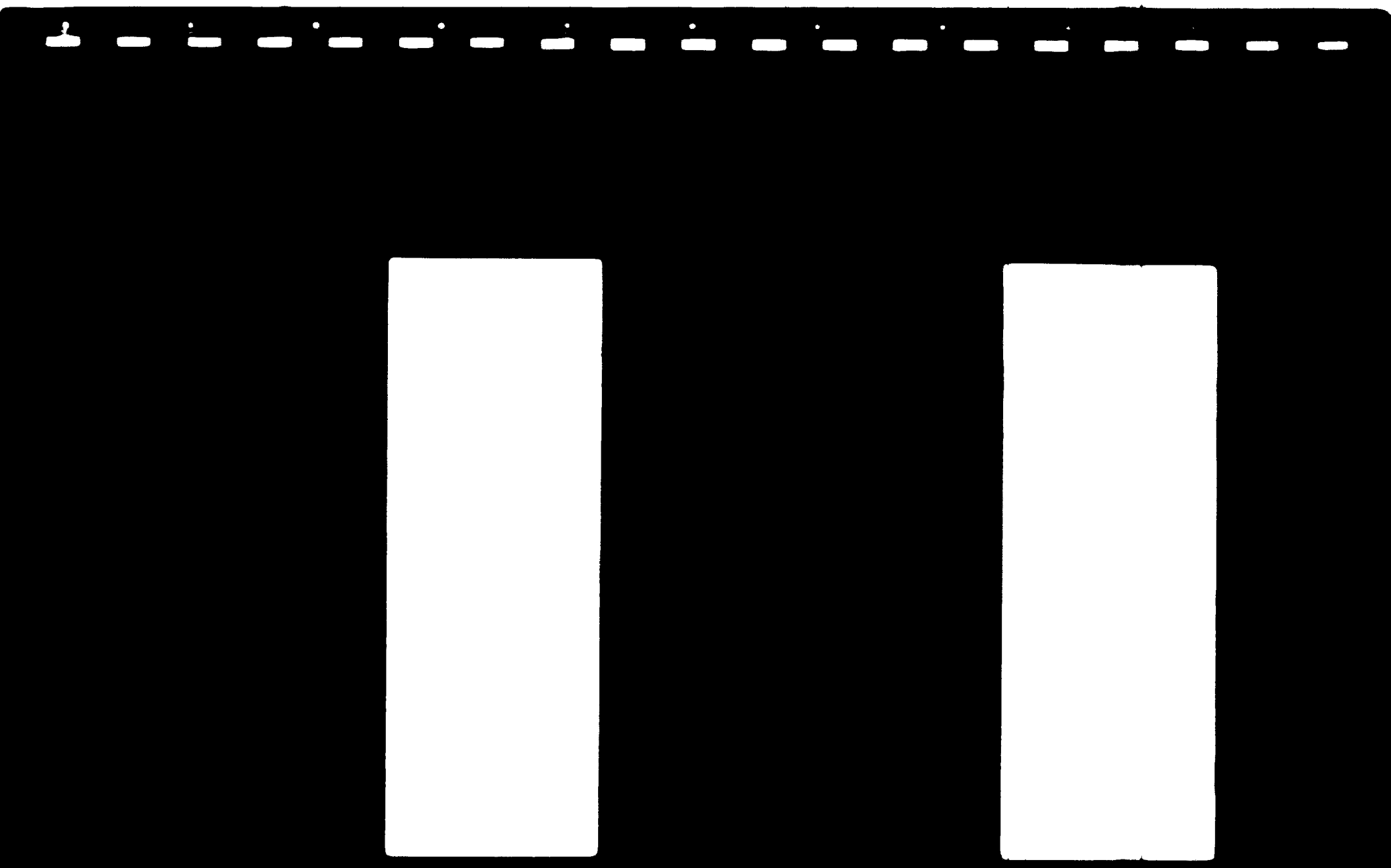


Geotechnical Investigation
Shoreline Protection/Marsh Creation
Lake Borgne at Bayou Dupre'
and Shell Beach

For:
State of Louisiana
Department of Natural Resources
Baton Rouge, Louisiana
December 2002

LOUIS J. CAPOZZOLI & ASSOCIATES, INC. Geotechnical Engineers

James M. Aronstein, Jr. P.E.
Charles L. Eustis, P.E.
David P. Sauls, P.E.

Louis J. Capozzoli, ScD, P.E.
Consultant

23 December 2002

State of Louisiana
Department of Natural Resources
P. O. Box 44027 - Capitol Station
Baton Rouge, Louisiana 70804-4027

Attention: Mr. Luke E. LeBas, P.E.

Re: Geotechnical Investigation
Shoreline Protection/Marsh Creation
Lake Borgne at Bayou Dupre' and Shell Beach
DNR Contract No. 2503-03-15 PO-30
LJC&A File: 02-115

Gentlemen:

This is our report for the above project per our 28 October 2002 proposal and the addition to the proposal dated 30 October 2002. This report presents site and subsoil conditions followed by an evaluation of our analyses. Geotechnical engineering analyses were done for soil bearing stability, slope stability, settlement, rate of settlement, and conclusions in a summary.

PROJECT DESCRIPTION

This project consists of two reaches in Lake Borgne at the edge of the marsh. Bayou Dupre' area has the boring locations shown on sheet 1 for the first reach. The second reach is Shell Beach with borings made at the locations shown on sheet 2. The borings were made in 2 to 3 feet of water except for boring 3 at Bayou Dupre' where the depth of water was 15 feet and at boring 9 where the water depth was 6 feet. It is estimated the water surface elevation of Lake Borgne was about elevation 0; this varies by ½ to 1 foot. The borings, laboratory testing, and engineering were done to develop a structure constructed of Class 250 rip-rap and/or this rip-rap with an encased pocket of lightweight aggregate which would form a barrier to allow siltation landward of the structure and create marsh to provide shoreline protection.

SITE AND SUBSURFACE CONDITIONS

The following descriptions and the graphical presentations on sheets 3 and 4 are general. For details, refer to the individual boring logs at the back of this report. The soils from the mudline at the Bayou Dupre' area are depicted on sheet 3. The Bayou Dupre' soils are more compressible in that they are very soft slightly organic clay, organic clay, and peat to about elevation -10 feet. At borings 1, 2, and 3, these materials are underlain by very soft to soft clay, silty clay, and slightly organic clay to as deep as elevation -53 feet at boring 3. The eastern portion of this reach is east of Bayou Dupre' and shows that borings 4, 5, and 12 have the similar compressive upper soils but encounter very loose to loose clayey sand and silty sand interspersed with some layers of firm silty sand and clayey sand. The sands extend as deep as elevation -37 feet. At boring 12, a very dense silty sand occurs at elevation -35 feet and it extends to the termination elevation of -39 feet. At boring 3, soft slightly organic clay extends to

10555 AIRLINE HIGHWAY, BATON ROUGE, LOUISIANA 70816
TELEPHONE (225) 293-2460 FAX (225) 293-2463

elevation -52 feet and is underlain by firm sand and clayey sand to elevation -62 feet. This boring was terminated in dense clayey sand at elevation -65 feet.

At the Shell Beach reach which is eastward of the Bayou Dupre' reach, the mud bottom of Lake Borgne relates to 2 feet below elevation 0 (water surface) except at boring 9 where it was 6 feet below water surface. The clays and silts here were slightly organic or organic in the top 3 to 4 feet and were underlain by very soft to soft clay and slightly organic clay except for a few layers of very soft organic clay to as deep as elevation -41 feet at boring 9. At boring 11, firm clayey sand and loose silty sand occur at elevation -25 feet and extend to elevation -34 feet. This boring was terminated in soft gray clay at elevation -38 feet. In general, the soils at the Shell Beach reach are not as compressible as those encountered in the profile at the Bayou Dupre' reach.

EVALUATION

The soils at Lake Borgne near the edge of the marsh are very soft materials as determined from the laboratory data on tables 1 through 3, which report the unconfined compression and unconsolidated undrained triaxial tests performed on the samples. The samples were obtained continuously in the top 10 feet of the borings and then on 5 foot centers. Refer to an appendix, Field and Laboratory Analyses for a description of the work done in the field and in the laboratory. Table 4 presents mini vane shear test results which have strengths remarkably close to the strength test data reported on tables 1 through 3.

We used the results of laboratory tests along with our experience with similar type soils to determine soil bearing pressures for the soil conditions at each of the borings. These were then used to compare to loadings from different structure types. We have developed 7 structure types which are depicted on sheets 5 and 6. These are cross sections of the structures and present possible variations of materials to try and maintain a safety factor against soil bearing of at least 1.2. These will be discussed later. The bearing pressure is the controlling factor, but we also performed slope stability analyses of the analyzed sections of rock and rock/lightweight aggregate (furrow method). A safety factor of 1.3 is desirable for slope stability. If the safety factor is lower than those mentioned above or just barely stable conditions, they can be contemplated for sections at this site. A significant safety factor is 1.0. The safety factor of 1.0 is incipient failure and any safety factor below that means that failure will probably occur. Safety factors less than 1.2 could creep to failure with time. We have also evaluated the structures proposed at Lake Borgne as regards to settlement and rate of settlement. This will be discussed later. Settlement is important because over time the section could lower itself (settle or sink) below the water level and thus would not continue to perform as desired. The rate of settlement is important because this can help determine when the project should be revisited for placing additional rock to renourish the structure.

The settlement was determined from our experience, the consolidation tests performed on soils from each of the borings, and the natural moisture contents together with Atterberg limits. Refer to tables 1 through 3, figures 1 through 12 for the consolidation tests, and figures 13 through 27 for sieve analyses on granular materials.

SOIL BEARING STABILITY

The structures analyzed for this project are depicted on sheets 5 and 6. They were analyzed using the ultimate soil bearing pressure at each of the borings and an average pressure for each of the sections. Results of these analyses are on sheets 7, 8, and 9. The simple section of Case 1 for a 4 foot high section of rock only in 2 feet of water indicated adequate safety factors except at locations near borings 2, 7, and 10. Considering this, Case 2 was evaluated for a 4 foot high composite section of rock and lightweight aggregate in 2 feet of water. However, this

section will be difficult to construct the lightweight aggregate in the water. Even with this lower pressure of 354 psf versus the 454 psf for Case 1, the Case 2 condition showed that borings 2 and 7 had safety factors less than 1.2 and boring 10 had a safety factor of 1.25. Again, we recommend a safety factor of at least 1.2 be provided for bearing pressure. To further evaluate the possible structure for developing the shoreline protection and creation of marsh behind it, we looked at a condition where rock was placed in a 7 foot high section in 5 feet of water using Class 250 rip-rap only (Case 3). Refer to sheet 8 which depicts only four locations where an adequate bearing pressure is provided. The other areas will have failures. This shows that rock placed in 5 feet of water is not a viable option.

A pressure of 791 psf was used for Case 4 which is for boring 9 location in 6 feet of water and an 8 foot high section of Class 250 rip-rap only. This shows a safety factor of 1.34 which is considered adequate.

To come up with a section which is possibly viable for this project, we looked at Case 5 which is a 4 foot high furrow method section in 2 feet of water. The results of the soil bearing stability are shown on sheet 9. Again, borings 2, 7, and 10 were not adequate for a recommended minimum safety factor of 1.2, but they were about 1.0 or slightly greater for section 10 with 1.1.

It may be possible to have a section at borings 2, 7, and 10 which will tend to act as a unit and then possibly plunge or sink into the mudline at a later time. This considers the furrow method and geotextile fabric around the lightweight aggregate with a geogrid underlain by at least 6 inches of No. 57 crushed limestone and geotextile fabric on top of a geogrid which is underneath the section or at the surface of the mudline. This is a risk for placing materials in these three locations since they may not have the freeboard above the water of this section present for a long enough time to help with marsh creation and shoreline protection. Continually adding material until a structure remains above water is a risky option.

Referring to the furrow sections on sheets 5 and 6, please pay particular attention to detail A on sheet 6 which presents the geotextile fabric on top of the geogrid and 6 inch cushion of No. 57 limestone above that. On top of the limestone and between it and the Class 250 rip-rap/lightweight aggregate, a UX 1100 HS geogrid is recommended. This may tend to keep the section together while it sinks into the mudline from either settlement or slope stability failure. Regarding slope stability failure, the section may plunge or sink 8 feet at or near boring 2, and 2 feet at boring 10. Boring 7 has deeper weaker soils and the entire section could sink and require replenishing quite often to maintain a freeboard above the water.

To make the structure built up to 17 feet above mudline at Bayou Dupre' (Boring 3) for Case 6, two end sections by the furrow method to a height of 8 feet to then confine a horizontal section of 14 feet of lightweight aggregate on 1 foot of No. 57 limestone between two geogrids, and 2 feet of Class 250 rip-rap above water is needed. The two "end sections" have a safety factor of 1.0 for the 8 feet of rock (Class 250 rip-rap), but only a safety factor of 0.6 for the overall furrow section. This means it will sink or fail into the mud, probably 6 to 8 feet. The end furrow sections, if they can be constructed and sink as a unit into the mud, will have a safety factor of 1.9 once sunk and considering the underlying soil strengths. Consolidation settlement and elastic settlement will have to be added to the 6 to 8 feet of failure plunging or sinking into the ground. See the settlement section. Downward movement here could be as much as 17 feet. The horizontal structure part (14 feet of lightweight aggregate, etc.) will exert a pressure of 579 psf for a bearing stability safety factor of 1.5, but it may not stay confined with the large sinking of the end furrow sections. Our recommendation is to place 8 feet of rock on fabric at Bayou Dupre' (boring 3) for a safety factor of 1.2. That means 7 feet of water remains above the structure, but at least a base is started at this desired filled in area where 15 feet of water exists. A gain in shear strength of about 93 psf should occur after 3 to 5 years. This means if 8 more

feet of rock are placed after 3 to 5 years, the safety factor is 1.2 against a soil bearing failure. Consolidation settlement would still mean the rock is below the water surface. This is a stage constructed area because of the depth to mudline.

Case 7 for the structure near Boring 9, which is in 6 feet of water, has a safety factor of 1.6 for bearing (see sheet 8). This indicates the furrow section at Boring 9 is stable even in 6 feet of water.

A possible case (No. 8) is to have a 2 foot high section of Class 250 rip-rap placed at the existing marsh edge (no water) at/near borings 2, 7, and 10 which showed unstable sections for those previously discussed. The ultimate bearing pressure at these three location is about 400 psf. For 2 feet of rock exerting 310 psf, the soil bearing pressure safety factor is an acceptable 1.3.

The specifications for geotextile fabrics are given on sheet 10. Specification information for structural geogrid BX1200 and structural geogrid UX1100HS are given on sheets 11 and 12. It is recommended that the non-woven geotextile fabric be attached to the BX1200 geogrid. The BX1200 geogrid and the UX1100HS geogrid should each be integrally formed by using a positive mechanical interlock to the overlaps where joining of the roll widths are required. The lightweight aggregate should be completely contained within a non-woven geotextile fabric. The geotextile fabric is used to minimize migration of lightweight aggregate into the larger Class 250 rip-rap. Rip-rap must be placed and not dumped. The geogrid provides tensile strength which increases the safety factor for slope stability of the section within itself. This is discussed next.

SLOPE STABILITY

Slope stability analyses were run although the bearing stability is the governing or determining factor for stability of the structure. Results are shown on sheets 13 through 16. The cases depicted on sheets 13, 14, and 15 show a safety factor greater than 1.3 for slope stability. Using boring 2 and the Case 5 without geogrids, the slope stability safety factor is about 1.1. See sheet 16. This is the furrow method and it will be discussed more concerning the increase in slope stability safety factor because of the geogrids. The geogrids do not appreciable increase the soil bearing pressure.

The global stability was checked for the section depicted on sheet 16 and sheet 5 for Case 5. The reinforcement provided by the BX1200 and the UX1100HS geogrids increase the safety factor for global slope stability of the embankment. These geogrids can reduce differential settlements within a section by increasing embankment integrity. The reinforced embankment section with the geogrids has a safety factor increased to about 1.4 which is greater than the recommended safety factor of 1.3. However, it is pointed out that the three locations discussed before have a safety factor of less than 1.1 or 1 for bearing pressure and that is the governing factor. The significance of the increase in the embankment section stability is that it makes it act as a unit although the bearing may not be present for the structure stability.

