Reach 10

Introduction

The design section includes: clay embankment (EL +5.5 ft), underlain by a shallow Marsh deposit (EL -1.5 ft to EL -13.0 ft). The shallow Marsh is underlain by a Lacustrine Clay stratum (EL -13.0 to -29.0 ft) which mantles a lower Beach Sand deposit located at EL. -29.0 feet to -48.0 ft. Beneath the Beach Sand stratum lies a Bay Sound Clay layer that extends to an EL -70.0 ft. The clay embankment material was assigned a unit weight of 109 pcf with a cohesion of 500 psf. The shear strength values used for the clay embankment are higher than those in the underlying marsh deposit. The elevation of the flood side ground line at the wall face is approximately EL 2.5 ft resulting in 3.0 ft difference in soil elevation across the wall. The existing I-wall has a top elevation of 12.4 ft consisting of a concrete cap and Frodingham 1B sheet pile to tip elevation of -6.0 ft. Figures D-1 and D-2 show the Geo-Studio and FLAC model cross sections. The FLAC model created by the template is constrained to use horizontal soil layers so the top of the upper marsh strata was set at EL -1.5 ft, as it is shown on the flood side of the I-Wall in Figure D-2, without sloping to the levee toe to best capture the wall displacement behavior.

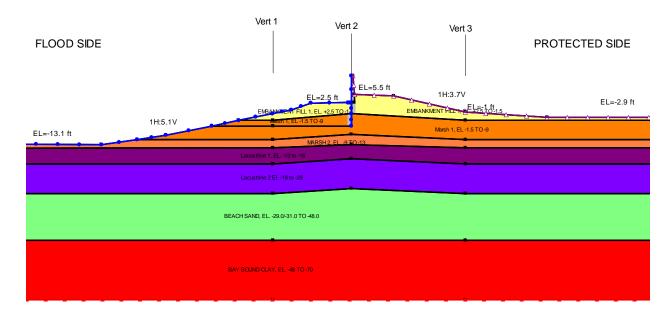


Figure D-1. Geo-Studio model for 17th Street Outfall Canal Reach 10

Flood Side Protected Side

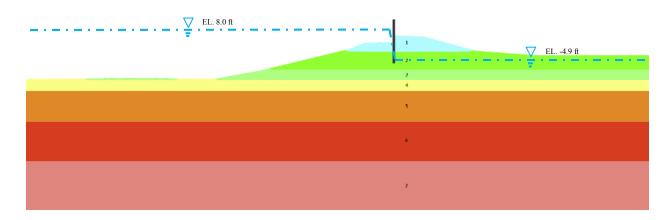


Figure D-2. FLAC Model for 17th Street Outfall Canal Reach 10

Foundation Parameters

The FLAC analyses are based on simple Mohr-Coulomb constitutive models (elastic-perfectly plastic soil behavior). Unit weight and shear strength parameters for the various soil layers were based on the information in the MOWL Report. The cross section used is the Seep/W file from the MOWL report. As-built drawings were examined for the properties of the I-Wall.

Soil modulus values were determined or selected assuming the soils are linearly elastic and isotropic with Poisson's ratio based on expected drainage conditions during loading. The parameters used for analysis are presented in Tables D-1 thru D-4. The soil modulus values were selected using the same G/Su ratios selected for the FLAC model calibrated to the London Load Test (LLT) results. The soil modulus values used in the LLT FLAC model were primarily based on pressuremeter testing and relationships for G/Su. At London Avenue Canal, the shear modulus values were determined by multiplying the G/Su ratio for a given soil by its undrained shear strength. Young's Modulus for the levee and sand were assigned the same value used in the LLT calibration. The at-rest earth pressure coefficients are computed only to initialize stresses during model development so equilibrium can be reached in fewer computational steps.

At 17th Street Outfall Canal, seepage conditions were modeled as steady state using the Seep/W model, and previously accepted material seepage properties and protected side boundary conditions, from the MOWL report. The flood side canal total head boundary was incrementally raised from a starting water level of EL +0.4 ft to EL +1.0 ft and then by 1 ft. The water table was assumed to be constant for the protected side two feet below the ground surface -4.9 ft and 8.0 ft for the flood side. The water table elevations are presented on figure D-2.

Table D-1. Summary of Centerline Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf)	φ' (deg)
1 – Embankment	2.5	-1.5	109	3.385	700	0
2 – Marsh 1	-1.5	-9.0	109	3.385	375	0
3 – Marsh 2	-9.0	-13.0	82	2.547	350	0
4 – Lacustrine 1	-13.0	-18.0	106	3.292	300	0
5 – Lacustrine 2	-18.0	-29.0	102	3.168	300	0
6 – Beach Sand	-29.0	-48.0	122	3.789	0	30
7 – Bay Sound Clay	-48.0	-70.0	105	3.261	830	0

Table D-2. Centerline Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment	225	1.58E+05	0.40	56250	262500	0.86
2 – Marsh 1	200	7.50E+04	0.47	25510	416667	0.95
3 – Marsh 2	200	7.00E+04	0.47	23810	388889	0.97
4 – Lacustrine 1	300	9.00E+04	0.47	30612	500000	0.95
5 – Lacustrine 2	300	9.00E+04	0.47	30612	500000	0.96
6 – Beach Sand	1	7.32E+05	0.33	275188	732000	0.75
7 – Bay Sound Clay	600	4.98E+05	0.495	166555	16600000	0.99

Table D-3. Summary of Toe Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf)	φ' (deg)
1 – Embankment	2.5	-1.5	109	3.385	500	0
2 – Marsh 1	-1.5	-9.0	109	3.385	180	0
3 – Marsh 2	-9.0	-13.0	82	2.547	180	0
4 – Lacustrine 1	-13.0	-18.0	106	3.292	180	0
5 – Lacustrine 2	-18.0	-29.0	102	3.168	258	0
6 – Beach Sand	-29.0	-48.0	122	3.789	0	30
7 – Bay Sound Clay	-48.0	-70.0	105	3.261	800	0

Table D-4. Toe Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment	315	1.58E+05	0.40	56250	262500	0.86
2 – Marsh 1	200	3.60E+04	0.47	12245	200000	0.95
3 – Marsh 2	200	3.60E+04	0.47	12245	200000	0.97
4 – Lacustrine 1	300	5.40E+04	0.47	18367	300000	0.95
3 – Lacustrine 2	300	7.74E+04	0.47	26327	430000	0.96
4 – Beach Sand	1	7.32E+05	0.33	275188	732000	0.75
5 – Bay Sound Clay	600	4.80E+05	0.495	160535	16000000	0.99

Structural Parameters

The current I-wall structure was modeled as two beam elements: (1) the upper concrete portion of the I-wall and (2) the supporting sheet pile beneath the concrete. Interface elements were applied to the wall below the ground surface. These elements allow slip and separation between the soil and wall. The shear strength of the interfaces was set at 90% of the shear strength of the strongest cohesive soil layer.

In FLAC the structural beam properties are formulated in plane stress (like a plate) and are adjusted for plane strain conditions by dividing Young's modulus by $1-v^2$ (v = Poisson's ratio). The structural parameters are included in Table D-5.

Table D-5. Summary of Structural Parameters

Member	E (psi)	E* (psi)	E* (psf)	I (in4/ft)	E*I (lbft2/ft)	A (in2/ft)	E*A (lb/ft)	ν
Concrete	3.00E+06	3.13E+06	4.50E+08	1728	3.75E+07	144	4.50E+08	0.2
Frodingham 1 B	2.90E+07	3.19E+07	4.59E+09	36.02	7.97E+06	7.87	2.51E+08	0.3

E = Young's Modulus

E* = Adj. Young's Modulus for Plain Strain

I = Moment of Inertia per foot of wall

A = Cross Sectional Area per foot of wall

v = Poisson's Ratio

Loading Conditions and Gap Formation

Canal water loadings are modeled as mechanical pressures acting normal to the ground surface and normal to the wall face. When a gap is included between the soil and I-wall a horizontal mechanical pressure is added to both the soil and the wall to the depth of the gap.

Gap development is modeled following the step-by-step procedure outlined in the London Avenue Outfall Canal Reevaluation report as well as the IPET report. The total horizontal stress in the element adjacent to the wall is compared to the hydrostatic pressure that would exist if a

gap were present. If the hydrostatic water pressure exceeds the total horizontal stress it is assumed that a gap would form. Each zone is checked as canal water levels are raised from the normal pool elevation of 0.4 ft to the maximum operating level of 8 ft in 1 ft increments. Gaps were deepened in 1 ft increments as they developed.

At lower canal water levels, it is believed the higher soil level on the protected side of the wall serves to increase the horizontal stresses along the flood side of the sheet pile which slows the progression of the gap.

Results

The gap depth calculations prepared by Black and Veatch which follow IPET guidance was checked and compared with the FLAC results. The gap depth extends to the tip of the sheet pile for both methods. The FLAC and hand calculation analysis had the gap extending to approximate EL -6.0 ft. It should be noted that for even the shallower water depths, the hand calculation resulted in a gap to approximate EL -6.0 ft. The gap tip is 23.0 ft above the sand interface.

The maximum protected side ground displacement for the MLV at water level EL 8.0 ft was about 1.499 inches. The maximum developed crack depth was 8.5 ft. Graphs of the top of protected side ground and top of wall displacement and gap propagation versus canal water elevation can be found in Figures D-4 and D-5.

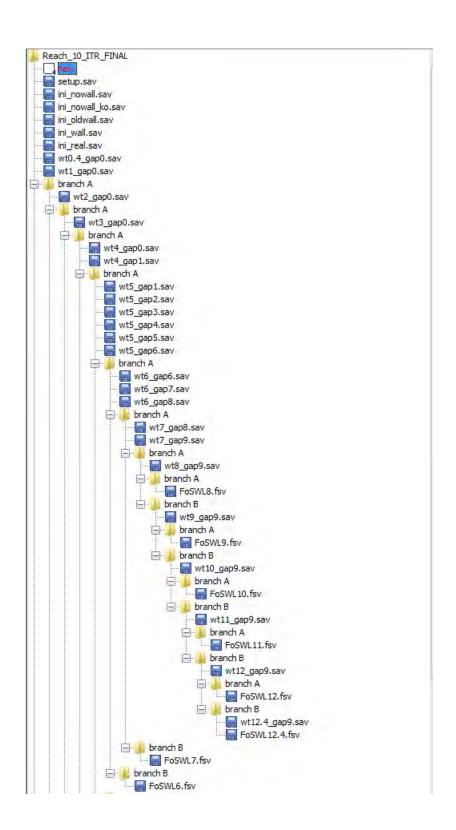




Figure D-3. FLAC model progression of water loading and gap development for Reach 10

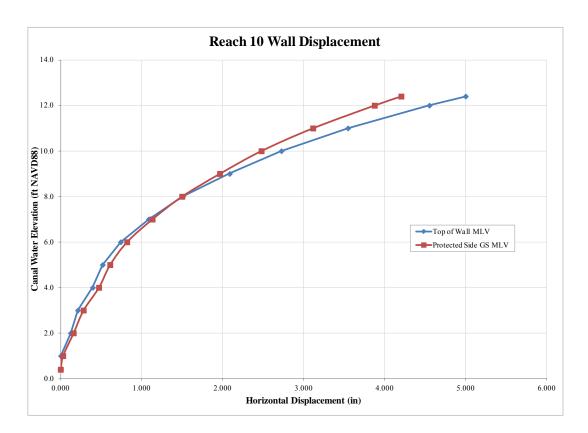


Figure D-4. FLAC computed I-wall displacement.

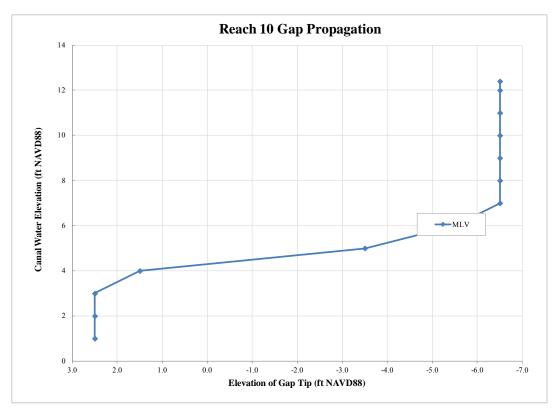


Figure D-5. FLAC computed gap propagation

The automated c- ϕ reduction technique in FLAC was used for all factor of safety (FoS) calculations. Figure D-6 presents the computed factors of safety for differing canal water levels and Figures D-7 through D-14 show the shear strain increment (ssi) and wall locations (original and displaced) for factor of safety at varying water levels. A summary of the FoS and controlling failure mode (global stability or wall rotation) are presented in Table D-6.

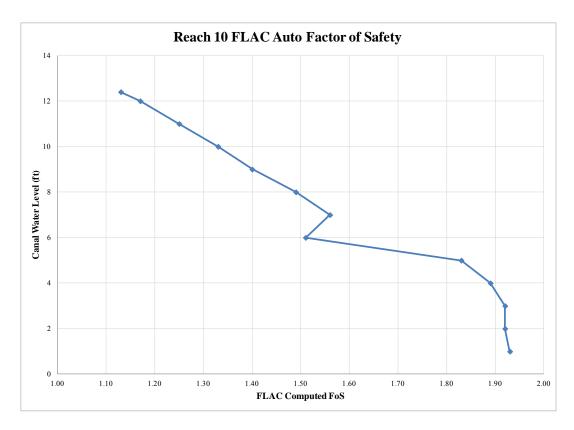


Figure D-6. FLAC computed factor of safety (automated c-φ reduction technique).

Table D-6. Summary of FLAC FoS and Controlling Failure Mode.

Canal WL	FLACAUTO	Controlling
(ft)	FoS	Failure Mode
1	1.93	Global Stability
2	1.92	Global Stability
3	1.92	Global Stability
4	1.89	Global Stability
5	1.83	Global Stability
6	1.51	Global Stability
7	1.56	Global Stability
8	1.49	Global Stability
9	1.40	Global Stability
10	1.33	Global Stability
11	1.25	Global Stability
12	1.17	Global Stability
12.4	1.13	Global Stability

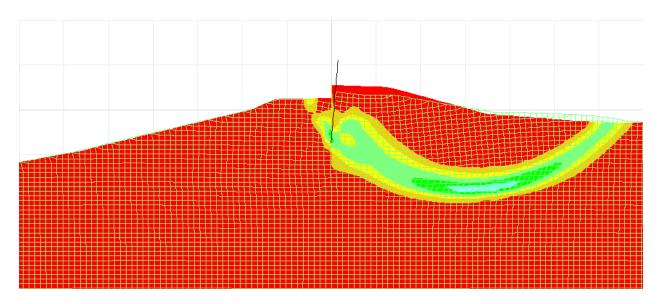


Figure D-7. WL+1 ft, FoS ssi and wall displacement magnified 5X.

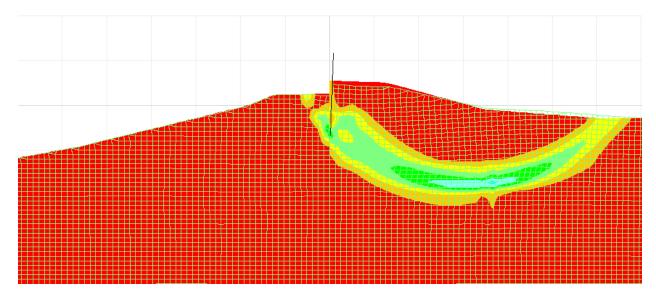


Figure D-8. WL+2 ft, FoS ssi and wall displacement magnified 5X.

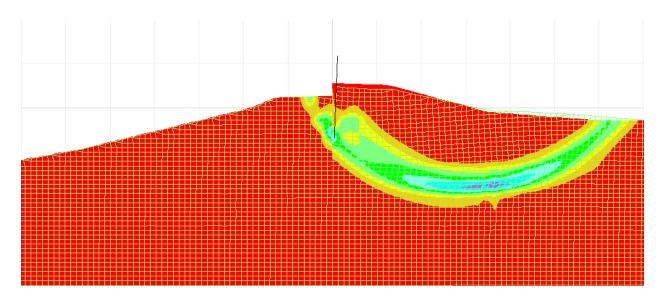


Figure D-9. WL+3 ft, FoS ssi and wall displacement magnified 5X.

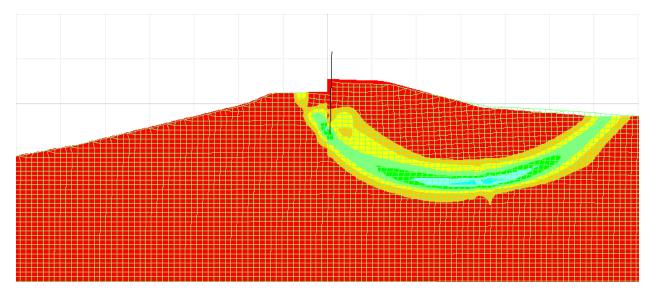


Figure D-10. WL+4 ft, FoS ssi and wall displacement magnified 5X.

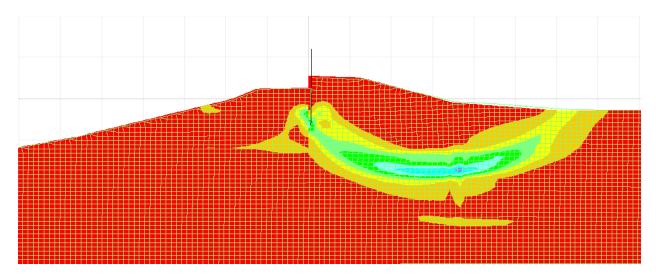


Figure D-11. WL+5 ft, FoS ssi and wall displacement magnified 5X.

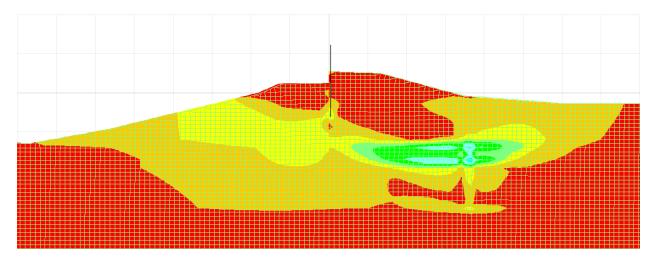


Figure D-12. WL+6 ft, FoS ssi and wall displacement magnified 5X.

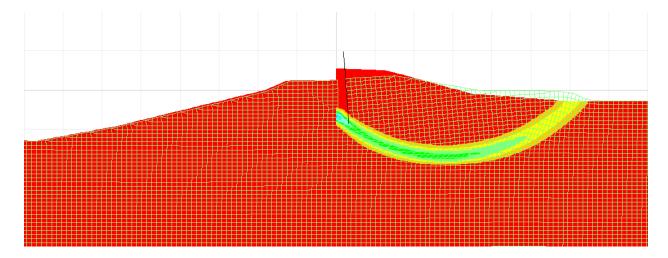


Figure D-13. WL+7 ft, FoS ssi and wall displacement magnified 5X.

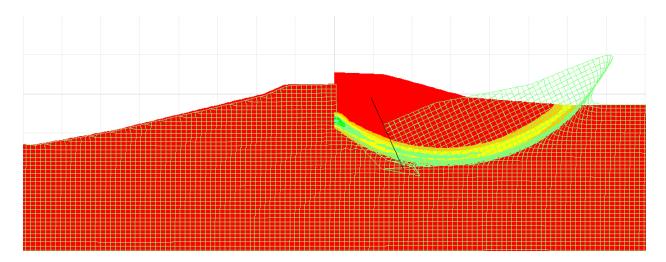


Figure D-14. WL+8 ft, FoS ssi and wall displacement magnified 5X.

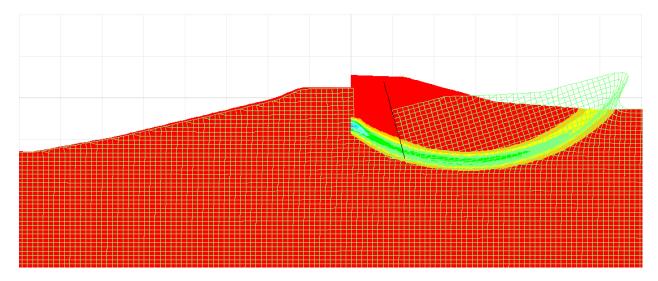


Figure D-15. WL+9 ft, FoS ssi and wall displacement magnified 5X.

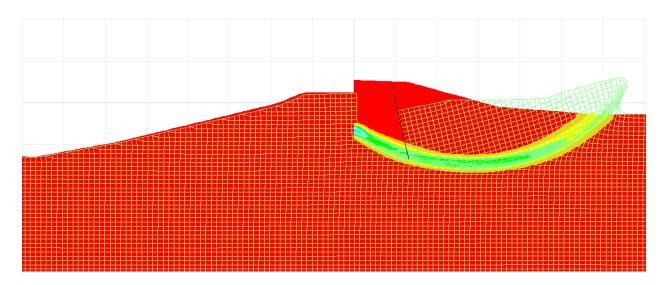


Figure D-16. WL+10ft, FoS ssi and wall displacement magnified 5X.

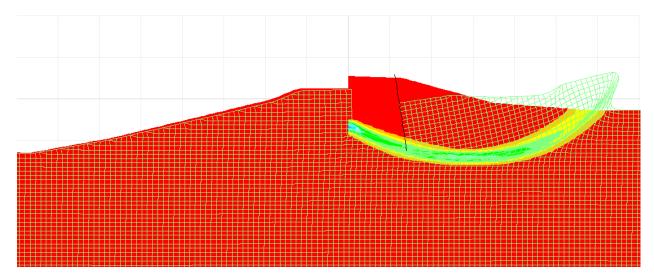


Figure D-17. WL+11 ft, FoS ssi and wall displacement magnified 5X.

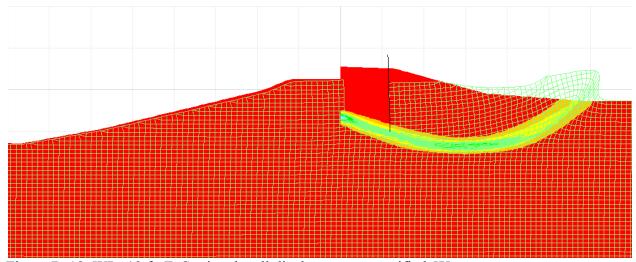


Figure D-18. WL+12 ft, FoS ssi and wall displacement magnified 5X.

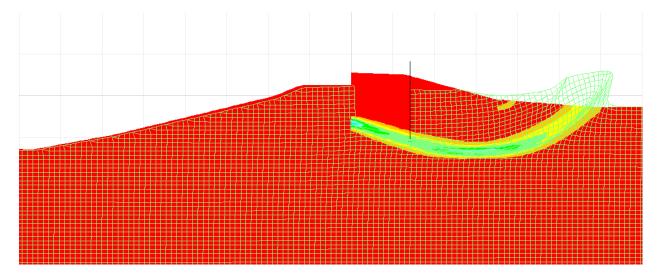


Figure D-19. WL+12.4 ft, FoS ssi and wall displacement magnified 5X.

Reach 11

Introduction

The design section includes: clay embankment (EL +5.5 ft), underlain by a shallow Marsh deposit (EL -6.0 ft to EL -16.0 ft). The shallow Marsh is underlain by a Lacustrine clay stratum (EL -16.0 to -27.0 ft) which mantles a lower Beach Sand deposit located at EL -27.0 ft to EL -42.0 ft. Beneath the Beach Sand stratum lies a Bay Sound Clay layer that extends to an EL of -70.0 ft. The upper clay embankment material was assigned a unit weight of 118 pcf with a cohesion of 800 psf. The shear strength values used for the clay embankment are higher than those in the underlying marsh deposit. The elevation of the flood side ground line at the wall face is approximately EL 2.5 ft resulting in 3.0 ft difference in soil elevation across the wall. The existing I-wall has a top elevation of 12.5 ft consisting of a concrete cap and Frodingham 1B sheet pile to tip elevation of -6.0 ft. Figures D-1 and D-2 show the Geo-Studio and FLAC model cross sections. The FLAC model created by the template is constrained to use horizontal soil layers so the top of the upper marsh strata was set at EL -6.0 ft, as it is shown on the flood side of the I-Wall in Figure D-2, without sloping to the levee toe to best capture the wall displacement behavior.

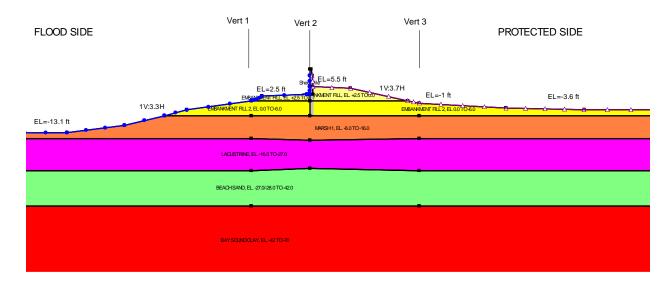


Figure D-1. Geo-Studio model for 17th Street Outfall Canal Reach 11

Flood Side Protected Side

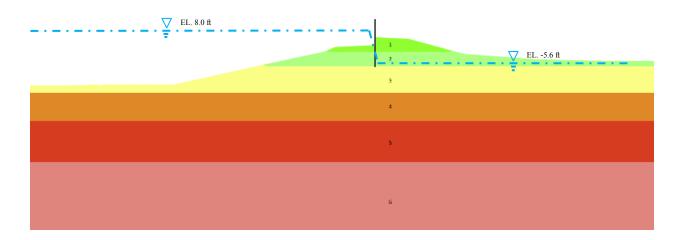


Figure D-2. FLAC Model for 17th Street Outfall Canal Reach 11

Foundation Parameters

The FLAC analyses are based on simple Mohr-Coulomb constitutive models (elastic-perfectly plastic soil behavior). Unit weight and shear strength parameters for the various soil layers were based on the information in the MOWL Report. The cross section used is the Seep/W file from the MOWL report. As-built drawings were examined for the properties of the I-Wall.

Soil modulus values were determined or selected assuming the soils are linearly elastic and isotropic with Poisson's ratio based on expected drainage conditions during loading. The parameters used for analysis are presented in Tables D-1 thru D-4. The soil modulus values were selected using the same G/Su ratios selected for the FLAC model calibrated to the London Load Test (LLT) results. The soil modulus values used in the LLT FLAC model were primarily based on pressuremeter testing and relationships for G/Su. At London Avenue Canal, the shear modulus values are determined by multiplying the G/Su ratio for a given soil by its undrained shear strength. Young's Modulus for the levee and sand were assigned the same value used in the LLT calibration. The at-rest earth pressure coefficients are computed only to initialize stresses during model development so equilibrium can be reached in fewer computational steps.

At 17th Street Outfall Canal, seepage conditions were modeled as steady state using the Seep/W model, and previously accepted material seepage properties and protected side boundary conditions, from the MOWL report. The flood side canal total head boundary was incrementally raised from a starting water level of EL +0.4 ft to EL +1.0 ft and then by 1 ft. The water table was assumed to be constant for the protected side two feet below the ground surface -5.6 ft and 8.0 ft for the flood side. The water table elevations are presented on figure D-2.

Table D-1. Summary of Centerline Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf)*	φ' (deg)
1 – Embankment 1	5.5	0.0	118	3.665	800	0
2 – Embankment 2	0.0	-6.0	108	3.354	425	0
3 – Marsh	-6.0	-16.0	99	3.075	275	0
4 – Silty Sand	-16.0	-27.0	103	3.199	275	0
5 – Beach Sand	-27.0	-42.0	122	3.789	0	30
6 – Bay Sound Clay	-42.0	-70.0	104	3.230	700	0

Table D-2. Centerline Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment 1	197	1.58E+05	0.40	56250	262500	0.84
2 – Embankment 2	371	1.58E+05	0.40	56250	262500	0.86
3 – Marsh	200	5.50E+04	0.47	18707	305556	0.96
4 – Lacustrine	300	8.25E+04	0.47	28061	458333	0.96
5 – Beach Sand	-	7.32E+05	0.33	275188	732000	0.75
6 – Bay Sound Clay	600	4.20E+05	0.495	140468	14000000	0.99

Table D-3. Summary of Toe Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf) *	φ' (deg)
1 – Embankment 1	5.5	0.0	106	3.292	400	0
2 – Embankment 2	0.0	-6.0	106	3.292	400	0
3 – Marsh	-6.0	-16.0	105	3.261	200	0
4 – Lacustrine	-16.0	-27.0	102	3.168	200	0
5 – Beach Sand	-27.0	-42.0	122	3.789	0	30
6 – Bay Sound Clay	-42.0	-70.0	102	3.168	700	0

Table D-4. Toe Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment 1	394	1.58E+05	0.40	56250	262500	0.86
2 – Embankment 2	394	1.58E+05	0.40	56250	262500	0.86
3 – Marsh	200	4.00E+04	0.47	13605	222222	0.95
4 – Lacustrine	300	6.00E+04	0.47	20408	333333	0.96
5 – Beach Sand	-	7.32E+05	0.33	275188	732000	0.75
6 – Bay Sound Clay	600	4.20E+05	0.495	140468	14000000	0.99

Structural Parameters

The current I-wall structure was modeled as two beam elements: (1) the upper concrete portion of the I-wall and (2) the supporting sheet pile beneath the concrete. Interface elements were applied to the wall below the ground surface. These elements allow slip and separation between the soil and wall. The shear strength of the interfaces was set at 90% of the shear strength of the strongest cohesive soil layer.

In FLAC the structural beam properties are formulated in plane stress (like a plate) and are adjusted for plane strain conditions by dividing Young's modulus by $1-v^2$ (v = Poisson's ratio). The structural parameters are included in Table D-5.

Table D-5. Summary of Structural Parameters

Member	E (psi)	E* (psi)	E* (psf)	l (in4/ft)	E*I (lbft2/ft)	A (in2/ft)	E*A (lb/ft)	ν
Concrete	3.00E+06	3.13E+06	4.50E+08	1728	3.75E+07	144	4.50E+08	0.2
Frodingham 1B	2.90E+07	3.19E+07	4.59E+09	36.02	7.97E+06	7.87	2.51E+08	0.3

E = Young's Modulus

E* = Adj. Young's Modulus for Plain Strain

I = Moment of Inertia per foot of wall

A = Cross Sectional Area per foot of wall

v = Poisson's Ratio

Loading Conditions and Gap Formation

Canal water loadings are modeled as mechanical pressures acting normal to the ground surface and normal to the wall face. When a gap is included between the soil and I-wall a horizontal mechanical pressure is added to both the soil and the wall to the depth of the gap.

Gap development is modeled following the step-by-step procedure outlined in the London Avenue Outfall Canal Reevaluation report as well as the IPET report. The total horizontal stress in the element adjacent to the wall is compared to the hydrostatic pressure that would exist if a gap were present. If the hydrostatic water pressure exceeds the total horizontal stress it is

assumed that a gap would form. Each zone is checked as canal water levels are raised from the normal pool elevation of 0.4 ft to the maximum operating level of 8 ft in 1 ft increments. Gaps were deepened in 1 ft increments as they developed.

At lower canal water levels, it is believed the higher soil level on the protected side of the wall serves to increase the horizontal stresses along the flood side of the sheet pile which slows the progression of the gap.

Results

The gap depth calculations prepared by Black and Veatch which follow IPET guidance was checked and compared with the FLAC results. The gap depth extends to the tip of the sheet pile for both methods. The FLAC and hand calculation analysis had the gap extending to approximate EL -6.0 ft. It should be noted that for even the shallower water depths, the hand calculation resulted in a gap to approximate EL -6.0 ft. The gap tip is 21.0 ft above the sand interface.

The maximum protected side ground displacement for the MLV at water level EL 8.0 ft was about 1.069 inches. The maximum developed crack depth was 9.0 ft. Graphs of the top of protected side ground and top of wall displacement and gap propagation versus canal water elevation can be found in Figures D-4 and D-5.

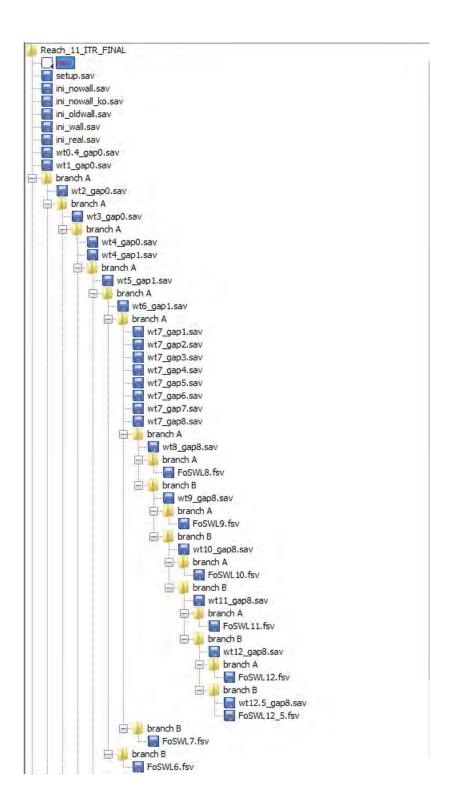




Figure D-3. FLAC model progression of water loading and gap development for Reach 11

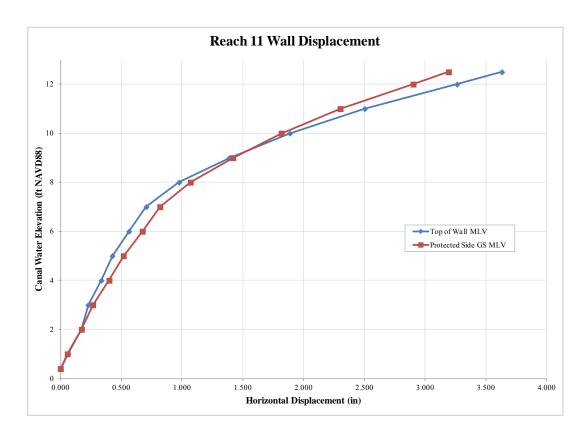


Figure D-4. FLAC computed I-wall displacement.

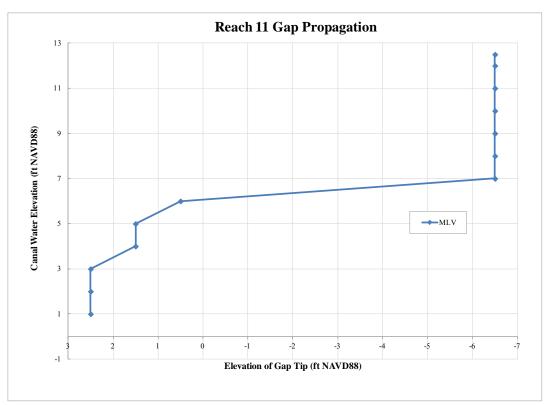


Figure D-5. FLAC computed gap propagation

The automated $c-\phi$ reduction technique in FLAC was used for all factor of safety (FoS) calculations. Figure D-6 presents the computed factors of safety for differing canal water levels and Figures D-7 through D-14 show the shear strain increment (ssi) and wall locations (original and displaced) for factor of safety at varying water levels. A summary of the FoS and controlling failure mode (global stability or wall rotation) are presented in Table D-6.

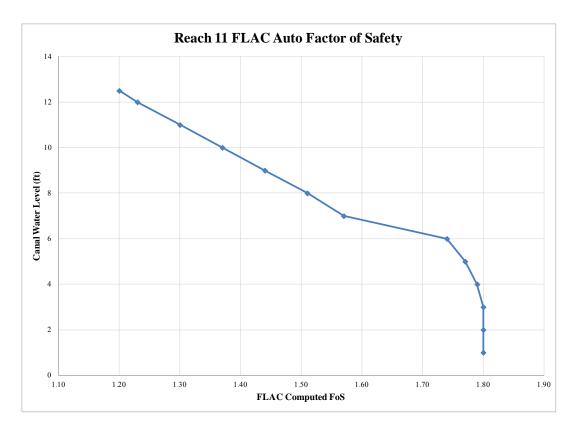


Figure D-6. FLAC computed factor of safety (automated c-φ reduction technique).

Table D-6. Summary of FLAC FoS and Controlling Failure Mode.

Canal WL	FLACAUTO	Controlling
(ft)	FoS	Failure Mode
1	1.80	Global Stability
2	1.80	Global Stability
3	1.80	Global Stability
4	1.79	Global Stability
5	1.77	Global Stability
6	1.74	Global Stability
7	1.57	Global Stability
8	1.51	Global Stability
9	1.44	Global Stability
10	1.37	Global Stability
11	1.30	Global Stability
12	1.23	Global Stability
12.5	1.20	Global Stability

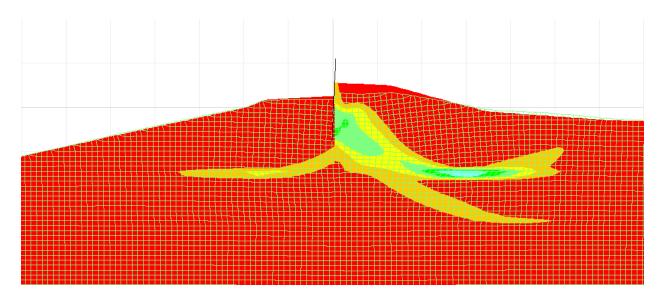


Figure D-7. WL+1 ft, FoS ssi and wall displacement magnified 5X.

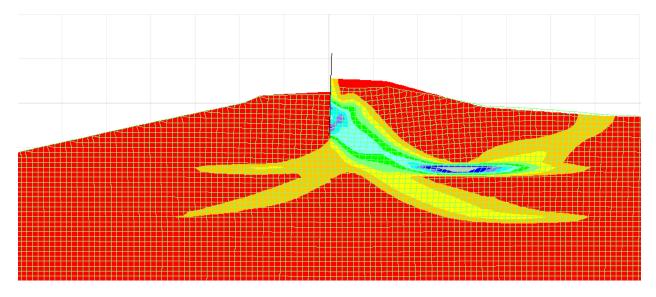


Figure D-8. WL+2 ft, FoS ssi and wall displacement magnified 5X.

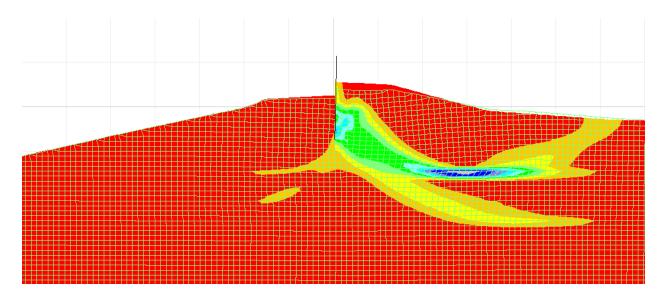


Figure D-9. WL+3 ft, FoS ssi and wall displacement magnified 5X.

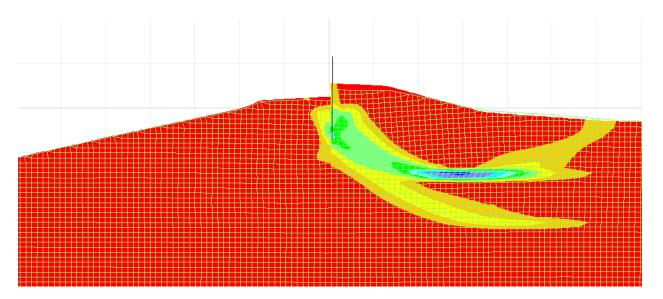


Figure D-10. WL+4 ft, FoS ssi and wall displacement magnified 5X.

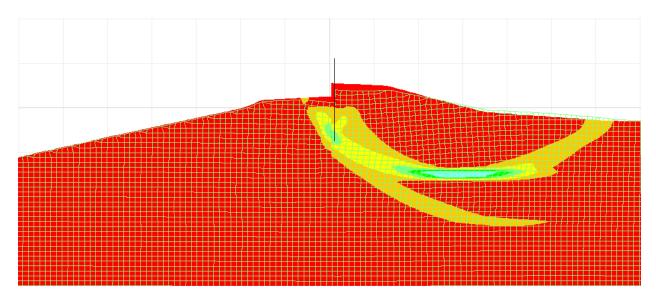


Figure D-11. WL+5 ft, FoS ssi and wall displacement magnified 5X.

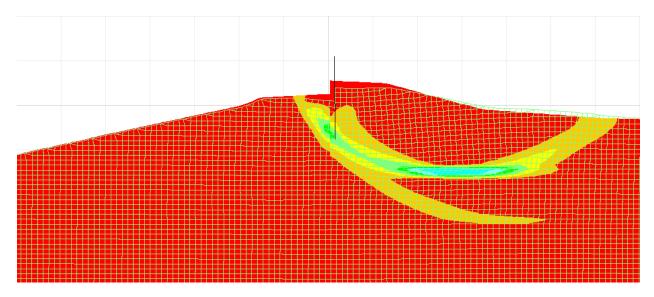


Figure D-12. WL+6 ft, FoS ssi and wall displacement magnified 5X.

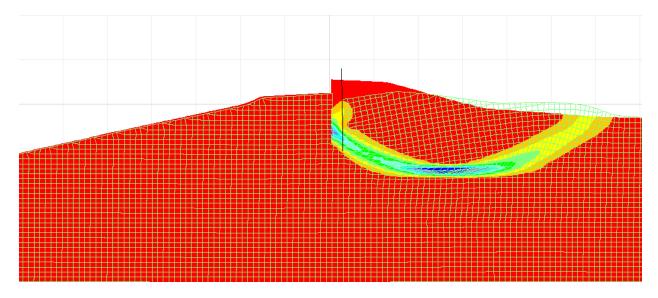


Figure D-13. WL+7 ft, FoS ssi and wall displacement magnified 5X.

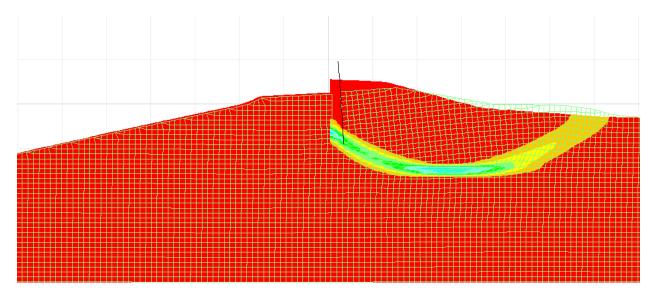


Figure D-14. WL+8 ft, FoS ssi and wall displacement magnified 5X.

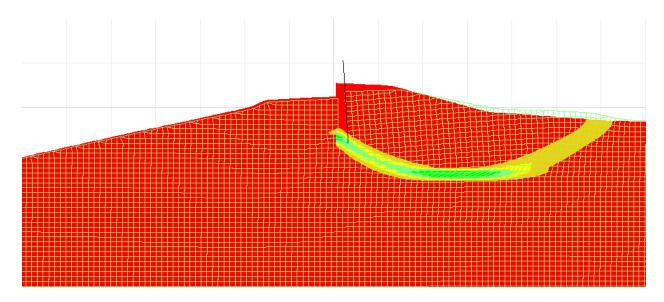


Figure D-15. WL+9 ft, FoS ssi and wall displacement magnified 5X.

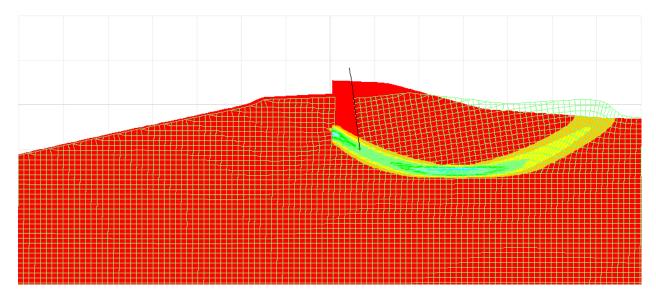


Figure D-16. WL+10 ft, FoS ssi and wall displacement magnified 5X.

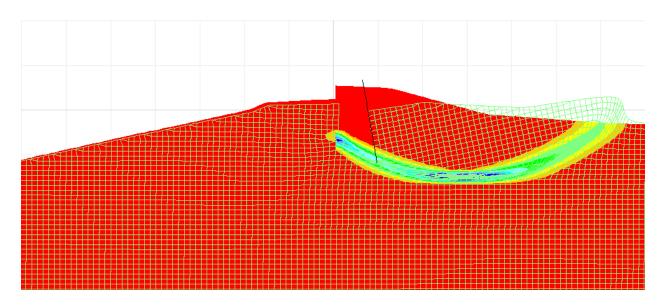


Figure D-17. WL+11 ft, FoS ssi and wall displacement magnified 5X.

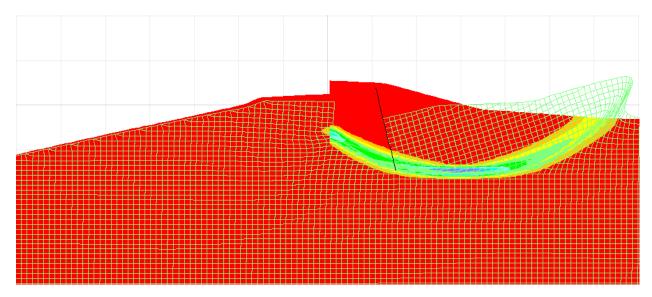


Figure D-18. WL+12 ft, FoS ssi and wall displacement magnified 5X.

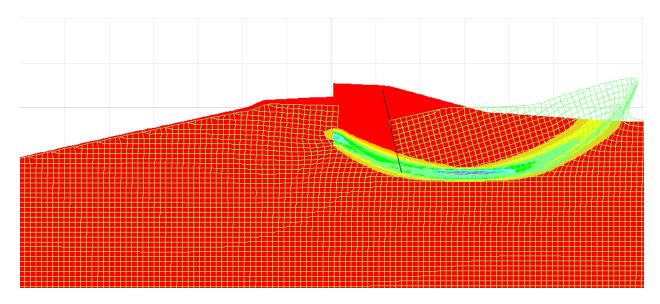


Figure D-19. WL+12.5 ft, FoS ssi and wall displacement magnified 5X.

Reach 14

Introduction

The design section includes: clay embankment (EL +6.0 ft), underlain by a shallow marsh deposit (EL -7.0 ft to EL -16.0 ft). The shallow marsh is underlain by a Silty Sand stratum (EL -16.0 to -19.0 ft) which mantles a lower Sand deposit located at EL -19.0 ft to -46.0 ft. Beneath the Sand stratum lies a Bay Sound Clay layer that extends to an EL of -70.0 ft. The upper clay embankment material was assigned a unit weight of 112 pcf with a cohesion of 860 psf. The shear strength values used for the clay embankment are higher than those in the underlying marsh deposit. The elevation of the flood side ground line at the wall face is approximately EL 4.2 ft resulting in 1.8 ft difference in soil elevation across the wall. The existing I-wall has a top elevation of 12.5 ft consisting of a concrete cap and Frodingham 1B sheet pile to tip elevation of -2.0 ft. Figures D-1 and D-2 show the Geo-Studio and FLAC model cross sections. The FLAC model created by the template is constrained to use horizontal soil layers so the top of the upper marsh strata was set at EL -7 ft, as it is shown on the flood side of the I-Wall in Figure D-2, without sloping to the levee toe to best capture the wall displacement behavior.

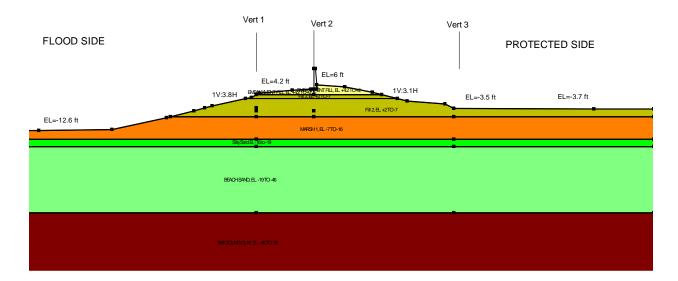


Figure D-1. Geo-Studio model for 17th Street Outfall Canal Reach 14

Flood Side Protected Side

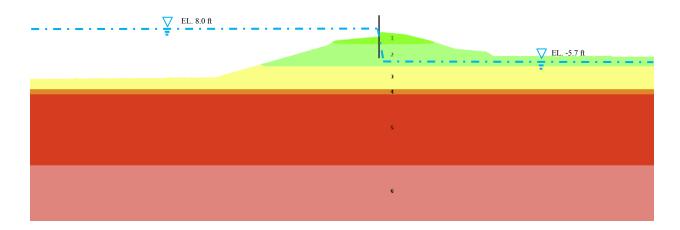


Figure D-2. FLAC Model for 17th Street Outfall Canal Reach 14

Foundation Parameters

The FLAC analyses are based on simple Mohr-Coulomb constitutive models (elastic-perfectly plastic soil behavior). Unit weight and shear strength parameters for the various soil layers were based on the information in the MOWL Report. The cross section used is the Seep/W file from the MOWL report. As-built drawings were examined for the properties of the I-Wall.

Soil modulus values were determined or selected assuming the soils are linearly elastic and isotropic with Poisson's ratio based on expected drainage conditions during loading. The parameters used for analysis are presented in Tables D-1 thru D-4. The soil modulus values were selected using the same G/Su ratios selected for the FLAC model calibrated to the London Load Test (LLT) results. The soil modulus values used in the LLT FLAC model were primarily based on pressuremeter testing and relationships for G/Su. At London Avenue Canal, the shear modulus values are determined by multiplying the G/Su ratio for a given soil by its undrained shear strength. Young's Modulus for the levee and sand were assigned the same value used in the LLT calibration. The at-rest earth pressure coefficients are computed only to initialize stresses during model development so equilibrium can be reached in fewer computational steps.

At 17th Street Outfall Canal, seepage conditions were modeled as steady state using the Seep/W model, and previously accepted material seepage properties and protected side boundary conditions, from the MOWL report. The flood side canal total head boundary was incrementally raised from a starting water level of EL +0.4 ft to EL +1.0 ft and then by 1 ft. The water table was assumed to be constant for the protected side two feet below the ground surface -5.7 ft and 8.0 ft for the flood side. The water table elevations are presented on figure D-2.

Table D-1. Summary of Centerline Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf)*	φ' (deg)
1 – Embankment 1	6.0	2.0	112	3.48	860	0
2 – Embankment 2	2.0	-7.0	105	3.26	450	0
3 – Marsh	-7.0	-16.0	94	2.92	350	0
4 – Silty Sand	-16.0	-19.0	122	3.79	0	30
5 – Sand	-19.0	-46.0	122	3.79	0	30
6 – Bay Sound Clay	-46.0	-70.0	102	3.17	710	0

Table D-2. Centerline Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment 1	183	1.58E+05	0.40	5.63E+04	2.63E+05	0.85
2 – Embankment 2	350	1.58E+05	0.40	5.63E+04	2.63E+05	0.86
3 – Marsh	200	7.00E+04	0.47	2.38E+04	3.89E+05	0.96
4 – Silty Sand	_	4.85E+05	0.33	2.50E+05	6.52E+05	0.75
5 – Sand	_	7.32E+05	0.33	2.75E+05	7.32E+05	0.75
6 – Bay Sound Clay	600	4.26E+05	0.495	1.42E+05	1.42E+07	0.99

Table D-3. Summary of Toe Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf) *	φ' (deg)
1 – Embankment 1	6.0	2.0	112	3.48	860	0
2 – Embankment 2	2.0	-7.0	105	3.26	500	0
3 – Marsh	-7.0	-16.0	94	2.92	150	0
4 – Silty Sand	-16.0	-19.0	122	3.79	0	30
5 – Sand	-19.0	-46.0	122	3.79	0	30
6 – Bay Sound Clay	-46.0	-70.0	102	3.17	490	0

Table D-4. Toe Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment 1	183	1.58E+05	0.40	5.63E+04	2.63E+05	0.85
2 – Embankment 2	315	1.58E+05	0.40	5.63E+04	2.63E+05	0.86
3 – Marsh	200	3.00E+04	0.47	1.02E+04	1.67E+05	0.96
4 – Silty Sand	_	4.85E+05	0.33	2.50E+05	6.52E+05	0.75
5 –Sand	ı	7.32E+05	0.33	2.75E+05	7.32E+05	0.75
6 – Bay Sound Clay	600	2.94E+05	0.495	9.83E+04	9.80E+06	0.99

Structural Parameters

The current I-wall structure was modeled as two beam elements: (1) the upper concrete portion of the I-wall and (2) the supporting sheet pile beneath the concrete. Interface elements were applied to the wall below the ground surface. These elements allow slip and separation between the soil and wall. The shear strength of the interfaces was set at 90% of the shear strength of the strongest cohesive soil layer.

In FLAC the structural beam properties are formulated in plane stress (like a plate) and are adjusted for plane strain conditions by dividing Young's modulus by $1-v^2$ (v = Poisson's ratio). The structural parameters are included in Table D-5.

Table D-5. Summary of Structural Parameters

Member	E (psi)	E* (psi)	E* (psf)	l (in4/ft)	E*I (lbft2/ft)	A (in2/ft)	E*A (lb/ft)	ν
Concrete	3.00E+06	3.13E+06	4.50E+08	1728	3.75E+07	144	4.50E+08	0.2
Frodingham 1 B	2.90E+07	3.19E+07	4.59E+09	36.02	7.97E+06	7.87	2.51E+08	0.3

E = Young's Modulus

E* = Adj. Young's Modulus for Plain Strain

I = Moment of Inertia per foot of wall

A = Cross Sectional Area per foot of wall

v = Poisson's Ratio

Loading Conditions and Gap Formation

Canal water loadings are modeled as mechanical pressures acting normal to the ground surface and normal to the wall face. When a gap is included between the soil and I-wall a horizontal mechanical pressure is added to both the soil and the wall to the depth of the gap.

Gap development is modeled following the step-by-step procedure outlined in the London Avenue Outfall Canal Reevaluation report as well as the IPET report. The total horizontal stress in the element adjacent to the wall is compared to the hydrostatic pressure that would exist if a gap were present. If the hydrostatic water pressure exceeds the total horizontal stress it is assumed that a gap would form. Each zone is checked as canal water levels are raised from the normal pool elevation of 0.4 ft to the maximum operating level of 8 ft in 1 ft increments. Gaps were deepened in 1 ft increments as they developed.

At lower canal water levels, it is believed the higher soil level on the protected side of the wall serves to increase the horizontal stresses along the flood side of the sheet pile which slows the progression of the gap.

Results

The gap depth calculations prepared by Black and Veatch which follow IPET guidance was checked and compared with the FLAC results. The gap depth extends to the tip of the sheet pile for both methods. The FLAC and hand calculation analysis had the gap extending to approximate EL -4.5 ft. It should be noted that for even the shallower water depths, the hand calculation resulted in a gap to approximate EL -4.5 ft. The gap tip is 11.5 ft above the sand interface.

The maximum protected side ground displacement for the MLV at water level EL 8.0 ft was about 0.645 inches. The maximum developed crack depth was 8.0 ft. Graphs of the top of protected side ground and top of wall displacement and gap propagation versus canal water elevation can be found in Figures D-4 and D-5.

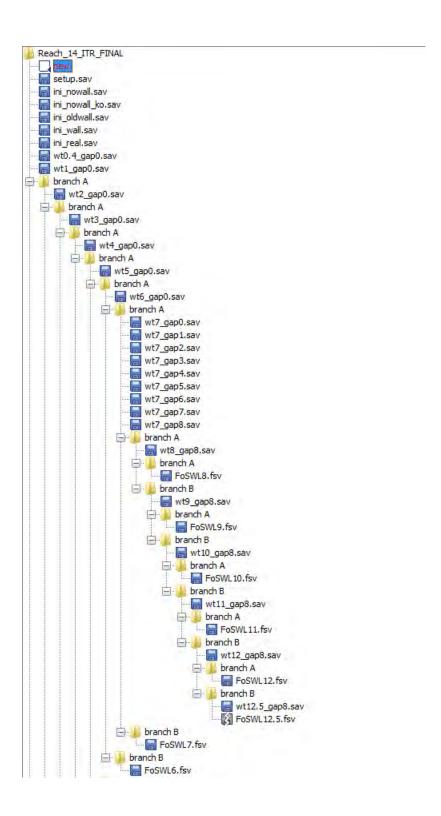




Figure D-3. FLAC model progression of water loading and gap development for Reach 14

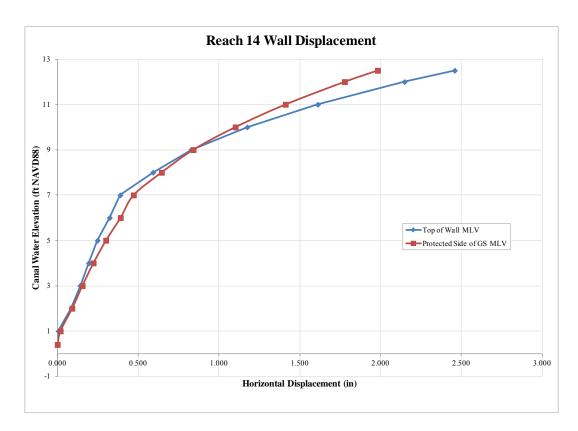


Figure D-4. FLAC computed I-wall displacement.

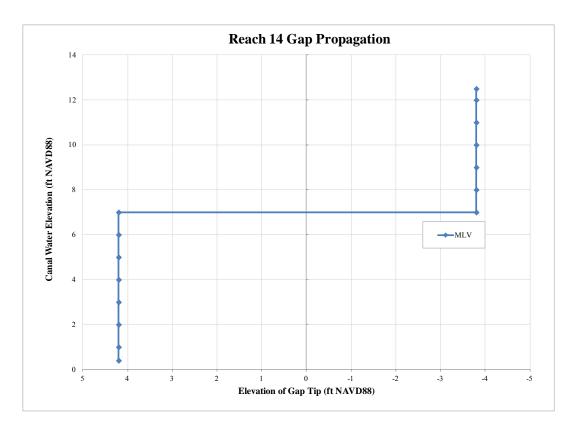


Figure D-5. FLAC computed gap propagation

The automated c-φ reduction technique in FLAC was used for all factor of safety (FoS) calculations. Figure D-6 presents the computed factors of safety for differing canal water levels and Figures D-7 through D-14 show the shear strain increment (ssi) and wall locations (original and displaced) for factor of safety at varying water levels. A summary of the FoS and controlling failure mode (global stability or wall rotation) are presented in Table D-6.

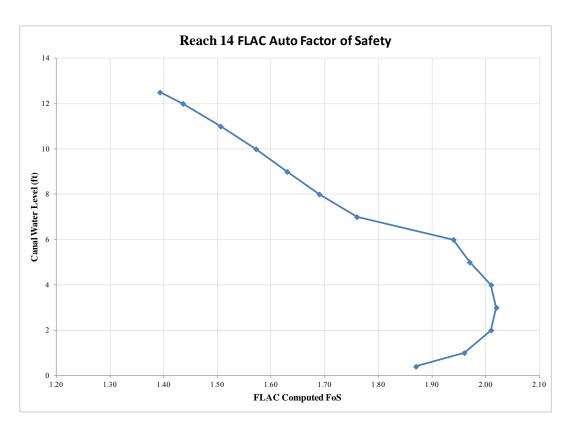


Figure D-6. FLAC computed factor of safety (automated c-φ reduction technique).

Table D-6. Summary of FLAC FoS and Controlling Failure Mode.

