be utilized for construction of features as described in SEA 571A.

Reduction in levee heights, reduced pumping capacity, and utilization of wick drains and staged construction for levee embankments would reduce the levee footprint compared to SEA 571. A total of approximately 235.2 acres of swamp and 25.0 acres of BLH would not be cleared based on polygons provided by CEMVN Engineering and the Suir and Saltus remote sensing data. Construction of the levee system to the height for a 1 percent chance of exceedance storm surge in year 2027 would not require impacting the entire right-of-way. Therefore, no tree clearing areas would be established within the 2022 levee system right of way.

On June 23, 2022, the non-federal sponsors (NFS) requested CEMVN perform additional work at the WSLP-108 levee reach to accommodate a proposed 1,500-foot runway extension at the Port of South Louisiana Executive Regional Airport located in Reserve, Louisiana. The airport serves private aviation at the Port of South Louisiana, many international industrial facilities, companies, and the growing communities along the Mississippi River. There is no commercial passenger service.

The shift in the alignment would be necessary due to Federal Aviation Administration requirements for clear safety zones and the required landing glide slope and would increase the length of levee by approximately 1,000 feet. The levee alignment footprint to accommodate the runway extension protrudes outside the SEA 571 ROW corridor (Figure 1). The NFS is responsible for all additional costs associated with levee alignment shift for the runway extension.

Table 1. Revised Hydraulic Design Elevations

Location	2027 Still Water Elevation 100YR 90% NAVD88	2027 Levee 100YR Construction Grade Elevation (ft. NAVD88)	Final T-Wall Elevations (ft. NAVD88)
WSLP-101	11.5	12.5	-
WSLP-102/Montz	12.2	13.9	17.9

WSLP-103	12.1	13.9	17.9
WSLP-104	10.6	11.5	-
WSLP-104 (I-55 PS)	11	12.0	17.4
WSLP-105	10.2	11.0	-
WSLP-105/Perrilloux	10.2	11	16.4
WSLP-105 (I-10)	10.1	11.0	16.4
WSLP-106	9.9	11.0	16.4
WSLP-107	8.6	9.6	15.9
WSLP-108/Miss B	7.3	8.6	14.9
WSLP-109	7.2	8.6	14.4
WSLP110/Hope	7.2	8.5	13.9
WSLP-111	7.2	8.5	13.9
WSLP-112	7.2	8.5	13.9
WSLP-113	7.2	8.5	13.9
Prescott	11.5	12.5	17.4
Bonne Carre N	11.1	12.5	-
Bonne Carre M	11.2	12.0	-
Bonne Carre S	11.5	12.5	-
St James	6.2	7.1	13.4

Drainage Canals Interior drainage canals would be slightly modified to raise the invert from -8 feet to -5 feet while maintaining the same top width. Materials excavated from the interior drainage canals would be spread between the protected side levee berm and the top of bank of the canal. The exterior drainage canal would be removed from much of the levee system. Exterior drainage canals would be constructed to the same approximate dimensions as described in SEA 571 approximately 200 feet either side of the outfall channels at drainage structures and pump stations to assist in distributing water at the immediate outflows of the pump stations and drainage structures. Alterations to drainage canal design are the result of H&H models updated during the 2021 Design Summit.

Drainage Structures and Pumping Stations H&H models updated during the 2021 Design Summit reduced required system heights and pumping capacities. As a result, pumping stations and drainage structure design were revised throughout the system. Montz North Canal and Ridgefield drainage structure locations were removed. Additional drainage gates were added to Montz South Canal and Perriloux to accommodate for the losses at Montz South Canal and Ridgefield, respectively. Table 2 is a summary of the drainage structures and pump stations for the Proposed Action.

Table 2: Pumping station and Drainage Structures

Station Name	Number of and size drainage structures	Pump capacity
Canadian National Railroad	1*	No pumps
Hope Canal	3-10'X10'	No Pumps (SEA 571 had pumps)

Mississippi Bayou	4 10’ X10’	No pumps
Reserve Relief Canal	1 16’X16’	2000 cfs
Perriloux	4 10’X10’	No pumps
Ridgefield	Removed and combined with Perriloux	No Pumps
I-55 Canal	2 16’X16’	2000 cfs
Montz North Canal	Removed and Combined with Montz South	No pumps
Montz South Canal	4 10’X10’	No Pumps
Prescott Canal	2 10’X10’	No Pumps (SEA 571 had pumps)

Power to the Reserve Relief Canal Pump Station will be provided via new distribution corridor that will run along access road F from US 61 (Figure 5). Additional wetland and BLH habitat would be impacted outside of the SEA 571 ROW corridor.

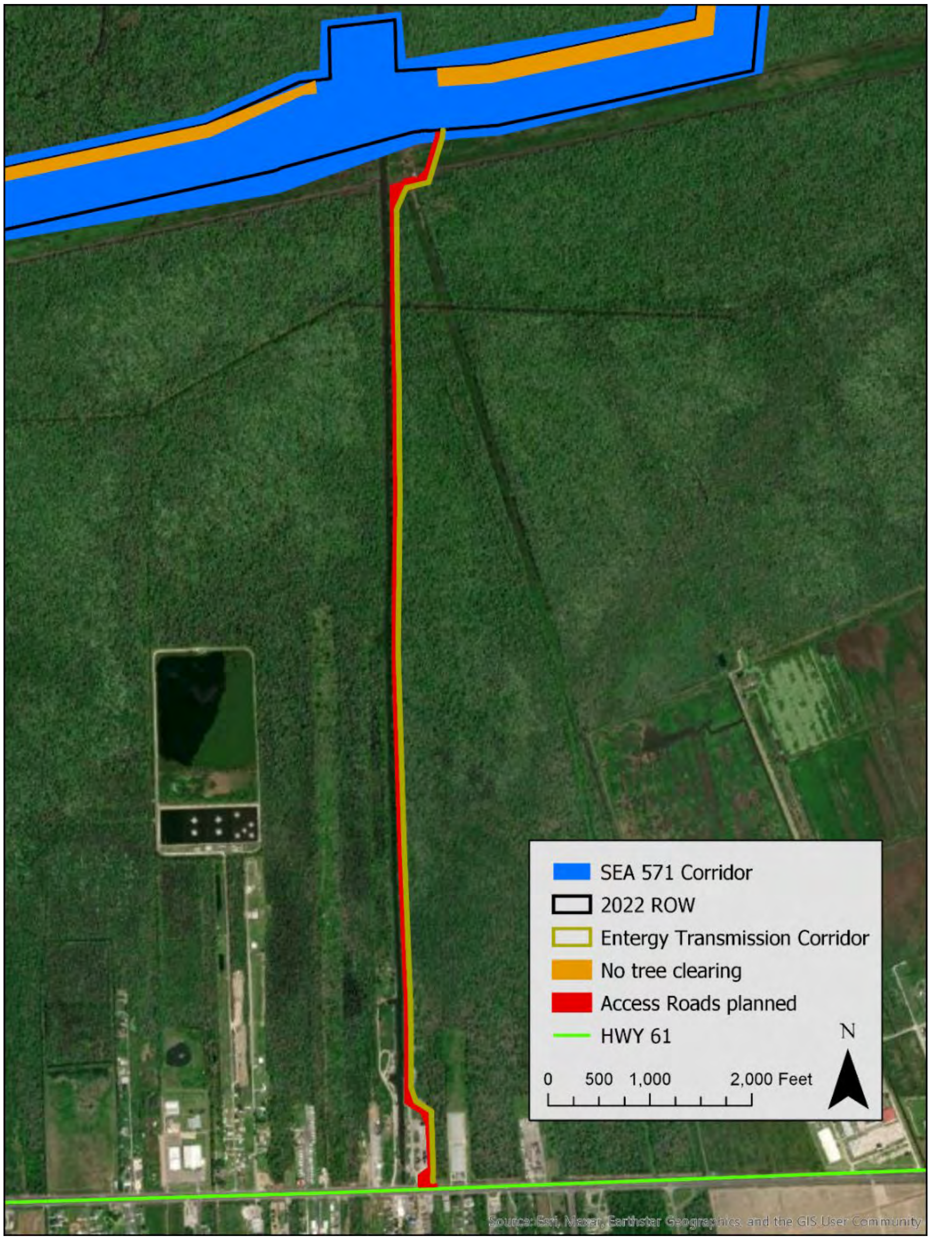


Figure 5. West Shore Lake Pontchartrain Project modifications showing Power transmission corridor (brown) and levee re-alignment to accommodate a proposed airport runway (square bump out in blue).

<u>Other Structures </u>A vehicular floodgate at the surface La State Highway 51 just east of the elevated I-55 bridges would be constructed. This vehicular gate would require closure of the existing highway, necessitating a bypass road around the gate construction. The proposed bypass road would require temporary construction and disturbance of approximately 6.5 acres areas outside the SEA 571 ROW corridor. Other vehicular gates through the existing floodwalls at the Reserve Pumping station and Prescott drainage structure but these will not increase the acreage disturbed to the bottom land hardwoods.

At locations of single pipeline crossings along the levee the proposed method of relocation is still under consideration. These lines may be directionally drilled beneath the levee system. Another potential option would be to build a floodwall to pass the pipeline through. This would be considered if the directional drill method proves impractical from a geotechnical standpoint or more costly than a dedicated floodwall. If floodwalls are utilized, they would be constructed to the same elevation as the rest of the WSLP floodwalls (2070 1% flood elevations).

<u>Temporary Construction Areas (Stockpiling and Staging)</u> The only planned stockpile area at this point is Stockpile A, however, other stockpile areas described in SEA #570 could still be used.

Approximately 0.25 acres outside of the construction ROW corridor described in SEA 571 would be used for temporary access roads and staging during construction near the Prescott Canal drainage structure (Figure 2).

Any other temporary construction areas utilized outside of the levee system ROW would be limited to existing developed sites and would avoid impacts to cultural, recreational, socioeconomic, farmland, environmental justice, and wetlands and other environmentally sensitive areas.

1. <u>Review of Compliance (§230.10 (a)-(d))</u>.

	Preliminary[1]		Final[2]	
A review of this project indicates that:				
a. The discharge represents the least environmentally damaging practicable alternative and if in a special aquatic site, the activity associated with the discharge must have direct access or proximity to, or be located in the aquatic ecosystem to fulfill its basic purpose (if no, see section 2 and information gathered for environmental assessment alternative);	[YES]	NO*	YES	NO
b. The activity does not appear to: (1) violate applicable state water quality standards or effluent standards prohibited under Section 307 of the Clean Water Act; (2) jeopardize the existence of Federally listed endangered or threatened species or their habitat; and (3) violate requirements of any Federally designated marine sanctuary (if no, see section 2b and check responses from resource and water quality certifying agencies);	[YES]	NO*	YES	NO
c. The activity will not cause or contribute to significant degradation of waters of the United States including adverse effects on human health, life stages of organisms dependent on the aquatic ecosystem, ecosystem diversity, productivity and stability, and recreational, esthetic, and economic values (if no, see section 2);	[YES]	NO*	YES	NO
d. Appropriate and practicable steps have been taken to minimize potential adverse impacts of the discharge on the aquatic ecosystem (if no, see section 5).	[YES]	NO*	YES	NO

2. <u>Technical Evaluation Factors (Subparts C-F)</u>.

	N/A	Not Significant	Significant*
a. Physical and Chemical Characteristics of the Aquatic Ecosystem (Subpart C).			
(1) Substrate impacts.		x	
(2) Suspended particulates/turbidity impacts.		x	
(3) Water column impacts.		x	
(4) Alteration of current patterns and water circulation.		x	
(5) Alteration of normal water fluctuations/ hydroperiod.		x	
(6) Alteration of salinity gradients.		x	
b. Biological Characteristics of the Aquatic Ecosystem (Subpart D).			
(1) Effect on threatened/endangered species and their habitat.		x	
(2) Effect on the aquatic food web.		x	
(3) Effect on other wildlife (mammals, birds, reptiles, and amphibians).		x	
c. Special Aquatic Sites (Subpart E).			
(1) Sanctuaries and refuges.		x	
(2) Wetlands.		x	
(3) Mud flats.	x		
(4) Vegetated shallows.		x	
(5) Coral reefs.	x		
(6) Riffle and pool complexes.	x		
d. Human Use Characteristics (Subpart F).			
(1) Effects on municipal and private water supplies.	x		
(2) Recreational and commercial fisheries impacts.		x	
(3) Effects on water-related recreation.		x	
(4) Esthetic impacts.		x	
(5) Effects on parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves.		x	

<u>Remarks</u>. Where a check is placed under the significant category, the preparer has attached explanation.

3. Evaluation of Dredged or Fill Material (Subpart G).[3]

a. The following information has been considered in evaluating the biological availability of possible contaminants in dredged or fill material.

(1) Physical characteristics	x
(2) Hydrography in relation to known or anticipated sources of contaminants	x
(3) Results from previous testing of the material or similar material in the vicinity of the project	
(4) Known, significant sources of persistent pesticides from land runoff or percolation	
(5) Spill records for petroleum products or designated (Section 311 of CWA) hazardous substances	x
(6) Other public records of significant introduction of contaminants from industries, municipalities, or other sources	x
(7) Known existence of substantial material deposits of substances which could be released in harmful quantities to the aquatic environment by man-induced discharge activities	
(8) Other sources (specify)	

Appropriate references:

b. An evaluation of the appropriate information in 3a above indicates that there is reason to believe the proposed dredge or fill material is not a carrier of contaminants, or the material meets the testing exclusion criteria.

[YES] NO*

4. Disposal Site Delineation (§230.11(f)).

a. The following factors, as appropriate, have been considered in evaluating the disposal site.

(1) Depth of water at disposal site	x
(2) Current velocity, direction, and variability at disposal site	
(3) Degree of turbulence	x
(4) Water column stratification	x
(5) Discharge vessel speed and direction	
(6) Rate of discharge	
(7) Dredged material characteristics (constituents, amount, and type of material, settling velocities)	x
(8) Number of discharges per unit of time	
(9) Other factors affecting rates and patterns of mixing (specify)	

Appropriate references:

b. An evaluation of the appropriate factors in 4a above indicates that the disposal site and/or size of mixing zone are acceptable.

[YES] NO*

5. Actions to Minimize Adverse Effects (Subpart H).

All appropriate and practicable steps have been taken, through application of the recommendations of §230.70-230.77 to ensure minimal adverse effects of the proposed discharge.

[YES] NO*

6. Factual Determination (§230.11).

A review of appropriate information as identified in items 2-5 above indicates that there is minimal potential for short- or long-term environmental effects of the proposed discharge as related to:

a. Physical substrate at the disposal site (review sections 2a, 3, 4, and 5 above).	YES	NO*
b. Water circulation, fluctuation and salinity (review sections 2a, 3, 4, and 5).	YES	NO*
c. Suspended particulates/turbidity (review sections 2a, 3, 4, and 5)	YES	NO*
d. Contaminant availability (review sections 2a, 3, and 4).	YES	NO*
e. Aquatic ecosystem structure and function (review sections 2b and c, 3, and 5).	[YES]	NO*
f. Disposal site (review sections 2, 4, and 5).	[YES]	NO*
g. Cumulative impact on the aquatic ecosystem.	[YES]	NO*
h. Secondary impacts on the aquatic ecosystem.	[YES]	NO*

*A negative, significant, or unknown response indicates that the project may not be in compliance with the Section 404(b)(1) Guidelines.

[1]Negative responses to three or more of the compliance criteria at this stage indicates that the proposed projects may not be evaluated using this "short form procedure". Care should be used in assessing pertinent portions of the technical information of items 2a-d, before completing the final review of compliance.

[2]Negative responses to one of the compliance criteria at this stage indicates that the proposed project does not comply with the guidelines. If the economics of navigation and anchorage of Section 404(b)(2) are to be evaluated in the decision-making process, the "short form" evaluation process is inappropriate.

[3]If the dredged or fill material cannot be excluded from individual testing, the "short form" evaluation process is inappropriate.

7. Evaluation Responsibility.

a. This evaluation was prepared by:

Name: Kristin Gunning
Position: Biologist
Organization: U.S. Army Corps of Engineers, New Orleans District
Date: March 20, 2023

b. This evaluation was reviewed by:

Name: Isaac Mudge
Position: Hydraulic Engineer
Organization: US Army Corps of Engineers, New Orleans District
Date: April 18, 2023

8. Findings.

a. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines .... __X_

b. The proposed disposal site for discharge of dredged or fill material complies with the Section 404(b)(1) guidelines with the inclusion of the following conditions ....___

c. The proposed disposal site for discharge of dredged or fill material does not comply with the Section 404(b)(1) guidelines for the following reason(s):

(1) There is a less damaging practicable alternative ....___
(2) The proposed discharge will result in significant degradation of the aquatic ecosystem ....___
(3) The proposed discharge does not include all practicable and appropriate measures to minimize potential harm to the aquatic ecosystem ....___

Date: 6 July 2023

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Date: 2023.07.06 09:27:32 -05'00'

Eric M. Williams
Chief, Environmental Planning Branch

Annex C: Department of Natural Resources, Coastal Zone Consistency Determination

JOHN BEL EDWARDS
GOVERNOR

THOMAS F. HARRIS
SECRETARY

State of Louisiana

DEPARTMENT OF NATURAL RESOURCES

OFFICE OF COASTAL MANAGEMENT

June 30, 2023

Kristin Gunning
Biologist, Environmental Studies Section
Corps of Engineers- New Orleans District
7400 Leake Avenue
New Orleans, LA 70118
Via e-mail: marshall.k.harper@usace.army.mil

RE: **C20140059 Mod 7**, Coastal Zone Consistency
New Orleans District, Corps of Engineers
Direct Federal Action
West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Project: Post design summit changes

Dear Ms. Gunning:

The above referenced project has been received by this office and has been found to be consistent with the Louisiana Coastal Resources Program as required by Section 307(c) (3) (B) of the Coastal Zone Management Act of 1972 as amended.

If you have any questions concerning this determination, please contact Ray Reich of the Consistency Section at (225) 342-7949 or ray.reich@la.gov
Sincerely,

/S/ Charles Reulet
Administrator
Interagency Affairs/Field Services Division

CR/MH/rar

cc: Hannah Pitts, LDWF
Dave Butler, LDWF
Sydney Dobson, CPRA
Les Rosso, State Lands
Joey Heintz, OCM / FI

Annex D: Endangered Species Act

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Louisiana Ecological Services Field Office
200 Dulles Drive
Lafayette, LA 70506
Phone: (337) 291-3100 Fax: (337) 291-3139

In Reply Refer To: February 24, 2023
Project code: 2023-0049014
Project Name: West Shore Lake Pontchartrain

Subject: Verification letter for the project named 'West Shore Lake Pontchartrain' for specified threatened and endangered species that may occur in your proposed project location pursuant to the Louisiana Endangered Species Act project review and guidance for other federal trust resources determination key (Louisiana DKey).

Dear Kristin Gunning:

The U.S. Fish and Wildlife Service (Service) received on February 24, 2023 your effects determination(s) for the 'West Shore Lake Pontchartrain' (the Action) using the Louisiana DKey within the Information for Planning and Consultation (IPaC) system. The Service developed this system in accordance with the Endangered Species Act of 1973 (ESA) (87 Stat.884, as amended; 16 U.S.C. 1531 et seq.).

Based on your answers, and the assistance in the Service's Louisiana DKey, you made the following effect determination(s) for the proposed Action:

Species	**Listing Status**	**Determination**
West Indian Manatee (*Trichechus manatus*)	Threatened	NLAA

Species protective measures (contained within this application) will be used by the applicant and will be incorporated into any special conditions of a DA permit; therefore the Service concurs with the U.S. Army Corps of Engineers "may affect, not likely to adversely affect" determination(s) for the species listed above. Your agency has met consultation requirements by informing the Service of your "No Effect" determinations. No consultation for this project is required for species that you determined will not be affected by this action.

This concurrence verification letter confirms you may rely on effect determinations you reached by considering the Louisiana DKey to satisfy agency consultation requirements under Section 7(a)(2) of the Endangered Species Act of 1973 (87 Stat. 884, as amended 16 U.S.C. 1531 et seq.;

ESA). No further consultation for this project is required for species that you determined will not be affected by this action.

The Service recommends that your agency contact the Louisiana Ecological Services Field Office or re-evaluate the project in IPaC if: 1) the scope or location of the proposed project is changed significantly, 2) new information reveals that the action may affect listed species or designated critical habitat; 3) the action is modified in a manner that causes effects to listed species or designated critical habitat; or 4) a new species is listed or critical habitat designated. If any of the above conditions occurs, additional consultation with the Louisiana Ecological Services Field Office should take place before project changes are final or resources committed.

Please Note: If the Federal Action may impact bald or golden eagles, additional coordination with the Service under the Bald and Golden Eagle Protection Act (BGEPA) (54 Stat. 250, as amended, 16 U.S.C. 668a-d) may be required. Please contact Ulgonda Kirkpatrick (phone: 321/972-9089, e-mail: ulgonda_kirkpatrick@fws.gov) with any questions regarding potential impacts to bald or golden eagles.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

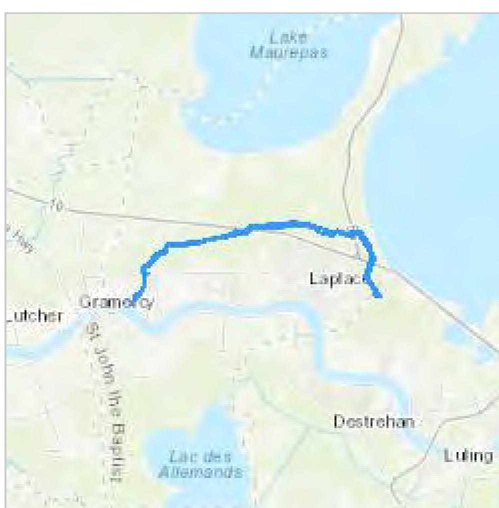
West Shore Lake Pontchartrain

2. Description

The following description was provided for the project 'West Shore Lake Pontchartrain':

> The Proposed Action would include modifications to the structural alignment of the levee system in St. John the Baptist and St. Charles Parishes, Louisiana described in the 2016 WSLP EIS, and modifications to features described in SEA 570 and SEA 571. The majority of changes would be within the SEA 571 construction ROW corridor, except for 3 locations.
>
> 1. Temporary bypass road near the I-55 pump station and drainage structures
> 2. Temporary construction activities near the Prescott Canal Drainage structure.
> 3. Levee system re-alignment to accommodate a proposed runway extension for the Port of South Louisiana's Executive Regional Airport in Reserve, Louisiana. Overall, less acres would be needed.
>
> All other design changes being considered would occur within the SEA 571 construction ROW corridor:
>
> 1. level system design
> 2. drainage canal designs and locations
> 3. drainage structure design, size, and location
> 4. pump station design, number, and locations
> 5. additional structures

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@30.085187,-90.62166436689091,14z



QUALIFICATION INTERVIEW

1. Is the action authorized, funded, or being carried out by a Federal agency?

   Yes

2. Is the action authorized, funded, or being carried out by the:

   a. U.S Army Corps of Engineers

3. Please identify your agency or organization type:

   a. Federal agency

4. Have you determined that the project will have "no effect" on federally listed species? (If unsure select "No")

   No

5. Are you with the U.S. Army Corps of Engineers Regulatory Division?

   No

6. Are you with the U.S. Army Corps of Engineers Planning Division?

   Yes

7. Is the action part of a Civil Works project?

   Yes

8. Does the action result in the discharge of fill into wetlands that meets the *de minis* standard?

   No

9. Is the action covered by a categorical exclusion?

   No

10. Will the action require the preparation of a National Environmental Policy Act of 1969 (NEPA; 83 Stat. 852, as amended; 42 U.S.C. 4321-4347): Environmental Assessment, an Environmental Impact Statement of similar document?

    Yes

11. Was a NEPA required Environmental Assessment, Environmental Impact Statement, or similar document prepared within the last 5 years for the action?

    Yes

12. [Hidden Semantic] Does the project intersect the west indian manatee AOI?

    Automatically answered
    Yes

13. (Semantic) Is the project located within the manatee consultation zone, excluding the Mississippi River?

    Automatically answered
    Yes

14. Is the project footprint entirely on land?

    No

15. Is the water depth within the project greater than 2 feet (at mean high tide)?

    Yes

16. Will the project occur during the months of June through November?

    Yes

17. Will the following Standard Manatee Conditions for in-Water Activities be included as permit conditions?

    Yes

18. [Hidden Semantic] Does the project intersect the pink mucket mussel AOI ?

    Automatically answered
    No

19. [Semantic] Does the project intersect the Northern Long-eared bat AOI?

    Automatically answered
    No

20. (Semantic) Does the project intersect the Louisiana black bear Range?

    Automatically answered
    No

IPAC USER CONTACT INFORMATION

Agency: Army Corps of Engineers
Name: Kristin Gunning
Address: 7400 Leake Ave
City: New Orleans
State: LA
Zip: 70118
Email kristin.t.gunning@usace.army.mil
Phone: 5048621514

Annex E: Fish and Wildlife Coordination Act Report

United States Department of the Interior

FISH AND WILDLIFE SERVICE
200 Dulles Drive
Lafayette, Louisiana 70506

November 14, 2023

Colonel Cullen Jones
Commander & District Engineer
U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Colonel Jones:

The U.S. Fish and Wildlife Service (Service) has prepared a final Fish and Wildlife Coordination Act Report on the U.S. Army Corps of Engineers (USACE), New Orleans District's (MVN) Supplemental Environmental Assessment (SEA) 571A for the West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction Leave System, St. Charles and St. John the Baptist Parishes, Louisiana. This is an update to the previously signed Fish and Wildlife Coordination Act Report to correct an error in Table 5, "Overall project negative impacts by habitat," address additional impacts, and acknowledge the addition of burning as an approved method of disposal for debris resulting from clearing and grubbing operations. The rest of the report remains the same as the previously signed (22 March 2023) version.