SETTLEMENT

The settlement for Case 1 section at borings 1, 2, 3, 4, 6, and 7 is 2 to 3 feet. The settlement for the Case 1 section at borings 5, 8, 9, 10, 11, and 12 is 9 to 12 inches. To determine the settlement for different pressure intensities, take the ratio of the pressure for another section and divided by the pressure of Case 1 which is 454 psf and multiply it times the settlement predicted for the borings given above. An example is for Case 6 where 15 feet of water requires a 17 foot high section and the pressure is 1331 psf, the settlement would be computed as follows: this is at boring 3, so the settlement is 2 to 3 feet for case 1 pressure of 454 psf. 1331 psf

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Geotextile Fabrics

Property	Test Method	Requirements Class D
AOS, U.S. Sieve, Min.	ASTM D 4751	70
Grab Tensile, lb, Min.	ASTM D 4632	180
% Elongation @ Failure, Min.	ASTM D 4632	50
Burst Strength psi, Min.	ASTM D 3787	290
Puncture, lb, Min.	ASTM D 4833	75
Trapezoid Tear Strength, lb. Min.	ASTM D 4533	50

Acceptable Non-Woven Geotextile Fabrics: AMOCO-4557,
Trevira 1127,
Crown Zellerbach 400,
Or Equivalents

Acceptable Woven Geotextile Fabrics: Mirafi 600X, or equivalents
(for Class 250 Rip-Rap Enire Section)

SHEET 11

Product Specification - Structural Geogrid BX1200

Tensar Earth Technologies, Inc. reserves the right to change its product specifications at any time. It is the responsibility of the specifier and purchaser to ensure that product specifications used for design and procurement purposes are current and consistent with the products used in each instance. Please contact Tensar Earth Technologies, Inc. at 800-836-7271 for assistance

The structural geogrid shall be an integrally formed grid structure manufactured of a stress resistant high density polyethylene material with molecular weight and molecular characteristics which impart: (a) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation; (b) high resistance to deformation when the geogrid is subjected to applied force in use; and (c) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to long-term environmental stress.

The structural geogrid shall accept applied force in use by positive mechanical interlock (i.e. by direct mechanical keying) with: (a) compacted soil or construction fill materials; (b) contiguous sections of itself when overlapped and embedded in compacted soil or construction fill materials; and (c) rigid mechanical connectors such as bodkins, pins or hooks. The structural geogrid shall possess sufficient cross sectional profile to present a substantial abutment interface to compacted soil or particulate construction fill materials and to resist movement relative to such materials when subject to applied force. The structural geogrid shall possess sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure. The structural geogrid shall possess complete continuity of all properties throughout its structure and shall be suitable for reinforcement of compacted soil or particulate construction fill materials to improve their long term stability in structural load bearing applications such as earth retention systems. The structural geogrid shall otherwise have the following characteristics:

Product Type: **Integrally Formed Structural Geogrid**
Load Transfer Mechanism: **Positive Mechanical Interlock**

Product Properties

Index Properties	Units	MD Values[1]	XMD Values[1]
• Aperture Dimensions[2]	mm (in)	25 (1.0)	33 (1.3)
• Minimum Rib Thickness[2]	mm (in)	1.27 (0.05)	1.27 (0.05)
Load Capacity			
• True Initial Modulus in Use[3]	kN/m(lb/ft)	400 (27,420)	650 (44,550)
• True Tensile Strength @2% Strain[3]	kN/m(lb/ft)	6.0 (410)	6.6 (590)
• True Tensile Strength @5% Strain[3]	kN/m(lb/ft)	11.8 (810)	19.6 (1,340)
Structural Integrity			
• Junction Efficiency[4]	%	93	
• Flexural Stiffness[5]	mg-cm	750,000	
• Aperture Stability[6]	kg-cm/deg	6.5	
Durability			
• Resistance to Installation Damage[7]	%SC / %SW / %GP	91 / 91 / 85	
• Resistance to Long Term Degradation[8]	%	100	

Dimensions and Delivery

The structural geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 3.0 meters (9.8 feet) or 4.0 meters (13.1 feet) in width and 50.0 meters (164 feet) in length. A typical truckload quantity is 165 to 220 rolls. On special request, the structural geogrid may also be custom cut to specific lengths or widths to suit site specific engineering designs.

Notes

1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D-4759. Brief descriptions of test procedures are given in the following notes. Complete descriptions of test procedures are available on request from Tensar Earth Technologies, Inc.
2. Nominal Dimensions.
3. True resistance to elongation when initially subjected to a load measured w[redacted]thout deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
4. Load transfer capability measured via GRI-GG2-87. Expressed as a percentage of ultimate tensile strength.
5. Resistance to bending force measured via ASTM D-5732-95, using specimens of width two ribs wide, with transverse ribs cut flush with exterior edges of longitudinal ribs (as a "ladder"), and of length sufficiently long to enable measurement of the overhang dimension. The overall Flexural Stiffness is calculated as the square root of the product of machine-and cross-machine-direction Flexural Stiffness values.
6. Resistance to in-plane rotational movement measured by applying a 20 kg-cm moment to the central junction of a 9 inch x 9 inch specimen restrained at its perimeter (U.S. Army Corps of Engineers Methodology for measurement of Torsional Rigidity).
7. Resistance to loss of load capacity or structural integrity when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW), and crushed stone classified as poorly graded gravel (GP). The geogrid shall be sampled in accordance with ASTM D5818 and load capacity shall be measured in accordance wi[redacted]
8. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments measured via EPA 9090 immersion testing.

Tensar Earth Technologies, Inc.
5883 Glenridge Drive, Suite 200
Atlanta, Georgia 30328-5363
(800) 836-7271

March 15, 2002
This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped to jobsite prior to March 15, 2002.

SHEET 12

Product Specification - Structural Geogrid UX1100HS

Tensar Earth Technologies, Inc. reserves the right to change its product specifications at any time. It is the responsibility of the specifier and purchaser to ensure that product specifications used for design and procurement purposes are current and consistent with the products used in each instance. Please contact Tensar Earth Technologies, Inc. at 800-836-7271 for assistance

The structural geogrid shall be an integrally formed grid structure manufactured of a stress resistant high density polyethylene material with molecular weight and molecular characteristics which impart: (a) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation; (b) high resistance to deformation when the geogrid is subjected to applied force in use; and (c) high resistance to loss of load capacity or structural integrity when the geogrid is subjected to long-term environmental stress.

The structural geogrid shall accept applied force in use by positive mechanical interlock (i.e. by direct mechanical keying) with: (a) compacted soil or construction fill materials; (b) contiguous sections of itself when overlapped and embedded in compacted soil or construction fill materials; and (c) rigid mechanical connectors such as bodkins, pins or hooks. The structural geogrid shall possess sufficient cross sectional profile to present a substantial abutment interface to compacted soil or particulate construction fill materials and to resist movement relative to such materials when subject to applied force. The structural geogrid shall possess sufficient true initial modulus to cause applied force to be transferred to the geogrid at low strain levels without material deformation of the reinforced structure. The structural geogrid shall possess complete continuity of all properties throughout its structure and shall be suitable for reinforcement of compacted soil or particulate construction fill materials to improve their long term stability in structural load bearing applications such as earth retention systems. The structural geogrid shall otherwise have the following characteristics:

Product Type: **Integrally Formed Structural Geogrid**
Load Transfer Mechanism: **Positive Mechanical Interlock**

Product Properties

Load Capacity	**Units**	**MD Values[1]**
• True Initial Modulus in Use[2]	kN/m(lb/ft)	800 (54,830)
• Tensile Strength @5% Strain[2]	kN/m(lb/ft)	27 (1,850)
• Ultimate Tensile Strength[2]	kN/m(lb/ft)	54 (3,700)
• Long-Term Allowable Load in Sands, Silts & Clay[3]	kN/m(lb/ft)	21 (1,410)
• Long-Term Allowable Load in Well Graded Sand[3]	kN/m(lb/ft)	19 (1,310)
• Long-Term Allowable Load in Aggregate[3]	kN/m(lb/ft)	18 (1,260)
Integrity of Product Structure		
• Junction Strength[4]	kN/m(lb/ft)	50 (3,430)
• Flexural Stiffness[5]	X1000 mg-cm	500
Durability		
• Resistance to Installation Damage[6]	%SC / %SW / %GP	95 / 87 / 83
• Resistance to Long Term Degradation[7]	%	100

Dimensions and Delivery

The structural geogrid shall be delivered to the jobsite in roll form with each roll individually identified and nominally measuring 1.33 meters (4.36 feet) in width and 76.2 meters (250.0 feet) in length. A typical truckload quantity is 432 rolls. On special request, the structural geogrid may also be custom cut to specific lengths or widths to suit site specific engineering designs.

Notes

1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D-4759. Brief descriptions of test procedures are given in the following notes. Complete descriptions of test procedures are available on request from Tensar Earth Technologies, Inc.
2. True resistance to elongation when initially subjected to a load measured via ASTM D6637 without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties.
3. True strength available for resisting force in long-term load bearing applications is determined by reducing ultimate tensile strength by state-of-practice factors for installation damage, degradation in use, product integrity limitations and long-term product deformation per GRI-GG4.
4. Load transfer capability measured via GRI-GG2-87.
5. Resistance to bending force measured via ASTM D-5732-95, using specimen dimensions of 864 millimeters in length by 1 aperture in width.
6. Resistance to loss of load capacity or structural integrity when subjected to mechanical installation stress in clayey sand (SC), well graded sand (SW), and crushed stone classified as poorly graded gravel (GP). The material shall be sampled in accordance with ASTM D5818 and load capacity measured in accordance with ASTM D6637.
7. Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments measured via EPA 9090 immersion testing.

Tensar Earth Technologies, Inc.
5883 Glenridge Drive, Suite 200
Atlanta, Georgia 30328-5363
(800) 836-7271

March 15, 2002
This product specification supersedes all prior specifications for the product described above and is not applicable to any products shipped to jobsite prior to March 15, 2002.

divided by 454 psf times 3 feet equals 8.8 feet of settlement. A similar calculation can be done for the other cases.

The above settlements are consolidation settlement. Elastic settlement will occur very rapidly and probably occur shortly after stone placement. Elastic settlement will be about 20 percent of the consolidation settlement. This means that the total settlement will be the consolidation settlement plus the elastic settlement. However, the elastic settlement may not be recognized because the placement of rock may just sink down or settle during construction and more rock will be placed.

RATE OF SETTLEMENT

The rate of settlement is determined from the consolidation tests and our experience with similar soils. Refer to sheet 17. This shows that about 50% of the predicted consolidation settlement will occur in about 3 years. The significance is that this might establish the time for replenishing the sections with additional rip-rap; possibly at a time of 3 to 5 years after construction of the project. Also shown on sheet 17 is that about 95% of the consolidation settlement occurs in 20 years; this means that the full amount of settlement will occur about 20 years after placement. Even if replenishment is done after 3 to 5 years, the added weight will start new consolidation settlement and this will eventually develop a decreasing rate of settlement. It may take several replenishings of the structure with stone to maintain the shoreline protection/marsh creation desired.

SUMMARY

The all rock structure (Case 1 on sheet 5) in 2 feet of water has adequate soil bearing except at borings 2, 7, and 10 where the section is unstable. The furrow method section (Case 5) with geotextile and 2 layers of geogrid for the structures are stable at 2 feet of water except for borings 2, 7, and 10, which have safety factors of about 1.0. These areas of safety factor of 1.0 are unstable structures but could be constructed to have rock sink into the mud until it stops. This is not a stable condition and risks losing the structure and not creating shoreline protection and marsh creation at these three locations. Locating a 2 foot thick build up of Class 250 rip-rap next to the marsh edge provides an adequate condition with a safety factor of 1.3. This could provide shoreline protection but not marsh creation at borings 2, 7, and 10.

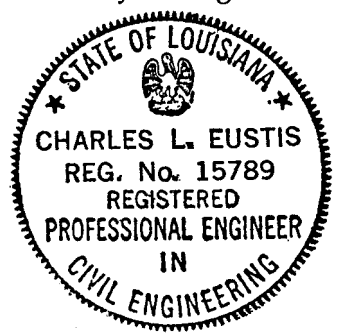
At Bayou Dupre' (Boring 3), the 15 feet of water is too deep for a stable section on the very soft soils. Again, risk could be taken for "end section" furrow method dikes to temporarily provide the confinement for lightweight aggregate horizontal section (see Case 6 on Sheet 6). Large downward movements from settlement and failure in bearing (plunging or sinking) will occur here. We advise against taking the risk. An option is to put 8 feet of rock on a geotextile fabric in this area of 15 feet of water to at least start a base at Bayou Dupre' (boring 3). A gain in shear strength from the 8 feet of rock load might allow 8 feet of rock to be placed 3 to 5 years later for a safety factor of 1.2 against a bearing shear failure. This section will settle a large amount.

Considering all cases looked at, Case 1 is recommended for all areas except use only 2 feet of Class 250 rip-rap farther inland at the marsh edge at borings 2, 7, and 10. Also at boring 3 in Bayou Dupre', only 8 feet of rip-rap can be initially placed in the 15 feet of water.

A deeper water depth exists at boring 9. Case 4 is stable here for 8 feet of rip-rap.

Settlements at the Bayou Dupre' half of the project will be about 2 to 3 feet, but 8 feet at Bayou Dupre' (boring 3). The shell beach half of the project will experience settlements of about 9 to 12 inches. These are consolidation settlements and elastic settlement of 20% of these will

occur even if during rock placement. The rate of settlement predicted suggests planning for renourishing the section by adding rock to the structure after 3 to 5 years.



Very truly yours,

Louis J. Capozzoli & Associates, Inc.

Charles L. Eustis

CLE/cc

Enclosures: Appendix, Field and Laboratory Analyses
Sheets 1 and 2, Boring Plan
Sheets 3 and 4, Subsurface Profile
Sheet 5, Structure Sections Cases 1 through 5
Sheet 6, Furrow Method Sections Cases 6 and 7
Sheet 7 through 9, Ultimate Soil Bearing Pressures
Sheet 10, Geotextile Fabrics
Sheet 11, Product Specification - Structural Geogrid BX1200
Sheet 12, Product Specification - Structural Geogrid UX1100HS
Sheets 13 through 16, Slope Stability
Sheet 17, Rate of Consolidation Settlement
Tables 1 through 3, Laboratory Data
Tables 4 and 5, Mini Vane Shear Test Results
Figures 1 through 12, Consolidation Test Reports
Figures 13 through 27, Grain Size Curves
Logs of Borings 1 through 12

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

FIELD AND LABORATORY ANALYSES

Borings. As per our *DNR Contract No. 2503-03-15, Shoreline Protection/Marsh Creation in Lake Borgne, PO-30,* 12 borings - ranging in depth from 22 to 73 feet - were taken between 8 through 15 November 2002 at the locations shown on sheet 1. Drilling was performed with one of our Failing 1500 truck-mounted rotary type drill rigs mounted on a shallow draft elevating boat. The borings were advanced with a wet drilling process method. Undisturbed soil samples, suitable for laboratory analyses, were obtained by hydraulically pushing a 30 inch long, 3 inch O.D. thinwall Shelby tube sampler into the ground a distance of 24 inches at a time. Classification samples of granular soils (sand) were obtained by performing the Standard Penetration Test (SPT). This test consists of driving a 24 inch long, 2 inch O.D. sampler into the ground with blows from a 140 pound hammer falling 30 inches. The resulting penetration resistance is the total number of blows required to drive the sampler 12 inches after first seating it for 6 inches. The boring was sampled continuously in the top 10 feet below the mudline, and then on 5 foot centers to borehole termination. The samples were classified in the field by our technician and were then prepared for transport.

Field work particulars in tabularized form are:

Inwater Boring Number	Total Depth (Feet)	Continuous Sampling (Feet)	Sampling at Depths >50 Ft. (Feet)	4 Inch Casing Set (Feet)
1	23	10	--	--
2	42	10	--	--
3	73	10	23	32
4	43	10	--	20
5	24	10	--	--
6	25	10	--	--
7	45	10	--	20
8	25	10	--	20
9	47	10	--	20
10	22	10	--	15
11	44	10	--	--
12	45	10	--	20
Totals	**458**	**120**	**23**	**147**

The detailed boring logs are attached.