Canal WL	FLACAUTO	Controlling
(ft)	FoS	Failure Mode
1	1.96	Global Stability
2	2.01	Global Stability
3	2.02	Global Stability
4	2.01	Global Stability
5	1.97	Global Stability
6	1.94	Global Stability
7	1.76	Global Stability
8	1.69	Global Stability
8.9	1.64	Global Stability
9	1.63	Global Stability
10	1.57	Global Stability
11	1.51	Global Stability
12	1.44	Global Stability
12.5	1.39	Global Stability

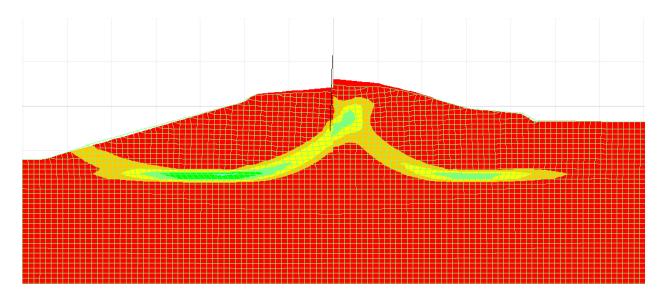


Figure D-7. WL+1 ft, FoS ssi and wall displacement magnified 5X.

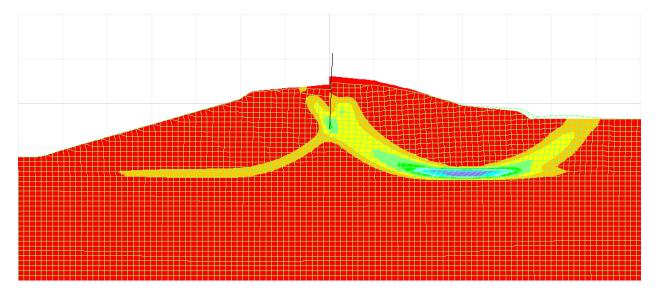


Figure D-8. WL+2 ft, FoS ssi and wall displacement magnified 5X.

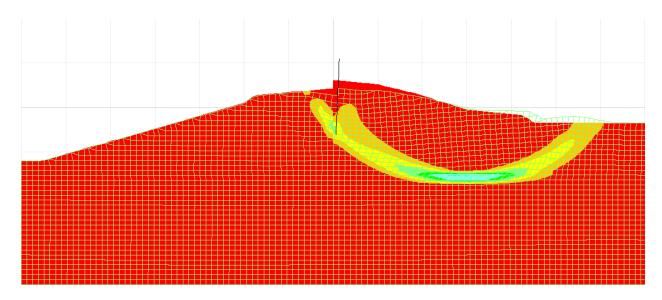


Figure D-9. WL+3 ft, FoS ssi and wall displacement magnified 5X.

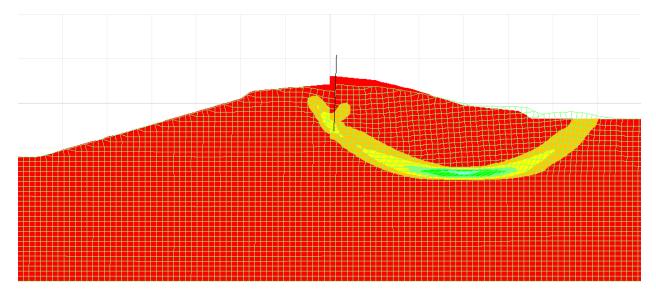


Figure D-10. WL+4 ft, FoS ssi and wall displacement magnified 5X.

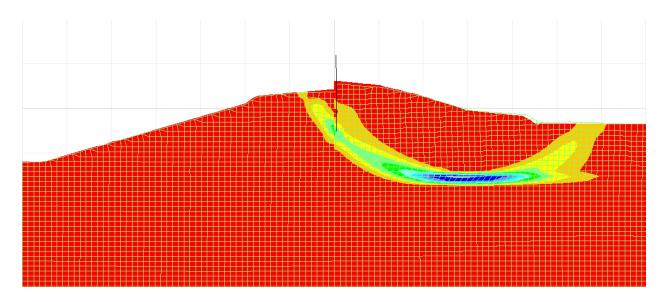


Figure D-11. WL+5 ft, FoS ssi and wall displacement magnified 5X.

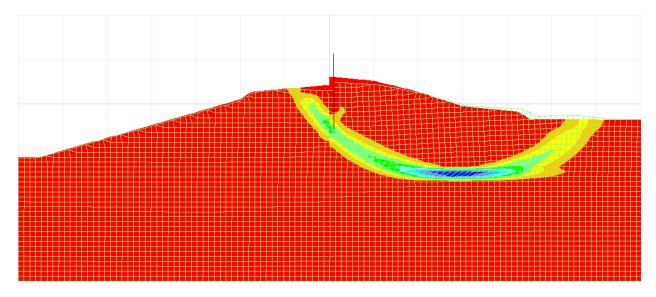


Figure D-12. WL+6 ft, FoS ssi and wall displacement magnified 5X.

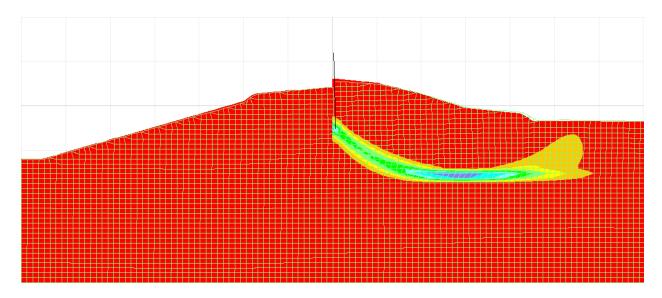


Figure D-13. WL+7 ft, FoS ssi and wall displacement magnified 5X.

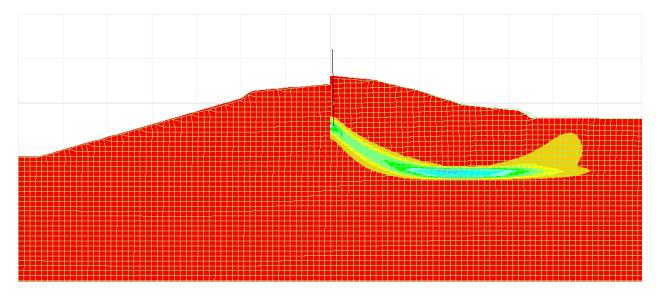


Figure D-14. WL+8 ft, FoS ssi and wall displacement magnified 5X.

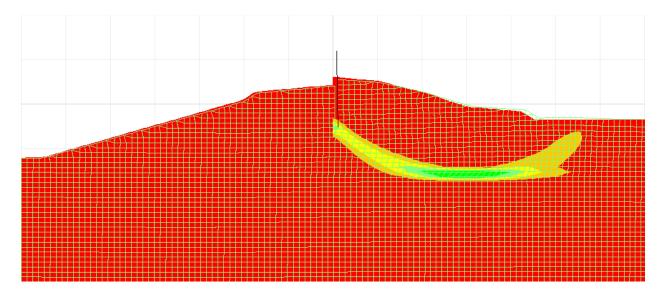


Figure D-15. WL+9 ft, FoS ssi and wall displacement magnified 5X.

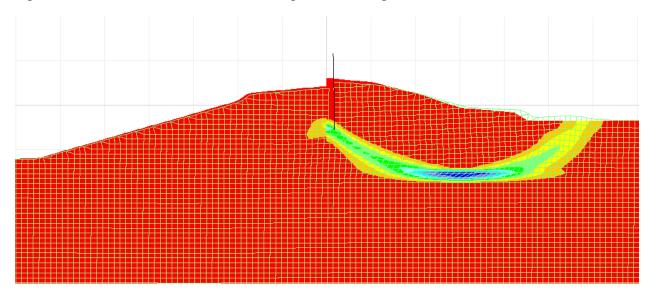


Figure D-16. WL+10 ft, FoS ssi and wall displacement magnified 5X.

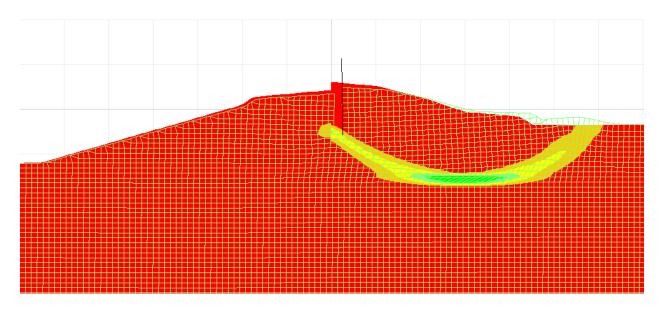


Figure D-17. WL+11 ft, FoS ssi and wall displacement magnified 5X.

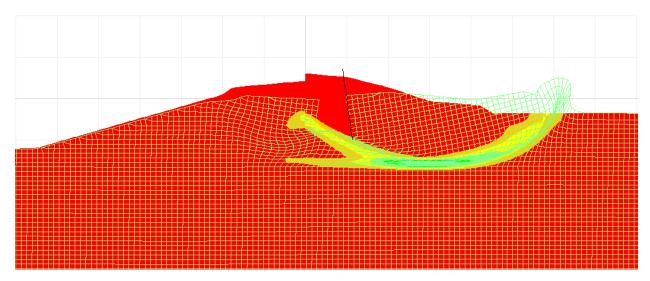


Figure D-18. WL+12 ft, FoS ssi and wall displacement magnified 5X.

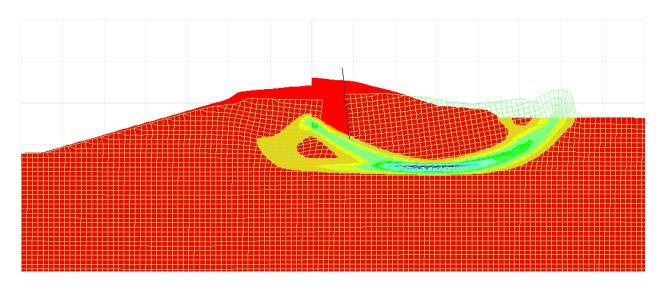


Figure D-19. WL+12.5 ft, FoS ssi and wall displacement magnified 5X.

Reach 15A

Introduction

The design section includes: clay embankment (EL +6.5 ft), underlain by a shallow Marsh deposit (EL -5.0 ft to EL -13.0 ft). The shallow Marsh is underlain by a Beach Sand stratum (EL -13.0 to -46.0 ft) which mantles a lower Bay Sound Clay deposit which extends to an EL of -70.0 ft. The upper clay embankment material was assigned a unit weight of 114 pcf with a cohesion of 800 psf. The shear strength values used for the clay embankment are higher than those in the underlying marsh deposit. The elevation of the flood side ground line at the wall face is approximately EL 3.6 ft resulting in 2.9 ft difference in soil elevation across the wall. The existing I-wall has a top elevation of 13.0 ft consisting of a concrete cap and Frodingham 1B sheet pile to tip elevation of -4.5 ft. Figures D-1 and D-2 show the Geo-Studio and FLAC model cross sections. The FLAC model created by the template is constrained to use horizontal soil layers so the top of the upper marsh strata was set at EL -5 ft, as it is shown on the flood side of the I-Wall in Figure D-2, without sloping to the levee toe to best capture the wall displacement behavior.

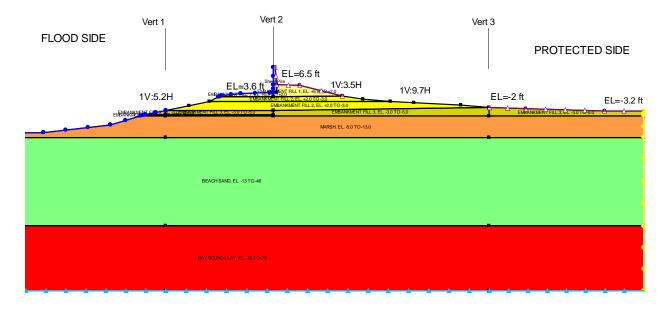


Figure D-1. Geo-Studio model for 17th Street Outfall Canal Reach 15A

Flood Side Protected Side

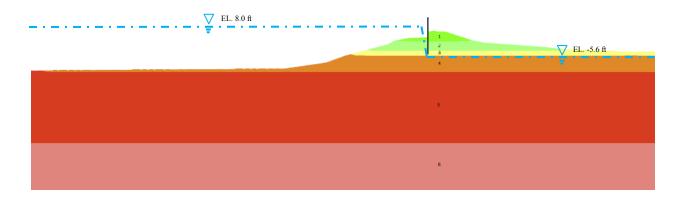


Figure D-2. FLAC Model for 17th Street Outfall Canal Reach 15A

Foundation Parameters

The FLAC analyses are based on simple Mohr-Coulomb constitutive models (elastic-perfectly plastic soil behavior). Unit weight and shear strength parameters for the various soil layers were based on the information in the MOWL Report. The cross section used is the Seep/W file from the MOWL report. As-built drawings were examined for the properties of the I-Wall.

Soil modulus values were determined or selected assuming the soils are linearly elastic and isotropic with Poisson's ratio based on expected drainage conditions during loading. The parameters used for analysis are presented in Tables D-1 thru D-2. The soil modulus values were selected using the same G/Su ratios selected for the FLAC model calibrated to the London Load Test (LLT) results. The soil modulus values used in the LLT FLAC model were primarily based on pressuremeter testing and relationships for G/Su. At London Avenue Canal, the shear modulus values are determined by multiplying the G/Su ratio for a given soil by its undrained shear strength. Young's Modulus for the levee and sand were assigned the same value used in the LLT calibration. The at-rest earth pressure coefficients are computed only to initialize stresses during model development so equilibrium can be reached in fewer computational steps.

At 17th Street Outfall Canal, seepage conditions were modeled as steady state using the Seep/W model, and previously accepted material seepage properties and protected side boundary conditions, from the MOWL report. The flood side canal total head boundary was incrementally raised from a starting water level of EL +0.4 ft to EL +1.0 ft and then by 1 ft. The water table was assumed to be constant for the protected side two feet below the ground surface -5.6 ft and 8.0 ft for the flood side. The water table elevations are presented on figure D-2.

Table D-1. Summary of Centerline Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf)*	φ' (deg)
1 – Embankment 1	6.5	2.0	114	3.540	800	0
2 – Embankment 2	2.0	-3.0	114	3.540	375	0
3 – Embankment 3	-3.0	-5.0	114	3.540	500	0
4 – Marsh	-5.0	-13.0	94	2.919	350	0
5 – Beach Sand	-13.0	-46.0	122	3.789	0	30
6 – Bay Sound Clay	-46.0	-70.0	102	3.168	735	0

Table D-2. Centerline Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment 1	197	1.58E+05	0.40	56250	262500	0.85
2 – Embankment 2	420	1.58E+05	0.40	56250	262500	0.85
3 – Embankment 3	315	1.58E+05	0.40	56250	262500	0.85
4 – Marsh	200	7.00E+04	0.47	23810	388889	0.96
5 – Beach Sand	-	7.32E+05	0.31	275188	732000	0.75
6 – Bay Sound Clay	600	4.41E+05	0.495	147492	14700000	0.99

Table D-3. Summary of Toe Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf)	φ' (deg)
1 – Embankment 1	6.5	2.0	114	3.540	500	0
2 – Embankment 2	2.0	-3.0	114	3.540	500	0
3 – Embankment 3	-3.0	-5.0	114	3.540	500	0
4 – Marsh	-5.0	-13.0	94	2.919	200	0
5 – Beach Sand	-13.0	-46.0	122	3.789	0	30
6 – Bay Sound Clay	-46.0	-70.0	102	3.230	522	0

Table D-4. Toe Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment 1	315	1.58E+05	0.40	56250	262500	0.85
2 – Embankment 2	315	1.58E+05	0.40	56250	262500	0.85
3 – Embankment 3	315	1.58E+05	0.40	56250	262500	0.85
4 – Marsh	200	4.00E+04	0.47	13605	222222	0.96
5 – Beach Sand	-	7.32E+05	0.33	275188	732000	0.75
6 – Bay Sound Clay	600	3.13E+05	0.495	104749	10440000	0.99

Structural Parameters

The current I-wall structure was modeled as two beam elements: (1) the upper concrete portion of the I-wall and (2) the supporting sheet pile beneath the concrete. Interface elements were applied to the wall below the ground surface. These elements allow slip and separation between the soil and wall. The shear strength of the interfaces was set at 90% of the shear strength of the strongest cohesive soil layer.

In FLAC the structural beam properties are formulated in plane stress (like a plate) and are adjusted for plane strain conditions by dividing Young's modulus by $1-v^2$ (v = Poisson's ratio). The structural parameters are included in Table D-5.

Table D-5. Summary of Structural Parameters

Member	E (psi)	E* (psi)	E* (psf)	I (in4/ft)	E*I (lbft2/ft)	A (in2/ft)	E*A (lb/ft)	ν
Concrete	3.00E+06	3.13E+06	4.50E+08	1728	3.75E+07	144	4.50E+08	0.2
Frodingham 1B	2.90E+07	3.19E+07	4.59E+09	36.02	7.97E+06	7.87	2.51E+08	0.3

E = Young's Modulus

E* = Adj. Young's Modulus for Plain Strain

I = Moment of Inertia per foot of wall

A = Cross Sectional Area per foot of wall

v = Poisson's Ratio

Loading Conditions and Gap Formation

Canal water loadings are modeled as mechanical pressures acting normal to the ground surface and normal to the wall face. When a gap is included between the soil and I-wall a horizontal mechanical pressure is added to both the soil and the wall to the depth of the gap.

Gap development is modeled following the step-by-step procedure outlined in the London Avenue Outfall Canal Reevaluation report as well as the IPET report. The total horizontal stress in the element adjacent to the wall is compared to the hydrostatic pressure that would exist if a gap were present. If the hydrostatic water pressure exceeds the total horizontal stress it is

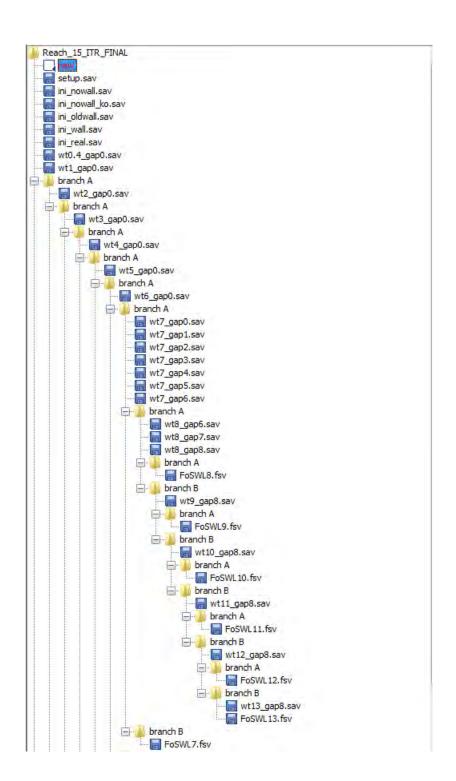
assumed that a gap would form. Each zone is checked as canal water levels are raised from the normal pool elevation of 0.4 ft to the maximum operating level of 8 ft in 1 ft increments. Gaps were deepened in 1 ft increments as they developed.

At lower canal water levels, it is believed the higher soil level on the protected side of the wall serves to increase the horizontal stresses along the flood side of the sheet pile which slows the progression of the gap.

Results

The gap depth calculations prepared by Black and Veatch which follow IPET guidance was checked and compared with the FLAC results. The gap depth extends to the tip of the sheet pile for both methods. The FLAC and hand calculation analysis had the gap extending to approximate EL -4.5 ft. It should be noted that for even the shallower water depths, the hand calculation resulted in a gap to approximate EL -4.5 ft. The gap tip is 8.5 ft above the sand interface.

The maximum protected side ground displacement for the MLV at water level EL 8.0 ft was about 0.509 inches. The maximum developed crack depth was 9.5 ft. Graphs for the top of protected side ground and top of wall displacement and gap propagation versus canal water elevation can be found in Figures D-4 and D-5.



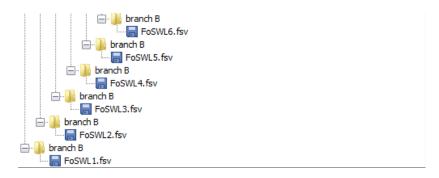


Figure D-3. FLAC model progression of water loading and gap development for Reach 15A

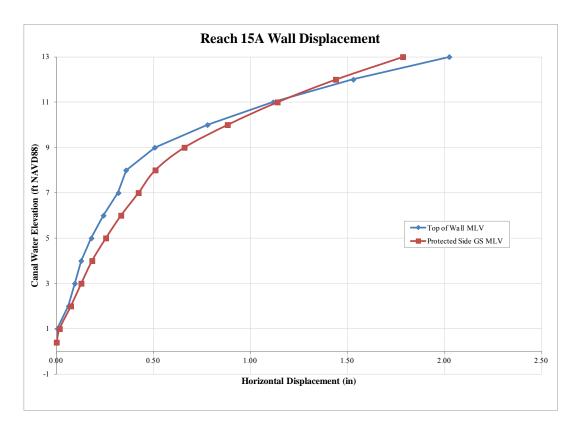


Figure D-4. FLAC computed I-wall displacement.

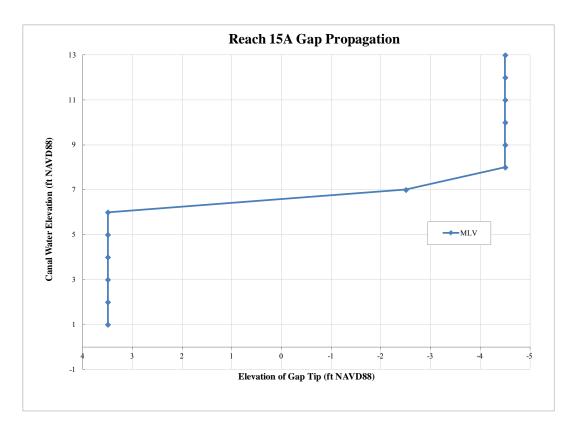


Figure D-5. FLAC computed gap propagation

The automated c-φ reduction technique in FLAC was used for all factor of safety (FoS) calculations. Figure D-6 presents the computed factors of safety for differing canal water levels and Figures D-7 through D-14 show the shear strain increment (ssi) or and wall locations (original and displaced) for factor of safety at varying water levels. A summary of the FoS and controlling failure mode (global stability or wall rotation) are presented in Table D-6.

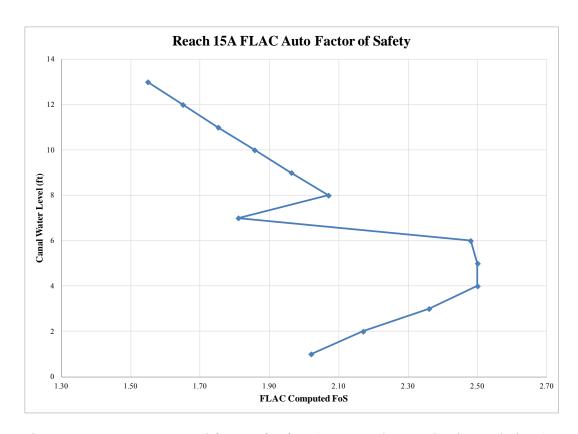


Figure D-6. FLAC computed factor of safety (automated c-φ reduction technique).

Table D-6. Summary of FLAC FoS and Controlling Failure Mode.

Canal WL	FLACAUTO	Controlling
(ft)	FoS	Failure Mode
1	2.02	Global Stability
2	2.17	Global Stability
3	2.36	Global Stability
4	2.50	Global Stability
5	2.50	Global Stability
6	2.48	Global Stability
7	1.81	Global Stability
8	2.07	Global Stability
9	1.96	Global Stability
10	1.86	Global Stability
11	1.75	Global Stability
12	1.65	Global Stability
13	1.55	Global Stability

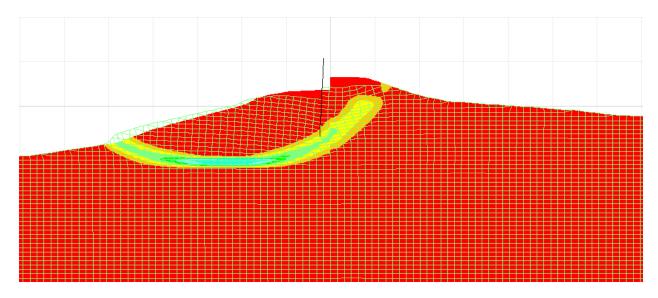


Figure D-7. WL+1 ft, FoS ssi and wall displacement magnified 5X.

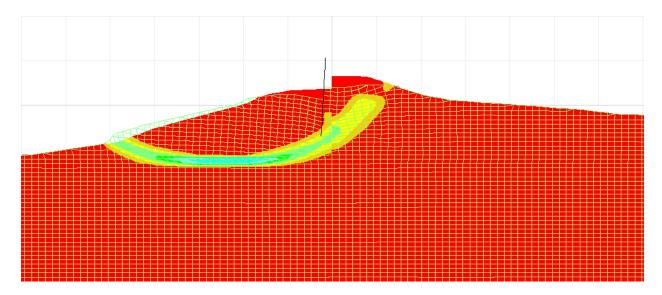


Figure D-8. WL+2 ft, FoS ssi and wall displacement magnified 5X.

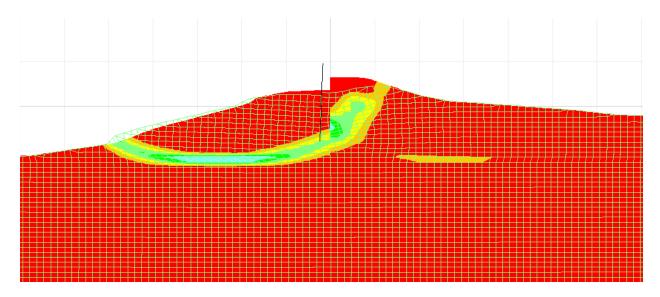


Figure D-9. WL+3 ft, FoS ssi and wall displacement magnified 5X.

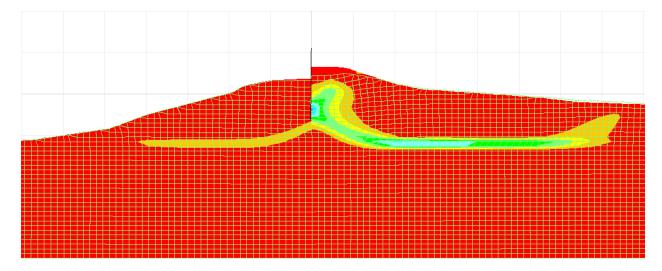


Figure D-10. WL+4 ft, FoS ssi and wall displacement magnified 5X.

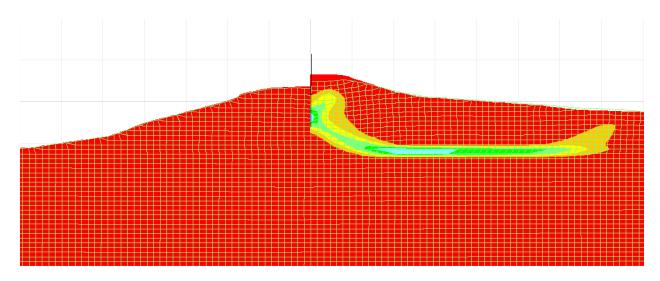


Figure D-11. WL+5 ft, FoS ssi and wall displacement magnified 5X.

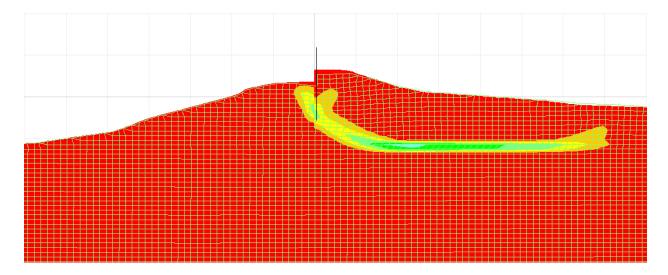


Figure D-12. WL+6 ft, FoS ssi and wall displacement magnified 5X.

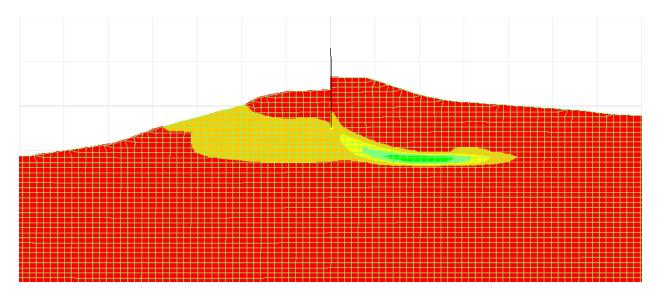


Figure D-13. WL+7 ft, FoS ssi and wall displacement magnified 5X.

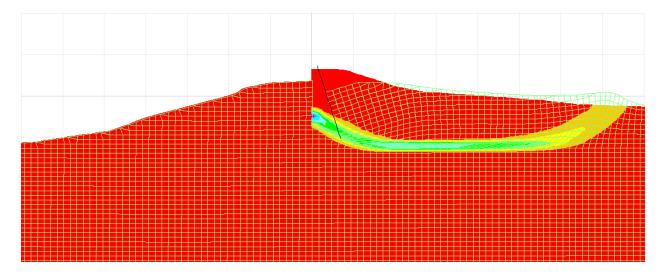


Figure D-14. WL+8 ft, FoS ssi and wall displacement magnified 5X.

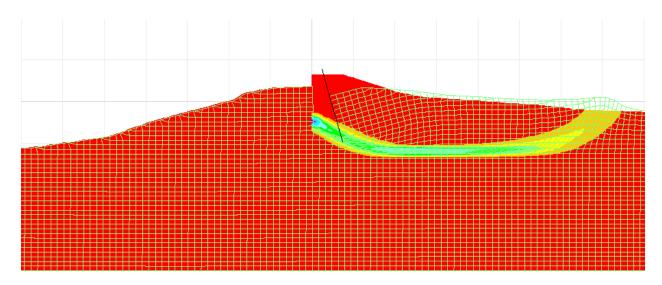


Figure D-15. WL+9 ft, FoS ssi and wall displacement magnified 5X.

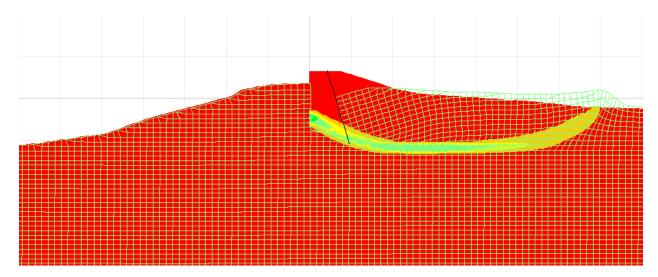


Figure D-16. WL+10 ft, FoS ssi and wall displacement magnified 5X.

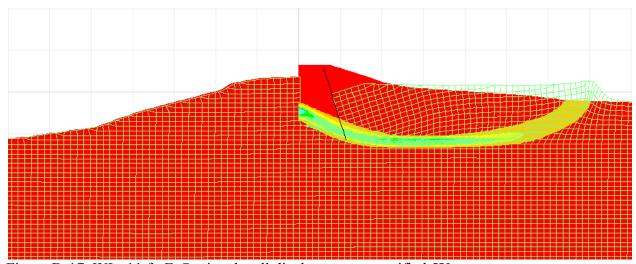


Figure D-17. WL+11 ft, FoS ssi and wall displacement magnified 5X.

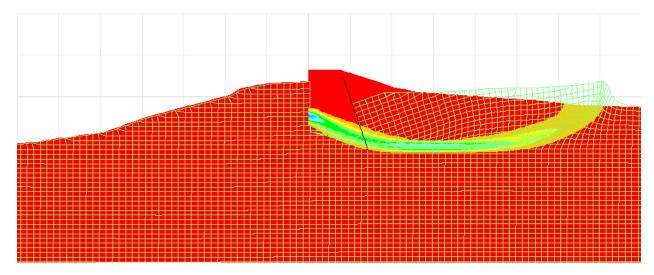


Figure D-18. WL+12 ft, FoS ssi and wall displacement magnified 5X.

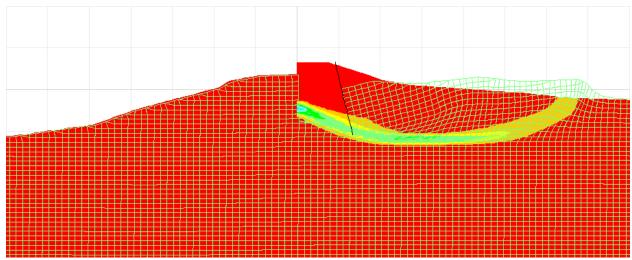


Figure D-19. WL+13 ft, FoS ssi and wall displacement magnified 5X.

Reach 17

Introduction

The design section includes: clay embankment (EL +9.9 ft), underlain by a shallow Marsh deposit (EL -3.0 ft to EL -12.0 ft). The shallow Marsh is underlain by a Beach Sand stratum (EL -12.0 to -46.0 ft) which mantles a lower Bay Sound Clay deposit which extends to an EL of -70.0 ft. The upper clay embankment material was assigned a unit weight of 116 pcf with a cohesion of 800 psf. The shear strength values used for the clay embankment are higher than those in the underlying marsh deposit. The elevation of the flood side ground line at the wall face is approximately EL 9.9 ft resulting in 0.0 ft difference in soil elevation across the wall. The existing I-wall has a top elevation of 13.5 ft consisting of a concrete cap and Frodingham1B sheet pile to tip elevation of -2.5 ft. Figures D-1 and D-2 show the Geo-Studio and FLAC model cross sections. The FLAC model created by the template is constrained to use horizontal soil layers so the top of the upper marsh strata was set at EL -3 ft, as it is shown on the flood side of the I-Wall in Figure D-2, without sloping to the levee toe to best capture the wall displacement behavior.

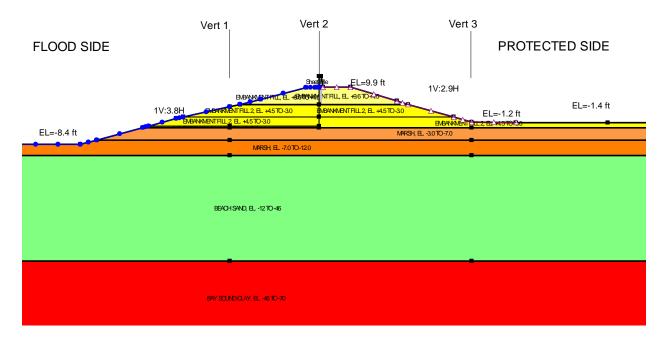


Figure D-1. Geo-Studio model for 17th Street Outfall Canal Reach 17

Flood Side Protected Side

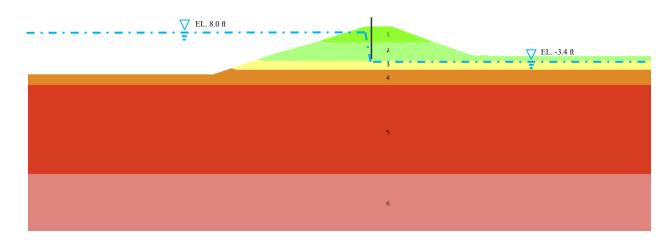


Figure D-2. FLAC Model for 17th Street Outfall Canal Reach 17

Foundation Parameters

The FLAC analyses are based on simple Mohr-Coulomb constitutive models (elastic-perfectly plastic soil behavior). Unit weight and shear strength parameters for the various soil layers were based on the information in the MOWL Report. The cross section used is the Seep/W file from the MOWL report. As-built drawings were examined for the properties of the I-Wall.

Soil modulus values were determined or selected assuming the soils are linearly elastic and isotropic with Poisson's ratio based on expected drainage conditions during loading. The parameters used for analysis are presented in Tables D-1 thru D-4. The soil modulus values were selected using the same G/Su ratios selected for the FLAC model calibrated to the London Load Test (LLT) results. The soil modulus values used in the LLT FLAC model were primarily based on pressuremeter testing and relationships for G/Su. At London Avenue Canal, the shear modulus values are determined by multiplying the G/Su ratio for a given soil by its undrained shear strength. Young's Modulus for the levee and sand were assigned the same value used in the LLT calibration. The at-rest earth pressure coefficients are computed only to initialize stresses during model development so equilibrium can be reached in fewer computational steps.

At 17th Street Outfall Canal, seepage conditions were modeled as steady state using the Seep/W model, and previously accepted material seepage properties and protected side boundary conditions, from the MOWL report. The flood side canal total head boundary was incrementally raised from a starting water level of EL +0.4 ft to EL +1.0 ft and then by 1 ft. The water table was assumed to be constant for the protected side two feet below the ground surface -3.4 ft and 10.0 ft for the flood side. The water table elevations are presented on figure D-2.

Table D-1. Summary of Centerline Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf)*	φ' (deg)
1 – Embankment 1	9.9	4.5	116	3.60	800	0
2 – Embankment 2	4.5	-3.0	113	3.51	650	0
3 – Marsh 1	-3.0	-7.0	108	3.35	450	0
4 – Marsh 2	-7.0	-12.0	108	3.35	450	0
5 – Beach Sand	-12.0	-46.0	122	3.79	0	30
6 – Bay Sound Clay	-46.0	-70.0	107	3.32	835	0

Table D-2. Centerline Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment 1	197	1.58E+05	0.40	56250	262500	0.85
2 – Embankment 2	242	1.58E+05	0.40	56250	262500	0.85
3 – Marsh 1	200	9.00E+04	0.47	30612	500000	0.95
4 – Marsh 2	200	9.00E+04	0.47	30612	500000	0.95
5 – Beach Sand	_	7.32E+05	0.33	275188	732000	0.75
6 – Bay Sound Clay	600	5.00E+05	0.495	167559	16700000	0.99

Table D-3. Summary of Toe Soil Parameters

Material	Strata top elevation (NAVD88)	Strata bottom elevation (NAVD88)	unit wt. (pcf)	unit wt/g	Su (psf)*	φ' (deg)
1 – Embankment 1	9.9	4.5	116	3.60	800	0
2 – Embankment 2	4.5	-3.0	113	3.51	600	0
3 – Marsh 1	-3.0	-7.0	108	3.35	425	0
4 – Marsh 2	-7.0	-12.0	108	2.35	320	0
5 – Beach Sand	-12.0	-46.0	122	3.79	0	30
6 – Bay Sound Clay	-46.0	-70.0	107	3.32	555	0

Table D-4. Toe Most Likely Value Modulus

Material	E/Su	E (psf)	Poisson	G (psf)	K (psf)	ko
1 – Embankment 1	197	1.58E+05	0.40	56250	262500	0.85
2 – Embankment 2	263	1.58E+05	0.40	56250	262500	0.85
3 – Marsh 1	200	8.50E+04	0.47	28912	472222	0.95
4 – Marsh 2	200	6.40E+04	0.47	21769	355556	0.95
5 – Beach Sand	_	7.32E+05	0.33	275188	732000	0.75
6 – Bay Sound Clay	600	3.30E+05	0.495	111371	11100000	0.99

Structural Parameters

The current I-wall structure was modeled as two beam elements: (1) the upper concrete portion of the I-wall and (2) the supporting sheet pile beneath the concrete. Interface elements were applied to the wall below the ground surface. These elements allow slip and separation between the soil and wall. The shear strength of the interfaces was set at 90% of the shear strength of the strongest cohesive soil layer.

In FLAC the structural beam properties are formulated in plane stress (like a plate) and are adjusted for plane strain conditions by dividing Young's modulus by $1-v^2$ (v = Poisson's ratio). The structural parameters are included in Table D-5.

Table D-5. Summary of Structural Parameters

Member	E (psi)	E* (psi)	E* (psf)	I (in4/ft)	E*I (lbft2/ft)	A (in2/ft)	E*A (lb/ft)	ν
Concrete	3.00E+06	3.13E+06	4.50E+08	1728	3.75E+07	144	4.50E+08	0.2
Frodingham1B	2.90E+07	3.19E+07	4.59E+09	36.02	7.97E+06	7.87	2.51E+08	0.3

E = Young's Modulus

E* = Adj. Young's Modulus for Plain Strain

I = Moment of Inertia per foot of wall

A = Cross Sectional Area per foot of wall

v = Poisson's Ratio

Loading Conditions and Gap Formation

Canal water loadings are modeled as mechanical pressures acting normal to the ground surface and normal to the wall face. When a gap is included between the soil and I-wall a horizontal mechanical pressure is added to both the soil and the wall to the depth of the gap.

Gap development is modeled following the step-by-step procedure outlined in the London Avenue Outfall Canal Reevaluation report as well as the IPET report. The total horizontal stress in the element adjacent to the wall is compared to the hydrostatic pressure that would exist if a gap were present. If the hydrostatic water pressure exceeds the total horizontal stress it is

assumed that a gap would form. Each zone is checked as canal water levels are raised from the normal pool elevation of 0.4 ft to the maximum operating level of 10.0 ft in 1 ft increments. Gaps were deepened in 1 ft increments as they developed.

At lower canal water levels, it is believed the higher soil level on the protected side of the wall serves to increase the horizontal stresses along the flood side of the sheet pile which slows the progression of the gap.

Results

The gap depth calculations prepared by Black and Veatch which follow IPET guidance was checked and compared with the FLAC results. The gap depth extends to the tip of the sheet pile for the hand calculation analysis but not for the FLAC analysis. The hand calculation analysis had the gap extending to approximately EL -4.5 ft with the gap tip for the hand calculation being 11.5 ft above the sand interface. It should be noted that even for the shallower water depths, the hand calculations resulted in a gap developing to approximate EL -4.5 ft. Figure D-3 shows the total horizontal stresses and water pressures plotted against depth in FLAC. This data representation of the two lines never intersecting accurately depicts that a gap did not develop.

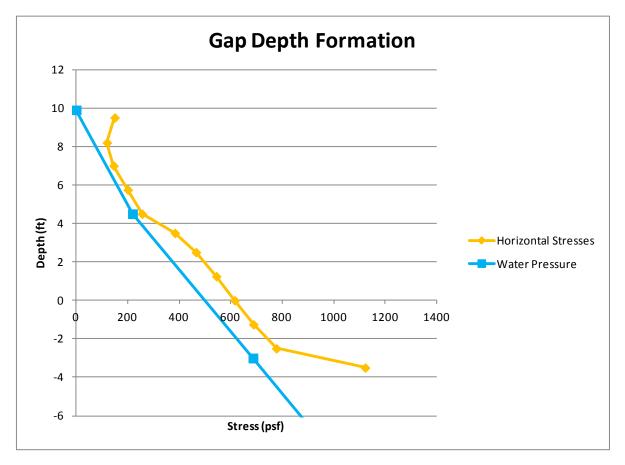
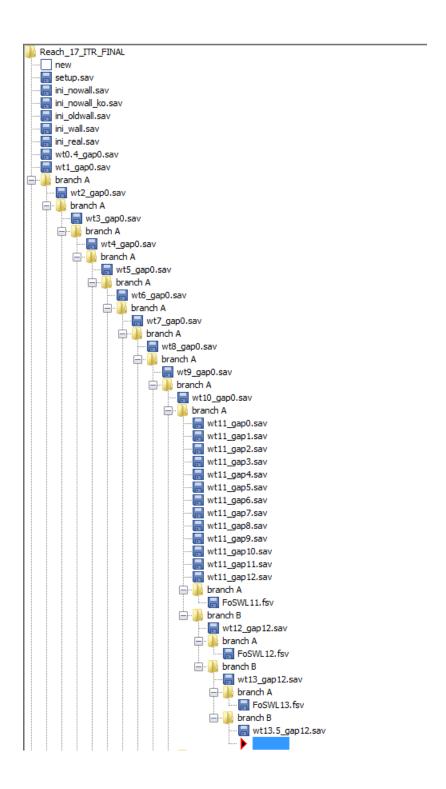


Figure D-3. Geo-Studio model for 17th Street Outfall Canal Reach 17

The maximum protected side ground displacement for the MLV at water level EL 10.0 ft was about 0.59 inches. The maximum developed crack depth was 0 ft. The undeveloped crack depth leading to a gap formation was not initiated due to insignificant hydrostatic forces acting on the wall. The elevation of the flood side ground surface at the wall face is approximately EL 9.9 ft resulting in 0.1 ft difference between the resulting water level and ground surface elevation. Graphs for the top of protected side ground and top of wall displacement and gap propagation versus canal water elevation can be found in Figures D-5 and D-6.



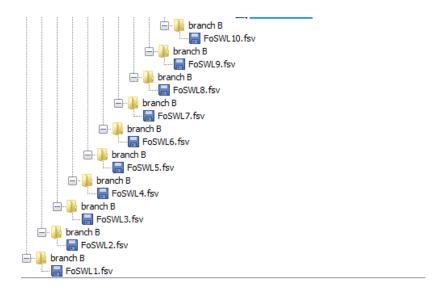


Figure D-4. FLAC model progression of water loading and gap development for Reach 17

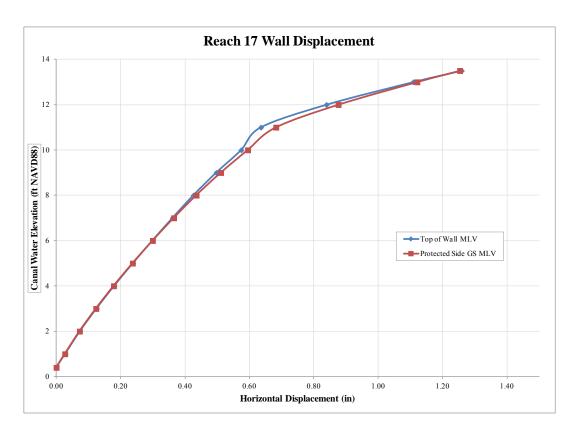


Figure D-5. FLAC computed I-wall displacement.

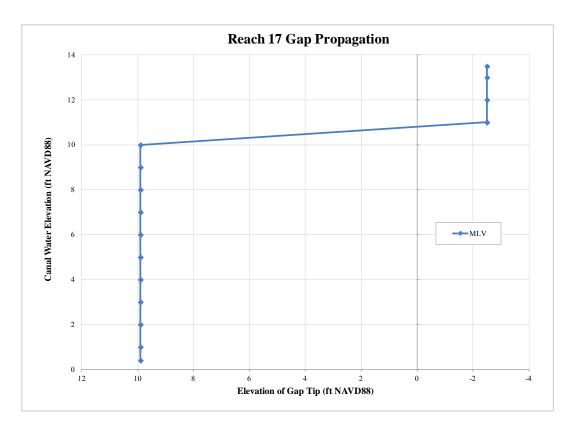


Figure D-6. FLAC computed gap propagation

The automated c-\$\phi\$ reduction technique in FLAC was used for all factor of safety (FoS) calculations. Figure D-7 presents the computed factors of safety for differing canal water levels and Figures D-8 through D-17 show the shear strain increment (ssi) and wall locations (original and displaced) for factor of safety at varying water levels. A summary of the FoS and controlling failure mode (global stability or wall rotation) are presented in Table D-6.

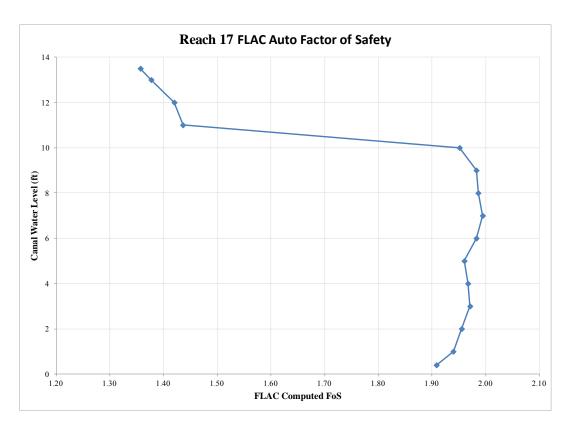


Figure D-7. FLAC computed factor of safety (automated c-φ reduction technique).

Table D-6. Summary of FLAC FoS and Controlling Failure Mode.

Canal WL	FLACAUTO	Controlling
(ft)	FoS	Failure Mode
1	1.94	Global Stability
2	1.96	Global Stability
3	1.97	Global Stability
4	1.97	Global Stability
5	1.97	Global Stability
6	1.98	Global Stability
7	1.99	Global Stability
8	1.99	Global Stability
9	1.98	Global Stability
10	1.95	Global Stability
11	1.44	Global Stability
12	1.42	Global Stability
13	1.38	Global Stability
13.5	1.36	Global Stability

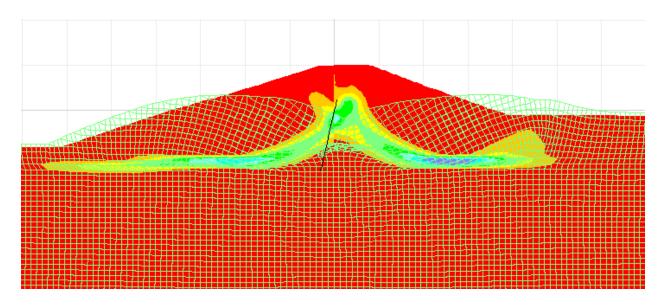


Figure D-8. WL+1 ft, FoS ssi and wall displacement magnified 60X.

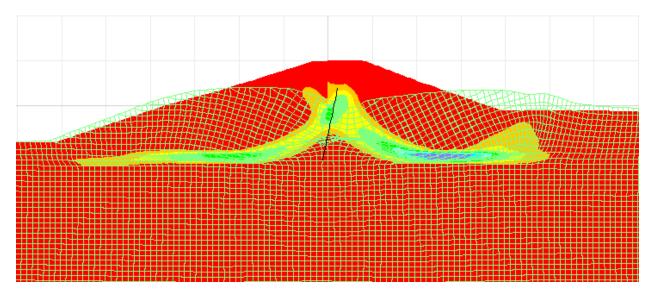


Figure D-9. WL+2 ft, FoS ssi and wall displacement magnified 60X.

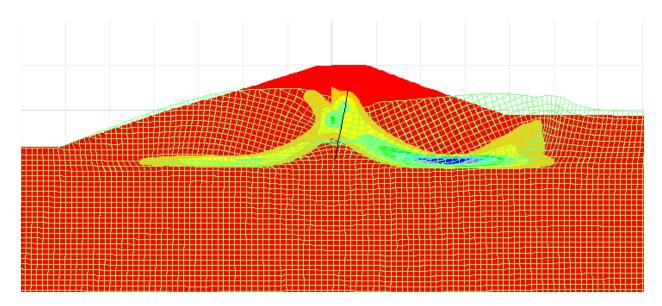


Figure D-10. WL+3 ft, FoS ssi and wall displacement magnified 60X.

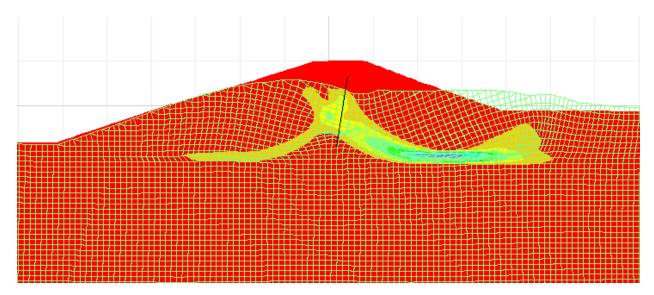


Figure D-11. WL+4 ft, FoS ssi and wall displacement magnified 60X.

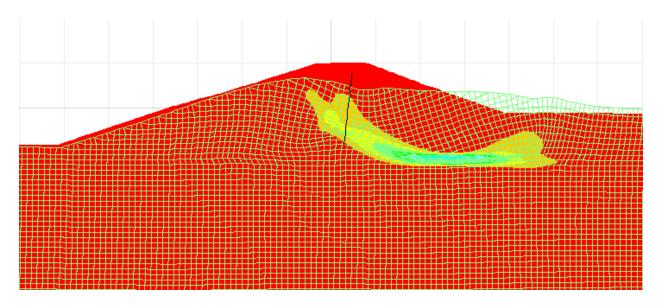


Figure D-12. WL+5 ft, FoS ssi and wall displacement magnified 60X.

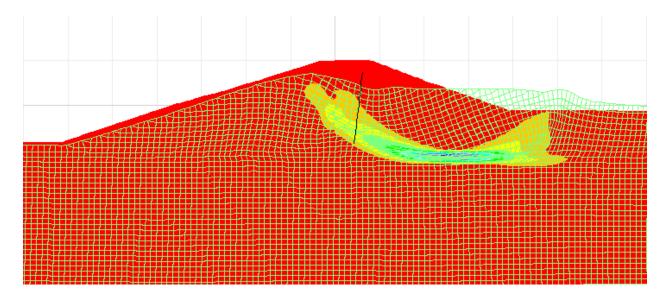


Figure D-13. WL+6 ft, FoS ssi and wall displacement magnified 60X.

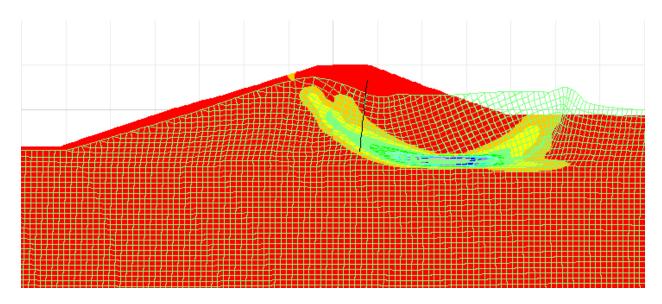


Figure D-14. WL+7 ft, FoS ssi and wall displacement magnified 60X.

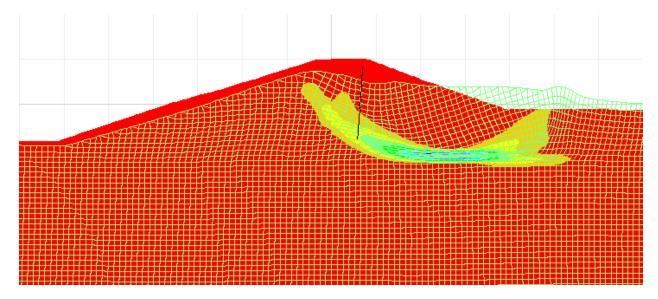


Figure D-15. WL+8 ft, FoS ssi and wall displacement magnified 60X.

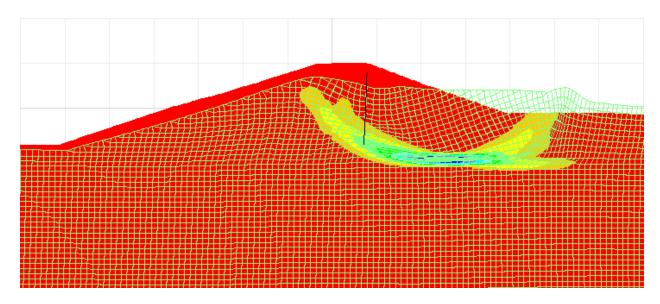


Figure D-16. WL+9 ft, FoS ssi and wall displacement magnified 60X.

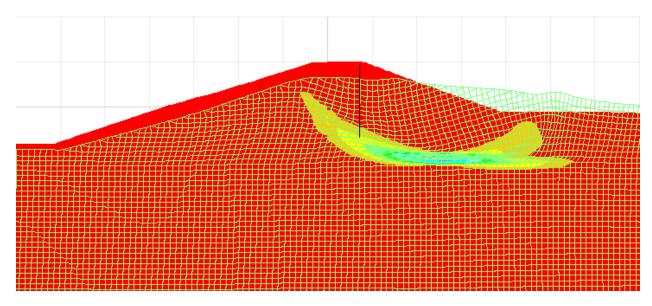


Figure D-17. WL+10 ft, FoS ssi and wall displacement magnified 60X.

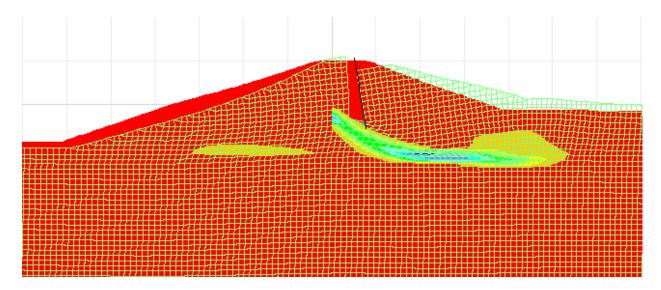


Figure D-18. WL+11 ft, FoS ssi and wall displacement magnified 60X.

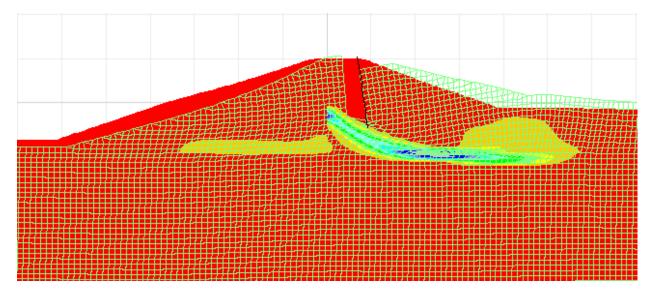


Figure D-19. WL+12 ft, FoS ssi and wall displacement magnified 60X.

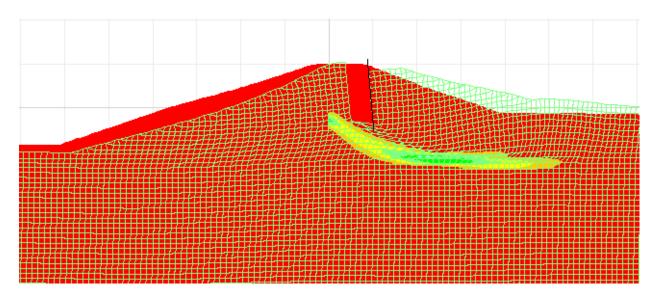


Figure D-20. WL+13 ft, FoS ssi and wall displacement magnified 60X.

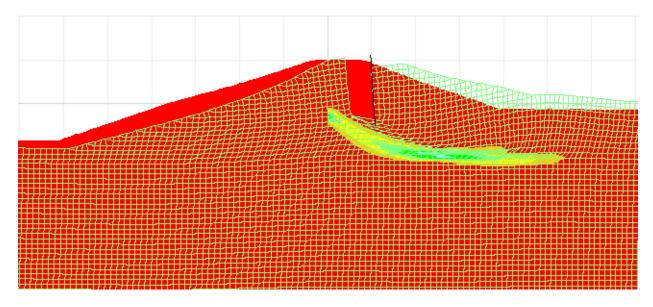
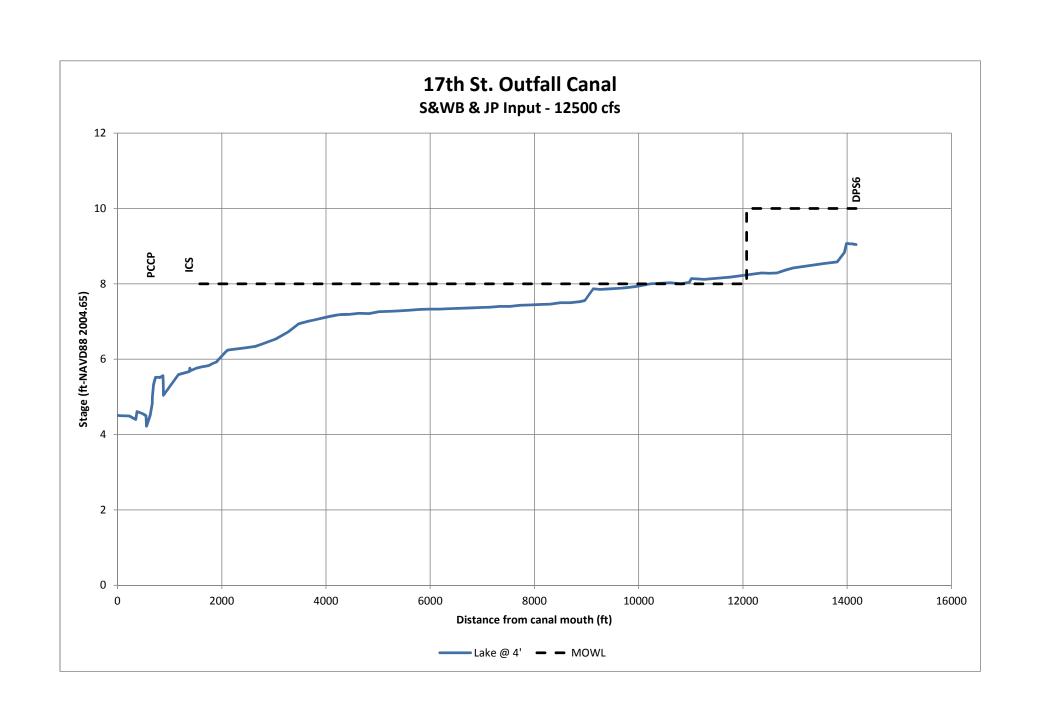


Figure D-21. WL+13.5 ft, FoS ssi and wall displacement magnified 60X.