This project was previously described in the 2016 WSLP Environmental Impact Statement (EIS) and SEAs 570 and 571 (USACE, 2016 WSLP EIS. The Record of Decision (ROD) for the 2016 WSLP EIS was signed by the Assistant Secretary of the Army on September 14, 2016. Funding for the construction of the WSLP project was appropriated via Public Law 115-123, the Bipartisan Budget Act of 2018 (BBA-18) which was signed into law February 9, 2018. The Proposed Action would include modifications to the WSLP levee system in St. John the Baptist and St. Charles Parishes, Louisiana described in the 2016 WSLP EIS, SEA 570 and SEA 571. Most changes would be within the construction Right of Way (ROW) corridor, except for 5 locations (see below for details). The Service has prepared three Fish and Wildlife Coordination Act (FWCA) Reports for the WSLP project, one for the Environmental Impact Statement in April 2014, one for the Surveys and Borings EA in May 2019, and most recently for the Construction EIS in June 2020. The Service has also prepared one comment letter on the Chief of Engineers Report in Feb 2015; five Planning-aid Reports dated January 21, 1985, June 30, 1987, April 3, 1997, May 4, 2001, and October 9, 2012, for previous reconnaissance studies; and one letter for a Notice of Intent dated January 9, 2009. These reports are herein incorporated by reference and can be found here.

This report contains an analysis of the impacts on fish and wildlife resources that would result from the implementation of the updated proposed project and provides recommendations to minimize adverse project impacts while maximizing beneficial project impacts on those resources. The Service prepared this final report under the authority of the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.). A copy of the report was provided to the National Marine Fisheries Service (NMFS) and the Louisiana Department of Wildlife and Fisheries (LDWF) for review, and their comments are included in this final report. This final report constitutes the report of the Secretary of the Interior as required by Section 2(b) of the Fish and Wildlife Coordination Act (FWCA, 48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Proposed Action would include modifications to the WSLP levee system in St. John the Baptist and St. Charles Parishes, Louisiana, described in the 2016 WSLP EIS, SEA 570 and SEA 571. Most changes (Figure 1) would be within the SEA 571 construction ROW corridor, except for the following five locations:

1. Temporary bypass roads near the I-55 pump station and drainage structures;
2. Temporary construction activities near the Prescott Canal Drainage structure;
3. Power transmission corridor for the Reserve Relief Pump Station;
4. Levee system re-alignment to accommodate a proposed runway extension for the Port of South Louisiana's Executive Regional Airport in Reserve, Louisiana; and,
5. Shell pipeline relocation at reserve relief canal.

All other design changes being considered would occur within the SEA 571 construction ROW corridor. Those design changes include:

1. Levee system design;
2. Drainage canal designs and locations;
3. Drainage structure design, size, and location 4. Pump station design, number, and locations; and
5. Additional structures.

Overall, there would be a decrease in acreage of construction area due to levee system design changes resulting from the 2021 Design Summit. These include updated Hydraulic and Hydrology models that lowered the required system heights and reduced the required pumping capacities and thus the pump station footprint. Additionally, levee re-designs included the use of wick drains and staged construction that would reduce the overall levee system construction footprint and allow for large areas within the 2022 ROW where there would not be any construction activities unless necessary for levee system improvements due to RSLR.

The dominant forested habitat types in the study area are bottomland hardwoods and swamp. Vegetation commonly found in these wetland areas includes sugarberry, red maple, sweetgum, American elm, black willow, green and pumpkin ash, and water oak, in the bottomland hardwood habitat and bald cypress, tupelo gum, lizard's tail, swamp lily, buttonbush, and duckweeds in the swamp habitat. Scattered portions of upland hardwoods, scrub/shrub uplands, and scrub/shrub wetlands also are found along and within the developed areas. Except for Lake Pontchartrain, Lake Maurepas, and the Mississippi River, which border the study area, most of the open water within the study area consists mainly of tidal streams, canals, and ditches. The shallower open water areas may support submerged and/or floating aquatic vegetation such as alligator weed, dollar weed, coontail, frog bit, naiads, water hyacinth, American lotus, Salvinia, and pondweeds.

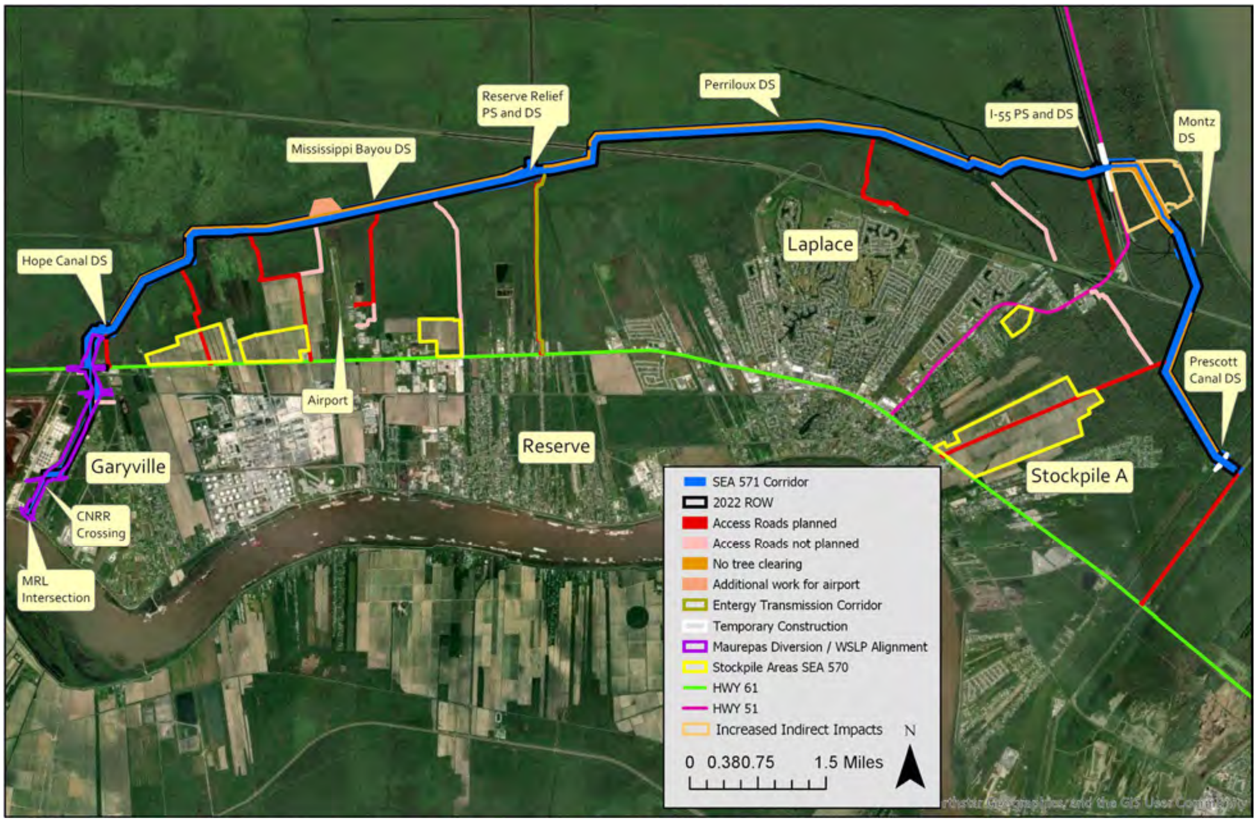


Figure 1. West Shore Lake Pontchartrain Project modifications.

In our February 24, 2023, letter, the Service concurred with the Corps' determination that the project as proposed is not likely to adversely affect any threatened or endangered species. For detailed discussion on Threatened and Endangered species, Species of Concern, Migratory Birds, and bald eagles please refer to the June 2020 FWCA Report for the WSLP Feasibility Study EIS. Should the scope or location of the project change, or if project construction has not commenced within 1 year, the Corps should reinitiate consultation with the Service.

Impacts Assessment

The Service defines impacts as effects relative to fish and wildlife resources. Impacts may be direct or indirect. Direct impacts include all project-related construction impacts. Indirect impacts are impacts from an action that occur later in time or farther removed in distance and may have landscape-scale implications. Indirect Exterior and Indirect High impacts are greater indirect impacts near the levee alignment. Indirect Low are lesser indirect impacts further away from the levee alignment.

Wetland impacts associated with the entire WSLP Project (including those described in the 2016 WSLP EIS, SEA 570, SEA 571, SEA 576, 2023 WSLP SEIS, and associated with the proposed action) were estimated by using the Wetland Value Assessment (WVA) Swamp Community Model for Civil Works Version 2.0 (Swamp WVA) and the WVA Bottomland Hardwoods Community Model for Civil Works Version 1.2 (BLH WVA). These models calculate average annual habitat units (AAHUs), which is based on habitat quality and quantity, for both the future with project (FWP) and future without project (FWOP) conditions. Both direct and indirect impacts to swamp and BLH habitats were assessed. These models are approved for regional use on USACE Civil Works projects.

The Swamp and BLH WVAs utilize an assemblage of variables considered important to the suitability of each habitat type for supporting a diversity of fish and wildlife species. The WVAs allow for a numeric comparison of each future condition and provides a quantitative estimate of project-related impacts to fish and wildlife resources.

The WVAs used to calculate impacts for the SEA 571 were re-evaluated to consider changes to the levee system associated with the Proposed Action. Assumptions for these WVAs were updated using field work and remotely sensed habitat data from the SEA 571 and updated hydrologic modeling. The currently certified version of the WVAs were utilized. Net direct impacts to wetlands were lower due to large areas within the 2022 levee system right-of-way where no vegetation impacts would occur unless necessary for future levee modifications required due to relative sea level rise increases. Indirect impacts to wetlands were found to be similar across the impact areas except for an approximately 128-acre area near I-55.

Direct Impacts

Area no longer clearing trees

These areas are within the 2022 levee system right of way, but construction of the levee system to the height for a 1% chance of exceedance storm surge in year 2070 would not require impacting the entire right-of-way. A total of approximately 235.2 acres of swamp and 25.0 acres of BLH would not be cleared based on polygons provided by USACE MVN Engineering and the Suir and Saltus remote sensing data (Table 1 and Figure 2). The total reduction in AAHUs associated with this was estimated by calculating the number of acres by habitat and impact area (from the SEA 571) and then multiplying it by the corresponding AAHU/acre from each impact area and habitat type calculated for the SEA 571 WVA analysis.

Table 1. Reduction in impacts from not clearing trees in the overall project (top table) and on Louisiana Department of Wildlife and Fisheries property (lower table).

SEA 571 Changes in impacts from No Tree Clearing Areas - Overall				
Habitat Area	Habitat Type	Acres	AAHU/ac	Total AAHUs
East	Swamp	160.70	0.49	78.25
West	Swamp	0.08	0.43	0.03
Central	Swamp	74.46	0.60	44.76
East	BLH	24.66	0.71	17.59
West	BLH	0.00	0.66	0.00
Central	BLH	0.35	0.81	0.29

SEA 571 Changes in impacts from No Tree Clearing Areas - LDWF property				
Habitat Area	Habitat Type	Acres	AAHU/ac	Total AAHUs
East	Swamp	56.59	0.49	27.56
West	Swamp	0.08	0.43	0.03
Central	Swamp	5.17	0.60	3.11
East	BLH	16.74	0.71	11.94
West	BLH	0.00	0.66	0.00
Central	BLH	0.08	0.81	0.06

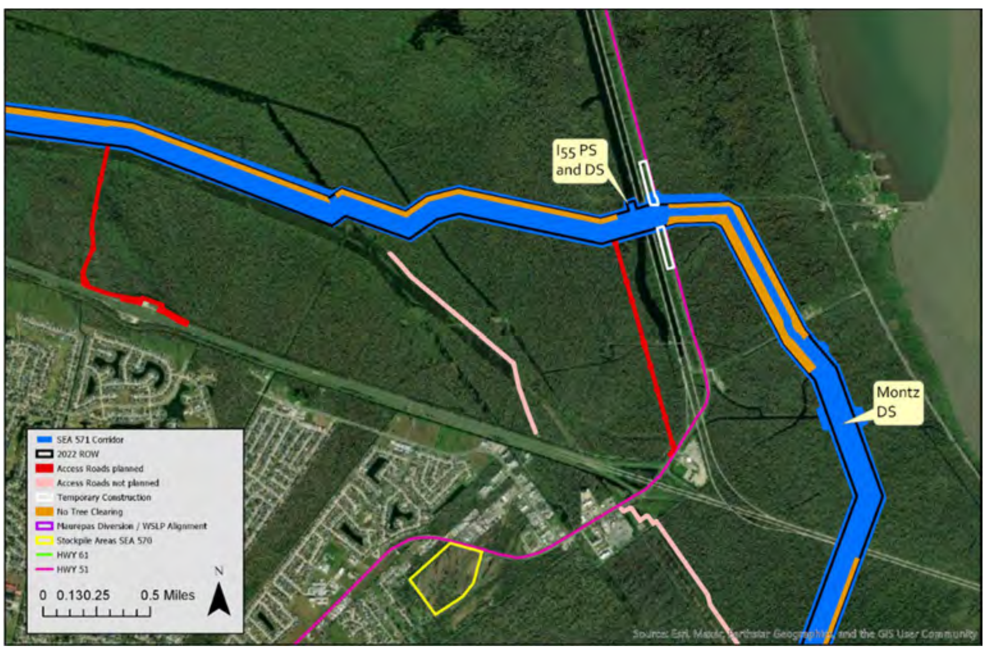


Figure 2. West Shore Lake Pontchartrain Project modifications showing no tree clearing areas (orange) within the existing Right of Way (ROW – blue within black outline).

Temporary bypass roads near the I-55 pump station and drainage structures

An additional ~1.2 acres of swamp and ~4.1 acres of BLH would be impacted outside of the SEA 571 corridor to construct a temporary bypass road near the I-55 pump station and drainage structure (Figure 3). All these impacts would be on LDWF property and within the eastern habitat area. These impacts would be considered permanent, because it is not likely the area would be able to return to existing conditions due to the degraded nature of the site and low regeneration rates. There would be a total of -0.6 and -2.9 AAHUs of impacts to swamp and BLH habitats, respectively.

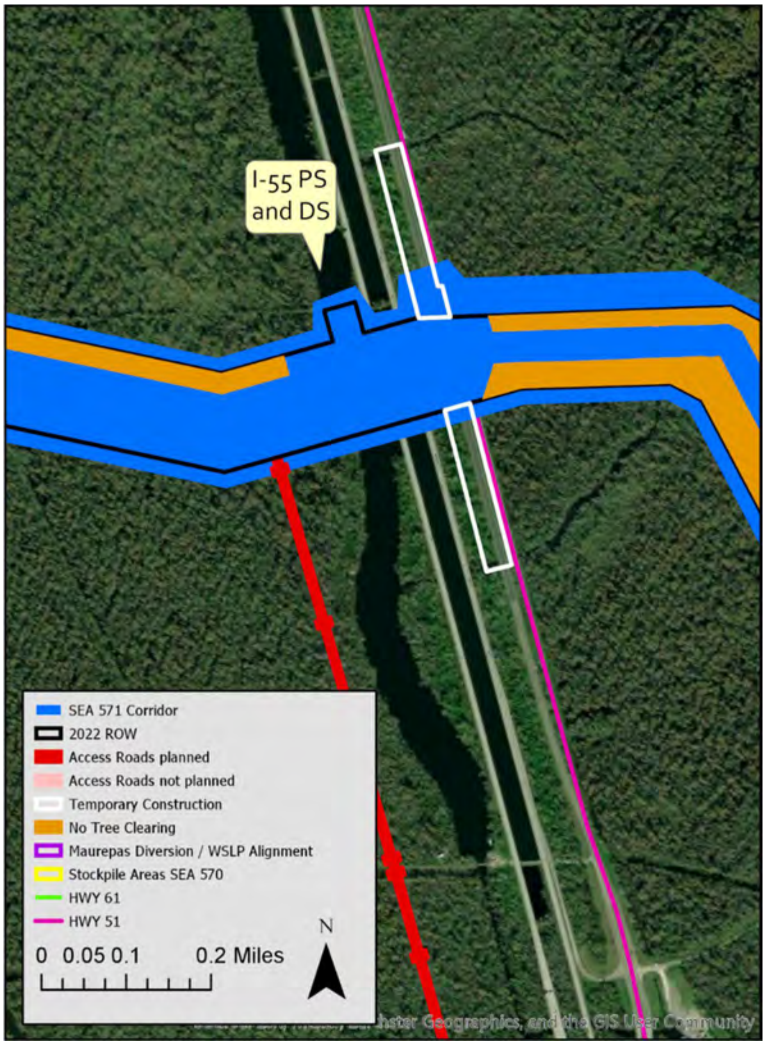


Figure 3. West Shore Lake Pontchartrain Project modifications showing temporary bypass roads (white outline) near the I-55 pump station and drainage structures.

Temporary construction activities near the Prescott Canal Drainage structure

An additional ~0.16 acres of swamp and ~0.87 acres of BLH would be impacted outside of the SEA 571 corridor for temporary construction activities near the Prescott Canal drainage structure (Figure 4). None of these impacts would be on LDWF property. All impacts would be within the eastern habitat area. These impacts would be considered permanent, because it is not likely the area would be able to return to existing conditions due to the degraded nature of the site and low regeneration rates. There would be a total of -0.08 and -0.62 AAHUs of impacts to swamp and BLH habitats, respectively.

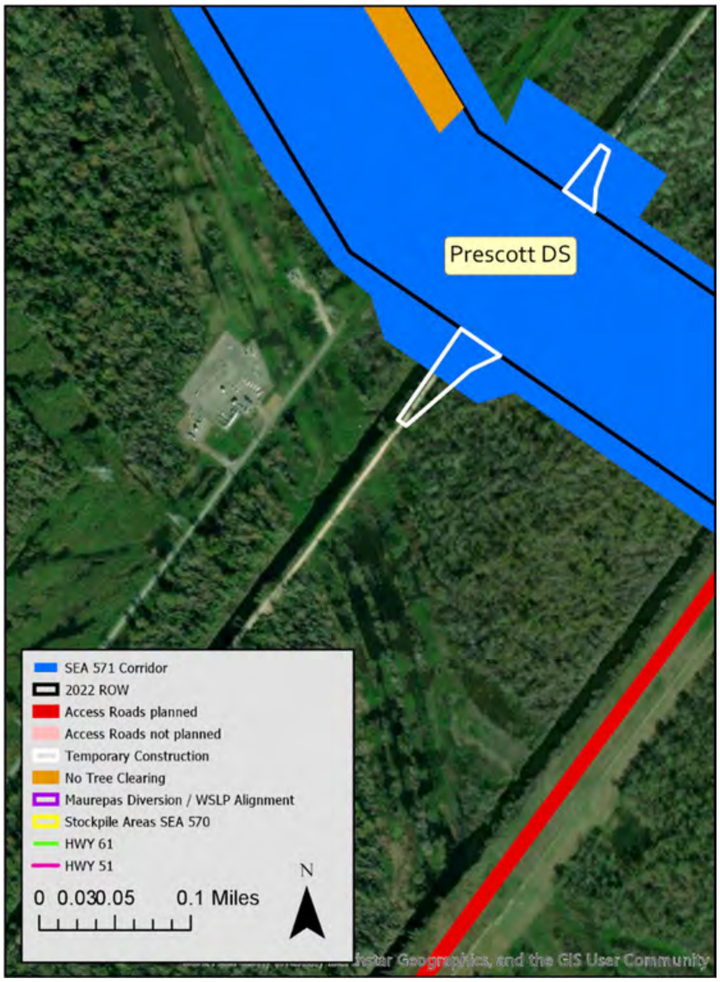


Figure 4. West Shore Lake Pontchartrain Project modifications showing temporary construction activities (white outline) near the Prescott Canal Drainage structure.

Power transmission corridor for the Reserve Relief pump station

An additional ~2.4 acres of swamp and ~1.76 acres of BLH would be impacted outside of the SEA 571 corridor to construct a power transmission corridor along the Reserve Relief canal access road (Table 2 and Figure 5). None of these impacts would be on LDWF property. Impacts would be within the eastern and central habitat areas. There would be a total of -1.25 and -1.32 AAHUs of impacts to swamp and BLH habitats, respectively.

Table 2. Additional impacts from the power transmission corridor.

SEA 571A Power Transmission Corridor for the Reserve Relief pump station				
Habitat Area	Habitat Type	Acres	AAHU/ac	Total AAHUs
East	Swamp	1.44	0.49	0.70
Central	Swamp	0.92	0.60	0.55
East	BLH	1.12	0.71	0.80
Central	BLH	0.64	0.8125	0.52

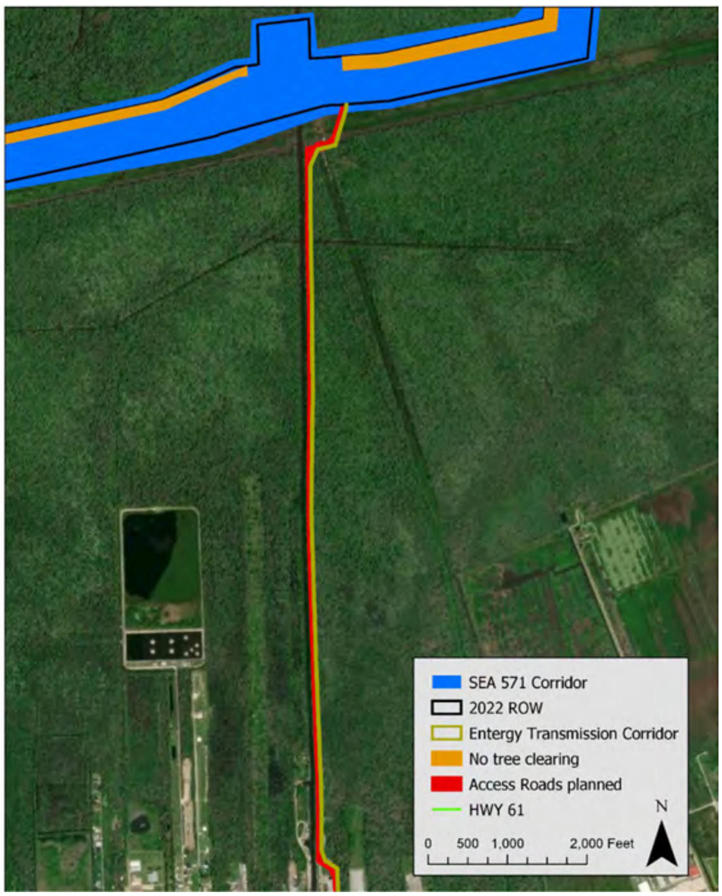


Figure 5. West Shore Lake Pontchartrain Project modifications showing Power transmission corridor (brown) and levee re-alignment to accommodate a proposed airport runway (square bump out in blue).

Levee system re-alignment to accommodate a proposed runway extension for the Port of South Louisiana's Executive Regional Airport in Reserve, Louisiana (Figure 5)

An additional ~29.07 acres of swamp and < ~0.01-acre of BLH would be impacted outside of the SEA 571 corridor to accommodate a proposed runway extension for the Port of South Louisiana's Executive Regional Airport in Reserve, Louisiana (Figure 5). None of these impacts would be on

LDWF property. Impacts would be within the central habitat areas. There would be a total of 17.47 and -0.005 AAHUs of impacts to swamp and BLH habitats, respectively.

Shell pipeline relocation at reserve relief canal

An additional 0.014-acre of BLH and 0.431-acre of swamp would be impacted outside of the SEA 571 corridor to accommodate the Shell pipeline relocation at reserve relief canal (Figure 6 and Table 3). None of these impacts would be on LDWF property. Impacts would be within the central habitat areas. There would be a total of -0.001 and – 0.211 AAHUs of impacts to BLH and swamp habitats, respectively.

Table 3. Impacts outside of the SEA 571 corridor resulting from the Shell pipeline relocation at reserve relief canal.