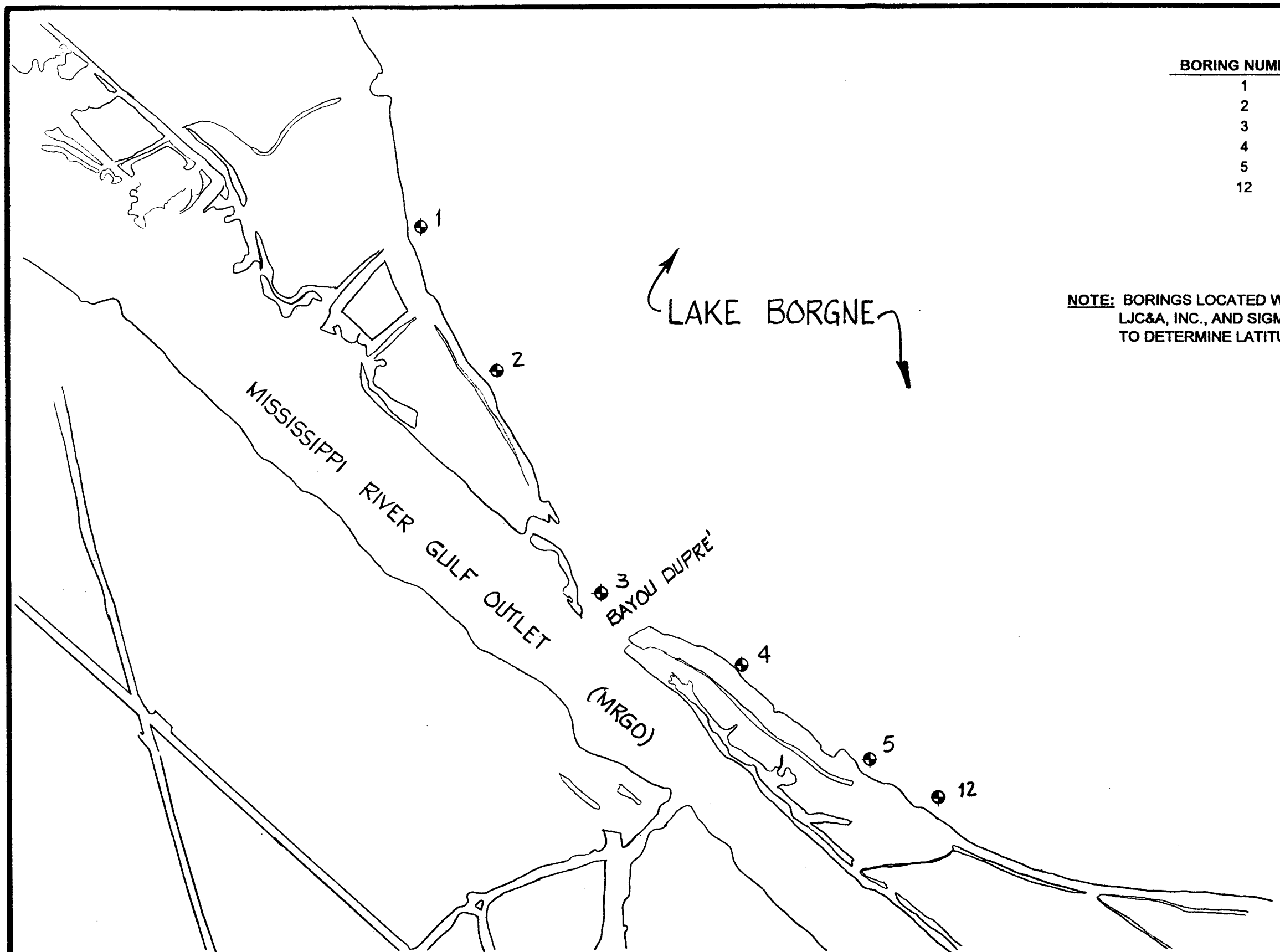
Expenses incurred were: mobilization/demobilization of our drill equipment plus crew travel from our Baton Rouge office to the site; mobilization/demobilization/rental of shallow draft elevating boat; rig-up/rig-down; travel between boreholes; plus 5 days crew living expenses.

Laboratory. All soil samples from the above field operations were taken to our soil mechanics laboratory where additional analyses were performed. Laboratory testing included 77 unconfined and 9 unconsolidated, undrained triaxial compression tests with moisture content and density determinations; 12 consolidation tests with rebound; 45 Atterberg limit determinations; 15 dry sieve analyses; plus 86 miniature vane shear tests.

The compression - unconfined, triaxial, and vane shear - tests provided the strength properties of the soil. The moisture content, density, Atterberg limit determinations and sieve

analyses data furnished additional soil classifications to supplement field methods and provided other design parameters. Consolidation testing along with other data enabled settlement predictions. The results of these analyses are on tables 1 through 5 and figures 1 through 27.

Field and laboratory analyses provide the bases, along with our expertise and experience, for evaluating this site for the proposed project. All field and laboratory testing conformed to appropriate ASTM standards.



BORING NUMBER	LATITUDE NORTH	LONGITUDE WEST
1	29° 57' 27.90"	89° 50' 48.00"
2	29° 57' 08.52"	89° 50' 36.24"
3	29° 56' 38.10"	89° 50' 20.22"
4	29° 56' 28.02"	89° 49' 58.02"
5	29° 56' 15.36"	89° 49' 37.92"
12	29° 56' 09.78"	89° 49' 27.06"

NOTE: BORINGS LOCATED WITH ASSISTANCE OF LA. DNR REPRESENTATIVE, LJC&A, INC., AND SIGMA CONSULTING GROUP, INC. USED GPS INSTRUMENTS TO DETERMINE LATITUDE AND LONGITUDE.

PLAN

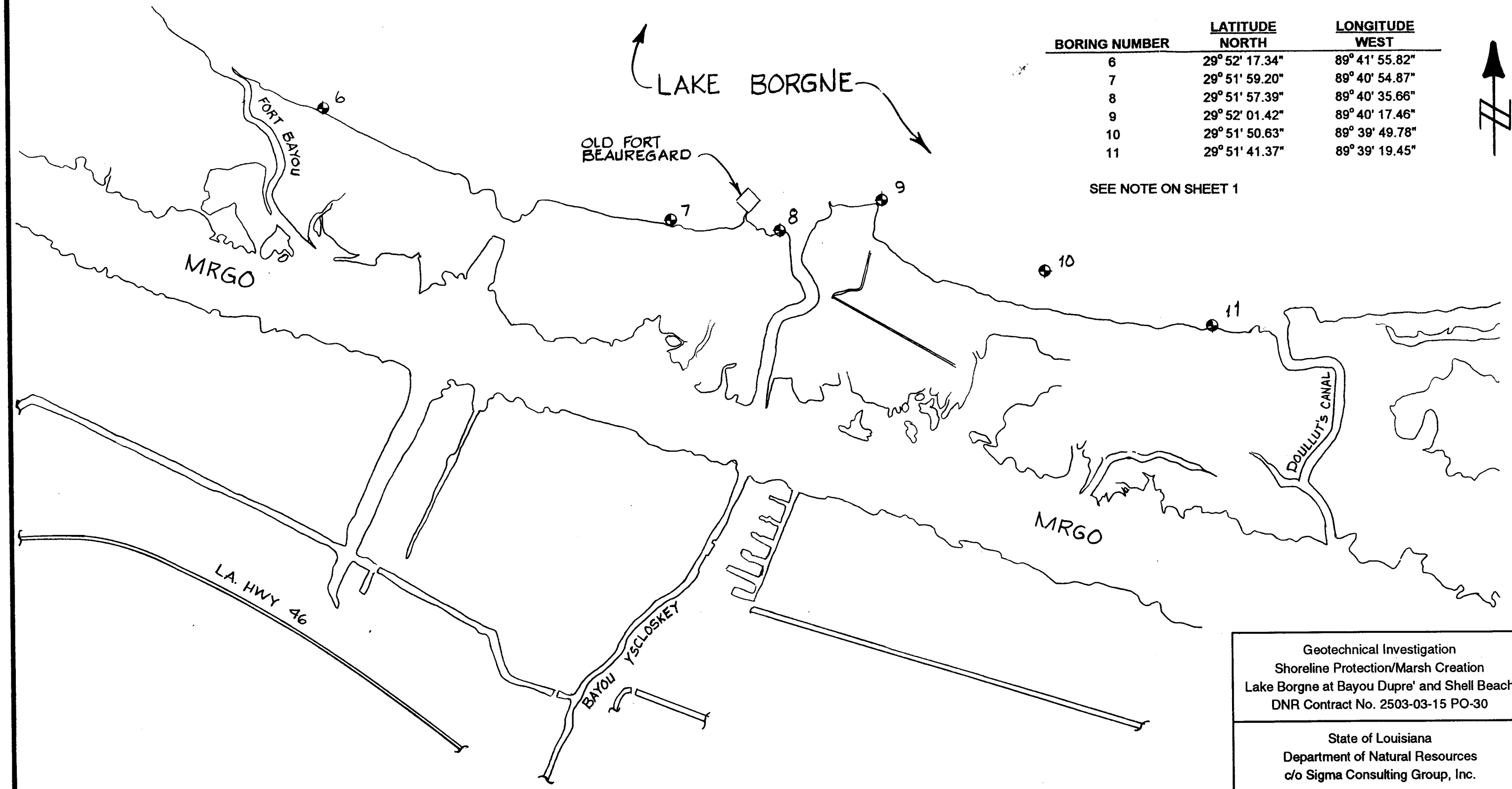
SCALE: 1 IN. = 1500 FT.

Geotechnical Investigation
Shoreline Protection/Marsh Creation
Lake Borgne at Bayou Dupre' and Shell Beach
DNR Contract No. 2503-03-15 PO-30

State of Louisiana
Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Louis J. Capozzoli & Associates, Inc.
Geotechnical Engineers
Baton Rouge, Louisiana

Scale Shown	Dwn. BJB 2 DEC02 Ckd. LJC 20 DEC02	File No. 02-115
Boring Plan		Sheet No. 1



BORING NUMBER	LATITUDE NORTH	LONGITUDE WEST
6	29° 52' 17.34"	89° 41' 55.82"
7	29° 51' 59.20"	89° 40' 54.87"
8	29° 51' 57.39"	89° 40' 35.66"
9	29° 52' 01.42"	89° 40' 17.46"
10	29° 51' 50.63"	89° 39' 49.78"
11	29° 51' 41.37"	89° 39' 19.45"

SEE NOTE ON SHEET 1

PLAN

SCALE: 1 IN. = 1500 FT.

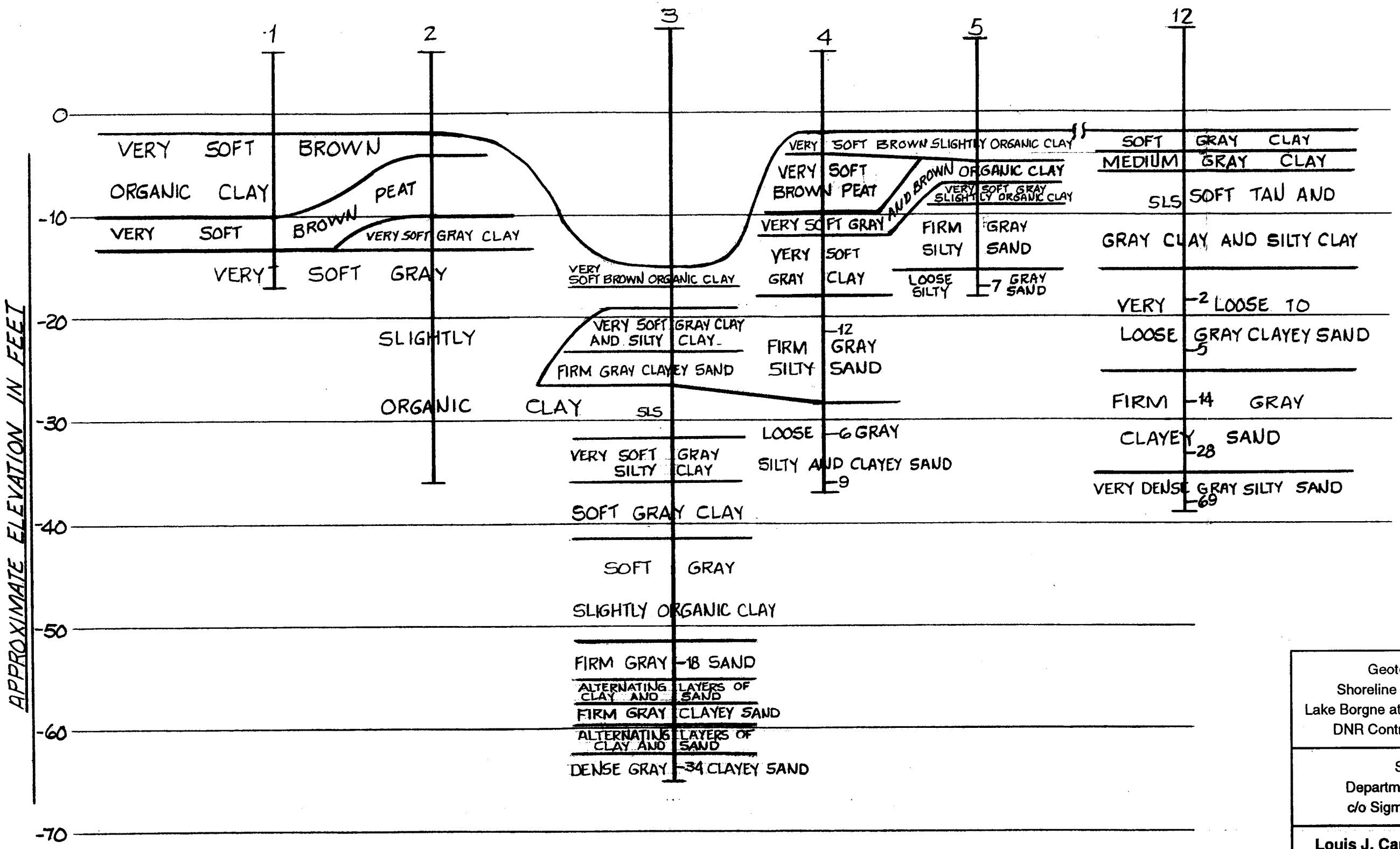
Geotechnical Investigation
Shoreline Protection/Marsh Creation
Lake Borgne at Bayou Dupre' and Shell Beach
DNR Contract No. 2503-03-15 PO-30

State of Louisiana
Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Louis J. Capozzoli & Associates, Inc.
Geotechnical Engineers
Baton Rouge, Louisiana

Scale Shown	Dwn. BJB 2 DEC 02 Ckd. 6JE 20 DEC 02	File No. 02-115
Boring Plan		Sheet No. 2

BAYOU DUPRE'



NOTES:

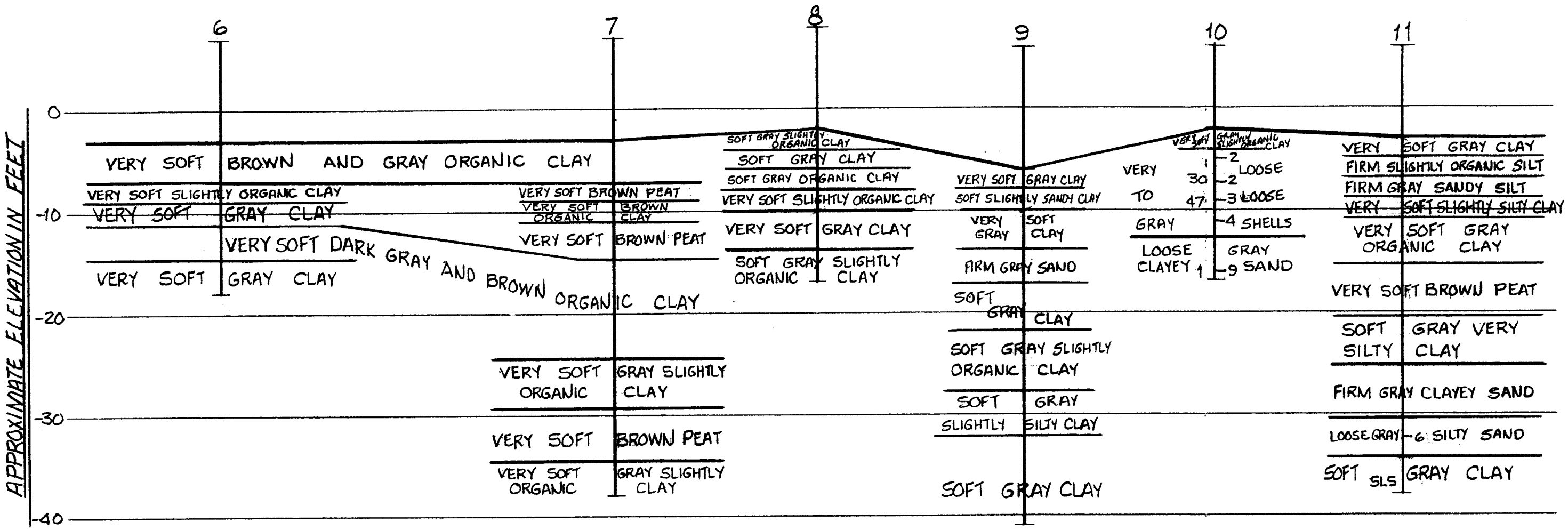
1. SOIL STRATIFICATION SHOWN BETWEEN BORINGS IS A NECESSARY INTERPOLATION WHICH MAY OR MAY NOT AGREE WITH THE ACTUAL SOIL CONDITION OUTSIDE OF THE BORINGS.
2. **SLS** AT LEFT SIDE OF BORING INDICATES SLICKENSIDED (PREFRACTURED) CLAY CONDITION.
3. THE NUMBERS AT RIGHT SIDE OF BORINGS ARE PENETRATION RESISTANCES IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES.