Appendix G- Maximum Operatin	ng Water Level (MOV	VL) Data	



	Hydraulic Information (I	Flowline)	Geotechnical Information	n	Geotechnical Information	1
W.S. Elev.	W.S. Elev. + Uncertainty		Distance from DPS 6 (East Side)	Reach	Distance from DPS 6 (West Side)	Reach
(ft)	(ft)	(ft)	(ft)		(ft)	
8.5	9.0	0.0	. ,		. ,	
8.6	9.1	9.7	237	35	364	18
8.6	9.1	19.5	1013		1000	
8.6	9.1	29.2	1013	34	1000	17
8.6	9.1	39.0	1500	34	1500	1,
8.6				33		16
	9.1	48.7	1500	33	1500	16
8.6	9.1	58.4	2960	22	3115	450
8.6	9.1	68.2	2960	32	3115	15B
8.6	9.1	77.9	3104		3521	
8.6	9.1	87.7	3104	31	3521	15A
8.6	9.1	97.4	3395		4365	
8.6	9.1	107.1	3395	30	4365	14
8.6	9.1	116.9	4131		5165	
8.6	9.1	126.6	4131	29	5165	13
8.6	9.1	136.4	4589		5465	
8.6	9.1	146.1	4589	28	5465	12
8.6	9.1	155.8	5116		5965	
8.6	9.1	165.6	5116	27	5965	11
8.6	9.1	175.3	5327	**	7260	
8.6	9.1	185.1	5327	26	7260	10
8.3	8.8	225.1	5819	20	7565	10
8.1	8.6		5819	25		9
		363.1 612.1		25	7565 7005	9
8.0	8.5	613.1	6795	24	7995	
7.9	8.4	1213.1	6795	24	7995	8
7.9	8.4	1363.1	7752		8310	_
7.8	8.3	1513.1	7752	23	8310	7
7.8	8.3	1663.1	8469		8605	
7.8	8.3	1813.1	8469	22	8605	6
7.7	8.2	2413.1	10546		9042.5	
7.6	8.1	2913.1	10546	21	9042.5	5
7.6	8.1	3158.1	11019		9320	
7.5	8.0	3199.7	11019	20	9320	4
7.5	8.0	3241.3	11671		9720	
7.5	8.0	3282.9	11671	19	9720	3B
7.5	8.0	3324.5	12098	13	9865	30
7.5	8.0	3366.1	12030		9865	3A
7.5	8.0	3559.1			10365	JA
						2
7.5	8.0	3947.1			10365	2
7.5	8.0	4140.1			11495	
7.4	7.9	4333.1			11495	1
7.4	7.9	4526.1			11926.5	
7.4	7.9	4719.1				
7.4	7.9	4912.1				
7.4	7.9	5045.1				
7.1	7.6	5203.1				
7.0	7.5	5291.1				
7.0	7.5	5484.1				
7.0	7.5	5677.1				
7.0	7.5	5870.1				
7.0	7.5	6063.1				
6.9	7.4	6256.1				
6.9	7.4	6449.1				
6.9	7.4	6642.1				
6.9	7.4	6835.1				
6.9	7.4	7028.1				
6.9	7.4	7221.1				
6.9	7.4	7414.1				
6.9	7.4	7607.1				
6.8	7.3	7800.1				
6.8	7.3	7993.1				
6.8	7.3	8186.1				
6.8	7.3	8379.1				
6.8	7.3	8572.1				
6.8	7.3	8765.1				
6.8	7.3	8958.1				
6.8	7.3	9151.1				
6.7	7.2	9344.1				
	7.2					
6.7	1.4	9537.1				
6.7						
	7.2	9730.1				
6.7	7.2 7.2	9923.1				
6.7 6.6	7.2 7.2 7.1	9923.1 10116.1				
6.7 6.6 6.6	7.2 7.2 7.1 7.1	9923.1				
6.7 6.6	7.2 7.2 7.1	9923.1 10116.1				

	Hydraulic Information (F	Flowline)	Geotechnical Information	n	Geotechnical Information	ı
W.S. Elev.	W.S. Elev. + Uncertainty		Distance from DPS 6 (East Side)	Reach	Distance from DPS 6 (West Side)	Reach
(ft)	(ft)	(ft)	(ft)		(ft)	
6.2	6.7	10898.1				
6.0	6.5	11141.1				
5.9	6.4	11399.1				
5.8	6.3	11527.1				
5.8	6.3	11720.1				
5.8	6.3	12013.1				
5.7	6.2	12056.1				
5.7	6.2	12064.3				
5.7	6.2	12072.6				
5.7	6.2	12080.8				
5.7	6.2	12089.1				
5.5	6.0	12254.1				
5.4	5.9	12264.1				
5.4	5.9	12355.1				
5.3	5.8	12422.1				
5.3	5.8	12537.1				
5.3	5.8	12569.1				
5.3	5.8	12659.1				
5.2	5.7	12779.1				
5.3	5.8	12784.1				
5.2	5.7	12790.1				
5.2	5.7	12796.1				
5.2	5.7	12802.1				
5.1	5.6	13002.1				
4.5	5.0	13291.1				
4.8	5.3	13293.6				
5.0	5.5	13296.1				
5.0	5.5	13298.6				
5.1	5.6	13301.1				
5.0	5.5	13361.1				
5.0	5.5	13381.1				
5.0	5.5	13401.1				
5.0	5.5	13421.1				
5.0	5.5	13441.1				
4.9	5.4	13461.1				
4.8	5.3	13481.1				
4.5	5.0	13501.1				
4.3	4.8	13506.1				
4.0	4.5	13546.1				
3.7	4.2	13616.1				
4.0	4.5	13626.1				
4.1	4.6	13686.1				
4.1	4.6	13796.1				
3.9	4.4	13821.1				
4.0	4.5	13943.1				
4.0	4.5	14121.1				
4.0	4.5	14171.1				

Appendix H – DDR Reach 16





U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT

GEOTECHNICAL ENGINEERING DESIGN DOCUMENT REPORT (DDR) ON REACH 16 FOR THE 17TH ST. OUTFALL CANAL.

Prepared by:
GEOTECHNICAL AND HTRW BRANCH
ST. LOUIS DISTRICT CORPS OF ENGINEERS
CEMVS-EC-G
MARCH 2013

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Executive Summary

This Design Documentation Report (DDR) presents the geotechnical analyses, conclusions, and recommendations for the seepage remediation of Stations 641+85 to 658+00 (Reach 16) of 17th Street Canal. The seepage addendum June 2012, USACE-MVS showed that there are two isolated areas along Reach 16 with a factor of safety less than the USACE criteria of 1.6. In order to better define the stratigraphy of these two isolated areas, MVS requested additional geotechnical exploration and testing and completed additional seepages analyses. A total of fifteen new borings (17MVS-01PU to 08PU and 17MVS-01CU to 07CU) were drilled close to the existing drainage ditch and in the crown of the levee. The new borings were used to obtain more accurate unit weights, obtain sand gradations and fine content, determine top elevation for the Bay Sound Clay layer, and more accurately identify the soil stratification.

Due to the variation in ground surface elevation (GSE) on the protected side of the I-wall, low spots along the levee toe, and the existence of sandy silt strata within the fine grain blanket, reach 16 was divided in four sub-reaches. These sub-reaches include 16A (655+00 to 658+00), 16B (652+00 to 655+00), 16C (646+41 to 652+00), and 16D (641+85 to 646+41. Detailed seepage analyses were complete on each sub-reach at Stations 657+65, 653+37, 648+89, and 645+10 respectively. A summary of the results are provided on Table 1 and the permeability values used for the fine grain blanket and levee core are shown on Table 2. These values are from the USACE division regulation on soil mechanics design data number 1110-1-400 (DIVR-1110-1-400).

Of the total four I-wall levee sub-reaches analyzed, sub-reaches 16A, 16B, and 16C were recommended for remediation to achieve acceptable factors of safety for the target water level of El. +8.3 feet. (These water elevations are different than the previously used canal water elevations found in the seepage addendum (June 2012, USACE-MVS)) The recommendation would be to install a sheet pile cutoff wall to elevation -55.0 feet in sub-reaches 16A to 16C. This should include a 100 foot extension at each end to account for end effects. The limits of the sheet pile remediation including the 100 foot extension at each end are from Sta. 645+41 to Sta. 659+00 for a total length of 1359 feet.

Table 1 Summary of Factors of Safety for Seepage Analysis in Reach 16

Reach/Station	Factor of Safety without remediation	Factor of Safety with remediation
16A: Sta. 657+65	0.40^{1}	n/a ^{1,3}
16B: Sta. 653+37	1.19 ¹	n/a ^{1,3}
16C: Sta. 648+89	0.42^{1}	6.31 1
16D: Sta. 645+10	2.55^{2}	n/a

Note: 1 Water elevation in canal is EL. + 8.3 ft

3 There is no excess head; therefore, the Factor of Safety is not applicable.

² Water elevation in canal is EL. + 8.2 ft

Table 2: Permeability of Fine Grain Materials Used

Soil Type	Blanket Thickness (ft)	Suggested Design Values kbl (ft/sec)
	<5	3.28E-05
Silty Sand	5 to 10	2.62E-05
	>10	1.97E-05
	<5	1.64E-05
Sand and Silty Sand	5 to 10	1.31E-05
Sand and Silty Sand	10 to 15	9.80E-06
	>15	6.56E-06
	<5	1.31E-05
	5 to 10	9.80E-06
Clay and Silty Clay	10 to 15	4.92E+06
	15 to 20	1.64E-06
	>20	2.62E-07

Objective and Purpose

The purpose of this DDR is to document remediation work along the 17th St. Outfall Canal in Jefferson Parish, Louisiana. Remediation of Reach 16 is necessary to reduce the risk of a seepage failure. This area was identified in the reevaluation report dated March 2013.

Existing Reports

In addition to the B&V and URS reports, other major design reports published on this canal include:

- Remediation of Floodwalls on the 17th Street Canal OFC-05, Design Documentation Report (DDR), dated February 2011.
- Seepage Addendum Geotechnical Engineering Report Remediation to Raise the Maximum Operating Level for the 17th Street Canal OFC-05, dated December 2010.
- Seepage Addendum 2 Geotechnical Engineering Report Remediation to Raise the Maximum Operating Level for the 17th Street Canal OFC-05 (Reach 16), dated September 2011.
- Geotechnical engineering seepage addendum on Reach 16 for the 17th St. Outfall canal, CEMVS-EC-G JUNE 2012

Seepage analysis

A factor of safety of at least 1.6 is required per Corps HSDRRS seepage criteria. The seepage factor of safety was calculated for two water elevations + 8.3 feet (sub-reach 16A, B and C) and + 8.2 feet (sub-reach 16D). These water elevations are different than the previously used canal water elevations found in the seepage addendum (June 2012, USACE-MVS) due to a change in the 17th Street Outfall Canal Maximum Operating Water Level (MOWL) profile in January, 2013.

The seepage analysis was completed using Geostudio's SEEP/W seepage software. The previous SEEP/W models analyzed in the seepage addendum (June 2012, USACE-MVS) were modified to include information obtained from the new exploration drilled at the center line and at the protected side toe of the I-wall. The new exploration confirmed the existence of a sandy layer within the blanket for sub-reaches 16A and 16C. The exploration also confirmed the presence of clean sand material within the core of the levee in sub-reaches 16A, 16B and 16C. In order for SEEP/W to match the newly acquired subsurface data, an average thickness per strata was used to model the blanket in the protected side and the clean sand material in the center line of the levee. The averaging of each sub-reach stratification can be found in appendix D. For the canal side of the levee boring A-17 was used to determine the extension of the clay cap, no averaging was required. The new hydraulic grade line or total head at the top of the aquifer was plotted from the results of each SEEP/W analysis and seen below in Table 2. Seepage gradients were calculated from the levee centerline to the lowest point in the drainage ditch, selected from survey points taken in 2011. The factor of safeties were calculated at the most critical point, which was also the lowest point within the drainage ditch, provided in Table 1 previously. The SEEP/W models are provided in appendix B.

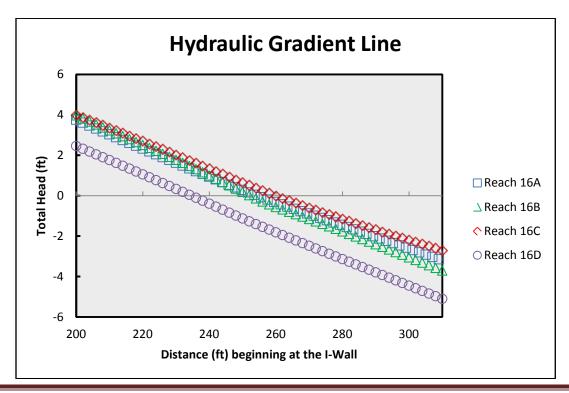


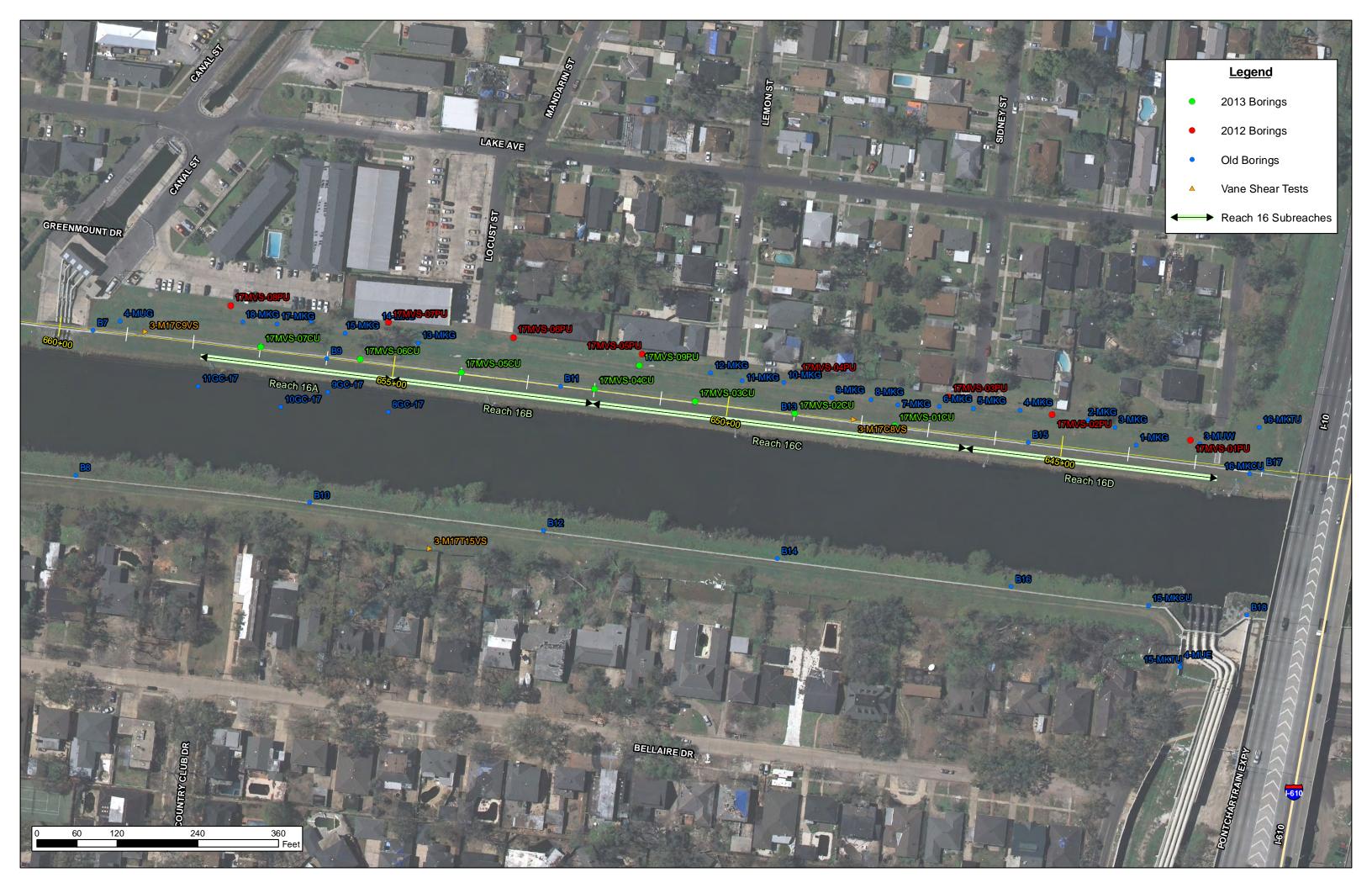
Figure 1: Hydraulic Gradient Line

Conclusion

MVS has developed the following conclusions and remedial measures.

- The existing direct connection at the bottom of the canal along reach 16 increases the velocity vectors that concentrate at the landside ditch, resulting in high pore pressures and exit gradients in the ditch bottom.
- MVS chose to conservatively model the levee core as a SP for sub-reach 16A. The boring logs show the material close to the threshold for a SP which is 10% fine material. The fine content in the sand layer within the levee core has values of 12.2%, 18.1% and 10.4% (17MVS-O6CU, Samples 3C-2, 4A: 17MVS-07CU, Sample 5B-2). MVS feels since the entire sand layer is close to the threshold it can be easily pressurized by the high pore pressures caused by the open connection in the canal. Also, the fine content encountered in protected side sand layer is below 10%. In order to keep geological profile continuity the same sand material that was encountered in the protected side was assumed to exist in the levee core.
- Sub-reach 16B has an existing factor of safety much closer to the required 1.6 and could be repaired by adding material to the protected side slope and ditch. The sheetpile solutions recommended for reaches 16A and 16C would have to be substantially extended into reach 16B to ensure 3-D end effects were accounted for. After considering these required extensions, and in order to maintain continuity with the seepage remediation for sub-reach 16A and 16C, MVS decided to extend the sheet pile wall along the entirety of sub-reach 16B.
- An existing storm drain collector pipe exists along the protected side levee toe in reach 16. Without remediation, high canal water levels will create high piezometric pressures in the foundation of the collector pipe. The condition of the collector pipe is unknown. If a flaw exists in the pipe, (poorly compacted zone along the pipe; or deteriorated metal), the excess piezometric pressures will initiate seepage flow through into the pipe through the deteriorated metal. This in turn can erode the foundation soils, moving them into the pipe's interior. If uncontrolled, this internal erosion can end up as uncontrolled seepage.
- Therefore, sub-reaches 16A, 16B and 16C are recommended for remediation to achieve acceptable factors of safety for the target water level of El. +8.3. The method of remediation for seepage for these sub-reaches is to install sheet piling five feet off-center of the existing I-wall, towards the protected side, penetrating five feet into the underlying Bay Sound Clay until a tip elevation of -55.0 feet. Sub-reach 16D is not deficient for the seepage stability analyses.
- The sheet pile cutoff wall will included 16A, 16B, and 16C extending from sta. 645+41 to sta. 659+00 to include a 100 foot extension at each end to account for "end-effects" i.e. underseepage being diverted around the ends of the wall.

Appendix A: Boring Data



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ame	of Proje	ct:			ige & Water Board of New Orleans		
		мет			Canal, Station 617+50 to Station 663+00 and Jefferson Parishes, Louisiana		1 <u>0</u>
	For:	Modies			ers, Consulting Engineers, New Orleans,	louisiana	
		17_s					_
		23.75			DatumC.DGr. Water Depth_20.		
Semple	BAI	IPLE Foot	DEPTH	STRATUM		*STANDARD	 -
No.	From	To	From	To	VISUAL CLASSIFICATION	PENETRATION TEST	
1,	0.0	1.0	0.0	1.0	Stiff brown & gray silty clay w/clayey		
					silt layers		
2	1.0	2.0	1.0	2.0	Soft brown & gray clay w/silt & decayed] -
					roots		
3	2.0	3.0	2.0		Soft gray sandy clay		
4	3.0	3.5		3.5	Soft gray sandy clay w/sand layers		
5	3.5	4.0	3.5	4.0	Medium stiff gray clay		
6	4.0	4.5	4.0	4.5	Soft gray & brown clay w/sand layers		
					& organic matter		
7	4.5	5.0	4.5	5.0	Soft brown humus		
							<u></u>
							_ ž
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EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS METAIRIE. LA.

or:	Modje	ski an	d Mast	ers, Ir	nc., Consulting Engineers, New Orleans,	Lo	uisiana	_
	•				A. J. Mayeux Date 25 May	19	81	_
Groun	d Elev.	33	(Est.)		Datum Gr. Water Depth _S	ee '	Text	_ 2
Sample		IPLE — Feet		STRATUM eet	VISUAL CLASSIFICATION		STANDARD ENETRATION	7 ¯
No.	From	To	From	Te			TEST] .
			0.0	0.3	Asphalt	<u> </u>		<u></u>
			0.3	.75	Fill			<u>_3</u>
1	2.0	2.5	.75	4.5	Stiff gray & tan silty clay w/clay		ļ	
			<u> </u>		layers	<u> </u>	<u></u>	
	5.0	5.5	4.5		Miscellaneous fill (Bricks, glass, sand,	↓_		
					clay & etc.)			40
2	8.0	8.5		9.0	Ditto	L		
3	9.0	10.5	9.0		Loose tan silty sand w/some clay	2	4] .
4	11.5	13.0		15.0	Loose tan silty sand w/some wood	L	4	
5	15.0	16.5	15.0	18.0	Soft gray clay w/wood & organic matter	1	4	50
6	19.0	19.5	18.0	20.0	Medium stiff gray & tan clay w/roots			Ľ
7	20.0	21.5	20.0		Very dense gray sand w/shell fragments	10	50=10"	≧ ‡ -
8	23.5	25.0	<u> </u>		Ditto	ш	50=8"	DEPTH
9	28.5	30.0			Ditto	11	50=8"	<u>ا</u> ا
10	33.5	35.0			Ditto	12	50=8"	
11	38.5	40.0		43.0	Ditto	13	50=8"	
12	43.5	45.0	43.0		Dense gray sand w/shell fragments	9	33	
13	48.5	50.0		50.0	Ditto	7	32	
								_
					,			
								_

No. 652+50 in crown of levee.

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					R. Courtiade 25 Ma			- .
Boring	No d Elev	33 (E	Boil Tecl Est.)		R. Courtiade Date 25 Ma Date Cairo Gr. Water Depth	S	ee Text	
	SAM	PLE	DEPTH S	TRATUM	On. water Depth _	_	STANDARD	- <u>-</u>
Sample No.	From	Feet To	From	Te	VISUAL CLASSIFICATION	- 1	NETRATION TEST	
			0.0	0.3	Asphalt			1 -
1	2.0	2.5	0.3		Stiff gray & tan clay w/clayey silt	1		30
					layers, brick & shell fragments	1		_
2	5.0	5.5		6.5	Stiff gray & tan clay w/shell & brick			1
					fragments & glass]
3	8.0	8.5	6.5	10.0	Stiff gray & tan clay w/clayey silt			40
					lenses			
4	10.5	11.0	10.0		Loose tan sand] .
5	12.0	13.5			Ditto	2	5	
6	14.5	16.0		17.0	Ditto	2	7	50
7	17.0	18.5	17.0	:	Wood	3	13	Ľ.
8	19.5	20.0		20.5	Wood w/large roots & sandy clay			ĭ.
9	21.0	22.5	20.5		Very dense gray sand	5	50=7"	DEPT
10	23.5	25.0		26.5	Ditto	31	20=2"	
11	28.5	30.0	26.5	31.5	Dense gray sand	12	48	
12	33.5	35.0	31.5	37.0	Very dense gray sand	52=	12"(Seat) _
13	38.5	40.0	37.0		Dense gray sand w/shell fragments	12	32	
14	43.5	44.0			Dense gray sand	13	35	
15	48.5	50.0		50.0	Dense gray sand w/clay pockets & shell	17	45	
					fragments	\perp		_
			_					_

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METAIRIE. LA.

	Mod 1	eski aı	nd Mast	ers. I	nc., Consulting Engineers. New Orleans	т.		
Roring					George Hardee Date 29 May			
					Datum Cairo Gr. Water Depth Se			
Sample No.	SAMPLE DEPTH STRATUM Depth — Feet Feet		STRATUM	VISUAL CLASSIFICATION	٠.	STANDARD NETRATION	- <u>24</u>	
	From	To	Frem	 	A-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1-1		TEST	-
			0.0	0.6	Asphalt w/shells			30
1	1.5	2.5		4.0	Loose tan silty sand Medium stiff brown silty clay w/shells.	ļ		ا ا
				7.0	clayey silt & clay pockets			1
2	4.5	5.5	4.0	7.0	Medium stiff gray & brown clay w/sandy			┪ ・
					silt layers		1	40
3	7.5	8.5	7.0	10.0	Stiff gray & brown clay w/silty sand			
					lenses			
4	11.0	11.5	10.0		Loose tan & gray sand]
5	11.5	13.0		14.5	Ditto	2	6	50
6	14.0	15.5	14.5	16.0	Medium stiff dark gray organic clay	2	4	Ę.
					w/roots & humus pockets			Ĭ.
			16.0	18.0	Wood		<u> </u>	DEPT
7	19.5	20.0	18.0	20.0	Medium stiff gray clay w/roots, wood &			_
					concretions			
8	20.0	21.5	20.0		Very dense gray sand	11	50=10"	
9	22.5	24.0			Ditto	14	50=11"	
0	25.5	27.0			Ditto	27	50=7"	
1	28.5	30.0			Ditto	14	50=11"	
2	33.5	35.0			Ditto	20	50=7"	-
3	38.5	40.0	_	42.0	Ditto	15	50=10"	
4	43.5	45.0	42.0		Dense gray sand	12	35	_
5.	48.5	50.0		50.0	Ditto	12	38	
								•
								_

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METAIRIE LA

orin	No1				A. J. Mayeux Date 26 May			- -
Groun	d Elev.	31 (E	Est.)		Datum Cairo Gr. Water Depth	See	Text	- 20
Sample No.		IPLE Feet		STRATUM Teet	VISUAL CLASSIFICATION		STANDARD ENETRATION TEST	7
			0.0	0.3	Asphalt	+		† -
			0.3	1.0	Fill	1		30
1	2.0	2.5	1.0	4.0	Medium stiff gray & tan clay w/sand	1		1 34
					lenses, pockets & roots			1
2	5.0	5.5	4.0	7.5	Stiff gray & tan silty clay w/shell			1 -
					fragments			40
3	8.0	8.5	7.5	10.0	Miscellaneous fill (clay, sandy clay,]
					sand, gravel, bricks & etc.)			_
4	11.5	13.0	10.0	15.5	Loose tan silty sand	2	5	
5	15.0	16.5	15.5	16.5	Loose tan sand w/clay & wood	2	4	50
6	17.5		1	18.5	Medium stiff gray clay w/wood, organic	_		ī.
					matter & roots	_		I
7				21.0	Medium dense gray sand w/wood	3	19	DEPT
8	21.0	22.5	21.0	23.5	Dense gray sand w/shell fragments	8		
9		25.0	23.5	27.0	Very dense gray sand w/shell fragments	10	50=8"	
10		30.0	 	33.5	Dense gray sand	5	42	_
l 1 		35.0	 	38.0	Very dense gray sand	1	50=8"	
12	38.5	40.0	38.0		Medium dense gray sand w/shell	5	12	
					fragments & clay layers			
13	43.5	45.0			Ditto	6	17	-
14	48.5	50.0		50.0	Ditto	7	22	
			ļ		·			
								4

No. 642+00 in crown of levee.

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

No	s						
Elev			nnician ₋				
. 2.0	33 ((Est.)		Datum Cairo Gr. Water Depth	ee '	Text	- 2
SAM Depth	Feet	F	TRATUM eet	VISUAL CLASSIFICATION		STANDARD	7
From	To	,	<u> </u>	Acabalta and a salar	-	TEST	-
					+-	 -	┨,
1 5	2.5		 		┪	 	1 3
1.0	2.5	0.7	4.0		+	 	-
4.5	5.5	4.0	7.0		-	 	-
-,,,		"7.0	'		· <u>/</u>	 	┤,
7.5	8.5	7.0	10.0		1	 	1 4
					\dagger		1
10.5	11.5	10.0	12.0	·			1
				concretions			5
13.5	14.5	12.0	15.0	Soft tan & gray clay w/sand pockets,	1		=
				shells & gravel			Z Z
15.0	16.5	15.0	17.0	Medium dense tan & gray sand w/clay	1	14	DEPTH
				pockets			_
17.5	19.0	17.0		Medium stiff gray & tan clay w/sand	1	5	
				pockets & roots] .
19.5	20.5		20.5	Ditto			
20.5	22.0	20.5	23.0	Dense gray sand	4	47	
23.0	24.5	23.0	25.0	Very dense gray sand	21	50=10"	
25.5	27.0	25.0		Dense gray sand	13	48	.
28.5	30.0			Ditto	15	49	l
33.5	35.0		38.0	Ditto	12	46	_
38.5	40.0	38.0		Very dense gray sand w/shell fragments	21	50=9"	
43.5	45.0		47.0	Very dense gray sand	15	53	·
48.5	50.0	47.0	50.0	Medium dense gray sand w/silt	6	23	
	15.0 17.5 19.5 20.5 23.0 25.5 28.5 33.5 38.5 43.5	1.5 2.5 4.5 5.5 7.5 8.5 10.5 11.5 13.5 14.5 15.0 16.5 17.5 19.0 19.5 20.5 20.5 22.0 23.0 24.5 25.5 27.0 28.5 30.0 33.5 35.0 38.5 40.0 43.5 45.0	1.5 2.5 0.7 4.5 5.5 4.0 7.5 8.5 7.0 10.5 11.5 10.0 15.0 16.5 15.0 17.5 19.0 17.0 19.5 20.5 20.5 23.0 24.5 23.0 25.5 27.0 25.0 28.5 30.0 33.5 35.0 38.5 40.0 38.0 43.5 45.0	1.5 0.0 0.2 0.7 1.5 2.5 0.7 4.0 4.5 5.5 4.0 7.0 10.5 11.5 10.0 12.0 13.5 14.5 12.0 15.0 17.5 19.0 17.0 17.0 19.5 20.5 20.5 23.0 23.0 24.5 23.0 25.0 28.5 30.0 38.0 38.0 33.5 45.0 47.0	0.0 0.2 Asphalt w/shells 0.2 0.7 Loose tan silty sand 1.5 2.5 0.7 4.0 Medium compact brown clayey silt with gravel 4.5 5.5 4.0 7.0 Stiff brown silty clay w/shells & clayer silt pockets 7.5 8.5 7.0 10.0 Medium stiff tan & gray clay w/clayey sand layers & pockets 10.5 11.5 10.0 12.0 Medium stiff gray & tan clay with concretions 13.5 14.5 12.0 15.0 Soft tan & gray clay w/sand pockets, shells & gravel 15.0 16.5 15.0 17.0 Medium dense tan & gray sand w/clay pockets 17.5 19.0 17.0 Medium stiff gray & tan clay w/sand pockets & roots 19.5 20.5 20.5 Ditto 20.5 22.0 20.5 23.0 Dense gray sand 23.0 24.5 23.0 25.0 Very dense gray sand 28.5 30.0 Ditto 33.5 35.0 38.0 Ditto 38.5 40.0 38.0 Very dense gray sand 47.0 Very dense gray sand 43.5 45.0 47.0 Very dense gray sand	Tem	Test Test

Fig. 12

EUSTIS ENGINEERING COMPANY

SOIL AND FOUNDATION CONSULTANTS
METAIRIE, LA.

For:					nc., Consulting Engineers, New Orleans			- .
		2.0	Soil Tecl					_
Groun	d Elev.	33	(Est.)		Datum Gr. Water Depth	See	Text	- 20
Sample No.		IPLE Feet To		STRATUM cet To	VISUAL CLASSIFICATION		STANDARD ENETRATION TEST	
			0.0	0.3	Asphalt			† .
1	2.0	2.5	0.3	3.5	Compact gray & tan clayey silt w/clay			30
					layers			i -
2	5.0	5.5	3.5	6.0	Medium stiff gray & tan clay w/shell	T		1
					& brick fragments			1
3	6.5	8.0	6.0	8.5	Miscellaneous fill (cinders, gravel,	9	28	40
		<u> </u>		ļ. .	lignite, glass, clayey silt & clay]
		ļ			layers)	_		_
4	9.0	10.5	8.5	11.0	Loose tan silty sand w/clay layers &	5	8	
			•		some gravel	-		<u>50</u>
5	11.5	13.0	11.0	13.5	Very loose tan silty sand w/few clay	2=	18"(Seat)	Ľ.
		<u> </u>			pockets, shells & gravel	V.		DEPTH !
6	14.0	15.5	13.5	17.0	Loose tan silty sand w/organic clay	1	5	DEF
					layers			
7	17.5	18.0		19.0	Wood	<u> </u>		
8	19.0	20.5	19.0		Very dense gray sand	7	54	-
9	23.5	23.5			Ditto ,	50	=8"(Seat)	
10	28.5	30.0			Ditto	22		
11	33.5	35.0			Ditto	50	=9"(Seat)	
12	38.5	40.0			Very dense gray sand w/a layer of shell fragments	50	=9"(Seat)	-
13	43.5	45.0		46.5	Very dense gray sand	50	=7"(Seat)	
14	48.5	50.0	46.5	50.0	Very dense gray silty sand	25	52	
								_
								_
	_			_				

	FOR		17th	Street	Canal R	leevalı	uation	LAB	ORATO	RY E	BORIN	IG LO	OG	(1)2	ZZ					(3),(4)								SAN	IPLE NO	T
UND	STURI SLES C	BED NLY	Job I	io. 13-	082B			(2) E	BORING	G# 1	MVS	<u>- 01 (</u>	<u>CU</u>	(3)5	STA/	V 545	3 56.	05		= 36b	3618				Δ Δ.)	WEIGHT
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& SUB SAMP. O.O	TESTS ASSIGNED	G			VET WT.	WATER CONTENT	STRATUM CHANGE	BORI	NG LOG	CONSIS- TENCY	C	COLOF	₹	MOI	DIFICA	TION :	SYMBO	LS	. RES.	U.C.	DENS	L.L	. P.L.	D-10		WATER CONTENT			% Material	%
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			17th St	reet Ca	nal Re	evalu	ıation	L	_AB	ORA	ORY	ВО	RIN	G L	og	(1)	ZZ				(1),(3	3),(4) L	OCAT	ION:					SAN	/IPLE N	10	
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9-23

		17th Stree	t Canal R	Reevalu	uation	LABO	RATO	RY B	ORIN	G LOG	(1)Z	Z			(1),(3),(4) L	OCATI	ON:					SAMP	LE NO	
FOR UNDISTUI SAMPLES	RBED	Job No. 1	3-082B			(2) BC	ORING	#1 <u>7 </u>	MVS -	01 CU	(3)5	STA											7 to	, 13	WEIGHT
					((5) Wat	ter Tab	ie			(6)	DATE	TAKE	N <u>02</u>	/17/13		_ (8) G.S	.E		·				
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SAMP. TEST	O G	SAMPLE PAN NO.		WATER CONTENT	STRATUM CHANGE	BORIN	G LOG	CONSIS- TENCY	C	OLOR	MOE	DIFICAT	ION SY	MBOLS	PENTRN . RES.	U.C.T.	DENSIT Y	L.L.		D-10 SIZE	WATER CONTENT	UCT DEPTH	Organic Content %	Coarse Material %	
	7	23.0	25.5	23		SP	F		R		RT	OX			48										193.9
A 53	8	25.5	28.0	22	•	SP	F		SR		RI	01			77					1190				96.4	
	9	561 28·0	29.5	22 22	29.5	SP	F		2 R			SIF			115								•	•	
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B-fo		204	38.0	FE C	38.0	SR			a R		SEF	ÓΧ													180.2
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	//	38 · 0	179.9	2.1		SP	F		G R		SIF	ox OX		.	6										149.3
c		39.5	43.0		43.0	NS																			
3	12	43.0	44.5	22	44 •5	SM			GR		CS	SIF	OX		18								•	88 • 7	157.5
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且			看被試											1-1-1-1										分下基本	
		CLASSIF	TERN	ИJ	RE	CORDER	TSL			CHECKER		<u>su</u>		DATA AN	ALYZED	2/19/13	_				SHEET		F 10 SHI	EETS	

	DR	17th Stre		Reeval	uation	LABOR			(1)Z (3)S					(1)),(3),(4)) LOC	ATIO	N:						SAMF	PLE NO		Ļ			
SAMPLI	URBED S ONLY	Job No. 1	3-082B			(2) BO		-	<u>vivs</u>	- 01 (<i>3</i> U	‡		TAKE	:N	02/1	7/13			(8)) G.S. l	 F					14	ž 15	5	WEIGHT
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DEPTH S & SUB SAMP.	ASSIGNED D O C	SAMPI E	<u> </u> DEPTHS						ગીભીભી	<u>ીણાંભા</u>						1	PENTRI		BU	_K #	ATTERBERG	ω ί S LIMIT	91/1/10	TEST ZE WATE			တ်ထြက်ကြ Organic	© © © © © Coarse		Ö
SAMP. 出	SSA G	PAN NO	WEIWI	ā .	STRATUM CHANGE		LOG			OLOR		, , , , , , , , , , , , , , , , , , ,	- , , , ,	, , ,	YMBOL	S	. RES.	U.C.	.T. DEN	SIT	L.L.	P.L.	D-10 SIZ	ZE WATE	ν DEP			Materia	۱%	
	1 14	exturbs the color of the	54.5		54.5	SM			GR	1 74		25	SIF	OX.	ΘX			7								•		88		78.0
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FOI	₹	17th Stree	t Canal I	Reeval	uation		PRATO					(1)Z					(1),(3)),(4) LC	CATIO	ON:					SAMP	LE NO	_
UNDISTU SAMPLES	IRBED S ONLY	Job No. 1	3-082B				ORING	-	MVS -	<u> 01 C</u>	U	(3)S		TAKE	EN	02/17/1	3		(8	8) G.S	.E.					6	WEIGHT
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DEPTH SLS CONTROL SAMP. SAMP.	L O G	SAMPLE PAN NO	DEPTHS	WATER	STRATU	M BOBIA	NG LOG			oLor Olor	<u> </u>				AMBOP:	PEN	TON	J.C.T.	BULK	ATTERBEF	RG LIMIT	D-10 SI	TEST	UCT	Organic Content %	Coarse	1
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		CLASSIF	ER	NJ	F	RECORDER	<u>TSL</u>			CHECK	ER	75	<u> </u>		DATA A	NALYZE	:D <u>2/1</u>	19/13					SHEE	т <u>9</u> с	of <u>10</u> shi	EEIS	

					rt Canal	Reeval	uation	LA	BOR	АТО	RY E	BORII	NG L	.OG	(1)ZZ				(1),(3	3),(4) L	OCAT	ION:						SAM	PLE NO	
le de	يدر	BED ONLY	Job		3-082B			(2) BOI	RING	3# 17	MVS	<u>- 01</u>	CU)STA.															17	WEIGHT
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			С	LASSIF	IER	MJ		RECOR	DER_	TSL			CH	ECKER_	1	<u> </u>		_ DA	TA ANA	ALYZEC)2	2/19/13					SH	EET.	<u> 10</u> C)F <u>/</u> /_S	HEETS	

		17th Stre	et Canal F	Reeval	uation	LABO	RATO	RY B	ORIN	IG LO	G	(1)Z	Z				(1),(3),(4) L	OCAT	ON:					SAMI	PLE NO	
FOR UNDISTURE SAMPLES O	(1) S ONLY Job No. 13-082B (2) BORING#1 TMVS - 02 CU (3) (6)														4520	0.38	-	E 36	636C	9.24	ł					L	WEIGHT
	(5) Water Table (6)															02/19/1				(8) G.S			126				
TESTS ASSIGNED	LO	SAMPI − ⋈ m 4 m	ြောင္ DEPTHS		STRATUM PP PP				3333	2 4 8 8 8	388					DEN	TO.		BULK DENSIT	ATTERBE	G LIMIT		TES	LICT	Organic	Coarse	DRY
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		17th St	eet Car	al Re	evalu	ation	L/	BOI	RATC	RY E	BORI	NG L	.OG	(1)	ZZ				(1),	(3),(4) L	OCAT	ION:						SAME	PLE NO	
FOR UNDISTUR SAMPLES	BED ONLY	Job No.	13-082	В			(2	2) BC	RIN	G# 1	MVS	<u> </u>	CU		STA															SHT
J							(5)	Wate	er Tai	ble				(6) DAT	E TAK	EN	02/	/19/13		_	(8) G. S	S.E						2	WEIGHT
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	- FOR		17th Stre	et Canal	Reeva	uation	L	ABORAT	ORY E	BOR	ING	LOG	(1)ZZ				(1),	(3),(4)	LOCA	TIO	N:				SAMF	PLE NO	
UNE SAM	FOR ISTUR PLES (R URBED Job No. 13-082B (2) BORING#11 MVS - 02 CU (3)ST																									3	WEIGHT
		(5) Water Table (6) DA														EN	02/	19/13			(8)	G.S.E						
DEPTH & SUB SAMP.	TESTS ASSIGNED	٦ ر						22222		1	33233	8 8 8 8 8 8 8 8 8	တ္ထုတ္ထု	4 4 4	4 4 4	4 8 8	51			BULK			32728				1 	DRY
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Γ			17th Street Can	al Reeval	uation	LABORAT	ORY B	ORIN	G LOG	(1)ZZ			(1)	,(3),(4) L	OCATI	ON:					SAMP	LE NO	
UND	FOR STURI	BED NLY	Job No. 13-082E	3		(2) BORIN	3)STA							- -				L	1	WEIGHT				
J						E TAKE		/19/13			8) G.S.E						<u> </u>							
DEPTH	TS SNED	L	SAMPLE DEPTH	2										PENTRN 2002/2012		BULK 1	ATTERBERG	LIMIT		TEST	CIERCIES UCT	Organic	හිසිම්ම්ම් Coarse	DRY
SAMP.	TESTS ASSIGNED	G	PAN NO. WET		STRATUM CHANGE	BORING LO	S CONSIS-	C	OLOR	M	/IODIFIC	ATION S	YMBOLS	RES.	U.C.T.	DENSIT Y	L.L.	D-10	0 SIZE	WATER CONTENT		Content %		
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	505		17th Street Ca	nal Reeval	uation	LABO	RATO	RY B	ORIN	IG LC	G	(1)2	ZZ				(1	1),(3)	,(4) L (OCATI	ON:						SAMP	LE NO	
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, FOR	1	17th Street Canal Reevaluation	LABORATORY BORING LO		(1)ZZ		(1),(3),(4	4) LOCATION:		SAMPLE NO	
UNDISTUR SAMPLES	RBED ONLY	Job No. 13-082B	(2) BORING#17 MVS - 02 (CU	(3)STA					PB6 +0 PB 11	WEIGHT
			(5) Water Table		(6) DATE		2/19/13	(8) G.S.E. _			
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•	1		17th Str	eet Can	al Re	evalu	ation	LABC	RATO	DRY E	BORIN	IG LO	OG	(1)Z	Z				(1),((3),(4) L							SAMP	LE NO	
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FC	ND.	ŀ	17th Stree	t Canal	Reeva	luation	LABO	DRATO	DRY E	BORII	NG L	OG	(1)Z					(1),	(3),(4) L	OCATI	ON:					SAMP	LE NO	
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UND SAM		BED ONLY	Job No. 13-	082B	(2)	BORING#	MVS - 03 CU	(3)STA			3	WEIGHT
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	FOR	17th Street Canal Reevaluation LABORATORY BORING LOG RURBED Job No. 13-082B (2) BORING# 17 MVS - 03 CU (3):													1) <i>ZZ</i>					((1),(3),(4) L	OCAT	TION	l:						8	SAMP	LE NO		누						
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FC	ND.	17th Street Canal Reevaluatio	on LABORAT	ORY BOR	ING LOG	(1)ZZ		(1),(3),(4) LOCA	ΓΙΟΝ:				SAMP	LE NO	
	URBED	Job No. 13-082B	(2) BORIN	IG# [7 MV	S - 03 CU	(3)STA								0.1		WEIGHT
			(5) Water Ta	able		(6) DATE TA	KEN <u>02</u>	/16/13	_	(8) G.S.E. _				<u>8 1</u>	<u>v 15</u>	
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	OR	17th Street Canal Reevaluation LABORATORY BORING LOG (1)Z (2) BORING##7 MVS - 03 CU (3)S																(1),	(3),(4) L	OCAT	ION:						SA	MPLE	≣ NO	
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٢	1		CLASSIF	IER	MJ		Principals Land	RECO	RDER <u>TS</u>			CH	IECKER	<u> </u>	<u>(5</u>	Rv. 60.5	DA ^T	ΓΑ ΑΝ	IALYZEC	2/14/	/13					SHEE	г_4_	OFS	HEETS	

Γ																			(1),	(3),(4)	LOCAT	ION:						SAM	IPLE NO	
UN SAI	FOR DISTU MPLES	RBED	Job No. 13-082B (2) BORING# <u>17 MVS - 04 CU</u>																										Ц	WEIGHT
									ater Ta						DATE			02/14				(8) G. :								
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۲			CLAS	SIFIER	MJ	**************************************	F	RECORE	DER_TS	SL	15	CH	IECKER_	F.C	S		DAT	ANAL	YZED	2/14/	13				9	HEET	г <u>5</u>	OF <u>11</u>	SHEETS	

11.0-150

	FOR		17th S	treet C	anal F	Reeval	uation	LAE	BORAT	ORY	BOR	ING I	LOG		1)ZZ_		·			(1),	(3),(4	l) LC	CATI	ON:						SAMF	PLE NO	
	ISTURI PLES (BED ONLY	Job N	o. 13-0	82B			(2)	BORIN	IG# <u>17</u>	MV:	S - 04	4 CU	丰	3)ST/															5	5	WEIGHT
									Vater T							ATE				14/13		_		(8) G .								. →
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			CLAS	SIFIER_	MJ			RECO	RDERT	SL			CHECKER		EC:	<u> </u>		DAT	A AN	IALYZED	2/14	4/13	_					SHEE	г_6	OF_ <u>//</u> _S	SHEETS	

		17th Stre	et Canal	Reeval	uation	LABO	RATO	RY B	ORII	NG L	OG	(1)Z	Z				(1),	(3),(4)	LOCAT	ION:						SAMF	PLE NO	
UNDIS	OR TURBED ES ONLY	Job No.	13-082B			(2) BO	RING	# <u>17 </u>	MVS	- 04	CU	(3)S														•	O	WEIGHT
						(5) Wat							DATE				14/13			(8) G .								
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& SUB C	ASSIG G		WET WI		STRATUM CHANGE	BORING	G LOG	CONSIS- TENCY		COLOF	₹	MOD	IFICAT	TION S	YMBO	LS	PENTRN . RES.	U.C.T	BULK DENSIT Y	L.L.	P.L.	D-10	SIZE	WATER CONTENT	DEPTH		Material %	,
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		CLASSIF	IER M	i i i i i i i J	R	ECORDE	RTSL			CH	IECKER.	E	CS	f Slate	DAT	A AN	NALYZED_	2/14/1	3	2 St. 6				SHEET	7	OF <u>//</u> S	SHEETS	Á

FO	1	17th Street Canal Reevalu				ORING LOG	(1)ZZ	(1),(3)	,(4) LOCATI	ON:		SAMPLE NO	
UNDISTU	RBED	Job No. 13-082B	(2	2) BORING	# <u>17 </u>	MVS - 04 CU	(3)STA					7- 16	WEIGHT
		·	(5) Water Tab	ole		(6) DATE TAKEN	2/15/13		8) G.S.E.			
рертн б	L	122420 1224 1224 1224 1324 1324 1324 1324 1324	10 10 10 10 10 10 10 10 10 10 10 10 10 1	22222	28 27 28 28 28	3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	50 0 4 4 4 4 4 4 4 4 8 4 8 9 9 9 9 9 9 9 9 9	55 55 55 55 55 55 55 55 55 55 55 55 55	971R 900 659 82 650 659	ATTERBERG LIMIT	1E21	28888888888	90 DRY
& SUB SAMP.	O G	SAMPLE DEPTHS WATER CONTENT	STRATUM CHANGE	BORING LOG	CONSIS- TENCY	COLOR	MODIFICATION SYMBOLS	PENTRN RES. U	J.C.T. DENSIT	L.L. P.L. D-10 SIZE	WATER CONTENT DEPTH	Organic Coarse Content % Material	
<u>-</u> 54	7	19.0 21.5 21	• 9	PF		LGR		78	,	1240		• 97	8 131.8
A	8	21.5 24.0 22		PF		LGR		154					130,0
	9	24.0 26.5 24	• 5	PF		GR		79					132.4.
=	10	26.5 29.0 23	• 5	PF		G, R						•	137.9
B-5	11	24.0 31.5 19	• 3	AP F		GR S	SIF	97		1,280		. 96	
	12	31.5 34.0 23	• (PF		GR III	ST SIF	96				•	
	13	34.0 36.5 22	• 5	SP F		GR .	SIFOX	134				•	227,1
- - - - - - - - - - - -	14	36.5 39.0 24	• 5	PF		SR	SIF OX	114		1170	,	. 96	171.4 5 174.2
	15	39.0 41.5 24	41.5	PF		GR III	SIF OX	107		-1110	7	. 96	
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 D	16	44.5 46.0 26				GR	CS OX SIF	68					198.5
		250.0 26	•					EPCF E					118.5
	I	CLASSIFIER MJ	REC	CORDERTSL		CHECKER	ECS DATA	ANALYZED 2	2/15/13		SHEET 8	OFSHEETS	

		17th Street C	Job No. 13-082B LABORATORY BORING LOG (2) BORING# 17 MVS - 04 CU														(1)	,(3),(4)	LOCAT	ION:				402	SAM	PLE NO	1.
FOI UNDISTU SAMPLE	IRBED	Job No. 13-0	82B			(2) BC	RING	# <u>17</u>	MVS	- 04	CU	(3)S	STA												DQ 17	,18,19	WEIGHT
O					((5) Wa t	er Tab	ole				(6)	DATE	TAKE	EN	02/1	5/13			(8) G .	S.E						
рертн ю	L	T 0 8 4 9 0 V	- 20 0 0 € ±	12 2 4		21212	25 23		3 8 2	33 32	35 37	888	4 4 4 4 3	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	44 48 49	51	252	55 57 58	BNFK	8 2 E	SERG LIMIT	86/28	15 4 5	UCT	Organic	Coarse	DRY
DEPTH S S S S S S S S S S S S S S S S S S S	O G	SAMPLE DE PAN NO. WE		VATER ONTENT	STRATUM CHANGE	BORIN	G LOG	CONSIS- TENCY		COLO	R	MOD	DIFICA	TION S	YMBOI	LS	PENTRI . RES.	U.C.	T. DENSIT	L.L.	P.L.	D-10 S	ZE WATER			Material %	
		46.0 4	9.5		49.5	NS												: 1:::				no e				•	
- - A-5	1,7	49.5 5	1.0	28	51.0	SM -			GR.	2800		CS	SIF	•			20	3							•	89.5	5
A _[>'	' '	218 22	19.14	24		SM !			GR			A75	į AS	e)	SLF	ΚE											184.0
		51.05	4.5		54.5	NS							400 000														
<u> </u>	18	54.5 5	6.0	28	56.0	SM			GNG			CS					18					-			•	88.0	
= >`		SER FEE		46		8A -			GNE	12		HRS	C(A			70 2.4											175.6
B ,		56.05	9 • 5		59.5	WS									4-1												
\exists	19	59.5 6	1 -0	47	41.0	CH	55	50	GNG			SERVICE ROOM SECURITY	SIF	100000000000000000000000000000000000000				a							•	•	
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D																						1948 3 - 4 - 15 7 - 17					
			• Su Bala South		•					S <u>= 1 </u>												•			•		
				0 7 14 1				SW C			1 H										Mak						<u> </u>
		CLASSIFIER_	MJ		R	ECORDE	R TSL			CI	HECKER		ECS		DAT	A AN	ALYZED	2/15/	13				SHE	_{ET} 9	OF	SHEETS	

		17th Street Ca	nal R	eevalu	ation	LA	BOR	ATO	RY E	BORI	NG I	_OG	(1)Z	Z				(1)	,(3),(4	1) LO C	CATIC	ON:						SAMP	LE NO	
FOR UNDISTURBE SAMPLES ON	ED.	Job No. 13-08	2B			(2)	BOR	ING	# <u>17</u>	MVS	- 04	CU	(3)5	STA														2	0	WEIGHT
						_ , ,_	Water								TAK			/15/13				3) G.S								
DEPTH S H	L	- 7 c 4 c o r		11 13 13	15 16 17	2 9 9	3228	24 25	26 27 28	3812	333	3,38,54	39 4	4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	4 4 4	48	5 20 4							69 71 71				8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	98886	DRY
TESTS ASSIGNED	O G	SAMPLE DEP PAN NO. WET		WATER CONTENT	STRATU	BC BC	RING I	LOG	CONSIS- TENCY		COLC)R	MOE	DIFICA	TION S	SYMB	OLS	PENTRI . RES.	u.c	C.T.	BULK Ensit = Y	ATTERBE L.L.	P.L.	D-10 S	SIZE	TEST WATER CONTENT	UCT DEPTH	Organic Content %	Coarse Material %	,
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40 8 /		CLASSIFIER	MJ		117	RECO	RDER_	TSI	islists.		الا م	HECKER	- - E	CS	Problems	DA	TA AN	NALYZED.	2/15	5/13			. 14			SHEET	. 10	OFS	HEETS	

FOR	1	7th Stre	et Cana	al Reev	valua	tion	LABO	RATO	RY E	ORIN	G LO	G	(1)ZZ_				(1),	(3),(4) L	OCATI	ON:				-	SAMP	LE NO	<u></u>
UNDISTURBED SAMPLES ONLY	J	Job No. 1	13-082E	3			(2) BC	ORING	# <u>17</u>	MVS -	04 C	:U	(3)STA.												2	1	WEIGHT
								ter Tal					(6) DA				/15/13			8) G.S							
LESTS O C C C C C C C C C C C C C C C C C C	_	SAMPLE		10		일일 <u>다</u> MUTAST							86444				DENTRA SISSISSISSISSISSISSISSISSISSISSISSISSIS		BULK	ATTERBEI	8 LIMIT	<u> </u>	1ES1 7 7 7 7 7 7 7 9 7 9 9 9 9 9 9 9 9 9 9	UCT	Organic & & & & & & & & & & & & & & & & & & &	හිසි සිසි Coarse	DRY
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<u></u>		67.0	98		54 819		CH	SIS	ST GT	SNG			CSI	66	S E												64.3
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B			124		55										Park												83.5
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71.0		AL TO-				alt per				100							1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		Build Sha				a dia				
l		CLASSIFI	ER	MJ		R	ECORDE	ER TSI	L		CHE	CKER	ECS		DA	TA AT	NALYZED	2/15/13					SHEE	T	OF/_SI	HEETS	



	FOR		17th Street	t Canal Reev	aluation	LABORA	TORY E	BORIN	G LOG		(1)ZZ_						CATIC						SAI	MPLE NO	
UNE		BED ONLY	Job No. 13	3-082B		(2) BOR	ING#17	MVS -	<u>- 05 CU</u>	<u> </u>	(3)STA.	N 5	44707	1.95	***	E 3	6635	75.13		· <u>·····</u>				1	WEIGHT
						(5) Water	Table				(6) DA	TE TAK	EN	02/20/13	3		(8) G.S.E .		10.18					
DEPTH	S ED	L	- 0 m 4 m m		12 4 1 1 2 1 2 1 3			3338	32 33	38 37	8 0 1 1 1 1 1 1	\$ 4 4	4 4 6 6			28 24	9228			122				88288	
& SUB SAMP 0.0	TESTS ASSIGNED	O G	SAMPLE I				OG CONSIS- TENCY	С	OLOR		MODIFIC	ATION	SYMBOL	S PENT	rrn :s. u	.C.T.	BULK DENSIT Y	L.L. P.	ID 10		TEST WATER CONTENT	UCT DEPTH	Organio Content		
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-															1,4 (1)										
A-					St. Park Line							2 2 2													4 × 11
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LMN Form 721 Revised May. 2010

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LMN Form 721 Revised May. 2010

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LMN Form 721 Revised May. 2010

SUMMARY OF LABORATORY TEST RESULTS

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Current Date: 1/17/2013

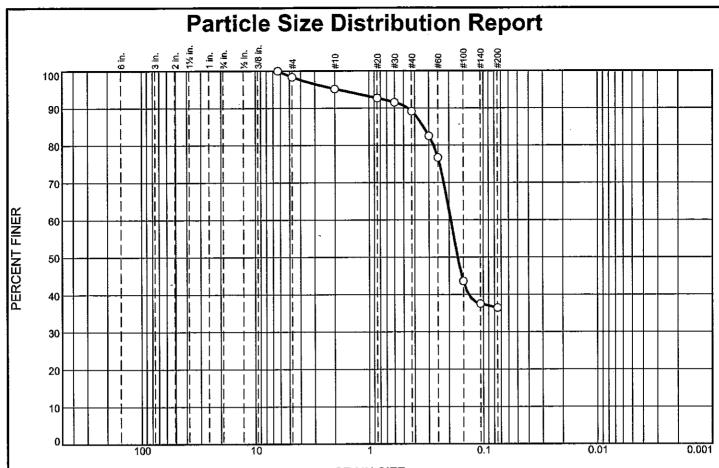
Boring: Project Number: 10-017136

17MVS-01PU - Final

3C2 6	3C1	3A2 3B	3A1	∾ గే	1B	14	Sample Number
9.2 10.5 13.0 15.5	8.5	7.2	6.5	2.0	1.0	0.0	Depth
SO LGR CL4 W/ S, ARS CH, RT LGR SM W/ ARS CH, RT LGR SP W/ O, ARS CH LGR SM W/ O, ARS CH	VSO LGR CL4	M LGR CH4 W/ ARS SM, CC	M LGR CH4 W/ ARS O	LGR SM W/ O, G M LGR CH4 W/ ARS SP. WD	LGR & BK SM W/ O, RT, G	VST BR CH3 W/ LYS ML, LYS SM, G	Visual Classification
SM SM	C _4	유 오 오 오	오	CH4	NS NS	23	uscs
·	14		5			œ	E (f)
24 28 22	28	5 5	52	ල ල	, œ	23	¥
	92	72	70	•		99	Dry Dens (pcf)
	119	108	107			122	Wet Dens (pcf)
	2	100	100			87	% bi % bi ov
·	S	٤	ଚ			င်	Shear Test Type
	1	0	ı			ı	Angle
	220	500	514			2341	Cohesion (psf)
	439		1028		•	4683	Unconf. Comp. Str.
	32	98	91			70	F
-	15	36	23			20	Ţā
	17	62	68			50	ъ
	0.19	0.50	0.47				Torvane (tsf)
SV SV					SV	}	Other Tests

Remarks:

Stantec Consulting Services Inc.