Habitat Type	Acres	AAHUs
BLH	0.014	0.001
Swamp	0.431	0.211
TOTAL	**0.445**	**0.212**

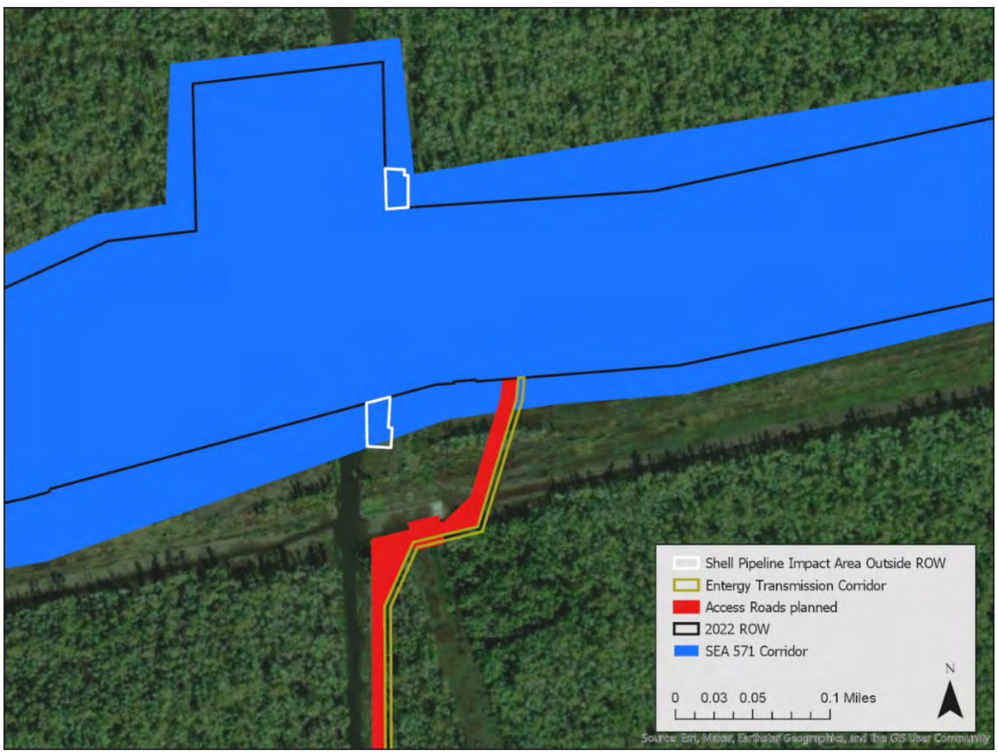


Figure 6. Map depicting the Shell Pipeline areas of impact outside the previously NEPA-clear right-of-way for the West Shore Lake Pontchartrain project.

Indirect Impacts

Additional hydraulic and hydrologic (H&H) model simulations (Figure 7) were run to assess the additional indirect impacts associated with changes in the levee system such as removal of the exterior drainage canal, design changes to the interior drainage canal, and design changes to drainage structures. Indirect impacts to wetlands were found to be similar to those described in SEA 571, except for an approximately 245 acres near I-55 (Figure 8) where the H&H model report suggested there would be additional hydrologic impacts beyond what was assessed in SEA 571. These 245 acres were previously accounted for in the SEA571 and would be spread across the Indirect impacts previously labeled interior low, indirect impacts interior high, and exterior impacts area (Table 4). In addition, approximately 30 acres of this area would be new indirect impact acres on the exterior of the levee system (Table 5). Approximately 89 acres would be on LDWF property (Table 5). The AAHU/ac for each habitat type and area combination was used to calculate the number of AAHUs to be removed from the SEA 571 WVAs (Table 4).

Table 4. Previously accounted for impacts (SEA 571) within the area of increased indirect impacts (Figure 7) that would be removed and reevaluated.

Increased Indirect Impacts within SEA 571 assessed areas Acres and AAHUs removed from WVAs			
SEA 571 impact area	Habitat	Acres	SEA 571 AAHUs
Indirect Inside Low East	BLH	8.57	0.18
Indirect Inside High East	BLH	17.71	1.12
Exterior east	BLH	6.89	0.36
LDWF - Indirect Inside Low East	BLH	8.57	0.18
LDWF - Indirect Inside High East	BLH	15.17	0.96
Indirect Inside Low East	Swamp	13.64	0.10
Indirect Inside High East	Swamp	87.94	7.10
Exterior east	Swamp	79.93	3.93
LDWF - Indirect Inside Low East	Swamp	13.64	0.10
LDWF - Indirect Inside High East	Swamp	51.98	4.20

Increased water levels as compared to the SEA 571 condition were assumed to reduce growth rates, basal area, and stand structure for swamp habitats within the 245-acre increased indirect impacts areas. For BLH habitats, it was expected to reduce average diameter at breast height (dbh). From TY10 – TY50 basal area and average dbh from the SEA 571 WVAs were reduced by 15% for each TY for both BLH and swamp to account for this. In addition to this, stand structure was reduced for the increased area. Table 5 is a summary of the results by area and habitat type for the increased indirect impacts area.

Table 5. Summary of additional negative Indirect impact areas.

Increased Indirect Impact Areas Additional negative impacts			
Impact area	Habitat	Acres	AAHUs
Indirect Inside East Increased Indirect Impacts	BLH	26.29	-3.11
Indirect Outside East Increased Indirect Impacts	BLH	18.01	-4.42
LDWF - Insider East Increased Indirect Impacts	BLH	23.74	-2.81
Indirect Inside East Increased Indirect Impacts	Swamp	101.58	-8.77
Indirect Outside East Increased Indirect Impacts	Swamp	99.14	-4.91
LDWF - Insider East Increased Indirect Impacts	Swamp	65.62	-5.67

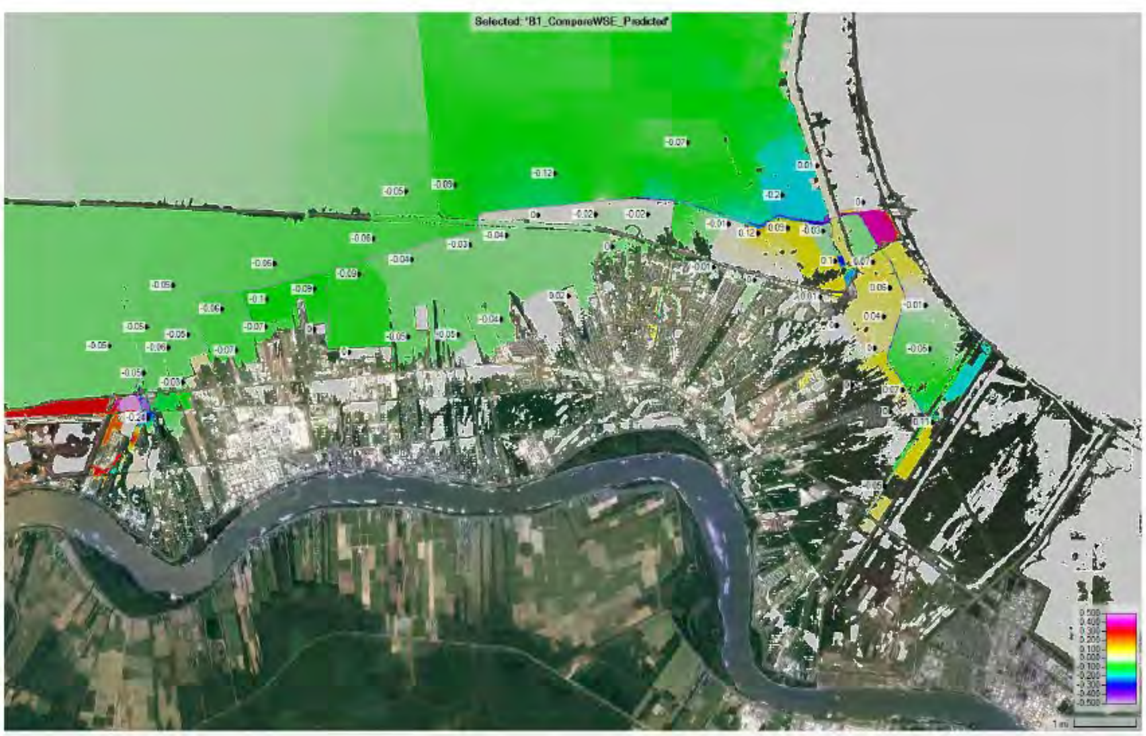


Figure 7. West Shore Lake Pontchartrain results of the additional hydraulic and hydrologic model run to assess for additional indirect impacts associated with changes in the levee system. Figure taken from USACE hydraulic and hydrologic (H&H) model simulations.

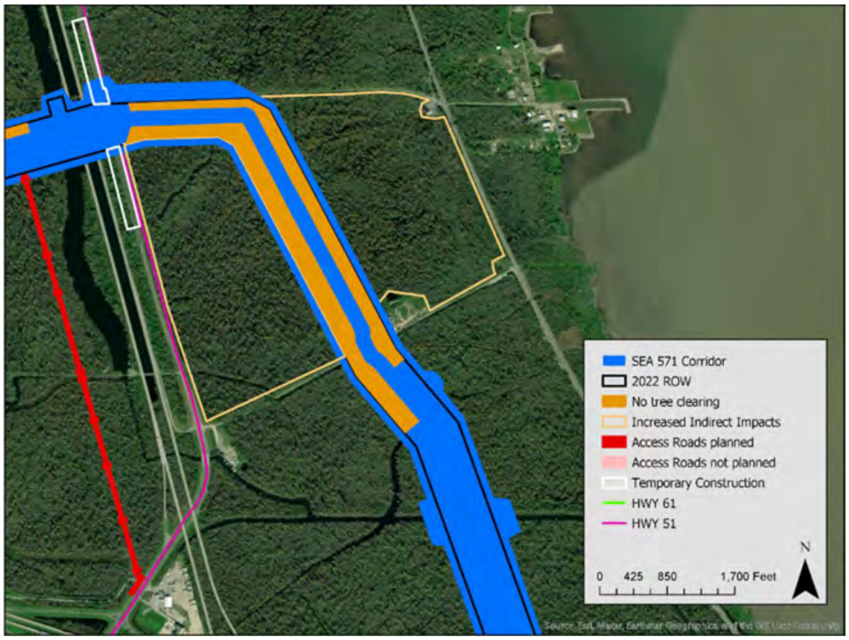


Figure 8. West Shore Lake Pontchartrain area of increased indirect impacts (orange outline) based on additional hydraulic and hydrologic model.

Overall Project Summary

The overall Project impacts for all St. Charles and St. John the Baptist levee system features, and their mitigation features are shown in Table 6. Many of these impacts were accounted for in previous FWCA Reports and NEPA documents. Table 7 shows the potential mitigation projects by habitat. Tables 6 and 7 were developed to show the accumulation of all the impacts and mitigation potential for WSLP in one place, including the current new impacts.

Table 6. Overall project negative impacts by habitat.

	Acres*	AAHUs*
SEA 571 Cumulative Swamp Direct**	1,138	-595
SEA 571 Cumulative Swamp Indirect**	9,754	-352
SEA 571 Cumulative BLH Direct**	242	-169
SEA 571 Cumulative BLH Indirect**	4,635	-124
SEA 571A Additional Swamp Direct***	-201	104
SEA 571A Increased Swamp Indirect Impacts	201	-3
SEA 571A Additional BLH Direct***	-18	13
SEA 571A Increased BLH Indirect Impacts	44	-6
Maurepas Diversion Swamp Direct Negative	95	-52
Maurepas Diversion Swamp Indirect Negative	7,539	-154
Maurepas Diversion BLH Direct Negative	79	-29
Maurepas Diversion BLH Indirect Negative	1,830	-7
Maurepas Diversion Fresh Marsh Direct Negative	0	0
Maurepas Diversion Fresh Marsh Indirect Negative	2,743	-20
Total Swamp Direct	1,032	-544
Total Swamp Indirect	17,494	-509
Total Swamp	**18,526**	**-1,052**
Total BLH Direct	303	-185
Total BLH Indirect	6,509	-137
Total BLH	**6,812**	**-322**
Total Marsh Direct	0	0
Total Marsh Indirect	2,743	-20
Total Marsh	**2,743**	**-20**

*SEA 571 cumulative impacts represent the updated levee system described in SEA 571, which includes impacts assessed in the 2016 WSLP EIS and SEA 571

** SEA 571A additional direct impacts represents the net acres and net AAHUs. The WSLP levee system as described in SEA 571A would have a net reduction in wetland acres impacted and a net increase in wetland AAHUs.

*SEA 571 cumulative impacts represent the updated levee system described in SEA 571, which includes impacts assessed in the 2016 WSLP EIS and SEA 571

** SEA 571A additional direct impacts represents the net acres and net AAHUs. The levee system in SEA 571A would be a net reduction in wetland acres and AAHUs.

Table 7. West Shore Lake Pontchartrain mitigation by habitat.

WSLP Project mitigation by habitat		
Type	**Acres**	**AAHUs**
Maurepas Diversion MSA2 - Swamp	8,814	1,239
SEA 576 - BLH St. James[*,**]	Up to ~73	Up to ~36
SEA 576 - BLH Mitigation Banks[*,**]	TBD	TBD
Maurepas Diversion - Marsh (Guste Island)[*]	~75	20
Marsh Mitigation Banks[*]	TBD	TBD

*BLH and Marsh impacts would be mitigated through one or a combination of the Projects listed in the table above.
**EA #576 discussed approximately 1,504 AAHUs of swamp and 343 AAHUs of BLH impacts due to WSLP.

The Service does not oppose the changes to construction of the WSLP Project provided the previously documented (June 2020 FWCA Report) fish and wildlife conservation recommendations are included and adequately addressed in the design report and related authorizing documents. The Service has no additional recommendations or changes from the previous June 2020 FWCA Report recommendations apart from updating the total impacted acres and AAHUs found in recommendation #2 to that listed in Table 6 above. Recommendations from our 2020 FWCA Report are copied below for your convenience.

1) Any impacts occurring on LDWF owned and managed property should only be mitigated on LDWF owned and managed property. In this case, impacts occurring on Maurepas Swamp WMA should be mitigated on the WMA. As required by the conveyance documents, tracts of land located on the WMA are restricted in use and should be preserved in their natural state. Any action which damages or diminishes the property’s natural state should be subject to enhancement, restoration, or replacement in kind and contiguous with the WMA. Adequate and appropriate mitigation should be planned with and approved by LDWF.

2) Full, in-kind compensation (quantified as Average Annual Habitat Units) is recommended for 1,338 acres (-729 AAHUs) of unavoidable direct (levee and access road footprints) construction adverse impacts and 26,835 acres (-652 AAHUs) of indirect (enclosed and exterior wetlands) habitat value losses on forested wetlands associated with levee construction. To help ensure that the proposed mitigation features meet their goals, the Service provides the following recommendations.

    a) If applicable, a General Plan should be developed by USACE, LDWF, and the Service in accordance with Section 3(b) of the Fish and Wildlife Coordination Act for mitigation lands.
    b) The proposed BBA-18 Mitigation proposal, Joyce WMA Swamp Enhancement project is located on LDWF’s Joyce WMA. This proposed mitigation project has been planned without prior consultation with appropriate LDWF staff. LDWF, the Service and other interested resource agencies need to be consulted in order for staff to determine whether or not the project is acceptable.

c) Mitigation measures should be constructed concurrently with the flood damage reduction features that they are mitigating (i.e., mitigation construction should be initiated no later than 18 months after levee construction has begun).

d) If mitigation is not implemented concurrent with levee construction, the amount of mitigation needed should be reassessed and adjusted to offset temporal losses.

e) USACE should remain responsible for the required mitigation until the mitigation is demonstrated to be fully compliant with interim success and performance criteria. At a minimum, this should include compliance with the requisite vegetation, elevation, acreage, and dike gapping criteria.

f) The acreage restored and/or managed for mitigation purposes, and adjacent affected wetlands, should be monitored over the project life. This monitoring should be used to evaluate mitigation project impacts, the effectiveness of the compensatory mitigation measures, and the need for additional mitigation should those measures prove insufficient.

3) The levee alignment could potentially have impacts to the Maurepas Swamp Diversion project (Maurepas Diversion). The WSLP project impacts may potentially be mitigated for by the Maurepas Diversion project. The Service recommends close coordination with the planning objectives and planning team of the restoration project and that any potential impacts to the Maurepas Diversion project be addressed. In addition, the Service recommends close coordination with the Service and LDWF if the use of the Maurepas Diversion for mitigation for the WSLP project impacts is undertaken.

4) If USACE declares the enclosed wetlands will be used as a flood storage area, the Service recommends that USACE and the nonfederal sponsor be responsible for preservation and maintaining the enclosed wetlands as the flood storage area within the levee system.

5) Due to concerns that the construction of the levee may alter natural periods of inundation or soil saturation in the impounded and exterior wetlands and could prove detrimental to their function and longevity (e.g., reduced existing water exchange in regard to water depth, delays in water movement, water stacking, and impacts to water quality), the Service recommended additional investigations prior to authorization. USACE responded that the determination of number and locations of hydrologic gauges will be developed during PED phase and is part of the overall Operations and Maintenance (O&M) cost. To date this has not been completed during the PED phase. Therefore, the Service again makes the following recommendations:

a) USACE undertake, as necessary, hydrologic adaptions, such as gapping existing ridges, dikes or any barrier, both in the interior and exterior swamp to allow for adequate water exchange.

b) USACE undertake, as necessary, the installation of additional culverts and/or water control structures in the levee to ensure adequate water exchange while maintaining that all structures should be closed only in advance of tropical storms.

c) That USACE ensures that all structures should be closed only in advance of named tropical storms.

d) That hydrologic gauges be placed and maintained in appropriate locations to assist in determining future impacts to enclosed and exterior forested wetlands. These gauges could be supported or cost-shared through existing activities such as through the US Geological Survey (USGS) or CRMS.

e) Additionally, the Service recommends a biomass study be conducted to help determine impacts to the forested wetlands.

If USACE has decided to not undertake the above recommendations (recommendation #5) the Service would like to meet and discuss a future course of action to ensure adequate mitigation for those impacts. That meeting should occur prior to the approval of the proposed changes.

6) The WSLP levee crosses four separate tracts of Maurepas Swamp WMA (i.e., Mellon, MC Davis, Rogers 1, and Rogers 2). Each individual Act of Sale or Act of Donation requires property alienated by WSLP levee construction to be exchanged for other property of equal or greater wetland ecological function and value.

7) Operational plans for floodgates and water control structures should be developed to maximize the open cross-sectional area for as long as possible. Water control structure operation manuals or plans should be developed in coordination with the Service and other natural resource agencies.

8) To aid in water quality improvements, any pumping stations associated with the project should not discharge directly into canals or other open water bodies, but rather into wetland systems that can assimilate nutrients being discharged.

9) The trigger for structure closures would be tropical storm events. Therefore, the project would not close the system more often due to higher day-to-day sea level rise impacts. If the sponsor/operator sees a higher level of sea level rise and starts to see increased soil saturation/flooding in developed areas, they may want to change the operations to close the structures at high tides. A change in operations would be considered a separate project purpose and authorization and would require a new NEPA documentation and/or approval for this operational change. It is unknown at present how water levels within the system would be managed if a change in operation due to RSLR is realized. Hence, there is a potential for substantial additional indirect impacts to swamp and fish and wildlife resources to occur. If the system is closed more often due to higher RSLR impacts, the Service recommends additional impacts be evaluated and mitigated.

10) If it becomes necessary to use borrow sources other than the previously proposed environmentally cleared sites, the Service recommends USACE begin investigating potential borrow sources in coordination with the Service. Borrow sites to be considered should have minimal impacts to fish and wildlife resources. The Service provided a list of such sites via a September 9, 2008, letter and identified a priority selection process for borrow sites in our August 7, 2006, letter to USACE regarding the Greater New Orleans Hurricane and Storm Damage Risk Reduction project (Appendix A). That prioritization process should be utilized if additional borrow sites are needed (please contact Cathy Breaux (337)291-3122 for more information).

11) The Service recommends that enough money be set aside for adaptive management to address potential impacts of the enclosed and exterior wetlands. The Service, LDWF, and other natural resource agencies should be coordinated with in the development of plans and specifications

for all mitigation features and any monitoring and/or adaptive management plans. In addition, the Service recommends the Monitoring and Adaptive Management Plan, as it is further developed, be provided to the Service and LDWF for review, comment, and input.

12) To avoid adverse impacts to bald eagles and their nesting activities the Service and LDWF recommend that a qualified biologist continue to inspect the construction site for the presence of new or undocumented bald eagle nest within 1,500 feet of the levee construction area.

13) To avoid adverse impacts to nesting wading bird colonies the Service and LDWF recommend that a qualified biologist continue to inspect the construction site for the presence of undocumented nesting colonies during the nesting season (i.e., September 1 through February 15 for wading bird nesting colonies and October through mid-May for bald eagles.

14) West Indian manatees occasionally enter Lakes Pontchartrain and Maurepas and associated coastal waters and streams during the summer months (i.e., June through September). During in-water work in areas that potentially support manatees all personnel associated with the project should be instructed about the potential presence of manatees, manatee speed zones, and the need to avoid collisions with and injury to manatees. All personnel should be advised that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act of 1972 and the Endangered Species Act of 1973. Additionally, personnel should be instructed not to attempt to feed or otherwise interact with the animal, although passively taking pictures or video would be acceptable. For more detail on avoiding contact with manatee contact this office. Should a proposed action directly or indirectly affect the West Indian manatee, further consultation with this office will be necessary.

15) Construction of the WSLP levee will occur partly within the boundaries of Maurepas Swamp Wildlife Management Area. Please continue to coordinate all activities within the WMA with LDWF. Please contact Mike Perot (225) 765-3978 or mperot@wlf.la.gov for more information about appropriate WMA authorizations.

16) The Service recommends that the USACE contact the Service for additional consultation if: 1) the scope or location of the proposed project is changed significantly, 2) new information reveals that the action may affect listed species or designated critical habitat; 3) the action is modified in a manner that causes effects to listed species or designated critical habitat; or 4) a new species is listed or critical habitat designated. Additional consultation as a result of any of the above conditions or for changes not covered in this consultation should occur before changes are made and or finalized.

We appreciate the exceptional cooperation of your staff on this study, and we look forward to our continued coordination with you to further protect fish and wildlife resources. If you need additional assistance or have questions regarding this letter, please contact Cathy Breaux (337/291-3122) of this office.

Sincerely,

Brigette D. Firmin

Brigette D. Firmin
Field Supervisor
Louisiana Ecological Services Office

cc: NMFS, Baton Rouge, LA
LA Dept. of Wildlife and Fisheries, Baton Rouge, LA

Annex F: National Marine Fisheries Service Essential Fish Habitat letter

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

October 1, 2013 F/SER46/LA:jk
225/389-0508

Ms. Joan Exnicios, Chief
Environmental Planning and Compliance Branch
New Orleans District, U.S. Army Corps of Engineers
Post Office Box 60267
New Orleans, Louisiana 70160-0267

Dear Ms. Exnicios:

NOAA's National Marine Fisheries Service (NMFS) has received your letter dated August 23, 2013, transmitting the Integrated Draft Feasibility Report and Environmental Impact Statement (EIS) titled "**West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Study**." The U.S. Army Corps of Engineers (USACE) is evaluating alternatives to provide hurricane and tropical storm surge protection to residents in St. Charles, St. John the Baptist, and St. James Parishes, Louisiana.

The Corps has identified Alternative C as the Tentatively Selected Plan (TSP). Alternative C consists of approximately 18 miles of levees spanning from the West Guide Levee of the Bonnet Carré Spillway, along Interstate Highway 10, and terminating at the Mississippi River levee near Garyville, Louisiana. The TSP would directly impact approximately 775 acres and enclose 8,424 acres of forested wetlands and swamp habitats.

NMFS believes there are environmental concerns and requests additional information be included in the Final EIS. The following comments identify areas where additional information is necessary to demonstrate compliance with applicable laws and regulations pertaining to mitigation and the National Environmental Policy Act (NEPA).

General Comments

NMFS does not object to hurricane protection to reduce risk to life or property, or to the proposed levee alignment. However, we find the draft EIS lacks information necessary to demonstrate adverse wetland impacts would be fully offset through the implementation of an adequate mitigation plan. Specifically, adverse wetland impacts are not quantified by the Wetland Value Assessment methodology determined acceptable under USACE guidelines for Louisiana habitats. In addition, the mitigation plan included in Appendix A, Annex K, proposes conceptual mitigation ideas only which also have not been assessed or quantified to determine benefits. Lacking an assessment of impacts and benefits, it is unclear how the USACE can determine wetland impacts would be fully offset in compliance with the Clean Water Act. Lacking an adequate assessment of mitigation benefits, or a discussion which clearly identifies the potential for long term wetland impacts if mitigation is inadequate, it is unclear how the draft

EIS fully complies with NEPA requirements. Finally, the proposed mitigation plan does not have sufficient information to demonstrate compliance with the 12 "items" required by mitigation regulations. This information is necessary for project planning purposes, including alternatives analysis, and equally important for public disclosure of the type and location of the mitigation.

NMFS is concerned the source of more than 3 million cubic yards of borrow material for levee construction is not identified, and associated impacts discussed, in the draft EIS. Unless there is a commitment to not obtain borrow from wetlands or other sensitive habitats, NMFS believes failure to discuss or disclose what could be a significant environmental impact is a violation of NEPA. We encourage the USACE to use non-wetland borrow locations to the maximum extent practicable. If the USACE determines wetland impacts associated with borrow sources are unavoidable, a discussion and quantification of such wetland impacts (and mitigation costs) should be included in a supplemental draft EIS for this project.

While direct wetland impacts have been quantified for the TSP in terms of acreage, NMFS does not agree sufficient information has been provided to demonstrate indirect impacts to more than 8,000 acres of enclosed wetlands would not occur. The draft Adaptive Management and Monitoring Plan has not been finalized, but at present, only includes monitoring of mitigation plan success and corrective actions to be taken if such actions do not result in anticipated benefits. The draft Adaptive Management and Monitoring Plan does not include efforts to evaluate whether project implementation results in adverse impacts to enclosed wetlands. The final EIS should include an Adaptive Management and Monitoring Plan, developed in coordination with the natural resource agencies, which evaluates the impact of levee construction and water control structure operations on enclosed wetlands. NMFS recommends sufficient funds be included in the overall cost projection to sufficiently address adaptive management and monitoring needs for the enclosed wetlands and the mitigation areas.

According to the draft EIS, under both intermediate and high sea level rise scenarios, in 50 years all structures providing drainage between enclosed wetlands and exterior waters would be closed the vast majority of the time. However, no discussion is provided to identify how water levels in enclosed wetlands would be managed. The final EIS should identify and discuss this issue.