Geotechnical Investigation
Shoreline Protection/Marsh Creation
Lake Borgne at Bayou Dupre' and Shell Beach
DNR Contract No. 2503-03-15 PO-30

State of Louisiana
Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Louis J. Capozzoli & Associates, Inc.
Geotechnical Engineers
Baton Rouge, Louisiana

Scale Shown	Dwn. BJB 4 DEC 02 Ckd. 20 DEC 02	File No. 02-115
Subsurface Profile		Sheet No. 3



NOTES:

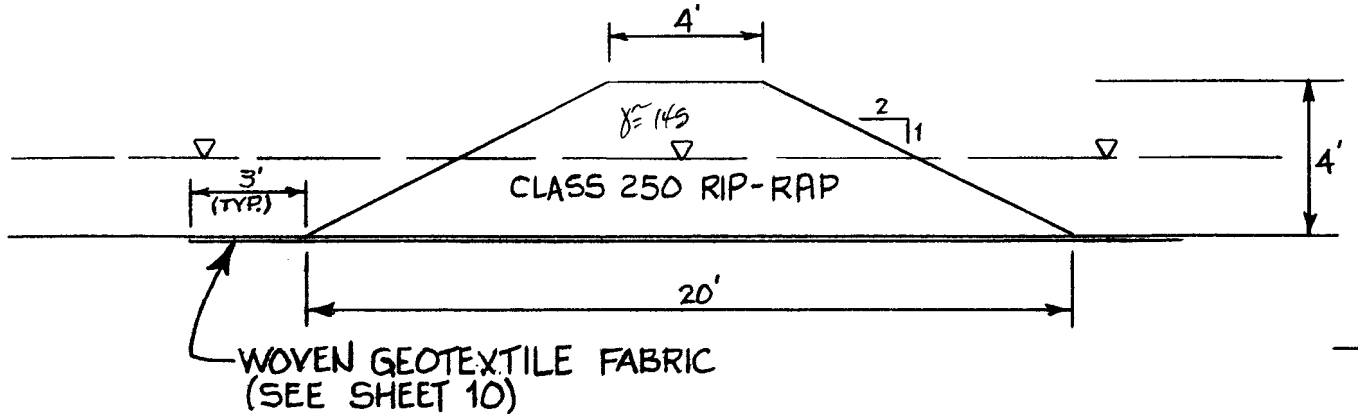
1. SOIL STRATIFICATION SHOWN BETWEEN BORINGS IS A NECESSARY INTERPOLATION WHICH MAY OR MAY NOT AGREE WITH THE ACTUAL SOIL CONDITION OUTSIDE OF THE BORINGS.
2. THE NUMBERS AT LEFT SIDE OF BORING ARE PERCENTAGES OF GRAVEL/SHELL BY WEIGHT IN SOIL FOR THOSE SAMPLES CONTAINING GRAVEL.
3. **SLS** AT LEFT SIDE OF BORING INDICATES SLICKENSIDED (PREFRACTURED) CLAY CONDITION.
4. THE NUMBERS AT RIGHT SIDE OF BORINGS ARE PENETRATION RESISTANCES IN BLOWS PER FOOT FOR A 140 POUND HAMMER FALLING 30 INCHES.

Geotechnical Investigation
Shoreline Protection/Marsh Creation
Lake Borgne at Bayou Dupre' and Shell Beach
DNR Contract No. 2503-03-15 PO-30

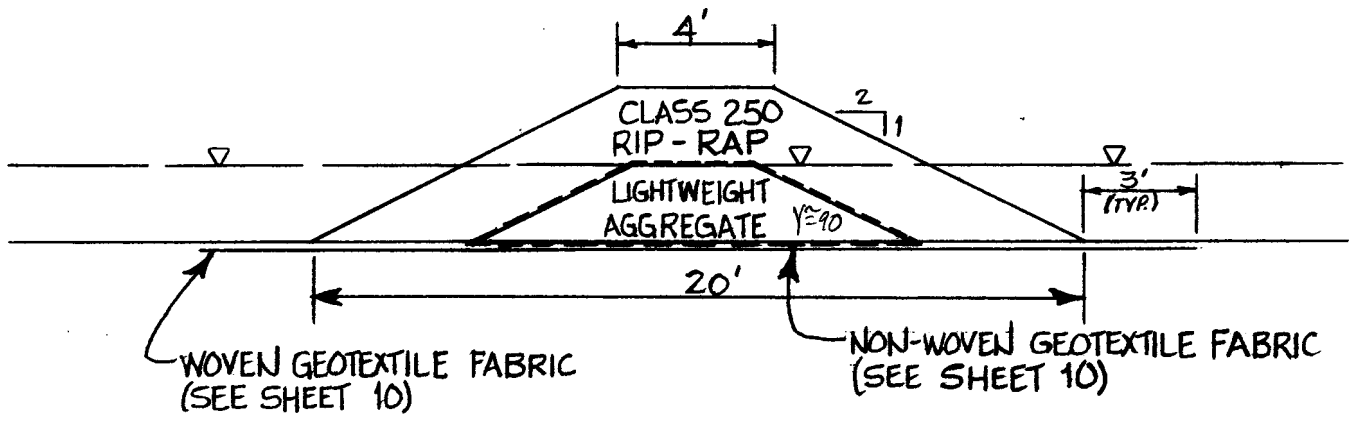
State of Louisiana
Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Louis J. Capozzoli & Associates, Inc.
Geotechnical Engineers
Baton Rouge, Louisiana

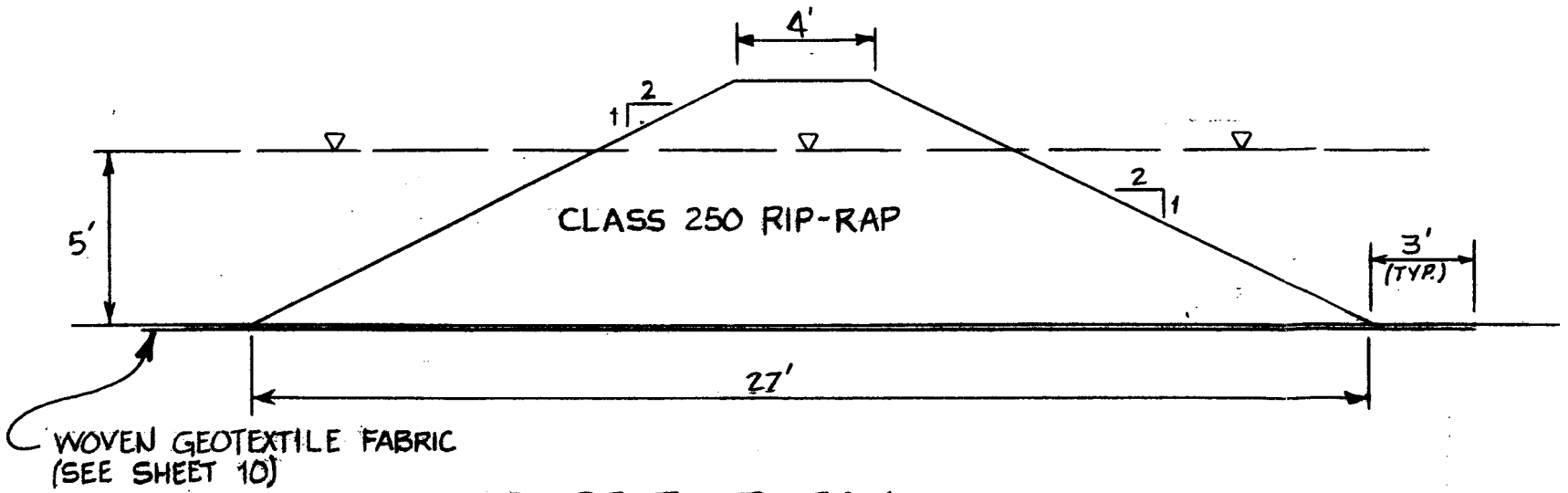
Scale Shown	Dwn. BJB 4 DEC 02 Ckd. 20 DEC 02	File No. 02-115
Subsurface Profile		Sheet No. 4



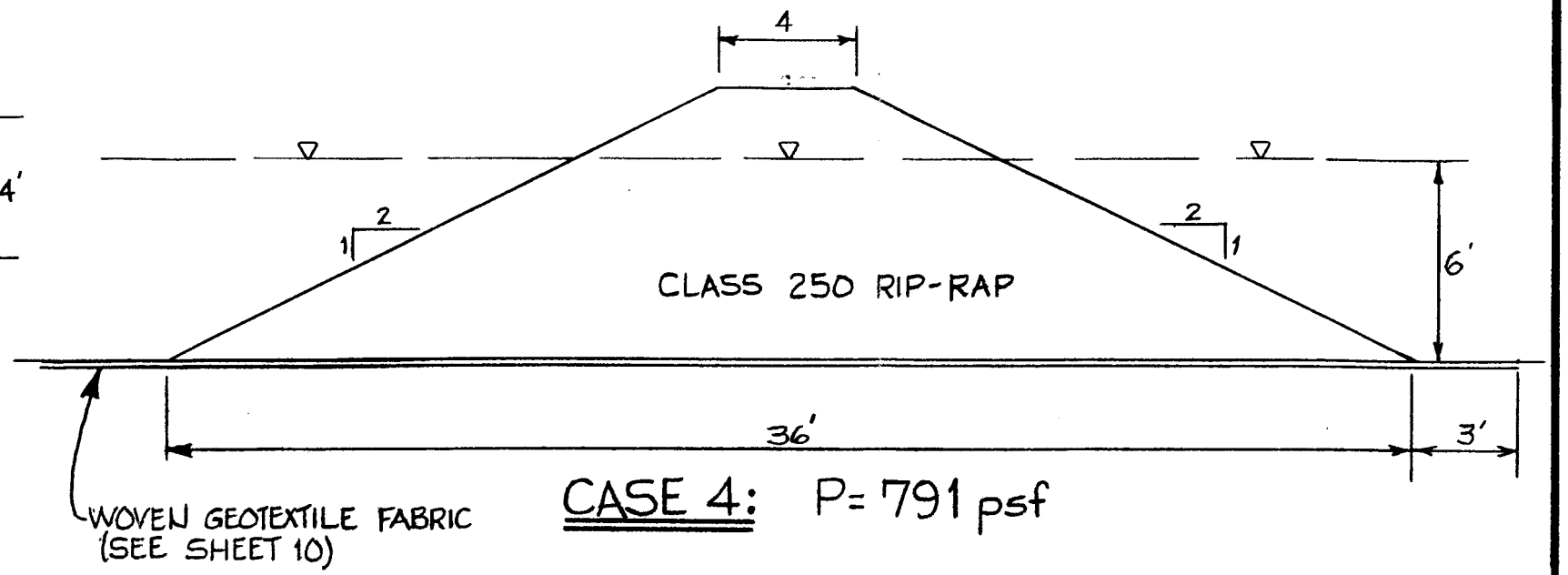
CASE 1: P = 454 psf



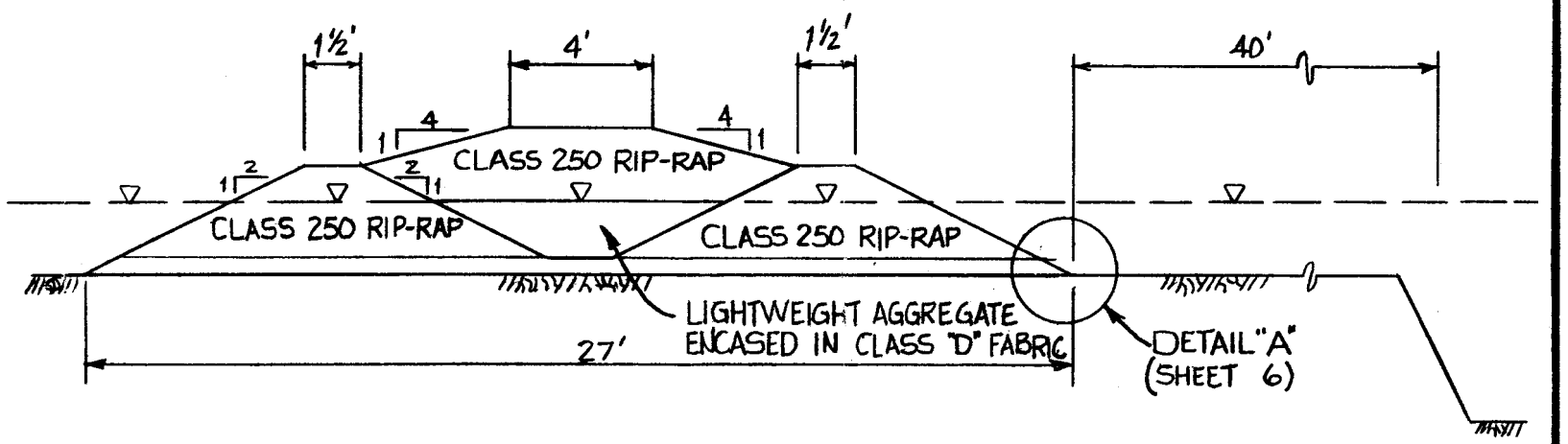
CASE 2: P=354 psf



CASE 3: P= 704 psf



CASE 4: P= 791 psf



CASE 5: P= 402 psf

FURROW METHOD SECTION

Geotechnical Investigation
Shoreline Protection/Marsh Creation
Lake Borgne at Bayou Dupre' and Shell Beach
DNR Contract No. 2503-03-15 PO-30

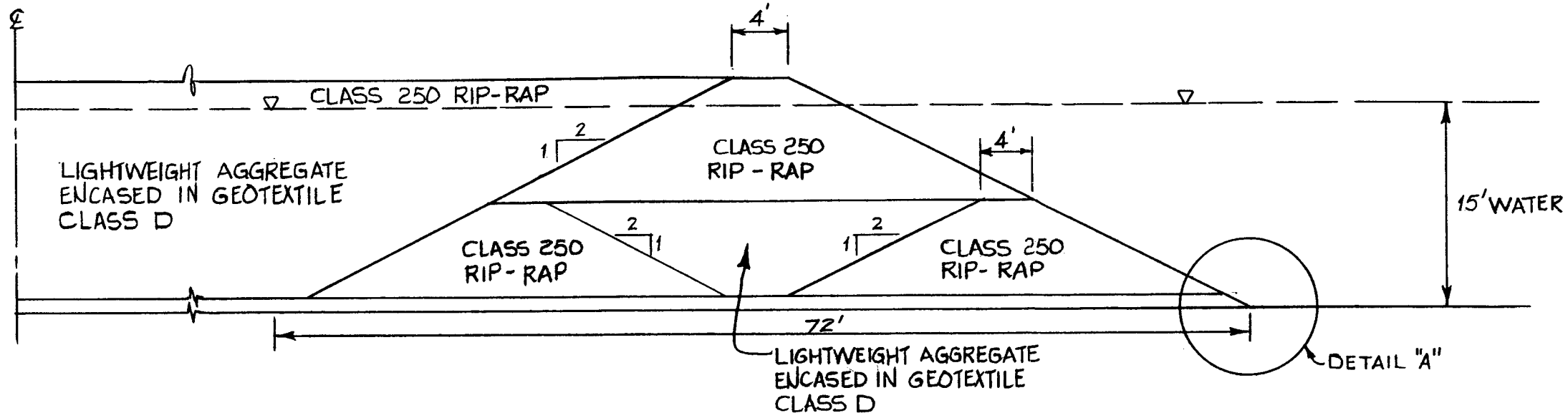
State of Louisiana
Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Louis J. Capozzoli & Associates, Inc.
Geotechnical Engineers
Baton Rouge, Louisiana