GRAIN SIZE - mm. % Gravel % Sand % Fines % +3" Clay Medium Fine Silt Coarse Fine Coarse 36.5 52,6 0.0 0.0 1.6 3.2 6.1

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X≍NO)
1/4	100.0		
#4	98.4		
#10	95.2		
#20	92.7		
#30	91.6		
#40	89.1		
#50	82.5		
#60	76.7		
#100	43.6		
#140	37.6		
#200	36.5		
-			

LGR & BK SM V	Soil Description W O, RT, G	
PL=	Atterberg Limits	Pl=
D ₉₀ = 0.4598 D ₅₀ = 0.1682 D ₁₀ =	<u>Coefficients</u> D ₈₅ = 0.3348 D ₃₀ = C _u =	D ₆₀ = 0.1935 D ₁₅ = C _c =
USCS= SM	<u>Classification</u> AASHT	-O=
	<u>Remarks</u>	

(no specification provided)

Source of Sample: 17 MVS-01 PU Sample Number: 1B

Depth: 1.0

Date: 12/7/12

Stantec

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

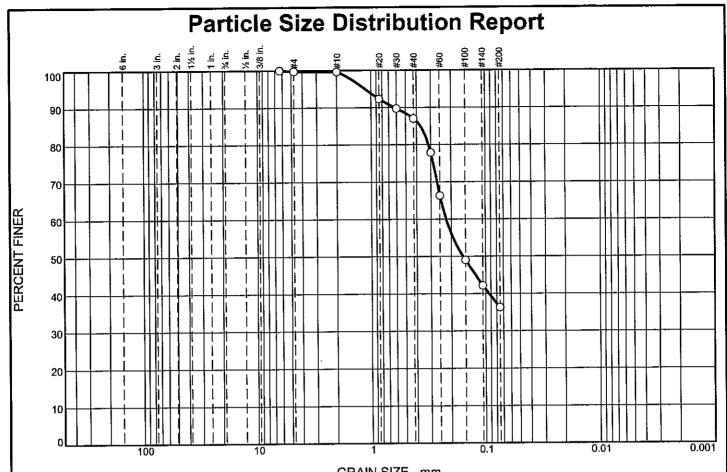
Saint Rose, Louisiana

Project No: 10-017136

Figure

Tested By: JC

Checked By: MJB/JS



	% Gr	avel		% Sand		% Fines	
% +3"	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.2	12.6	50.7	36.3	

	SIEVE	PERCENT	SPEC.*	PASS?
	SIZE	FINER	PERCENT	(X=NO)
	1/4	100.0		
	#4	99.8		1
	#10	99.6		
	#20	92.3		
	#30	89.7		
	#40	87.0		
	#50	77.9		
,	#60	66.3		
	#100	49.0		
	#140	42.2		
	#200	36.3		
		1		ļ
				1
	L	L	1	

LGR SM W/ ARS	Soil Description SCH, RT	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 0.6244 D ₅₀ = 0.1573 D ₁₀ =	Coefficients D ₈₅ = 0.3679 D ₃₀ = C _u =	D ₆₀ = 0.2214 D ₁₅ = C _c =
USCS= SM	<u>Classification</u> AASHT	O=
	<u>Remarks</u>	

* (no specification provided)

Source of Sample: 17MVS-01PU **Sample Number:** 4

Depth: 10.5

Date: 12/7/12

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

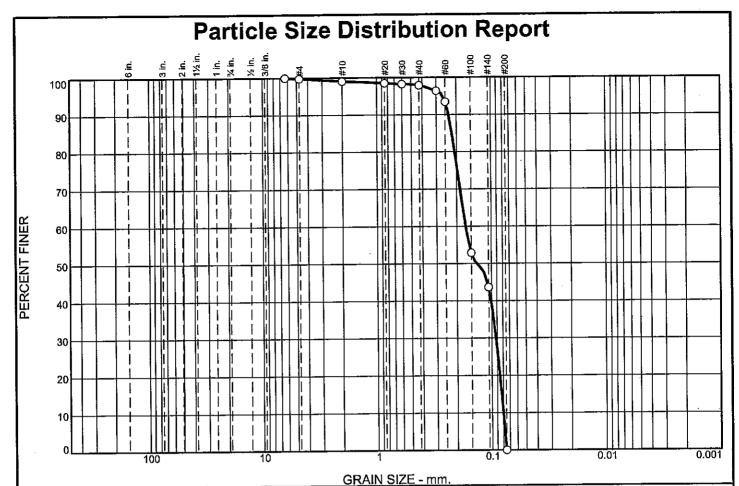
Saint Rose, Louisiana

Project No: 10-017136

Figure

Tested By: JC

Checked By: MJB/JS



·		% G	avel		% Sand		% Fin	es
% +3"		Coarse	Fin	e Coarse	Medium	Fine	Silt	Clay
 0.0		0.0	0.2	2 0.7	1.2	97.9	0.0	0.0
SIEVE SIZE	PERCENT	SPEC		PASS? (X=NO)	LGR SP	Soil D	<u>escription</u>	
1/4 #4	100.0 99.8					·		

SILVE	. LICOLINI	00.	
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	99.8		
#10	99.1		
#20	98.5		
#30	98.3		
#40	97.9		
#50	96.4		
#60	93.4		
#100	52.9		
#140	43.7		
#200	0.0		
			1
			[
	İ		1
!			

Atterberg Limits LL=	PI=
$ \begin{array}{c} \text{Coefficients} \\ D_{85} = 0.2196 \\ D_{30} = 0.0921 \\ C_{u} = 2.10 \end{array} $	D ₆₀ = 0.1675 D ₁₅ = 0.0826 C _c = 0.63
<u>Classification</u> AASHTO	 =
<u>Remarks</u>	
	Coefficients D85= 0.2196 D30= 0.0921 Cu= 2.10 Classification AASHTO

(no specification provided)

Source of Sample: 17MVS-01PU Sample Number: 5

Depth: 13.0

Date: 12/7/12

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

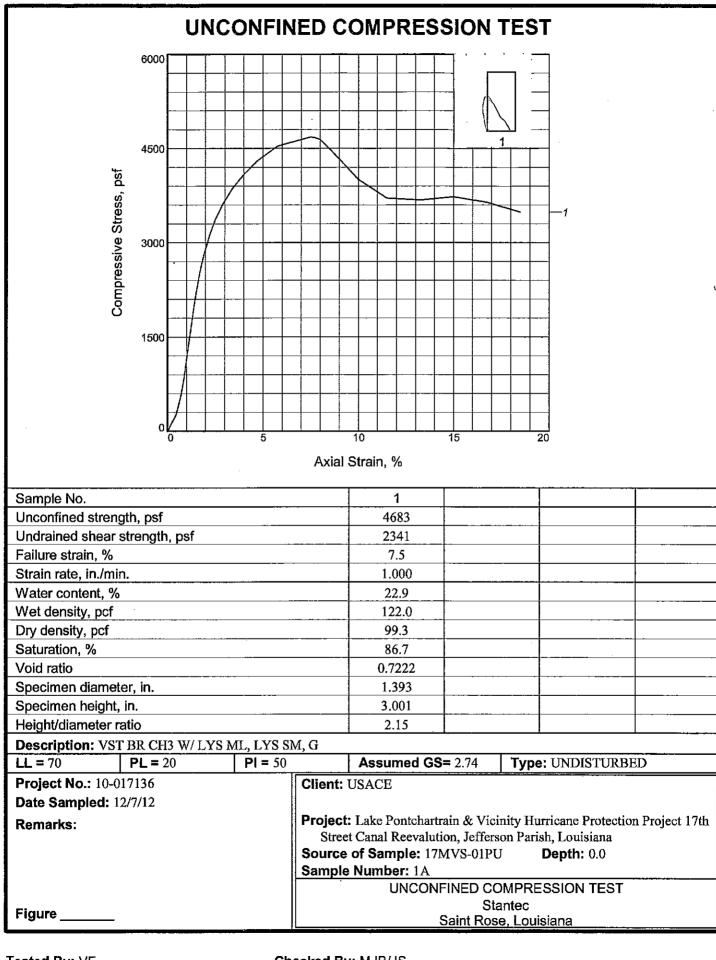
Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Project No: 10-017136

Figure

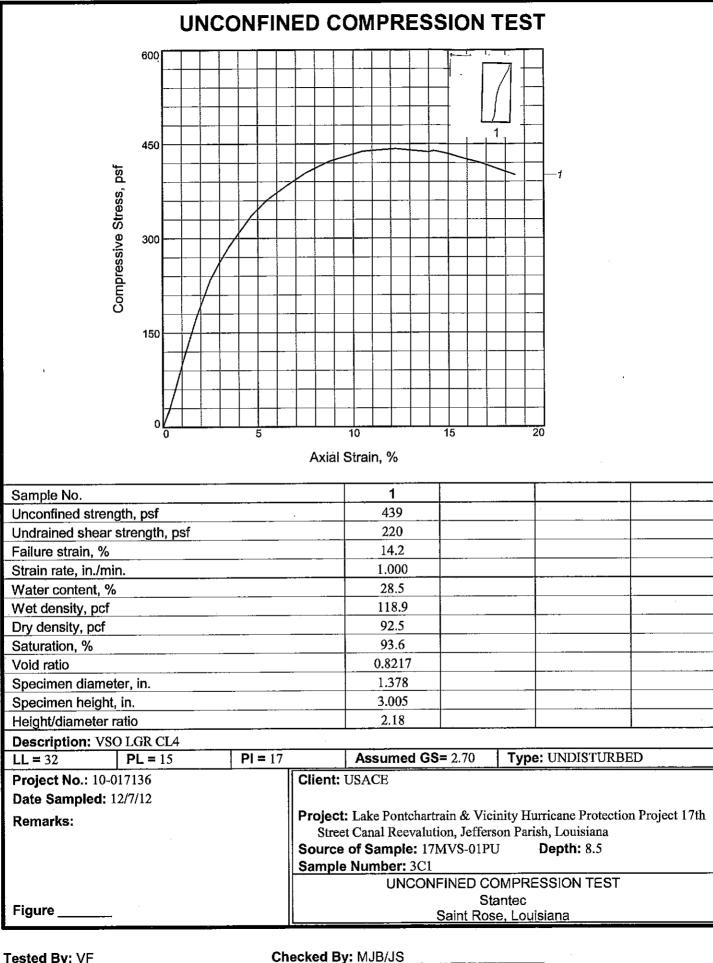
Checked By: MJB/JS Tested By: JC



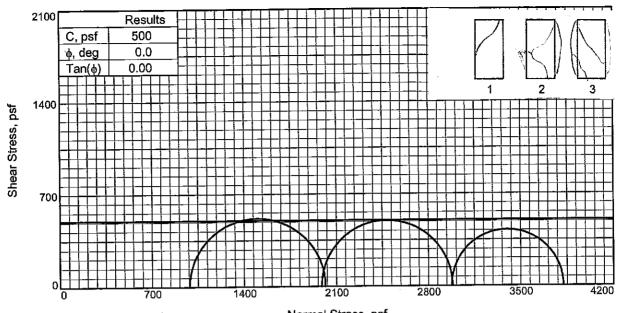
Tested By: VF Checked By: MJB/JS

UNCONFINED COMPRESSION TEST 2000 1500 Compressive Stress, psf 1000 500 Axial Strain, % 1 Sample No. 1028 Unconfined strength, psf 514 Undrained shear strength, psf 10.3 Failure strain, % 1.000 Strain rate, in./min. 52.5 Water content, % 106.8 Wet density, pcf 70.0 Dry density, pcf Saturation, % 99.7 Void ratio 1.4437 Specimen diameter, in. 1.391 3.009 Specimen height, in. 2.16 Height/diameter ratio Description: M LGR CH4 W/ ARS O Type: UNDISTURBED PI = 68**Assumed GS=** 2.74 **LL =** 91 PL = 23Project No.: 10-017136 Client: USACE Date Sampled: 12/7/12 **Project:** Lake Pontchartrain & Vicinity Hurricane Protection Project 17th Remarks: Street Canal Reevalution, Jefferson Parish, Louisiana Source of Sample: 17MVS-01PU Depth: 6.5 Sample Number: 3A1 **UNCONFINED COMPRESSION TEST** Stantec Figure Saint Rose, Louisiana

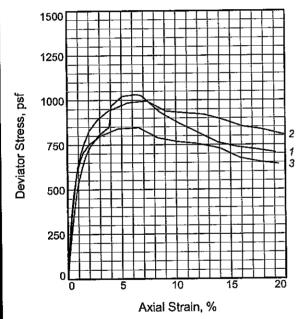
Tested By: VF ____ Checked By: MJB/JS



Tested By: VF



Normal Stress, psf



Sample No.		nple No.	1	2	3	
	Initial	Water Content, % Dry Density, pcf Saturation, % Void Ratio	50.4 71.8 99.8 1.3833 1.392	51.5 70.9 99.9 1.4139 1.388	57.0 66.6 99.5 1.5693 1.400	
١		Diameter, in. Height, in.	3.006	3.007_	3.008	
3	At Test	Water Content, % Dry Density, pcf Saturation, % Void Ratio Diameter, in. Height, in.	50.4 71.8 99.8 1.3833 1.392 3.006		57.0 66.6 99.5 1.5693 1.400 3.008	
Ī	Str	ain rate, in./min.	1.000	1.000	1.000	
ļ	Ba	ck Pressure, psi	0.00	0.00	0.00	
	Се	ll Pressure, psi	6.84	13.80	20.66	
	Fai	il. Stress, psf	1032	996	847	
		Strain, %	6.3	7.3	6.6	
	Ult	. Stress, psf	763	890	728	
		Strain, %	13.8	14.3	14.1	
_	σ ₁	Failure, psf	2017	2983	3822	
	σ_3	Failure, psf	985	1987	2975	

Type of Test:

Unconsolidated Undrained Sample Type: UNDISTURBED

Description: M LGR CH4 W/ ARS SM, CC

LL= 98

PL= 36

PI= 62

Assumed Specific Gravity= 2.74

Remarks:

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project

17th Street Canal Reevalution, Jefferson Parish, Louisiana

Source of Sample: 17MVS-01PU

Depth: 7.5

Sample Number: 3B

Proj. No.: 10-017136

Date Sampled: 12/7/12

TRIAXIAL SHEAR TEST REPORT

Stantec

Saint Rose, Louisiana

Figure

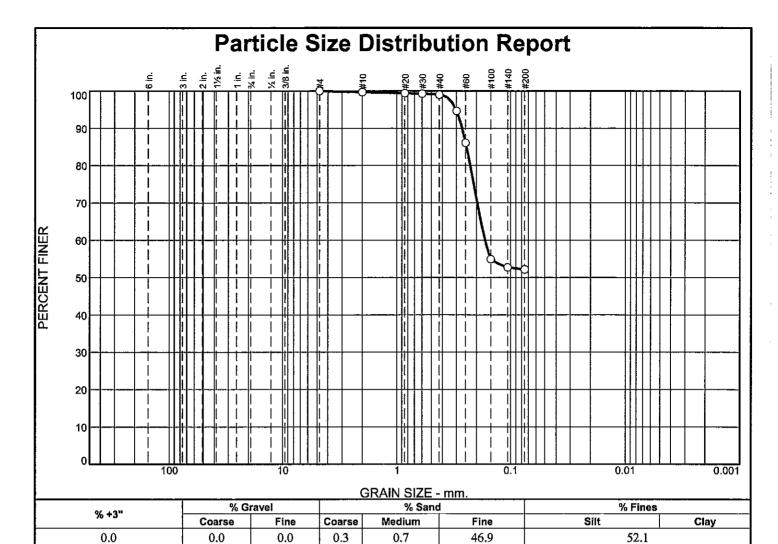
SUMMARY OF LABORATORY TEST RESULTS

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Boring: Project Number: 10-017136 17MVS-02PU - Final

Current Date: 12/13/2012

Remarks: Stantec	7 6 01	ـــــ د 4	2A2	2 <u>4</u> 102	1 1 1 1 1 1 1 1 1	1 _A	Sample Number
:ks: :ec Con	13.5 16.0	ω o			1.0 2.0	-	e Depth
Remarks: Stantec Consulting Services Inc.	BR SP BR SP W/O, G	BR SP	BR ML W/ RT	M BR CHOA W/ ARS ML, G ST BR CH2 W/ LYS SM, O, G, RT	BR ML W/ ARS CH, G BR ML W/ ARS CH, G	VST BR CL6 W/ ARS CH	Visual Classification
	ର ଧ ଧ	တ္ ဗု	6 ≥	다. 다.	<u> </u>	CT6	uscs
				N			臣(壬)
	20 21	-	3 6	29 56	1 1	16	**
				97			Dry Dens (pcf)
				8			Wet Dens (pcf)
				88			& t
				5		;	Shear Test Type
·				ı			Angle
Ā Ā				974			Cohesion (psf)
Le Name:				1947			Unconf. Comp.
Chec) Final				121		46	Ę
Checked By: Final 17MVS				29		21	P
v: vs-02				92		25	P I
PU be bos				0.90			Torvane (tsf)
Checked By:	S/	sv	sv				Other



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X≓NO)
#4	100.0		
#10	99.7		
#20	99.4		
#30	99.3		
#40	99.0		
#50	94.6		
#60	86.1		
#100	54.9		
#140	52.7		
#200	52.1		

	I	
BR ML W/ RT	Soil Description	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 0.2684 D ₅₀ = D ₁₀ =	Coefficients D ₈₅ = 0.2456 D ₃₀ = C _u =	D ₆₀ = 0.1685 D ₁₅ = C _c =
USCS≃ ML	Classification AASHTO	=
	<u>Remarks</u>	

(no specification provided)

Source of Sample: 17MVS-02PU Sample Number: 2A2

Depth: 4.5

Tested By: JC

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

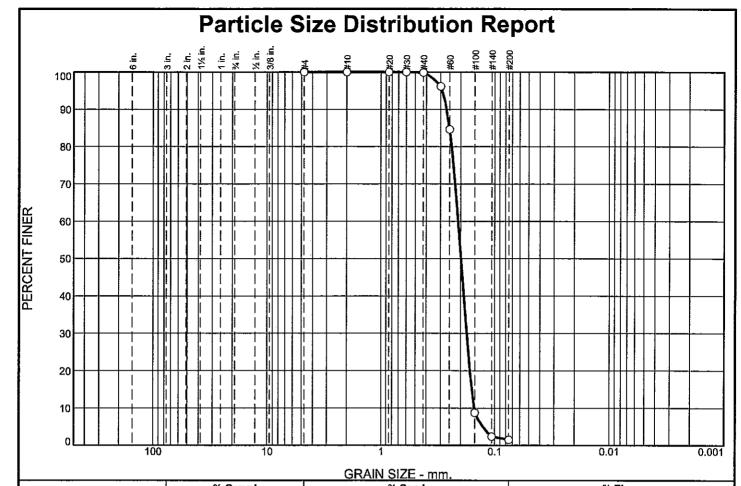
Figure

Date: 12/7/12

Saint Rose, Louisiana

Stantec

Checked By: MJB



% +3"	L	% Gr	avel		% Sand		% Fine	es
 76 で3		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0		0.0	0.0	0.0	0.1	98.4	1.5	
SIEVE SIZE	PERCEN FINER	T SPEC.			BR SP	Soil	<u>Description</u>	
#4 #10	100.0 100.0							

SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#30	100.0		
#40	99.9		
#50	96.2		
#60	84.6		
#100	8.7		
#140	2.4		
#200	1.5		
		1	I

BR SP	Soil Description	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 0.2657 D ₅₀ = 0.1986 D ₁₀ = 0.1521	<u>Coefficients</u> D ₈₅ = 0.2509 D ₃₀ = 0.1767 C _u = 1.38	D ₆₀ = 0.2105 D ₁₅ = 0.1592 C _c = 0.98
USCS= SP	Classification AASHTC) =
	<u>Remarks</u>	

(no specification provided)

Source of Sample: 17MVS-02PU Sample Number: 4

Depth: 8.5

Date: 12/7/12

Stantec

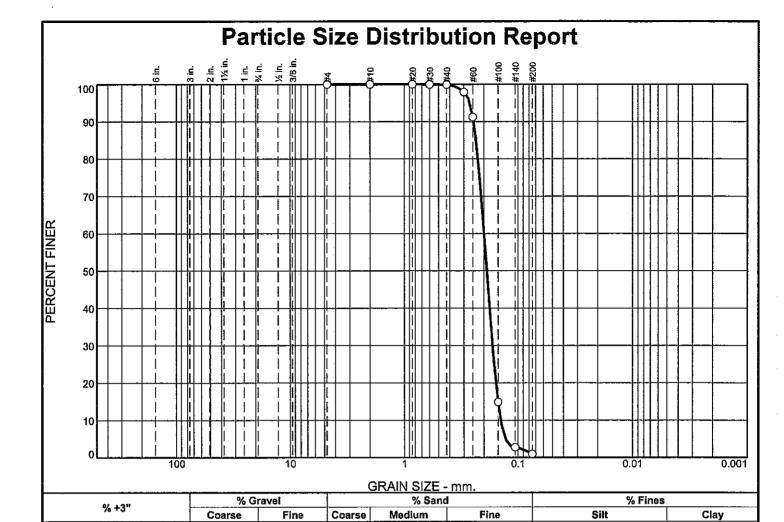
Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana Project No: 10-017136

Figure



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#30	100.0		
#40	99.9		
#50	97.9		
#60	91.2		
#100	14.9		
#140	2.8		
#200	0.9		
	1		

0.0

0.0

0.0

0.1

99.0

BR SP	Soil Description	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 0.2465 D ₅₀ = 0.1888 D ₁₀ = 0.1420	Coefficients D85= 0.2351 D30= 0.1679 Cu= 1.41	D ₆₀ = 0.1997 D ₁₅ = 0.1502 C _c = 0.99
USCS= SP	Classification AASHT	O=
	<u>Remarks</u>	

0.9

Date: 12/7/12

(no specification provided)

0.0

Source of Sample: 17MVS-02PU Sample Number: 6

Depth: 13.5

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

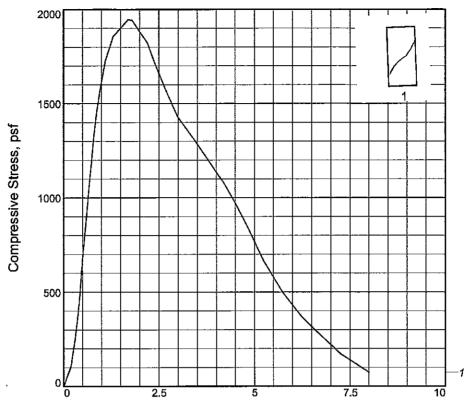
Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136 **Figure**

Stantec

Saint Rose, Louisiana





Axial Strain, %

Sample No.	1	
Unconfined strength, psf	1947	
Undrained shear strength, psf	973	
Failure strain, %	1.7	
Strain rate, in./min.	1.000	
Water content, %	56.2	
Wet density, pcf	97.5	
Dry density, pcf	62.4	
Saturation, %	89.5	
Void ratio	1.6892	
Specimen diameter, in.	1.392	
Specimen height, in.	3.011	
Height/diameter ratio	2.16	

Description: M BR CHOA W/ ARS ML, G

LL = 121	PL = 29	P1 = 92	Assumed GS= 2.69	Type: UNDISTURBED
Project No.: 10-	017136		Client: USACE	

Date Sampled: 12/17/12

Remarks:

CHEIL OBACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana
Source of Sample: 17MVS-02PU

Depth: 2.7

Sample Number: 1C2

UNCONFINED COMPRESSION TEST

Stantec Saint Rose, Louisiana

Figure ____

SUMMARY OF LABORATORY TEST RESULTS

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Current Date: 1/17/2013

Boring: Project Number: 10-017136

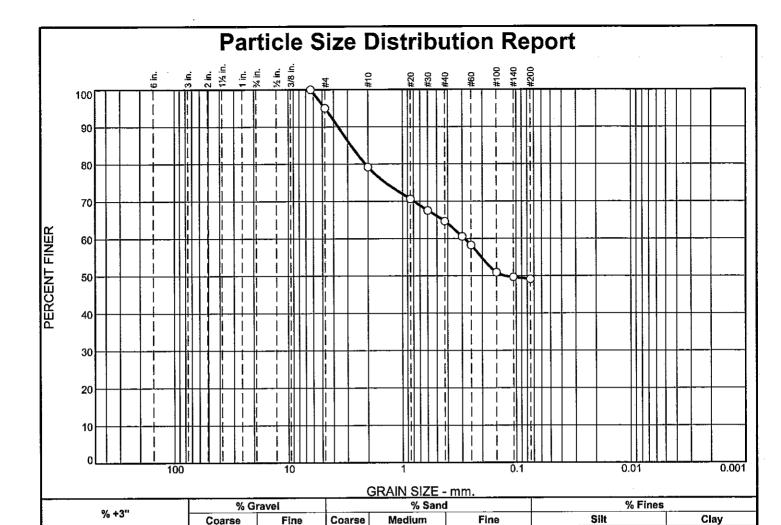
17MVS-03PU - Final

										_
	o (ن ان	4	ו נג	ه د) ;	ਨੇ ਫ	1 7	Sample Number	_
	14.0	<u></u>	9.0	ж Эп	40	י ס	20.0	<u>,</u> 0	Depth	
	LGR SP W/ ARS CH, RT, O	LGR SP W/ G. WD	LGR SP W/ ARS CH, G	IGB SM W// ABS CH G	I GR SM W/ ARS CH G	BB SD W/ ABS CH BT	BR SP W/LYS CH. RT. G	BRISM W/ ARSICH, G, RT	Visual Classification	
	SP (SP -	နှ နှ	2 :	S 0	ה ח	SP	2 2	USCS	_
									夏 (f)	-
	30	<u>ω</u>	23 -	,	19	7	ωο	p 4	W ₃	-
									Dens (pcf)	,
·			·						Wet Dens (pcf)	- ! -
									& &	
									Shear Test Type	}
									Angle	
									Cohesion (psf)	
									Comp.	
									Ħ	-
					·				ΡŢ	
									PI	_
									Torvane (tsf)	
	SV		9	S.	SV		SV	v.	Other	_

Remarks:

Stantec Consulting Services Inc.

Checked By: 77. File Name: 17MVS-03PU_be_boring_log_v10_0.



15.8

Fine

5.0

Medium

14.6

Fine

15.5

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0	- · ·	
#4	95.0		
#10	79.2		
#20	70.6		
#30	67.5		
#40	64.6		
#50	60,5		
#60	58.2		
#100	50.9		
#140	49.7		
#200	49.1		
1			
1			
L *		<u> </u>	

Coarse

0.0

	Soil Description	
BR SM W/ ARS	•	
•		1
PL=	Atterberg Limits LL=	P[=
D ₉₀ = 3.6417 D ₅₀ = 0.1272 D ₁₀ =	Coefficients D ₈₅ = 2.8126 D ₃₀ = C _u =	D ₆₀ = 0.2871 D ₁₅ = C _c =
USCS= SM	Classification AASHT0	O=
	<u>Remarks</u>	

(no specification provided)

0.0

Source of Sample: 17MVS-03PU Sample Number: 1A

Depth: 0.0

Date: 12/7/12

49.1

Stantec

Client: USACE

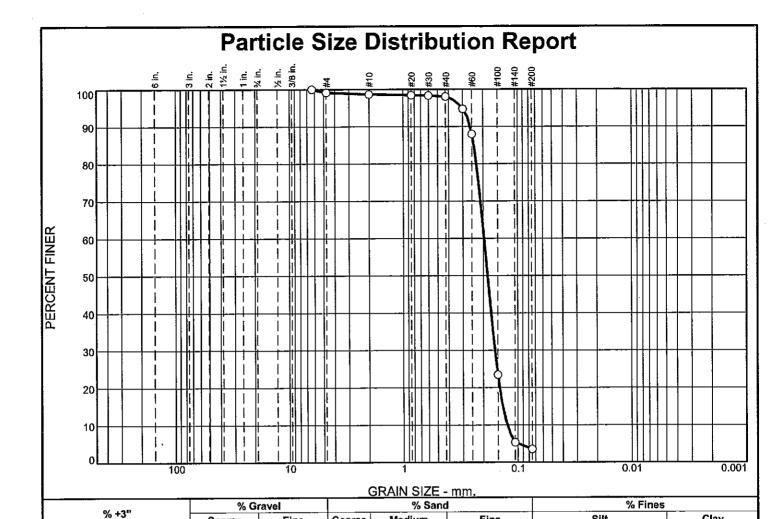
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Project No: 10-017136 **Figure**

Checked By: M#B/JS Tested By: JC



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	99.2		
#10	98.7		
#20	98.4		
#30	98.3		
#40	98.1		
#50	94.7		
#60	88.0		
#100	23.5		
#140	5.4		
#200	3.5		

0.0

0.6	94.6		3.5
BR SP	So W/ LYS CH, R	il Description T, G	
PL=	<u>Att</u> L	terberg Limits L=	Pl=
D ₉₀ = D ₅₀ = D ₁₀ =		Coefficients 85= 0.2408 30= 0.1588 u= 1.58	D ₆₀ = 0.1965 D ₁₅ = 0.1359 C _c = 1.03
USCS:		lassification AASHTO=	
		Remarks	

Silt

Clay

(no specification provided)

Source of Sample: 17MVS-03PU Sample Number: 1C

0.0

Depth: 2.0

Date: 12/7/12

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana **Project No:** 10-017136

Coarse

0.5

Fine

0.8

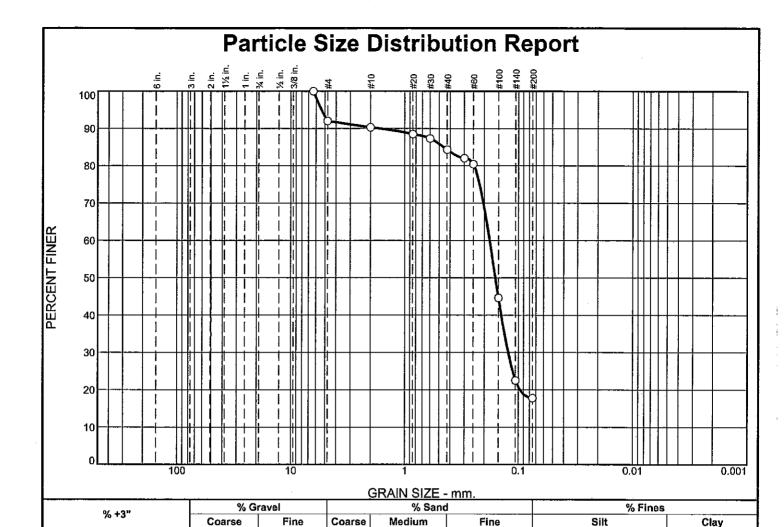
Medium

Fine

Figure

Tested By: JC

Checked By: MAB/JS



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	92.0		
#10	90.3		
#20	88.5		
#30	87.3		
#40	84.3		
#50	82.0	,	
#60	80.5		
#100	44.6		
#140	22.5		
#200	17.8		
* (F- 4: - : 1	<u> </u>	

0.0

Fine

8.0

Coarse

1.7

6.0

T CD CD CTTT LD	Soil Description	
LGR SM W/ AR	S CH, G	
	Atterberg Limits	
PL=	LL=	PI=
D ₉₀ = 1.6493 D ₅₀ = 0.1597 D ₁₀ =	Coefficients D ₈₅ = 0.4563 D ₃₀ = 0.1230 C _u =	D ₆₀ = 0.1794 D ₁₅ = C _c =
USCS= SM	Classification AASHT	O=
	<u>Remarks</u>	
	•	

(no specification provided)

Source of Sample: 17MVS-03PU **Sample Number:** 2

Stantec

Saint Rose, Louisiana

Depth: 4.0

0.0

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Fine

66.5

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

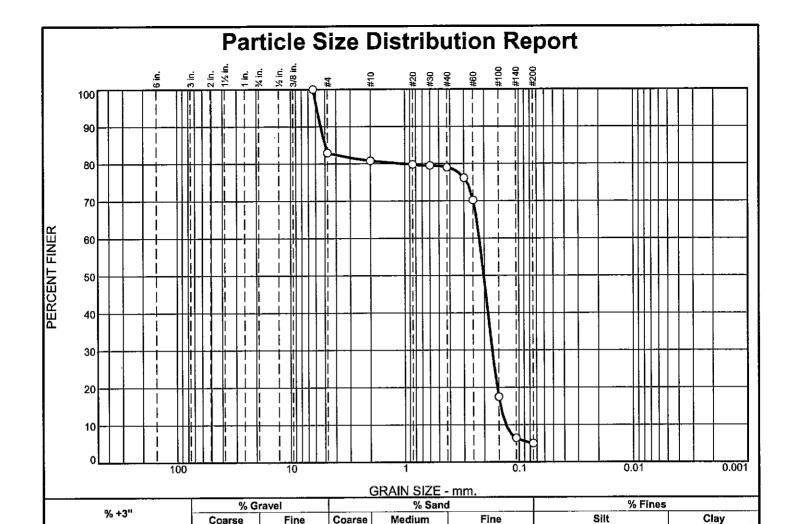
Date: 12/7/12

Clay

17.8

Tested By: JC

Checked By: MJB/JS



2.1

Fine

17.1

Medium

1.7

74.1

SIEVE	PERCENT	SPEC.	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	82.9		
#10	80.8		
#20	79.8		
#30	79.5		
#40	79.1		
#50	76.2		
#60	70.2		
#100	17.5		
#140	6.5		
#200	5.0		
* /	:G - +!	<u> </u>	<u> </u>

Coarse

0.0

LGR SM W/ AR	S CH, G	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 5.4359 D ₅₀ = 0.2022 D ₁₀ = 0.1304	Coefficients D85= 4,9647 D30= 0.1708 Cu= 1.70	D ₆₀ = 0.2212 D ₁₅ = 0.1447 C _c = 1.01
USCS= SM	Classification AASHT	O=
	<u>Remarks</u>	

(no specification provided)

Source of Sample: 17MVS-03PU

Depth: 6.5

Sample Number: 3

0.0

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Stantec

Project No: 10-017136

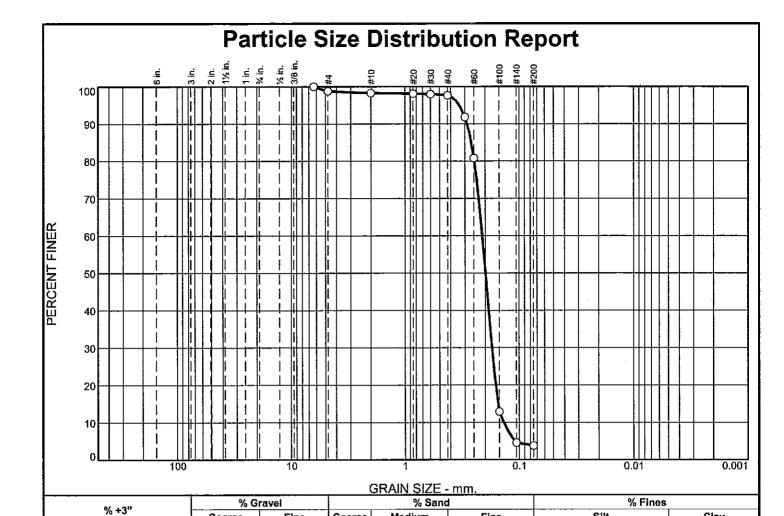
Figure

Date: 12/7/12

5.0

Tested By: JC

Checked By: MJB/JS



0.5

Fine

1.2

Medium

0.6

Fine

93.9

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	98.8		
#10	98.3		
#20	98.1		
#30	98.0		
#40	97.7		
#50	91.8		
#60	80.8		
#100	12.9		
#140	4.6		
#200	3.8		
	ļ		
		:	

Coarse

0.0

LGR SP W/ ARS	Soil Description CH, RT, O	
PL=	Atterberg Limits	PI=
D ₉₀ = 0.2866 D ₅₀ = 0.1985 D ₁₀ = 0.1371	Coefficients D ₈₅ = 0.2628 D ₃₀ = 0.1739 C _u = 1.55	$D_{60} = 0.2120$ $D_{15} = 0.1536$ $C_{c} = 1.04$
USCS= SP	Classification AASHT	O=
	<u>Remarks</u>	

Silt

3.8

Clay

(no specification provided)

0.0

Source of Sample: 17MVS-03PU Sample Number: 6

Depth: 14.0

Stantec

Saint Rose, Louisiana

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

Figure

Date: 12/7/12

Tested By: JC

SUMMARY OF LABORATORY TEST RESULTS

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Project Number: 10-017136 Boring: 17MVS-04PU - Final

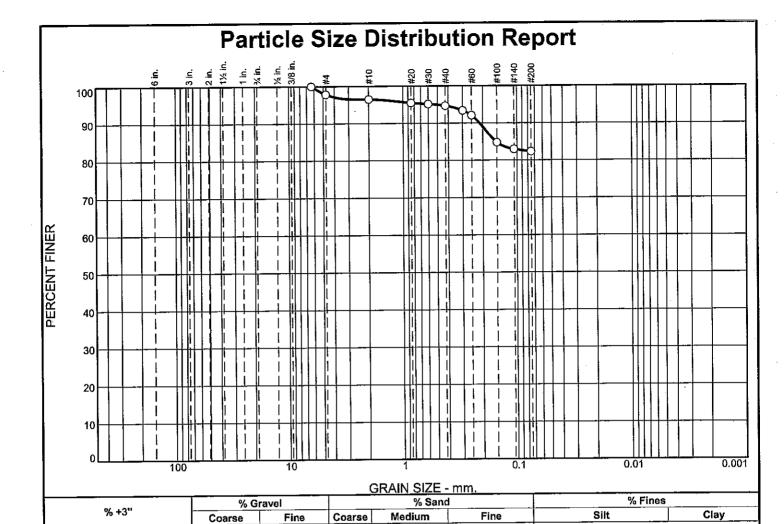
Current Date: 1/17/2013

· · · · · · · · · · · · · · · · · · ·		<u>_</u> .	
	5 4 4 3 2 D	5 1 5 1 5	Sample Number
	2.0 3.0 4.0 6.5 9.0 11.5	1.0	Depth
	LGR SM W/ G, R1 LGR SP W/O, RT T SM W/ ARS CH, WD, RT T SP W/O, RT T SM W/O, RT T SM W/O T SM W/ G, O, RT T SM W/ RT	BR ML W/ ARS & LYS CH, G LGR SM W/ LYS CH, G	Visual Classification
	0 N N N N N N N N N N N N N N N N N N N	SML	uscs
		_ , . ,	至(允)
	20 21 26	16	
·			Dry Dens (pcf)
			Wet Dens (pcf)
			æ æ tt
			Shear Test Type
			Angle
			Cohesion (psf)
		·	Unconf. Comp. Str.
			F
		·	Id
			ΙΨ
			Torvane (tsf)
			Other

Remarks:

Stantec Consulting Services Inc.

Checked By: ()



1 0

1.4

2.1

12.4

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	97.9		
#10	96.5		
#20	95.5		
#30	95.2		
#40	94.7		
#50	93.4		
#60	92.1		
#100	84.8		
#140	83.0		
#200	82.3		
	<u> </u>	<u> </u>	<u> </u>

0.0

BR ML W/ ARS	Soil Description & LYS CH, G		
PL=	Atterberg Limits	PI=	
D ₉₀ = 0.2134 D ₅₀ = D ₁₀ =	Coefficients D85= 0.1526 D30= Cu=	D ₆₀ = D <u>15</u> = C _c =	
USCS= ML	<u>Classification</u> AASHT0)=	
	<u>Remarks</u>		

823

Date: 12/7/12

* (no specification provided)

Source of Sample: 17MVS-04PU Sample Number: 1A

0.0

Depth: 0.0

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

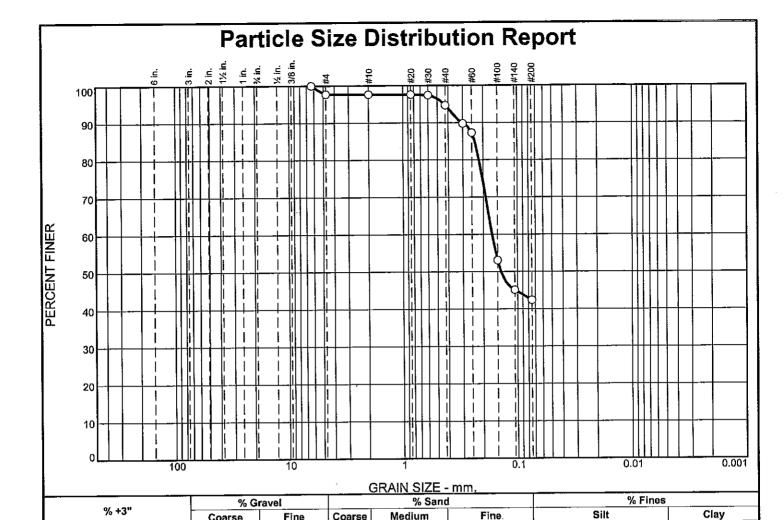
Street Canal Reevalution, Jefferson Parish, Louisiana **Figure Project No:** 10-017136

Saint Rose, Louisiana

Stantec

Checked By: MJB/JS

Tested By: JC



0.1

Fine

2.3

Medium

Fine.

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	97.7		
#10	97.6		
#20	97.6		
#30	97.4		
#40	94.7	1	
#50	89.8		
#60	87.3		
#100	53.0		
#140	45.1		
#200	42.4		
	1	1	1
		<u> </u>	

Coarse

0.0

2.9	52.3		42.4							
LGR SI	Soil Description LGR SM W/ LYS CH, G									
PL=		erberg Limits _=	PI=							
D ₉₀ = D ₅₀ = D ₁₀ =	0.3074 D 0.1400 D C	<u>Coefficients</u> 85= 0.2364 30= u=	D ₆₀ = 0.1673 D ₁₅ = C _c =							
USCS		<u>lassification</u> AASHTO=	:							
		<u>Remarks</u>								

* (no specification provided)

0.0

Source of Sample: 17MVS-04PU Sample Number: 1B

Depth: 1.0

Date: 12/7/12

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

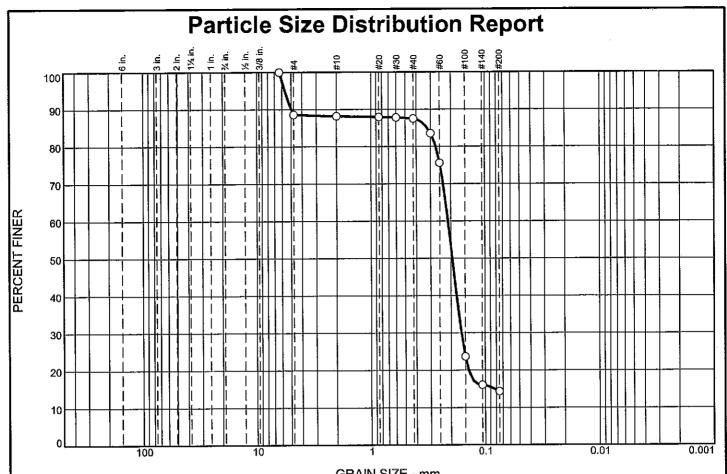
Street Canal Reevalution, Jefferson Parish, Louisiana

Figure Project No: 10-017136

Saint Rose, Louisiana

Checked By: MJB/JS

Tested By: JC



	% Gravel		% Sand		% Fine	es	
% +3"	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	11.4	0.4	0.7	73.1	14.4	

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO) _
1/4	100.0		
#4	88.6		
#10	88.2		
#20	87.9		
#30	87.8	,	
#40	87.5		
#50	83.5		
#60	75.6		
#100	23.7		
#140	16.1		1
#200	14.4		
	ĺ		

T SM W/ ARS C	Soil Description H, WD, RT	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 4.9701 D ₅₀ = 0.1946 D ₁₀ =	Coefficients D ₈₅ = 0.3208 D ₃₀ = 0.1622 C _u =	$D_{60} = 0.2121$ $D_{15} = 0.0826$ $C_{c} = 0.0826$
USCS= SM	<u>Classification</u> AASHT	0=
	Remarks	

Date: 12/7/12

(no specification provided)

Source of Sample: 17MVS-04PU Sample Number: 2

Depth: 4.0

Client: USACE

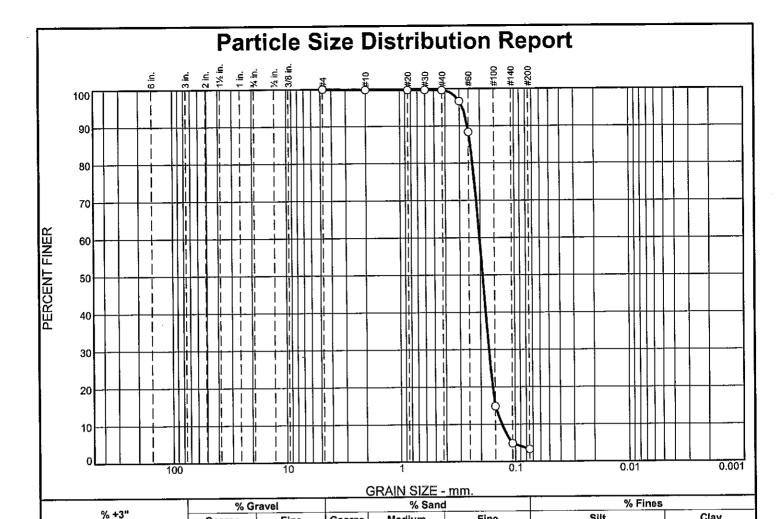
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: <u>10-017136</u> **Figure**

Saint Rose, Louisiana

Stantec



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X≃NO)
#4	100.0		
#10	99.8		
#20	99.7		
#30	99.7		
#40	99.6		!
#50	96.7		
#60	88.3		
#100	14.8		
#140	4.9		
#200	3.3	1	
	1		
		1	!

0.0

0.2	96.3		3.3
T SP W		Soil Description	
PL=	E	Atterberg Limits LL=	Pl=
D ₉₀ = (D ₅₀ = (D ₁₀ = (),2552),1913),1313	Coefficients D85= 0.2416 D30= 0.1692 Cu= 1.55	D ₆₀ = 0.2029 D ₁₅ = 0.1503 C _c = 1.07
USCS=	= SP	Classification AASHT	0=
		<u>Remarks</u>	

Silt

Clay

(no specification provided)

Source of Sample: 17MVS-04PU Sample Number: 3

Depth: 6.5

0.0

Client: USACE

Coarse

0.2

Fine

0.0

Medium

Fine

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

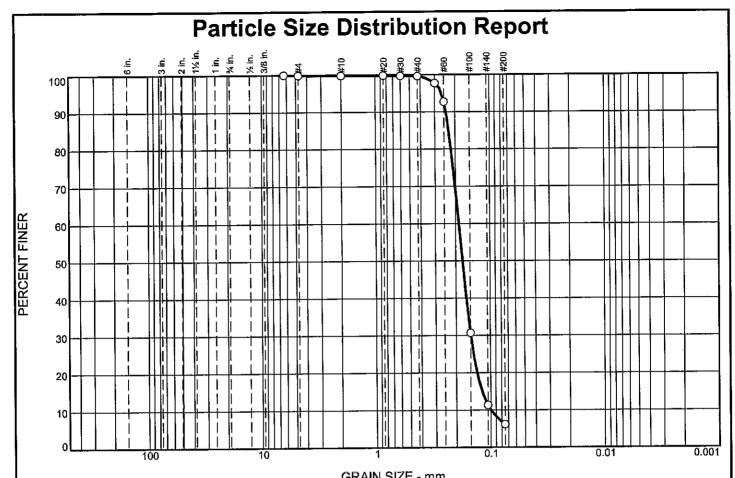
Stantec

Project No: 10-017136

Figure

Date: 12/7/12

Tested By: JC



				<u> PRAIN SIZE :</u>	1111111.		
	% Gı	ravel		% Sand	.	% Fines	· · · · · · · · · · · · · · · · · · ·
% +3"	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.1	0.2	93.4	6.2	

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	99.9		
#10	99.8		
#20	99.8		
#30	99.7		
#40	99.6		
#50	97.7		
#60	92.7		
#100	30.7		
#140	11.4		
#200	6.2		
]	
			1

	Soil Description	
T SM W/O		
	844 - 1 1 f 14	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 0.2407 D ₅₀ = 0.1750 D ₁₀ = 0.0997	Coefficients D ₈₅ = 0.2280 D ₃₀ = 0.1490 C _u = 1.88	D ₆₀ = 0.1877 D ₁₅ = 0.1191 C _c = 1.19
USCS= SM	<u>Classification</u> AASHTC)=
	<u>Remarks</u>	

Date: 12/7/12

Figure

(no specification provided)

Source of Sample: 17MVS-04PU **Sample Number:** 4

Depth: 9.0

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

Saint Rose, Louisiana

Stantec

Checked By: MJB/JS

Tested By: JC

SUMMARY OF LABORATORY TEST RESULTS

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Boring: Project Number: 10-017136

17MVS-05PU - Final

Current Date: 1/17/2013

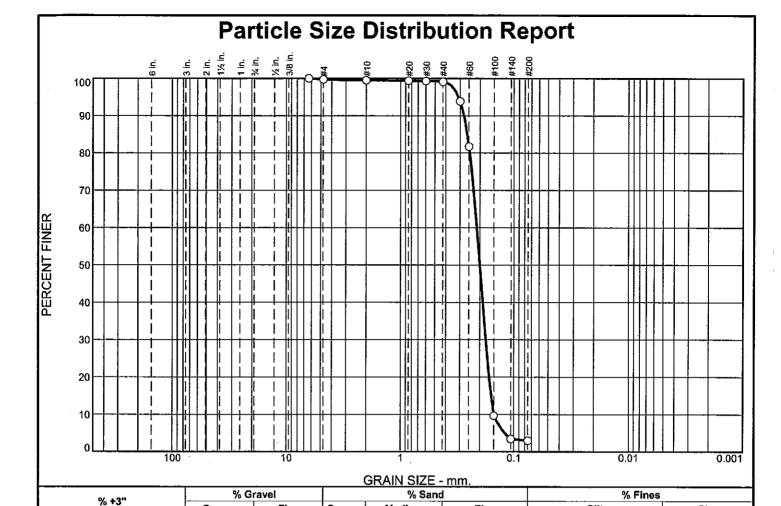
																											_			
	24	23	22	21	20	19	1 8	17	6	1 5	14	ಪ	12	⇉	5	ဖ	œ	7	o	σı	გ	#	44	3B	3 _A	2B	2A	1B	14	Sample Number
					49.5	47.0	44.5	42.0	39.5	37.0	34.5	32.0	29.5	27.0	24.5	22.0	19.5	17.0	14.5	12.0	10.0	9.0	8.0	5.0	4.0	3.0	2.0	1.0	0.0	Depth
	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF, RT	LGR SP W/ SIF	LGR SP W/ SIF	LGR SM W/ SIF, G	LGR SP	LGR SM	LGR SM	TSP	TSP	T SM W/RT	T SM W/ ARS CH	BR & T SP W/ LYS CH, G, RT	M BR & T CH3 W/ ARS SP, O	M BR CH4 W/ ARS SP, ARS ML, O	BR MH W/ ARS SP, ARS CH, G	M BR CL4 W/ ARS & LYS SM, O	Vigual Classification
	SP	SP	SP	SP	ŞP	SP	SP.	ş	SP.	SP	ş	SP	SP	ş	ş	SP.	MS	SP	SM	MS	ş	SP.	MS	SM.	ş	웊	유	至	유 4	USCS
																											7			E (£)
	အ	25	3	34	25	28	29	28	27	28	29	28	<u>ω</u>	3 <u>5</u>	36	23	26	27	23	23	20	9	12	ဖ	5	39	47	39	28	**
																										84	73			Dry Dens (pcf)
_																										113	107			Wet Dens (pcf)
														_												97	96			% † †
																										Ξ	ົດ			Shear Test Type
	٠																									0	ı			Angle
																										529	582			Cohesion (psf)
													٠														1164			Unconf. Comp. Str.
	٠																									සු	87	54	39	F
					_																					20	8	45	24	
																		_								43	69	9	5	ΡΊ
																										0.55	0.45			Torvane (tsf)
	SV				۷S			_	S۷				SV				SV		S۷	٧S	S۷			S۷	S۷					Other
							•						•													•	•			

Remarks:

Stantec Consulting Services Inc.

Checked By:

File Name: 17MVS-05PU_be_boring_log_v10_0.