Specific Comments

Chapter 2
Section 2.4.5 Essential Fish Habitat

Page 2-24. NMFS agrees project implementation would not adversely impact essential fish habitat (EFH). As such, an EFH assessment is unnecessary. NMFS recommends this section be deleted from the final EIS. Likewise, NMFS recommends Section 4.3.5 also be removed from the final EIS.

Chapter 4
Section 4.3.2 Vegetation Resources

Page 4-12. Wording in the second paragraph indicates Alternative C would directly impact 719 acres of wetlands, while Table 4-2 indicates 775 acres of wetlands would be impacted. The correct numbers should be provided in the final EIS.

We appreciate the opportunity to review and comment on the Integrated Draft Feasibility Report and EIS. If you have questions regarding comments provided above, please direct your questions to Lisa Abernathy at lisa.abernathy@noaa.gov or by phone at (225) 389-0508, extension 209.

Sincerely,

Virginia M. Fay

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

c:
FWS, Lafayette, Walther
EPA, Dallas, Keeler, Ettinger
LA DNR, Consistency, Haydel
F/SER46, Swafford
F/SER4, Rolfes
Files

Annex G: Programmatic Agreement among The United States Army Corps of Engineers, Louisiana State Historic Preservation Officer, and The Advisory Council on Historic Preservation regarding the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction System

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, NEW ORLEANS DISTRICT
7400 LEAKE AVE
NEW ORLEANS LA 70118-3651

No known historic properties will be affected by this undertaking. Therefore, our office has no objection to the implementation of this project. This effect determination could change should new information come to our attention.

Kristin P. Sanders
State Historic Preservation Officer
Date 6/5/2023

Regional Planning and
Environment Division, South
Environmental Planning Branch
Attn: CEMVN-PDS-N

Kristin Sanders, SHPO
LA State Historic Preservation Officer
P.O. Box 44247
Baton Rouge, LA 70804-4241

RE: Continued Section 106 Review Consultation
Undertaking: West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction System (HSDRRS), SEA 571A, St. John the Baptist and St. Charles Parishes, Louisiana.

Determination: No Historic Properties Affected

Dear Ms. Sanders:

The U.S. Army Corps of Engineers, New Orleans District (CEMVN) is proposing additional work to the previously consulted on Supplemental Environmental Assessments (SEA) 570 and 571 which evaluated potential impacts of related activities necessary to investigate potential changes to the structural alignment to the proposed levee footprint in St. John the Baptist and St. Charles Parishes, Louisiana (LA), as described in the West Shore Lake Pontchartrain Environmental Impact Statement (2016 WSLP EIS; http://www.mvn.usace.army.mil/About/Projects/West-Shore-Lake-Pontchartrain/).

The Record of Decision (ROD) for the 2016 WSLP EIS was signed by the Assistant Secretary of the Army on September 14, 2016. A Programmatic Agreement (PA) entitled *Programmatic Agreement among The United States Army Corps of Engineers, Louisiana State Historic Preservation Officer, and The Advisory Council on Historic Preservation regarding the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction System* was executed on May 16, 2014 among the Louisiana State Historic Preservation Officer (SHPO), the Advisory Council of Historic Preservation (ACHP) and the CEMVN pursuant to Section 106 of the National Historic Preservation act and its implementing regulation found at 36 CFR 800.14(b). As part of CEMVN's evaluation and in partial fulfillment of responsibilities under the National Environmental Policy Act, Section 106 of the National Historic Preservation Act, and the stipulations of the PA, CEMVN offers you the opportunity to review and comment on the potential of the proposed action described in this letter to affect historic properties. Additionally, in accordance with the of responsibilities of Executive Order 13175, CEMVN offers Federally-recognized Tribes the opportunity to review and comment on the potential of the proposed undertaking described in this letter to significantly affect protected tribal resources, tribal rights, or tribal lands.

Description of the Undertaking

The purpose of the proposed action is to construct a Hurricane Storm Damage Risk Reduction System (HSDRRS) for parts of St. John the Baptist and St. Charles Parishes, Louisiana on the eastern bank of the Mississippi River. Adjustments were considered based on the results of a design summit that was held in 2021 to examine all aspects of the project to reduce the cost while still providing the authorized 1% exceedance risk reduction. New field data were incorporated into updated, more precise Hydraulic and Hydrologic models and results of hydraulic re-designs lowered the required system heights and reduced the required pumping capacities. Additionally, levee re-designs included use of wick drains and staged construction to reduce levee embankment. In sum, the entire system was optimized to reduce costs while maintaining the same level of risk reduction. The design summit was the kickoff for design changes that are being considered in the SEA 571A. The majority of changes would be within the SEA 571 construction ROW corridor, except for 4 locations:

1. Temporary bypass roads near the I-55 pump station and drainage structures
2. Temporary construction activities near the Prescott Canal Drainage structure
3. Power transmission corridor for the Reserve Relief Pump Station
4. Levee system re-alignment to accommodate a proposed runway extension for the Port of South Louisiana's Executive Regional Airport in Reserve, Louisiana

Design changes within the SEA 571 construction ROW include:

1. Levee system design, drainage canal designs and locations
2. Drainage structure design, size and locations
3. Pumpstation design, number and locations
4. Additional structures.

The location of the proposed action is in St. John the Baptist and St. Charles Parishes, near the communities of Montz in St. Charles Parish, and Laplace, Reserve, and Grayville in St. John the Baptist Parish, Louisiana (Figure 1).

Area of Potential Effects (APE)

<u>I-55</u>

A vehicular floodgate at the surface of La State Highway 51 just east of the elevated I-55 bridges would be constructed. This vehicular gate would require closure of the existing highway, necessitating a bypass road around the gate construction. The proposed bypass road would require temporary construction and disturbance of approximately 6.5 acres outside the SEA 571 ROW construction corridor (Figure2).

Prescott Canal Drainage Structure

Approximately 0.25 acres outside of the construction ROW construction corridor described in SEA 571 would be used for temporary access roads and staging during construction near the Prescott Canal drainage structure (Figure 3).

Reserve Relief Pump Station

Power to the Reserve Relief Canal Pump Station will be provided via a new transmission corridor that will run along an access road from US 6 and will be approximately 9.5 acres (Figure 4).

Executive Regional Airport Expansion

The Executive Regional Airport serves private aviation at the Port of South Louisiana, any international industrial facilities, companies, and the growing communities along the Mississippi River. A runway extension is critical to the future growth of aviation and transportation along the New Orleans-Baton Rouge corridor. The alignment of the WSLP-108 as designed will not accommodate the Port's proposed 1500 ft runway extension. A shift in the alignment design would be necessary due to FAA requirements for clear safety zones and the required landing glide slope. The currently proposed action will increase the levee footprint by approximately 1,000 ft to satisfy the runway extension needs. As proposed, the extension of the WSLP-108 would occur directly north of the existing airport. The proposed Airport Expansion APE is approximately 14 acres in total, with approximately 6 acres located outside the SEA 571 corridor (Figures 5 and 6).

Design changes within the SEA 571 construction corridor will not alter the previously consulted APE. The total additional APE for this undertaking is approximately 22.25 acres.

Identification and Evaluation

Background and literature review was conducted by CEMVN staff in April 2023. Historic properties in the project vicinity were identified based on a review of the National Register of Historic Places (NRHP) database, the Louisiana Cultural Resources Map, historic map research, and a review of cultural resources survey reports. The literature review revealed there has been extensive cultural resources investigations of the majority of the APE and adjacent surround. These investigations include: Hunter 2014 (LDOA Report No. 22-5468), Kelley 2011 (LDOA Report No. 22-3879), Lee 2000 (LDOA Report No. 22-2327), Norton 2014 (LDOA Report No. 22-4580), Poplin 1988 (LDOA Report No. 22-1259), Robblee 1998 (LDOA Report No. 2180), Rothrock 2015 (LDOA Report No., 22-4868), Ryan 2019 (LDOA Report No. 22-4571-1), Ryan 2020 (LDOA Report No. 22-4571-2), Stanyard N.D. (LDOA Report No. 22-4417), and Wells 2014 (LDOA Report No. 22-4571). No cultural resources or historic properties were identified as a result of these investigations.

The proposed Prescott Canal Drainage Structure (Figure 3) and the Reserve Relief Well Pump Station Power Transmission Corridor (Figure 4) APEs are located entirely within previous survey corridors. Approximately 6.5 acres of the proposed I-55 Bypass Road APE are outside previous survey areas. Adjacent surveys [Lee 2000 (LDOA Report No. 22-2327), Ryan 2019 (LDOA Report No. 22-4571-1), Ryan 2020 (LDOA Report No. 22-4571-2)] did not find any historic properties in the vicinity of the proposed construction APE. Additionally, heavy construction and development of I-55, U.S. Hwy 51, and Peavine Road suggests a low probability of intact cultural deposits within the proposed I-55 Bypass Road APE (Figure 2). Approximately 6 acres of the proposed airport expansion APE are outside previous survey areas. Previous surveys within and adjacent to the proposed Airport Expansion APE [Rothrock 2015 (LDOA Report No., 22-4868), Ryan 2019 (LDOA Report No. 22-4571-1), Wells 2014 (LDOA Report No. 22-4571)] did not identify any historic properties suggesting a low probability of historic properties within the remaining 6 acres (Figure 6).

Given the absence of identified historic properties, the intense survey coverage, previous construction and development, and the low probability of the presence of unidentified resources, USACE has determined that the existing surveys constitute a reasonable and good faith effort at identification and evaluation of historic properties and based on it, that it is unlikely that any unidentified properties are present in the currently proposed APEs.

Assessment of Effects

Based on the information presented in this letter, CEMVN has determined that there are no historic properties, as defined in 36 CFR 800.16 (l) in the APE. Therefore, CEMVN is making a finding of **No Historic Properties Affected** for this undertaking and submitting it to you for review and comment. This project will be subject to the standard change in scope of work, unexpected discovery, and unmarked human burial sites act provisions. CEMVN requests your comments within 30 days, per 36 CFR 800.5(c).

If you have any questions or require additional information concerning this undertaking, please contact Ms. Ashley Fedoroff, Archaeologist, at (601) 631-5278 or via e-mail Ashley.M.Fedoroff@usace.army.mil, or Mr. Brian Ostahowski, Tribal Liaison, at (504) 862-2188 or via email at Brian.E.Ostahowski@usace.army.mil.

Sincerely,

FOR ERIC M. WILLIAMS
Chief, Environmental Planning Branch

State of Louisiana
Office of the Lieutenant Governor
Department of Culture, Recreation & Tourism
Office of Cultural Development

Billy Nungesser
Lieutenant Governor

Kristin P. Sanders
Assistant Secretary

June 20, 2023

Department of the Army
U.S. Army Corps of Engineers, New Orleans District
7400 Leake Avenue
New Orleans La 70118-3651
Attn: Eric Williams

Re: Draft Supplemental Environmental Assessment
West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Levee System
St. Charles and St. John the Baptist Parishes, Louisiana
SEA#571A

Dear Mr. Williams:

Thank you for your letter received June 5, 2023, regarding the Draft Supplemental Environmental Assessment (SEA 571A) for the West Shore Lake Pontchartrain Hurricane and Storm Risk Reduction Levee System St. Charles and St. John the Baptist Parishes, Louisiana, and a draft Finding of No Significant Impact. The draft of SEA 571A evaluates the potential impacts of altering the levee alignment footprint as described in the West Shore Lake Pontchartrain Environmental Impact Statement (2016 WSLP EIS) and SEA 571, and modifications to features described in SEA 570 and SEA 571.

A Programmatic Agreement (PA) regarding the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction System was executed on May 16, 2014, among SHPO, the Advisory Council of Historic Preservation (ACHP) and the CEMVN pursuant to Section 106 of the National Historic Preservation act and its implementing regulation found at 36 CFR 800.14(b). Our office had no objections to the Proposed Action under the stipulations as outlined in the 2014 programmatic agreement {Appendix VII, Annex G) to identify and evaluate cultural resources.

If you have questions or concerns, please contact Renee Erickson in our Division of Archaeology at rerickson@crt.la.gov.

Sincerely,

Kristin Sanders
State Historic Preservation Officer

Programmatic Agreement
among
The United States Army Corps of Engineers,
Louisiana State Historic Preservation Officer,
and
The Advisory Council on Historic Preservation
regarding the
West Shore Lake Pontchartrain Hurricane and
Storm Damage Risk Reduction System

WHEREAS, historically, residents and businesses of St. Charles, St. John the Baptist, and St. James Parishes, Louisiana have suffered major damage as a result of storms and hurricanes. Recent hurricanes that have impacted the area include Hurricanes Katrina and Rita in 2005, Hurricanes Gustav and Ike in 2008, and Hurricane Isaac in 2012, which caused a storm surge in the area that threatened lives and damaged more than 7,000 homes; and

WHEREAS, the U.S. Congress recognized the need for a hurricane and storm damage risk reduction project in the area with two Congressional resolutions to authorize its study. The first was adopted on July 29, 1971 by the U.S. House of Representatives Committee on Public works.

“RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE HOUSE OF REPRESENTATIVES, UNITED STATES, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Lake Pontchartrain and Vicinity, Louisiana, published as House Document No. 231, 89th Congress, First Session, and other pertinent reports, with a view to determining whether modifications to the recommendations contained therein are advisable at this time, with particular reference to providing additional levees for hurricane protection and flood control in St. John the Baptist Parish and that part of St. Charles Parish west of the Bonnet Carré Spillway."

The U.S. Senate Committee on Public Works adopted a resolution on September 20, 1974.

“RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Lake Pontchartrain and Vicinity, Louisiana, published as House Document No. 231, 89th Congress, First Session, and other pertinent reports, with a view to determining whether modifications to the recommendations contained therein are advisable at this time, for hurricane protection and flood control in St. James Parish."

WHEREAS, the United States Army Corps of Engineers (USACE) has been working with state and local officials to study potential solutions to reduce damage caused by hurricane and tropical storm surge in the three-parish area. This study has come to be known as the West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction Study; and

WHEREAS, the USACE has determined that the WSLP project is an "Undertaking" pursuant to the National Historic Preservation Act of 1966 (16 U.S.C. 470), as amended, (NHPA), and may have an adverse effect on properties included or eligible for inclusion in the National Register of Historic Places (NRHP); and

WHEREAS, the USACE has elected to fulfill its obligations under Section 106 of the NHPA through the execution and implementation of a Programmatic Agreement (this Agreement) as provided in 36 CFR 800.14(b); and

WHEREAS, the USACE notified the Advisory Council on Historic Preservation (ACHP) of the potential for this undertaking to adversely affect historic properties pursuant to the ACHP's implementing regulations (36 CFR Part 800); and

WHEREAS, the ACHP accepted the invitation to participate in consultation to develop this Agreement and to seek ways to avoid, minimize, or mitigate adverse effects on historic properties; and

WHEREAS, the USACE consulted with the Louisiana State Historic Preservation Officer (LA SHPO), Tribal Historic Preservation Officers (THPO) and federally recognized Indian Tribes as defined under 36 CFR 800.16(m) (Tribes), and other appropriate consulting parties in developing this Agreement in order to define efficient and cost effective processes for taking into consideration the effects of the WSLP project upon historic properties pursuant to 36 CFR 800.14(b); and

WHEREAS, the USACE acknowledges Tribes as sovereign nations which have a unique government-to-government relationship with the federal government and its agencies; USACE further acknowledges its Trust Responsibility to those Tribes; and

WHEREAS, the USACE made a reasonable and good faith effort to identify any Tribes that may attach religious and cultural significance to historic properties that may be affected by the undertaking; and

WHEREAS, the USACE has invited the Alabama-Coushatta Tribe of Texas, Caddo Nation of Oklahoma, Chitimacha Tribe of Louisiana, Choctaw Nation of Oklahoma, Coushatta Tribe of Louisiana, Jena Band of Choctaw Indians, Mississippi Band of Choctaw Indians, Quapaw Tribe of Oklahoma, Seminole Nation of Oklahoma, Seminole Tribe of Florida, and the Tunica-Biloxi Tribe of Louisiana to consult in the development of this Agreement. The Quapaw Tribe of Oklahoma and the Seminole Tribe of Florida have independently determined that the undertaking is not within their tribe's area of interest and do not wish to comment; and

WHEREAS, the USACE will invite any interested Tribe who participates in the development of this Agreement to sign this Agreement as an Invited Signatory Party, and those Tribes not requesting to sign this Agreement as an Invited Signatory Party will be invited to sign as a Concurring Party; and

WHEREAS, the USACE has involved the public through the National Environmental Policy Act (NEPA) process, which affords all persons, organizations and government agencies the right to review and comment on proposed major federal actions that are evaluated by a NEPA document. Public meetings to collect input during planning were held in January 2009, February 2011, November 2012, April 2013, and May 2013. On August 23, 2013, the USACE released an Integrated Draft Feasibility Report and Environmental Impact Statement for the WSLP project (Draft Report) to the public for a review period of forty-five (45) calendar days. The public review period was extended an additional 14 days to October 22, 2013 as compensation for Federal Government shutdown of 2013. This document included a general discussion of cultural resources within the study area. Public hearings of the Draft Report were held on September 10, September 17, and November 2, 2013. Comments received during the 59-day review and the public hearings are being incorporated into the Integrated Final Feasibility Report and Environmental Impact Statement; and

WHEREAS, the USACE has taken appropriate measures to identify other parties that may be interested specifically in the development of this Agreement, by notification to the Parish Presidents of St. James, St. John the Baptist, and St. Charles Parishes, as well as to four (4) historical associations within these three parishes, and has invited such parties to participate in the development and execution of this Agreement; and

WHEREAS, the USACE has also taken steps to notify the wider public with newspaper announcements in the Times-Picayune of New Orleans, and NOLA.com of New Orleans. The USACE will furthermore take appropriate steps to involve and notify parties, as appropriate, during the implementation of the terms of this Agreement; and

WHEREAS, the Louisiana Coastal Protection and Restoration Authority Board (CPRAB) is a local sponsor for WSLP project and has participated in the development of this Agreement and will be invited to sign this Agreement as a Concurring Party. Any additional local sponsors for the WSLP project will also be invited to sign this Agreement as a Concurring Party; and

NOW, THEREFORE, the USACE, ACHP, and LA SHPO agree that the implementation of the following stipulations will evidence that the USACE has taken into account the effects of the WSLP project upon historic properties.

STIPULATIONS

The USACE shall adhere to the process and protocols set forth in this Agreement.

I. Correspondence

Electronic mail (email) will serve as the official correspondence method for all communications regarding this Agreement and its provisions. See Appendix A for a list of contacts and email addresses. Contact information in Appendix A may be updated as needed without an amendment to this Agreement. It is the responsibility of each signatory to immediately inform the USACE of any change in name, address, email address, or phone number of any point-of-contact. The USACE will forward this information to all signatories by email. Failure of any party to this Agreement to notify the USACE of any change to a point-of-contact's information shall not be grounds for asserting that notice of a proposed action was not received.

A. All standard response timeframes established by 36 CFR Part 800 will apply to this Agreement, unless an alternative response timeframe is agreed to by the LA SHPO and Tribes. The USACE may request expedited review by the LA SHPO and Tribes on a case by case basis. Such expedited review period shall not be less than 10 working days.

II. Tribal Consultation

A. The Chitimacha Tribe of Louisiana, the Choctaw Nation of Oklahoma, and the Coushatta Tribe of Louisiana participated in the development of this Agreement and will sign this Agreement as an Invited Signatory Party.

B. The Mississippi Band of Choctaw Indians participated in the development of this Agreement and will be invited to sign this Agreement as a Concurring Party.

C. The Alabama-Coushatta Tribe of Texas, Caddo Nation of Oklahoma, Jena Band of Choctaw Indians, Seminole Nation of Oklahoma, and the Tunica-Biloxi Tribe of Louisiana will be invited to sign this Agreement as a Concurring Party.

D. The Seminole Tribe of Florida and the Quapaw Tribe of Oklahoma have independently determined that the undertaking is not within their tribe's area of interest and they have elected not to consult further in connection with the WSLP project.

E. The USACE shall make a reasonable and good faith effort to identify any additional Tribes that might attach religious and cultural significance to historic properties in the area of potential effects (APE) for the WSLP project.

F. The USACE shall consult with Tribes that are invited to sign this Agreement as Invited Signatory Parties and Tribes that are invited to sign this agreement as Concurring Parties, as well as any other Tribe that requests in writing to be a consulting party (collectively, “Consulting Tribes”).

G. The USACE will provide the Consulting Tribes with an executed copy of this Agreement and with copies of all plans, determinations, and findings provided to the LA SHPO.

III. Public Involvement

A. The USACE, in consultation with the LA SHPO, shall continue to identify and provide members of the public likely to be interested in the effects of the WSLP project upon historic properties with a description of the undertaking and the provisions of this Agreement.

B. Specific cultural resources data will not be released to the general public or become released as part of NEPA documents.

C. To the extent permitted under applicable federal laws and regulations (e.g., Section 304 of the NHPA, Section 9 of the Archaeological Resources Protection Act [ARPA]), the USACE will release to the public, documents developed pursuant to this Agreement, effects determinations, and Interim Progress Reports.

IV. Other Consulting Parties

A. Any member of the public expressing an interest in the effects of this undertaking on historic properties, may become a consulting party by submitting a written request to USACE.

B. The USACE, in consultation with the LA SHPO, will continue efforts during the duration of this Agreement to identify other parties with demonstrated interests in the preservation of historic properties.

C. The USACE will document the consulting parties in the consultation process for the WSLP project and maintain it as part of the administrative record.

D. If any dispute arises about the right to be recognized as a consulting party, the USACE will contact the ACHP and provide all appropriate documentation. The ACHP will participate in the resolution of the issue.

V. Identification, Evaluation, and Assessment of Effects Determinations

A. The USACE, in consultation with the LA SHPO and Consulting Tribes, will define and document the geographic areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist, referred to as an area of potential effects (APE). Because WSLP contains borrow sources and mitigation areas that are spatially distinct from the risk reduction system, there will be multiple APE (collectively, the WSLP APE). Each APE will assist in identifying the potential for direct, indirect, and cumulative effects upon historic properties. The reasonable and good faith identification and evaluation efforts will be limited to the identified WSLP APE.

B. WSLP APE are defined at this time to include areas that may be directly or indirectly impacted by:

1. A 55-foot wide and 18.27-mile long levee to be constructed in St. John the Baptist Parish, including its associated features (i.e., pump stations, canals, and drainage structures), as well as activities associated with construction (i.e., access roads and staging areas);

2. Three (3) 20-foot wide berms enclosing three residential communities located in St. James Parish with a combined total length of approximately 7 miles;

3. Installation of 145 flap gates on existing culverts below Highway 3125.

C. Borrow sources and mitigation sites are not yet fully defined, and will be coordinated for purposes of defining the APE by the USACE, LA SHPO, and Consulting Tribes. Additional areas of the WSLP APE will be identified as necessary.

D. Following the delineation of final WSLP APE components, the USACE will conduct a reasonable and good faith effort to identify historic properties located within the WSLP APE. Level of survey to be conducted within the APE and methodology will be developed in consultation with the LA SHPO and

Consulting Tribes, in a manner equivalent to the Section 106 Process of NHPA and equivalent to Reconnaissance or Phase I Investigations required by the Louisiana Division of Archaeology. Areas that are inaccessible or are determined to possess a low probability for containing historic properties may be excluded from survey after consultation with the LA SHPO and Consulting Tribes.

E. The USACE will ensure that the results of identification efforts are documented in reports that meet the standards of the Louisiana Division of Archaeology, and will ensure that the reports are submitted to the LA SHPO and Consulting Tribes for review and comment. The USACE will ensure that the comments provided by the LA SHPO and Consulting Tribes are addressed and incorporated into a final report.

F. The USACE will consult with the LA SHPO and Consulting Tribes on the eligibility of any properties identified during the identification effort. For any properties determined not eligible for nomination to the NRHP, no further consideration will be required under the terms of this Agreement. For those properties determined eligible for nomination, the USACE will proceed in accordance with Stipulation VI. For those properties whose eligibility for the NRHP cannot be determined on the basis of the identification effort, the USACE will consult with the LA SHPO and Consulting Tribes to determine if the proposed project can avoid the properties. If the properties can be avoided, the USACE will proceed as in Stipulation VI. If the properties cannot be avoided, the USACE will ensure that additional investigations to evaluate each property's eligibility for nomination will be undertaken.

G. The USACE will ensure that the results of the evaluation efforts are documented in reports that meet the standards of the Louisiana Division of Archaeology and will ensure that the reports are submitted to the LA SHPO and Consulting Tribes for review and comment. The USACE will ensure that the comments provided by the LA SHPO and Consulting Tribes are addressed and incorporated into a final report.

H. The USACE will consult with the LA SHPO and Consulting Tribes on the eligibility of the properties assessed during the evaluation effort. For any properties determined not eligible for nomination to the NRHP, no further consideration will be required. For those properties determined eligible for nomination, the USACE will proceed in accordance with Stipulation VII.

I. In the event of disagreement between the USACE, LA SHPO, and/or Consulting Tribes concerning the eligibility of a property for listing in the NRHP under 36 CFR Part 60, the USACE shall request a formal determination of eligibility for that property from the Keeper of the NRHP (Keeper). The determination by the Keeper will serve as the final decision regarding the NRHP eligibility of the property.