Scale	Dwn. BJB 20DEC 02	File No.
-----	Ckd. 20DEC02	02-115

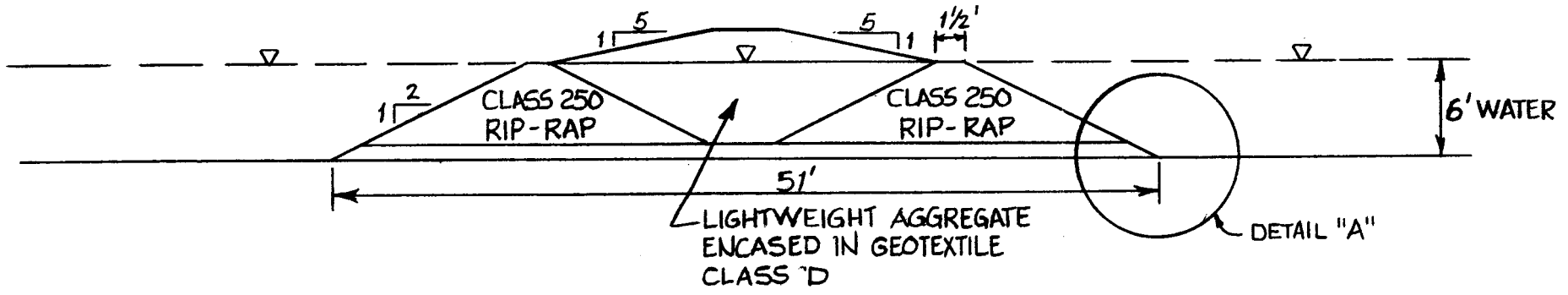
Structure Sections
Cases 1 through 5

Sheet No. 5

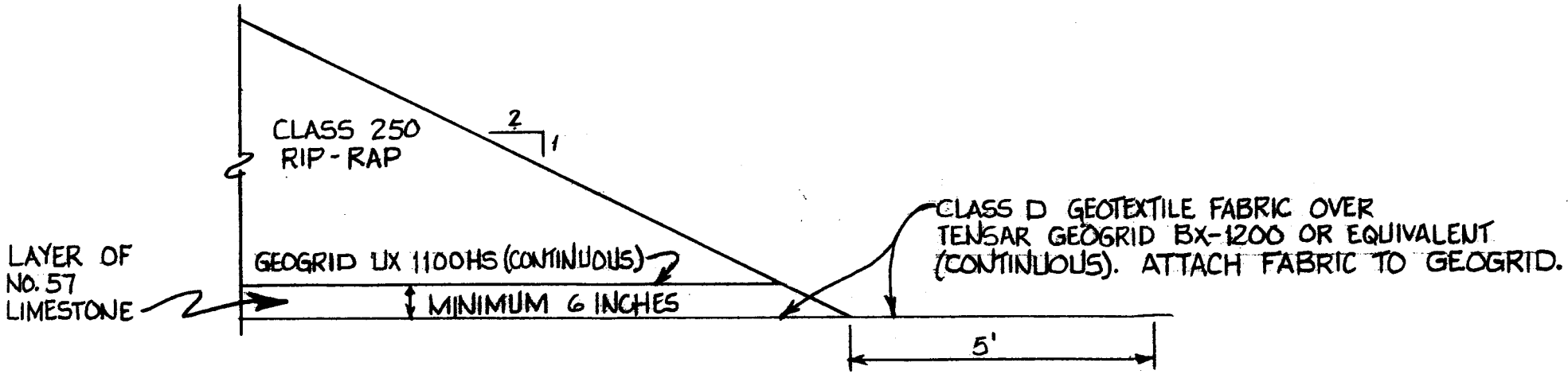


CASE 6: BAYOU DUPRE' (BORING 3) P= 1331 psf

SECTION SYMETRICAL ABOUT CENTERLINE



CASE 7: STRUCTURE NEAR BORING 9 P= 659 psf



DETAIL "A"

Geotechnical Investigation
Shoreline Protection/Marsh Creation
Lake Borgne at Bayou Dupre' and Shell Beach
DNR Contract No. 2503-03-15 PO-30

State of Louisiana
Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Louis J. Capozzoli & Associates, Inc.
Geotechnical Engineers
Baton Rouge, Louisiana

Scale	Dwn. BJB 20 DEC 02	File No.
----	Ckd. BJB 20 DEC 02	02-115

Furrow Method Sections Cases 6 and 7	Sheet No. 6

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Boring Number	Ultimate Soil Bearing Pressure (psf)	Safety Factor with P=454 psf (with P=354 psf)
1	666	1.47
2	400	0.88 (1.13)
3	775	1.71
4	844	1.86
5	722	1.59
6	648	1.43
7	404	0.89 (1.14)
8	1058	2.33
9	1055	2.32
10	444	0.98 (1.25)
11	1885	4.15
12	2220	4.89

$454 = 2(\gamma_r) + (2)(\gamma_{-64})$
$\gamma_r = 145.5 pcf$
$\gamma_r \sim 146 pcf$

Notes: 1. Case 1: P = 454 psf is for 4 foot high section of rock only in 2 feet of water

2. Case 2: (P = 354 psf) is for 4 foot high composite section of rock and lightweight aggregate in 2 feet of water.

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Boring Number	Ultimate Soil Bearing Pressure (psf)	Safety Factor with P=704 psf (with P=791 psf)
1	666	0.95
2	400	0.57
3	775	1.10
4	844	1.20
5	722	1.02
6	648	0.92
7	404	0.57
8	1058	1.50
9	1055	(1.34)
10	444	0.63
11	1885	2.68
12	2220	3.15

Notes: 1. Case 3: P = 704 psf is for a 7 foot high section in 5 feet of water of Class 250 rip-rap only.

2. Case 4: (P = 791 psf) is for boring 9 location in 6 feet of water and a 8 foot high section of Class 250 rip-rap only.

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Boring Number	Ultimate Soil Bearing Pressure (psf)	Safety Factor (with P=402 psf)
1	666	1.66
2	400	1.00
3	775	1.93
4	844	2.10
5	722	1.80
6	648	1.61
7	404	1.00
8	1058	2.63
9	1055	2.62
10	444	1.10
11	1885	4.68
12	2220	5.52

Notes: 1. Case 5: 4 Foot high Furrow Method Section (2 feet water depth)

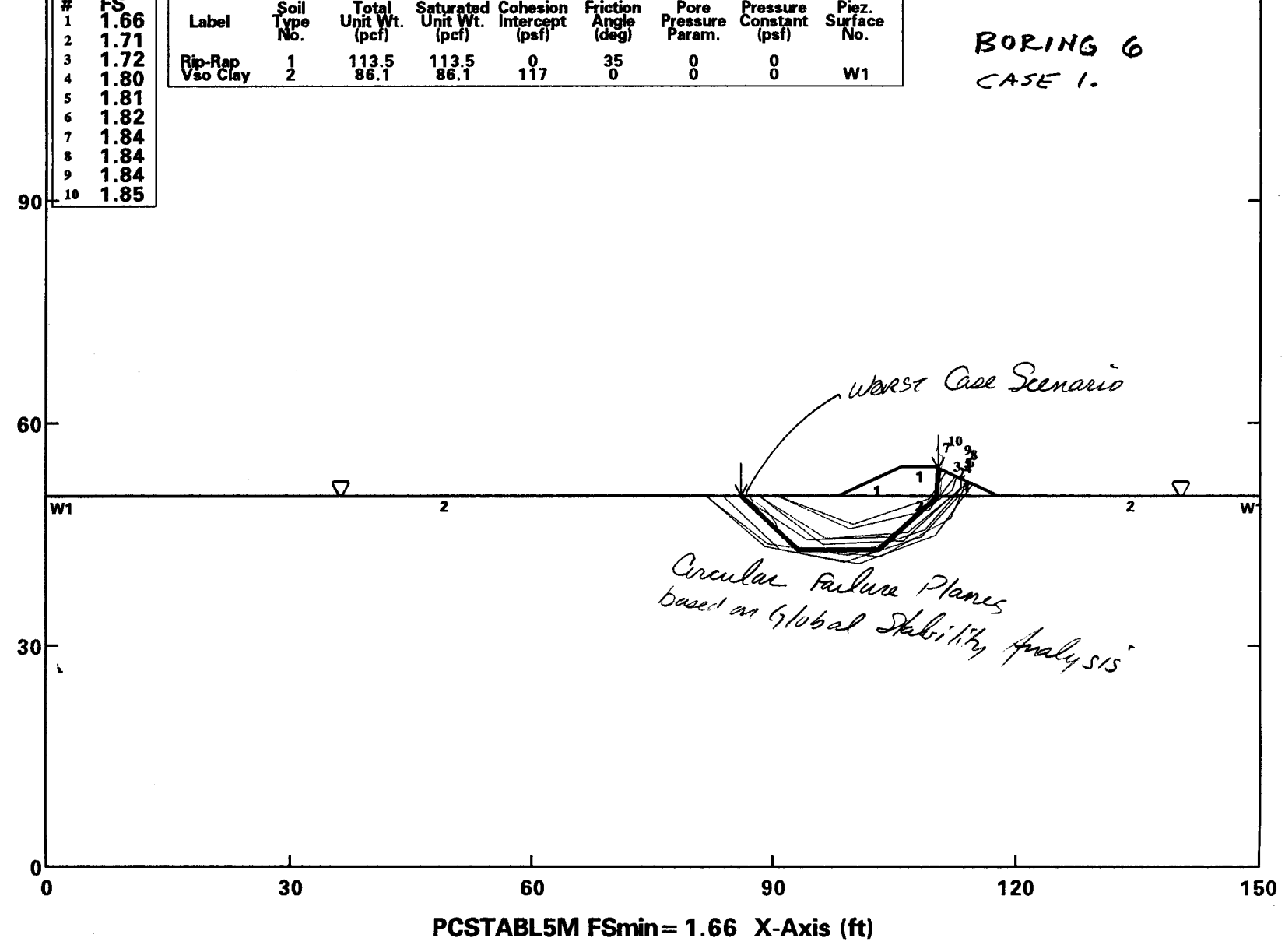
02-115 Coastal Restoration Project Lake Borgne

Ten Most Critical. C:021155.PLT By: BJB 12-12-02 10:51am

#	FS
1	1.66
2	1.71
3	1.72
4	1.80
5	1.81
6	1.82
7	1.84
8	1.84
9	1.84
10	1.85

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Rip-Rap	1	113.5	113.5	0	35	0	0	
Vso Clay	2	86.1	86.1	117	0	0	0	W1

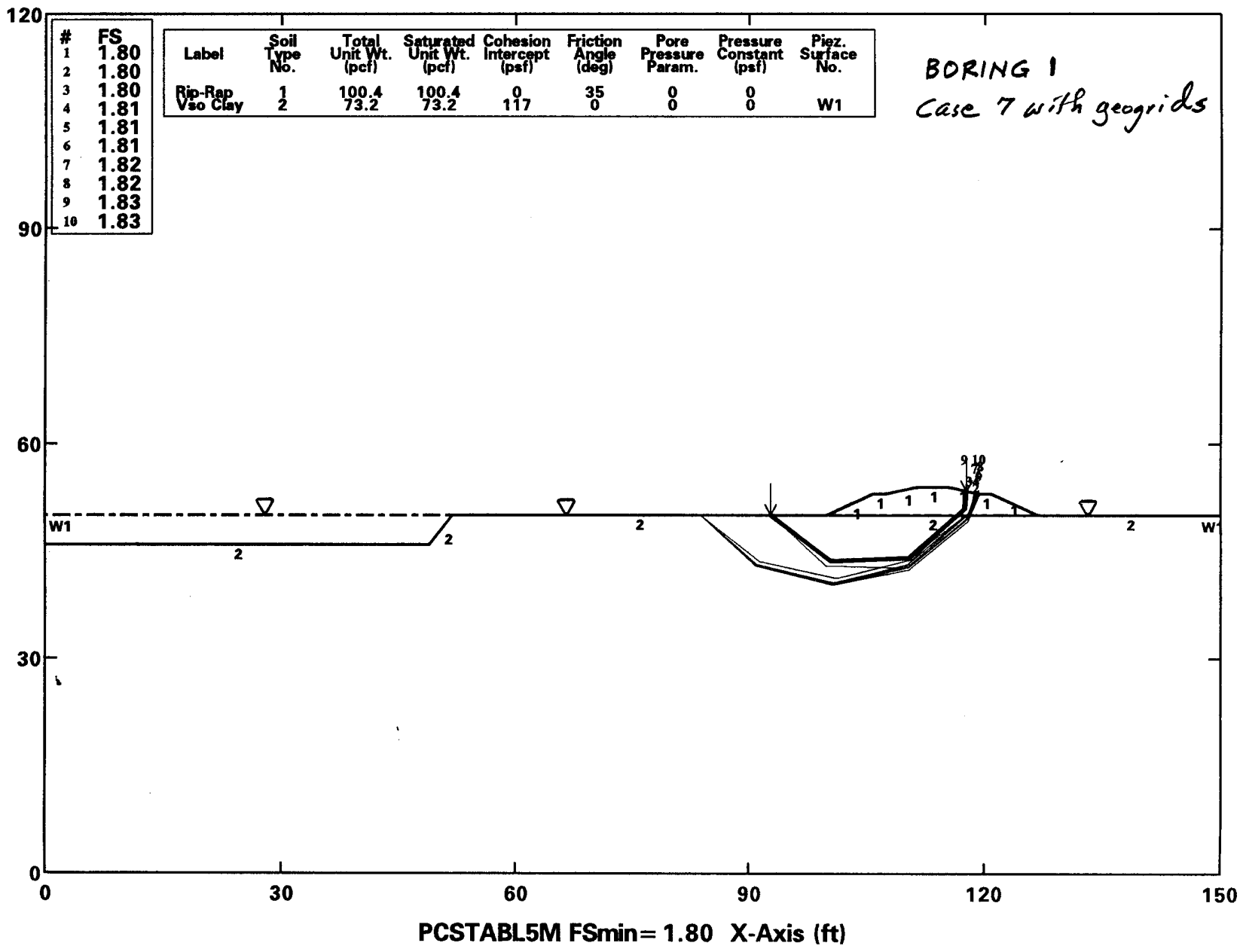
BORING 6
CASE 1.



SHEET 13

02-115 Coastal Restoration Project Lake Borgne

Ten Most Critical. C:021151.PLT By: bjb 12-11-02 3:49pm



#	FS
1	1.80
2	1.80
3	1.80
4	1.81
5	1.81
6	1.81
7	1.82
8	1.82
9	1.83
10	1.83

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Rip-Rap	1	100.4	100.4	0	35	0	0	
Vso Clay	2	73.2	73.2	117	0	0	0	W1

BORING 1
Case 7 with geogrids

SHEET 14

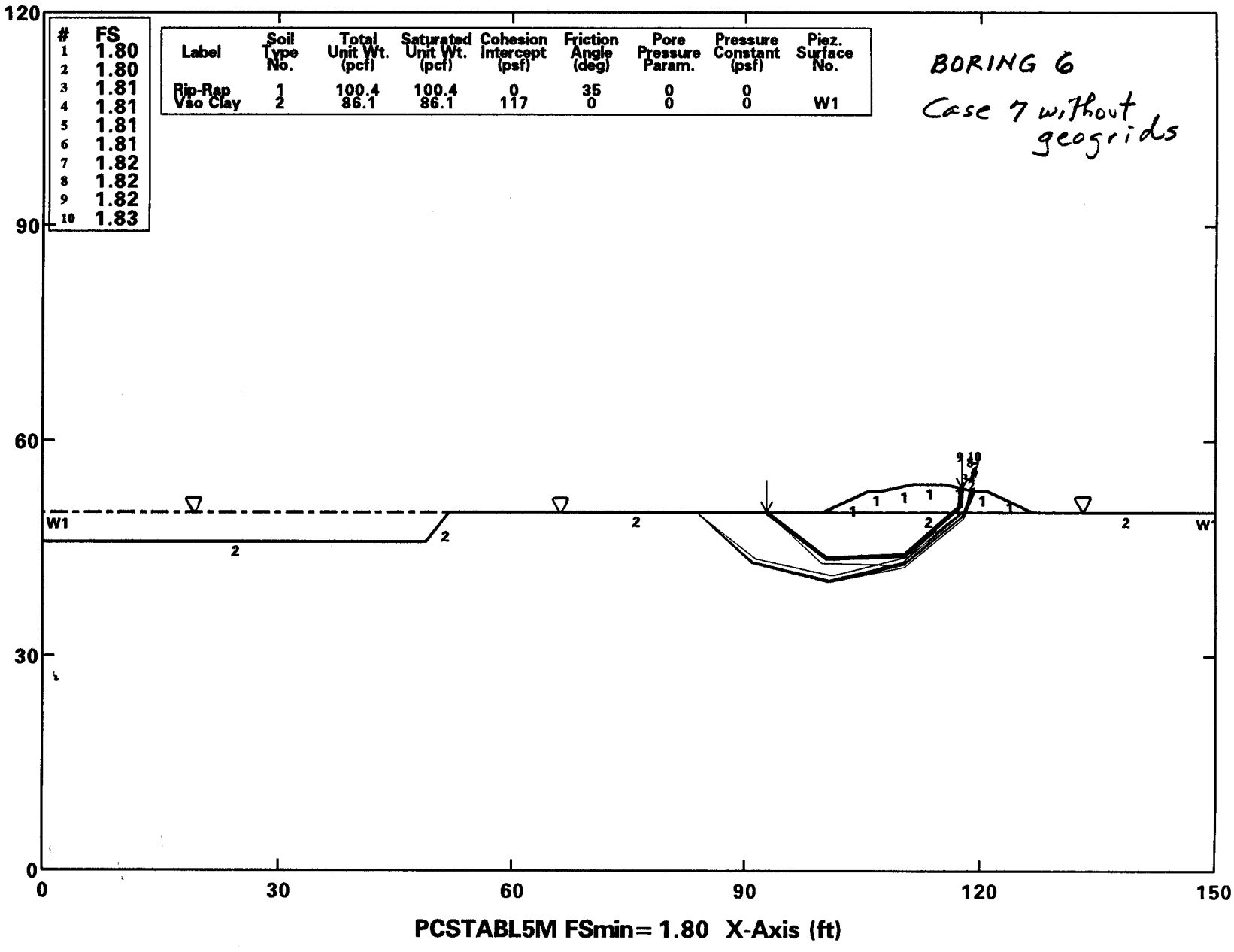
02-115 Coastal Restoration Project Lake Borgne