0.3

Fine

0.2

Medium

0.4

Fine

96.1

PERCENT	SPEC.*	PASS?
FINER	PERCENT	(X=NO)
100.0		
99.8		
99.5		
99.4		
99.3		
99.1		
93.9		
81.7		
9.7		
3.5		
3.0		
	100.0 99.8 99.5 99.4 99.3 99.1 93.9 81.7 9.7 3.5	100.0 99.8 99.5 99.4 99.3 99.1 93.9 81.7 9.7 3.5

Coarse

0.0

BR & T SP W/L	Soil Description YS CH, G, RT	
PL≕	Atterberg Limits LL=	PI≃
D ₉₀ = 0.2771 D ₅₀ = 0.2004 D ₁₀ = 0.1506	Coefficients D ₈₅ = 0.2587 D ₃₀ = 0.1770 C _u = 1.42	$D_{60} = 0.2131$ $D_{15} = 0.1583$ $C_{c} = 0.98$
USCS= SP	Classification AASHT	O=
	Remarks	

Silt

3.0

(no specification provided)

0.0

Source of Sample: 17MVS-05PU Sample Number: 3A

Depth: 4.0

Date: 12/7/12

Clay

Stantec

Saint Rose, Louisiana

Client: USACE

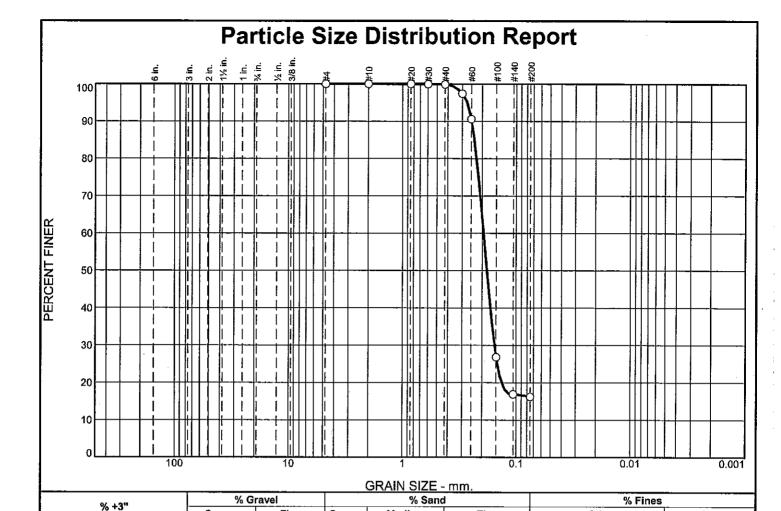
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

Figure

Tested By: JC



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#30	100.0		
· #40	99.9		
#50	97.4		
#60	90.6	<u>'</u>	
#100	26.8		
#140	16.9		
#200	16.2		
		,	

0.0

Fine

0.0

Coarse

0.0

Medium

0.1

T SM W/ ARS C	Soil Description H	
PL=	Atterberg Limits LL=	Pi=
D ₉₀ = 0.2481 D ₅₀ = 0.1815 D ₁₀ =	<u>Coefficients</u> D ₈₅ = 0.2348 D ₃₀ = 0.1551 C _u =	D ₆₀ = 0.1943 D ₁₅ = C _c =
USCS= SM	Classification AASHT	O=
	<u>Remarks</u>	

Silt

16.2

Fine

83.7

* (no specification provided)

Source of Sample: 17MVS-05PU Sample Number: 3B

0.0

Depth: 5.0

Date: 12/7/12

Clay

Stantec

Client: USACE

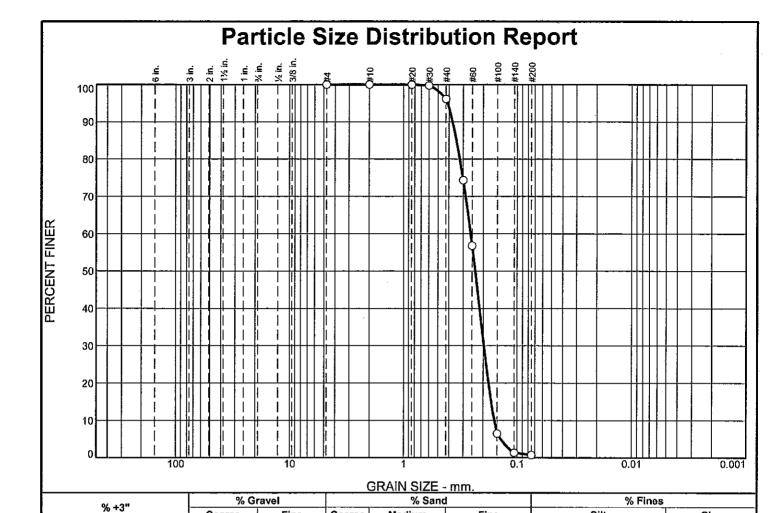
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana **Project No:** 10-017136

Figure

Tested By: JC



0.0

Medium

3.9

Fine

95.3

Fine

0.0

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#30	99.8		
# 4 0	96.1		
#50	74.4		
#60	56.8		
#100	6.5		
#140	1.3		
#200	0.8		
* (

Coarse

0.0

T SP	Soil Description	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 0.3717 D ₅₀ = 0.2350 D ₁₀ = 0.1589	Coefficients D ₈₅ = 0.3436 D ₃₀ = 0.1970 C _U = 1.62	D ₆₀ = 0.2577 D ₁₅ = 0.1694 C _c = 0.95
USCS= SP	Classification AASHTO)=
	<u>Remarks</u>	

Silt

8.0

(no specification provided)

0.0

Source of Sample: 17MVS-05PU Sample Number: 4C

Tested By: JC

Depth: 10.0

Date: 12/7/12

Clay

Stantec

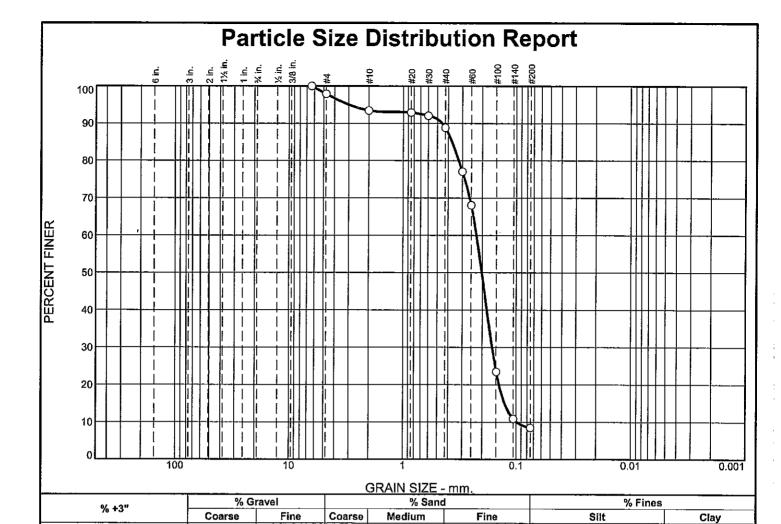
Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136 Figure

Saint Rose, Louisiana



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	97.9		
#10	93.4		
#20	92.9		
#30	92.1		
#40	88.8		
#50	77.0		
#60	68.1		
#100	23.5		
#140	10.9		
#200	8.5		

0.0

2.1

4.5

4.6

80.3

PL= Atterberg Limits P = Coefficients D ₉₀ = 0.4527 D ₈₅ = 0.3698 D ₆₀ = 0.2249 D ₅₀ = 0.2018 D ₃₀ = 0.1633 D ₁₅ = 0.1265 C _u = 2.28 C _c = 1.20 Classification AASHTO=	PL= LL= P = Coefficients D ₉₀ = 0.4527 D ₈₅ = 0.3698 D ₆₀ = 0.2249 D ₅₀ = 0.2018 D ₃₀ = 0.1633 D ₁₅ = 0.1265 D ₁₀ = 0.0987 C _u = 2.28 C _c = 1.20 Classification	LGR SM	Soil Description	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccc} & & & & & & & & & \\ D_{90} = & 0.4527 & & D_{85} = & 0.3698 & & D_{60} = & 0.2249 \\ D_{50} = & 0.2018 & & D_{30} = & 0.1633 & & D_{15} = & 0.1265 \\ D_{10} = & 0.0987 & & C_{u} = & 2.28 & & C_{c} = & 1.20 \\ & & & & & & & & \\ USCS = & SM & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & & \\ & & & & & & \\ & & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & & \\ & & & & & \\ & & & & & & \\ & & & & & \\ & & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & & \\ & & & & \\ & & & & & \\ & & & & \\ & & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & \\ & & & & \\ & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & &$	DI =		DI-
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	rt-		rı -
USCS= SM Classification AASHTO=	USCS= SM AASHTO=	D ₉₀ = 0.4527 D ₅₀ = 0.2018 D ₁₀ = 0.0987	<u>Coefficients</u> D ₈₅ = 0.3698 D ₃₀ ≈ 0.1633 C _u = 2.28	D ₆₀ = 0.2249 D ₁₅ = 0.1265 C _c = 1.20
	<u>Remarks</u>	USCS= SM)=
<u>Remarks</u>			<u>Remarks</u>	

(no specification provided)

Source of Sample: 17MVS-05PU Sample Number: 5

0.0

Depth: 12.0

Date: 12/7/12

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

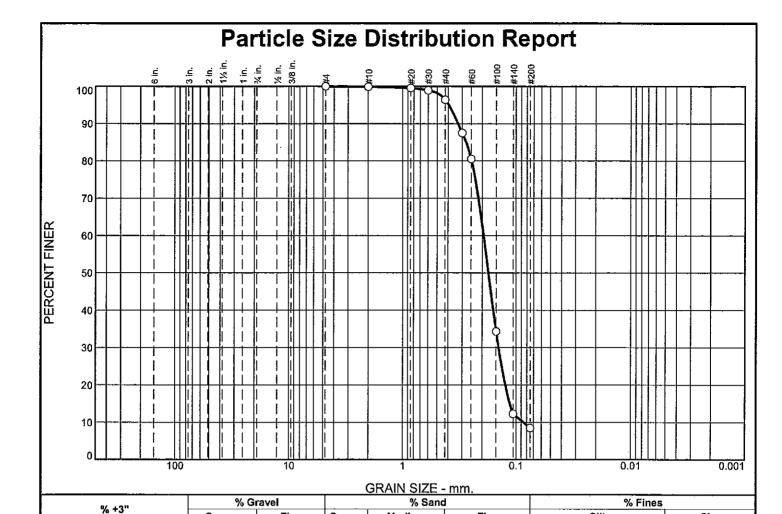
Saint Rose, Louisiana

Project No: 10-017136

Figure

8.5

Tested By: JC



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	99.9		
#20	99.6		
#30	98.9		
#40	96.4		
#50	87.5		
#60	80.5		
#100	34.3		
#140	12.3		
#200	8.5	·	

0.0

Fine

0.0

Coarse

0.1

Medium

Fine

3.5	87.9		8.5
LGR S		l Description	
PL=	<u>Atte</u> LL	erberg Limits =	Pl=
D ₉₀ = D ₅₀ = D ₁₀ =		oefficients 15= 0.2772 10= 0.1428 1= 2.25	D ₆₀ = 0.1943 D ₁₅ = 0.1136 C _c = 1.22
USCS		<u>assification</u> AASHTO≕	
		<u>Remarks</u>	

Silt

Clay

(no specification provided)

Source of Sample: 17MVS-05PU Sample Number: 6

0.0

Depth: 14.5

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

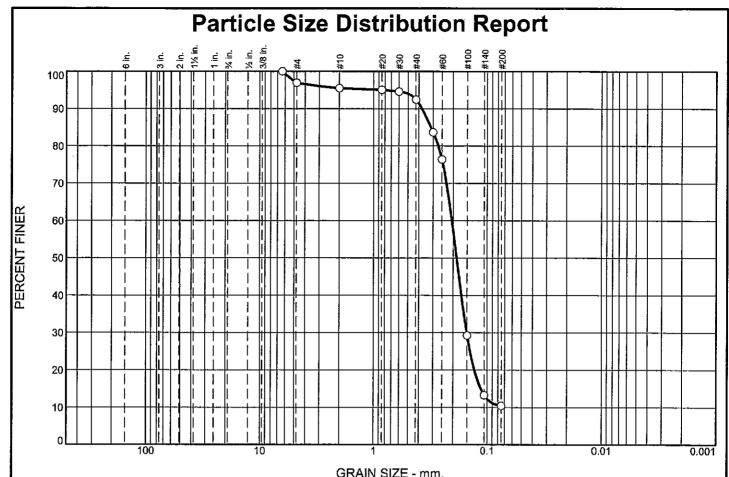
Stantec

Project No: 10-017136

Figure

Date: 12/7/12

Tested By: JC Checked By: MJB/JS



0/, ±2#	% +3" % Gravel Coarse Fine				% Fines		
78,13			Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	1.4	3,1	81.9	10.5	

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	96.9		
#10	95.5		
#20	95.1		
#30	94.6		
#40	92.4		
#50	83.7		
#60	76.4		
#100	29.3		
#140	13.3		
#200	10.5		

Soil Description LGR SM W/ SIF, G			
PL=	Atterberg Limits LL=	PI≔	
D ₉₀ = 0.3760 D ₅₀ = 0.1861 D ₁₀ =	Coefficients D ₈₅ = 0.3134 D ₃₀ = 0.1513 C _u =	D ₆₀ = 0.2051 D ₁₅ = 0.1137 C _c =	
USCS= SM	<u>Classification</u> AASHT0	O=	
	<u>Remarks</u>		

Date: 12/7/12

(no specification provided)

Source of Sample: 17MVS-05PU Sample Number: 8

Depth: 19.5

Stantec Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

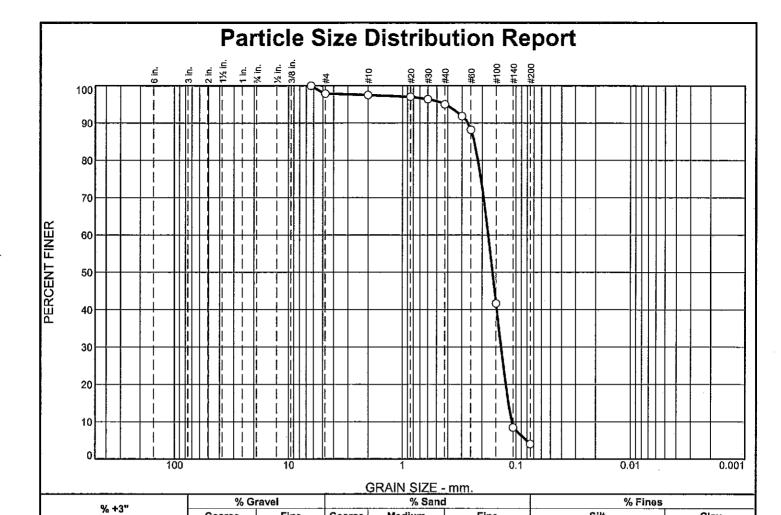
Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136 **Figure**

Saint Rose, Louisiana

Checked By: MUB/JS

Tested By: JC



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	97.9		
#10	97.5		
#20	97.0	,	
#30	96.4		
#40	95.0		
#50	91.9		
#60	88.2		
#100	41.7		
#140	8.4		
#200	4.0	·	
	#40 #40 #30 #40 #50 #60 #100 #140	SIZE FINER 1/4 100.0 #4 97.9 #10 97.5 #20 97.0 #30 96.4 #40 95.0 #50 91.9 #60 88.2 #100 41.7 #140 8.4	SIZE FINER PERCENT 1/4 100.0 #4 97.9 #10 97.5 #20 97.0 #30 96.4 #40 95.0 #50 91.9 #60 88.2 #100 41.7 #140 8.4

0.0

Fine

2.1

Coarse

0.4

Medium

Fine

2.5	91.0		4.0		
Soil Description LGR SP W/ SIF					
PL=	<u>Att</u>	erberg <u>Limits</u> .=	PI=		
D ₉₀ = (D ₅₀ = (D ₁₀ = (coefficients 185= 0.2342 130= 0.1355 101= 0.1355	D ₆₀ = 0.1761 D ₁₅ = 0.1165 C _c = 0.96		
USCS=		l <u>assification</u> AASHTO=			
		Remarks			

Silt

Clay

* (no specification provided)

Source of Sample: 17MVS-05PU **Sample Number:** 12

Depth: 29.5

0.0

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

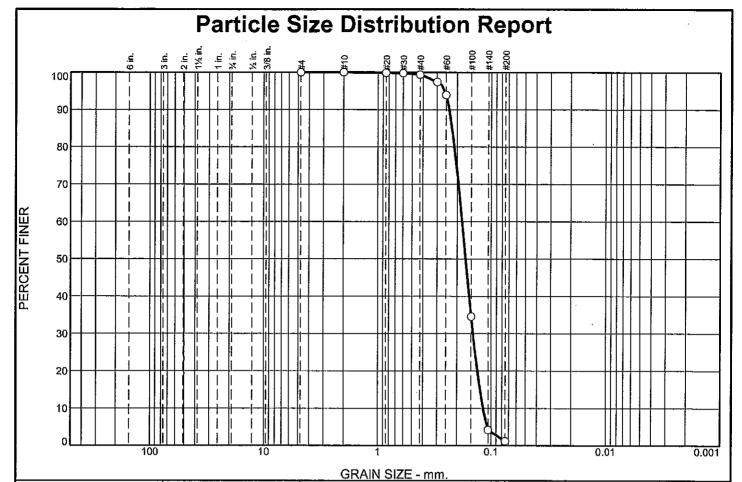
Stantec

Project No: 10-017136

Figure

Date: 12/7/12

Checked By: MJB/JS Tested By: JC



	% +3"		% Grave	el .		% Sand		% Fines	
	70 TJ		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
	0.0		0.0	0.0	0.0	0.6	98.2	1.2	
ı	SIEVE	PERCENT	SPEC.*	PASS	37	[Soil	Description	
	6175	CINCO	DEDCENT	/V_N/	as I	T CD CD			

·	SIEVE	PERCENT	SPEC.*	PASS?
	SIZE	FINER	PERCENT	(X=NO)
	#4	100.0		
	#10	100.0		
	#20	99.9		
	#30	99.8		
	#40	99.4		
	#50	97.4		
	#60	94.0		
	#100	34.6		
	#140	4.2		
	#200	1.2		

LGR SP	Soil Description	
PL=	Atterberg Limits LL=	PI≃
D ₉₀ = 0.2348 D ₅₀ = 0.1683 D ₁₀ = 0.1173	Coefficients D ₈₅ = 0.2218 D ₃₀ = 0.1445 C _u = 1.54	D ₆₀ = 0.1808 D ₁₅ = 0.1250 C _c = 0.98
USCS= SP	Classification AASHTO)=
	<u>Remarks</u>	•

(no specification provided)

Source of Sample: 17MVS-05PU Sample Number: 16

Tested By: JC

Depth: 39.5

Date: 12/7/12

Figure

Stantec

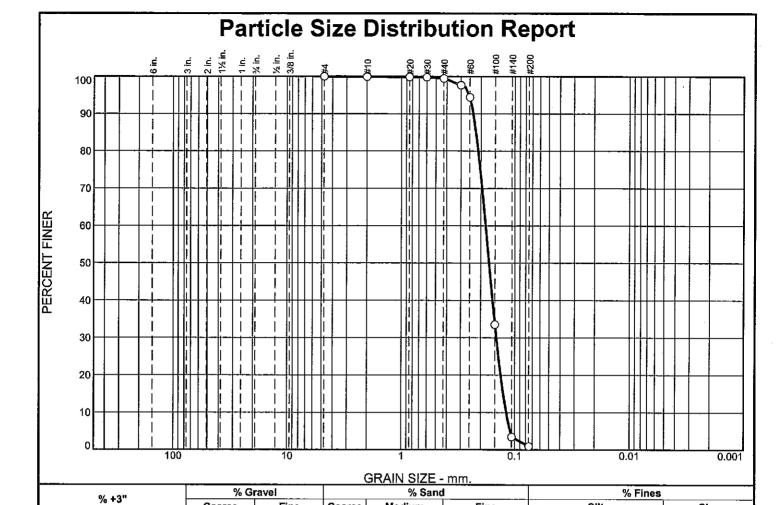
Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana Project No: 10-017136

Carre Rose, Eouisiana



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	99.9		
#20	99.9		
#30	99.8	-	
#40	99.5		
#50	97.7		
#60	94.4		
#100	33.6		
#140	3.5		
#200	0.9		

0.0

Fine

0.0

Coarse

0.1

Medium

Fine

0.4	98.6	,	0.9			
Soil Description LGR SP W/ SIF						
PL=	<u>Atte</u> LL	erberg Limits .=	PI=			
D ₉₀ = (D ₅₀ = (D ₁₀ = (0.2335 Di 0.1691 Di 0.1189 Ci	0.2211 0.2211 0.1458 0.1458	D ₆₀ = 0.1814 D ₁₅ = 0.1265 C _c = 0.99			
USCS=	SP CI	lassification AASHT(D=			
		Remarks				
	_					

Silt

Clay

Date: 12/7/12

(no specification provided)

Source of Sample: 17 MVS-05PU Sample Number: 20

Depth: 49.5

Tested By: JC

0.0

Client: USACE

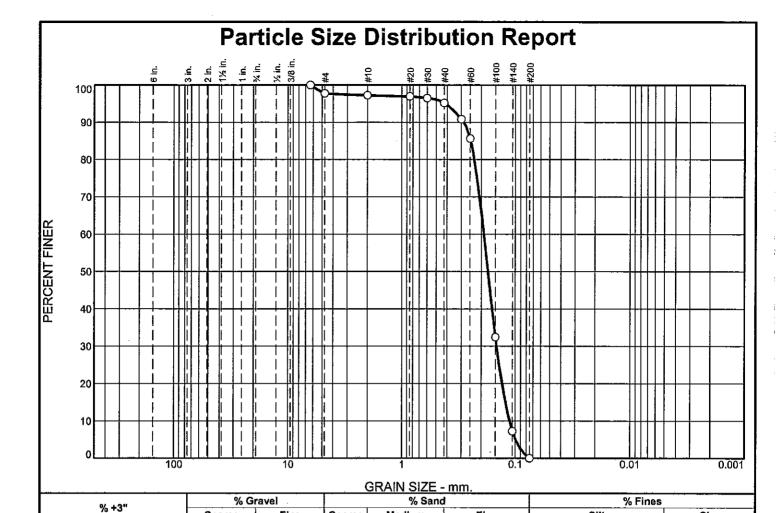
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136 **Figure**

Saint Rose, Louisiana

Stantec



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		·
#4	97.8		
#10	97.2		
#20	96.9		
#30	96.5		
#40	95.2		
#50	90.8		
#60	85.7		
#100	32.5		
#140	7.3		
#200	0.0		
* / ''			Ļ.,

0.0

Fine

2.2

Coarse

0.6

Medium

2.0

Fine

95.2

LGR SP W/ SIF	Soil Description	
PL=	Atterberg Limits	PI=
D ₉₀ = 0.2853 D ₅₀ = 0.1746 D ₁₀ = 0.1124	Coefficients D85= 0.2470 D30= 0.1464 Cu= 1.69	D ₆₀ = 0.1897 D ₁₅ = 0.1223 C _c = 1.01
USCS= SP	<u>Classification</u> AASHTO)=
	<u>Remarks</u>	

Silt

0.0

Clay

0.0

(no specification provided)

0.0

Source of Sample: 17MVS-05PU **Sample Number:** 24

Tested By: JC

Depth: 59.5

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

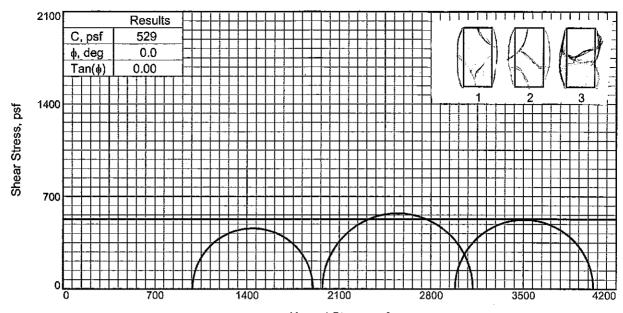
Figure

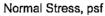
Date: 12/7/12

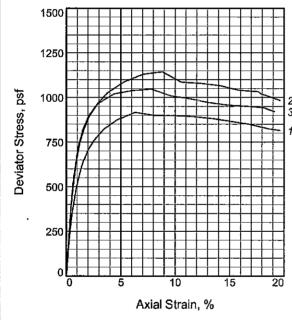
Saint Rose, Louisiana

UNCONFINED COMPRESSION TEST 2000 1500 Compressive Stress, psf 1000 500 Axial Strain, % Sample No. 1 Unconfined strength, psf 1164 Undrained shear strength, psf 582 Failure strain, % 10.0 Strain rate, in./min. 1.000 Water content, % 46.7 Wet density, pcf 107.5 Dry density, pcf 73.3 Saturation, % 96.5 Void ratio 1.3179 Specimen diameter, in. 1.387 Specimen height, in. 3.007 Height/diameter ratio 2.17 Description: M BR CH4 W/ ARS SP, ARS ML, O PL = 18 PI = 69 **Assumed GS=** 2.72 Type: UNDISTURBED LL = 87**Project No.:** 10-017136 **Client: USACE** Date Sampled: 12/7/12 Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th Remarks: Street Canal Reevalution, Jefferson Parish, Louisiana Source of Sample: 17MVS-05PU Depth: 2.0 Sample Number: 2A **UNCONFINED COMPRESSION TEST** Stantec Figure _ Saint Rose, Louisiana

Tested By: VF Checked By: MJB/JS







	Sai	mple No.	1	2	3	
2	Initial	Water Content, % Dry Density, pcf Saturation, % Void Ratio Diameter, In. Height, in.	38.9 81.3 96.7 1.1032 1.390 3.008	32.8 87.1 93.2 0.9645 1.395 3.007	33.7 86.8 95.2 0.9701 1.390 3.008	
1	At Test	Water Content, % Dry Density, pcf Saturation, % Void Ratio Diameter, in. Height, in.	38.9 81.3 96.7 1.1032 1.390 3.008	32.8 87.1 93.2 0.9645 1.395 3.007	33.7 86.8 95.2 0.9701 1.390 3.008	
		ain rate, in./min. ck Pressure, psi	1.000 0.00	1.000 0.00	1.000 0.00	
	Fai	ll Pressure, psi il. Stress, psf Strain, %	6.84 917 6.3	13.70 1144 8.8	20.71 1047 7.8	
	Ult.	. Stress, psf Strain, % Failure, psf	867 15.1 1902	1067 14.1 3117	958 14.9 4029	
		Failure, psf	985	1973	2982	

Type of Test:

Unconsolidated Undrained
Sample Type: UNDISTURBED

Description: M BR & T CH3 W/ ARS SP, O

LL= 63

PL= 20

PI= 43

Assumed Specific Gravity= 2.74

Remarks:

Sample Number: 2B

Source of Sample: 17MVS-05PU

Client: USACE

Proj. No.: 10-017136

Date Sampled: 12/7/12

Depth: 3.0

TRIAXIAL SHEAR TEST REPORT Stantec

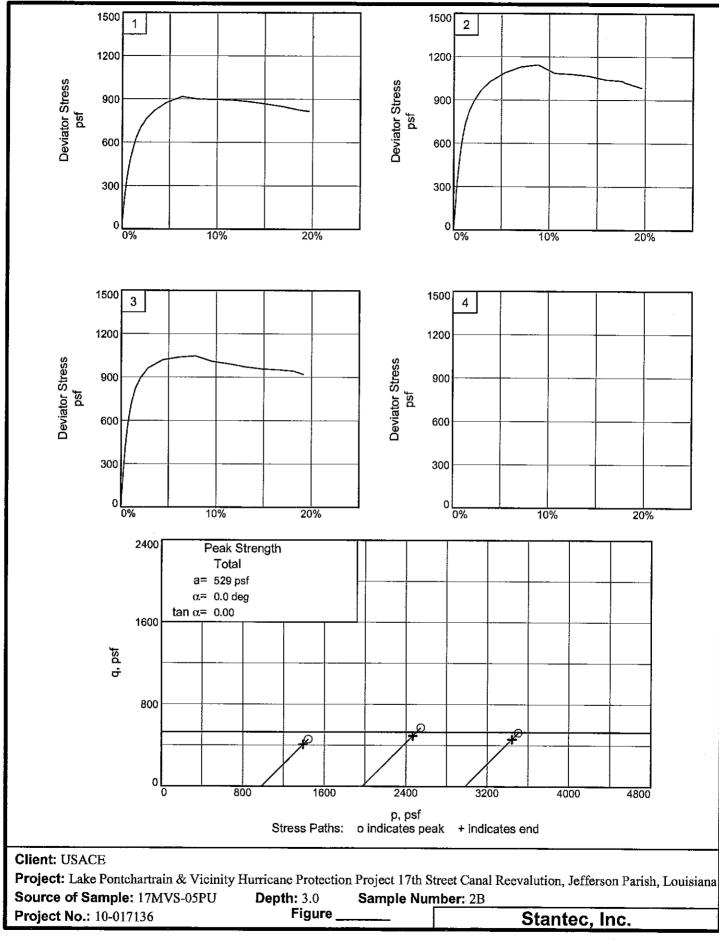
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project

17th Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Figure

Tested By: VF



SUMMARY OF LABORATORY TEST RESULTS

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

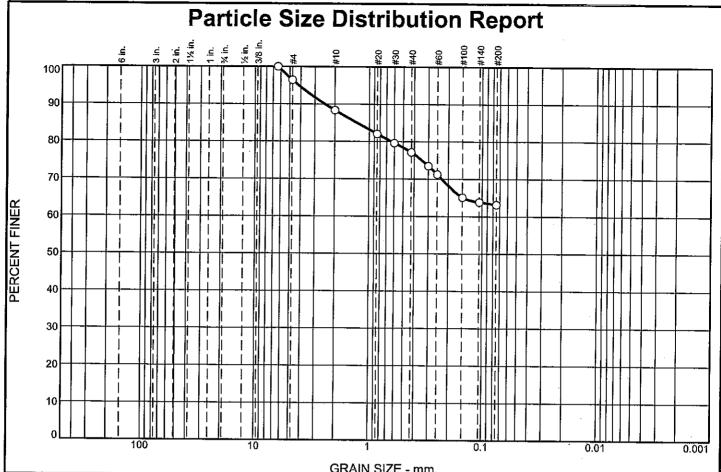
Current Date: 1/17/2013

Project Number: 10-017136 Boring: 17MVS-06PU - Final

Number 1A 1B 1C 2 3
Depth 0.0 1.0 2.0 4.0 6.5 9.0 11.5
Visual Classification BR & T ML W/ ARS CH, G, RT T SM W/RT, O T SP W/RT T SP W/RT T SP W/RT T SP W/G T SP W/G
SP USCS
冠(宁)
10 25 26 27 16
Dens (pcf)
Dens (pcf)
ate A
Test Type
Angle
(psf)
Str.
Ę
 된
(tsf)
Other Tests SV SV SV SV

Stantec Consulting Services Inc.

Remarks:



GRAIN SIZE - IIIII.							
% +3"	% Gr	avel	% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.6	8.0	11.2	14.0	63.2	

SIE	VE	PERCENT	SPEC.*	PASS?
SI	ZE	FINER	PERCENT	(X=NO)
1,	/4	100.0		
#	4	96.4		Ì
#1	10	88.4		
#2	20	82.0		
#3	30	79.6		
#4	40	77.2		
#5	50	73.5		
#6	50	71.2		
#1	00	65.1		
#1	40	63.8		
#2	00	63.2		
	į			

BR & T ML W/	Soil Description ARS CH, G, RT	
PL≂	Atterberg Limits LL=	PI=
D ₉₀ = 2.4543 D ₅₀ = D ₁₀ =	<u>Coefficients</u> D ₈₅ = 1.2817 D ₃₀ ≈ C _u =	D ₆₀ = D ₁₅ = C _c =
USCS= SM	Classification AASHT0)=
	Remarks	

(no specification provided)

Source of Sample: 17MVS-06PU Sample Number: 1A

Depth: 0.0

Date: 12/7/12

Stantec

Client: USACE

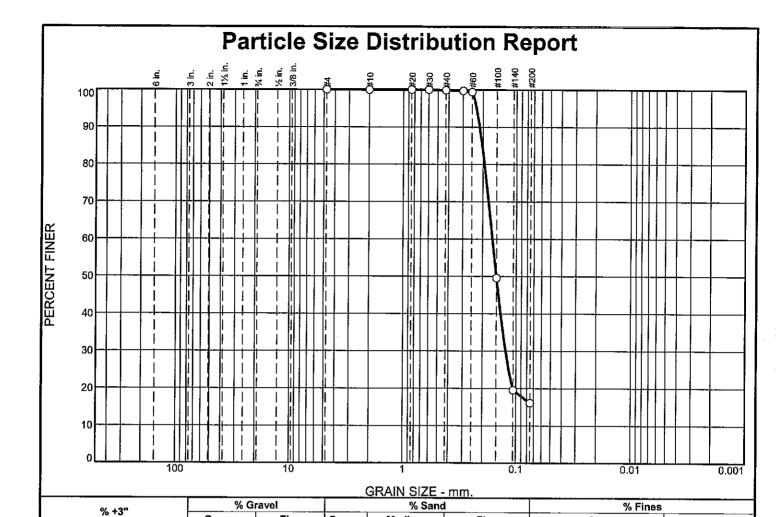
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana Project No: 10-017136

Figure

Tested By: JC



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#30	100.0		
#40	99.9		
#50	99.7		
#60	99.4		
#100	49.6		
#140	19.6		
#200	16.1		
		i	

0.0

Fine

0.0

Coarse

0.0

Medium

0.1

Fine

83.8

T SM W/ RT	Soil Description	
PL=	Atterberg Limits LL=	Pl=
D ₉₀ = 0.2137 D ₅₀ = 0.1505 D ₁₀ =	Coefficients D ₈₅ = 0.2026 D ₃₀ = 0.1241 C _u =	D ₆₀ = 0.1635 D ₁₅ = C _c =
USCS= SM	<u>Classification</u> AASHTO	:= :=
	<u>Remarks</u>	

Silt

16.1

Clay

(no specification provided)

Source of Sample: 17MVS-06PU Sample Number: 1C

0.0

Depth: 2.0

Date: 12/7/12

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

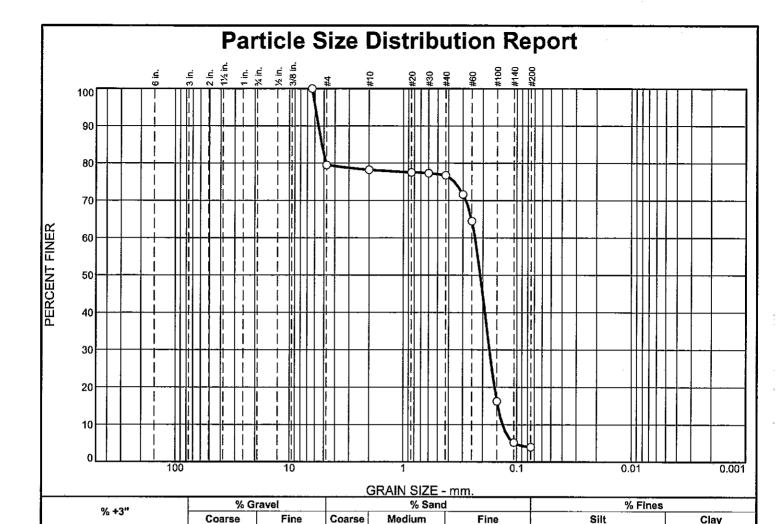
Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Project No: 10-017136

Figure

Tested By: JC



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	79.5		
#10	78.2		
#20	77.5		
#30	77.3		
#40	76.7		
#50	71.6		
#60	64.5		
#100	16.2		
#140	5.2		
#200	4.0		

0.0

T SP W/ RT	Soil Description	
PL=	Atterberg Limits LL=	Pl=
D ₉₀ = 5.5889 D ₅₀ = 0.2109 D ₁₀ = 0.1337	Coefficients D ₈₅ = 5.2086 D ₃₀ = 0.1749 C _u = 1.76	D ₆₀ = 0.2348 D ₁₅ = 0.1473 C _c = 0.97
USCS= SP	<u>Classification</u> AASHT0	D=
	<u>Remarks</u>	
·		

(no specification provided)

0.0

Source of Sample: 17MVS-06PU **Sample Number:** 2

Depth: 4.0

Fine

20.5

1.3

1.5

72.7

Date: 12/7/12

Clay

4.0

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

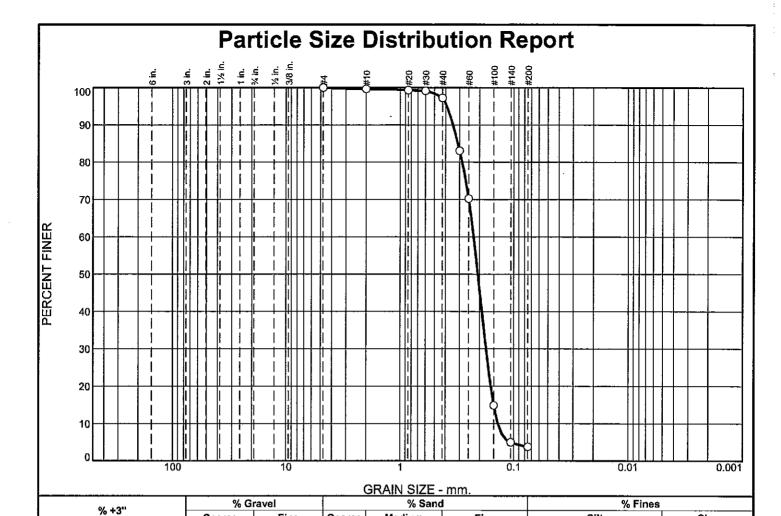
Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Project No: 10-017136

Figure

Tested By: JC Checked By: MJB/JS



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	99.7		
#20	99.3		
#30	99.2		
#40	97.3		
#50	83.1		
#60	70.3		
#100	14.9		
#140	5.0		
#200	3.8		
1		·	
1			
· · · · · · · · · · · · · · · · · · ·		15	

0.0

Fine

0.0

Coarse

0.3

Medium

2.4

Fine

93.5

T SP W/ RT	Soil Description	
PL=	Atterberg Limits	Pl=
D ₉₀ = 0.3429 D ₅₀ = 0.2077 D ₁₀ = 0.1377	Coefficients D ₈₅ = 0.3104 D ₃₀ = 0.1759 C _u = 1.64	D ₆₀ = 0.2261 D ₁₅ = 0.1502 C _c = 0.99
USCS= SP	Classification AASHT0)= D=
	<u>Remarks</u>	

Silt

3.8

(no specification provided)

0.0

Source of Sample: 17MVS-06PU Sample Number: 3

Depth: 6.5

Date: 12/7/12

Clay

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

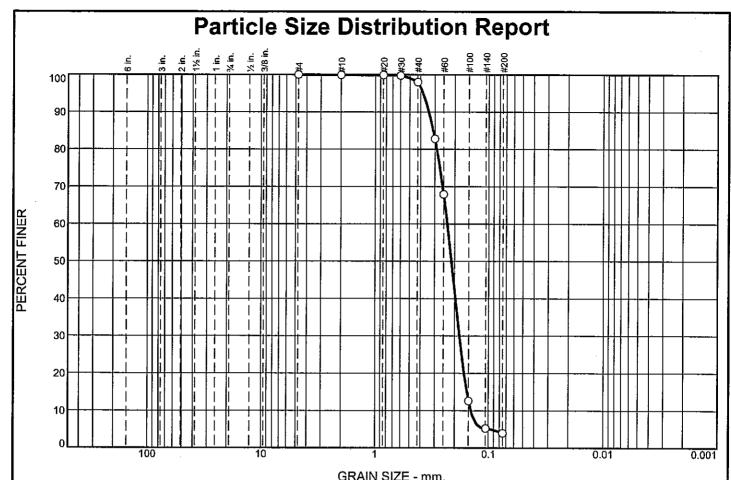
Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Project No: 10-017136

Figure

Tested By: JC



	% +3" % Gravel		% Gravel % Sand			% Fines	
76 · · 3	Coarse	Fine	Coarse	Coarse Medium Fine	Silt	Clay	
0.0	0.0	0.0	0.1	1.9	94.0	4.0	-

	SIEVE	PERCENT	SPEC.*	PASS?
	SIZE	FINER	PERCENT	(X=NO)
	#4	100.0		
	#10	99.9		
	#20	99.9		
ı	#30	99.7		
	#40	98.0		
	#50	82.8		
	#60	68.0		
	#100	12.6		
	#140	5.2		
	#200	4.0		
			;	
	,			

T SP	Soil Description	
1 51		
PL=	Atterberg Limits LL=	Pl=
D ₉₀ = 0.3391 D ₅₀ = 0.2135 D ₁₀ = 0.1432	Coefficients D85= 0.3104 D30= 0.1810 Cu= 1.62	D ₆₀ = 0.2322 D ₁₅ = 0.1552 C _c = 0.99
USCS= SP	Classification AASHT	O=
	Remarks	

(no specification provided)

Source of Sample: 17MVS-06PU Sample Number: 4

Depth: 9.0

Date: 12/7/12

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Project No: 10-017136

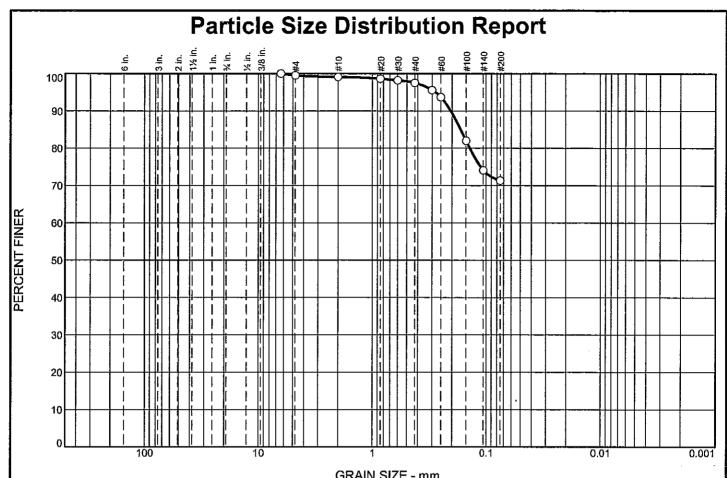
Figure

Tested By: <u>JC</u>

SUMMARY OF LABORATORY TEST RESULTS

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Stantec Consulting Services Inc. Boring: Project Number: 10-017136 Remarks: Number Sample 65432611 Depth 11.5 1.0 2.0 4.0 6.5 9.0 BR ML W/ ARS CH, O, SIF
ST BR CL6 W/ LYS & ARS SP, G
T SM W/ ARS CH, O, RT
T SP W/ ARS CH, RT
T SM W/ WD
T SM W/ WD
T SM W/ ARS CH 17MVS-07PU - Final Visual Classification USCS SM SM SM SM SM E (f) Οī Ş Dens (pcf) Āī 107 (pcf) Dens Wet 119 Sat 47 Type Test Shear S Angle Cohesion (psf) 1512 File Name: 17MVS-07PU be boring log_v10_0. Current Date: 1/17/2013 Unconf. Comp. Str. 3025 Checked By: ដ 45 ם 23 Ä 23 Torvane (tsf) Other Tests Ş



% +3"	% Grave!		% Gravel % Sand		% Fines	•	
70 T3	Coar	se Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.5	0.4	1.6	26.2	71.3	
SIEVE	PERCENT S	SPEC.* PA	SS?		e all D	escription	

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	99,5		
#10	99.1		
#20	98.6		
#30	98.2		
#40	97.5		
#50	95.6		:
#60	93.7		
#100	82.0		
#140	74.1		•
#200	71.3		
			-
		,	

BR ML W/ ARS	Soil Description CH, O, SIF	
PL≃	Atterberg Limits LL=	P !=
D ₉₀ = 0.2050 D ₅₀ = D ₁₀ =	Coefficients D ₈₅ = 0.1678 D ₃₀ = C _u =	D ₆₀ = D ₁₅ = C _c =
USCS= ML	Classification AASHT	D=
	Remarks	

(no specification provided)

Source of Sample: 17MVS-07PU Sample Number: 1A

Depth: 0.0

Client: USACE

Stantec

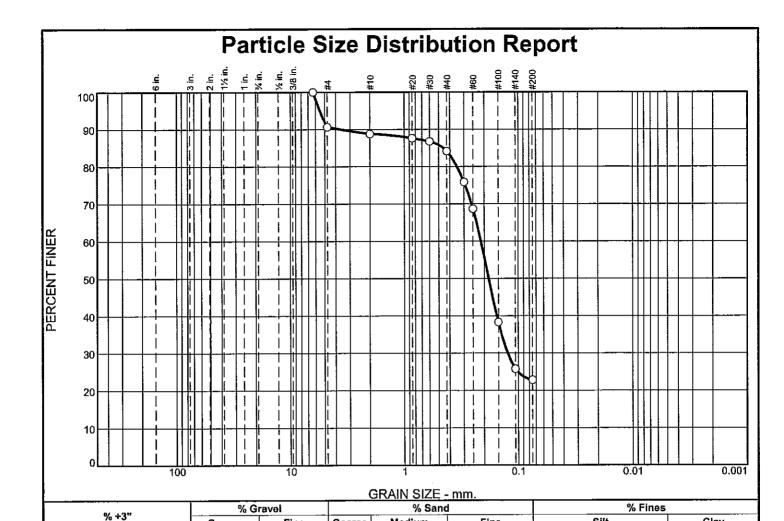
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Date: 12/7/12

Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Project No: 10-017136



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	90.7		
#10	88.8		
#20	87.7		
#30	86.8		
#40	84.1		
#50	75.9		
#60	68.7		
#100	38.3		
#140	25.8		
#200	22.8		
			1
	1		
* ,			

0.0

Fine

9.3

Coarse

1.9

Medium

4.7

Fine

61.3

T SM W/ ARS C	Soil Description T SM W/ ARS CH, O, RT						
PL=	Atterberg Limits	Pl=					
D ₉₀ = 3.6172 D ₅₀ = 0.1825 D ₁₀ =	Coefficients D ₈₅ = 0.4549 D ₃₀ = 0.1239 C _u =	D ₆₀ = 0.2137 D ₁₅ = C _c =					
USCS= SM	<u>Classification</u> AASHT	O=					
	Remarks						

Silt

22.8

Date: 12/7/12

Clay

(no specification provided)

Source of Sample: 17MVS-07PU Sample Number: 1C

0.0

Depth: 2.0

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

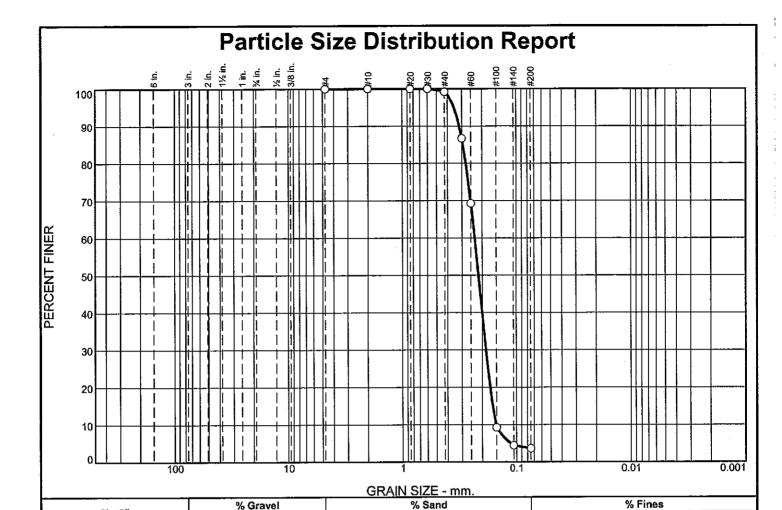
Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136 Figure

Saint Rose, Louisiana

Stantec

Checked By: MAP/JS



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	100.0		
#20	100.0		
#30	100.0		
#40	99.2		
#50	86.7		
#60	69.3		
#100	9.2		
#140	4.4		
#200	3.6		
*			<u> </u>

0.0

Fine

0.0

Coarse

0.0

Medium

8.0

Fine

95.6

T SP W/ ARS CI	Soil Description I, RT	
PL=	Atterberg Limits	PI=
D ₉₀ = 0.3153 D ₅₀ = 0.2153 D ₁₀ = 0.1518	Coefficients D ₈₅ = 0.2932 D ₃₀ = 0.1853 C _u = 1.53	D ₆₀ = 0.2320 D ₁₅ = 0.1617 C _c = 0.97
USCS= SP	Classification AASHT	O=
	<u>Remarks</u>	

Silt

3.6

Clay

(no specification provided)

Source of Sample: 17MVS-07PU Sample Number: 2

Depth: 4.0

% +3"

0.0

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

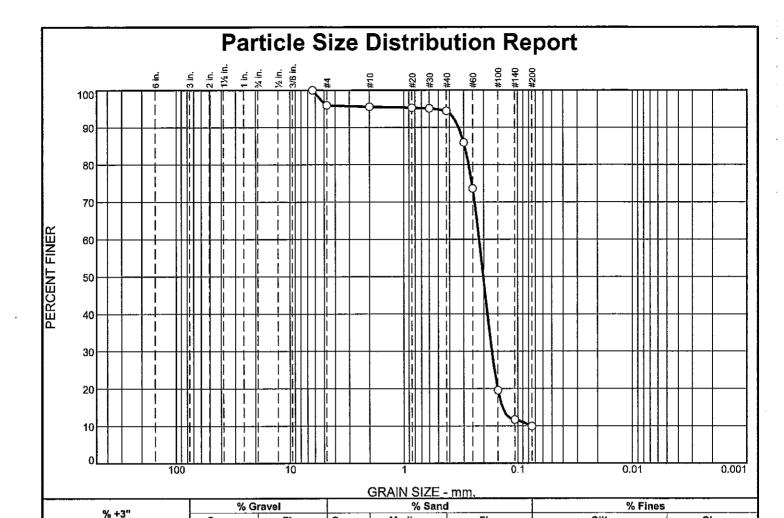
Project No: 10-017136

Date: 12/7/12

Saint Rose, Louisiana

Stantec

Checked By: MAS/JS



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	96.0		
#10	95.5		•
#20	95.3		
#30	95.1		
#40	94.4		
#50	86.0		
#60	73.6		
#100	19.6		
#140	11.7		
#200	9.9		
•			
*			l

0.0

Fine

4.0

Coarse

0.5

Medium

1.1

Fine

84.5

	Soil Description	
T SM W/ WD		
	Atterberg Limits	
PL=	LL=	PI=
D ₉₀ = 0.3322 D ₅₀ = 0.2019 D ₁₀ = 0.0759	Coefficients D ₈₅ = 0.2944 D ₃₀ = 0.1695 C _U = 2.89	D ₆₀ = 0.2196 D ₁₅ = 0.1367 C _G = 1.72
USCS= SM	Classification AASHTO	=
	<u>Remarks</u>	

Silt

9.9

Clay

(no specification provided)

0.0

Source of Sample: 17MVS-07PU Sample Number: 3

Tested By: JC

Depth: 6.5

Stantec Client: USACE

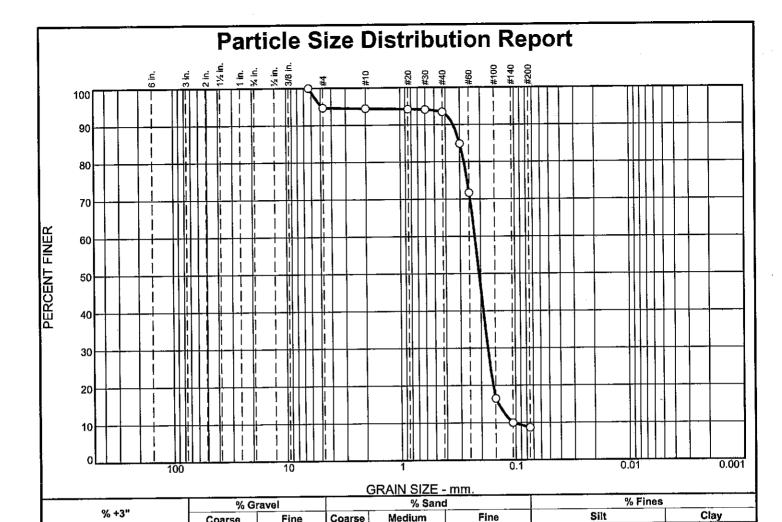
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

Date: 12/7/12

Saint Rose, Louisiana



Medium

Fine

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
1/4	100.0		
#4	94.7		
#10	94.4		
#20	94.2		
#30	94.1		
#40	93.4		
#50	84.9		
#60	71.7		
#100	16.5		
#140	10.0		
#200	8.7		
			1
	ļ.		
			1
			1
	rification provide		<u> </u>

Coarse

0.0

Fine

5.3

Coarse

0.3

1.0	84.7		8.7
T SM W	 -	il Description	
PL=		terberg Limits L=	. Pl=
D ₉₀ = (D ₅₀ = (D ₁₀ = ().3418 D).2065 D).1063 C	Coefficients 85= 0.3006 30= 0.1747 u= 2.11	$D_{60}^{=0.2243}$ $D_{15}^{=0.1413}$ $C_{c}^{=1.28}$
USCS=		lassification AASHT	·O=
		<u>Remarks</u>	

(no specification provided)

0.0

Source of Sample: 17MVS-07PU Sample Number: 4

Depth: 9.0

Date: 12/7/12

Stantec

Client: USACE

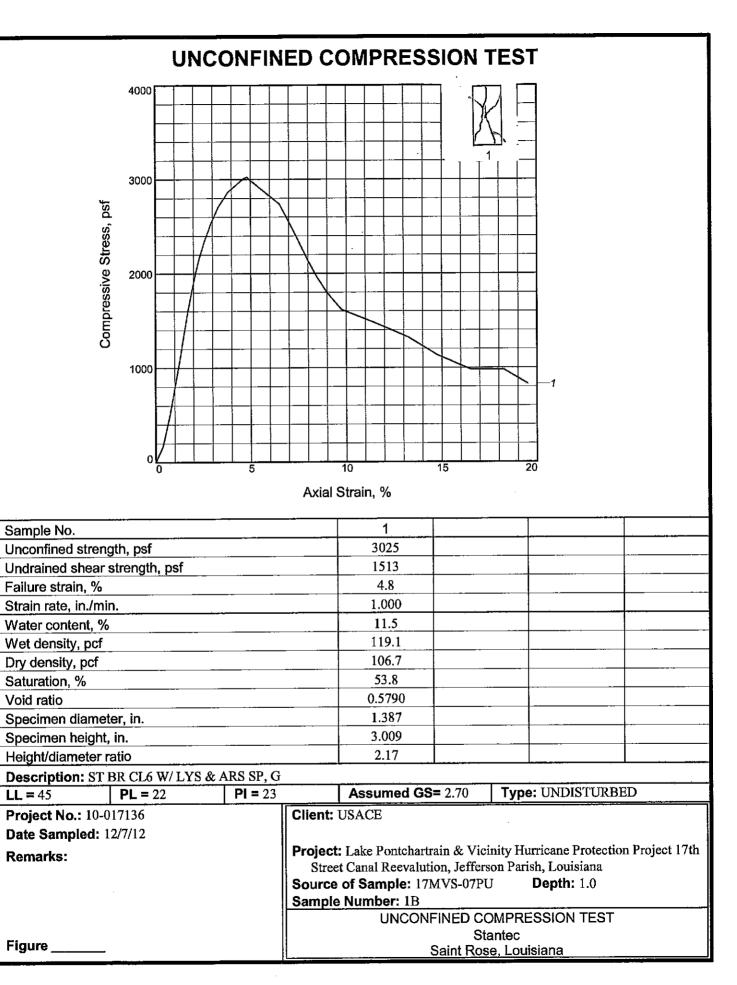
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

Figure

Saint Rose, Louisiana



Tested By: VF Checked By: MJB/JS

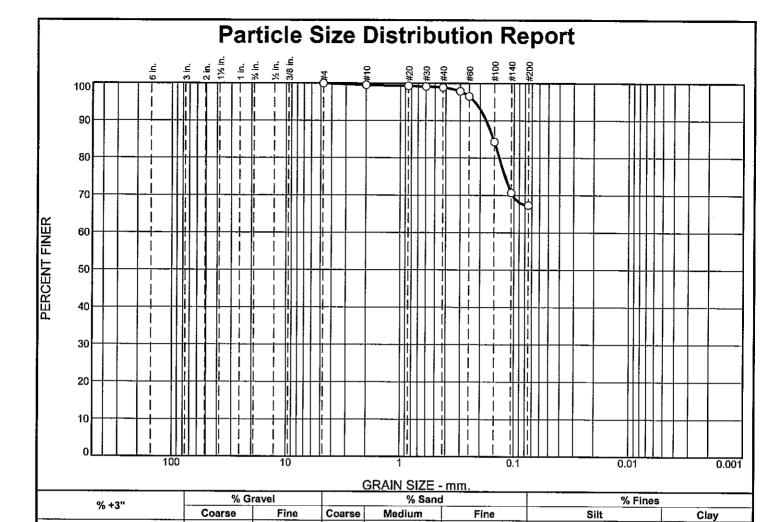
SUMMARY OF LABORATORY TEST RESULTS

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Project Number: 10-017136 Boring: 17MVS-08PU - Final

Current Date: 12/13/2012

Remarks: Stantec	7 6	Оп	<u>-</u> -	3A	28 !	2A	1 _A	Sample Number
s:	3 5 5		8.0	4.0	3.0	20	0.0	Depth
Remarks: Stantec Consulting Services Inc.	TSM W/O	TSM	TSM	M GR & BR CH4 W/LYS & ARS SM	T SM W/ O, ARS CH, SIF, RT	T & BR ML W/ ARS SP, RT, O, WD	BR & T ML W/ ARS CH	Visual Classification
	s s	MS	¥ 242	요	SZ	<u> </u>		uscs
,								E (f)
	32	30	<u>မ</u> မ	43!	2 -	1 12	 3	-
	·		-	79			4	Dry Dens
		·		113			7	Wet Dens
				1 00		•		at tes
				딘			1	Shear Test
	•			0				Angle
野生日				658		•		Cohesion (psf)
e Name:						٠		Unconf.
Check 17MV				ස			Ę	F
Checked By: 17mvs-08pu				17		-	Z	PI.
J be I				8				T I
Checked By: File Name: 17MVS-08FU_be_boring_log_v10_0.				0.61				Torvane (tsf)
9_v10_0.	SV	SV V	ys.		SV			Other



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	99.6	:	
#20	99.3		
#30	99.1		
#40	98.9		
#50	97.8		
#60	96.5		
#100	84.3		
#140	70.7		
#200	67.3		

0.7	31.6		67.3	
T ML V	<u>So</u> i W/ ARS CH, RT	il Description		
PL=	Atte	erberg Limits .≕	P i=	
D ₉₀ = D ₅₀ = D ₁₀ =	0.1772 Dg Dg Dg C	Coefficients 135= 0.1526 130= 130=	D ₆₀ = D ₁₅ = C _c =	
USCS:		l <u>assification</u> AASHT	-O=	
		<u>Remarks</u>		

Date: 12/7/12

(no specification provided)

Source of Sample: 17 MVS-08PU Sample Number: 2A

Depth: 2.0

0.4

Stantec

Client: USACE

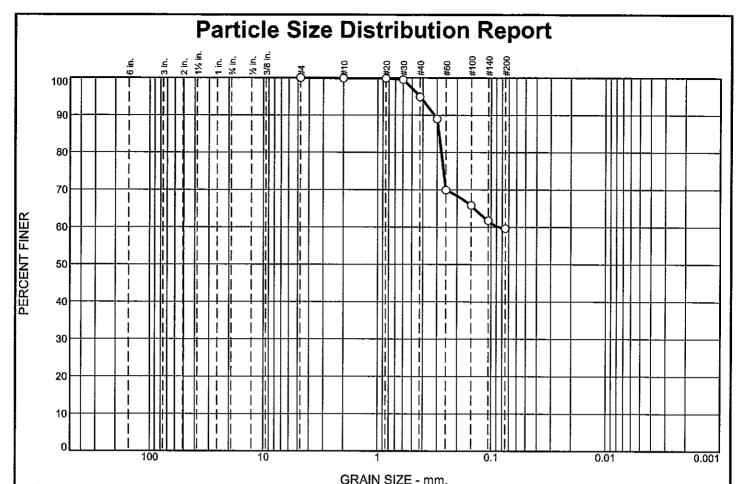
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136 **Figure**

Saint Rose, Louisiana

Tested By: JC



Coarse Fine Coarse Medium Fine Silt Clay	% +3"	% Gr	avel		% Sand		% Fine	s
0.0 0.0 0.1 5.0 35.2 59.7	78 +3	Coarse	Fine	Coarse	Medium		Silt	
270 010 012 2002 2012	0.0	0.0	0.0	0.1	5.0	35.2	59.7	

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	99.9		
#20	99.8		
#30	99.5		
#40	94.9		
#50	89.0		
#60	69,9		
#100	65.8		
#140	61.8		
#200	59.7		

ST GR & T CH2	Soil Description W/ ARS SP, O, RT	
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 0.3168 D ₅₀ = D ₁₀ =	Coefficients D ₈₅ = 0.2875 D ₃₀ = C _u =	D ₆₀ = 0.0859 D ₁₅ = C _c =
USCS= CH2	Classification AASHTO)=
	<u>Remarks</u>	
	<u></u>	

(no specification provided)

Source of Sample: 17MVS-08PU Sample Number: 3B

Depth: 5.0

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

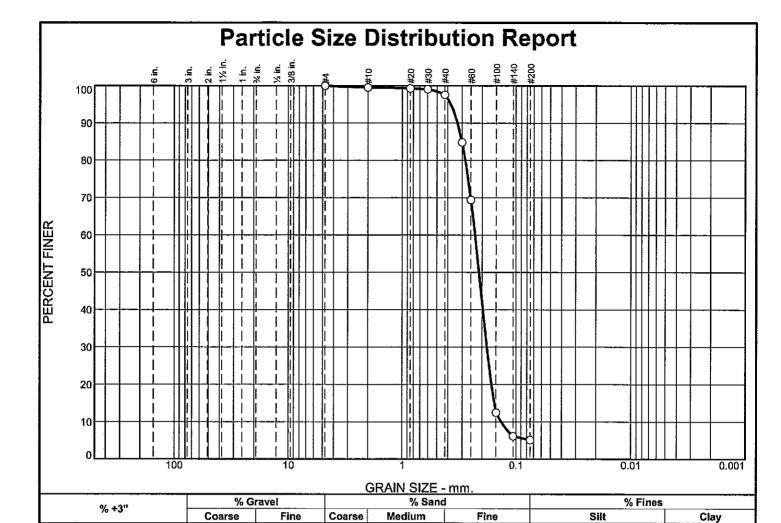
Street Canal Reevalution, Jefferson Parish, Louisiana

Saint Rose, Louisiana

Project No: 10-017136

Figure

Date: 12/7/12



1.9

92.5

SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	99.5		
#20	99.3		
#30	99.1		
#40	97.6		
#50	84.9		
#60	69.4		
#100	12.5		
#140	6.2		
#200	5.1		
*	10 11	<u> </u>	

0.0

0.0

0.5

T SM	Soil Description	
PL=	Atterberg Limits LL=	Pl=
D ₉₀ = 0.3286 D ₅₀ = 0.2124 D ₁₀ = 0.1349	Coefficients D ₈₅ = 0.3007 D ₃₀ = 0.1809 C _u = 1.71	D ₆₀ = 0.2302 D ₁₅ = 0.1555 C _c = 1.05
USCS= SM	<u>Classification</u> AASHT0	O=
	<u>Remarks</u>	

(no specification provided)

0.0

Source of Sample: 17MVS-08PU Sample Number: 4

Depth: 8.0

Date: 12/7/12

Stantec

Saint Rose, Louisiana

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

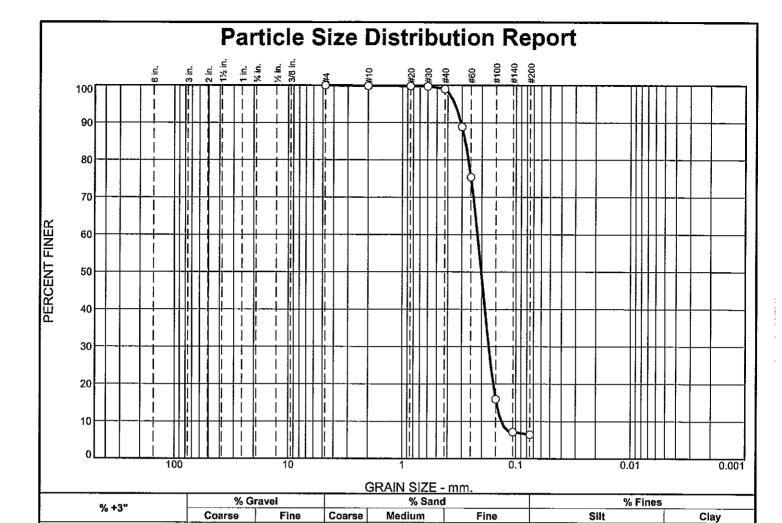
Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

Figure

5.1

Tested By: JC



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	99.9		
#20	99.8		
#30	99.7		
#40	99.0		
#50	88.9		
#60	75.4		
#100	16.0		
#140	7.1		
#200	6.5		
*			

0.0

0.0

0.1

0.9	92.5 6.5				
T SM	So	il Description			
PL=		terberg Limits L=	PI=		
D ₉₀ = (D ₅₀ = (D ₁₀ = (0.3064 D 0.2026 D 0.1337 C	Coefficients 85= 0.2812 30= 0.1732 u= 1.64	D ₆₀ = 0.2187 D ₁₅ = 0.1480 C _c = 1.03		
USCS=	<u>C</u> SM	lassification AASHTC)=		
		Remarks			

(no specification provided)