VI. Coordination of Effects Determinations

A. The USACE shall evaluate the effects of a project activity on historic properties in a holistic manner and will not segment activities. In the event the USACE determines that any aspect of the project activity will have an effect or adverse effect on a historic property within the WSLP APE, the entire project activity will be reviewed accordingly.

B. Consultation under this Agreement will be concluded for USACE findings of *no historic properties affected* and *no adverse effect* when the LA SHPO and Consulting Tribes have been provided the opportunity to review and comment on the written documentation and either concur or do not object within 30 days of receipt of the USACE finding, and subject to the provisions of this Agreement.

C. Following submission of written documentation to the LA SHPO and Consulting Tribes, the USACE may propose a finding of *no adverse effect with conditions*, as appropriate. Such conditions may include, but are not limited to:

1. Avoidance and/or preservation-in-place of historic properties;

2. Modifications or conditions to ensure consistency with the Secretary of Interior's Standards for the Treatment of Historic Properties and applicable guidelines.

D. In the event of an objection by the LA SHPO, Consulting Tribes or other consulting parties regarding the USACE's findings of *no historic properties affected*, findings of *no adverse effect*, and findings of *no adverse effect with conditions*, the USACE shall seek to resolve such objection through consultation in accordance with procedures outlined in Stipulation XII.

VII. Resolution of Adverse Effects

A. In the event that the USACE, in consultation with the LA SHPO and Consulting Tribes, determines that the implementation of a project activity may result in an adverse effect to historic properties (as defined in 36 CFR 800.5(a)(1) and (2) of the ACHP's regulations), the USACE shall notify the ACHP, LA SHPO, Consulting Tribes, other consulting parties and the public. If the project activity will affect a National Historic Landmark, USACE shall also notify the National Park Service (NPS). The notification of adverse effect shall include the following documentation, subject to the confidentiality provisions of 36 CFR 800.6:

1. Summary description of the activity area;

2. Summary of identification efforts in accordance with this agreement;

3. Summary analysis of effects to historic properties;

4. Summary of alternatives considered to avoid or reduce adverse effects;

5. Proposed mitigation measures in accordance with Stipulation VIII when adverse effects cannot be avoided or conditioned to reach a determination of no adverse effect; and

6. Request for ACHP comment and involvement, as appropriate.

B. The ACHP, LA SHPO, Consulting Tribes, and any additional consulting parties, including the NPS, as appropriate, shall be afforded an opportunity to review and to comment on the adverse effect notification for a period of thirty (30) calendar days after receipt of the adverse effect notification.

C. Should the USACE, LA SHPO, and Consulting Tribes disagree on the proposed mitigation measures, the USACE shall seek to resolve such objection through consultation in accordance with Stipulation XII.

VIII. Standard Mitigation Measures

A. The USACE, in coordination with the ACHP, LA SHPO, Consulting Tribes, and other consulting parties, will identify standard mitigation measures for adverse effects to historic properties. Standard mitigation measures will be tailored to the significance of the historic property, and may include, but are not necessarily limited to, one or more of the following:

1. Public Interpretation;

2. Documentation consistent with the Level II Standards of the Historic American Building Survey/Historic American Engineering Record (HABS/HAER);

3. Historical, Architectural or Archeological Monographs;

4. Rehabilitation of historic buildings in accordance with the Secretary of the Interior's Standards for the Treatment of Historic Properties (36 CFR Part 68);

5. Off-site mitigation, including acquisition of property or preservation easements on property, as appropriate and legal, containing threatened resources of comparable significance in circumstances where there is an imminent need to proceed with construction activity and it is in the public interest;

6. Ethnographic studies;

7. Studies of traditional cultural properties;

8. Relocation of historic properties to sites approved by the LA SHPO as possessing similar overall character; and

9. Data recovery for archeological properties.

B. In the event that the ACHP, LA SHPO, and/or Consulting Tribes determine that standard mitigation measures are not adequate or appropriate to resolve adverse effects, the USACE, LA SHPO, and Consulting Tribes will consult to negotiate additional mitigation measures. Other consulting parties may express their concerns regarding mitigation measures through written comments submitted to any of the signatories to the Agreement.

C. Once the USACE, ACHP, LA SHPO, and/or Consulting Tribes agree to the terms of the mitigation, such agreement will be formalized through an MOA executed and implemented pursuant to 36 CFR 800.6(c). Such MOA shall be forwarded to all signatories to this Agreement. If there is a disagreement that cannot be resolved, the formal dispute provisions at Stipulation XII will be implemented.

IX. Curation

The USACE will ensure that all collections and associated records retrieved or created during the life of this Agreement are curated in accordance with 36 CFR Part 79.

X. Unanticipated Discoveries and Effects

A. In the event that the USACE discovers a previously unidentified cultural resource, including but not limited to archeological sites, standing structures, human remains, and properties of traditional religious and cultural significance to Tribes, during the execution of the project, the USACE immediately shall secure the immediate jobsite by the most appropriate quickly available means, to include but not necessarily limited to a 50-foot radius buffer around the unexpected discovery, and suspend work in that buffered area of the affected resource. The USACE shall immediately notify the LA SHPO, Consulting Tribes, and additional consulting parties, as appropriate, of the finding. Any previously unidentified cultural resource will be treated as though it is eligible for the NRHP until other determination may be made. If consulting parties agree that the cultural resource is not eligible for the NRHP, then suspension of work will end. If consulting parties agree that the cultural resource is eligible for the NRHP, then the USACE, in consultation with the LA SHPO and Consulting Tribes, will develop a treatment plan or Standard Mitigation Measures agreement in accordance with Stipulation VIII. USACE will implement the plan or Standard Mitigation Measures agreement once approved by the LA SHPO, Consulting Tribes, and additional consulting parties, as appropriate. If there is a disagreement that cannot be resolved, the formal dispute provisions at Stipulation XII will be implemented.

B. In the event that the USACE is notified of a previously unidentified archaeological property on federal or tribal land during the execution of any of the undertakings, the USACE will ensure that procedures established by ARPA 1979 (Public Law

96-95; 16 U.S.C. 470aa-mm), as amended, and implementing regulations (43 CFR Part 7) will be followed.

C. The USACE shall insure that all contractors are made aware of the requirements of this Agreement. Language of Stipulation X shall be included in Construction Plans and Specifications. In the event that a contractor discovers a previously unidentified cultural resource, the contractor shall immediately notify the USACE and refrain from further project activities within a minimum of 50 feet from the discovery (50-foot radius no work buffer), and shall take reasonable efforts to avoid and minimize harm to the cultural resource. The USACE shall implement any additional measures thought necessary to secure the historic property for safety and security concerns.

D. In the event that previously unidentified effects to historic properties are identified following the completion of work within an activity area, any party may provide the USACE with evidence of such effects for a period of twelve (12) months from the completion of the affecting work. The USACE, in consultation with the LA SHPO, Consulting Tribes, and ACHP, as appropriate, will review and if determined necessary will develop a treatment plan or Standard Mitigation Measures agreement in accordance with Stipulation VIII.

E. If the USACE, LA SHPO, and/or Consulting Tribes cannot agree on an appropriate course of action to address the discovery situation, the USACE shall initiate the dispute resolution process set forth in Stipulation XII.

XI. Discovery of Human Remains

A. Language of Stipulation XI shall be included in Construction Plans and Specifications, to offer fullest knowledge of the importance therein.

B. When human remains or indications of a burial are discovered, the individual(s) who made the discovery shall immediately notify the local law enforcement and the USACE, New Orleans District. All work shall cease within a minimum of 50 feet from the discovery (50-foot radius no work buffer) until and unless determined otherwise in consultation according to this Agreement.

C. The USACE may authorize the activity in the direct discovery areas to resume, following the completion of all necessary steps as outlined below.

D. In the event that the USACE is notified of a previously unidentified burial, including burial sites, human skeletal remains, or burial artifacts, on private or state land during the execution of any of the Undertakings, the USACE will ensure that the procedures established in the Louisiana Unmarked Human Burial Sites Preservation Act (La. R.S. 8:671-681) will be followed.

E. In the event that the USACE is notified of a previously unidentified burial, including burial sites, human remains or funerary objects, on federal or tribal land during the execution of any of the undertakings, the USACE will ensure that procedures established by ARPA 1979 (Public Law 96-95; 16 U.S.C. 470aa-mm), as amended, and implementing regulations (43 CFR Part 7) will be followed.

F. In the event that the USACE is notified of a previously unidentified American Indian burial, including burial sites, human remains or funerary objects, on federal or tribal land during the execution of any of the undertakings, the USACE will ensure that procedures established by the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 and the regulations that implement it (43 CFR Part 10) will be followed.

G. The USACE shall have an archaeologist immediately survey or resurvey the general area where the remains were found to determine the nature of the remains and evaluate the possibility of preserving the remains in place or whether they will need to be exhumed/moved. Tribes likely to have a cultural affiliation with the remains will be notified by telephone immediately in accordance with 43 CFR Part 10.4(b). If possible, Tribal representative(s) shall be present to advise on appropriate treatment of the exposed remains and on the most appropriate long-term solution.

H. The USACE shall provide information collected on the nature of the remains and a recommended plan of action pursuant to 43 CFR 10.5(e) within five (5) working days to the Consulting Tribes and the LA SHPO. The USACE shall consult with all relevant parties to determine the appropriate course of action with regard to the human remains and any accompanying artifacts, grave goods, or funerary objects.

I. All signatories agree that the most appropriate treatment, if feasible, is to protect the remains and permanently preserve the burial in situ.

J. If the USACE, after consultation, determines that protection, avoidance, or repair is not feasible, disinterment shall be conducted in accordance with methods and procedures developed in accordance with the appropriate federal and state laws and in consultation with the Consulting Tribes and the LA SHPO.

XII. Dispute Resolution

A. Except for the resolution of eligibility issues, as set forth in Stipulation V, should the LA SHPO, Consulting Tribes, or a member of the public disagree on the implementation of the provisions of this agreement, they will notify the USACE, who will seek to resolve such objection through consultation.

B. If the dispute cannot be resolved through consultation, the USACE shall forward all documentation relevant to the dispute to the ACHP, including any proposed resolution identified during consultation. Within seven (7) calendar days after receipt of all pertinent documentation, the ACHP may:

1. Provide the USACE with recommendations to take into account in reaching final decision regarding the dispute; or

2. Notify the USACE that it will comment pursuant to 36 CFR 800.7(c) and provide formal comments within twenty-one (21) calendar days.

C. Any recommendation or comment provided by the ACHP will be understood to pertain only to the subject of the dispute, and the USACE's responsibilities to fulfill all actions that are not subject of the dispute will remain unchanged.

D. If the ACHP does not provide the USACE with recommendations or notification of its intent to provide formal comments within seven (7) calendar days, the USACE may assume that the ACHP does not object to its recommended approach and it will proceed accordingly.

XIII. Administration, Effect, and Duration of this Agreement

A. This Agreement will be signed in counterparts and shall take effect upon execution by the ACHP, USACE, and LA SHPO.

B. This Agreement will remain in effect for ten (10) years from the date of execution, unless extended for a two-year period by written agreement negotiated by all signatories.

C. All signatories to this Agreement shall meet annually to evaluate the effectiveness of this Agreement, beginning one (1) year after the date of execution. The USACE shall coordinate such annual meetings following the execution of this Agreement. At each annual meeting, held in manner and location as mutually agreed upon by all signatories, the effectiveness of the Stipulations of this Agreement shall be discussed. After five (5) years, all signatories will begin the discussion to consider any cumulative effects as discussed by Stipulation XIV.

XIV. Comprehensive Review

A. Upon completion of the construction activities for the WSLP project, the USACE will analyze the undertaking holistically to identify cumulative effects upon historic properties. Cumulative effects are those coincident effects on specific resources of all related activities, not just the proposed actions governed by the Stipulations of this Agreement.

B. The USACE, in consultation with the signatories to this Agreement, shall identify and implement additional mitigation measures to address adverse cumulative effects, as appropriate. If there is a disagreement that cannot be resolved, the formal dispute provisions at Stipulation XII will be implemented.

C. Measures to address adverse cumulative effects shall be documented in a report that meets the standards of the Louisiana Division of Archaeology and will be submitted to the LA SHPO and Consulting Tribes for review and comment. The final cumulative report shall be distributed to the signatories to this Agreement, as well as any additional consulting parties.

XV. Amendment and Termination

A. Notwithstanding any provision of this Agreement, USACE, ACHP, LA SHPO, and Invited Signatory Parties may request that it be amended, whereupon these parties will consult to consider such amendment. The USACE will facilitate such consultation within thirty (30) days of receipt of the written request. Any amendment will be in writing and will be signed by the USACE, ACHP, LA SHPO, and Invited Signatory Parties, and shall be effective on the date of the final signature.

B. Any Invited Signatory Party may withdraw its participation in this Agreement by providing thirty (30) days advance written notification to all other parties. In the event of withdrawal by one Invited Signatory Party, the Agreement will remain in effect for the other signatories.

C. The Agreement may be terminated in accordance with 36 CFR Part 800. Any party requesting termination of this Agreement shall provide thirty (30) days advance written notification to all other signatories.

Execution of this Agreement by the ACHP, USACE, and LA SHPO and implementation of its terms, evidences that the USACE has taken into account the effects of the WSLP project upon historic properties and has afforded the ACHP an opportunity to comment.

From:	Lindsey Bilyeu
To:	Fedoroff, Ashley M CIV USARMY CEMVN (USA)
Subject:	[Non-DoD Source] RE: CEMVN WSLP SEA 571A Consultation Letter
Date:	Tuesday, July 11, 2023 1:46:00 PM

Ashley,

Thank you for the additional information. Our office is unaware of any Choctaw cultural or sacred sites in the immediate project area. We concur with the finding of "no historic properties affected". However, we ask that work be stopped, and our office contacted immediately, in the event that Native American artifacts or human remains are encountered.

If you have any questions, please contact me.

Thank you,

Lindsey D. Bilyeu, M.S.
Program Coordinator 2
Choctaw Nation of Oklahoma
Historic Preservation Department
P.O. Box 1210
Durant, OK 74702
Office: (580) 642-8377
Cell: (580) 740-9624

From: Fedoroff, Ashley M CIV USARMY CEMVN (USA) <Ashley.M.Fedoroff@usace.army.mil>
Sent: Monday, June 12, 2023 1:58 PM
To: Lindsey Bilyeu <lbilyeu@choctawnation.com>
Subject: RE: CEMVN WSLP SEA 571A Consultation Letter

Hello Lindsey,

I've included the GPS coordinates of the 4 new construction areas below. I've also attached KMLs of each pin and zoomed screen shots of the construction APE polygons. In the screen shots, the blue color represents previously surveyed areas, and the pink represents areas not previously surveyed.

Construction Coordinates (center points):
Airport (Lat. 30.099047°, Long. -90.584655°)
Reserve Relief Pump Station Pin (Lat. 30.094320°, Long. -90.546197°)
I-55 Temp Construction Pin (Lat. 30.107243°, Long. -90.441478°)
Prescott DS Pin (Lat. 30.058559°, Long. -90.421328°)

I hope this helps. If you need more information, please let me know.

Respectfully,

Ashley

Ashley M. Fedoroff, MA, MPH
Archaeologist
U.S. Army Corps of Engineers
New Orleans District
Email: ashley.m.fedoroff@usace.army.mil
Phone: 601.631.5278

From: Lindsey Bilyeu <lbilyeu@choctawnation.com>
Sent: Friday, June 9, 2023 12:40 PM
To: Fedoroff, Ashley M CIV USARMY CEMVN (USA) <Ashley.M.Fedoroff@usace.army.mil>
Subject: [Non-DoD Source] RE: CEMVN WSLP SEA 571A Consultation Letter

Ashley,

The Choctaw Nation of Oklahoma thanks the USACE, New Orleans District, for the correspondence regarding the above referenced project. St. John the Baptist and St. Charles Parishes lie in our area of historic interest. The Choctaw Nation has two known sites in St. John the Baptist Parish. Could you provide me the general location of the newly proposed construction (Section/Township/Range or GPS coordinates)? I need to make sure these sites don't fall in the APE.

Thank you,

Lindsey D. Bilyeu, M.S.
Program Coordinator 2
Choctaw Nation of Oklahoma
Historic Preservation Department
P.O. Box 1210
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Office: (580) 642-8377
Cell: (580) 740-9624

From: Fedoroff, Ashley M CIV USARMY CEMVN (USA) <Ashley.M.Fedoroff@usace.army.mil>
Sent: Wednesday, May 10, 2023 10:42 AM
To: Ian Thompson <ithompson@choctawnation.com>; Lindsey Bilyeu <lbilyeu@choctawnation.com>
Cc: Ostahowski, Brian E CIV USARMY CEMVN (USA) <Brian.E.Ostahowski@usace.army.mil>; Emery, Jason A CIV USARMY CEMVN (USA) <Jason.A.Emery@usace.army.mil>
Subject: CEMVN WSLP SEA 571A Consultation Letter

Good Morning,

Attached, please find a letter regarding continued consultation for the West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction System (HSDRRS), SEA 571A, St. John the

Baptist and St. Charles Parishes, Louisiana undertaking.

Based on the information presented in this letter, CEMVN has determined that there are no historic properties, as defined in 36 CFR 800.16 (l) in the APE. Therefore, CEMVN is making a finding of No Historic Properties Affected for this undertaking and submitting it to you for review and comment. This project will be subject to the standard change in scope of work, unexpected discovery, and unmarked human burial sites act provisions. CEMVN requests your comments within 30 days, per 36 CFR 800.5(c).

If you have any questions or require additional information concerning this undertaking, please contact Ms. Ashley Fedoroff, Archaeologist, at (601) 631-5278 or via e-mail Ashley.M.Fedoroff@usace.army.mil, or Mr. Brian Ostahowski, Tribal Liaison, at (504) 862-2188 or via email at Brian.E.Ostahowski@usace.army.mil.

Respectfully,
Ashley

Ashley M. Fedoroff, MA, MPH
Archaeologist
U.S. Army Corps of Engineers
New Orleans District
Email: ashley.m.fedoroff@usace.army.mil
Phone: 601.631.5278

This message is intended only for the use of the individual or entity to which it is addressed and may contain information that is privileged, confidential and exempt from disclosure. If you have received this message in error, you are hereby notified that we do not consent to any reading, dissemination, distribution or copying of this message. If you have received this communication in error, please notify the sender immediately and destroy the transmitted information. Please note that any view or opinions presented in this email are solely those of the author and do not necessarily represent those of the Choctaw Nation.

Programmatic Agreement
among
The United States Army Corps of Engineers,
Louisiana State Historic Preservation Officer,
and
The Advisory Council on Historic Preservation
regarding the
West Shore Lake Pontchartrain Hurricane and
Storm Damage Risk Reduction System

Execution of this Agreement by the ACHP, USACE, and LA SHPO and implementation of its terms, evidences that the USACE has taken into account the effects of the WSLP project upon historic properties and has afforded the ACHP an opportunity to comment.

Signatory:

United States Army Corps of Engineers

By: Richard L. Hansen   Date: 5/15/14

Richard L. Hansen
Colonel, U.S. Army
District Commander

Programmatic Agreement
among
The United States Army Corps of Engineers,
Louisiana State Historic Preservation Officer,
and
The Advisory Council on Historic Preservation
regarding the
West Shore Lake Pontchartrain Hurricane and
Storm Damage Risk Reduction System

Execution of this Agreement by the ACHP, USACE, and LA SHPO and implementation of its terms, evidences that the USACE has taken into account the effects of the WSLP project upon historic properties and has afforded the ACHP an opportunity to comment.

Signatory:

Louisiana State Historic Preservation Officer

By: Pam Breaux   Date: 5-15-14

Pam Breaux
Louisiana State Historic Preservation Officer
Louisiana Office of Cultural Development

Programmatic Agreement
among
The United States Army Corps of Engineers,
Louisiana State Historic Preservation Officer,
and
The Advisory Council on Historic Preservation
regarding the
West Shore Lake Pontchartrain Hurricane and
Storm Damage Risk Reduction System

Execution of this Agreement by the ACHP, USACE, and LA SHPO and implementation of its terms, evidences that the USACE has taken into account the effects of the WSLP project upon historic properties and has afforded the ACHP an opportunity to comment.

Signatory:

Advisory Council on Historic Preservation

By: John M. Fowler   Date: 5/16/14
John M. Fowler
Executive Director
Advisory Council on Historic Preservation

Programmatic Agreement
among
The United States Army Corps of Engineers,
Louisiana State Historic Preservation Officer,
and
The Advisory Council on Historic Preservation
regarding the
West Shore Lake Pontchartrain Hurricane and
Storm Damage Risk Reduction System

Invited Signatory Party:

Chitimacha Tribe of Louisiana

By: John Paul Darden
John Paul Darden, Chairman

Date: 6-25-14

APPENDIX A
CONTACT INFORMATION

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State Historic Preservation Officer
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Louisiana State Historic Preservation Office
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Coastal Protection and Restoration Authority Board
Jerome Zeringue, Chair
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Baton Rouge, LA 70804

Elizabeth Davoli,
Coastal Resources Scientist Manager
Environmental Section, Planning & Research Division
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DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

February 27, 2014

Regional Planning and
Environment Division, South
New Orleans Environmental Branch

Reid Nelson, Director
Office of Federal Agency Programs
Advisory Council on Historic Preservation
Old Post Office
1100 Pennsylvania Ave., NW, Suite 809
Washington, D.C. 20004

Dear Mr. Nelson:

The United States Army Corps of Engineers (USACE), New Orleans District (CEMVN), is consulting for development of a Programmatic Agreement (PA) for the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction System (WSLP) Study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate.

The proposed undertakings of the WSLP Study have the potential to effect historic properties. The WSLP Study was first authorized in 1971 and experienced many variations and delays, but now finds further development to be directed by the USACE SMART Feasibility Study Process. A draft Integrated Feasibility Report and Environmental Impact Statement for the WSLP study is available for review at
http://www.mvn.usace.army.mil/Portals/56/docs/PD/Projects/WSLP/WSLPFINAL.pdf.

The CEMVN is currently funding a cultural resources survey for an approximately 18.5 mile, 550-foot wide, proposed levee corridor (TSP C) (to include construction, adjacent drainage ditch reservoirs, and Right-of-Way), that is the largest single component of the WSLP study. This levee corridor is immediately adjacent to previous cultural resource surveys (as per Louisiana SHPO files) with negative findings, for approximately 10 linear miles. Approximately 1.8 miles of levee corridor pass through or adjacent to cultural resource site 16SJB68 (Angelina Plantation) near the Mississippi River. This site received extensive cultural resources survey in 2012 (Louisiana Site Report 22-4288), and did not locate National Register of Historic Places (NRHP) eligible resources within the proposed levee corridor. Remaining areas of corridor that remain unsurveyed are within seasonally wet lands not conducive to recoverable human activity or preserved cultural resources. No other cultural resources have been recorded within 1 miles of the TSP C levee corridor. It is anticipated that any previously unrecorded cultural resource will be located by the current survey underway for the WSLP study.

Remaining undertakings of the WSLP Study are defined as "non-structural" and were not sufficiently designated in time to be included within the currently-conducted cultural resources survey, but are thought to be similarly low-probability to affect cultural resources. Existing Louisiana Highway 3125 has an elevated roadway, and will serve as a low berm to prevent storm water from affecting any resources to its south. A series of flap gates will be integrated under the roadway to allow natural water-flow as necessary and not artificially create flood damages. Site 16SJ1 is a prehistoric mound site on private property, considered eligible for the NRHP and approximately 600 feet south of Highway 3125. Two other sites located within 1000 feet of 16SJ1 are 16SJ50 (prehistoric midden; NRHP eligibility undetermined) and 16SJ51 (prehistoric mound; NRHP eligibility undetermined), located approximately 500 feet and 250 feet south of Highway 3125, respectively. The other recorded cultural resource within ½ mile of Highway 3125 within WSLP system is 16SJ56 (historic trash dump; NRHP ineligible according to SHPO). Highway 3125 also crossed the property boundaries of Wilton (16SJ20) and Helvetia (16SJ21) Plantations, portions of which are considered eligible for the NRHP; however according to cultural resources survey in 2011 (Louisiana Site Report 22-3017) no NRHP eligible portion is located in areas of potential effect by proposed flap gates under Highway 3125.

Protective low berms will be built around residences in the small communities of Gramercy and Grand Point, and similarly were not sufficiently designated in time to receive a cultural resources survey. A total of 3 berms with approximate 15-foot basal footprint are proposed. Total length of berms proposed is approximately 6.5 miles. These berm footprints are also thought to be of low probability to affect cultural resources because of: 1) their distance (ca. 1.4, 1.5, and 2.5 miles at closest) to the Mississippi River natural levee and its more stable soils; 2) their closer proximity to seasonally wet soils; 3) the lack of an identified cultural resource by any proximate cultural resources survey; and 4) their overlap on previously developed land likely to have disturbed any previously existing cultural resource.

The SMART Feasibility Study Process implemented by USACE designates that the WSLP Study should next seek Congressional approval for construction and move to Preliminary Engineering Design (PED) of proposed features, using information and risks now extant. Discussion for a Programmatic Agreement to be formed is considered as follows:

1) Any cultural resource that may be found during the currently ongoing cultural resources survey will not have opportunity for NRHP testing if such is required by findings.
2) Borrow Material for the TSP C levee is expected to come from Bonnet Carre Spillway and has been previously coordinated for Section 106. Any change of borrow source must be coordinated for Section 106.
3) Mitigation for swamp or bottomland hardwoods that may be destroyed during construction activities, is proposed for an area near the Amite River Diversion canal. This location has not been coordinated for Section 106, and therefore must be coordinated for Section 106.