Ten Most Critical. C:021152.PLT By: bjb 12-11-02 3:54pm

#	FS
1	1.80
2	1.80
3	1.81
4	1.81
5	1.81
6	1.81
7	1.82
8	1.82
9	1.82
10	1.83

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Rip-Rap	1	100.4	100.4	0	35	0	0	
Vso Clay	2	86.1	86.1	117	0	0	0	W1

BORING 6
Case 7 without geogrids



SHEET 15

02-115 Coastal Restoration Project Lake Borgne

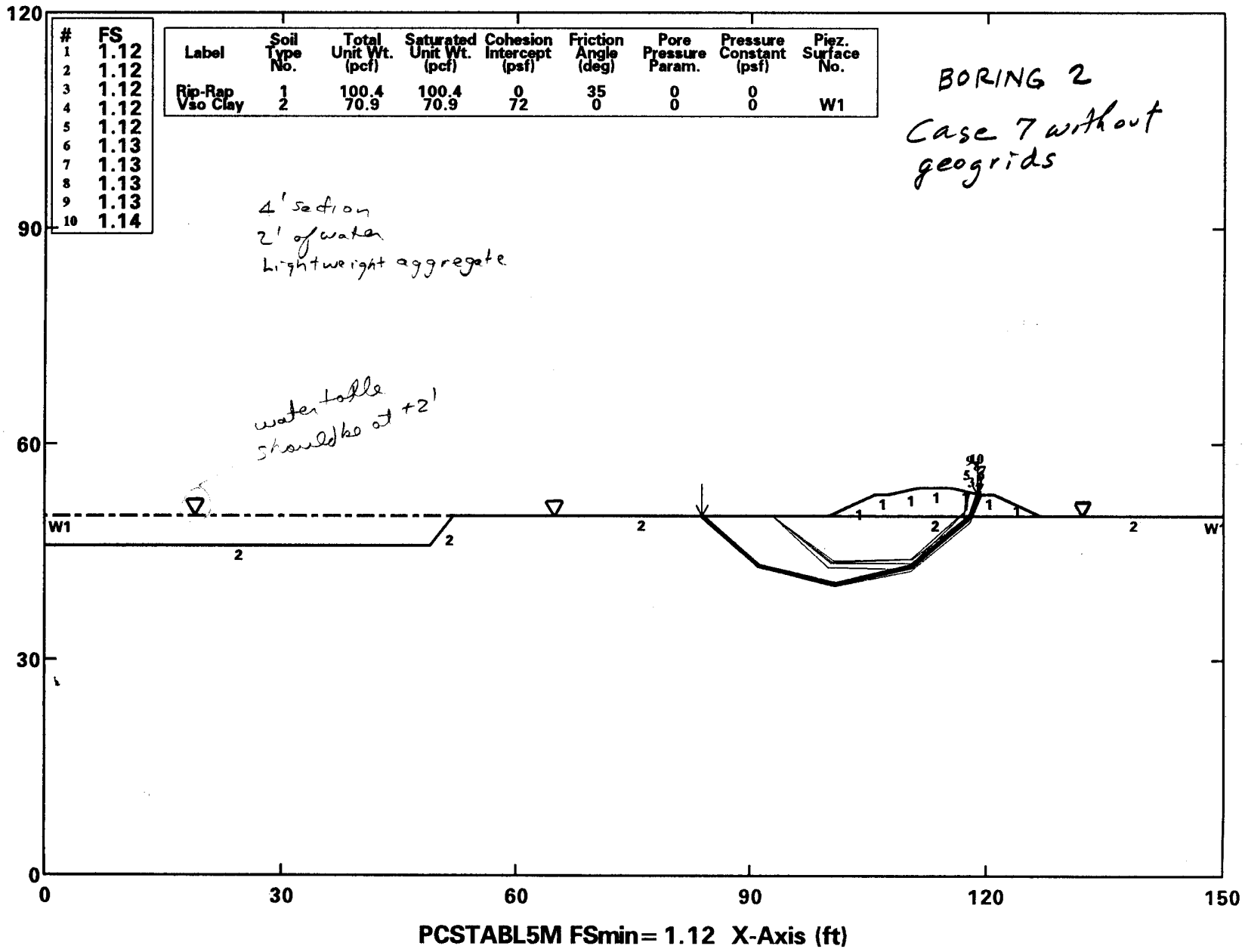
Ten Most Critical. C:021153.PLT By: bjb 12-11-02 4:20pm

#	FS
1	1.12
2	1.12
3	1.12
4	1.12
5	1.12
6	1.13
7	1.13
8	1.13
9	1.13
10	1.14

Label	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Rip-Rap	1	100.4	100.4	0	35	0	0	
Vso Clay	2	70.9	70.9	72	0	0	0	W1

BORING 2
Case 7 without geogrids

4' section
2' of water
Lightweight aggregate



SHEET 16

% Consolidation

1 YEAR

5 YEARS

10 YEARS

20 YEARS

100

1000

10,000

120.0 days

TIME IN DAYS

40-4501
10 DIVISIONS PER INCH SHORT SIDE
THREE 5¼ INCH CYCLES LONG SIDE

L. L. RIDGWAY COMPANY, INC.
PRINTED IN U.S.A.

SHORELINE PROTECTION AT LAKE BORGNE

LABORATORY DATA

TABLE 1 FILE NO: 02-115

BORING NUMBER	DEPTH FEET	MOISTURE %	UNIT WEIGHT WET PCF	UNIT WEIGHT DRY PCF	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	COMPRESSION TEST qu TSF	COMPRESSION TEST % STRAIN	COMPRESSION TEST START PRESSURE KSF	COMPRESSION TEST TYPE FAILURE	TEST TYPE
1	8.0 - 10.0	172	76.2	28.0	147	52	95	0.09	15		Yield	U
1	10.0 - 12.0	183	76.8	27.1	169	55	114	0.12	13		Multiple Shear	U
1	12.0 - 14.0	216	74.4	23.6	242	105	137	0.15	14		Multiple Shear	U
1	14.0 - 16.0	254	68.1	19.2				0.10	6		Multiple Shear	U
1	16.0 - 18.0	570	59.0	8.8	749	400	349	0.15	10		Multiple Shear	U
1	21.0 - 23.0	125	84.7	37.7				0.13	15		Yield	U
2	8.0 - 10.0	166	73.0	27.5	173	75	98	0.06	13		Multiple Shear	U
2	10.0 - 12.0	447	64.8	11.9				0.08	14		Multiple Shear	U
2	12.0 - 14.0	613	69.2	9.7				0.08	14		Multiple Shear	U
2	14.0 - 16.0	561	76.4	11.6				0.07	13		Multiple Shear	U
2	16.0 - 18.0	36	111.6	82.0				0.07	11		Bulge	U
2	21.0 - 23.0	83	102.8	56.2	79	37	42	0.17	15		Yield	U
2	26.0 - 28.0	72	100.9	58.8				0.13	9		Multiple Shear	U
2	31.0 - 33.0	87	96.4	51.6				0.15	11		Multiple Shear	U
2	36.0 - 38.0	78	93.3	52.3	81	27	54	0.11	13		Multiple Shear	U
2	41.0 - 43.0	87	93.4	49.9				0.19	15		Yield	U
3	23.0 - 25.0	279	75.0	19.8	374	150	224	0.11	7		Multiple Shear	U
3	25.0 - 27.0	65	98.4	59.7				0.06	10		Multiple Shear	U
3	27.0 - 29.0	53	100.3	65.6				0.09	10		Multiple Shear	U
3	29.0 - 31.0	37	113.7	82.9	41	22	19	0.16	15		Yield	U
3	31.0 - 33.0	39	113.1	81.5				1.84	13	.52	Bulge	QU
3	36.0 - 38.0	67	96.1	57.6	71	31	40	0.20	8		SLS (60 Degrees)	U
3	41.0 - 43.0	35	117.5	87.2				0.23	15		Yield	U
3	46.0 - 48.0	55	95.3	61.4	78	33	45	0.32	15		Yield	U
3	51.0 - 53.0	73	99.7	57.8				0.26	15		Yield	U
3	56.0 - 58.0	65	96.4	58.5				0.37	15		Yield	U
3	61.5 - 63.0											Dry Sieve
3	66.0 - 68.0	22	116.9	96.0				1.08	15	2.56	Yield	QU
3	71.5 - 73.0											Dry Sieve
4	8.0 - 10.0	106	93.6	45.6				0.17	15		Yield	U
4	10.0 - 12.0	358	76.3	16.6	200	87	113	0.11	15		Yield	U
4	12.0 - 14.0	345	69.6	15.7				0.10	15		Yield	U
4	14.0 - 16.0	391	68.3	13.9				0.10	15		Yield	U
4	16.0 - 18.0	148	97.4	39.3	93	30	63	0.20	15		Yield	U
4	21.0 - 23.0	73	105.9	61.2	55	22	33	0.23	15		Yield	U
4	26.5 - 28.0											Dry Sieve

SHORELINE PROTECTION AT LAKE BORGNE

LABORATORY DATA

TABLE 2 FILE NO: 02-115

BORING NUMBER	DEPTH FEET	MOISTURE %	UNIT WEIGHT WET PCF	UNIT WEIGHT DRY PCF	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	COMPRESSION TEST TSF	COMPRESSION TEST % STRAIN	COMPRESSION TEST START PRESSURE KSF	COMPRESSION TEST TYPE FAILURE	TEST TYPE
4	31.0 - 33.0	32	120.4	91.2	26	26	0	0.88	7	1.40	Multiple Shear	QU
4	36.5 - 38.0											Dry Sieve
4	41.5 - 43.0											Dry Sieve
5	9.0 - 11.0	73	92.3	53.5	84	36	48	0.09	15		Yield	U
5	11.0 - 13.0	197	82.8	27.9	141	52	89	0.20	10		Multiple Shear	U
5	13.0 - 15.0	73	90.9	52.7	98	41	57	0.09	9		Multiple Shear	U
5	15.0 - 17.0	46	114.3	78.3				0.49	12		Multiple Shear	U
5	17.0 - 19.0	28	119.1	93.2	25	22	3	0.74	9	1.04	Bulge	QU
5	22.5 - 24.0											Dry Sieve
6	10.0 - 12.0	203	76.8	25.4	175	81	94	0.09	15		Yield	U
6	12.0 - 14.0	228	67.2	20.5				0.09	13		Multiple Shear	U
6	14.0 - 16.0	85	95.7	51.8	99	41	58	0.09	10		Multiple Shear	U
6	16.0 - 18.0	51	91.5	60.7				0.13	11		Multiple Shear	U
6	18.0 - 20.0	144	87.1	35.8	158	62	96	0.19	10		Multiple Shear	U
6	23.0 - 25.0	43	98.7	69.0	122	41	81	0.11	10		Multiple Shear	U
7	10.0 - 12.0	162	82.1	31.4				0.10	9		Multiple Shear	U
7	12.0 - 14.0	158	83.0	32.2	138	50	88	0.08	13		Multiple Shear	U
7	14.0 - 16.0	391	73.6	15.0				0.09	10		Multiple Shear	U
7	16.0 - 18.0	146	86.1	35.0				0.05	14		Multiple Shear	U
7	18.0 - 20.0	296	74.9	18.9	248	111	137	0.15	8		Multiple Shear	U
7	23.0 - 25.0	279	81.1	21.4	173	57	116	0.07	10		Multiple Shear	U
7	28.0 - 30.0	148	81.4	32.8				0.07	8		Multiple Shear	U
7	33.0 - 35.0	112	87.2	41.1	95	37	58	0.07	14		Multiple Shear	U
7	38.0 - 40.0	372	75.5	16.0				0.10	15		Yield	U
7	43.0 - 45.0	85	97.3	52.7				0.22	9		Vertical Shear	U
8	10.0 - 12.0	68	105.8	63.1	43	20	23	0.28	14		Multiple Shear	U
8	12.0 - 14.0	63	108.3	66.5	50	18	32	0.24	10		Multiple Shear	U
8	14.0 - 16.0	193	87.2	29.7				0.26	7		Multiple Shear	U
8	16.0 - 18.0	76	90.8	51.6	109	42	67	0.15	10		Multiple Shear	U
8	18.0 - 20.0	45	107.4	74.0				0.15	13		Multiple Shear	U
8	23.0 - 25.0	102	95.6	47.4	122	37	85	0.28	11		Multiple Shear	U
9	12.0 - 14.0	54	105.6	68.4				0.13	11		Multiple Shear	U
9	14.0 - 16.0	61	111.0	69.0	46	25	21	0.27	15		Yield	U
9	16.0 - 18.0	53	104.2	67.9				0.18	15		Yield	U

SHORELINE PROTECTION AT LAKE BORGNE

LABORATORY DATA

TABLE 3 FILE NO: 02-115

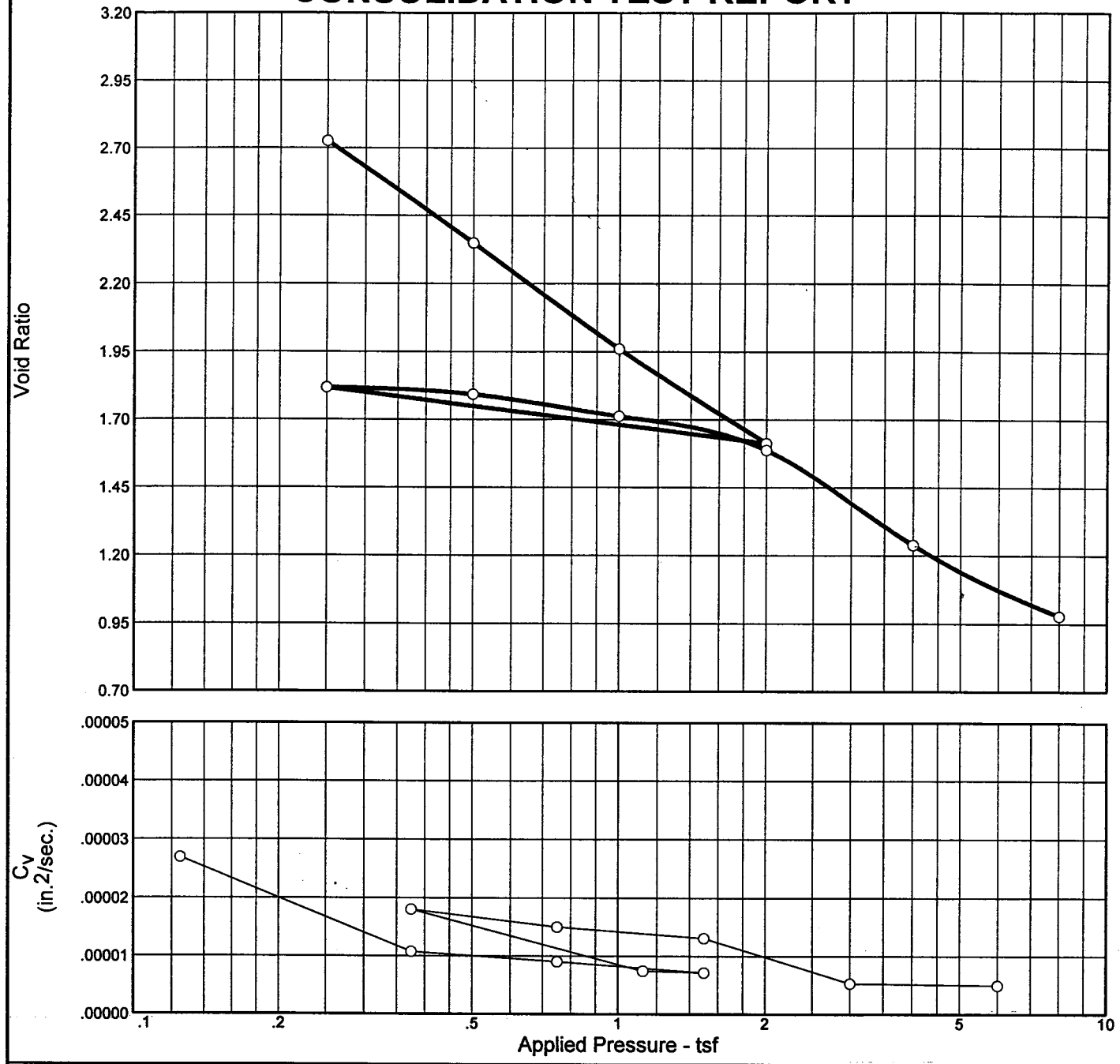
BORING NUMBER	DEPTH FEET	MOISTURE %	UNIT WEIGHT WET PCF	UNIT WEIGHT DRY PCF	ATTERBERG LIMITS LL	ATTERBERG LIMITS PL	ATTERBERG LIMITS PI	COMPRESSION TEST TSF	COMPRESSION TEST % STRAIN	COMPRESSION TEST START PRESSURE KSF	COMPRESSION TEST TYPE FAILURE	TEST TYPE
9	18.0 - 20.0	62	106.1	65.4				0.18	15		Yield	U
9	20.0 - 22.0	30	117.0	89.8				0.65	8	.52	Bulge	QU
9	25.0 - 27.0	77	94.2	53.4	187	72	115	0.27	6		Multiple Shear	U
9	30.0 - 32.0	86	94.4	50.7	128	59	69	0.40	9		Multiple Shear	U
9	35.0 - 37.0	38	109.5	79.4				0.36	15		Yield	U
9	40.0 - 42.0	34	109.5	81.9				0.39	15		Yield	U
9	45.0 - 47.0	42	105.1	74.2	87	34	53	0.40	9		Multiple Shear	U
10	8.0 - 10.0	68	97.1	57.9	75	28	47	0.08	15		Yield	U
10	12.5 - 14.0											Dry Sieve
10	14.5 - 16.0											Dry Sieve
10	21.5 - 23.0											Dry Sieve
11	9.0 - 11.0	54	104.3	67.6	55	25	30	0.21	15		Yield	U
11	11.0 - 13.0	76	98.6	56.2	21	19	2	0.68	9	.19	Bulge	QU
11	13.0 - 15.0	27	119.3	94.2				1.05	7	.30	Bulge	QU
11	15.0 - 17.0	52	104.6	68.8	45	24	21	0.08	15		Yield	U
11	17.0 - 19.0	155	87.2	34.2				0.21	11		Multiple Shear	U
11	22.0 - 24.0	285	74.3	19.3	358	130	228	0.17	8		Multiple Shear	U
11	27.0 - 29.0	50	120.5	80.2	30	17	13	0.80	9	1.09	Bulge	QU
11	32.0 - 34.0	29	120.3	92.9				0.75	15	1.40	Yield	QU
11	37.5 - 39.0											Dry Sieve
11	42.0 - 44.0	50	105.9	70.5				0.36	4		SLS (50 Degrees)	U
12	10.0 - 12.0	45	122.0	84.2	68	26	42	0.33	10		Multiple Shear	U
12	12.0 - 14.0	36	122.9	90.2				0.64	10		Multiple Shear	U
12	14.0 - 16.0	36	117.0	86.1	61	26	35	0.38	10		SLS (45 Degrees)	U
12	16.0 - 18.0	41	118.5	83.9				0.42	14		Multiple Shear	U
12	18.0 - 20.0	67	108.1	64.7	78	36	42	0.23	11		Multiple Shear	U
12	23.5 - 25.0											Dry Sieve
12	28.5 - 30.0				27	21	6					
12	33.5 - 35.0											Dry Sieve
12	38.5 - 40.0											Dry Sieve
12	43.5 - 45.0											Dry Sieve