0.0

Source of Sample: 17MVS-08PU **Sample Number:** 5

Depth: 8.0

Stantec

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

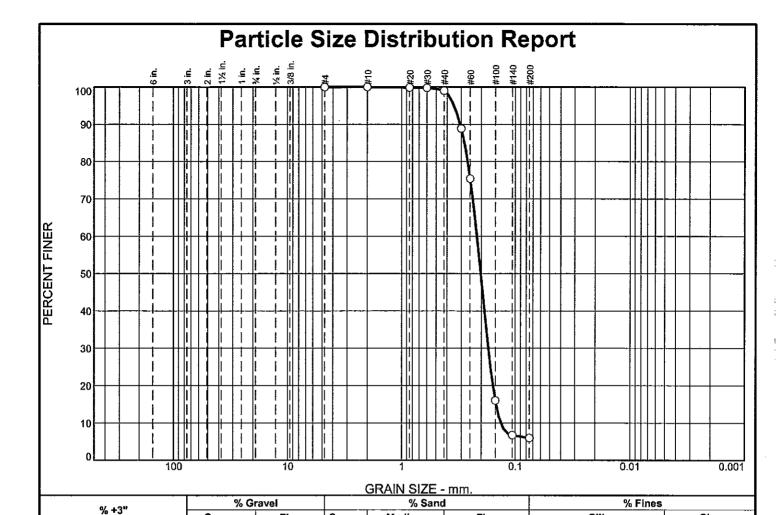
Street Canal Reevalution, Jefferson Parish, Louisiana

Project No: 10-017136

Figure

Date: 12/7/12

Saint Rose, Louisiana



SIEVE	PERCENT	SPEC.*	PASS?
SIZE	FINER	PERCENT	(X=NO)
#4	100.0		
#10	100.0		
#20	99.9		
#30	99.8		
#40	99.0		
#50	88.9		
#60	75.4		
#100	16.1		
#140	6.8		
#200	6.0		
* (16		

Coarse

0.0

Fine

0.0

Coarse

0.0

Medium

1.0

Fine

93.0

PL=	Atterberg Limits LL=	PI=
D ₉₀ = 0.3066 D ₅₀ = 0.2023 D ₁₀ = 0.1339	Coefficients D ₈₅ = 0.2812 D ₃₀ = 0.1730 C _U = 1.63	D ₆₀ = 0.2185 D ₁₅ = 0.1478 C _C = 1.02
USCS= SM	Classification AASHTO=	:
	<u>Remarks</u>	

Silt

6.0

(no specification provided)

0.0

Source of Sample: 17MVS-08PU Sample Number: 6

Depth: 13.0

Date: 12/7/12

Clay

Stantec

Client: USACE

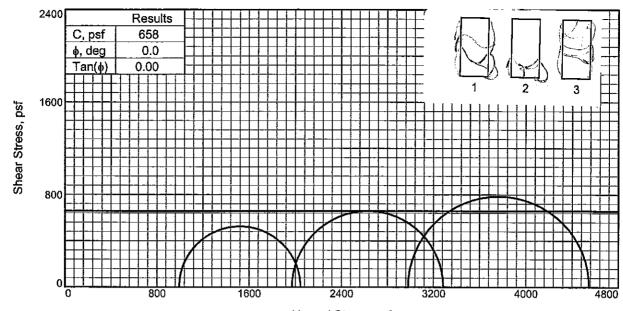
Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th

Street Canal Reevalution, Jefferson Parish, Louisiana

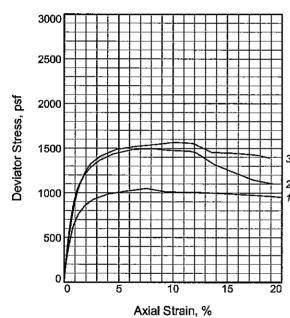
Saint Rose, Louisiana

Project No: 10-017136

Figure



Normal Stress, psf



	Sai	mple No.	1	2	3	
		Water Content, % Dry Density, pcf	42.8 79.0	42.9 78.0	43.2 77.7	
	Initial	Saturation, %	100,4	98.6	98.6	
	Ξ	Void Ratio	1.1664	1.1917	1.2018	
		Diameter, in.	1.391	1.392	1.395	
		Height, in.	3.005	3.008	3.006	
		Water Content, %	42.8	42.9	43.2	
3	¥	Dry Density, pcf	79.0	78.0	77.7	
٦	At Test	Saturation, %	100.4	98.6	98.6	
2	4۲.	Void Ratio	1.1664	1.1917	1.2018	
1	_	Diameter, in.	1.391	1.392	1.395	
		Height, in.	3.005	3.008	3.006	
	Str	ain rate, in./min.	1.000	1.000	1.000	
	Bad	ck Pressure, psi	0.00	0.00	0.00	
	Cel	l Pressure, psi	6.91	13.69	20.70	
	Fai	l. Stress, psf	1050	1316	1567	
	S	Strain, %	7.6	13.8	10.1	
	Ult.	Stress, psf	992	1316	1453	
	S	Strain, %	14.6	13.8	13.6	
H	σ_1	Failure, psf	2045	3287	4547	
	σ_3	Failure, psf	995	1971	2981	

Type of Test:

Unconsolidated Undrained
Sample Type: UNDISTURBED

Description: M GR & BR CH4 W/ LYS & ARS

SM

LL= 83

PL= 17

Pi= 66

Assumed Specific Gravity= 2.74

Remarks:

Client: USACE

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project

17th Street Canal Reevalution, Jefferson Parish, Louisiana

Source of Sample: 17MVS-08PU

Depth: 4.0

Sample Number: 3A

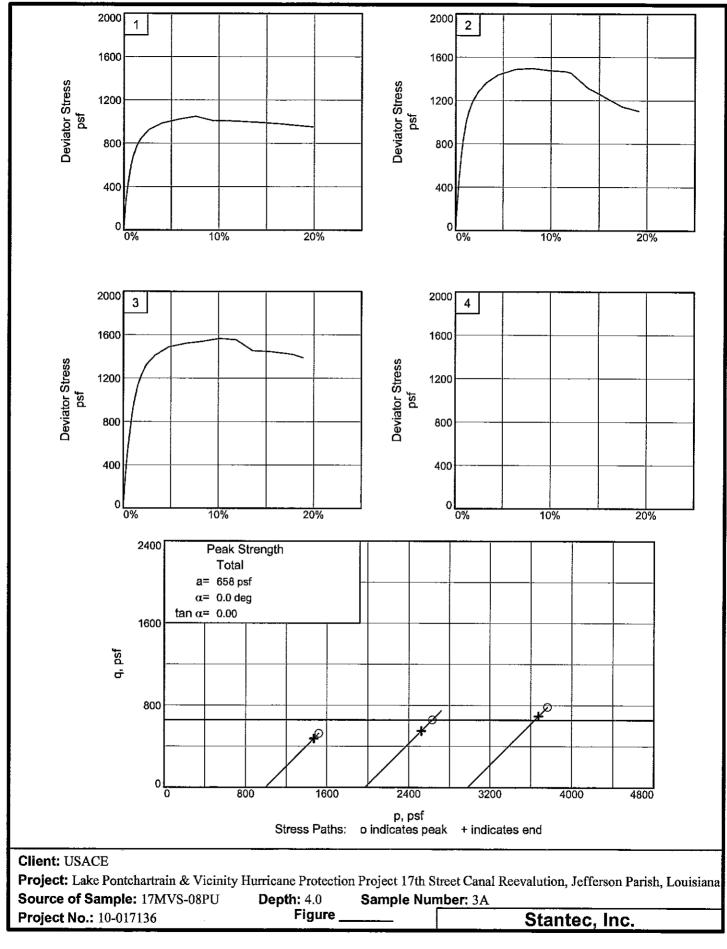
Proj. No.: 10-017136

Date Sampled: 12/7/12

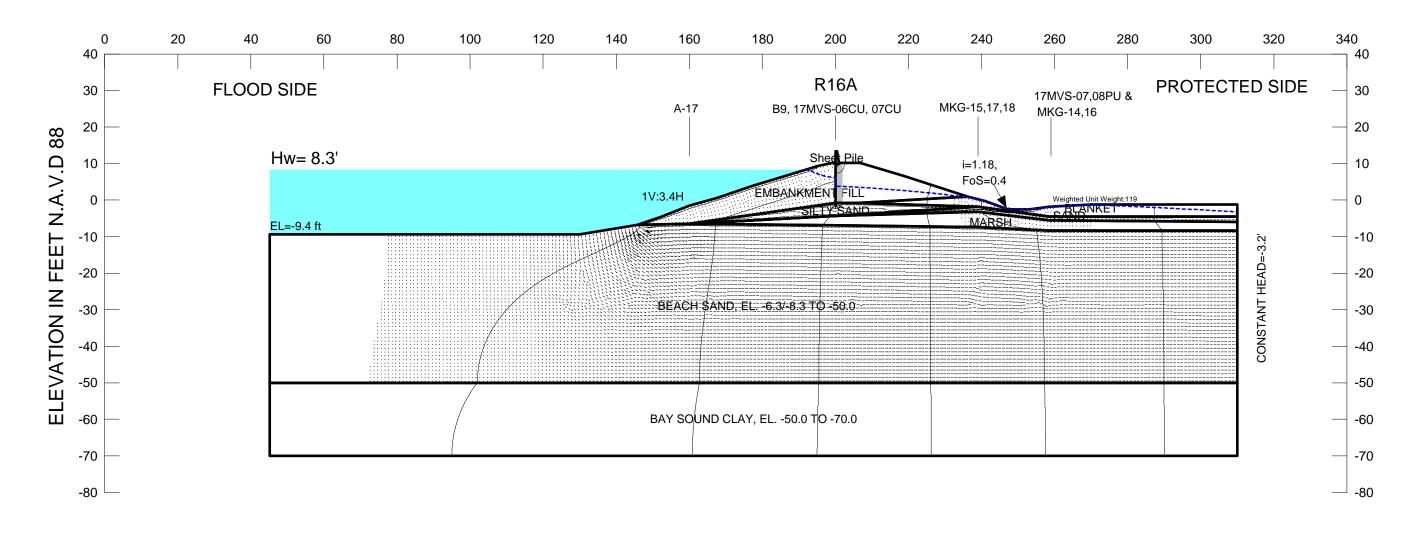
TRIAXIAL SHEAR TEST REPORT Stantec

Saint Rose, Louisiana

Figure



Appendix B: Seepage Analysis



Name: EMBANKMENT FILL Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: BEACH SAND, EL. -6.3/-8.3 TO -50.0 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1 Name: BAY SOUND CLAY, EL. -50.0 TO -70.0 Model: Saturated Only K-Sat: 2.62e-007 ft/sec K-Ratio: 1

Name: Sheet Pile Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1 Name: MARSH Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1 Name: BLANKET Model: Saturated Only K-Sat: 1.64e-005 ft/sec K-Ratio: 1 Name: SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1 Name: SILTY SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1

GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING PLATES.



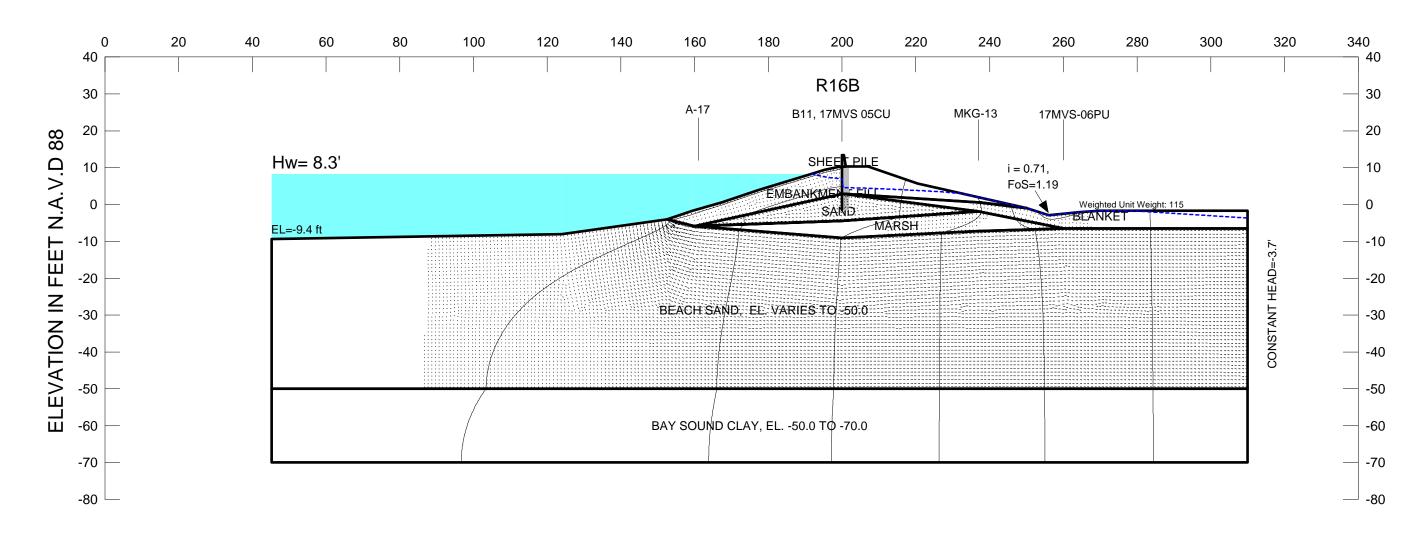


US Army Corps of Engineers®

US Army Corps of Engineers® Saint Louis District New Orleans District

LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

17th STREET OUTFALL CANAL, REACH 16A, CASE: Seepage Analysis STA. 655+00 to 658+00 ORLEANS PARISH, LOUISIANA



Name: EMBANKMENT FILL Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: BEACH SAND, EL. VARIES TO -50.0 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1 Name: BAY SOUND CLAY, EL. -50.0 TO -70.0 Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: SHEET PILE Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1 Name: BLANKET Model: Saturated Only K-Sat: 1.64e-005 ft/sec K-Ratio: 1 Name: MARSH Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1 Name: SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1

GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORING. SEE BORING PLATES.

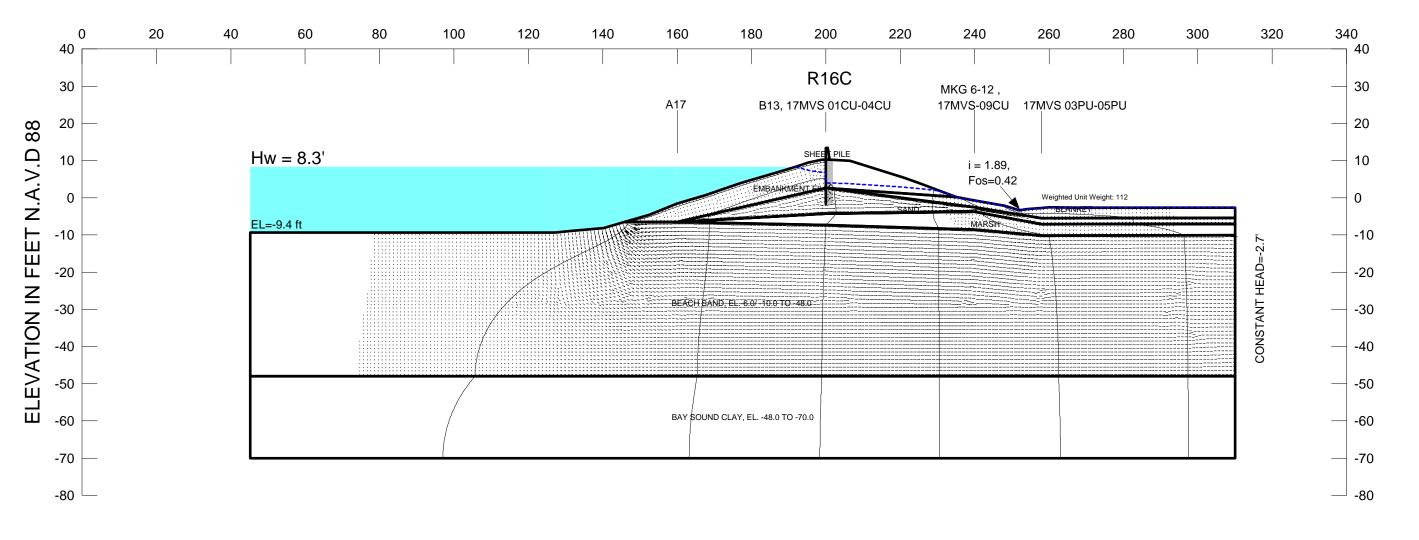




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LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

17th STREET OUTFALL CANAL, REACH 16B, CASE: Seepage Analysis STA. 652+00 TO 655+00 ORLEANS PARISH, LOUISIANA



Name: EMBANKMENT FILL Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: MARSH Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1

Name: BEACH SAND, EL.-6.0/ -10.0 TO -48.0 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1 Name: BAY SOUND CLAY, EL. -48.0 TO -70.0 Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: SHEET PILE Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1 Name: SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1 Name: BLANKET Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1

GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING PLATES.

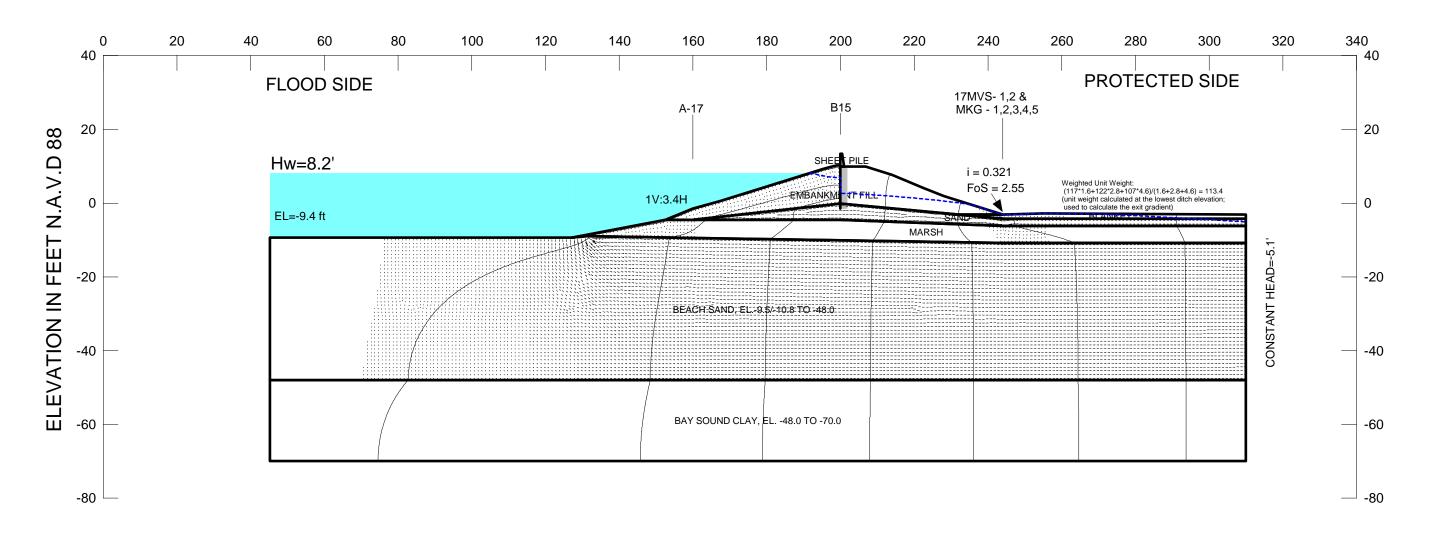




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LAKE PONTCHARTRAIN, LA. AND VICINITY **HURRICANE PROTECTION PROJECT**

17th STREET OUTFALL CANAL, REACH 16C CASE: Seepage Analysis STA. 646+41 TO 652+00 ORLEANS PARISH, LOUISIANA



Name: EMBANKMENT FILL Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: MARSH Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1

Name: BEACH SAND, EL.-9.5/-10.8 TO -48.0 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1
Name: BAY SOUND CLAY, EL. -48.0 TO -70.0 Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: SHEET PILE Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1
Name: SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1
Name: BLANKET Model: Saturated Only K-Sat: 1.64e-005 ft/sec K-Ratio: 1

GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING PLATES.

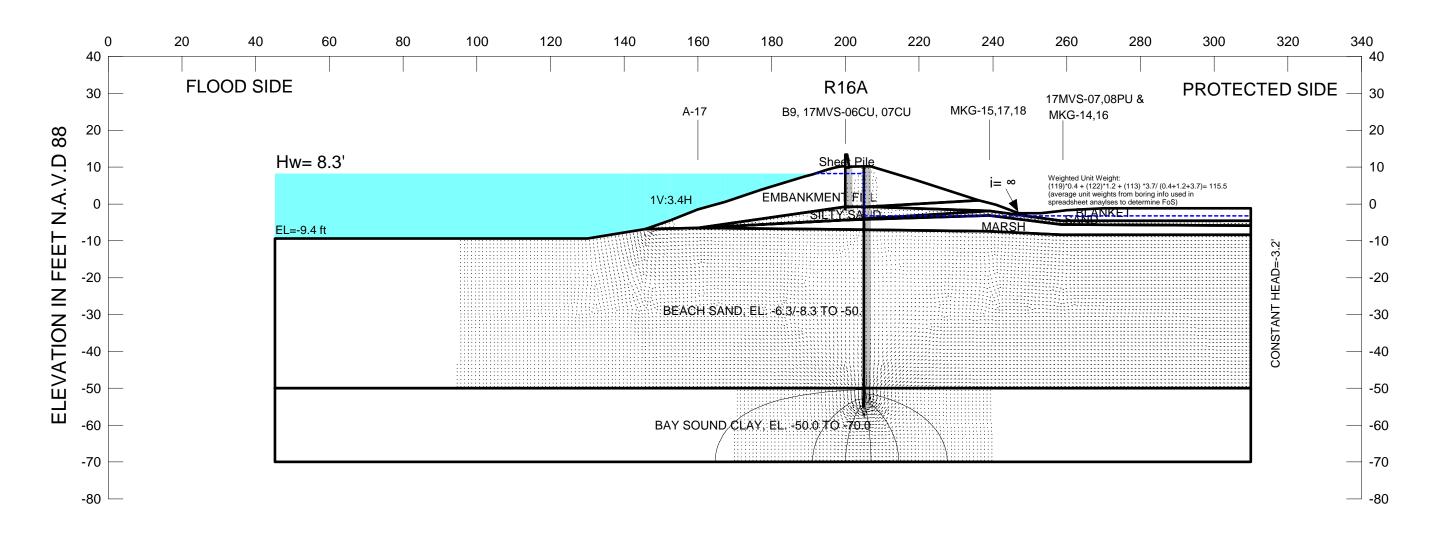




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Saint Louis District
New Orleans District

LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

17th STREET OUTFALL CANAL, REACH 16D, CASE: Seepage Analysis STA. 641+85 TO 646+41 ORLEANS PARISH, LOUISIANA



Name: EMBANKMENT FILL Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: BEACH SAND, EL. -6.3/-8.3 TO -50.0 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1
Name: BAY SOUND CLAY, EL. -50.0 TO -70.0 Model: Saturated Only K-Sat: 2.62e-007 ft/sec K-Ratio: 1

Name: Sheet Pile Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1
Name: MARSH Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1
Name: BLANKET Model: Saturated Only K-Sat: 1.64e-005 ft/sec K-Ratio: 1
Name: SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1
Name: SILTY SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1

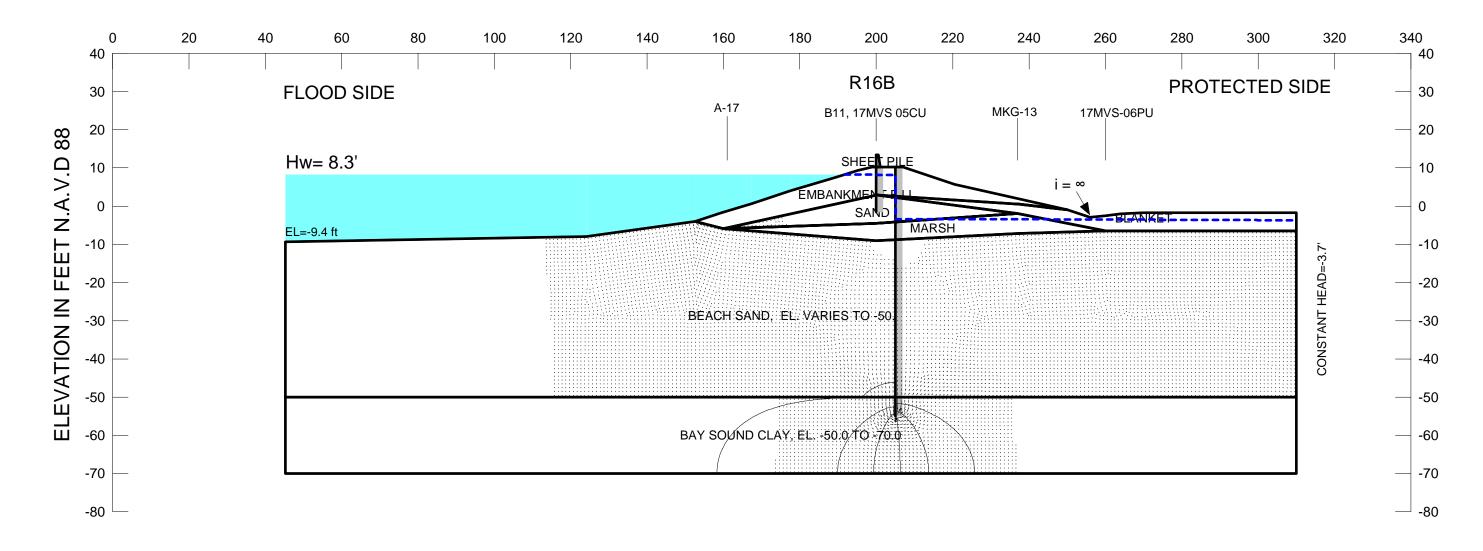
GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING PLATES.



LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

17th STREET OUTFALL CANAL, REACH 16A, CASE: Seepage Analysis with Sheetpile STA. 655+00 to 658+00 ORLEANS PARISH, LOUISIANA



Name: EMBANKMENT FILL Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: BEACH SAND, EL. VARIES TO -50.0 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1 Name: BAY SOUND CLAY, EL. -50.0 TO -70.0 Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: SHEET PILE Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1 Name: BLANKET Model: Saturated Only K-Sat: 1.64e-005 ft/sec K-Ratio: 1 Name: MARSH Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1 Name: SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1

GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS. SEE BORING PLATES.

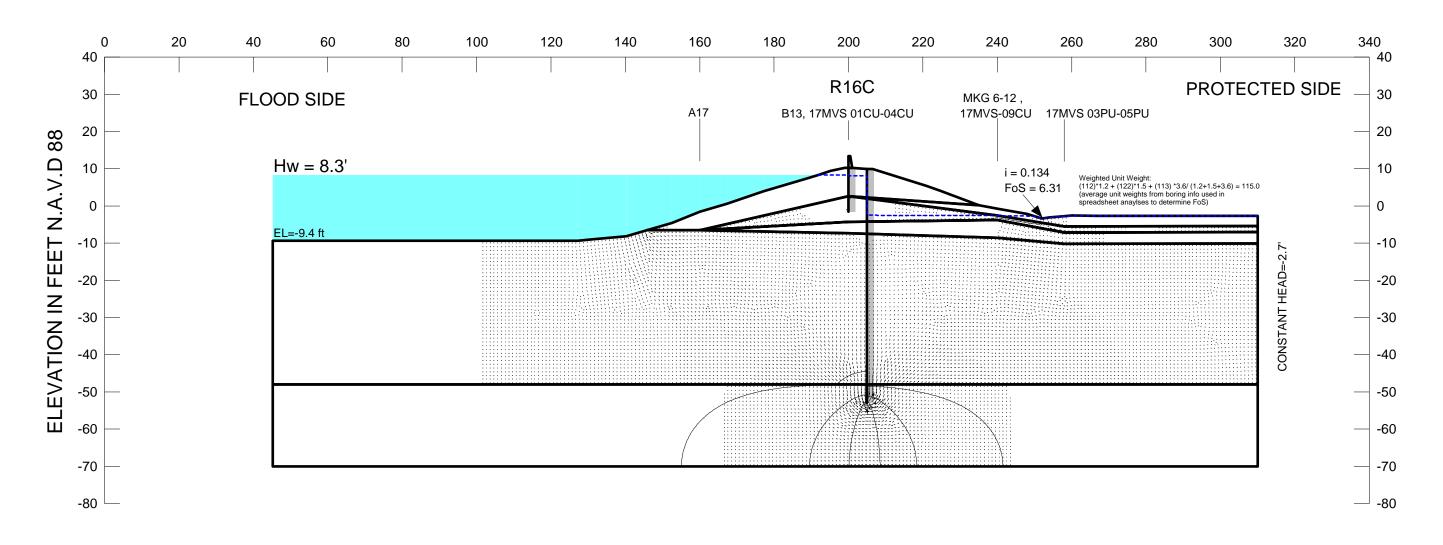




LAKE PONTCHARTRAIN, LA. AND VICINITY

HURRICANE PROTECTION PROJECT

17th STREET OUTFALL CANAL, REACH 16B, CASE: Seepage Analysis with Sheetpile STA. 652+00 to 655+00 ORLEANS PARISH, LOUISIANA



Name: EMBANKMENT FILL Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: MARSH Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1

Name: BEACH SAND, EL.-6.0/ -10.0 TO -48.0 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1
Name: BAY SOUND CLAY, EL. -48.0 TO -70.0 Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1

Name: SHEET PILE Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1
Name: SAND Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1
Name: BLANKET Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1

GENERAL NOTES

CLASSIFICATION STRATIFICATION
SHEAR STRENGTHS AND UNIT WEIGHTS OF
THE SOIL WERE BASED ON THE RESULTS OF
UNDISTURBED BORINGS. SEE BORING PLATES.





LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

17th STREET OUTFALL CANAL, REACH 16C, CASE: Seepage Analysis with Sheetpile STA. 646+41 to 652+00 ORLEANS PARISH, LOUISIANA

Seepage Analysis Reach 16A Station 655+00 to 658+00

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File Information

Created By: Liljegren, James Revision Number: 464

Last Edited By: Goltz, Amanda MVS

Date: 3/11/2013 Time: 10:26:50 AM

File Name: R16A_new CL borings.gsz

Directory: Z:\

Last Solved Date: 3/11/2013 Last Solved Time: 10:27:12 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec

Unit Weight of Water: 62.4 pcf

View: 2D

Analysis Settings

Seepage Analysis

Kind: SEEP/W

Method: Steady-State

Settings

Include Air Flow: No

Control

Apply Runoff: No

Convergence

Convergence Type: Head Vector Norm Maximum Number of Iterations: 500

Tolerance: 0.001

Maximum Change in K: 0.1 Rate of Change in K: 1.02 Minimum Change in K: 1e-005 Equation Solver: Parallel Direct

Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec Duration: 0 sec Ending Time: 0 sec

Materials

EMBANKMENT FILL

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BEACH SAND, EL. -6.3/-8.3 TO -50.0

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BAY SOUND CLAY, EL. -50.0 TO -70.0

Model: Saturated Only

Hydraulic

K-Sat: 2.62e-007 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Sheet Pile

Model: Saturated Only

Hydraulic

K-Sat: 1e-010 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

MARSH

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BLANKET

Model: Saturated Only

Hydraulic

K-Sat: 1.64e-005 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SILTY SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Boundary Conditions

Drainage

Review: true

Type: Total Flux (Q) 0

Curb

Type: Head (H) -3.2

Max Operating Level (8.3 ft) Type: Head (H) 8.3

Regions

	Material	Points	Area (ft²)
Region 1	Sheet Pile	2,6,7,29,8,14	2.6250625
	BAY SOUND		
Region 2	CLAY, EL50.0	27,28,15,10,9	5296
	TO -70.0		
Region 3	BLANKET	38,35,41,23,5,22,30,42,31,32,26,49,47,43	245.10608
Region 4	MARSH	52,34,44,46,25,40,48,45,51	391.22
Region 5	SILTY SAND	52,33,38,43,34	141.46146
Region 6	SAND	34,43,47,49,25,46,44	109.8675
Region 7	EMBANKMENT	36,19,18,17,16,20,24,1,13,21,12,2,14,8,29,3,4,35,3	603.33579
Region 7	FILL	8,33,52	003.33379
	BEACH SAND,		
Region 8	EL6.3/-8.3 TO	9,11,37,50,36,52,51,45,48,40,27	11089.463
	-50.0		

Lines

	Start Point	End Point	Left Side Material	Hydraulic Boundary
Line 1	2	6		
Line 2	6	7		
Line 3	8	14	Sheet Pile	
Line 4	14	2		
Line 5	27	28		Curb
Line 6	28	15		
Line 7	15	10		
Line 8	10	9		Max Operating Level (8.3 ft)
Line 9	7	29		
Line 10	29	8		
Line 11	38	35		
Line 12	14	39	Sheet Pile	
Line 13	46	25		
Line 14	44	46		

Line 15				
Line 17 38 43	Line 15	43	47	
Line 18 35 41 Drainage Line 19 41 23 Drainage Line 20 23 5 Drainage Line 21 5 22 Drainage Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 30 25 40 Curb Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 38 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 Line 48 Line 49 21 12	Line 16	47	49	
Line 19	Line 17	38	43	
Line 20 23 5 Drainage Line 21 5 22 Drainage Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 49 21 12	Line 18	35	41	Drainage
Line 21 5 22 Drainage Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Curb Line 30 25 40 Curb Line 31 40 48 Curb Line 32 48 45 Curb Line 34 51 52 Curb Line 35 27 9 Curb Line 36 52 33 Curb Line 37 33 38 Curb 33 Curb Line 39 49 25 Curb Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 48 13 21 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 48 13 21 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 48 13 21 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 19	41	23	Drainage
Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Curb Line 30 25 40 Curb Line 31 40 48 Curb Line 32 48 45 Curb Line 33 45 51 Curb Line 34 51 52 Curb Line 35 27 9 Curb Line 37 33 38 Cure 33 Curb Line 39 49 25 Curb Line 39 49 25 Curb Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 49 21 12	Line 20	23	5	Drainage
Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 21	5	22	Drainage
Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Curb Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 Line 48 Line 49 21 12	Line 22	22	30	Drainage
Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Curb Line 29 34 44 Curb Line 30 25 40 Curb Line 31 40 48 Curb Line 32 48 45 Curb Line 33 45 51 Curb Line 34 51 52 Curb Line 35 27 9 Curb Line 36 52 33 Curb Line 37 33 38 Curb 38 43 34 Curb 38 Curb 38 Curb 38 Curb 38 Curb 38 Curb 39 Cur	Line 23	30	42	Drainage
Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 24	42	31	Drainage
Line 27	Line 25	31	32	Drainage
Line 28 52 34 44	Line 26	32	26	Drainage
Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 27	26	49	Curb
Line 30	Line 28	52	34	
Line 31	Line 29	34	44	
Line 32	Line 30	25	40	Curb
Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 31	40	48	
Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Max Operating Level (8.3 ft) Line 49 21 12 Max Operating Level (8.3 ft)	Line 32	48	45	
Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 33	45	51	
Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 34	51	52	
Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19	Line 35	27	9	
Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 36	52	33	
Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 37	33	38	
Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 38	43	34	
Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 39	49	25	
Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 40	36	19	Max Operating Level (8.3 ft)
Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 41	19	18	Max Operating Level (8.3 ft)
Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 42	18	17	Max Operating Level (8.3 ft)
Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 43	17	16	Max Operating Level (8.3 ft)
Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 44	16	20	Max Operating Level (8.3 ft)
Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 45	20	24	Max Operating Level (8.3 ft)
Line 48 13 21 Line 49 21 12	Line 46	24	1	Max Operating Level (8.3 ft)
Line 49 21 12	Line 47	1	13	Max Operating Level (8.3 ft)
	Line 48	13	21	
Line 50 12 2	Line 49	21	12	
	Line 50	12	2	

Line 51	29	3	
Line 52	3	4	Drainage
Line 53	35	4	Drainage
Line 54	36	52	
Line 55	9	11	Max Operating Level (8.3 ft)
Line 56	11	37	Max Operating Level (8.3 ft)
Line 57	37	50	Max Operating Level (8.3 ft)
Line 58	50	36	Max Operating Level (8.3 ft)
Line 59	40	27	Curb

Points

	X (ft)	Y (ft)
Point 1	192.2	8.4
Point 2	200	10.2
Point 3	206.8	10.216
Point 4	219	6.558
Point 5	247	-2.455
Point 6	200	13.4
Point 7	200.5	13.4
Point 8	201	9.9
Point 9	45.2	-50
Point 10	45.2	-70
Point 11	45.2	-9.4
Point 12	199	10.2
Point 13	195.2	9.4
Point 14	200	9.9
Point 15	177.4	-70
Point 16	177.43556	4
Point 17	167.4	0.6
Point 18	160	-1.5
Point 19	152.5	-4.5
Point 20	189.18	7.5
Point 21	198.05	10
Point 22	249	-2.521
Point 23	241	-0.259

Point 24	190.85778	8
Point 25	310	-5.93
Point 26	310	-1.203
Point 27	310	-50
Point 28	310	-70
Point 29	200.96775	10.126
Point 30	253	-2.518
Point 31	260	-1.683
Point 32	270	-1.203
Point 33	200	-0.8
Point 34	200	-4.3
Point 35	236.1	1
Point 36	145.73143	-6.8
Point 37	130	-9.33585
Point 38	206.14634	-0.8
Point 39	200	-1.5
Point 40	310	-8.39
Point 41	239	0.255
Point 42	258.5	-1.86
Point 43	239	-1.845
Point 44	239	-3.145
Point 45	239	-7.445
Point 46	258.5	-5.59
Point 47	258.5	-4.56
Point 48	258.5	-8.39
Point 49	310	-4.56
Point 50	140	-7.74001
Point 51	200	-6.9
Point 52	160	-6.5

Seepage Analysis Reach 16B Station 652+00 TO 655+00

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File Information

Created By: Liljegren, James Revision Number: 451

Last Edited By: Goltz, Amanda MVS

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Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf

View: 2D

Analysis Settings

Seepage Analysis

Kind: SEEP/W

Method: Steady-State

Settings

Include Air Flow: No

Control

Apply Runoff: No

Convergence

Convergence Type: Head Vector Norm Maximum Number of Iterations: 500

Tolerance: 0.001

Maximum Change in K: 0.1 Rate of Change in K: 1.02 Minimum Change in K: 1e-005 Equation Solver: Parallel Direct

Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec Duration: 0 sec Ending Time: 0 sec

Materials

EMBANKMENT FILL

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BEACH SAND, EL. VARIES TO -50.0

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BAY SOUND CLAY, EL. -50.0 TO -70.0

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SHEET PILE

Model: Saturated Only

Hydraulic

K-Sat: 1e-010 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BLANKET

Model: Saturated Only

Hydraulic

K-Sat: 1.64e-005 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

MARSH

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Boundary Conditions

Drainage

Review: true

Type: Total Flux (Q) 0

Curb

Type: Head (H) -3.7

Max Operating Level (8.3 ft)

Type: Head (H) 8.3

Regions

	Material	Points	Area (ft²)
Region 1	SHEET PILE	1,5,6,7	2.376
Region 2	BAY SOUND	11,9,8,10	5296

	CLAY, EL50.0 TO -70.0		
Region 3	BLANKET	27,4,37,21,38,23,24,30,25,26,22,20,32,31	355.37951
Region 4	EMBANKMENT FILL	23,3,2,7,1,13,14,18,15,16,36,17,35,39,27,4,37,2 1,38	449.1938
Region 5	SAND	35,34,31,27,39	284.9
Region 6	MARSH	35,34,31,32,33,28	336.1
Region 7	BEACH SAND, EL. VARIES TO -50.0	10,12,19,17,35,28,33,32,20,8	11261.645

Lines

	Start Point	End Point	Hydraulic Boundary	Right Side Material	Left Side Material
Line 1	1	5			
Line 2	5	6			
Line 3	6	7	Drainage		
Line 4	9	8	Curb		
Line 5	10	11	Max Operating Level (8.3 ft)		
Line 6	9	11			
Line 7	4	23			
Line 8	1	7		SHEET PILE	SHEET PILE
Line 9	1	29			SHEET PILE
Line 10	10	8			
Line 11	27	4			
Line 12	23	24	Drainage		
Line 13	24	30	Drainage		
Line 14	30	25	Drainage		
Line 15	25	26	Drainage		
Line 16	26	22	Drainage		
Line 17	22	20	Curb		
Line 18	20	32			
Line 19	31	27			
Line 20	31	32			
Line 21	28	33			
Line 22	32	33			

Line 23	4	37		
Line 24	37	21		
Line 25	21	38		
Line 26	38	23		
Line 27	23	3	Drainage	
Line 28	3	2	Drainage	
Line 29	2	7		
Line 30	1	13		
Line 31	13	14	Max Operating Level (8.3 ft)	
Line 32	14	18	Max Operating Level (8.3 ft)	
Line 33	18	15	Max Operating Level (8.3 ft)	
Line 34	15	16	Max Operating Level (8.3 ft)	
Line 35	16	36	Max Operating Level (8.3 ft)	
Line 36	36	17	Max Operating Level (8.3 ft)	
Line 37	17	35		
Line 38	35	39		
Line 39	39	27		
Line 40	35	34		
Line 41	34	31		
Line 42	28	35		
Line 43	10	12	Max Operating Level (8.3 ft)	
Line 44	12	19	Max Operating Level (8.3 ft)	
Line 45	19	17	Max Operating Level (8.3 ft)	
Line 46	8	20	Curb	
				<u> </u>

Points

	X (ft)	Y (ft)
--	--------	--------

Point 1	200	10.2
Point 2	207	10.296
Point 3	220.5	5.682
Point 4	237	0.581
Point 5	200	13.4
Point 6	200.5	13.4
Point 7	201	10.296
Point 8	310	-50
Point 9	310	-70
Point 10	45.2	-50
Point 11	45.2	-70
Point 12	45.2	-9.4
Point 13	199	10.2
Point 14	195.2	9.4
Point 15	177.43556	4
Point 16	167.4	0.6
Point 17	152.5	-4
Point 18	189.18	7.5
Point 19	124	-8
Point 20	310	-6.5
Point 21	244	-0.255
Point 22	310	-1.683
Point 23	250	-0.976
Point 24	256	-2.92
Point 25	264	-2.048
Point 26	270	-1.683
Point 27	200	2.9
Point 28	200	-9.1
Point 29	200	-1.5
Point 30	260	-2.5
Point 31	237	-1.919
Point 32	260	-6.5
Point 33	237	-7.219
Point 34	200	-4.5
Point 35	160	-5.9
Point 36	159.5	-1.7

Point 37	237.4	0.53323
Point 38	244.5	-0.31508
Point 39	199.3	2.746

Seepage Analysis Reach 16C Station 646+41 to 652+00

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File Information

Created By: Liljegren, James Revision Number: 462

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File Name: R16C_new CL borings.gsz

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Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf

Vis. 2D

View: 2D

Analysis Settings

Seepage Analysis

Kind: SEEP/W

Method: Steady-State

Settings

Include Air Flow: No

Control

Apply Runoff: No

Convergence

Convergence Type: Head Vector Norm Maximum Number of Iterations: 500

Tolerance: 0.001

Maximum Change in K: 0.1 Rate of Change in K: 1.02 Minimum Change in K: 1e-005 Equation Solver: Parallel Direct

Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec Duration: 0 sec Ending Time: 0 sec

Materials

EMBANKMENT FILL

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

MARSH

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BEACH SAND, EL.-6.0/ -10.0 TO -48.0

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BAY SOUND CLAY, EL. -48.0 TO -70.0

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SHEET PILE Model: Saturated Only

Hydraulic

K-Sat: 1e-010 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BLANKET

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Boundary Conditions

Drainage

Review: true

Type: Total Flux (Q) 0

Curb

Type: Head (H) -2.7

Safe Operating Level (8.3 ft)

Type: Head (H) 8.3

Flux Sections

Flux Section 1

Coordinates

Coordinate: (252, -28) ft Coordinate: (252, 0) ft

Regions

	Material	Points	Area (ft²)
Region 1	SHEET PILE	5,10,11,12	2.4
Region 2	BEACH SAND, EL 6.0/ -10.0 TO -48.0	20,37,46,27,13,41,15,1,25,2,40,39	10408.286
Region 3	BAY SOUND CLAY, EL48.0 TO -70.0	13,14,42,41	5825.6
Region 4	EMBANKMENT FILL	21,29,7,6,12,5,16,17,4,26,3,22,23,24,40,39,9	462.37572
Region 5	BLANKET	9,21,34,30,31,28,43,32,33,8,19,44,35	220.125
Region 6	SAND	39,9,35,44,19,38,49,45,36,47	415.57006
Region 7	MARSH	39,47,36,45,49,38,27,46,37,20	439.29994

Lines

	Start	End	Undraulia Daundami	Right Side	Left Side
	Point	Point	Hydraulic Boundary	Material	Material
Line 1	5	10			
Line 2	10	11			
Line 3	11	12	Drainage		
Line 4	5	12		SHEET PILE	
Line 5	39	9			
Line 6	27	13	Curb		
Line 7	41	15	Safe Operating Level (8.3 ft)		
Line 8	1	25	Safe Operating Level (8.3 ft)		
Line 9	25	2	Safe Operating Level (8.3 ft)		
Line 10	2	40	Safe Operating Level (8.3 ft)		
Line 11	40	39			
Line 12	13	14	Curb		
Line 13	14	42			
Line 14	42	41	Safe Operating Level (8.3 ft)		
Line 15	41	13			

Line 16	1	15	Safe Operating Level (8.3 ft)	
Line 17	21	9		
Line 18	21	29	Drainage	
Line 19	29	7	Drainage	
Line 20	7	6	Drainage	
Line 21	5	16	Safe Operating Level (8.3 ft)	
Line 22	17	4	Safe Operating Level (8.3 ft)	
Line 23	4	26	Safe Operating Level (8.3 ft)	
Line 24	26	3	Safe Operating Level (8.3 ft)	
Line 25	3	22	Safe Operating Level (8.3 ft)	
Line 26	22	23	Safe Operating Level (8.3 ft)	
Line 27	23	24	Safe Operating Level (8.3 ft)	
Line 28	24	40	Safe Operating Level (8.3 ft)	
Line 29	17	16	Safe Operating Level (8.3 ft)	
Line 30	12	6	Drainage	
Line 31	21	34	Drainage	
Line 32	34	30	Drainage	
Line 33	30	31	Drainage	
Line 34	31	28	Drainage	
Line 35	32	33	Drainage	
Line 36	33	8	Drainage	
Line 37	8	19	Curb	
Line 38	28	43	Drainage	
Line 39	43	32	Drainage	
Line 40	46	37		
Line 41	36	45		
Line 42	35	44		

				T	1
Line 43	9	35			
Line 44	37	20			
Line 45	27	46			
Line 46	44	19			
Line 47	39	47			
Line 48	19	38			
Line 49	9	48			SHEET PILE
Line 50	5	9			SHEET PILE
Line 51	45	49			
Line 52	49	38			
Line 53	38	27	Curb		
Line 54	47	36			
Line 55	20	39			

Points

	X (ft)	Y (ft)
Point 1	127.2	-9.4
Point 2	140.2	-8.1
Point 3	177.1	3.9
Point 4	192.2	8.4
Point 5	200	10.2
Point 6	206.5	9.9
Point 7	221	5.39
Point 8	310	-2.659
Point 9	200	2.6
Point 10	200	13.4
Point 11	200.5	13.4
Point 12	201	10.2
Point 13	310	-48
Point 14	310	-70
Point 15	45.2	-9.4
Point 16	199	10.2
Point 17	195.2	9.4
Point 18	310	-11
Point 19	310	-5.359

Point 20	200	-7.3
Point 21	235	0.192
Point 22	167.4	0.6
Point 23	160	-1.5
Point 24	152.5	-4.6
Point 25	131.2	-9
Point 26	189.18	7.5
Point 27	310	-10.029
Point 28	254	-3.1
Point 29	224.78	4
Point 30	248	-2.169
Point 31	252	-3.378
Point 32	260	-2.595
Point 33	267	-2.659
Point 34	240	-0.72
Point 35	240	-2.52
Point 36	240	-3.82
Point 37	240	-8.52
Point 38	310	-7.029
Point 39	160	-6.5
Point 40	145.8	-6.5
Point 41	45.2	-48
Point 42	45.2	-70
Point 43	258	-2.76
Point 44	258	-5.46
Point 45	258	-7.13
Point 46	258	-10.13
Point 47	200	-4.3
Point 48	200	-1.5
Point 49	259	-7.12806

Seepage Analysis Reach 16D Station 641+85 to 646+41

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File Information

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Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf

View: 2D

Analysis Settings

Seepage Analysis

Kind: SEEP/W

Method: Steady-State

Settings

Include Air Flow: No

Control

Apply Runoff: No

Convergence

Convergence Type: Head Vector Norm Maximum Number of Iterations: 500

Tolerance: 0.001

Maximum Change in K: 0.1 Rate of Change in K: 1.02 Minimum Change in K: 1e-005 Equation Solver: Parallel Direct

Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec Duration: 0 sec Ending Time: 0 sec

Materials

EMBANKMENT FILL

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

MARSH

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BEACH SAND, EL.-9.5/-10.8 TO -48.0

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BAY SOUND CLAY, EL. -48.0 TO -70.0

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SHEET PILE

Model: Saturated Only

Hydraulic

K-Sat: 1e-010 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BLANKET

Model: Saturated Only

Hydraulic

K-Sat: 1.64e-005 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Boundary Conditions

Drainage

Review: true

Type: Total Flux (Q) 0

Curb

Type: Head (H) -5.1

Safe Operating Level (8.2 ft)

Type: Head (H) 8.2

Regions

	Material	Points	Area (ft²)
Region 1	SHEET PILE	2,8,9,10,18	2.625
Region 2	BAY SOUND	13,34,11,12	5825.6

	CLAY, EL48.0 TO -70.0		
Region 3	EMBANKMENT FILL	5,22,32,31,4,3,10,18,2,16,27,37,23,24,25,33,30, 36	561.59935
Region 4	BEACH SAND, EL 9.5/-10.8 TO - 48.0	19,44,38,11,12,14,15,1,26,35,21	10073.27
Region 5	MARSH	1,25,33,20,28,45,43,29,38,44,19,21,35,26	823.93009
Region 6	BLANKET	36,40,41,42,6,39,5	87.252
Region 7	SAND	33,30,36,40,41,42,29,43,45,28,20	364.99996

Lines

	Start Point	End Point	Left Side Material	Hydraulic Boundary
Line 1	2	8		
Line 2	8	9		
Line 3	9	10		
Line 4	10	18	SHEET PILE	
Line 5	18	2		
Line 6	21	19		
Line 7	25	33		
Line 8	33	30		
Line 9	30	7	SHEET PILE	
Line 10	18	30	SHEET PILE	
Line 11	13	34		
Line 12	34	11		Curb
Line 13	12	13		Safe Operating Level (8.2 ft)
Line 14	11	12		
Line 15	26	35		
Line 16	35	21		
Line 17	36	30		
Line 18	5	36		
Line 19	5	22		Drainage
Line 20	22	32		Drainage
Line 21	32	31		
Line 22	31	4		Drainage
Line 23	4	3		Drainage

Line 24	3	10	Drainage
Line 25	2	16	Safe Operating Level (8.2 ft)
Line 26	16	27	Safe Operating Level (8.2 ft)
Line 27	27	37	Safe Operating Level (8.2 ft)
Line 28	37	23	Safe Operating Level (8.2 ft)
Line 29	23	24	Safe Operating Level (8.2 ft)
Line 30	24	25	Safe Operating Level (8.2 ft)
Line 31	38	11	Curb
Line 32	12	14	Safe Operating Level (8.2 ft)
Line 33	14	15	Safe Operating Level (8.2 ft)
Line 34	15	1	Safe Operating Level (8.2 ft)
Line 35	1	26	Safe Operating Level (8.2 ft)
Line 36	1	25	Safe Operating Level (8.2 ft)
Line 37	33	20	
Line 38	20	28	
Line 39	29	38	Curb
Line 40	36	40	
Line 41	40	41	
Line 42	41	42	
Line 43	42	6	Curb
Line 44	6	39	Drainage
Line 45	39	5	Drainage
Line 46	42	29	Curb
Line 47	43	29	
Line 48	38	44	
Line 49	44	19	
Line 50	28	45	
Line 51	45	43	

Points

	X (ft)	Y (ft)
Point 1	127.2	-9.4
Point 2	200	10.2
Point 3	206.8	9.9
Point 4	214	7.6

Point 5	244	-3.1
Point 6	310	-3.1
Point 7	200	-1.5
Point 8	200	13.4
Point 9	200.5	13.4
Point 10	201	9.9
Point 11	310	-48
Point 12	45.2	-48
Point 13	45.2	-70
Point 14	45.2	-9.4
Point 15	81.7	-9.4
Point 16	199	10.2
Point 17	195.2	9.4
Point 18	200	9.9
Point 19	244	-10.8
Point 20	200	-4.6
Point 21	200	-10.1
Point 22	228	1.878
Point 23	167.4	0.6
Point 24	160	-1.5
Point 25	152.5	-4.6
Point 26	131.2	-9
Point 27	198.05	10
Point 28	244	-6.2
Point 29	310	-6.2
Point 30	200	-0.1
Point 31	222.8	4
Point 32	223.1	3.87758
Point 33	160	-4.6
Point 34	310	-70
Point 35	160	-9.45727
Point 36	232	-3.08182
Point 37	195.3	9.3
Point 38	310	-10.8
Point 39	255	-2.856
Point 40	244	-4.2

Point 41	255	-4.2
Point 42	310	-4.2
Point 43	255	-6.2
Point 44	255	-10.8
Point 45	244.3	-6.2

Seepage Analysis with Sheetpile Reach 16A Station 655+00 to 658+00

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File Information

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Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec

Unit Weight of Water: 62.4 pcf

View: 2D

Analysis Settings

Seepage Analysis

Kind: SEEP/W

Method: Steady-State

Settings

Include Air Flow: No

Control

Apply Runoff: No

Convergence

Convergence Type: Head Vector Norm Maximum Number of Iterations: 500

Tolerance: 0.001

Maximum Change in K: 0.1 Rate of Change in K: 1.02 Minimum Change in K: 1e-005 Equation Solver: Parallel Direct

Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec Duration: 0 sec Ending Time: 0 sec

Materials

EMBANKMENT FILL

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BEACH SAND, EL. -6.3/-8.3 TO -50.0

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BAY SOUND CLAY, EL. -50.0 TO -70.0

Model: Saturated Only

Hydraulic

K-Sat: 2.62e-007 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Sheet Pile

Model: Saturated Only

Hydraulic

K-Sat: 1e-010 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

MARSH

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BLANKET

Model: Saturated Only

Hydraulic

K-Sat: 1.64e-005 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SILTY SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Boundary Conditions

Drainage

Review: true

Type: Total Flux (Q) 0

Curb

Type: Head (H) -3.2

Max Operating Level (8.3 ft) Type: Head (H) 8.3

Regions

	Material	Points	Area (ft²)
Region 1	Sheet Pile	2,6,7,29,8,14	2.6250625
Region 2	BAY SOUND CLAY, EL50.0	27 29 15 10 0	5296
Region 2	TO -70.0	27,28,15,10,9	3290
Region 3	BLANKET	38,35,41,23,5,22,30,42,31,32,26,49,47,43	245.10608
Region 4	MARSH	52,34,44,46,25,40,48,45,51	391.22
Region 5	SILTY SAND	52,33,38,43,34	141.46146
Region 6	SAND	34,43,47,49,25,46,44	109.8675
Region 7	EMBANKMENT FILL	36,19,18,17,16,20,24,1,13,21,12,2,14,8,29,53,3,4,35 ,38,33,52	603.33578
Region 8	BEACH SAND, EL6.3/-8.3 TO -50.0	9,11,37,50,36,52,51,45,48,40,27	11089.463

Lines

	Start Point	End Point	Left Side Material	Hydraulic Boundary
Line 1	2	6		
Line 2	6	7		
Line 3	8	14	Sheet Pile	
Line 4	14	2		
Line 5	27	28		Curb
Line 6	28	15		
Line 7	15	10		
Line 8	10	9		Max Operating Level (8.3 ft)
Line 9	7	29		
Line 10	29	8		
Line 11	38	35		
Line 12	14	39	Sheet Pile	
Line 13	46	25		
Line 14	44	46		

Line 15				
Line 17 38 43 Line 18 35 41 Drainage Line 19 41 23 Drainage Line 20 23 5 Drainage Line 21 5 22 Drainage Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 49 21 12	Line 15	43	47	
Line 18 35 41 Drainage Line 19 41 23 Drainage Line 20 23 5 Drainage Line 21 5 22 Drainage Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 A4 Line 29 34 44 A4 Line 30 25 40 Curb Line 31 40 48 A4 Line 32 48 45 A5 Line 33 45 51 52 Line 34 51 52 52 Line 35 27 9 A4 A4 Line 37 33 38 A4	Line 16	47	49	
Line 19 41 23 Drainage Line 20 23 5 Drainage Line 21 5 22 Drainage Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Curb Line 29 34 44 Curb Line 30 25 40 Curb Line 31 40 48 48 Line 32 48 45 45 Line 34 51 52 Line 35 27 9 9 Line 36 52 33 Line 37 33 38 Line 39 49 25 Line 40 36 19 Max Operat	Line 17	38	43	
Line 20 23 5 Drainage Line 21 5 22 Drainage Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 49 21 12	Line 18	35	41	Drainage
Line 21 5 22 Drainage Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 19	41	23	Drainage
Line 22 22 30 Drainage Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 Line 49 21 12	Line 20	23	5	Drainage
Line 23 30 42 Drainage Line 24 42 31 Drainage Line 25 31 32 Drainage Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 21	5	22	Drainage
Line 24	Line 22	22	30	Drainage
Line 25 31 32 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 48 13 21 Line 49 21 12	Line 23	30	42	Drainage
Line 26 32 26 Drainage Line 27 26 49 Curb Line 28 52 34 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 48 13 21 Line 49 21 12	Line 24	42	31	Drainage
Line 27	Line 25	31	32	Drainage
Line 28 52 34 44 Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 26	32	26	Drainage
Line 29 34 44 Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 27	26	49	Curb
Line 30 25 40 Curb Line 31 40 48 Line 32 48 45 Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 49 21 12 12	Line 28	52	34	
Line 31	Line 29	34	44	
Line 32	Line 30	25	40	Curb
Line 33 45 51 Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 31	40	48	
Line 34 51 52 Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Max Operating Level (8.3 ft) Line 49 21 12 Max Operating Level (8.3 ft)	Line 32	48	45	
Line 35 27 9 Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Max Operating Level (8.3 ft) Line 49 21 12 Max Operating Level (8.3 ft)	Line 33	45	51	
Line 36 52 33 Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 34	51	52	
Line 37 33 38 Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 35	27	9	
Line 38 43 34 Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 36	52	33	
Line 39 49 25 Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 37	33	38	
Line 40 36 19 Max Operating Level (8.3 ft) Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 38	43	34	
Line 41 19 18 Max Operating Level (8.3 ft) Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 39	49	25	
Line 42 18 17 Max Operating Level (8.3 ft) Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 40	36	19	Max Operating Level (8.3 ft)
Line 43 17 16 Max Operating Level (8.3 ft) Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 41	19	18	Max Operating Level (8.3 ft)
Line 44 16 20 Max Operating Level (8.3 ft) Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 42	18	17	Max Operating Level (8.3 ft)
Line 45 20 24 Max Operating Level (8.3 ft) Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 43	17	16	Max Operating Level (8.3 ft)
Line 46 24 1 Max Operating Level (8.3 ft) Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 44	16	20	Max Operating Level (8.3 ft)
Line 47 1 13 Max Operating Level (8.3 ft) Line 48 13 21 Line 49 21 12	Line 45	20	24	Max Operating Level (8.3 ft)
Line 48 13 21 Line 49 21 12	Line 46	24	1	Max Operating Level (8.3 ft)
Line 49 21 12	Line 47	1	13	Max Operating Level (8.3 ft)
	Line 48	13	21	
Line 50 12 2	Line 49	21	12	
	Line 50	12	2	