4) Although considered low potential lands to contain cultural resources, the flap gates to be placed along Highway 3125 are not sufficiently configured to determine if they may impact a cultural resource. PED should designate that no construction take place within agreed distance from sites 16SJ1, 16SJ50, and 16SJ51. Section 106 coordination should be agreed once offset from previously-existing Highway 3125 is known.
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6) Currently proposed features leave approximately 80 homes outside of the WSLP system. 33 of these homes are calculated to require lifting to include them within the desired protection from a 100-year storm event. Any homes to be raised should be examined to determine if raising would adversely affect any existing NRHP status.

Maps and information that are helpful to familiarize with project area, are enclosed. A teleconference has been scheduled for March 6, 2014, at 10 a.m. central time, and the agenda and call-in information will be provided by email.

The point of contact at the CEMVN is Dr. Paul Hughbanks. You can reach him at the above address or by phone at (504) 862-1100 or by e-mail at Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter will be submitted to Dr. Tom McCulloch, tmcculloch@achp.gov.

Sincerely,

Sandra Stiles
for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

February 27, 2014

Regional Planning and
Environment Division, South
New Orleans Environmental Branch

Ms. Pam Breaux
State Historic Preservation Officer
Department of Culture, Recreation, & Tourism
P.O. Box 44247
Baton Rouge, LA 70804

Dear Ms. Breaux:

The United States Army Corps of Engineers (USACE), New Orleans District (CEMVN), is consulting for development of a Programmatic Agreement (PA) for the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction System (WSLP) Study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate.

The proposed undertakings of the WSLP Study have the potential to effect historic properties. The WSLP Study was first authorized in 1971 and experienced many variations and delays, but now finds further development to be directed by the USACE SMART Feasibility Study Process. A draft Integrated Feasibility Report and Environmental Impact Statement for the WSLP study is available for review at http://www.mvn.usace.army.mil/Portals/56/docs/PD/Projects/WSLP/WSLPFINAL.pdf.

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Maps and information that are helpful to familiarize with project area, are enclosed. A teleconference has been scheduled for March 6, 2014, and the agenda and call-in information will be provided by email.

The point of contact at the CEMVN is Dr. Paul Hughbanks. You can reach him at the above address or by phone at (504) 862-1100 or by e-mail at Paul.J.Hughbanks@usace.army.mil. An electronic cop of this letter is also being sent to Section106@crt.la.gov.

Sincerely,

for Sandra Stiles
Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF:

February 27, 2014

Regional Planning and
Environment Division, South
New Orleans Environmental Branch

Mr. Jerome Zeringue, Executive Director
Coastal Protection and
Restoration Authority Board of Louisiana
P.O. Box 94004
Office of Governor-Coastal, 4th Floor
Baton Rouge, LA 70804

Dear Mr. Zeringue:

The United States Army Corps of Engineers (USACE), New Orleans District (CEMVN), is consulting for development of a Programmatic Agreement (PA) for the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction System (WSLP) Study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate.

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The point of contact at the CEMVN is Dr. Paul Hughbanks. You can reach him at the above address or by phone at (504) 862-1100 or by e-mail at Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter will be submitted to Ms. Elizabeth Jarrell, elizabeth.jarrell@la.gov and Ms. Elizabeth Davoli, elizabeth.davoli@la.gov.

Sincerely,

Sandra Stiles
for Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

MAY 03 2013

Ms. Pam Breaux
State Historic Preservation Officer
Department of Culture, Recreation and Tourism
Office of Cultural Development
P.O. Box 44247
Baton Rouge, Louisiana 70804

Re: West Shore Lake Pontchartrain Hurricane Protection Project, St. John the Baptist and St. Charles Parish, Louisiana.

Dear Ms. Breaux:

The U.S. Army Corps of Engineers, New Orleans District (The Corps) has been in process of collecting data to select an alignment for construction of a levee in St. Charles and St. John the Baptist Parish, intended to protect the citizens of these parishes from storm surges that have shown able to cause extreme flooding. No construction has yet taken place on the ground, and the Corps has developed three alignments that appear most suitable given the various interests of federal and local governments. Each of these alignments begins at the western guide levee of the Bonnet Carre Spillway, and then diverge in different paths to protect various amounts of land and urban settlement. An image showing each of these three alignments is enclosed in this letter, for your review.

The Corps has been studying the need for this protection levee for many years, and in 2001 requested that Earth Search, Inc. conduct a cultural resources survey of an alignment very similar to Alignment A (Report 22-2559; Wilson et al. 2003). No cultural resources were located as a result of this survey. Alignments C and D have not received specific cultural resources surveys, although the Corps has reviewed available records of previous surveys or previously recorded cultural resources, and found that large portions of these alignments have been partially covered by other surveys without finding cultural resources. However, the Corps does intend to continue collecting information as to the potential effects caused by the construction of any protection levee, as well as potential effects of weather events after any levee is in place. This information will continue to be compared to known cultural resource locations and surveys. The Corps will continue consultation in compliance with Section 106 of the National Historic Preservation Act.

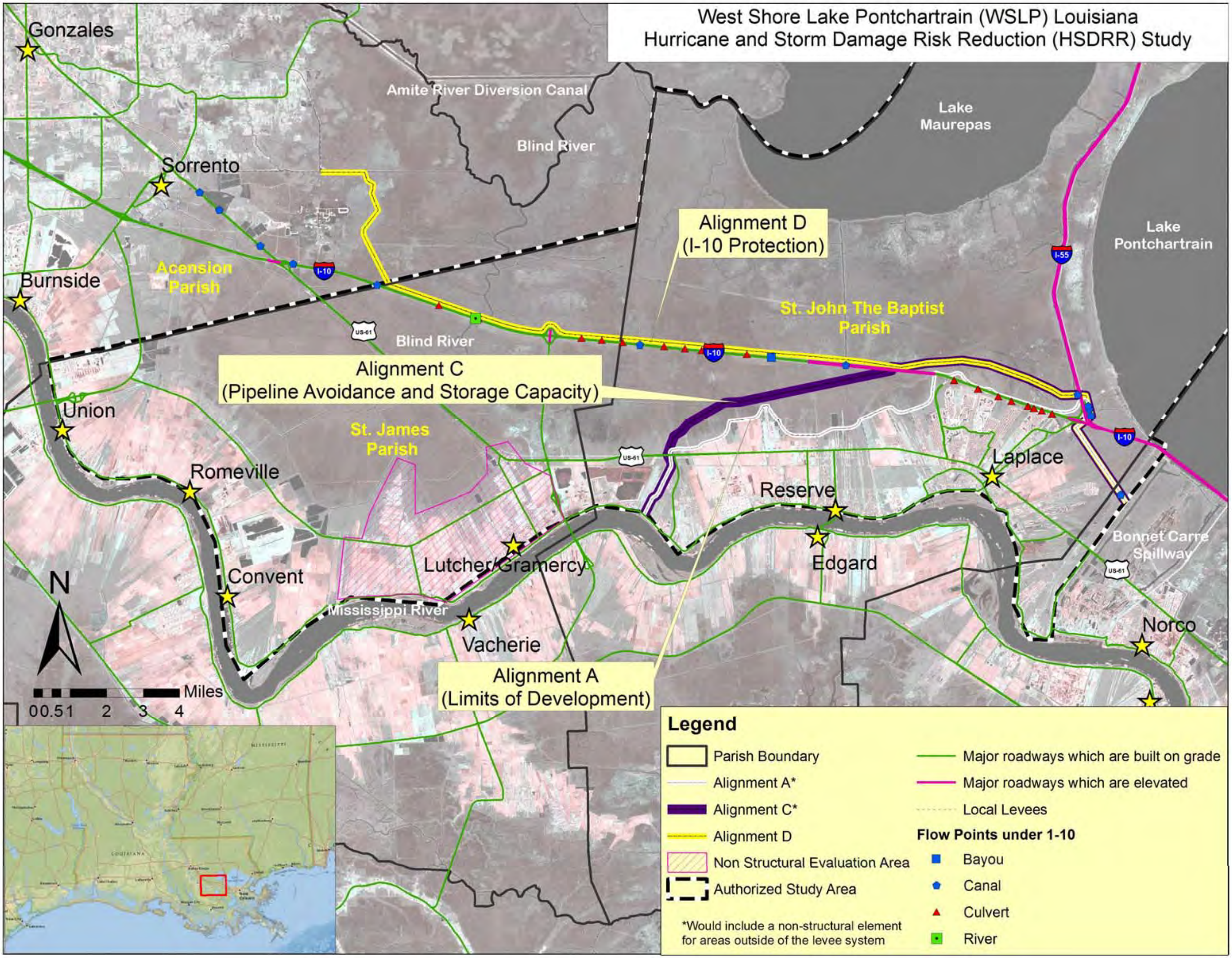
The Corps has sent this letter with intention to inform you of the current status of this project and our continuing efforts to be aware of any potential to affect historic resources. If you have concerns with this method and area of investigation, we invite you to notify us of those concerns so that we may be fully aware of them as this project proceeds. Please contact project archaeologist Dr. Paul Hughbanks, (504) 862-1100, Paul.J.Hughbanks@usace.army.mil, with any questions or comments.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures



West Shore Lake Pontchartrain (WSLP) Louisiana
Hurricane and Storm Damage Risk Reduction (HSDRR) Study
Gonzales
Amite River Diversion Canal
Lake Maurepas
Blind River
Sorrento
Alignment D (I-10 Protection)
Lake Pontchartrain
Acension Parish
Burnside
I-10
I-55
St. John The Baptist Parish
US-61
Blind River
Alignment C (Pipeline Avoidance and Storage Capacity)
Union
St. James Parish
Laplace
Romeville
Reserve
Bonnet Carre Spillway
Edgard
Lutcher/Gramercy
Convent
N
Mississippi River
Vacherie
Norco
Alignment A (Limits of Development)
Miles
0 0.5 1 2 3 4
Legend
Parish Boundary
Alignment A*
Alignment C*
Alignment D
Non Structural Evaluation Area
Authorized Study Area
*Would include a non-structural element for areas outside of the levee system
Major roadways which are built on grade
Major roadways which are elevated
Local Levees
Flow Points under 1-10
Bayou
Canal
Culvert
River

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Carlos Bullock, Chairman
Alabama-Coushatta Tribe of Texas
571 State Park Rd 56
Livingston, TX 77351

Dear Chairman Bullock:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

The CEMVN has determined that implementation of the selected TSP for each study has the potential to cause effects on historic properties and proposes to develop two PAs to establish Section 106 consultation procedures tailored to the accelerated schedules required by the USACE SMART Feasibility Study Process. The undertakings have been summarized in previous Section 106 consultation correspondence and are detailed in the draft Integrated Feasibility Report and Programmatic Environmental Impact Statement for the SWC LA study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/SouthwestCoastal.aspx and the draft Integrated Feasibility Report and Environmental Impact Statement for the WSLP study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

A teleconference has been scheduled for March 10, 2014, and the agenda and call-in information will be provided by email. We request that you inform us of your desire to participate as a consulting party in these PAs. Given the accelerated schedules, CEMVN requests that consultation for the development of the PAs utilize a combination of email and teleconferences.

As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; rebecca.hill@usace.army.mil. An electronic copy of this letter and all future correspondence pertaining to the development of the PAs will be provided electronically to Mr. Bryant J. Celestine, Historic Preservation Officer, Alabama Coushatta Tribe of Texas, celestine.bryant@actribe.org.

Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Brenda Shemayme Edwards, Chairwoman
Caddo Nation of Oklahoma
P.O. Box 487
Binger, OK 73009

Dear Chairwoman Edwards:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

John Paul Darden, Chairman
Chitimacha Tribe of Louisiana
P.O. Box 661
Charenton, LA 70523

Dear Chairman Darden:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

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Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
P.O. Box 1210
Durant, OK 74702-1210

Dear Chief Pyle:

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The CEMVN has determined that implementation of the selected TSP for each study has the potential to cause effects on historic properties and proposes to develop two PAs to establish Section 106 consultation procedures tailored to the accelerated schedules required by the USACE SMART Feasibility Study Process. The undertakings have been summarized in previous Section 106 consultation correspondence and are detailed in the draft Integrated Feasibility Report and Programmatic Environmental Impact Statement for the SWC LA study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/SouthwestCoastal.aspx and the draft Integrated Feasibility Report and Environmental Impact Statement for the WSLP study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

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As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; rebecca.hill@usace.army.mil. An electronic copy of this letter and all future correspondence pertaining to the development of the PAs will be provided electronically to Dr. Ian Thompson, Director/Tribal Historic Preservation Officer, Choctaw Nation of Oklahoma, ithompson@choctawnation.com.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Kevin Sickey, Chief
Coushatta Tribe of Louisiana
P.O. Box 818
Elton, LA 70532

Dear Chief Sickey:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

The CEMVN has determined that implementation of the selected TSP for each study has the potential to cause effects on historic properties and proposes to develop two PAs to establish Section 106 consultation procedures tailored to the accelerated schedules required by the USACE SMART Feasibility Study Process. The undertakings have been summarized in previous Section 106 consultation correspondence and are detailed in the draft Integrated Feasibility Report and Programmatic Environmental Impact Statement for the SWC LA study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/SouthwestCoastal.aspx and the draft Integrated Feasibility Report and Environmental Impact Statement for the WSLP study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

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As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; rebecca.hill@usace.army.mil. An electronic copy of this letter and all future correspondence pertaining to the development of the PAs will be provided electronically to Dr. Linda Langley, Tribal Historic Preservation Officer, Coushatta Tribe of Louisiana, llangley@mcneese.edu, and Mr. Michael Tarpley, Deputy Tribal Historic Preservation Officer, Coushatta Tribe of Louisiana, kokua.aina57@gmail.com.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

B. Cheryl Smith, Principal Chief
Jena Band of Choctaw Indians
P.O. Box 14
Jena, LA 71342

Dear Principal Chief Smith:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

The CEMVN has determined that implementation of the selected TSP for each study has the potential to cause effects on historic properties and proposes to develop two PAs to establish Section 106 consultation procedures tailored to the accelerated schedules required by the USACE SMART Feasibility Study Process. The undertakings have been summarized in previous Section 106 consultation correspondence and are detailed in the draft Integrated Feasibility Report and Programmatic Environmental Impact Statement for the SWC LA study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/SouthwestCoastal.aspx and the draft Integrated Feasibility Report and Environmental Impact Statement for the WSLP study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

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As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; rebecca.hill@usace.army.mil. An electronic copy of this letter and all future correspondence pertaining to the development of the PAs will be provided electronically to Ms. Dana Masters, Tribal Historic Preservation Officer, Jena Band of Choctaw Indians, jbc.thpo106@aol.com, and Ms. Lillie McCormick, Environmental Director, Jena Band of Choctaw Indians, lmmccormickjbc@centurytel.net.

Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Phyliss J. Anderson, Chief
Mississippi Band of Choctaw Indians
P.O. Box 6257
Choctaw, MS 39350

Dear Chief Anderson:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

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As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; rebecca.hill@usace.army.mil. An electronic copy of this letter and all future correspondence pertaining to the development of the PAs will be provided electronically to Mr. Kenneth H. Carleton, Tribal Historic Preservation Officer/ Archaeologist, Mississippi Band of Choctaw Indians, kcarleton@choctaw.org.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Leonard M. Harjo, Principal Chief
Seminole Nation of Oklahoma
P.O. Box 1498
Wewoka, OK 74884

Dear Principal Chief Harjo:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

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As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; rebecca.hill@usace.army.mil. An electronic copy of this letter and all future correspondence pertaining to the development of the PAs will be provided electronically to Ms. Natalie Harjo, Tribal Historic Preservation Officer, Seminole Nation of Oklahoma, harjo.n@sno-nsn.gov.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

James Billie, Chairman
Seminole Tribe of Florida
6300 Stirling Road
Hollywood, FL 33024

Dear Chairman Billie:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

The CEMVN has determined that implementation of the selected TSP for each study has the potential to cause effects on historic properties and proposes to develop two PAs to establish Section 106 consultation procedures tailored to the accelerated schedules required by the USACE SMART Feasibility Study Process. The undertakings have been summarized in previous Section 106 consultation correspondence and are detailed in the draft Integrated Feasibility Report and Programmatic Environmental Impact Statement for the SWC LA study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/SouthwestCoastal.aspx and the draft Integrated Feasibility Report and Environmental Impact Statement for the WSLP study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

A teleconference has been scheduled for March 10, 2014, and the agenda and call-in information will be provided by email. We request that you inform us of your desire to participate as a consulting party in these PAs. Given the accelerated schedules, CEMVN requests that consultation for the development of the PAs utilize a combination of email and teleconferences.

As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; rebecca.hill@usace.army.mil. An electronic copy of this letter and all future correspondence pertaining to the development of the PAs will be provided electronically to Mr. Paul N. Backhouse, Tribal Historic Preservation Officer, Seminole Tribe of Florida, paulbackhouse@semtribe.com; Ms. Anne Mullins, Deputy Tribal Historic Preservation Officer, annemullins@semtribe.com; Mr. Bradley Mueller, Compliance Review Supervisor, bradleymueller@semtribe.com; and Ms. Alison Swing, Compliance Review Data Analyst, alisonswing@semtribe.com.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

MARCH 7, 2014

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Earl J. Barbry, Sr., Chairman
Tunica-Biloxi Tribe of Louisiana
P.O. Box 1589
Marksville, LA 71351

Dear Chairman Barbry:

The United States Army Corps of Engineers, New Orleans District (CEMVN), is continuing consultation to develop Programmatic Agreements (PAs) for two studies, the Southwest Coastal Louisiana (SWC LA) study and the West Shore Lake Pontchartrain (WSLP) study, in accordance with 36 CFR § 800.14(b) of the regulations implementing Section 106 of the National Historic Preservation Act. We invite you to participate in the consultation for the development of these two separate PAs.

The CEMVN has determined that implementation of the selected TSP for each study has the potential to cause effects on historic properties and proposes to develop two PAs to establish Section 106 consultation procedures tailored to the accelerated schedules required by the USACE SMART Feasibility Study Process. The undertakings have been summarized in previous Section 106 consultation correspondence and are detailed in the draft Integrated Feasibility Report and Programmatic Environmental Impact Statement for the SWC LA study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/SouthwestCoastal.aspx and the draft Integrated Feasibility Report and Environmental Impact Statement for the WSLP study, available electronically for review at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

A teleconference has been scheduled for March 10, 2014, and the agenda and call-in information will be provided by email. We request that you inform us of your desire to participate as a consulting party in these PAs. Given the accelerated schedules, CEMVN requests that consultation for the development of the PAs utilize a combination of email and teleconferences.

As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; rebecca.hill@usace.army.mil. An electronic copy of this letter and all future correspondence pertaining to the development of the PAs will be provided electronically to Mr. Earl Barbry, Jr., Cultural Director, Tunica-Biloxi Tribe of Louisiana, earlii@tunica.org.

Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Carlos Bullock, Chairman
Alabama-Coushatta Tribe of Texas
571 State Park Rd 56
Livingston, TX 77351

Dear Chairman Bullock:

The United States Army Corps of Engineers (USACE), New Orleans District (CEMVN), has prepared an Integrated Draft Feasibility Report and Environmental Impact Statement (Integrated Draft Report) for the West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction Study. The Integrated Draft Report is available electronically for review at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain, and hard copies are available upon request.

In partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act (NEPA), and Section 106 of the National Historic Preservation Act, the CEMVN offers you the opportunity to review and comment on the potential of the proposed action described in the Integrated Draft Report to significantly affect protected tribal resources, tribal rights, or Indian lands. Consultation for the proposed action was initiated in a letter dated May 3, 2013.

The Integrated Draft Report proposes potential solutions to reduce damages from hurricane and tropical storm surge for residents in St. Charles, St. John the Baptist and St. James Parishes, Louisiana. Without action, an estimated 62,900 residents and 20,000 residential structures; 1,900 non-residential structures; and 165 public and quasi-public facilities will be at risk to damage from hurricane and tropical storm surge damages.

Eleven management measures were crafted to address storm surge. Structural and nonstructural features included levees, elevating buildings, and restoring cypress swamp. Measures were combined into a dozen alternative plans. A focused array of four alternative plans was evaluated under SMART Planning. Alternatives A and C are comprised of non-structural measures and levee alignments. A third plan (Alternative D) consists of a levee and flood wall alignment. A no-action plan is the basis to compare benefits and environmental impacts.

Alternative C is the Tentatively Selected Plan (TSP). Feasibility-level design will commence after the SMART Planning Agency Decision Milestone and will finish before a Final

Report. The TSP is an 18.27-mile risk reduction system around the communities of Montz, Laplace, Reserve, and Garyville with non-structural components in St. James Parish. The alignment of the TSP is shown in Figure 3-6 of the Integrated Draft Report. The risk of storm surge damage would be reduced for over 7,000 structures and four miles of I-10 located in the system. Inclusion of this segment of I-10 would help maintain a major emergency evacuation and re-entry route for residents of southeast Louisiana, including residents in the New Orleans metropolitan area. The TSP also includes non-structural measures for 1,571 structures in the communities of Gramercy, Lutcher, and Grand Point that are located outside of the proposed levee system. It is estimated that these non-structural measures would include elevation of 1,481 structures and acquisition of 90 structures. Implementation of non-structural features will be developed in more detail during feasibility level of design and analysis during which time an economic analysis will be conducted based on economic reaches. In developing the plan, consideration with be given to community cohesion and the requirements of E.O. 12898.

The structural component of the system would consist of earthen levees, floodwalls (T-walls), floodgates, drainage structures, and pump stations located along the alignment. The preliminary level of design, based on modeling for a 1 percent AEP storm event includes levee elevations that would range from +13.5 NAVD88 on the eastern reaches near the Bonnet Carré Spillway to +7.0 NAVD88 in the western portion of the project area. They would be constructed with 3:1 side slopes with a 10-foot crown width. Construction of levees would involve the placement of 3,100,000 cubic yards of compacted and uncompacted clay (borrow) material on top of 3,400,000 square yards of geotextile fabric. Approximately 26,124 cubic yards of aggregate limestone would be used to build a road on the levee crown. A conveyance canal at a depth of - 10 ft. NAVD88 would be situated along the levee. Floodwalls would be located under the I-10/I- 55 interchange and other areas where space is limited. Nine floodwall sections would span 5,304 linear feet over the length of the system. The system would include 2,080 feet of drainage gates, 288 feet of roadway gates, two railway gates, and thirty-six pipeline crossings. Four pump stations would be located along the alignment to ensure the project does not adversely impact local drainage. Design parameters will be further refined during feasibility level design and analysis which may result in changes to the design parameters; however, the TSP is anticipated to reduce risk for at minimum a 1 percent AEP storm event but not exceed a 0.5 percent AEP storm event.

The TSP would maintain hydrologic connectivity to the extent practicable through the use of water control structures except during closure for hurricane and tropical storm surge events. When the system is closed, pumps would operate on average for 1.7 storm events per year, which equates to closure of structures on average 8.5 days per year. The structural alignment would directly convert approximately 856 acres to uplands including approximately 775 acres of hydric soils, 14.8 acres of water bottoms, and 55.4 acres of prime farmlands. Approximately 8,424 acres of wetlands could be indirectly impacted due to enclosing the project area within the levee system. Further investigation is required to determine if cultural resources are located

within any part of the footprint. Additional environmental investigations will be performed during feasibility-level design and analysis. The estimated cost of the TSP is $880,851,070. The BCR for the TSP is equal to 1.63 to 1 with annualized net benefits equal to approximately $23,000,000.

Section 106 Consultation

Formal Section 106 consultation pursuant to 36 CFR § 800.3(c) has been initiated with the Louisiana State Historic Preservation Officer (SHPO) and eleven federally-recognized Tribes with an interest in USACE undertakings within the boundaries of CEMVN. The Choctaw Nation of Oklahoma has requested additional information regarding the undertaking, and the CEMVN will continue consultation with the SHPO and federally-recognized Tribes. With selection of the TSP as presented in the Integrated Draft Report, the CEMVN will now proceed with the identification and evaluation of historic properties, the results of which will be coordinated with the SHPO and federally-recognized Tribes in a continuation of Section 106 consultation.

Integrated Draft Report

Finally, I would like to offer my apologies for an oversight resulting in an error on page 7-2 of the Integrated Draft Report. You may note that both federally-recognized Tribes and non-federally- recognized tribes are included in Table 7.1: List of report recipients, and that the Mississippi Band of Choctaw Indians was inadvertently omitted. No disrespect was intended, and actions have already been taken to ensure that this is corrected for the final report.

This is the first CEMVN study within the USACE SMART Planning framework, which organizes the planning process for feasibility studies around key decision points. Over the next few months a public comment period will be conducted along with technical, peer and policy reviews. Additional feasibility work remains to be completed on engineering, cost estimating, environmental, economic, real estate and construction elements of the plan. Results of the reviews and additional feasibility work will be incorporated into the final report, which will be made available for review before the Chief of Engineers makes a final recommendation on the project.

Please review the Integrated Draft Report and provide comments. The official closing date for receipt of comments will be 45 days from the date on which the Notice of Availability of the Draft EIS appears in the Federal Register. Please send comments or questions on the Draft Integrated Report the U.S. Army Corps of Engineers, New Orleans District, Attention: Dr. William P. Klein, Jr., P.O. Box 60267, New Orleans, Louisiana 70160-0267. Telephone: (504) 862-2540; FAX: (504) 862-2088. Comments may also be provided electronically to the study web site at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

As always, should you have any questions or concerns about the proposed action or the SMART Planning framework, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. You may also contact the project archaeologist Dr. Paul Hughbanks with any questions or comments at (504) 862-1100 or Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter will be provided to Mr. Bryant J. Celestine, Historic Preservation Officer, Alabama Coushatta Tribe of Texas, celestine.bryant@actribe.org.

Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Brenda Shemayme Edwards, Chairwoman
Caddo Nation of Oklahoma
P.O. Box 487
Binger, OK 73009

Dear Chairwoman Edwards:

The United States Army Corps of Engineers (USACE), New Orleans District (CEMVN), has prepared an Integrated Draft Feasibility Report and Environmental Impact Statement (Integrated Draft Report) for the West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction Study. The Integrated Draft Report is available electronically for review at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain, and hard copies are available upon request.

In partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act (NEPA), and Section 106 of the National Historic Preservation Act, the CEMVN offers you the opportunity to review and comment on the potential of the proposed action described in the Integrated Draft Report to significantly affect protected tribal resources, tribal rights, or Indian lands. Consultation for the proposed action was initiated in a letter dated May 3, 2013.

The Integrated Draft Report proposes potential solutions to reduce damages from hurricane and tropical storm surge for residents in St. Charles, St. John the Baptist and St. James Parishes, Louisiana. Without action, an estimated 62,900 residents and 20,000 residential structures; 1,900 non-residential structures; and 165 public and quasi-public facilities will be at risk to damage from hurricane and tropical storm surge damages.

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The TSP would maintain hydrologic connectivity to the extent practicable through the use of water control structures except during closure for hurricane and tropical storm surge events. When the system is closed, pumps would operate on average for 1.7 storm events per year, which equates to closure of structures on average 8.5 days per year. The structural alignment would directly convert approximately 856 acres to uplands including approximately 775 acres of hydric soils, 14.8 acres of water bottoms, and 55.4 acres of prime farmlands. Approximately 8,424 acres of wetlands could be indirectly impacted due to enclosing the project area within the levee system. Further investigation is required to determine if cultural resources are located

within any part of the footprint. Additional environmental investigations will be performed during feasibility-level design and analysis. The estimated cost of the TSP is $880,851,070. The BCR for the TSP is equal to 1.63 to 1 with annualized net benefits equal to approximately $23,000,000.

Section 106 Consultation

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Integrated Draft Report

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Sincerely,

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

John Paul Darden, Chairman
Chitimacha Tribe of Louisiana
P.O. Box 661
Charenton, LA 70523

Dear Chairman Darden:

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Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO ATTENTION OF

Regional Planning and
Environment Division, South

Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
P.O. Box 1210
Durant, OK 74702-1210

Dear Chief Pyle:

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Kevin Sickey, Chief
Coushatta Tribe of Louisiana
P.O. Box 818
Elton, LA 70532

Dear Chief Sickey:

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

B. Cheryl Smith, Principal Chief
Jena Band of Choctaw Indians
P.O. Box 14
Jena, LA 71342

Dear Principal Chief Smith:

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Phyliss J. Anderson, Chief
Mississippi Band of Choctaw Indians
P.O. Box 6257
Choctaw, MS 39350

Dear Chief Anderson:

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Sincerely,

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Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO ATTENTION OF

Regional Planning and
Environment Division, South

John Berrey, Chairman
Quapaw Tribe of Oklahoma
P.O. Box 765
Quapaw, OK 74363

Dear Chairman Berrey:

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Sincerely,

Joan M. Exnicios

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Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Leonard M. Harjo, Principal Chief
Seminole Nation of Oklahoma
P.O. Box 1498
Wewoka, OK 74884

Dear Principal Chief Harjo:

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

James Billie, Chairman
Seminole Tribe of Florida
6300 Stirling Road
Hollywood, FL 33024

Dear Chairman Billie:

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In partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act (NEPA), and Section 106 of the National Historic Preservation Act, the CEMVN offers you the opportunity to review and comment on the potential of the proposed action described in the Integrated Draft Report to significantly affect protected tribal resources, tribal rights, or Indian lands. Consultation for the proposed action was initiated in a letter dated May 3, 2013.

The Integrated Draft Report proposes potential solutions to reduce damages from hurricane and tropical storm surge for residents in St. Charles, St. John the Baptist and St. James Parishes, Louisiana. Without action, an estimated 62,900 residents and 20,000 residential structures; 1,900 non-residential structures; and 165 public and quasi-public facilities will be at risk to damage from hurricane and tropical storm surge damages.

Eleven management measures were crafted to address storm surge. Structural and nonstructural features included levees, elevating buildings, and restoring cypress swamp. Measures were combined into a dozen alternative plans. A focused array of four alternative plans was evaluated under SMART Planning. Alternatives A and C are comprised of non-structural measures and levee alignments. A third plan (Alternative D) consists of a levee and flood wall alignment. A no-action plan is the basis to compare benefits and environmental impacts.

Alternative C is the Tentatively Selected Plan (TSP). Feasibility-level design will commence after the SMART Planning Agency Decision Milestone and will finish before a Final

Report. The TSP is an 18.27-mile risk reduction system around the communities of Montz, Laplace, Reserve, and Garyville with non-structural components in St. James Parish. The alignment of the TSP is shown in Figure 3-6 of the Integrated Draft Report. The risk of storm surge damage would be reduced for over 7,000 structures and four miles of I-10 located in the system. Inclusion of this segment of I-10 would help maintain a major emergency evacuation and re-entry route for residents of southeast Louisiana, including residents in the New Orleans metropolitan area. The TSP also includes non-structural measures for 1,571 structures in the communities of Gramercy, Lutcher, and Grand Point that are located outside of the proposed levee system. It is estimated that these non-structural measures would include elevation of 1,481 structures and acquisition of 90 structures. Implementation of non-structural features will be developed in more detail during feasibility level of design and analysis during which time an economic analysis will be conducted based on economic reaches. In developing the plan, consideration with be given to community cohesion and the requirements of E.O. 12898.

The structural component of the system would consist of earthen levees, floodwalls (T-walls), floodgates, drainage structures, and pump stations located along the alignment. The preliminary level of design, based on modeling for a 1 percent AEP storm event includes levee elevations that would range from +13.5 NAVD88 on the eastern reaches near the Bonnet Carré Spillway to +7.0 NAVD88 in the western portion of the project area. They would be constructed with 3:1 side slopes with a 10-foot crown width. Construction of levees would involve the placement of 3,100,000 cubic yards of compacted and uncompacted clay (borrow) material on top of 3,400,000 square yards of geotextile fabric. Approximately 26,124 cubic yards of aggregate limestone would be used to build a road on the levee crown. A conveyance canal at a depth of - 10 ft. NAVD88 would be situated along the levee. Floodwalls would be located under the I-10/I- 55 interchange and other areas where space is limited. Nine floodwall sections would span 5,304 linear feet over the length of the system. The system would include 2,080 feet of drainage gates, 288 feet of roadway gates, two railway gates, and thirty-six pipeline crossings. Four pump stations would be located along the alignment to ensure the project does not adversely impact local drainage. Design parameters will be further refined during feasibility level design and analysis which may result in changes to the design parameters; however, the TSP is anticipated to reduce risk for at minimum a 1 percent AEP storm event but not exceed a 0.5 percent AEP storm event.

The TSP would maintain hydrologic connectivity to the extent practicable through the use of water control structures except during closure for hurricane and tropical storm surge events. When the system is closed, pumps would operate on average for 1.7 storm events per year, which equates to closure of structures on average 8.5 days per year. The structural alignment would directly convert approximately 856 acres to uplands including approximately 775 acres of hydric soils, 14.8 acres of water bottoms, and 55.4 acres of prime farmlands. Approximately 8,424 acres of wetlands could be indirectly impacted due to enclosing the project area within the levee system. Further investigation is required to determine if cultural resources are located

within any part of the footprint. Additional environmental investigations will be performed during feasibility-level design and analysis. The estimated cost of the TSP is $880,851,070. The BCR for the TSP is equal to 1.63 to 1 with annualized net benefits equal to approximately $23,000,000.

Section 106 Consultation

Formal Section 106 consultation pursuant to 36 CFR § 800.3(c) has been initiated with the Louisiana State Historic Preservation Officer (SHPO) and eleven federally-recognized Tribes with an interest in USACE undertakings within the boundaries of CEMVN. The Choctaw Nation of Oklahoma has requested additional information regarding the undertaking, and the CEMVN will continue consultation with the SHPO and federally-recognized Tribes. With selection of the TSP as presented in the Integrated Draft Report, the CEMVN will now proceed with the identification and evaluation of historic properties, the results of which will be coordinated with the SHPO and federally-recognized Tribes in a continuation of Section 106 consultation.

Integrated Draft Report

Finally, I would like to offer my apologies for an oversight resulting in an error on page 7-2 of the Integrated Draft Report. You may note that both federally-recognized Tribes and non-federally- recognized tribes are included in Table 7.1: List of report recipients, and that the Mississippi Band of Choctaw Indians was inadvertently omitted. No disrespect was intended, and actions have already been taken to ensure that this is corrected for the final report.

This is the first CEMVN study within the USACE SMART Planning framework, which organizes the planning process for feasibility studies around key decision points. Over the next few months a public comment period will be conducted along with technical, peer and policy reviews. Additional feasibility work remains to be completed on engineering, cost estimating, environmental, economic, real estate and construction elements of the plan. Results of the reviews and additional feasibility work will be incorporated into the final report, which will be made available for review before the Chief of Engineers makes a final recommendation on the project.

Please review the Integrated Draft Report and provide comments. The official closing date for receipt of comments will be 45 days from the date on which the Notice of Availability of the Draft EIS appears in the Federal Register. Please send comments or questions on the Draft Integrated Report the U.S. Army Corps of Engineers, New Orleans District, Attention: Dr. William P. Klein, Jr., P.O. Box 60267, New Orleans, Louisiana 70160-0267. Telephone: (504) 862-2540; FAX: (504) 862-2088. Comments may also be provided electronically to the study web site at http://www.mvn.usace.army.mil/About/Projects/WestShoreLakePontchartrain.

As always, should you have any questions or concerns about the proposed action or the SMART Planning framework, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. You may also contact the project archaeologist Dr. Paul Hughbanks with any questions or comments at (504) 862-1100 or Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter will be provided to Mr. Paul N. Backhouse, Tribal Historic Preservation Officer, Seminole Tribe of Florida, paulbackhouse@semtribe.com; Ms. Anne Mullins, Deputy Tribal Historic Preservation Officer, annemullins@semtribe.com; Mr. Bradley Mueller, Compliance Review Supervisor, bradleymueller@semtribe.com; and Ms. Alison Swing, Compliance Review Data Analyst, alisonswing@semtribe.com.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

AUGUST 23, 2013

REPLY TO
ATTENTION OF

Regional Planning and
Environment Division, South

Earl J. Barbry, Sr., Chairman
Tunica-Biloxi Tribe of Louisiana
P.O. Box 1589
Marksville, LA 71351

Dear Chairman Barbry:

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As always, should you have any questions or concerns about the proposed action or the SMART Planning framework, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. You may also contact the project archaeologist Dr. Paul Hughbanks with any questions or comments at (504) 862-1100 or Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter will be provided to Mr. Earl Barbry, Jr., Cultural Director, Tunica-Biloxi Tribe of Louisiana, earlii@tunica.org.

Sincerely,

Joan M. Exnicios
Chief, Environmental Planning Branch

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

Carlos Bullock, Chairman
Alabama-Coushatta Tribe of Texas
571 State Park Rd 56
Livingston, TX 77351

Dear Chairman Bullock:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

The purpose of this letter is to initiate consultation for the WSLP LA HSDRR study, in partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act, and Section 106 of the National Historic Preservation Act. The CEMVN offers you the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands.

<u>Study Authority and History of Investigation</u>

The WSLP LA HSDRR study was initiated by two authorizations, one by the House of Representatives in 1971 and another by the Senate in 1974. Several formulations and reports have been accomplished since the original authorizations. In 1996 Congress authorized funding for a general investigation into hurricane and flood protection in St. James, St. John the Baptist, and St. Charles parishes in the area west of the Bonne Carré Spillway as part of the Lake Pontchartrain and Vicinity, Louisiana Authority. Subsequently, a feasibility study was initiated and the preliminary findings were presented to the PLD and St. John Parish in 1998. One of the eight alignments from the preliminary findings and an additional alignment presented by the PLD were chosen for further investigation and in 2003, the USACE presented alignment and

cost options to the PLD and St. John the Baptist Parish for these two alternatives. No consensus could be reached on which alignment to pursue and the study was halted. In 2006, the PLD developed a third alignment for consideration by the USACE and St. John the Baptist Parish. A preliminary screening level analysis was completed in 2007, and the PLD and the USACE agreed to re-initiate the feasibility study and an EIS.

Study Area

The WSLP LA HSDRR study area is located in St. Charles, St. John the Baptist and St. James parishes, Louisiana (see enclosed Figure 1). The study area is bounded on the east by the west guide levee of the Bonnet Carré Spillway, on the north by Lake Pontchartrain and Lake Maurepas, on the west by the St. James Parish line and on the south by the Mississippi River. The study area includes residential, commercial, industrial and undeveloped land. The southern portion of the study contains the communities of LaPlace, Reserve, Garyville, Gramercy, Lutcher and Convent. Most of the northern portion is occupied by the Maurepas Swamp Wildlife Management Area and includes sections of Interstate Highway 10 (I-10) and I-55.

Proposed Alignments

Thirty-two alignments were identified and screened based on objectives and constraints and local conditions, including pipeline avoidance and storage and infrastructure concerns, reducing the number of alignments to twelve. These twelve alignments were ranked based on their ability to meet the study objectives and avoid constraints, and the top four alignments that met evaluation criteria were carried forward for evaluation. An additional non-structural alternative was developed.

The final array of alternatives include the No Action Alternative; Alternative A: Spillway to Hope Canal/Mississippi River and Non-Structural Alternative; Alternative C: Spillway to Hope Canal/MS River (Pipeline Avoidance) and Non-Structural Alternative; Alternative D: Spillway to Ascension Parish (I-10 Protection) without Non-Structural Alternative; and Alternative E: Non-Structural Alternative (see enclosed Figure 2).

Section 106 Consultation

This letter initiates formal Section 106 consultation pursuant to 36 CFR § 800.3(c). The majority of the authorized study area is within the Maurepas Swamp, although the study area also contains natural levee of the Mississippi River. Upon selection of the tentatively selected plan and the identification of historic properties, in accordance with 36 CFR § 800.4, the CEMVN will continue Section 106 consultation. Also enclosed is a copy of the 3 May 2013 CEMVN letter to the Louisiana State Historic Preservation Officer.

Your response to this letter, including any information your office may wish to provide at this time concerning the proposed undertaking and its potential to significantly affect protected tribal resources, tribal rights, or Indian lands is greatly appreciated. Please also notify us of any other interested party who may wish to participate in this consultation.

As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. You may also contact the project archaeologist Dr. Paul Hughbanks with any questions or comments at (504) 862-1100 or Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter with enclosures will be provided to Mr. Bryant J. Celestine, Historic Preservation Officer, Alabama Coushatta Tribe of Texas, celestine.bryant@actribe.org.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

Brenda Shemayme Edwards, Chairwoman
Caddo Nation of Oklahoma
P.O. Box 487
Binger, OK 73009

Dear Chairwoman Edwards:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

The purpose of this letter is to initiate consultation for the WSLP LA HSDRR study, in partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act, and Section 106 of the National Historic Preservation Act. The CEMVN offers you the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands.

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Study Area

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Proposed Alignments

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Sincerely,

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Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

John Paul Darden, Chairman
Chitimacha Tribe of Louisiana
P.O. Box 661
Charenton, LA 70523

Dear Chairman Darden:

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As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. You may also contact the project archaeologist Dr. Paul Hughbanks with any questions or comments at (504) 862-1100 or Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter with enclosures will be provided to Mrs. Kimberly Walden, M. Ed., Cultural Director/Tribal Historic Preservation Officer, Chitimacha Tribe of Louisiana, kswalden@chitimacha.gov.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

Gregory E. Pyle, Chief
Choctaw Nation of Oklahoma
P.O. Box 1210
Durant, OK 74702-1210

Dear Chief Pyle:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

The purpose of this letter is to initiate consultation for the WSLP LA HSDRR study, in partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act, and Section 106 of the National Historic Preservation Act. The CEMVN offers you the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands.

<u>Study Authority and History of Investigation</u>

The WSLP LA HSDRR study was initiated by two authorizations, one by the House of Representatives in 1971 and another by the Senate in 1974. Several formulations and reports have been accomplished since the original authorizations. In 1996 Congress authorized funding for a general investigation into hurricane and flood protection in St. James, St. John the Baptist, and St. Charles parishes in the area west of the Bonne Carré Spillway as part of the Lake Pontchartrain and Vicinity, Louisiana Authority. Subsequently, a feasibility study was initiated and the preliminary findings were presented to the PLD and St. John Parish in 1998. One of the eight alignments from the preliminary findings and an additional alignment presented by the PLD were chosen for further investigation and in 2003, the USACE presented alignment and

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Section 106 Consultation

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

Kevin Sickey, Chief
Coushatta Tribe of Louisiana
P.O. Box 818
Elton, LA 70532

Dear Chief Sickey:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

B. Cheryl Smith, Principal Chief
Jena Band of Choctaw Indians
P.O. Box 14
Jena, LA 71342

Dear Principal Chief Smith:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

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Sincerely,

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

Phyliss J. Anderson, Chief
Mississippi Band of Choctaw Indians
P.O. Box 6257
Choctaw, MS 39350

Dear Chief Anderson:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

John Berrey, Chairman
Quapaw Tribe of Oklahoma
P.O. Box 765
Quapaw, OK 74363

Dear Chairman Berrey:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

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Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

May 3, 2013

Regional Planning and
Environment Division, South

Leonard M. Harjo, Principal Chief
Seminole Nation of Oklahoma
P.O. Box 1498
Wewoka, OK 74884

Dear Principal Chief Harjo:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

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The WSLP LA HSDRR study area is located in St. Charles, St. John the Baptist and St. James parishes, Louisiana (see enclosed Figure 1). The study area is bounded on the east by the west guide levee of the Bonnet Carré Spillway, on the north by Lake Pontchartrain and Lake Maurepas, on the west by the St. James Parish line and on the south by the Mississippi River. The study area includes residential, commercial, industrial and undeveloped land. The southern portion of the study contains the communities of LaPlace, Reserve, Garyville, Gramercy, Lutcher and Convent. Most of the northern portion is occupied by the Maurepas Swamp Wildlife Management Area and includes sections of Interstate Highway 10 (I-10) and I-55.

Proposed Alignments

Thirty-two alignments were identified and screened based on objectives and constraints and local conditions, including pipeline avoidance and storage and infrastructure concerns, reducing the number of alignments to twelve. These twelve alignments were ranked based on their ability to meet the study objectives and avoid constraints, and the top four alignments that met evaluation criteria were carried forward for evaluation. An additional non-structural alternative was developed.

The final array of alternatives include the No Action Alternative; Alternative A: Spillway to Hope Canal/Mississippi River and Non-Structural Alternative; Alternative C: Spillway to Hope Canal/MS River (Pipeline Avoidance) and Non-Structural Alternative; Alternative D: Spillway to Ascension Parish (I-10 Protection) without Non-Structural Alternative; and Alternative E: Non-Structural Alternative (see enclosed Figure 2).

Section 106 Consultation

This letter initiates formal Section 106 consultation pursuant to 36 CFR § 800.3(c). The majority of the authorized study area is within the Maurepas Swamp, although the study area also contains natural levee of the Mississippi River. Upon selection of the tentatively selected plan and the identification of historic properties, in accordance with 36 CFR § 800.4, the CEMVN will continue Section 106 consultation. Also enclosed is a copy of the 3 May 2013 CEMVN letter to the Louisiana State Historic Preservation Officer.

Your response to this letter, including any information your office may wish to provide at this time concerning the proposed undertaking and its potential to significantly affect protected tribal resources, tribal rights, or Indian lands is greatly appreciated. Please also notify us of any other interested party who may wish to participate in this consultation.

As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. You may also contact the project archaeologist Dr. Paul Hughbanks with any questions or comments at (504) 862-1100 or Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter with enclosures will be provided to Ms. Natalie Harjo, Tribal Historic Preservation Officer, Seminole Nation of Oklahoma, harjo.n@sno-nsn.gov.

Sincerely,

Joan M. Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

REPLY TO
ATTENTION OF

May 3, 2013

Regional Planning and
Environment Division, South

James Billie, Chairman
Seminole Tribe of Florida
6300 Stirling Road
Hollywood, FL 33024

Dear Chairman Billie:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

The purpose of this letter is to initiate consultation for the WSLP LA HSDRR study, in partial fulfillment of responsibilities under Executive Order 13175, the National Environmental Policy Act, and Section 106 of the National Historic Preservation Act. The CEMVN offers you the opportunity to review and comment on the potential of the proposed action to significantly affect protected tribal resources, tribal rights, or Indian lands.

Study Authority and History of Investigation

The WSLP LA HSDRR study was initiated by two authorizations, one by the House of Representatives in 1971 and another by the Senate in 1974. Several formulations and reports have been accomplished since the original authorizations. In 1996 Congress authorized funding for a general investigation into hurricane and flood protection in St. James, St. John the Baptist, and St. Charles parishes in the area west of the Bonne Carré Spillway as part of the Lake Pontchartrain and Vicinity, Louisiana Authority. Subsequently, a feasibility study was initiated and the preliminary findings were presented to the PLD and St. John Parish in 1998. One of the eight alignments from the preliminary findings and an additional alignment presented by the PLD were chosen for further investigation and in 2003, the USACE presented alignment and

cost options to the PLD and St. John the Baptist Parish for these two alternatives. No consensus could be reached on which alignment to pursue and the study was halted. In 2006, the PLD developed a third alignment for consideration by the USACE and St. John the Baptist Parish. A preliminary screening level analysis was completed in 2007, and the PLD and the USACE agreed to re-initiate the feasibility study and an EIS.

Study Area

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Proposed Alignments

Thirty-two alignments were identified and screened based on objectives and constraints and local conditions, including pipeline avoidance and storage and infrastructure concerns, reducing the number of alignments to twelve. These twelve alignments were ranked based on their ability to meet the study objectives and avoid constraints, and the top four alignments that met evaluation criteria were carried forward for evaluation. An additional non-structural alternative was developed.

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Your response to this letter, including any information your office may wish to provide at this time concerning the proposed undertaking and its potential to significantly affect protected tribal resources, tribal rights, or Indian lands is greatly appreciated. Please also notify us of any other interested party who may wish to participate in this consultation.

As always, should you have any questions or concerns about the proposed action, you may contact Ms. Rebecca Hill; Archeologist/Tribal Liaison; U.S. Army Corps of Engineers, New Orleans District; (504) 862-1474; Rebecca.Hill@usace.army.mil. You may also contact the project archaeologist Dr. Paul Hughbanks with any questions or comments at (504) 862-1100 or Paul.J.Hughbanks@usace.army.mil. An electronic copy of this letter with enclosures will be provided to Mr. Paul N. Backhouse, Tribal Historic Preservation Officer, Seminole Tribe of Florida, paulbackhouse@semtribe.com; Ms. Anne Mullins, Deputy Tribal Historic Preservation Officer, annemullins@semtribe.com; Mr. Bradley Mueller, Compliance Review Supervisor, bradleymueller@semtribe.com; Mr. Elliott York, Compliance Review and Data Analyst, elliottyork@semtribe.com; and Ms. Alison Swing, Compliance Review Data Analyst, alisonswing@semtribe.com.

Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P.O. BOX 60267
NEW ORLEANS, LOUISIANA 70160-0267

May 3, 2013

Regional Planning and
Environment Division, South

Earl J. Barbry, Sr., Chairman
Tunica-Biloxi Tribe of Louisiana
P.O. Box 1589
Marksville, LA 71351

Dear Chairman Barbry:

The United States Army Corps of Engineers (USACE) and the Pontchartrain Levee District (PLD) have initiated an investigation into the feasibility of providing hurricane and storm damage risk reduction to residents living in the area west of the Bonnet Carré Spillway between the Mississippi River and Lakes Pontchartrain and Maurepas and the St. James Parish line. The New Orleans District (CEMVN) is preparing a West Shore-Lake Pontchartrain (WSLP) Integrated Feasibility Study/Environmental Impact Statement (Integrated Report), which will describe all aspects of the WSLP Louisiana Hurricane and Storm Damage Risk Reduction (HSDRR) study, from its inception, through the evolution of the various alternatives, the discussion of potential impacts to all applicable natural, socioeconomic and cultural resources, to the decision to recommend a preferred alternative.