Boring	Depth (feet)			Dial Reading	TSF
1	8	-	10	12	0.06
1	10	-	12	18	0.09
1	12	-	14	23	0.12
1	14	-	16	16	0.08
1	16	-	18	26	0.13
1	21	-	23	22	0.11
2	8	-	10	10	0.05
2	10	-	12	12	0.06
2	12	-	14	11	0.06
2	14	-	16	12	0.06
2	16	-	18	11	0.06
2	21	-	23	27	0.14
2	26	-	28	21	0.11
2	31	-	33	23	0.12
2	36	-	38	20	0.10
2	41	-	43	34	0.17
3	23	-	25	20	0.10
3	25	-	27	12	0.06
3	27	-	29	20	0.10
3	29	-	31	12	0.06
3	31	-	33	12	0.06
3	36	-	38	33	0.17
3	41	-	43	23	0.12
3	46	-	48	33	0.17
3	51	-	53	40	0.20
3	56	-	58	45	0.23
3	66	-	68	24	0.12
4	8	-	10	28	0.14
4	10	-	12	20	0.10
4	12	-	14	20	0.10
4	14	-	16	17	0.09
4	16	-	18	32	0.16
4	21	-	23	36	0.18
4	31	-	33	59	0.30
5	9	-	11	17	0.09
5	11	-	13	29	0.15
5	13	-	15	16	0.08
5	15	-	17	87	0.44
5	17	-	19	17	0.09
6	10	-	12	15	0.08
6	12	-	14	15	0.08
6	14	-	16	18	0.09
6	16	-	18	22	0.11
6	18	-	20	33	0.17
6	23	-	25	17	0.09

Mini Vane Shear Test Results

Boring	Depth (feet)			Dial Reading	TSF
7	10		12	18	0.09
7	12		14	14	0.07
7	14		16	16	0.08
7	16	-	18	7	0.04
7	18	-	20	28	0.14
7	23	-	25	12	0.06
7	28	-	30	13	0.07
7	33	-	35	16	0.08
7	38	-	40	15	0.08
7	43	-	45	42	0.21
8	10	-	12	45	0.23
8	12	-	14	40	0.20
8	14	-	16	43	0.22
8	16	-	18	25	0.13
8	18	-	20	26	0.13
8	23	-	25	46	0.23
9	12	-	14	23	0.12
9	14	-	16	45	0.23
9	16	-	18	34	0.17
9	18	-	20	36	0.18
9	20	-	22	25	0.13
9	25	-	27	47	0.24
9	30	-	32	71	0.36
9	35	-	37	75	0.38
9	40	-	42	74	0.37
9	45	-	47	77	0.39
10	8	-	10	20	0.10
11	9	-	11	37	0.19
11	11	-	13	52	0.26
11	13	-	15	25	0.13
11	15	-	17	7	0.04
11	17	-	19	31	0.16
11	22	-	24	36	0.18
11	27	-	29	15	0.08
11	32	-	34	25	0.13
11	42	-	44	55	0.28
12	10	-	12	41	0.21
12	12	-	14	95	0.48
12	14	-	16	67	0.34
12	16	-	18	68	0.34
12	18	-	20	36	0.18

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	185.3 %	29.3	242	137	1.97			3.196

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 1 **Sample No.:** 12 - 14 feet

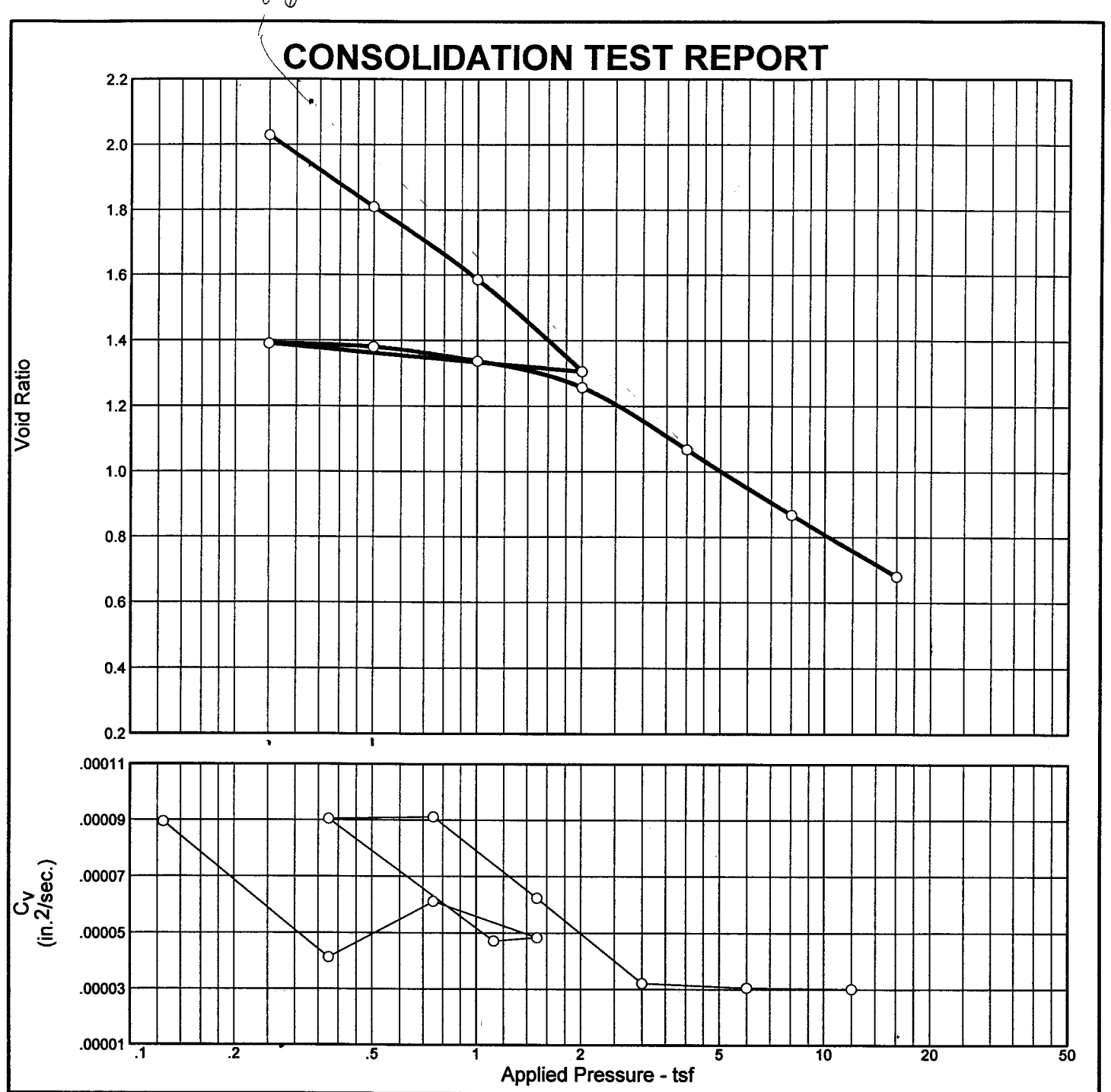
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 1

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
97.3 %	81.9 %	50.9	79	42	2.60			2.188

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 2 **Sample No.:** 21 - 23 feet

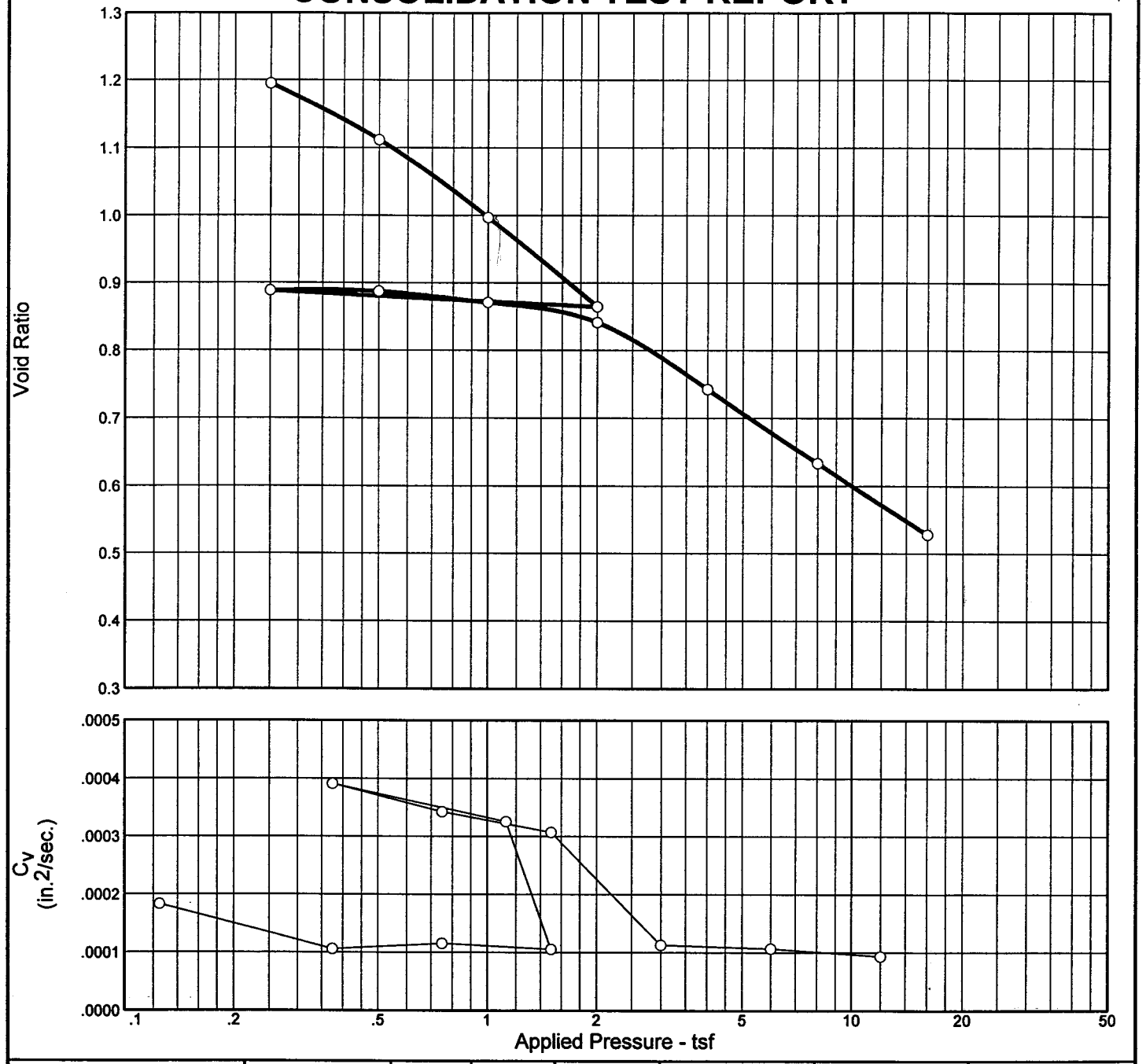
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 2

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
99.6 %	48.0 %	72.5	41	19	2.63			1.266

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 3 **Sample No.:** 29 - 31 feet

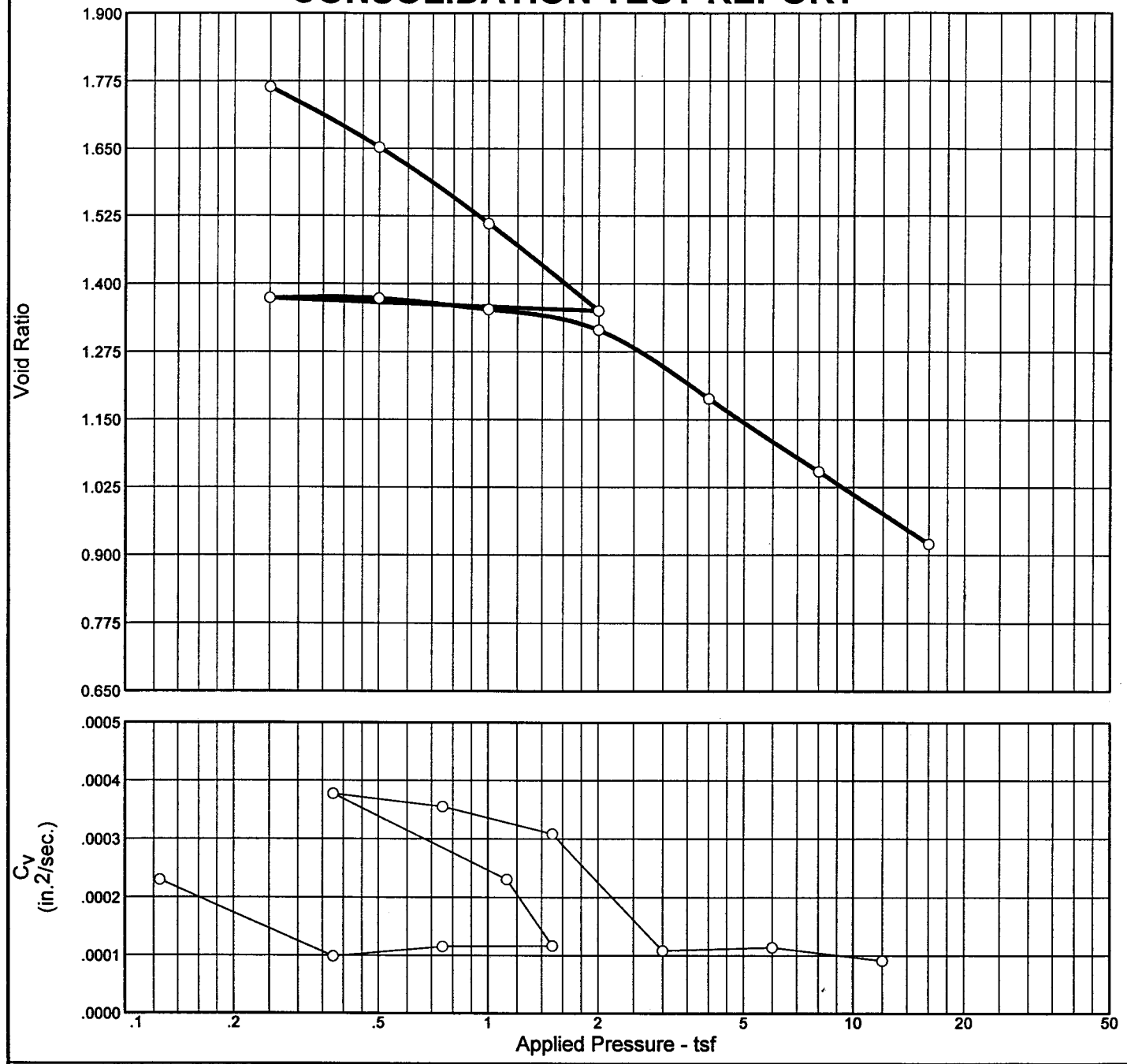
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 3