Line 51	3	4		Drainage
Line 52	35	4		Drainage
Line 53	36	52		
Line 54	9	11		Max Operating Level (8.3 ft)
Line 55	11	37		Max Operating Level (8.3 ft)
Line 56	37	50		Max Operating Level (8.3 ft)
Line 57	50	36		Max Operating Level (8.3 ft)
Line 58	40	27		Curb
Line 59	29	53		
Line 60	53	3		
Line 61	53	54	Sheet Pile	

Points

	X (ft)	Y (ft)
Point 1	192.2	8.4
Point 2	200	10.2
Point 3	206.8	10.216
Point 4	219	6.558
Point 5	247	-2.455
Point 6	200	13.4
Point 7	200.5	13.4
Point 8	201	9.9
Point 9	45.2	-50
Point 10	45.2	-70
Point 11	45.2	-9.4
Point 12	199	10.2
Point 13	195.2	9.4
Point 14	200	9.9
Point 15	177.4	-70
Point 16	177.43556	4
Point 17	167.4	0.6
Point 18	160	-1.5
Point 19	152.5	-4.5
Point 20	189.18	7.5
Point 21	198.05	10

Point 22	249	-2.521
Point 23	241	-0.259
Point 24	190.85778	8
Point 25	310	-5.93
Point 26	310	-1.203
Point 27	310	-50
Point 28	310	-70
Point 29	200.96775	10.126
Point 30	253	-2.518
Point 31	260	-1.683
Point 32	270	-1.203
Point 33	200	-0.8
Point 34	200	-4.3
Point 35	236.1	1
Point 36	145.73143	-6.8
Point 37	130	-9.33585
Point 38	206.14634	-0.8
Point 39	200	-1.5
Point 40	310	-8.39
Point 41	239	0.255
Point 42	258.5	-1.86
Point 43	239	-1.845
Point 44	239	-3.145
Point 45	239	-7.445
Point 46	258.5	-5.59
Point 47	258.5	-4.56
Point 48	258.5	-8.39
Point 49	310	-4.56
Point 50	140	-7.74001
Point 51	200	-6.9
Point 52	160	-6.5
Point 53	205	10.18822
Point 54	205	-55

Seepage Analysis with Sheetpile Reach 16B Station 652+00 to 655+00

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File Information

Created By: Liljegren, James Revision Number: 452

Last Edited By: Goltz, Amanda MVS

Date: 3/11/2013 Time: 10:53:19 AM File Name: R16Bgsz.gsz

Directory: Z:\

Last Solved Date: 3/11/2013 Last Solved Time: 10:53:32 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec

Unit Weight of Water: 62.4 pcf

View: 2D

Analysis Settings

Seepage Analysis

Kind: SEEP/W

Method: Steady-State

Settings

Include Air Flow: No

Control

Apply Runoff: No

Convergence

Convergence Type: Head Vector Norm Maximum Number of Iterations: 500

Tolerance: 0.001

Maximum Change in K: 0.1 Rate of Change in K: 1.02 Minimum Change in K: 1e-005 Equation Solver: Parallel Direct

Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec Duration: 0 sec Ending Time: 0 sec

Materials

EMBANKMENT FILL

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BEACH SAND, EL. VARIES TO -50.0

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BAY SOUND CLAY, EL. -50.0 TO -70.0

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SHEET PILE

Model: Saturated Only

Hydraulic

K-Sat: 1e-010 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BLANKET

Model: Saturated Only

Hydraulic

K-Sat: 1.64e-005 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

MARSH

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Boundary Conditions

Drainage

Review: true

Type: Total Flux (Q) 0

Curb

Type: Head (H) -3.7

Max Operating Level (8.3 ft)

Type: Head (H) 8.3

Regions

	Material	Points	Area (ft²)
Region 1	SHEET PILE	1,5,6,7	2.376
Region 2	BAY SOUND	11,9,8,10	5296

	CLAY, EL50.0		
	TO -70.0		
Region 3	BLANKET	27,4,37,21,38,23,24,30,25,26,22,20,32,31	355.37951
Region 4	EMBANKMENT	23,3,2,40,7,1,13,14,18,15,16,36,17,35,39,27,4,37,	449.1938
Negion 4	FILL	21,38	449.1938
Region 5	SAND	35,34,31,27,39	284.9
Region 6	MARSH	35,34,31,32,33,28	336.1
Region 7	BEACH SAND, EL. VARIES TO -50.0	10,12,19,17,35,28,33,32,20,8	11261.645

Lines

	Start Point	End Point	Hydraulic Boundary	Right Side Material	Left Side Material
Line 1	1	5			
Line 2	5	6			
Line 3	6	7	Drainage		
Line 4	9	8	Curb		
Line 5	10	11	Max Operating Level (8.3 ft)		
Line 6	9	11			
Line 7	4	23			
Line 8	1	7		SHEET PILE	SHEET PILE
Line 9	1	29			SHEET PILE
Line 10	10	8			
Line 11	27	4			
Line 12	23	24	Drainage		
Line 13	24	30	Drainage		
Line 14	30	25	Drainage		
Line 15	25	26	Drainage		
Line 16	26	22	Drainage		
Line 17	22	20	Curb		
Line 18	20	32			
Line 19	31	27			
Line 20	31	32			
Line 21	28	33			
Line 22	32	33			

Line 23	4	37		
Line 24	37	21		
Line 25	21	38		
Line 26	38	23		
Line 27	23	3	Drainage	
Line 28	3	2	Drainage	
Line 29	1	13		
Line 30	13	14	Max Operating Level (8.3 ft)	
Line 31	14	18	Max Operating Level (8.3 ft)	
Line 32	18	15	Max Operating Level (8.3 ft)	
Line 33	15	16	Max Operating Level (8.3 ft)	
Line 34	16	36	Max Operating Level (8.3 ft)	
Line 35	36	17	Max Operating Level (8.3 ft)	
Line 36	17	35		
Line 37	35	39		
Line 38	39	27		
Line 39	35	34		
Line 40	34	31		
Line 41	28	35		
Line 42	10	12	Max Operating Level (8.3 ft)	
Line 43	12	19	Max Operating Level (8.3 ft)	
Line 44	19	17	Max Operating Level (8.3 ft)	
Line 45	8	20	Curb	
Line 46	2	40		
Line 47	40	7		
Line 48	40	41		SHEET PILE

Points

	X (ft)	Y (ft)
Point 1	200	10.2
Point 2	207	10.296
Point 3	220.5	5.682
Point 4	237	0.581
Point 5	200	13.4
Point 6	200.5	13.4
Point 7	201	10.296
Point 8	310	-50
Point 9	310	-70
Point 10	45.2	-50
Point 11	45.2	-70
Point 12	45.2	-9.4
Point 13	199	10.2
Point 14	195.2	9.4
Point 15	177.43556	4
Point 16	167.4	0.6
Point 17	152.5	-4
Point 18	189.18	7.5
Point 19	124	-8
Point 20	310	-6.5
Point 21	244	-0.255
Point 22	310	-1.683
Point 23	250	-0.976
Point 24	256	-2.92
Point 25	264	-2.048
Point 26	270	-1.683
Point 27	200	2.9
Point 28	200	-9.1
Point 29	200	-1.5
Point 30	260	-2.5
Point 31	237	-1.919
Point 32	260	-6.5
Point 33	237	-7.219

Point 34	200	-4.5
Point 35	160	-5.9
Point 36	159.5	-1.7
Point 37	237.4	0.53323
Point 38	244.5	-0.31508
Point 39	199.3	2.746
Point 40	205	10.296
Point 41	205	-55

Seepage Analysis with Sheetpile Reach 16C Station 646+41 to 652+00

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File Information

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Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf

View: 2D

Analysis Settings

Seepage Analysis water level at 8.2

Kind: SEEP/W

Method: Steady-State

Settings

Include Air Flow: No

Control

Apply Runoff: No

Convergence

Convergence Type: Head Vector Norm Maximum Number of Iterations: 500

Tolerance: 0.001

Maximum Change in K: 0.1 Rate of Change in K: 1.02 Minimum Change in K: 1e-005 Equation Solver: Parallel Direct

Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec Duration: 0 sec Ending Time: 0 sec

Materials

EMBANKMENT FILL

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

MARSH

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BEACH SAND, EL.-6.0/ -10.0 TO -48.0

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BAY SOUND CLAY, EL. -48.0 TO -70.0

Model: Saturated Only

Hydraulic

K-Sat: 9.8e-006 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SHEET PILE Model: Saturated Only

Hydraulic

K-Sat: 1e-010 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

SAND

Model: Saturated Only

Hydraulic

K-Sat: 0.00049 ft/sec

Volumetric Water Content: 0 ft³/ft³

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

BLANKET

Model: Saturated Only

Hydraulic

K-Sat: 1.31e-005 ft/sec

Volumetric Water Content: 0 ft3/ft3

Mv: 0 /psf K-Ratio: 1 K-Direction: 0 °

Boundary Conditions

Drainage

Review: true

Type: Total Flux (Q) 0

Curb

Type: Head (H) -2.7

Safe Operating Level (8.3 ft)

Type: Head (H) 8.3

Flux Sections

Flux Section 1

Coordinates

Coordinate: (252, -28) ft Coordinate: (252, 0) ft

Regions

	Material	Points	Area (ft²)
Region 1	SHEET PILE	5,10,11,12	2.4
Region 2	BEACH SAND, EL 6.0/ -10.0 TO - 48.0	20,37,46,27,13,41,15,1,25,2,40,39	10408.286
Region 3	BAY SOUND CLAY, EL48.0 TO -70.0	13,14,42,41	5825.6
Region 4	EMBANKMENT FILL	21,29,7,6,50,12,5,16,17,4,26,3,22,23,24,40,39,	462.37573
Region 5	BLANKET	9,21,34,30,31,28,43,32,33,8,19,44,35	220.125
Region 6	SAND	39,9,35,44,19,38,49,45,36,47	415.57006
Region 7	MARSH	39,47,36,45,49,38,27,46,37,20	439.29994

Lines

	Start Point	End Point	Hydraulic Boundary	Right Side Material	Left Side Material
Line 1	5	10			
Line 2	10	11			
Line 3	11	12	Drainage		
Line 4	5	12		SHEET PILE	
Line 5	39	9			
Line 6	27	13	Curb		
Line 7	41	15	Safe Operating Level (8.3 ft)		
Line 8	1	25	Safe Operating Level (8.3 ft)		
Line 9	25	2	Safe Operating Level (8.3 ft)		
Line 10	2	40	Safe Operating Level (8.3 ft)		
Line 11	40	39			
Line 12	13	14	Curb		
Line 13	14	42			
Line 14	42	41	Safe Operating Level (8.3 ft)		

Line 15	41	13		
Line 16	1	15	Safe Operating Level (8.3 ft)	
Line 17	21	9		
Line 18	21	29	Drainage	
Line 19	29	7	Drainage	
Line 20	7	6	Drainage	
Line 21	5	16	Safe Operating Level (8.3 ft)	
Line 22	17	4	Safe Operating Level (8.3 ft)	
Line 23	4	26	Safe Operating Level (8.3 ft)	
Line 24	26	3	Safe Operating Level (8.3 ft)	
Line 25	3	22	Safe Operating Level (8.3 ft)	
Line 26	22	23	Safe Operating Level (8.3 ft)	
Line 27	23	24	Safe Operating Level (8.3 ft)	
Line 28	24	40	Safe Operating Level (8.3 ft)	
Line 29	17	16	Safe Operating Level (8.3 ft)	
Line 30	21	34	Drainage	
Line 31	34	30	Drainage	
Line 32	30	31	Drainage	
Line 33	31	28	Drainage	
Line 34	32	33	Drainage	
Line 35	33	8	Drainage	
Line 36	8	19	Curb	
Line 37	28	43	Drainage	
Line 38	43	32	Drainage	
Line 39	46	37		
Line 40	36	45		
Line 41	35	44		

Line 42	9	35		
Line 43	37	20		
Line 44	27	46		
Line 45	44	19		
Line 46	39	47		
Line 47	19	38		
Line 48	9	48		SHEET PILE
Line 49	5	9		SHEET PILE
Line 50	45	49		
Line 51	49	38		
Line 52	38	27	Curb	
Line 53	47	36		
Line 54	20	39		
Line 55	12	50	Drainage	
Line 56	50	6	Drainage	
Line 57	50	51		SHEET PILE

Points

	X (ft)	Y (ft)
Point 1	127.2	-9.4
Point 2	140.2	-8.1
Point 3	177.1	3.9
Point 4	192.2	8.4
Point 5	200	10.2
Point 6	206.5	9.9
Point 7	221	5.39
Point 8	310	-2.659
Point 9	200	2.6
Point 10	200	13.4
Point 11	200.5	13.4
Point 12	201	10.2
Point 13	310	-48
Point 14	310	-70
Point 15	45.2	-9.4
Point 16	199	10.2

Point 17	195.2	9.4
Point 18	310	-11
Point 19	310	-5.359
Point 20	200	-7.3
Point 21	235	0.192
Point 22	167.4	0.6
Point 23	160	-1.5
Point 24	152.5	-4.6
Point 25	131.2	-9
Point 26	189.18	7.5
Point 27	310	-10.029
Point 28	254	-3.1
Point 29	224.78	4
Point 30	248	-2.169
Point 31	252	-3.378
Point 32	260	-2.595
Point 33	267	-2.659
Point 34	240	-0.72
Point 35	240	-2.52
Point 36	240	-3.82
Point 37	240	-8.52
Point 38	310	-7.029
Point 39	160	-6.5
Point 40	145.8	-6.5
Point 41	45.2	-48
Point 42	45.2	-70
Point 43	258	-2.76
Point 44	258	-5.46
Point 45	258	-7.13
Point 46	258	-10.13
Point 47	200	-4.3
Point 48	200	-1.5
Point 49	259	-7.12806
Point 50	205	9.98182
Point 51	205	-53

17th Street Outfall Canal Reach 16 Seepage Factor of Safety Calculations

Reach 16A

		Weig	hted Unit v	veight	119.0													
			Critical o	gradient	0.907													
1				Total	Pore-Water	Pressure	Water	Cumulative	,		XY-Velocity				X-Conductivity	Y-Conductivity	Vol. Water	
Node	X (ft)	Y (ft)	Z (ft)	Head (ft)	Fiessule	Head (ft)	I IUX		_	_	_	X-Gradient	Y-Gradient	XY-Gradient	(ft/sec)	(ft/sec)	Content	Water Content
					(psf)	(1)	(ft³/sec)	(ft³)	(ft/sec)	(ft/sec)	(ft/sec)				, ,	` ′	(ft³/ft³)	Fn. (/psf)
13823	247	-2.455	0	-2.455	0	0	-3.76E-05	0	6.59E-06	3.61E-05	3.67E-05	6.04E-01	2.18E+00	2.27E+00	1.64E-05	1.64E-05	0	0
13815	246.8	-2.931	0	-1.2748	103.34702	1.6562	None	None	2.37E-05	2.05E-05	3.13E-05	0.3002728	1.13E+00	1.1698144	8.96E-05	8.96E-05	0	0
	0.51631			1.1802														
		exit gradient	2.286		FS	0.40												

Reach 16B

		Weig	hted Unit w	eight/	115.0													
			Critical g	radient	0.843													
				Total	Pore-Water	Pressure	Water	Cumulative	,		XY-Velocity				X-Conductivity	Y-Conductivity	Vol. Water	· ·
Node	X (ft)	Y (ft)	Z (ft)	Head (ft)		Head (ft)	I IUX	Water Flux	Magnitude	Magnitude	Magnitude	X-Gradient	Y-Gradient	XY-Gradient	(ft/sec)	(ft/sec)	Content	Water Content
				ricad (it)	(psf)	ricad (it)	(ft³/sec)	(ft³)	(ft/sec)	(ft/sec)	(ft/sec)				(11/300)	(11/300)	(ft³/ft³)	Fn. (/psf)
14546	256	-2.92	0	-2.92	0	0	-1.91E-05	0	7.58E-06	1.54E-05	1.72E-05	2.00E-01	9.29E-01	9.50E-01	1.64E-05	1.64E-05	0	0
14544	256	-6.6250435	0	-0.2864	395.52977	6.33862	None	None	5.04E-06	9.04E-06	1.04E-05	0.0628896	3.48E-01	0.35386047	8.01E-05	8.01E-05	0	0
	3.705044			2.63357														
		exit gradient	0.711		FS	1.19												

Reach 16C

			Weighted I	Unit weight	112																
			Critica	al gradient	0.795																
Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore-Wate	Pressure Head (ft)	Water Flux	Cumulative	X-Velocity M	Y-Velocity M	XY-Velocit	X-Gradient	Y-Gradient	XY-Gradier	X-Conducti	Y-Conduct	Vol. Water	Slope of V	ol. Water C	ontent Fn. ((/psf)
14116	252	-3.378	0	-3.378	0	0	-2.98E-05	0	6.39E-06	2.48E-05	2.56E-05	2.37E-01	1.88E+00	1.89E+00	1.31E-05	1.31E-05	0	0			
14115	252	-4.48	0	-1.2907425	199.0097	3.1892575	None	None	1.00E-05	1.48E-05	1.79E-05	0.210644	9.48E-01	0.971004	8.01E-05	8.01E-05	0	0			
	1.102			2.0872575																	
		exit gradient	1.894		FS	0.42															

17th Street Outfall Canal Reach 16 Seepage Factor of Safety Calculations

Reach 16D

		Weig	hted Unit v	veight	113.4													
			Critical of	gradient	0.817													
				Total	Pore-Water	Pressure	Water Flux	Cumulative	•		XY-Velocity				X-Conductivity	Y-Conductivity	Vol. Water	Slope of Vol.
Node	X (ft)	Y (ft)	Z (ft)		Pressure (psf)			Water Flux (ft³)	Magnitude	Magnitude	Magnitude	X-Gradient	Y-Gradient	XY-Gradient	(ft/sec)	(ft/sec)	Content	Water Content
				i icau (ii)	i lessure (psi)	rieau (it)	(11 / 300)	Water Flux (it)	(ft/sec)	(ft/sec)	(ft/sec)				(11/360)	(11/360)	(ft³/ft³)	Fn. (/psf)
13615	244	-3.1	0	-3.1	0	0	-2.50E-05	0	2.11E-06	1.81E-05	1.82E-05	4.68E-01	1.31E+00	1.39E+00	1.38E-05	1.38E-05	0	0
13612	244	-10.8	0	-0.6312	634.53533	10.16884	None	None	6.08E-06	2.59E-06	6.61E-06	0.0758858	1.09E-01	0.13267936	8.01E-05	8.01E-05	0	0
	7.7			2.46884														
		·																
		exit gradient	0.321		FS	2.55			_									

Reach 16C with Sheetpile

			Weighted I	Unit weight	115															
			Critica	al gradient	0.843															
Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore-Wate	Pressure Head (ft)	Water Flu	Cumula	tive X-Velocity M	Y-Velocity N	XY-Velocit	X-Gradient	Y-Gradient	XY-Gradier	X-Conducti	Y-Conduct	Vol. Water	Slope of \	/ol. Water	Content Fn
14114	252	-3.378	0	-3.378	0	0	-9.89E-06		0 4.97E-06	7.50E-06	9.00E-06	1.28E-01	5.57E-01	5.71E-01	1.31E-05	1.31E-05	0	()	
14111	252	-9.5933333	0	-2.5475259	439.6584	7.0458074	None	None	4.06E-07	6.30E-07	7.49E-07	0.005594	2.77E-02	0.02824	8.01E-05	8.01E-05	0	()	
	6.215333			0.8304741																
		exit gradient	0.134		FS	6.31														







U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT

GEOTECHNICAL ENGINEERING SEEPAGE ADDENDUM ON REACH 16 FOR THE 17TH ST. OUTFALL CANAL.

Prepared by:
GEOTECHNICAL AND HTRW BRANCH
ST. LOUIS DISTRICT CORPS OF ENGINEERS
CEMVS-EC-G
JUNE 2012

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Summary

The seepage addendum 2 (September 2011) shown that there are two areas along Reach 16 with factor of safety less than 1.6. In order to confirm and to validate if these two areas are representative for the entire reach, MVS has performed additional seepages analyses. Reach 16 was divided in four different sub-reaches to calculate different seepage factors of safety due to the variation in elevation at the levee toe and to the variation in blanket thickness along it. These sub-reaches include reach 16A (655+00 to 657+87), 16B (652+00 to 655+00), 16C (646+41 to 652+00), and 16D (642+65 to 646+41) and were chosen due to their proximity to low spots along the levee toe and the existence of a sandy silt strata within the fine grain blanket. A summary of the results are provided on Table 1 and the permeability values used for the fine grain blanket and levee core are shown on Table 2 and were obtained from the DIVR 1110-1-400.

The main difference between URS and MVS seepage factor if safety is that URS used the lowest elevation and kept it constant to model the GSE on the protected side, while MVS took in consideration the existence of the inlet drainage ditch in their Seep/W model. MVS exit gradients concentrate more at the low spot area while URS exit gradient are more spread due to the flat ground on the protected side.

Table 1 Summary of Factors of Safety for Seepage Analysis in Reach 16

Reach	URS Existing Conditions	MVS Existing Conditions
16A	1.66 1	1.70 3
16B	2.06 1	1.59 ³
16C	1.60 ²	1.32 4
16D	1.40 ²	2.76 4

Note: 1 Water elevation in canal EL. 10ft

² Water elevation in canal EL. 8ft

³ Water elevation in canal EL. 8.5ft

⁴ Water elevation in canal EL. 8.2ft

Table 2 Suggested Design Values for Ratio of Permeability of Pervious Substratum to Landslide Top Stratum and Permeability of Top Stratum

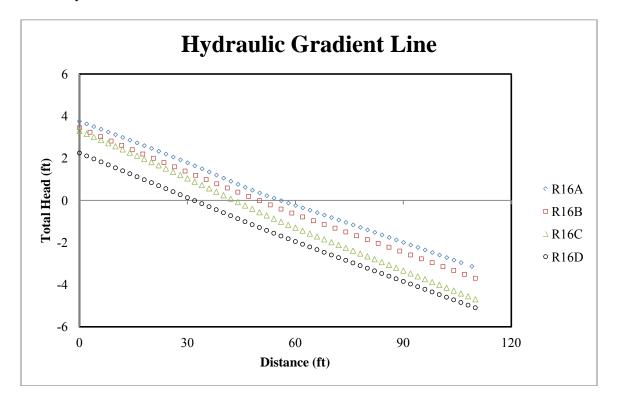
Stratum and Permeability of	1 Top Stratum	T = 15
Soil Type	Blanket Thickness (ft)	Suggested Design Values <i>kbl</i> (ft/sec)
		,
	<5	3.28E-05
Silty Sand	5 to 10	2.62E-05
	>10	1.97E-05
	<5	1.64E-05
Sand and Silty Sand	5 to 10	1.31E-05
Sand and Silty Sand	10 to 15	9.80E-06
	>15	6.56E-06
	<5	1.31E-05
	5 to 10	9.80E-06
Clay and Silty Clay	10 to 15	4.92E-06
	15 to 20	1.64E-06
	>20	2.62E-07

Seepage analysis

The critical seepage gradient for the landside blanket is determined by dividing the buoyant unit weight of the soils in the blanket by the unit weight of water. The method for determining the average unit weight for layered soils is shown in the example below. The factor of safety for seepage is determined by dividing the critical gradient by the calculated gradient across the blanket. A factor of safety of at least 1.6 is required per Corps criteria. The seepage factor of safety was calculated for two water levels 8.5' (Between 658+00 and 652+00) and 8.2' (Between 652+00 and 641+85).

The hydraulic grade line, or total head at the top of the aquifer, was plotted from the results of each SEEP/W analysis and is shown in table 3. Seepage gradients were calculated at offsets from the levee centerline using the June 2011 survey points for points selected at the levee toe and drainage ditch.

Table 3 Hydraulic Gradient Line



Reach 16A

Below is a geological section (Figure 1) and the boring logs (figure 2) used to develop the stratigraphy on Reach 16A (655+00 to 657+87), a table showing hydraulic properties used for the Seep/W (figure 2) analysis (Table 4), and a plan view cross section extent (figure 3). Two blanket soil materials are present in this reach at the lowest point inside the ditch, silty sand and marsh. The silty sand has a unit weight of 122 pcf and the marsh has a unit weight of 101 pcf. Assuming this stratigraphy is consistent through the subreach. The calculated average unit weight is 109 pcf.

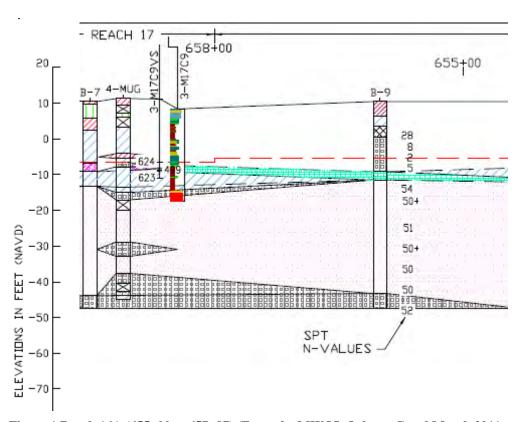


Figure 1 Reach 16A (655+00 to 657+87) (From the MWOL Orleans Canal March 2011 report)



Table 4 Summary of Hydraulic Property Values for landside blanket for R16A (655+00 to 657+87)

		Rea	ch 16A Hydraulic Properties			<u></u>	
Unit	Classification (USCS) (Typical)	Saturated Permeability (Kx)	Permeability Ratio (Ky/ Kx)	Top Elevation of Blanket (ft)	Bottom Elevation of Blanket (ft)	Thickness of Blanket (ft)	Unit Weight (PCF)
Levee Embankment CL	CH, CL	9.8e-006 ft/sec	1	N/A	N/A	N/A	N/A
Levee Embankment PS	CH, CL	1.64e-006 ft/sec	1	N/A	N/A	N/A	N/A
Silty Sand w/ Clay Layers	SM	3.28e-005 ft/sec	1	-2.5	-5.1	2.6	122
Marsh	СНО	1.31e-005 ft/sec	1	-5.1	-9.3	4.2	101

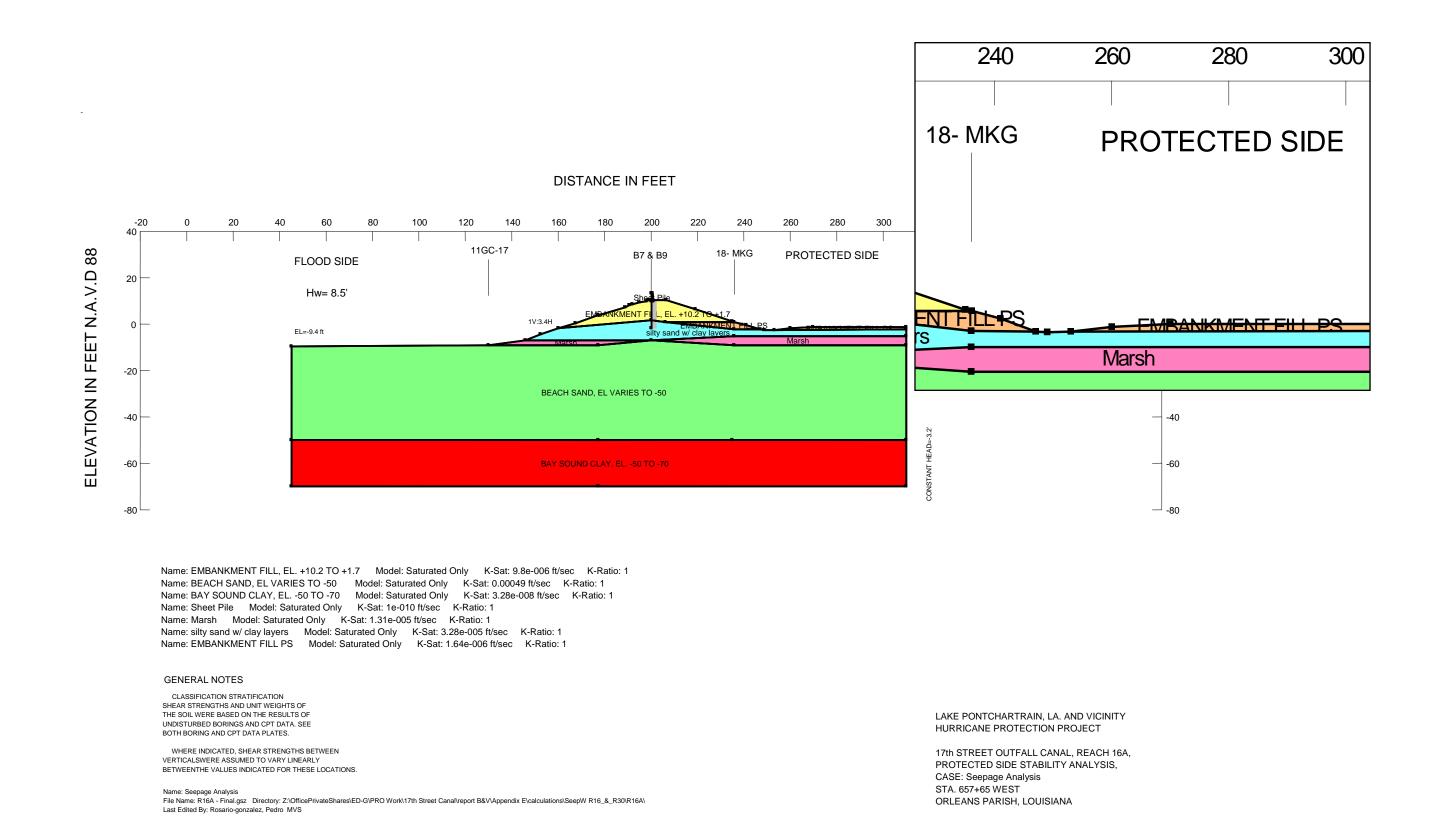


Figure 2 SLOPE/W Model Plot with Screen Shot of Drainage Inlet

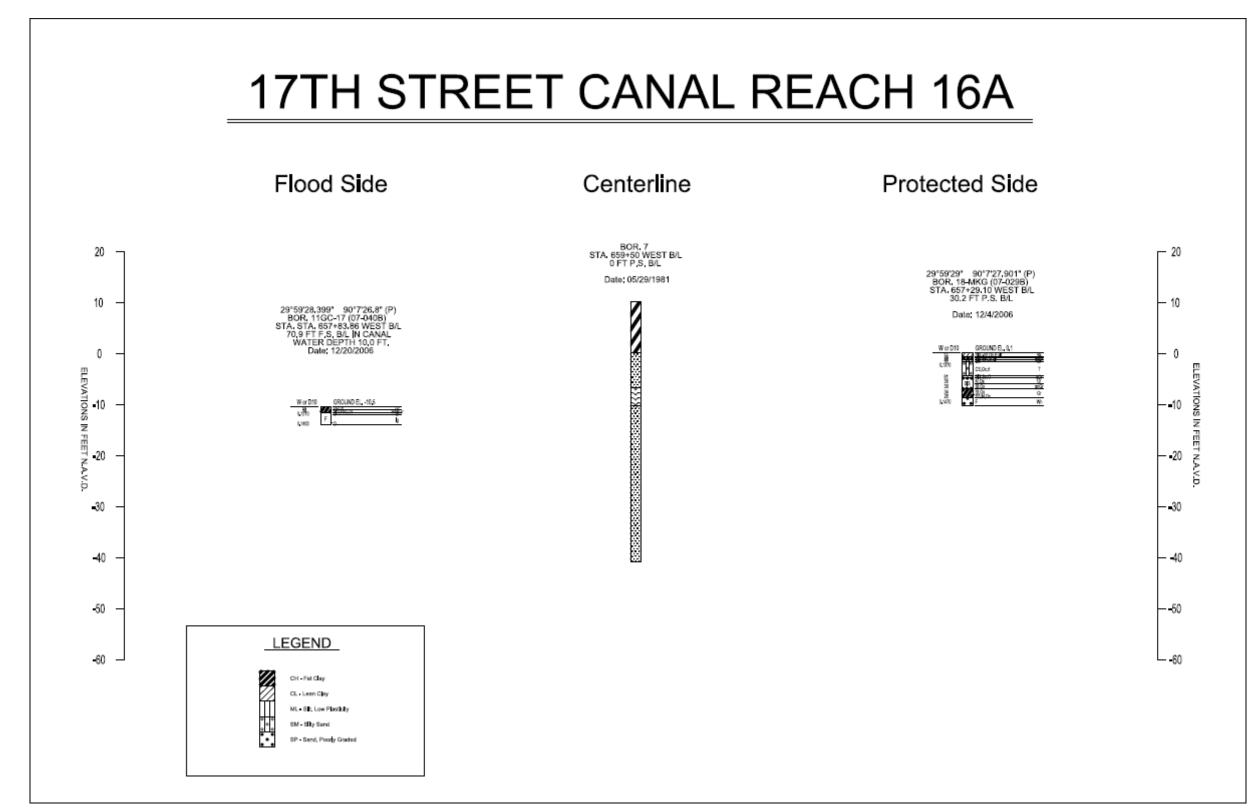


Figure 3 Reach 16A Boring Logs

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Project Number: 12-017136 Boring: 17MVS-08PU

Current Date: 11/27/2012

		_								
	7A	6A :	5 A	38	3A	2B	2A	1 E	Number	C C C
	15.5			5.0	4.0	3.0	2.0	1.0	Depth	
	TSP	TSP W/O	TSP W/O	ST GR & T CH2 W/ ARS SP, O, RT, SIF	ST GR & BR CH2 W/ LYS & ARS SM	T SM W/ O, ARS CH, SIF, RT	T SM W/ ARS CH, RT	T & BR ML W/ ARS SP, RT, O, WD	Visual Classification	
	နှ	& c	& 4	3 옷	요	MS	MS	<u> </u>	USCS	
									E (f)	_
	29	3 8	3 6	<u>υ</u>	ω	21	17	12 2	E SP	_
							٠	·	Dens (pcf)	Pry
									Dens (pcf)	Wet
									a∻ p.	
									Test Type	Shear
									Angle	
									(psf)) ; ;
	·				·				Comp.	Unconf.
									Ħ	
									72	
									14	
>									(tsf)]
									Tests)

Remarks:

Stantec Consulting Services Inc.

File Name: tmp_be_boring_kog_v10_0.xlsm

Checked By:

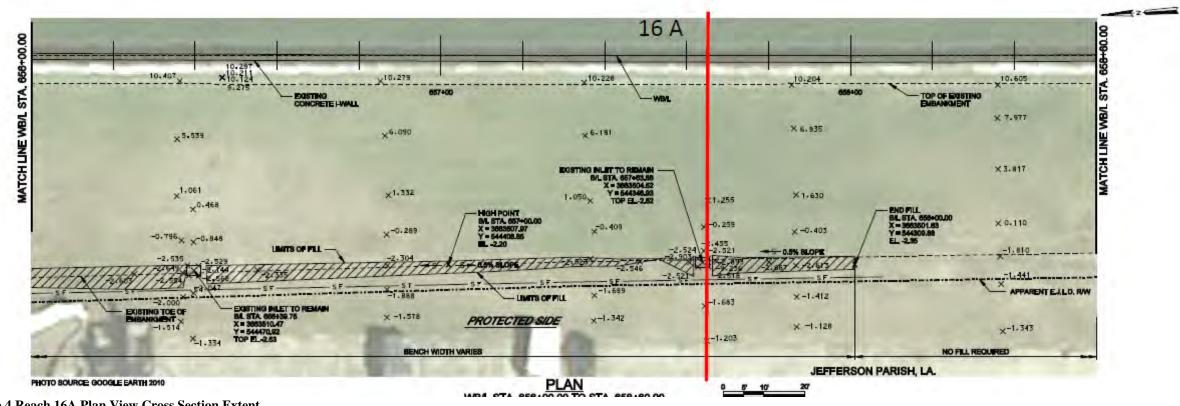


Figure 4 Reach 16A Plan View Cross Section Extent

Reach 16B

Below is a geological section (Figure 5) and the boring logs (figure 7) used to develop the statigraphy on Reach 16B (652+00 to 655+00), a table showing hydraulic properties used for the Seep/W (figure 6) analysis (Table 5), and a plan view cross section extent (figure 8). Two blanket soil materials are present in this reach at the lowest point inside the ditch, silty sand and marsh. The silty sand has a unit weight of 122 pcf and the marsh has a unit weight of 101 pcf. Assuming this stratigraphy is consistent through the subreach. The calculated average unit weight is 102 pcf.

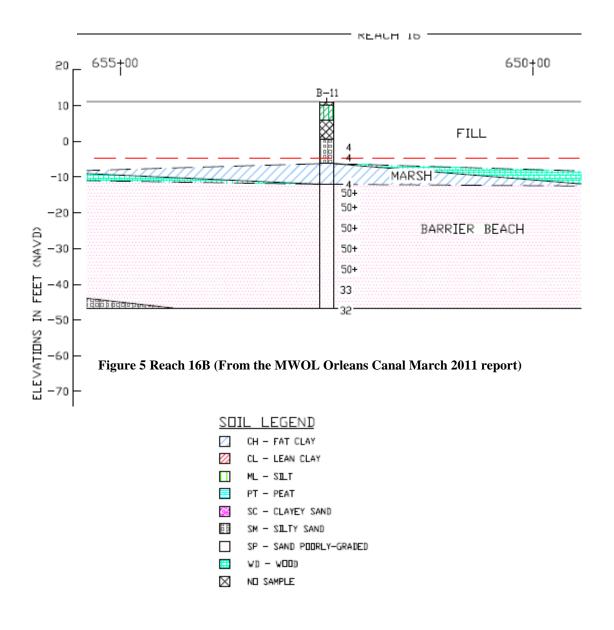


Table 5 Summary of Hydraulic Property Values for landside blanket for 16B(651+38 to 655+00)

Reach 16B Hydraul	lics Properties						
Unit	Classification (USCS) (Typical)	Saturated Permeability (Kx)	Permeability Ratio (Ky/ Kx)	Top Elevation of Blanket (ft)	Bottom Elevation of Blanket (ft)	Thickness of Blanket (ft)	Unit Weight (pcf)
Levee Embankment CL	CH, CL	9.8e-006 ft/sec	1	N/A	N/A	N/A	N/A
Silty Sand w/ Clay Layers	SM	3.28e-005 ft/sec	1	-2.92	-3.2	0.28	122
Marsh	СНО	1.31e-005 ft/sec	1	-3.2	-9.2	6	101

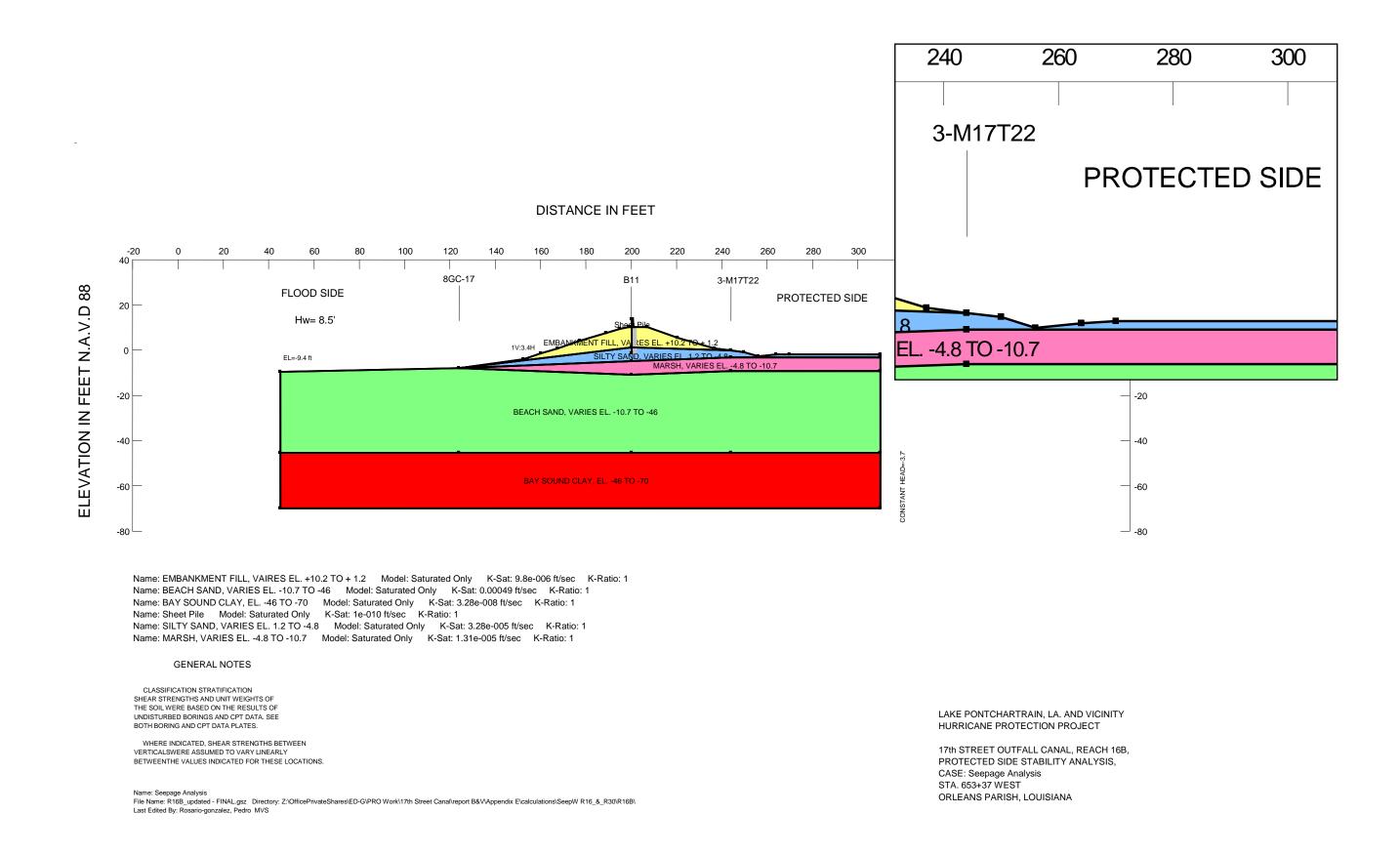


Figure 6 SLOPE/W Model Plot with Screen Shot of Drainage Inlet

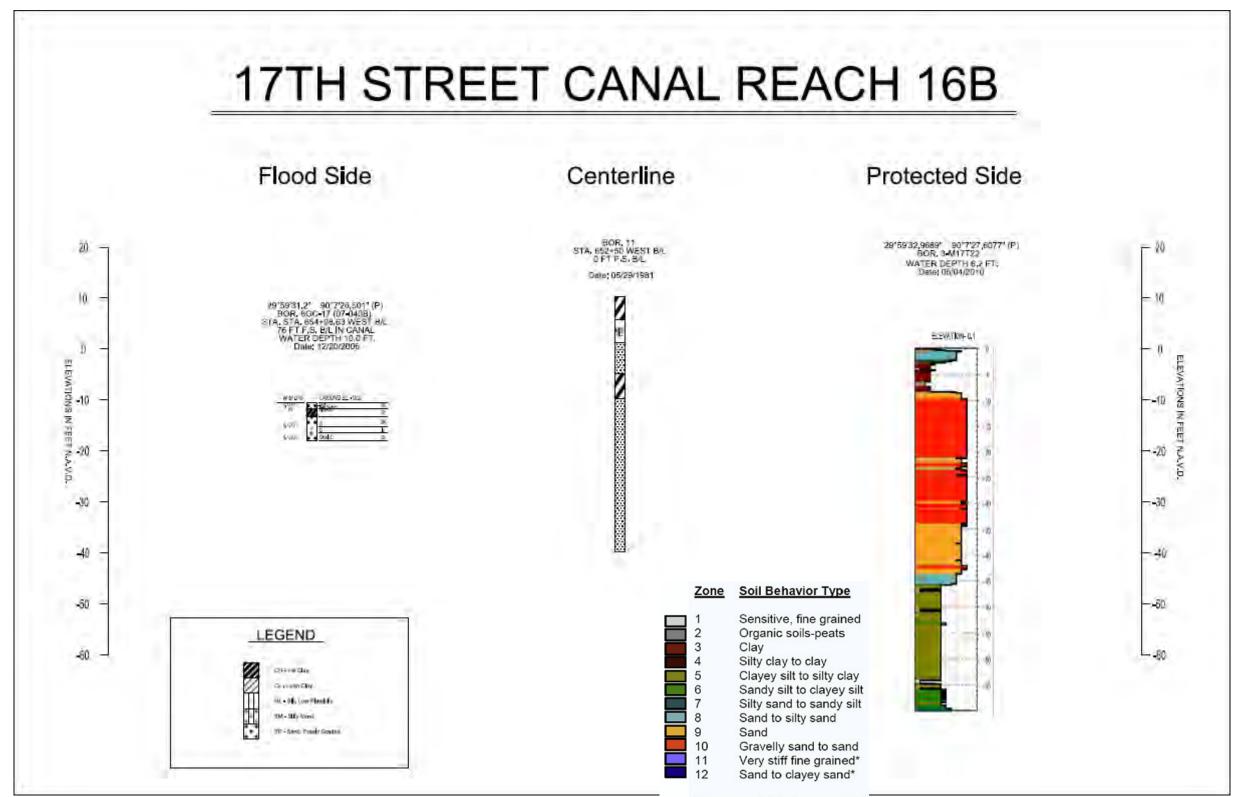


Figure 7 Reach 16B Boring Logs

*Overconsolidated or cemented

Page 14

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Boring: Project Number: 12-017136 Boring: 17MVS-07PU

Current Date: 11/27/2012

Remarks: Stantec	6 5 4 3 2 1 1 1 1 2 2 1 1 1 1 2 2 2 1 1 1 1 2	Sample Number
s:	1.0 2.0 4.0 9.5 11.5	Depth
Remarks: Stantec Consulting Services Inc.	BR SM W/ ARS CH, O, SIF, G ST BR CL4 W/LYS & ARS SP, G, SIF T SP W/ ARS CH, O, RT T SP W/ VD T SP W/ O, G T SP W/ RT T SP W/ ARS CH T SP W/ ARS CH	Visual Classification
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Checked By:	3	Torvane (tsf)
- og_v10_0.		Other

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Project Number: 12-017136 Boring: 17MVS-06PU

Current Date: 11/27/2012

	65 4 3 2 1 C B 5 5 4 3 2 2 C C B 5 5 6 5 6 5 6 6 6 6 6 6 6 6 6 6 6 6 6	Sample Number
	0.0 1.0 2.0 4.0 9.0 11.5	Depth
	BR & T SM W/ ARS CH, G, RT T SP W/RT, O T SP W/RT T SP W/RT T SP W/ RT T SP W/ G T SP W/ G	Visual Classification
	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	uscs
		是(£)
	10 2 2 25 26 21 20 16	
		Dry Dens (pcf)
		Wet Dens (pcf)
		& € 40 41 41
		Shear Test Type
		Angle
		Cohesion (psf)
		Unconf. Comp. Str.
		F
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()/_		Torvane (tsf)
		Other

Remarks:

Stantec Consulting Services Inc.

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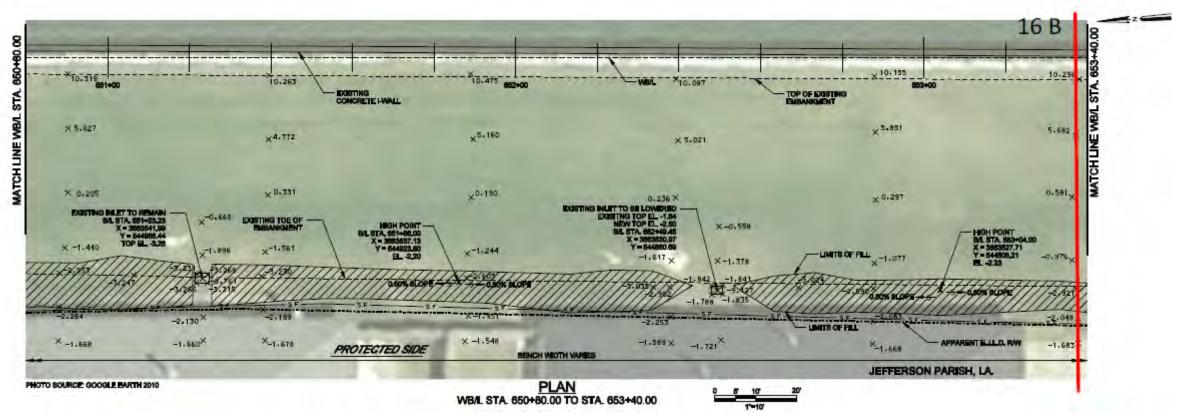


Figure 8 Reach 16B Plan View Cross Section Extent

Reach 16C

Below is a geological section (Figure 9) and the boring logs (figure 11) used to develop the statigraphy on Reach 16C (646+41 to 652+00), a table showing hydraulic properties used for the Seep/W (figure 10) analysis (Table 6), and a plan view cross section extent (figure 12). Three blanket soil materials are present in this reach at the lowest point inside the ditch, embankment fill, sand and marsh. The embankment fill has a unit weight of 114 pcf, the sand has a unit weight of 122 pcf and the marsh has a unit weight of 101 pcf. Assuming this stratigraphy is consistent through the subreach. The calculated average unit weight is 106 pcf.

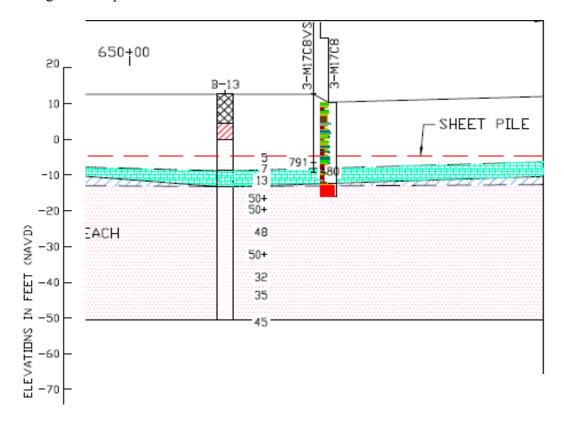


Figure 9 Reach 16C (From the MWOL Orleans Canal March 2011 report)



Table 6 Summary of Hydraulic Property Values for landside blanket for 16C (646+41 to 651+38)

Reach 16C Hydrau	lics Properties						
Unit	Classification (USCS) (Typical)	Saturated Permeability (Kx)	Permeability Ratio (Ky/ Kx)	Top Elevation of Blanket (ft)	Bottom Elevation of Blanket (ft)	Thickness of Blanket (ft)	Unit Weight (pcf)
Levee Embankment CL	CH, CL	9.8e-006 ft/sec	1	N/A	N/A	N/A	N/A
Levee Embankment PS	ML	1.64e-005 ft/sec	1	-3.4	-4.2	0.8	114
Sand	SP	0.00049 ft/sec	1	-4.2	-4.9	0.7	122
Marsh	СНО	1.31e-005 ft/sec	1	-4.9	-8.4	3.5	101

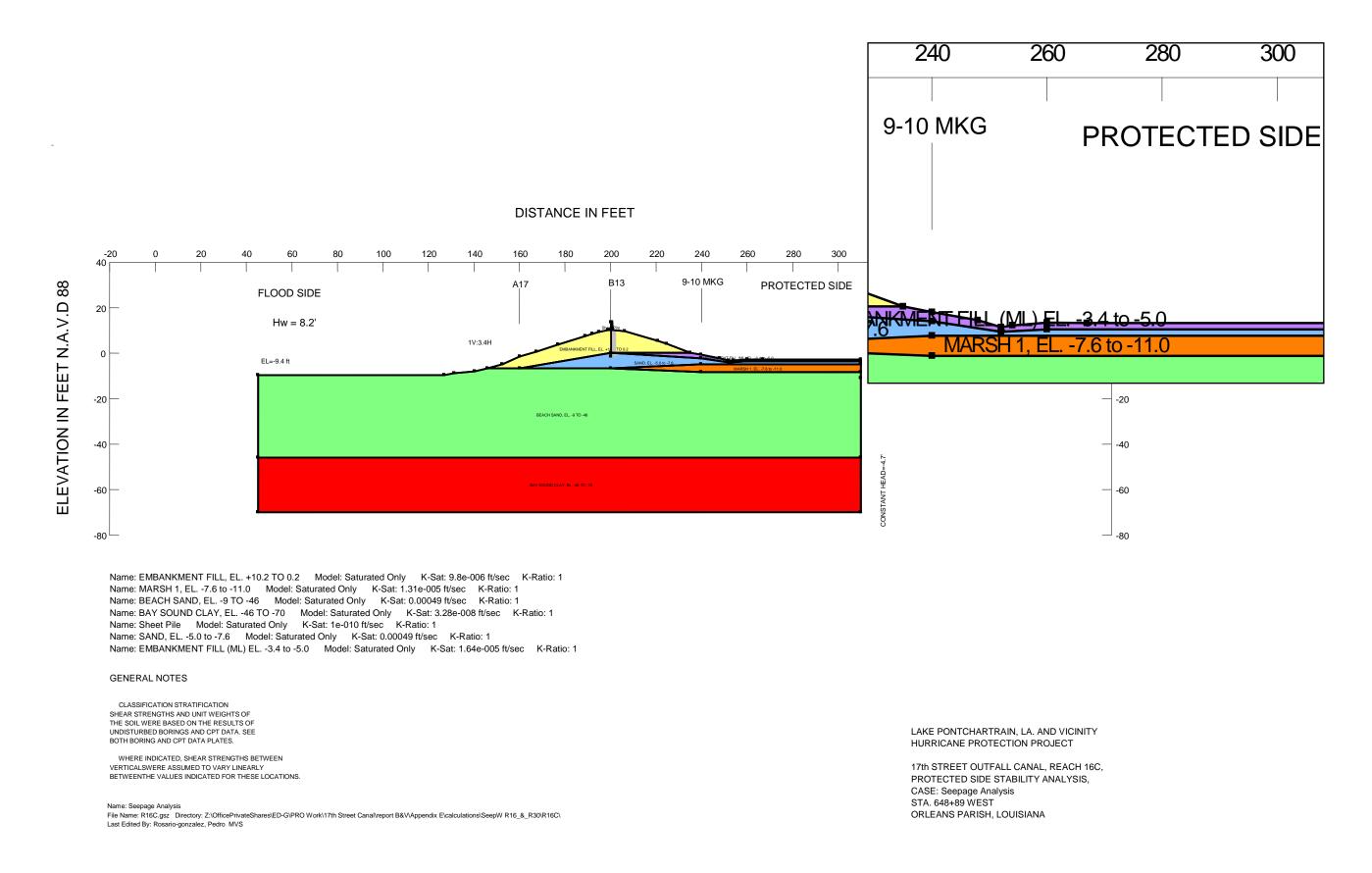


Figure 10 SLOPE/W Model Plot with Screen Shot of Drainage Inlet

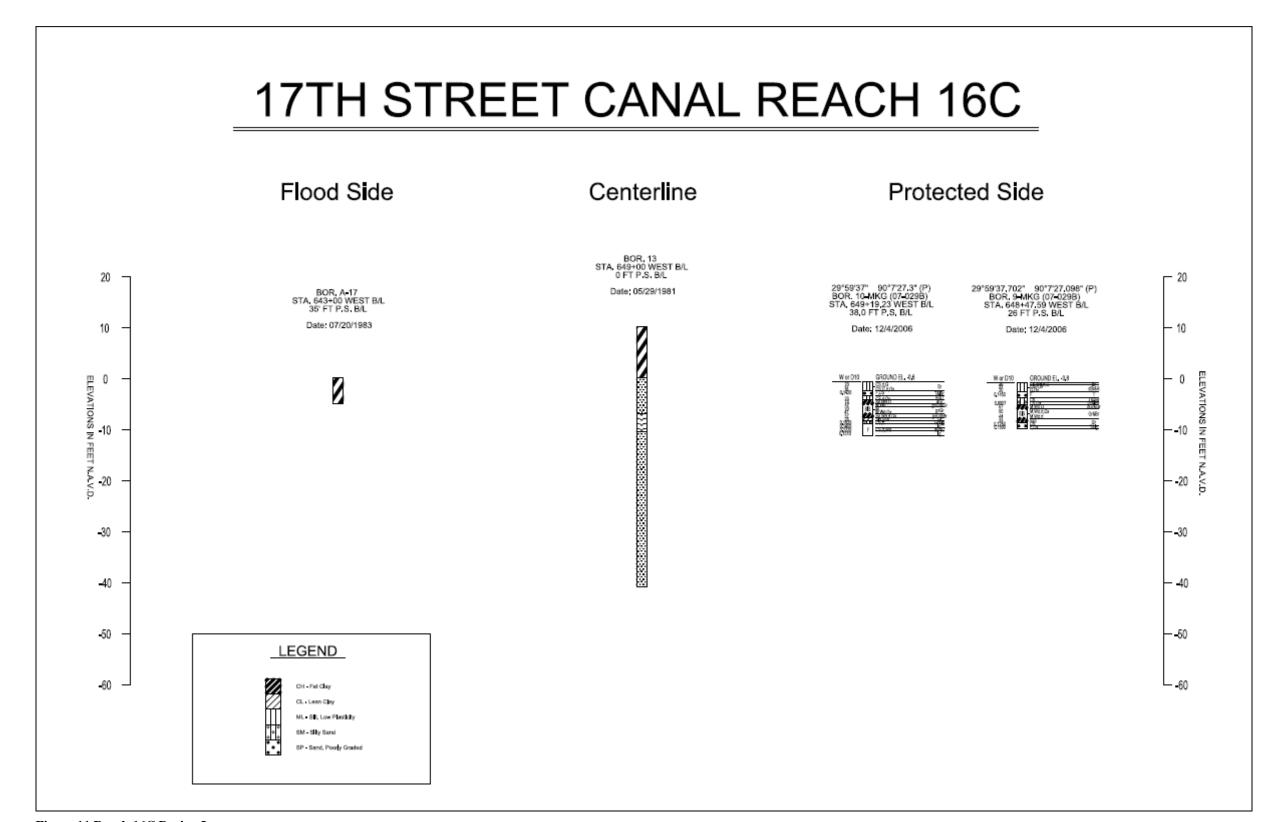


Figure 11 Reach 16C Boring Logs

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Project Number: 12-017136 Boring: 17MVS-06PU

Current Date: 11/27/2012

	65 4 3 2 1 C B 5 5 4 3 2 2 C C B 5 5 6 5 6 5 6 6 6 6 6 6 6 6 6 6 6 6 6	Sample Number
	0.0 1.0 2.0 4.0 9.0 11.5	Depth
	BR & T SM W/ ARS CH, G, RT T SP W/RT, O T SP W/RT T SP W/RT T SP W/ RT T SP W/ G T SP W/ G	Visual Classification
	\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	uscs
		是(£)
	10 2 2 25 26 21 20 16	
		Dry Dens (pcf)
		Wet Dens (pcf)
		& € 40 41 41
		Shear Test Type
		Angle
		Cohesion (psf)
		Unconf. Comp. Str.
		F
		Tg
		PI
()/_		Torvane (tsf)
		Other

Remarks:

Stantec Consulting Services Inc.

Checked By: X
File Name: 17MVS-06PU_be_boring_log_v10_0.