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Sincerely,

Joan M Exnicios

Joan M. Exnicios
Chief, Environmental Planning Branch

Enclosures

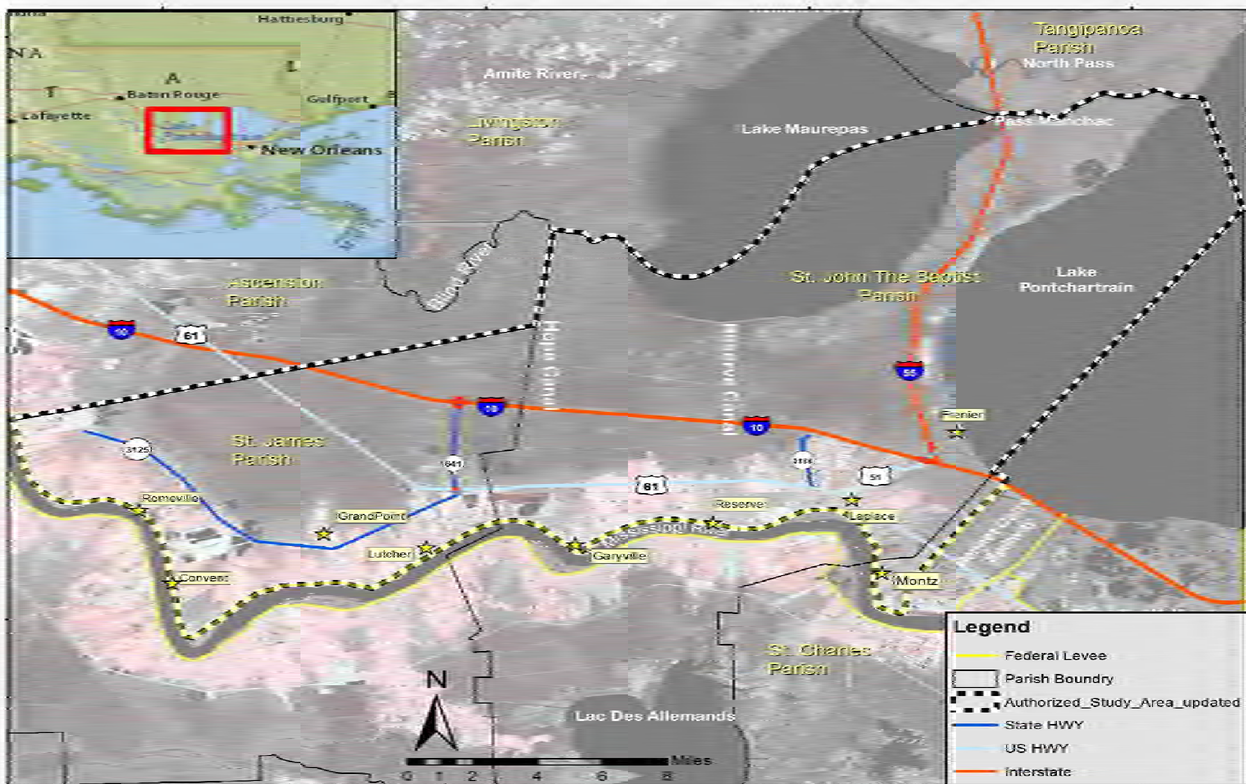

Figure 1. West Shore-Lake Pontchartrain Louisiana Hurricane and Storm Damage Risk Reduction Study Area.

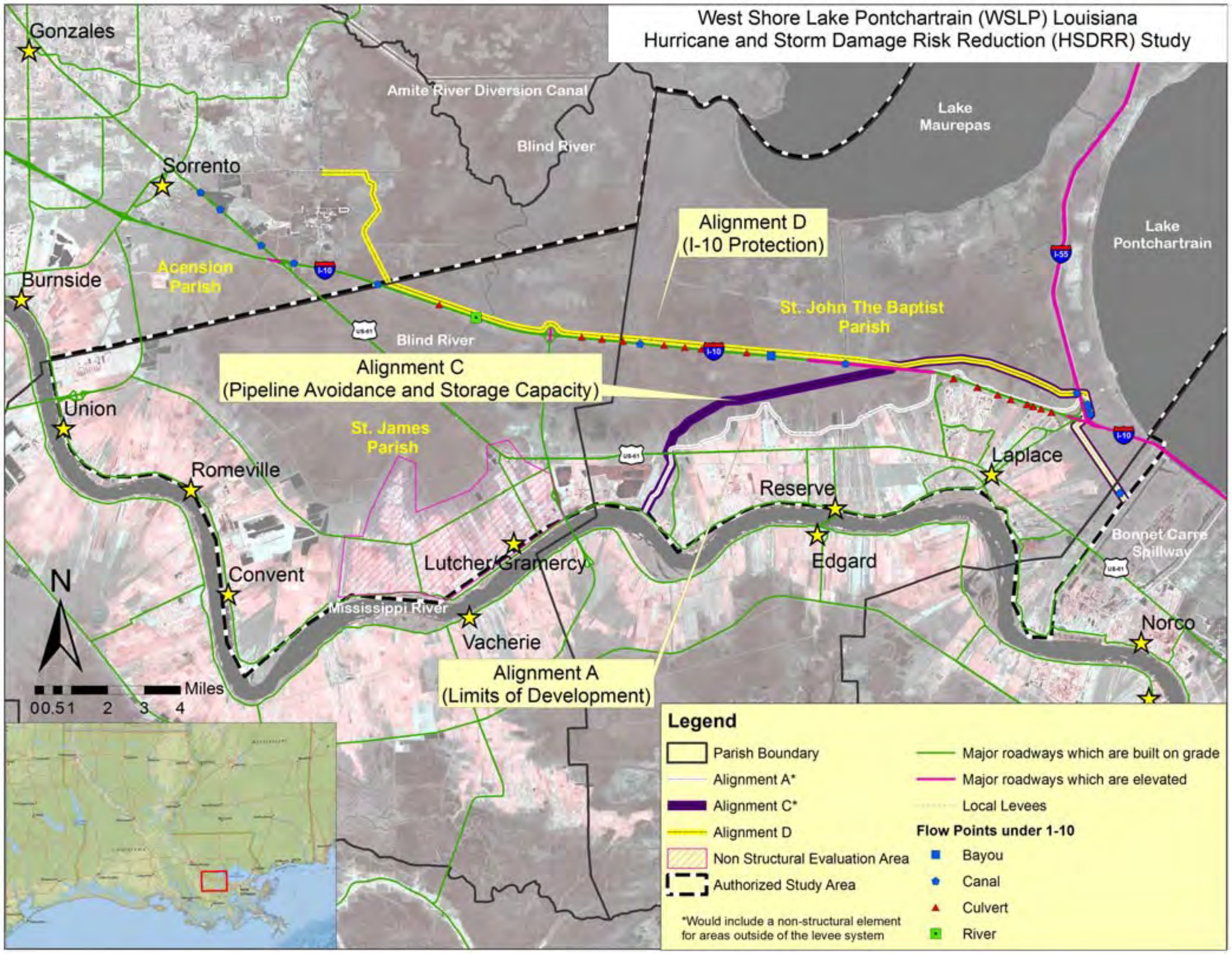

Figure 2. West Shore-Lake Pontchartrain Louisiana Hurricane and Storm Damage Risk Reduction Study Final Array of Alternatives.

Annex H: Floodplain Management

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, NEW ORLEANS DISTRICT
7400 LEAKE AVENUE
NEW ORLEANS LA 70118-3651

Mr. Rene Pastorek
Planning and Zoning Director
St. John the Baptist Parish
1811 W. Airline Hwy
LaPlace, LA 70068

Date: June 2, 2023

Dear Mr. Pastorek:

This letter is notifying you that a Draft Supplemental Environmental Assessment (SEA 571A) for the West Shore Lake Pontchartrain Hurricane and Storm Risk Reduction Levee System in St. Charles and St. John the Baptist Parishes, Louisiana, and a draft Finding of No Significant Impact (FONSI), have been prepared by the U.S. Army Corps of Engineers, New Orleans District (CEMVN).

Draft SEA 571A evaluates the potential impacts of altering the levee alignment footprint as described in the West Shore Lake Pontchartrain Environmental Impact Statement (2016 WSLP EIS) and SEA 571, and modifications to features described in SEA 570 and SEA 571. An electronic copy of the report and its appendices, along with the prior reports and supporting documents are located on the CEMVN District web page at: https://www.mvn.usace.army.mil/About/Projects/BBA-2018/West-Shore-Lake-Pontchartrain/.

The proposed action, as described in SEA 571A, is consistent with Executive Order (EO) 11990. All unavoidable impacts to wetlands associated with the proposed action would be fully mitigated to the full extent of the law.

The proposed action, as described in SEA 571A, would modify the floodplain. However, the proposed action is compliant with EO 11988 based on the reasons below:

a. The purpose of the proposed action is to construct a hurricane storm damage risk reduction system for parts of St. John the Baptist and St. Charles Parishes, Louisiana on the eastern bank of the Mississippi River. Construction of the proposed action would provide 1-percent annual exceedance risk reduction to these communities.

b. SEA 571A supplements the 2016 WSLP EIS. Part of the Recommended Plan, as described in the 2016 WSLP EIS, included construction of a levee alignment in St. John the Baptist and St. Charles Parishes. The 2016 WSLP EIS followed the eight-step process required in Section 2(a) of EO 11988 to demonstrate coordination and compliance with EO 11988. It was determined that the Recommended Plan, as described in the 2016 WSLP EIS, would avoid short-term and long-term adverse effects associated with the occupancy and the modification of the existing floodplain.

If you have questions or concerns, please contact Kristin Gunning by email at kristin.t.gunning@usace.army.mil or by phone at (504) 862-1514.

WILLIAMS.ERIC.MITCHELL.1065454323 Digitally signed by WILLIAMS.ERIC.MITCHELL.1065454323 Date: 2023.05.26 12:09:27 -05'00'

Eric M. Williams
Chief, Environmental Studies Branch

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS, NEW ORLEANS DISTRICT
7400 LEAKE AVENUE
NEW ORLEANS LA 70118-3651

Mr. Earl Matherne
Coastal Zone Management
P.O. Box 302
Hahnville, LA 70057

Date: June 2, 2023

Dear Mr. Matherne:

This letter is notifying you that a Draft Supplemental Environmental Assessment (SEA 571A) for the West Shore Lake Pontchartrain Hurricane and Storm Risk Reduction Levee System in St. Charles and St. John the Baptist Parishes, Louisiana, and a draft Finding of No Significant Impact (FONSI), have been prepared by the U.S. Army Corps of Engineers, New Orleans District (CEMVN).

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If you have questions or concerns, please contact Kristin Gunning by email at kristin.t.gunning@usace.army.mil or by phone at (504) 862-1514.

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Eric M. Williams
Chief, Environmental Studies Branch

Appendix VIII - Acronyms

2016 WSLP EIS - West Shore Lake Pontchartrain Environmental Impact Statement
AADT - Annual Average Daily Traffic
AAHU - Average Annual Habitat Unit
ACHP - Advisory Council of Historic Preservation
ACS - American Community Service
B.C. - before Christ
BCS – Bonnet Carre' Spillway
BGEPA – Bald and Golden Eagle Protection Act
BLH - Bottomland Hardwoods
BMP - Best Management Practice
C/L - Centerline
CAA - Clean Air Act
CAR - Coordination Act Report
CDP - Census Designated Place
CEMVN - United States Army Corps of Engineers, Mississippi Valley Division, New Orleans District
CEQ - Council of Environmental Quality
CFR - Code of Federal Regulations
CI - Cumulative Impacts
CO - Carbon Monoxide
CPT – Cone Penetration Testing
CR – Cultural Resources
CRMS - Coastwide Reference Monitoring System
CWA - Clean Water Act
CZMA - Coastal Zone Management Act
dBA - A weighted decibel
DOTD - Department of Transportation and Development
EFH – Essential Fish Habitat
EIS - Environmental Impacts Statement
EJ - Environmental Justice
EO – Executive Order
EPA – Environmental Protection Agency
ER – Engineering Regulation
ESA - Endangered Species Act
FONSI - Finding of No Significant Impacts
FWCA - Fish and Wildlife Coordination Act
FWOP - Future Without Project
FWP - Future With Project
HSI - Habitat Suitability Index
HSDRRS - Hurricane Storm Damage Risk Reduction System
HTRW - Hazardous, Toxic, and Radioactive Waste
HU - Habitat Unit

Hwy - Highway

I - Interstate

LA - Louisiana

LCA - Louisiana Coastal Area

LDEQ – Louisiana Department of Environmental Quality

LDNR – Louisiana Department of Natural Resources

LDWF – Louisiana Department of Wildlife and Fisheries

MBTA – Migratory Bird Treaty Act

MP2.5 - Particulate Material less than

MSWMA – Maurepas Swamp Wildlife Management Area

NAAQS - National Air Quality Standards

NEPA - National Environmental Policy Act

NMFS – National Marine Fisheries Service

No. - Number

NO2 - Nitrous dioxide

NPP - Nesting Prevention Plan

NRCS – National Resource Conservation Service

NRHP - National Register of Historic Places

O3 - Oxone

PA - Programmatic Agreement

Pb - Lead

PDS-C - United States Army Corps of Engineers, Mississippi Valley Division, Regional Planning Division, South, Environmental Planning Branch, Environmental Studies Section

PED - Planning, Engineering, and Design

ROD - Record of Decision

ROE- Right of Entry

ROW – Right of Way

SAV – Submerged Aquatic Vegetation

SEA - Supplemental Environmental Assessment

SHPO – State Historic Preservation Officer

SI - Suitability Index

T&E - Threated and Endangered

US - United States

USACE - United States Army Corps of Engineers

USDA – United States Department of Agriculture

USFWS – United States Fish and Wildlife Service

USGS - United States Geological Survey

W. - West

WMA – Wildlife Management Area

WQC - Water Quality Certificate

WSLP Project - West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Project

WVA - Wetland Value Assessment

Appendix IX: Public Comments and Responses

SEA #571A Public Review Comments and MVN Response			
Comment Number	**Commenter**	**Comment**	**USACE Response**
1	Hugh O'Conner, Louisiana Ecological Services Office, USFWS	In response to your letter on SEA 571A for the West Shore Lake Pontchartrain Hurricane and Storm Risk Reduction Levee System dated June 2, 2023, the USFWS Louisiana Ecological Services Office has no comments at this time.	Comment noted.
2	Kristin Sanders, State Historic Preservation Officer	Thank you for your letter received June 5, 2023, regarding the Draft Supplemental Environmental Assessment (SEA 571A) for the West Shore Lake Pontchartrain Hurricane and Storm Risk Reduction Levee System St. Charles and St. John the Baptist Parishes, Louisiana, and a draft Finding of No Significant Impact. The draft of SEA 571A evaluates the potential impacts of altering the levee alignment footprint as described in the West Shore Lake Pontchartrain Environmental Impact Statement (2016 WSLP EIS) and SEA 571, and modifications to features described in SEA 570 and SEA 571. A Programmatic Agreement (PA) regarding the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction System was executed on May 16, 2014, among SHPO, the Advisory Council of Historic Preservation (ACHP) and the CEMVN pursuant to Section 106 of the National Historic Preservation act and its implementing regulation found at 36 CFR 800.14(b). Our office had no objections to the Proposed Action under the stipulations as outlined in the 2014 programmatic agreement {Appendix VII, Annex G) to identify and evaluate cultural resources. If you have questions or concerns, please contact Renee Erickson in our Division of Archaeology at rerickson@crt.la.gov.	Comment noted.
3	David Bernhart, Southeast Regional Office, NOAA Fisheries	I recently received a hard copy via USPS of the Draft Supplemental EA (SEA 571A). It was addressed to: Mr. Dave Bernhart National Marine Fisheries Service Protected Species Division 13th Avenue South St. Petersburg, FL 33701 Please remove this contact address from your distribution list. I request to receive relevant NEPA documents electronically only. This will greatly increase our efficiency in being able to distribute	Comment noted. Mr. Bernhart was removed from the distribution list and will receive electronic copies only of future NEPA documents.

		and review your documents in a timely manner. Please send future correspondence, via email only, to nmfs.ser.eis@noaa.gov Please do not send both electronic and hard copies. Please discontinue sending hard copies entirely.	
4	Kelley Templet, Office of Coastal Management, Louisiana Department of Natural Resources	I am trying to review the Modification for WSLP (SEA # 571A) but I am unable to access/find an electronic copy of the report along with appendices on the CEMVN District's Website. Can you please assist me in where to access/locate this electronic copy?	USACE followed up with a call and Ms. Templet received a copy of Draft SEA 571A and FONSI
5	Joey Breaux, Office of Soil and Water Conservation, Louisiana Department of Agriculture and Forestry	The LA Department of Agricultural & Forestry/Office of Soil & Water Conservation has reviewed the attached Project and has no objection or further comment. If this office may be of any further assistance, please do not hesitate to contact us.	Comment noted.
6	Marissa Jimenez, Louisiana Department of Environmental Quality	The Louisiana Department of Environmental Quality (LDEQ) has received your request for comments on the above referenced project. After reviewing your request, the Department has no objections based on the information provided in your submittal. However, for your information, the following general comments have been included. Please be advised that if you should encounter a problem during the implementation of this project, you should immediately notify LDEQ's Single-Point-of contact (SPOC) at (225) 219-3640. • Please take any necessary steps to obtain and/or update all necessary approvals and environmental permits regarding this proposed project. • If your project results in a discharge to waters of the state, submittal of a Louisiana Pollutant Discharge Elimination System (LPDES) application may be necessary. • If the project results in a discharge of wastewater to an existing wastewater treatment system, that wastewater treatment system may need to modify its LPDES permit before accepting the additional wastewater. • All precautions should be observed to control nonpoint source pollution from construction activities. LDEQ has	Comment noted. All necessary approvals and permissions will be achieved prior to construction, to include LPDES permits for individual contract reaches.

		stormwater general permits for construction areas equal to or greater than one acre. It is recommended that you contact the LDEQ Water Permits Division at (225) 219-3590 to determine if your proposed project requires a permit. • If your project will include a sanitary wastewater treatment facility, a Sewage Sludge and Biosolids Use or Disposal Permit is required. An application form or Notice of Intent will need to be submitted if the sludge management practice includes preparing biosolids for land application or preparing sewage sludge to be hauled to a landfill. Additional information may be obtained on the LDEQ website at https://deq.louisiana.gov/page/sewage-biosolids or by contacting the LDEQ Water Permits Division at (225) 219-3590. • If any of the proposed work is located in wetlands or other areas subject to the jurisdiction of the U.S. Army Corps of Engineers, you should contact the Corps directly regarding permitting issues. If a Corps permit is required, part of the application process may involve a water quality certification from LDEQ. • All precautions should be observed to protect the groundwater of the region. Please be advised that water softeners generate wastewaters that may require special limitations depending on local water quality considerations. Therefore if your water system improvements include water softeners, you are advised to contact the LDEQ Water Permits to determine if special water quality-based limitations will be necessary. • Any renovation or remodeling must comply with LAC 33:III.Chapter 28, Lead-Based Paint Activities; LAC 33:III.Chapter 27, Asbestos-Containing Materials in Schools and State Buildings (includes all training and accreditation); and LAC 33:III.5151, Emission Standard for Asbestos for any renovations or demolitions. • If any solid or hazardous wastes, or soils and/or groundwater contaminated with hazardous constituents	

		are encountered during the project, notification to LDEQ's Single-Point-of-Contact (SPOC) at (225) 219-3640 is required. Additionally, precautions should be taken to protect workers from these hazardous constituents. • If the project will involve the removal or disturbance of any soils which may have contaminant concentrations that exceed the Limiting Screening Option Standards established by the LDEQ Risk Evaluation/Corrective Action Program (RECAP) Regulation, these materials may be considered a waste and disposed of at a permitted facility, or might be managed as part of a Solid Waste Beneficial Use or Soil Reuse Plan in accordance with LAC 33:VII.Chapter 11. Alternately, a site-specific RECAP Evaluation might be conducted and submitted to the LDEQ. • If any underground storage tanks are encountered during the project, they must be in compliance with the regulations found in LAC 33:XI of the Environmental Regulatory Code. If any contaminated soil or groundwater is encountered, the findings should be reported to LDEQ. Currently, St. Charles and St. John the Baptist Parishes are classified as attainment with the National Ambient Air Quality Standards and have no general conformity determination obligations. Please send all Solicitation of Views (SOVs) requests and questions to SOVs@la.gov.	
7	Coalition to Restore Coastal Louisiana; Environmental Defense Fund; Louisiana Wildlife Federation; National Audubon Society; National Wildlife Federation; Pontchartrain Conservancy	The Restore the Mississippi River Delta coalition (MRD) appreciates this opportunity to provide input on the Finding of No Significant Impact (FONSI) Supplemental Environmental Assessment (SEA) (571A) for the West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction Levee System. MRD is a coalition of national and regional nonprofit organizations working to advance an equitable, safer, and flourishing coast for Louisiana's communities, ecosystem, and economy. Our organizations have worked collectively for over a decade toward the restoration of Louisiana's critical coastal ecosystems, with individual organizations and members having an invested presence along the coast for nearly a century. We are represented by conservation, policy, science and outreach experts	As stated in the MRD's letter, to date, USACE interpretation of the Sackett v. EPA ruling, and implementation guidance has not been completed. It is not reasonable for CEMVN Civil Works to speculate interpretations and then evaluate interpretations for the proposed action as described in SEA 571A. Current design of the WSLP system would not completely eliminate surface water connectivity as the system would only be closed during the threat of a tropical storm system. During day-to-day operations drainage strictures would remain open and pumping stations would not be used.

		from Environmental Defense Fund, National Audubon Society, the National Wildlife Federation, Coalition to Restore Coastal Louisiana, Pontchartrain Conservancy, and Louisiana Wildlife Federation. We have long advocated for the use of innovative solutions that mimic natural processes to address pressing land loss issues in coastal Louisiana. Over the last couple of years, MRD has provided input on the WSLP by submitting comments on the Army Corps of Engineers' (Corps) scoping comment request, and on the draft Supplemental Environmental Impact Statement. We advocated for wetland mitigation for the WSLP with the Maurepas Swamp Project (MSP), which would provide a suite of ecosystem restoration and financial benefits. We were pleased that the Corps listened to stakeholders and worked closely with the Louisiana Coastal Protection and Restoration Authority (CPRA) to select the MSP as a mitigation feature for the WSLP, marking a first of its kind partnership that aligns coastal restoration and hurricane protection priorities. In light of the U.S. Supreme Court's May 25, 2023, decision in Sackett v. Environmental Protection Agency1, the circumstances under which this SEA was prepared have been changed substantially, requiring a complete reevaluation of the impacts to wetlands and the mitigation requirements for the WSLP project. Most notably, the SEA must evaluate the reasonably foreseeable impacts that would arise should the Sackett decision be interpreted as eliminating Clean Water Act jurisdiction for wetlands that would lose "a continuous surface water connection" as a result of the WSLP Hurricane and Storm Damage Risk Reduction Levee System. While our organizations believe that such an interpretation is not supported by Sackett—and is not scientifically supportable under any circumstance—such an interpretation is nevertheless a reasonably foreseeable outcome that would have significant implications for community safety, clean water, and wildlife. Under the SEA's current plan, approximately 8,000 acres of wetlands would be enclosed by the newly constructed levee system, potentially losing their continuous surface connection with the waters of the United States and constituting a significant environmental impact. If those approximately 8,000 acres of wetlands lose the protections provided by the Clean Water Act, they could be filled, drained, or	However, without new guidance, it is not clear whether the interior wetlands would remain jurisdictional and subject to CWA Section 404 requirements. Furthermore, the proposed action in SEA 571A does not include the enclosure of wetlands. Enclosure of wetlands associated with the WSLP Project were assessed in the 2016 WSLP EIS (ROD signed 14 September 2016), SEA 571 (FONSI signed 29 June 2020), and the 2023 WSLP SEIS (ROD signed 23 January 2023). Due to the uncertainty of ruling interpretation and the limited scope of this SEA, the USACE is not able to evaluate reasonably foreseeable direct, indirect, and cumulative effects to wetlands and alternatives as a result of this decision.

		otherwise damaged by future development activities without requiring a Clean Water Act section 404 permit and without having to avoid, minimize, or mitigate the harm to those wetlands as required by section 404. Under such a scenario, future development pressure is highly likely particularly given the flood damage reduction that will be provided by the levee system. Mitigation requirements for Corps civil works projects established by the Water Resources Development Act are in addition and independent of the mitigation requirements established by the Clean Water Act and its implementation regulations.2 The Corps' civil works mitigation requirements are also independent of Clean Water Act jurisdiction.3 The Water Resources Development Act requires that the Corps mitigate all losses to fish and wildlife created by a Corps project unless the Secretary determines that the adverse impacts to fish and wildlife would be "negligible." As a result, the Corps should revise and supplement SEA 571A to: 1. Fully evaluate the uncertainties surrounding the Sackett decision and the risk that the decision could be interpreted to eliminate Clean Water Act jurisdiction and protections for some or all of the wetlands located behind the newly constructed levee. 2. Fully evaluate the reasonably foreseeable direct, indirect, and cumulative effects to those wetlands and the significant ecosystem services they provide should Sackett be interpreted as described above. 3. Fully evaluate alternatives, including alternative levee alignments and other measures, to further avoid and minimize those risks and other impacts to the wetlands behind the newly constructed levee. 4. Identify steps the Corps will take to ensure that the wetlands behind the newly constructed levee will in fact retain legal protections (e.g., through a conservation easement, fee title purchase, or other legal mechanism). 5. Identify steps the Corps will take to ensure that cumulative effects of the levee system will be fully mitigated, and fully evaluate the costs of such measures. We request that the Corps withhold any final decision on the SEA until the Corps, the Environmental Protection Agency, and the	

		Council on Environmental Quality fully evaluate the implications of the Sackett decision and issue the new regulation on the scope of protections provided by the Clean Water Act referenced by the Assistant Secretary of the Army for Civil Works, Michael Connor, during a June 22, 2023 House Transportation and Infrastructure subcommittee hearing. Thank you again for the opportunity to comment on this SEA and we look forward to working with you in the future.	