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Boring:

Project Number: 12-017136 Boring: 17MVS-05PU Current Date: 11/27/2012

	24A	23A	22A	21A	20A	19A	18A	17A	16A	15A	14A	13A	12A	11A	10A	9A	8A	7A	6A	5A	ර	4B	\$	3B	3A	28	2A	₽	1 A	Number	Sащо1е
	59.5	57.0	54.5	52.0	49.5	47.0	44.5	42.0	39.5	37.0	34.5	32.0	29.5	27.0	24.5	22.0	19.5	17.0	14.5	12.0	10.0	9.0	8.0	5.0	4.0	3.0	2.0	1.0	0.0		Depth
	LGR SP W/ SIF, G	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF, RT	LGR SP W/ SIF	LGR SP W/ SIF	LGR SP W/ SIF, G	LGR SP	LGR SP	LGR SP	TSP	TSP	T SP W/ RT	T SP W/ ARS CH	BR & T SP W/ LYS CH, G, RT	ST BR & T CH3 W/ ARS SP, O	ST BR CH3 W/ ARS SP, ARS ML, O, RT	BR ML W/ ARS SP, ARS CH, G, O	ST BR CH2 W/ ARS & LYS SM, O		Visual Classification
	SP	SP	ş	ŞP	SP	SP	SP	SP	SP	SP	SP	SP	SP	SP	ŞP	SP	SP	SP	SP	SP	SP	SP	SP	SP	SP	요.	요.	¥.	CH2		USCS
																															р Б
· · · · · · · · · · · · · · · · · · ·	30	25	3	ω	25	28	29	28	27	28	29	28	<u>α</u>	35 5	36 6	23	26	27	23	23	20	9	12	9	5	41	38 8	39			N.
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																														ΘďΛī	Shear Test
																	-		-		·									,	Angle
																														(psf)	Cohesion
																														str.	Unconf.
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																								-			_				P I
> ·																														(tef)	Torvane
																														Tests	Other

Stantec Consulting Services Inc.

File Name: tmp_be_boring_log_v10_0.x1sm

Checked By:

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Boring: Project Number: 12-017136 Boring: 17MVS-04PU Current Date: 11/27/2012

	6 A	5 A	3A	3 6 3	ā ā 5	•	Sample
	14.0			3.0	2 1 C))	Depth
	T SP W/RT	TSPW/G,O	T SP W/ O, RT	LGR SP W/RT, O	LGR SP W/LYS CH, G	77 04 100 0 0 0 0 0 0 1 0 1 H	Visual Classification
	ဗူ ဗူ	 3 \cdot	ક્ષ પ	3 S	γγ <u>γ</u>	2	uscs
					•		E (f)
	26	2 22	23	; N -	- 4 -		¥
						(pcf)	Dry Dens
						(pcf)	Wet
	<u>.</u>						***************************************
						Туре	Shear Test
							Angle
						(Tod)	Cohesion
						Str.	Unconf.
				<u> </u>			F
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च ,						(COF)	Torvane
						0 0 0	Other

Stantec Consulting Services Inc.

File Name: tmp_be_boring_log_v10_0.x1sm

Checked By:

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Boring: Project Number: 12-017136 Boring: 17MVS-03PU

Current Date: 11/27/2012

65A 6A	Sample
0.0 1.0 2.0 3.0 4.0 11.5 14.0	Depth
BR SM W/ ARS CH, G, RT BR SM W/ ARS CH, G, RT BR SP W/ LYS CH, RT, G BR SP W/ ARS CH, RT LGR SP W/ ARS CH, G LGR SP W/ ARS CH, G LGR SP W/ ARS CH, G LGR SP W/ ARS CH, G CGR SP W/ ARS CH, G	Visual Classification
\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	uscs
	E(f)
3323197389	¥
(pcf)	Dry Dens
(pcf)	Wet
a	s p t
Туре	Shear Test
	Angle
(PSI)	Cohesion
Str.	Unconf.
	F
	TE
	P I
(1st)	Torvane
E e s C s	Other

Stantec Consulting Services Inc.

Checked By:

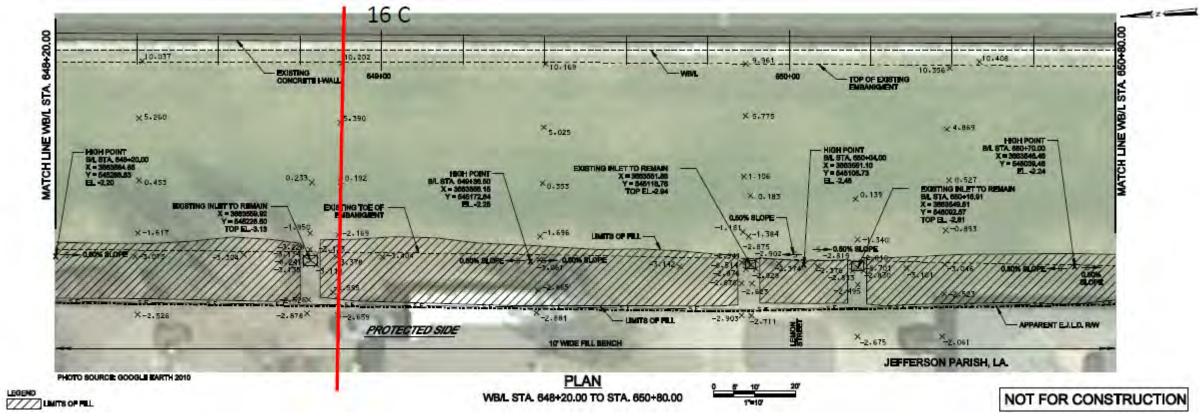


Figure 12 Reach 16C Plan View Cross Section Extent

Reach 16D

Below is a geological section (Figure 13) and the boring logs (figure 15) used to develop the statigraphy on Reach 16D (642+65 to 646+41), a table showing hydraulic properties used for the Seep/W (figure 14) analysis (Table 7), and a plan view cross section extent (figure 16). Three blanket soil materials are present in this reach at the lowest point inside the ditch, embankment fill, sand and marsh. The embankment fill has a unit weight of 114 pcf, the sand has a unit weight of 122 pcf and the marsh has a unit weight of 101 pcf. Assuming this stratigraphy is consistent through the subreach. The calculated average unit weight is 111 pcf.

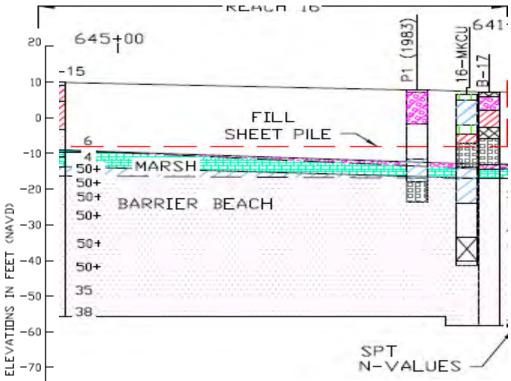


Figure 13 Reach 16D (From the MWOL Orleans Canal March 2011 report)



Table 7 Summary of Hydraulic Property Values for landside blanket for R16D (642+65 to 646+41)

Reach 16D Hydrau	lic Properties						
Unit	Classification (USCS) (Typical)	Saturated Permeability (Kx)	Permeability Ratio (Ky/ Kx)	Top Elevation of Blanket (ft)	Bottom Elevation of Blanket (ft)	Thickness of Blanket (ft)	Unit Weight (pcf)
Levee Embankment CL	CH, CL	2.62e-007 ft/sec	1	N/A	N/A	N/A	N/A
Levee Embankment PS	CH, CL	1.31e-005 ft/sec	1	-3.1	-4.2	1.1	114
Sand	SP	0.00049 ft/sec	1	-4.2	-7.4	3.2	122
Marsh	СНО	1.31e-005 ft/sec	1	-7.4	-11	3.6	101

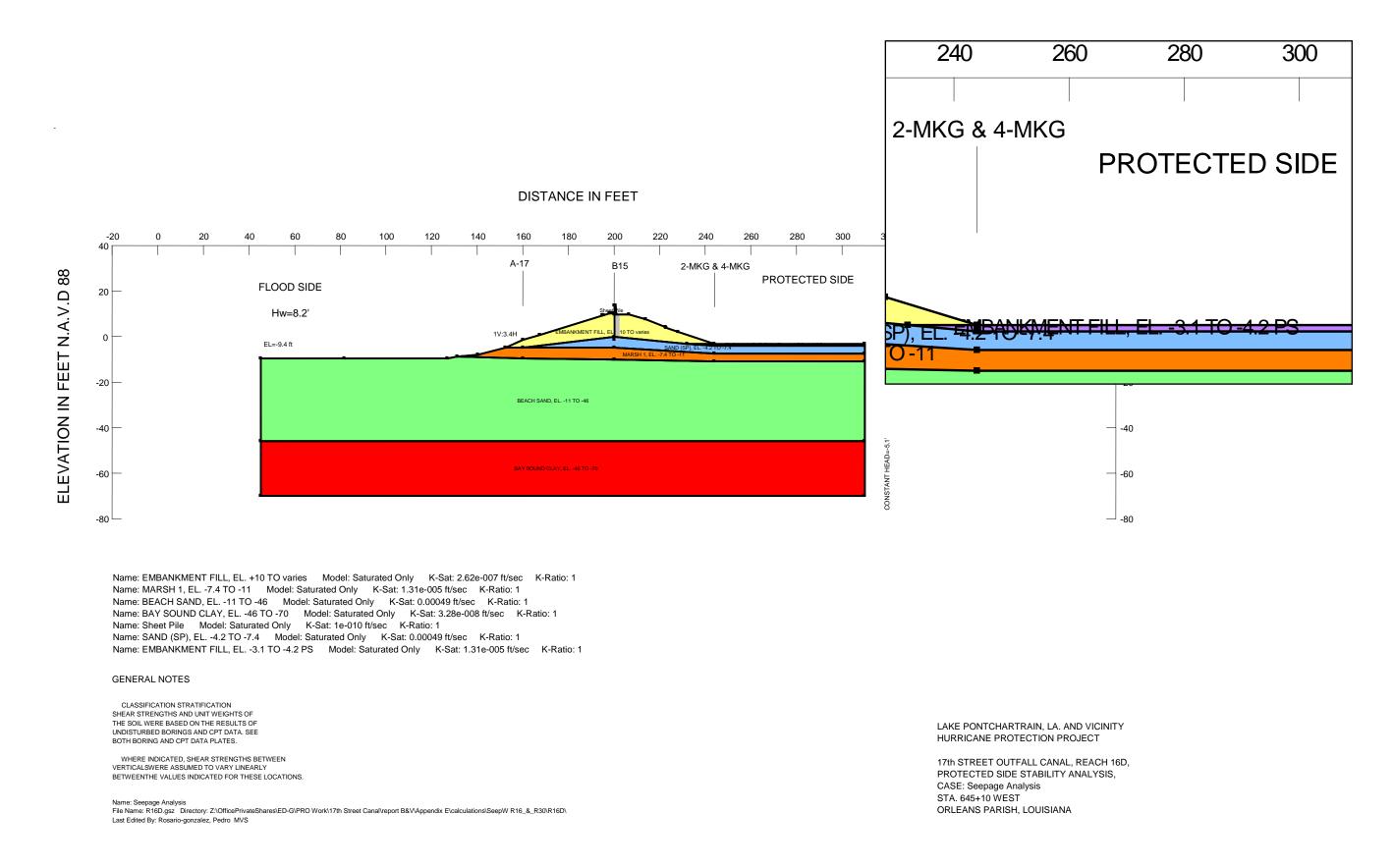


Figure 14 SLOPE/W Model Plot with Screen Shot of Drainage Inlet

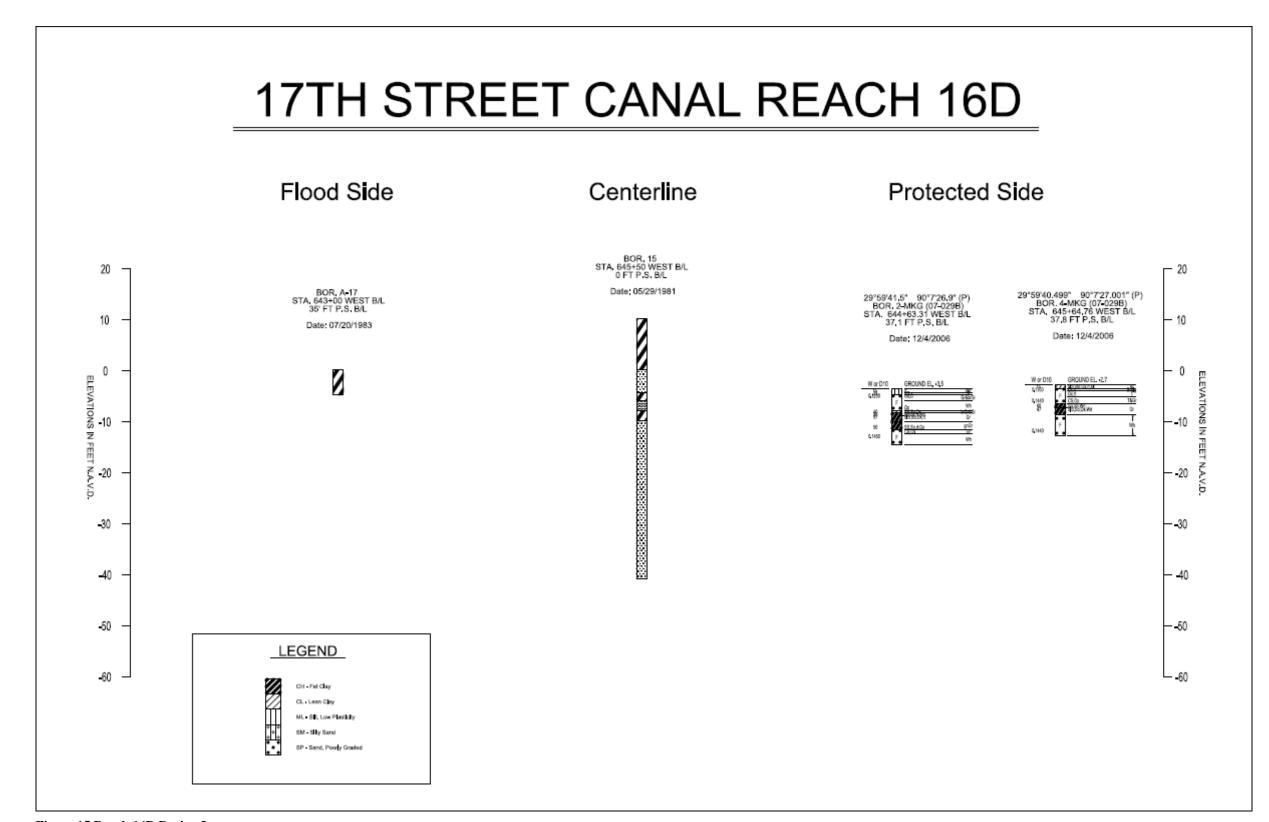


Figure 15 Reach 16D Boring Logs

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Project Number: 12-017136 Boring: 17MVS-02PU

Current Date: 11/27/2012

78 5 5 4 4 3 6 5 7 8 5 7 8 6 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7 8 7	Z 10
	Sample Number
0.0 1.0 2.0 2.7 4.0 4.5 11.0 13.5	Depth
BR ML W/ ARS CH, G BR ML W/ ARS CH, G BR ML W/ ARS CH, G M BR CH4 W/ ARS ML, O, G ST BR CH2 W/ LYS SM, O, G, RT BR SP BR SP BR SP BR SP BR SP BR SP BR SP BR SP BR SP BR SP BR SP BR SP BR SP W/ O, G	Visual Classification
\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	USCS
	E (£)
222222222222222222222222222222222222222	¥\$
(pcf)	Dry
(pcf)	Wet
	s th th
Туре	Shear Test
	Angle
FC I	Cohesion
St.	Unconf.
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	Id
	ΡI
	Torvane
i di di di di di di di di di di di di di	Other

Remarks:

Stantec Consulting Services Inc.

Checked By:
File Name: tmp_be_boring_log_v10_0.xlsm

Project: Lake Pontchartrain & Vicinity Hurricane Protection Project 17th StreetAssigned By:

Project Number: 12-017136 Boring: 17MVS-01PU

Current Date: 11/27/2012

	Sample Depth Visual Classification USCS
ST BR CL4 W/ LYS MIL, LYS SM, G BK & LGR SM W/ O, RT, G GR SM W/ O, RT, G M LGR CH4 W/ ARS SP, WD M LGR CH2 W/ ARS SO M LGR CH4 W/ ARS SM, CC M LGR CH4 W/ LYS & ARS SP, RT CH4 W/ SO LGR CL4 VSO LGR CH4 W/ S, ARS CH, RT LGR SP W/ ARS CH, RT LGR SP W/ ARS CH, O, WD LGR SP W/ O, ARS CH SP LGR SP W/ O, ARS CH SP 28 LGR SP W/ O, ARS CH SP 29 29 20 20 21 21 22 22 23 24 25 26 27 28 29 29 20 20 20 20 21 21 22 22 23 24 25 26 27 28 29 29 20 20 20 20 21 21 22 22 23 24 25 26 27 28 29 20 20 20 20 21 21 21 22 22 23 24 26 27 28 29 20 20 20 20 20 21 21 21 21 22 22 23 24 25 26 27 28 29 20 20 20 20 20 21 21 21 21 21 21 21 21 21 21 21 21 21	Visual Classification
LYSSM, G CL4 24 , WD CH2 SM 66 CH4 60 CH2 33 CH4 46 CH4 46 CH4 36 CL4 27 SP 28 SP 22	
228 4 5 1 3 3 6 6 8 2 4 5 1 3 3 6 6 8 2 4 5 1 3 3 6 6 8 2 4 5 1 3 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5	uscs
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	Dens (pcf)
······································	sat
	Shear Test
	Angle
	Cohesion (psf)
	Comp.
	F
	PI
	I A
	Torvane (tsf)
	Other Tests

Remarks:

Stantec Consulting Services Inc.

File Name: tmp_be_boring_log_v10_0.x1sm

Checked By:

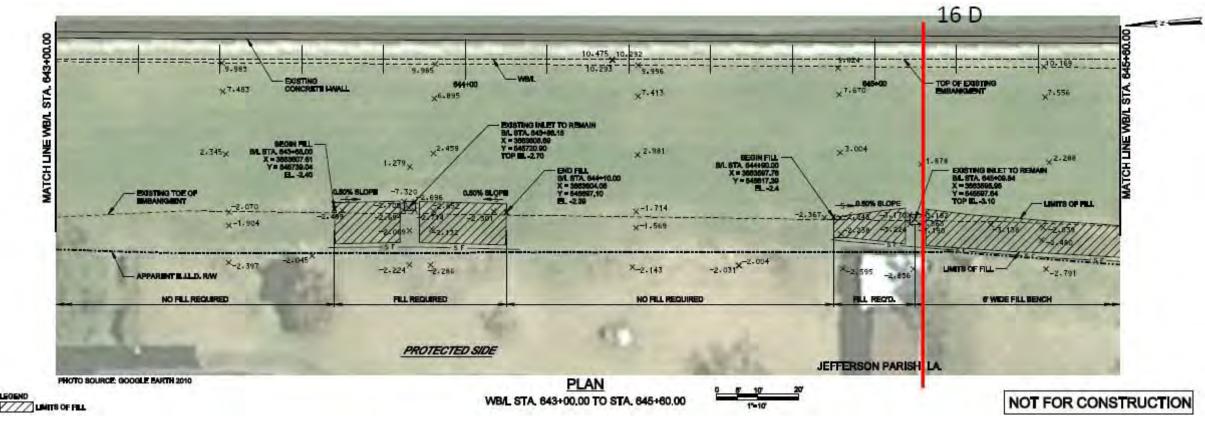


Figure 16 Reach 16C Plan View Cross Section Extent

Results

The following tables (8-11) and figures (17-20) provide detail of the results of the seepage analyses conducted for the selected sub-reaches on Reach 16. Results presented in these figures are for the critical locations for each sub-reach cross section.

Reach 16A

Table 8 R16A Seep/W outputs

				Weighted Unit weight		109													
				Critica	l gradient	0.747													
offset levee toe (ft)	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore-Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY- Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
0	13799	247	-2.455	0	-2.455	0	0	-2.59E-05	0	4.67E-06	1.07E-05	1.17E-05	6.01E-01	9.00E-01	1.08E+00	1.21E-05	1.21E-05	0	0
	13796	247	-9.3	0	0.54843	614.54184	9.848427	None	None	5.56E-06	5.50E-06	7.82E-06	0.0688968	2.22E-01	0.23208787	8.01E-05	8.01E-05	0	0
		0.045			0.00040														
		6.845			3.00343														
			exit gradient	0.439		FS	1.70												
6	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore-Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY- Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
	14205	253	-2.518	0	-2.518	0	0	-1.66E-05	0	1.72E-06	1.00E-05	1.02E-05	-2.95E-01	1.20E+00	1.24E+00	1.21E-05	1.21E-05	0	0
	14203	253	-9.3	0	0.16098	590.36537	9.460984	None	None	4.91E-06	5.50E-06	7.37E-06	0.0604252	2.21E-01	0.22893296	8.01E-05	8.01E-05	0	0
		6.782			2.67898														
		0.702			2.07696														
			exit gradient	0.395		FS	1.89												
19	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore-Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY- Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
	15115		-1.395	0	-1.395	0	0	-5.35E-07	0	1.26E-07	5.37E-07	5.52E-07	-6.37E-02		3.33E-01	1.64E-06	1.64E-06	0	0
	15112	266	-9.3	0	-0.5869	543.69982	8.713138	None	None	4.61E-06	1.28E-06	4.78E-06	0.0573764	4.92E-02	0.07560206	8.01E-05	8.01E-05	0	0
		7.905			0.80814														
			exit gradient	0.102		FS	7.30												

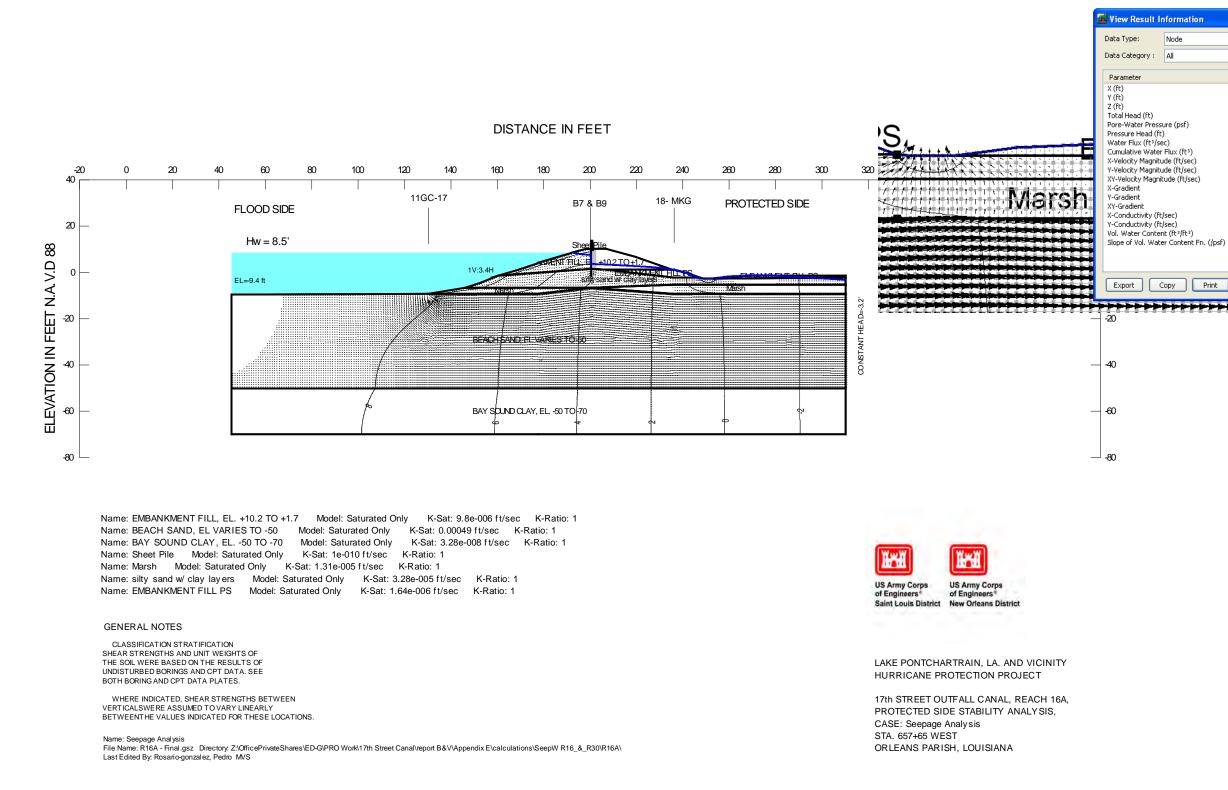


Figure 17 R16A SEEP/W Model Plot with Screen Shot of Drainage Inlet

Node

13799

-2.455

-2.455

-2.5876287e-005

4.6656927e-006

1.0693536e-005

1.1667065e-005

1.2083623e-005

1.2083623e-005

0.60067098

0.89974485

1.0818255

13796

-9.3

614.54184

9.8484269

5.5550485e-006

5.497028e-006

0.06889682

0.22162583

0.23208787

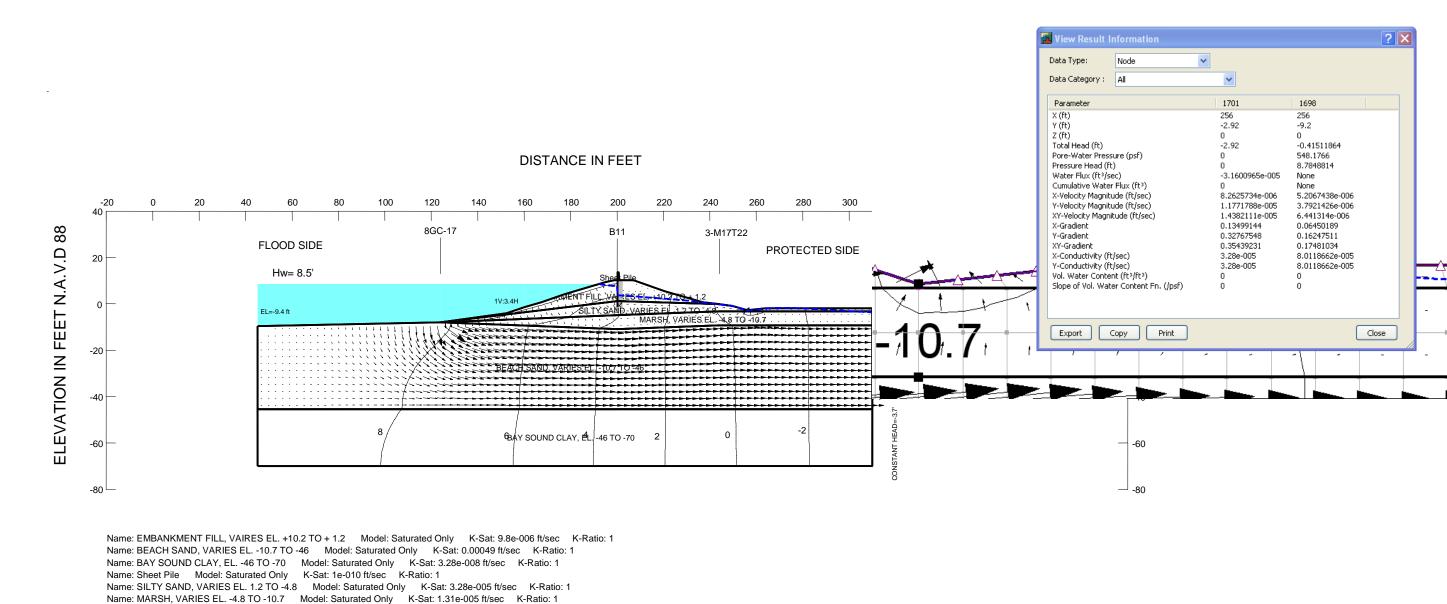
8.0118662e-005

Close

Reach 16B

Table 9 R16B Seep/W outputs

Table 9 1	R16B Seep	/W output:	S		1								1				T-		T-
				Weighted Unit weight		102													
				Critical g	radient	0.635													
offset levee toe (ft)	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore- Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY- Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
0	1604	244	-0.255	0	-0.255	0	0	-4.56E- 06	0	2.80E-06	1.04E-06	2.98E-06	1.28E-01	5.27E-02	1.38E-01	2.19E-05	2.19E-05	0	0
	1602	244	-9.2	0	0.3895	598.38494	9.5895	None	None	5.35E-06	1.49E-06	5.56E-06	0.0663101	4.89E-02	0.08238681	8.01E-05	8.01E-05	0	0
		8.945			0.6445														
			exit gradient	0.072		FS	8.81												
12	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore- Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY- Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
	1701	256	-2.92	0	-2.92	0	0	-3.16E- 05	0	8.26E-06	1.18E-05	1.44E-05	1.35E-01	3.28E-01	3.54E-01	3.28E-05	3.28E-05	0	0
	1698	256	-9.2	0	-0.4151	548.1766	8.78488	None	None	5.21E-06	3.79E-06	6.44E-06	0.0645019	1.62E-01	0.17481034	8.01E-05	8.01E-05	0	0
		6.28			2.50488														
			exit gradient	0.399		FS	1.59												
17	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore- Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY- Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
	1726	261.3333	- 2.3386667	0	-2.3387	0	0	-9.30E- 06	0	3.92E-06	3.29E-06	5.12E-06	-1.19E-01	9.33E-02	1.51E-01	3.28E-05	3.28E-05	0	0
	1747	262	-9.2	0	-0.7879	524.91816	8.41215	None	None	6.21E-06	2.96E-06	6.87E-06	0.0603019	1.21E-01	0.1350725	8.01E-05	8.01E-05	0	0
		6.893645			1.55082														
			ovit																
			exit gradient	0.225		FS	2.82												



GENERAL NOTES

CLASSIFICATION STRATIFICATION
SHEAR STRENGTHS AND UNIT WEIGHTS OF
THE SOIL WERE BASED ON THE RESULTS OF
UNDISTURBED BORINGS AND CPT DATA. SEE
BOTH BORING AND CPT DATA PLATES.

WHERE INDICATED, SHEAR STRENGTHS BETWEEN VERTICALSWERE ASSUMED TO VARY LINEARLY BETWEENTHE VALUES INDICATED FOR THESE LOCATIONS.

LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

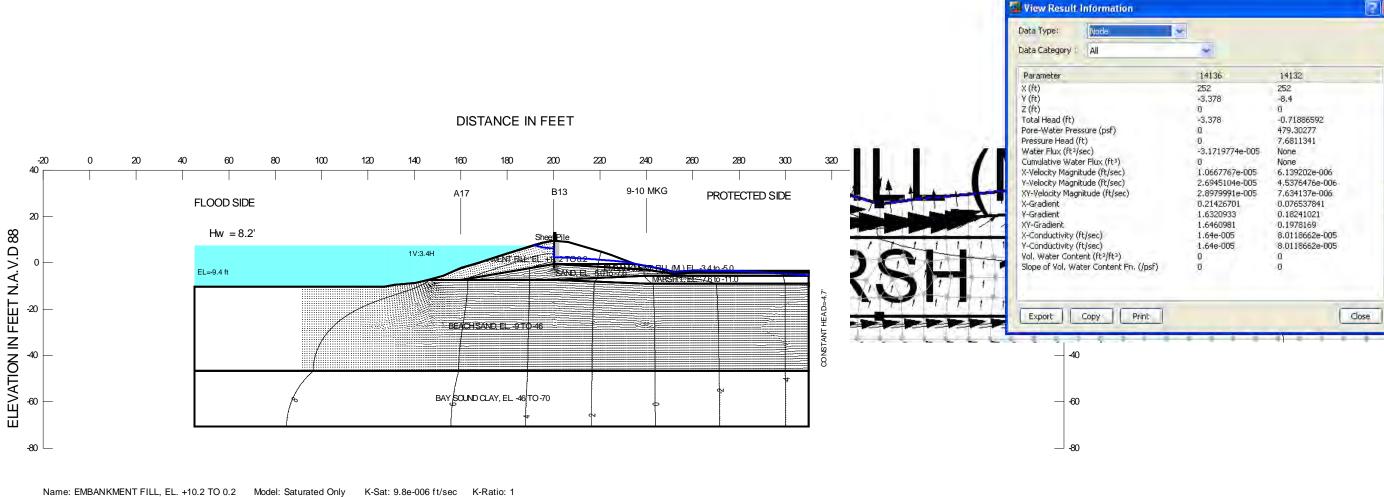
17th STREET OUTFALL CANAL, REACH 16B, PROTECTED SIDE STABILITY ANALYSIS, CASE: Seepage Analysis STA. 653+37 WEST ORLEANS PARISH, LOUISIANA

Figure 18 R16B SEEP/W Model Plot with Screen Shot of Drainage Inlet

Reach 16C

Table 10 R16C Seep/W outputs

				Weighted Unit weight		106													
				Critical g	radient	0.699													
offset levee toe (ft)	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore- Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY-Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
0	12950	235	0.192	0	0.192	0	0	-3.59E- 06	0	3.88E-06	1.73E-06	4.25E-06	2.85E-01	6.92E-02	2.93E-01	1.38E-05	1.38E-05	0	0
	12947	235	-8.2	0	0.64502	551.92898	8.845016	None	None	6.48E-06	7.25E-07	6.52E-06	0.08081	2.47E-02	0.084508196	8.01E-05	8.01E-05	0	0
		8.392			0.45302														
			exit gradient	0.054		FS	12.94												
17	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore- Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY-Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
	14136	252	-3.378	0	-3.378	0	0	-3.17E- 05	0	1.07E-05	2.69E-05	2.90E-05	2.14E-01	1.63E+00	1.65E+00	1.64E-05	1.64E-05	0	0
	14132	252	-8.4	0	-0.7189	479.30277	7.681134	None	None	6.14E-06	4.54E-06	7.63E-06	0.076538	1.82E-01	0.1978169	8.01E-05	8.01E-05	0	0
		5.022			2.65913														
			exit gradient	0.529		FS	1.32												
25	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore- Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY-Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
	14684	260	-2.595	0	-2.595	0	0	-2.43E- 06	0	6.07E-07	2.89E-06	2.95E-06	-4.41E- 02	1.75E-01	1.80E-01	1.64E-05	1.64E-05	0	0
	14681	260	-8.4	0	-1.3026	442.87583	7.097369	None	None	5.62E-06	4.02E-06	6.91E-06	0.070036	1.60E-01	0.17484208	8.01E-05	8.01E-05	0	0
		5.805			1.29237														
		0.000			1.20207														
			exit gradient	0.223		FS	3.14												



Name: EMBANKMENT FILL, EL. +10.2 TO 0.2 Model: Saturated Only K-Sat: 9.8e-006 ft/sec K-Ratio: 1
Name: MARSH 1, EL. -7.6 to -11.0 Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1
Name: BEACH SAND, EL. -9 TO -46 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1
Name: BAY SOUND CLAY, EL. -46 TO -70 Model: Saturated Only K-Sat: 3.28e-008 ft/sec K-Ratio: 1
Name: Sheet Pile Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1
Name: SAND, EL. -5.0 to -7.6 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1
Name: EMBANKMENT FILL (ML) EL. -3.4 to -5.0 Model: Saturated Only K-Sat: 1.64e-005 ft/sec K-Ratio: 1

GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS AND CPT DATA. SEE BOTH BORING AND CPT DATA PLATES.

WHERE INDICATED, SHEAR STRENGTHS BETWEEN VERTICALSWERE ASSUMED TO VARY LINEARLY BETWEENTHE VALUES INDICATED FOR THESE LOCATIONS

Name: Sepage Analysis
File Name: R16C.gsz Directory: Z:\OfficePrivateShares\ED-G\PRO Work\17th Street Canal\report B&V/Appendix E\calculations\SeepW R16_&_R30\R16C\
Last Edited By: Rosañ-ogonzalez, Pedro M/S



LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

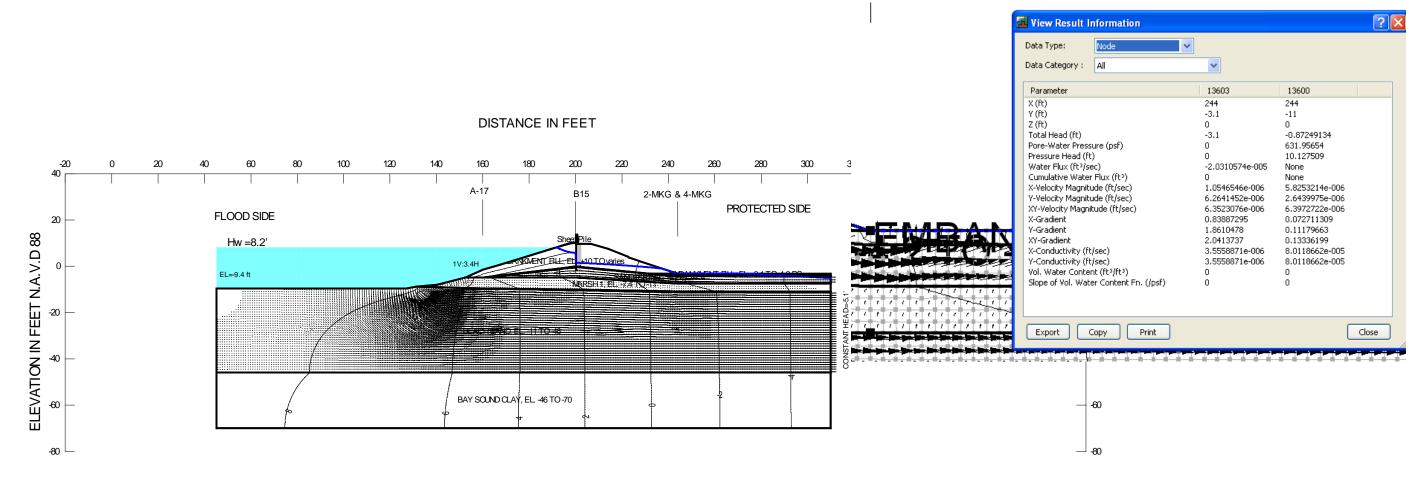
17th STREET OUTFALL CANAL, REACH 16C, PROTECTED SIDE STABILITY ANALYSIS, CASE: Seepage Analysis STA. 648+89 WEST ORLEANS PARISH, LOUISIANA

Figure 19 R16C SEEP/W Model Plot with Screen Shot of Drainage Inlet

Reach 16D

Table 11 R16D Seep/W outputs

				Weighted Unit weight		111													
				Critical o	gradient	0.779													
offset levee toe (ft)	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore-Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY- Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
0	13603	244	-3.1	0	-3.1	0	0	-2.03E-05	0	1.05E-06	6.26E-06	6.35E-06	8.39E-01	1.86E+00	2.04E+00	3.56E-06	3.56E-06	0	0
	13600	244	-11	0	-0.8725	631.95654	10.12751	None	None	5.83E-06	2.64E-06	6.40E-06	0.0727113	1.12E-01	0.13336199	8.01E-05	8.01E-05	0	0
		7.9			2.22751														
			exit gradient	0.282		FS	2.76												
23	Node	X (ft)	Y (ft)	Z (ft)	Total Head (ft)	Pore-Water Pressure (psf)	Pressure Head (ft)	Water Flux (ft³/sec)	Cumulative Water Flux (ft³)	X-Velocity Magnitude (ft/sec)	Y-Velocity Magnitude (ft/sec)	XY- Velocity Magnitude (ft/sec)	X- Gradient	Y- Gradient	XY- Gradient	X- Conductivity (ft/sec)	Y- Conductivity (ft/sec)	Vol. Water Content (ft³/ft³)	Slope of Vol. Water Content Fn. (/psf)
	15161	267	-3.1	0	-3.1	0	0	-1.54E-06	0	6.15E-08	1.55E-06	1.55E-06	-5.53E-11	1.17E-01	1.17E-01	1.31E-05	1.31E-05	0	0
	15158	267	-11	0	-2.4046	536.35282	8.595398	None	None	5.09E-06	2.00E-06	5.47E-06	0.0635446	7.91E-02	0.10145344	8.01E-05	8.01E-05	0	0
		7.9			0.6954														
			exit gradient	0.088		FS	8.85												



Name: EMBANKMENT FILL, EL. +10 TO varies Model: Saturated Only K-Sat: 2.62e-007 ft/sec K-Ratio: 1

Name: MARSH 1, EL. -7.4 TO -11 Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1

Name: BEACH SAND, EL. -11 TO -46 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1

Name: BAY SOUND CLAY, EL. -46 TO -70 Model: Saturated Only K-Sat: 3.28e-008 ft/sec K-Ratio: 1

Name: Sheet Pile Model: Saturated Only K-Sat: 1e-010 ft/sec K-Ratio: 1

Name: SAND (SP), EL. -4.2 TO -7.4 Model: Saturated Only K-Sat: 0.00049 ft/sec K-Ratio: 1

Name: EMBANKMENT FILL, EL. -3.1 TO -4.2 PS Model: Saturated Only K-Sat: 1.31e-005 ft/sec K-Ratio: 1

GENERAL NOTES

CLASSIFICATION STRATIFICATION SHEAR STRENGTHS AND UNIT WEIGHTS OF THE SOIL WERE BASED ON THE RESULTS OF UNDISTURBED BORINGS AND CPT DATA. SEE BOTH BORING AND CPT DATA PLATES.

WHERE INDICATED, SHEAR STRENGTHS BETWEEN VERTICALSWERE ASSUMED TO VARY LINEARLY BETWEENTHE VALUES INDICATED FOR THESE LOCATIONS.

Name: Seepage Analysis
File Name: R16D.gsz Directory: Z:\OfficePrivateShares\ED-G\PRO Work\17th Street Canal\report B&V\Appendix E\calculations\SeepW R16_&_R30\R16D\
Last Edited By: Rosario-gonzalez, Pedro M/S



LAKE PONTCHARTRAIN, LA. AND VICINITY HURRICANE PROTECTION PROJECT

17th STREET OUTFALL CANAL, REACH 16D, PROTECTED SIDE STABILITY ANALYSIS, CASE: Seepage Analysis STA. 645+10 WEST ORLEANS PARISH, LOUISIANA

Figure 20 R16A SEEP/W Model Plot with Screen Shot of Drainage Inlet

Hand Calculations example R16C:

Step 1

Obtained Hydraulic Grade Line graph from SEEP/W analysis.

Step2

Average gradients are defined as the change in total head across a layer of soil (Equation 1).

Equation 1:

$$i = \frac{(h_1 - h_2)}{(z_1 - z_2)}$$

 $i = Average\ Gradient$ $h_1 = Head\ at\ Top\ of\ Aquifer,ft$ $h_2 = Head\ at\ Bottom\ of\ Aquifer,ft$ $z_1 = Elevation\ at\ Top\ of\ Aquifer,ft$ $z_2 = Elevation\ at\ Bottom\ of\ Aquifer,f$

Equation 2:

$$\gamma_{AVG} = \frac{(z_1 * \gamma_1 + z_2 * \gamma_2 ...)}{(z_1 + z_2 ...)} = \frac{(0.8 * 114 + 0.7 * 122 + 101 * 3.5)}{(0.8 + 0.7 + 3.5)} = 106 \ pcf$$

$$z_{1,2} = thickness \ of \ Soil \ Strata, ft$$

$$\gamma_{1,2} = Unit \ Weight \ of \ Soil \ Strata, pcf$$

Equation 3:

$$i_c = \frac{(\gamma_{AVG} - \gamma_{WATER})}{(\gamma_{WATER})} = \frac{(106 - 62.4)}{62.4} = 0.699$$

 $i_c = Critical \ Gradient \ for \ Soil$ $\gamma_{AVG} = Average \ Unit \ Weight \ of \ Blanket, pcf$ $\gamma_{WATER} = Unit \ Weight \ of \ Water, 62.4 \ pcf$

Conclusion

Reach 16B and 16C were the only two reaches out of the four analyzed by MVS with a seepage FoS less than 1.6. In both deficiencies reaches there is a continuous inlet drainage ditch on the protected side of the levee. The Seep/W models shown the velocity vectors concentrate at the ditch, resulting in high pore pressures and exit gradients. While the URS seepage FoS are somewhat higher than the ones calculated by MVS, their analyses does not account for the variation in elevations on the protected side caused by the inlet ditch. Also, the stratigraphy used by URS and prepared by B&V to run seep/w was conservatively created for slope stability analysis and not for seepage analyses. Table 12 points out the differences between URS and MVS seepage analysis

Table 12 Differences between URS and MVS seepage analysis

	URS	MVS
No. Reach Analyzed on Seep/W	1	4
SWL (ft)	10 approximately 2000 ft after pump station 6	8.5 approximately 2000 ft after pump station 6
	8	8.2
		Sand and Marsh
Blanket	Maintained constant	Sand and Marsh
Distribution	(Clay fill and Marsh)	Silt, Sand and Marsh
		Clay, Sand and Marsh
		6.8
Blanket Thickness	5.0	6.3
(ft)	5.9	5.0
		7.9
Drainage Inlet Model on Seep/W	No	Yes
Hydraulic Permeability	Maintained previously from Black & Veatch	Obtained from DIVR 1110-1-400



								MKG-15,17,18
Boring name	de _l	pth	ele	ev	layer thickness	USCS	Fine content %	avg. thicknes
	0	0.7	-2.1	-2.8	1.7	SM	7.6	(ft) Blanket 2.1
	0.7 1.7	1.7 2.3	-2.8 -3.8	-3.8 -4.4	0.6	CH SM	8.4	SP 1.3 MARSH 4.3
14-MKG	2.3 5	5	-4.4	-7.1	4.3	CH CH		AQU x
	6.3	6.3 6.6	-7.1 -8.4	-8.4 -8.7	4.5	CL		
	6.6	7	-8.7	-9.1	0.4	SP		
Boring	4.		.1		layer		Fine	MVC 4446 0 DU 07 00 Du day
name	aeı	pth	eli	ev	thickness	USCS	content %	MKG-14,16 & PU- 07,08 Borings
	0	0.6	-0.9	-1.5		СН		avg. thicknes
	0.0		1.5	1.0	1	CL		(ft)
	0.6 1	1 1.6	-1.5 -1.9	-1.9 -2.5	0.6	SM	7	Blanket 2.7 SP 1.03
15-MKG	1.6	3	-2.5	-3.9		CH	12.2	MARSH 2.8
	3 3.7	3.7 5	-3.9 -4.6	-4.6 -5.9	5	SM CH	13.3	AQU x
	5	6.1	-5.9	-7 7.5		CH	10	
	6.1	6.6 7	-7 -7.5	-7.5 - 7. 9	0.4	SM SP	19	
							_	
Boring name	dej	pth	ele	ev	layer thickness	USCS	Fine content %	
Haille	0	1.6	-0.8	-2.4	tilickHess	ML	CONTENT 70	
	1.6	2	-2.4	-2.8	2.2	CL		
16-MKG	2 4	4 6.4	-2.8 -4.8	-4.8 -7.2		ML CH		
	6.4	7	-7.2	-7.8	3	CL		
	7	9.5	-7.8	-10.3	2.5	SP		
Boring	4.				layer		Fine	
name	dej	ptri	eli	ev	thickness	USCS	content %	
	0	0.4	-0.2	-0.6		ML		
	0.4 1	1 2.2	-0.6 -1.2	-1.2 -2.4	3.6	CL CH		
17-MKG	2.2	2.9	-2.4	-3.1		ML		
17-IVIKG	2.9 3.6	3.6 4.1	-3.1 -3.8	-3.8 -4.3	0.5	CL SM	10	
	4.1	7	-4.3	-7.2	3.6	CH		
	7 7.7	7.7 10	-7.2 -7.9	-7.9 -10.2	2.3	CH SP		
							_	
Boring name	de	pth	ele	ev	layer thickness	USCS	Fine content %	
	0	0.7	0.1	-0.6		CL		
	0.7	1.4	-0.6	-1.3	1.8	СН		
18-MKG	1.4 1.8	1.8 4.5	-1.3 -1.7	-1.7 -4.4	2.7	ML SM	5.7	
18-IVIKG	4.5	4.9	-4.4	-4.8	4.2	CL		
	4.9 7	7 8.7	-4.8 -6.9	-6.9 -8.6	4.2	CH CH		
	8.7	10.4	-8.6	-10.3	1.7	SP		
D					le e		F: · ·	
Boring name	de	pth	ele	ev	layer thickness	USCS	Fine content %	
	0	1	-1.3	-2.3		ML		
	1 2	2 4	-2.3 -3.3	-3.3 -5.3	4	CL SM	22.8	
07-PU	4	6.5	-5.3	-7.8	2.5	SP		
5710	6.5 9	9 11.5	-7.8 -10.3	-10.3 -12.8	2.5 2.5	SM SM	9.9 8.7	
	11.5	14	-10.3	-12.8	2.5	SM	0.7	
	14	16	-15.3	-17.3	2	SM		
Boring					layer		Fine	
name	dej	pth	ele	ev	thickness	USCS	content %	
	0	1	-2	-3	2	ML		
	1 2	2 3	-3 -4	-4 -5	3	ML ML		
	3	4	-5	-6	1	SM		
08-PU	4 5	5 8	-6 -7	-7 -10	4	CH CH		
	8	10.5	-10	-12.5	2.5	SM	5.1	
	10.5 13	13 15.5	-12.5 -15	-15 -17.5	2.5 2.5	SM SM	6.5 6	
	15.5	17	-17.5	-19	1.5	SM		

Boring name	d€	epth	el	ev	layer thickness	USCS	Fine content %
	0	1	-1.2	-2.2	2.5	CL	
	1	2.5	-2.2	-3.7	2.5	ML	
13-MKG	2.5	3.6	-3.7	-4.8		CL	
13-IVING	3.6	7.5	-4.8	-8.7	5.3	CH	
	7.5	7.8	-8.7	-9		CL	
	7.8	9.7	-9	-10.9	1.9	SP	
	b	lanket thick	nes		7.8		

	Borings		
		avg. thicknes (ft)	AVG aqu top elev.
	Blanket SP	2.5 0.0	x
	MARSH AQU	5.3 x	-9.0
avg b	lanket thic	knes=	7.8

	0	1	-2.4	-3.4		ML
	1	2	-3.4	-4.4	4	SM
	2	4	-4.4	-6.4		SM
06-PU	4	6.5	-6.4	-8.9	2.5	SP
00-10	6.5	9	-8.9	-11.4	2.5	SP
	9	11.5	-11.4	-13.9	2.5	SP
	11.5	14	-13.9	-16.4	2.5	SP
	14	16	-16.4	-18.4	2	SP
	bla	anket thick	nes		4	

PU-Borings										
		avg. thicknes (ft)	AVG aqu top elev.							
	Blanket SP	4.0 0.00	х							
	MARSH	0.0	<i>c</i> 4							
	AQU	Х	-6.4							
avg blanket thicknes= 4.0										

63.2

16.1

Boring name	de	pth	el	ev	layer thickness	USCS	Fine content %
	0	0.6	-2	-2.6	1.5	СН	,,
6-MKG	0.6 1.5	1.5 2.1	-2.6 -3.5	-3.5 -4.1	0.6	ML SP	
	2.1 7.9	7.9 9.7	-4.1 -9.9	-9.9 -11.7	5.8	CH SP	
		anket thick		-11.7	7.9	J.	
	0 0.5	0.5 1.4	-1.6 -2.1	-2.1 -3	1.4	CL ML	
7-MKG	1.4	2.4	-3	-4	1	SM	9.8
	2.4 3.1	3.1 3.7	-4 -4.7	-4.7 -5.3	7.1	CH CH	
	3.7 9.5	9.5 12	-5.3 -11.1	-11.1 -13.6	2.5	CH SP	
	bl	anket thick	nes		9.5		
	0	0.4	-2.6	-3	1.4	CL	
	1.4	1.4 3.6	-3 -4	-4 -6.2	2.2	ML SM	5.9
8-MKG	3.6 4.3	4.3 5.5	-6.2 -6.9	-6.9 -8.1		CL CH	
	5.5 6.5	6.5 7.5	-8.1 -9.1	-9.1 -10.1	3.9	ML CH	
	7.5	8.5 anket thick	-10.1	-10.1	1	SP	
	DI				7.5		
	1.7	1.7 2.9	-0.8 -2.5	-2.5 -3.7	1.7 2.5	ML SP	
9-MKG	2.9 4.2	4.2 7.7	-3.7 -5	-5 -8.5	3.5	SM CH	9.2
	7.7	8.9 anket thick	-8.5	-9.7	1.2	SP	
					7.7		
	0 1.7	1.7 2.7	-0.6 -2.3	-2.3 -3.3	1.7	ML SP	
10-MKG	2.7 3.5	3.5 7	-3.3 -4.1	-4.1 -7.6	4.9	ML CH	
-	7.6	7.6 8.2	-7.6 -8.2	-8.2 -8.8	0.6	CL	5.4
	8.2	10.5	-8.8	-8.8 -11.1	2.3	SP	5.1
	DI	anket thick	nes		7.6		
	0 0.5	0.5 3.3	0.4 -0.1	-0.1 -2.9	3.3	CL ML	
11-MKG	3.3 4.1	4.1 7.9	-2.9 -3.7	-3.7 -7.5	0.8 3.8	SP CH	
	7.9	9.5 anket thick	-7.5	-9.1	1.6	SP	
					7.9		
	0 0.4	0.4 1.5	0.8 0.4	0.4 -0.7	1.5	ML CH	
	1.5 2.2	2.2 3.3	-0.7 -1.4	-1.4 -2.5	0.7	SI ML	
12-MKG	3.3 3.8	3.8 4.8	-2.5 -3	-3 -4	4	SM CH	8.8
	4.8	6.2	-4 -5.4	-5.4 -6.2	0.8	CL SP	
		anket thick		-6.2	6.2	SP	
	0	1	-2.4	-3.4	1	SM	49.1
	1 2	2	-3.4 -4.4	-4.4 -5.4	3	SM SP	3.5
03-PU	3	4 6.5	-5.4 -6.4	-6.4 -8.9	2.5	SP SM	17.8
	6.5 9	9	-8.9 -11.4	-11.4 -13.9	2.5	SM SP	5
	11.5	14	-13.9	-16.4	2.5	SP	
	14 bl	16 anket thick	-16.4 nes	-18.4	2 6.5	SP	
	0	1	-2.7	-3.7		ML	
	1 2	2	-3.7 -4.7	-4.7 -5.7	3	SM SM	42.4
04-PU	3	4 6.5	-5.7 -6.7	-6.7 -9.2	1 2.5	SP SM	44.4
04-10	6.5	9	-9.2	-11.7	2.5	SP	14.4
	9 11.5	11.5 14	-11.7 -14.2	-14.2 -16.7	2.5 2.5	SM SM	6.2
	14 bl	16 anket thick	-16.7 nes	-18.7	6.5	SM	
	0	1	-1.9	-2.9		CL	
	1 2	2 3	-2.9 -3.9	-3.9 -4.9	4	MH CH	
	3	4	-4.9	-5.9		СН	
	5	5 8	-5.9 -6.9	-6.9 -9.9	4	SP SM	16.2
	8 9	9 10	-9.9 -10.9	-10.9 -11.9	1	SM SP	
	10 12	12 14.5	-11.9 -13.9	-13.9 -16.4	2 2.5	SP SM	
	14.5 17	17 19.5	-16.4 -18.9	-18.9 -21.4	2.5	SM SP	
	19.5	22	-21.4	-23.9	2.5	SM	
05-PU	22 24.5	24.5 27	-23.9 -26.4	-26.4 -28.9	2.5 2.5	SP SP	
	27 29.5	29.5 32	-28.9 -31.4	-31.4 -33.9	2.5 2.5	SP SP	
	32 34.5	34.5 37	-33.9 -36.4	-36.4 -38.9	2.5	SP SP	
	37	39.5	-38.9	-41.4	2.5	SP	
	39.5 42	42 44.5	-41.4 -43.9	-43.9 -46.4	2.5 2.5	SP SP	
	44.5 47	47 49.5	-46.4 -48.9	-48.9 -51.4	2.5 2.5	SP SP	
	49.5 52	52 54.5	-51.4 -53.9	-53.9 -56.4	2.5 2.5	SP SP	
	54.5	57	-56.4	-58.9	2.5	SP	
	57 59.5	59.5 61	-58.9 -61.4	-61.4 -62.9	2.5 1.5	SP SP	
	bl	anket thick	nes		9		

MKG-Borings

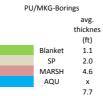
		avg. thicknes (ft)	top elev
	Blanket	1.8	
	SP	1.3	x
	MARSH	4.7	
	AQU	×	-8.7

PU-Borings

PO-BOTTINGS								
		avg. thicknes (ft)	AVG aqu top elev.					
	Blanket	2.7						
	SP	1.67	x					
	MARSH	3.0						
	AQU	×	-9.7					

avg blanket thicknes= 7.

Boring name	de	pth	el	⊇V	layer thickness	USCS	Fine content 9
	0	1	-3.5	-4.5	1	ML	
	1	3.4	-4.5	-6.9	2.4	SP	
1-MKG	3.4	5.7	-6.9	-9.2		CH	
	5.7	7.6	-9.2	-11.1	4.9	CH	
	7.6 8.3	8.3 9.5	-11.1 -11.8	-11.8 -13	1.2	CL SP	
		anket thick		-13	8.3	38	
	51	ariket triiek	nes		6.5		
	0	1.1	-3.5	-4.6	1.1	ML	
	1.1	4.3	-4.6	-7.8	3.2	SP	
2-MKG	4.3	4.7	-7.8	-8.2		CL	
	4.7	6.4	-8.2	-9.9	3.7	СН	
	6.4	8	-9.9	-11.5		СН	
	8	11	-11.5	-14.5	3	SP	
	bl	anket thick	nes		8		
	0	1	-3.5	-4.5		SM	
	1	2.1	-4.5	-5.6	2.9	SP	
3-MKG	2.1	2.9	-5.6	-6.4		SM	3.3
	2.9	5.3	-6.4	-8.8	2.4	CH	
	5.3	9.9 anket thick	-8.8	-13.4	4.6	SP	
	Di	anket tillek	iles		5.3		
	0	0.7	-2.7	-3.4	0.7	CL	
	0.7	3.7	-3.4	-6.4	3	SP	
4-MKG	3.7	4.5	-6.4	-7.2	2.1	CH	
	4.5	5.8	-7.2	-8.5	4.2	CH	
	5.8	10 anket thick	-8.5	-12.7	5.8	SP	
	51	ariket triiek	iles		5.6		
	0	0.5	-1.8	-2.3	1	СН	
	0.5	1	-2.3	-2.8		ML	
	1	2.5	-2.8	-4.3	2.5	SM	7.6
5-MKG	2.5 3.5	3.5 5.6	-4.3 -5.3	-5.3 -7.4		SP CH	
	5.6	7.3	-3.3 -7.4	-7.4	4.1	СН	
	7.3	7.6	-9.1	-9.4		CL	
	7.6	10	-9.4	-11.8	2.4	SP	
		anket thick	nes		7.6		
	0	1	-0.1	-1.1	4	СН	
17MVS-01PU	1 4	4	-1.1	-4.1		SM	36.5
1/10103-01F0	8.5	8.5 10.5	-4.1 -8.6	-8.6 -10.6	9	CH CL	
	10.5	13	-10.6	-13.1	9	SM	36.3
	13	15.5	-13.1	-15.6	2.5	SP	50.5
	bl	anket thick			13		
	0	1	-2.7	-3.7		CL	
	1	2.7	-3.7	-5.4	6	ML	
17MVS-02PU	2.7	4.5	-5.4	-7.2	0	СН	
	4.5	6	-7.2	-8.7		ML	
	6	8.5	-8.7	-11.2	2.5	SP	
	bl	anket thick	nes		6		



avg blanket thicknes=