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
76.4 %	53.7 %	57.6	55	33	2.63			1.849

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 4 **Sample No.:** 21 - 23 feet

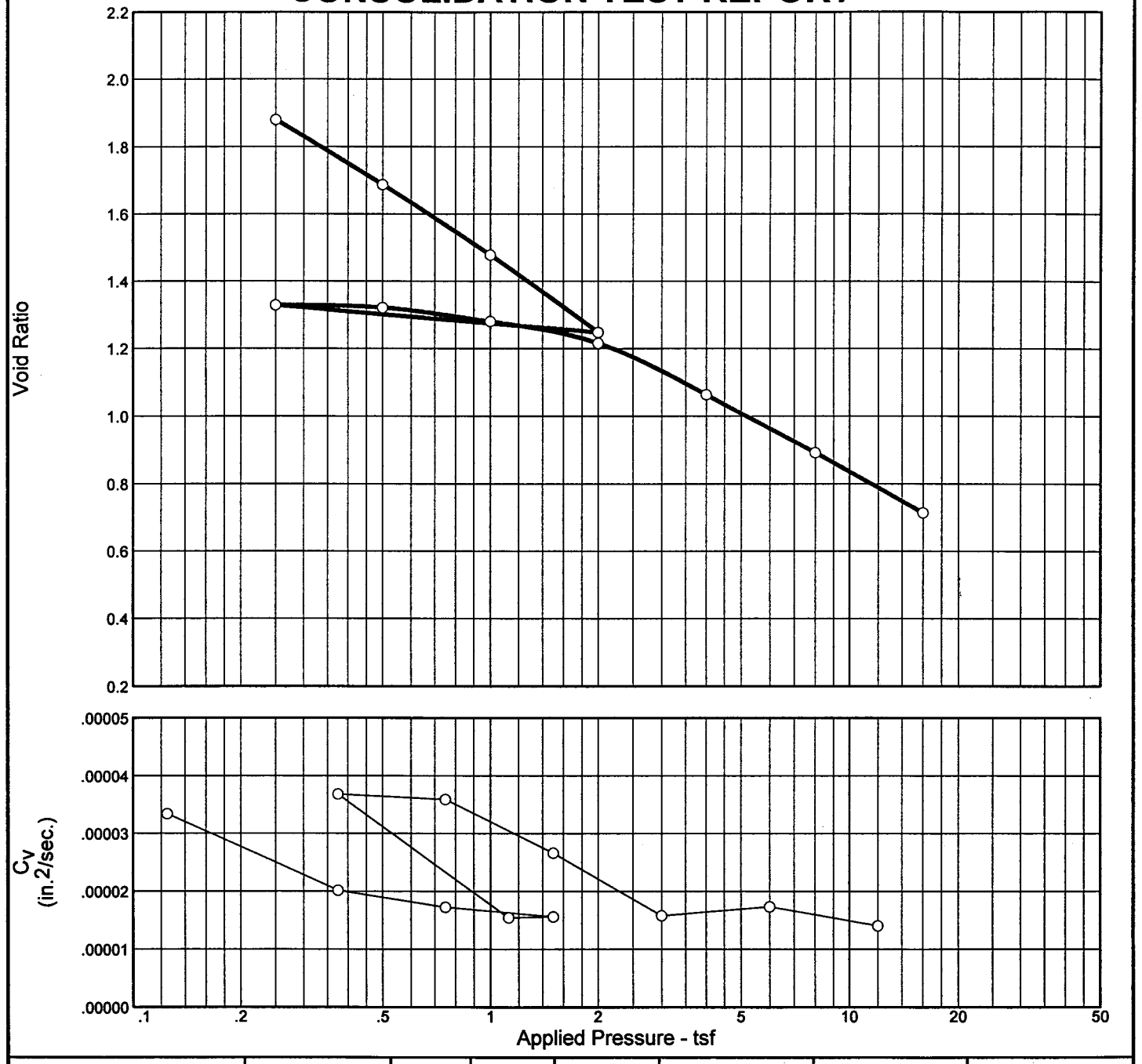
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 4

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	87.4 %	50.1	98	57	2.56			2.190

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 5 **Sample No.:** 13 - 15 feet

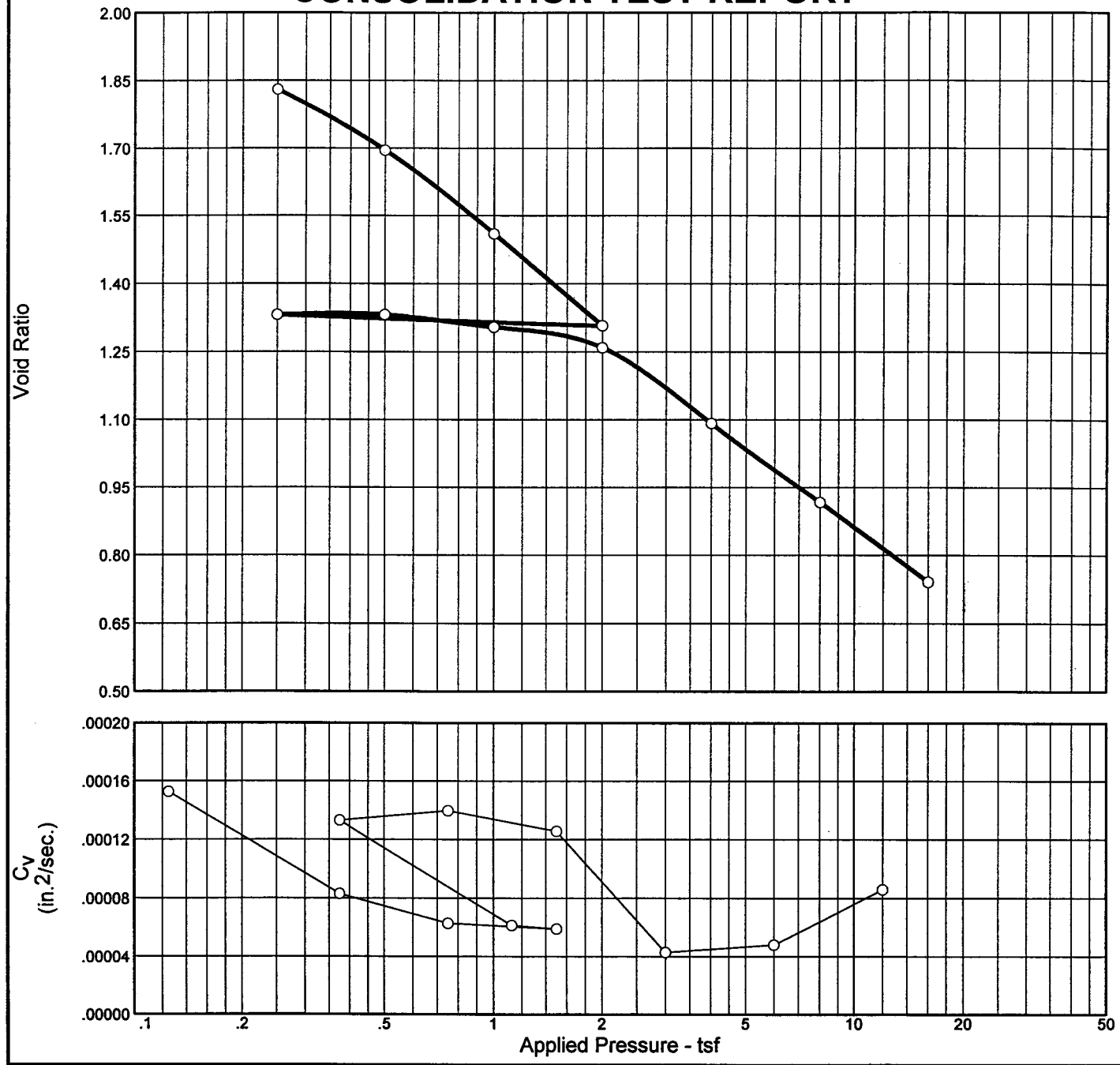
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 5

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	79.6 %	55.5	99	58	2.61			1.937

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 6 **Sample No.:** 14 - 16 feet

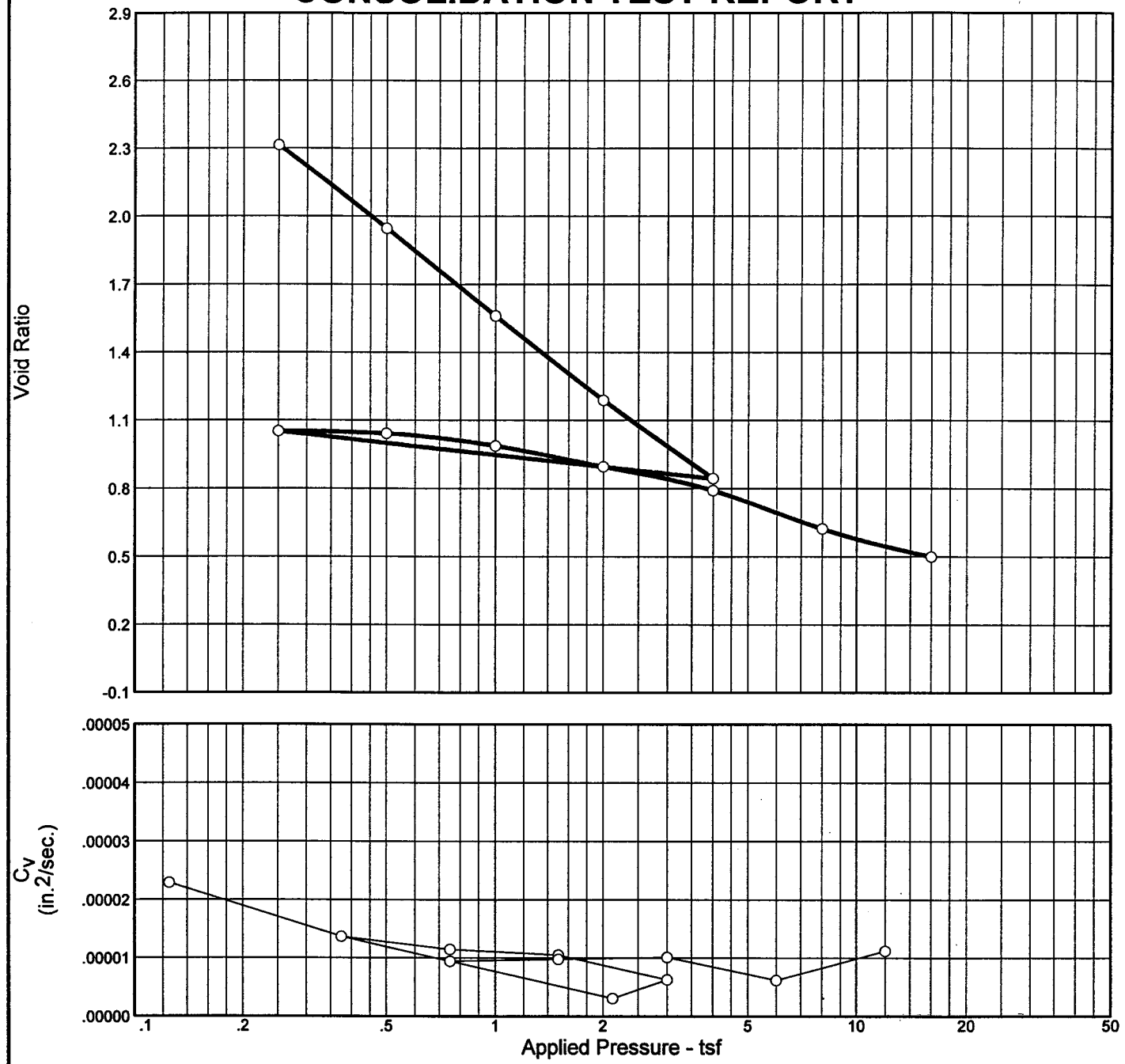
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 6

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	180.7 %	29.0	173	116	1.79			2.857

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 7 **Sample No.:** 23 - 25 feet

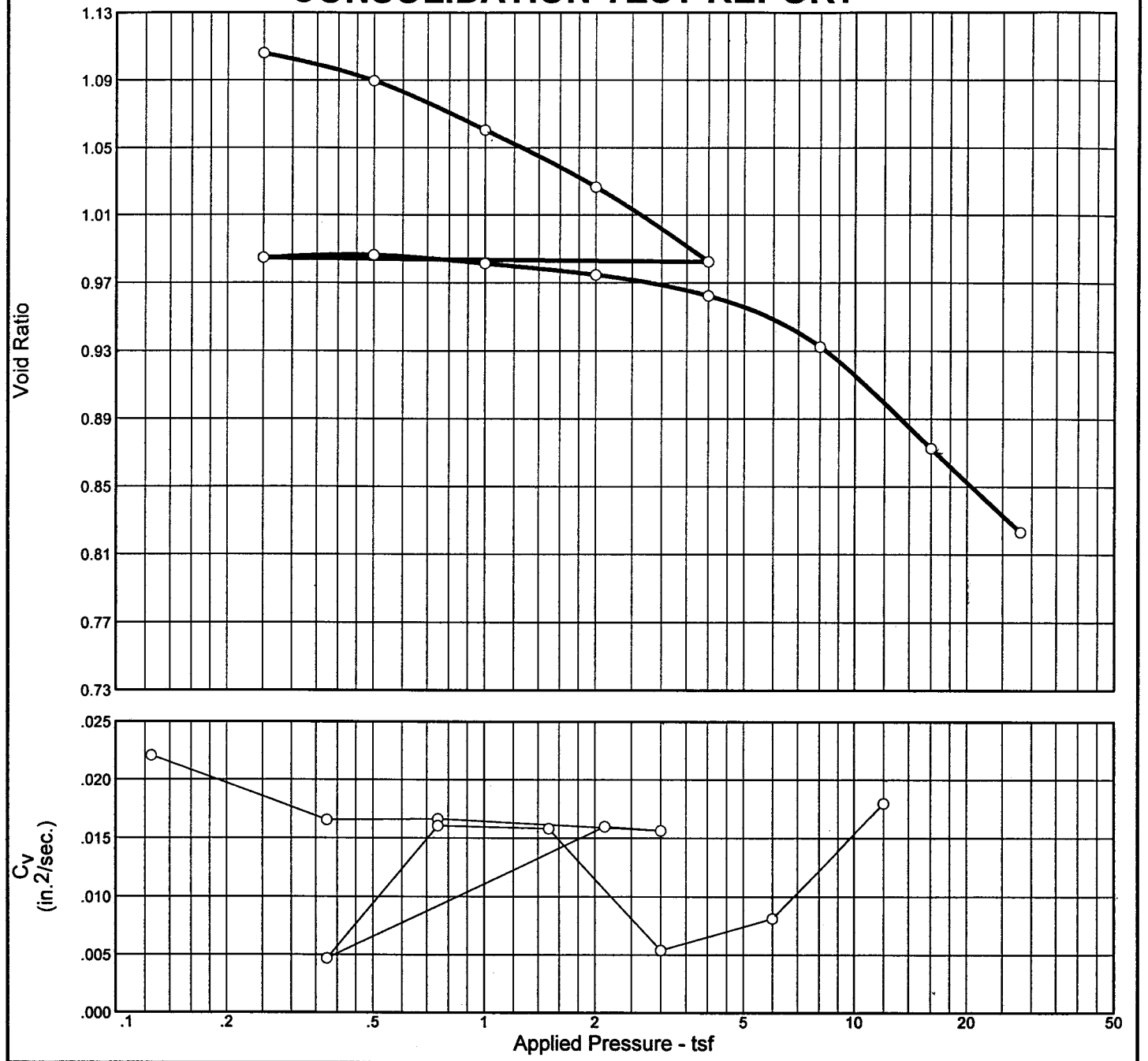
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 7

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	43.9 %	77.4	22	0	2.63			1.123

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 8 **Sample No.:** 12 - 14 feet

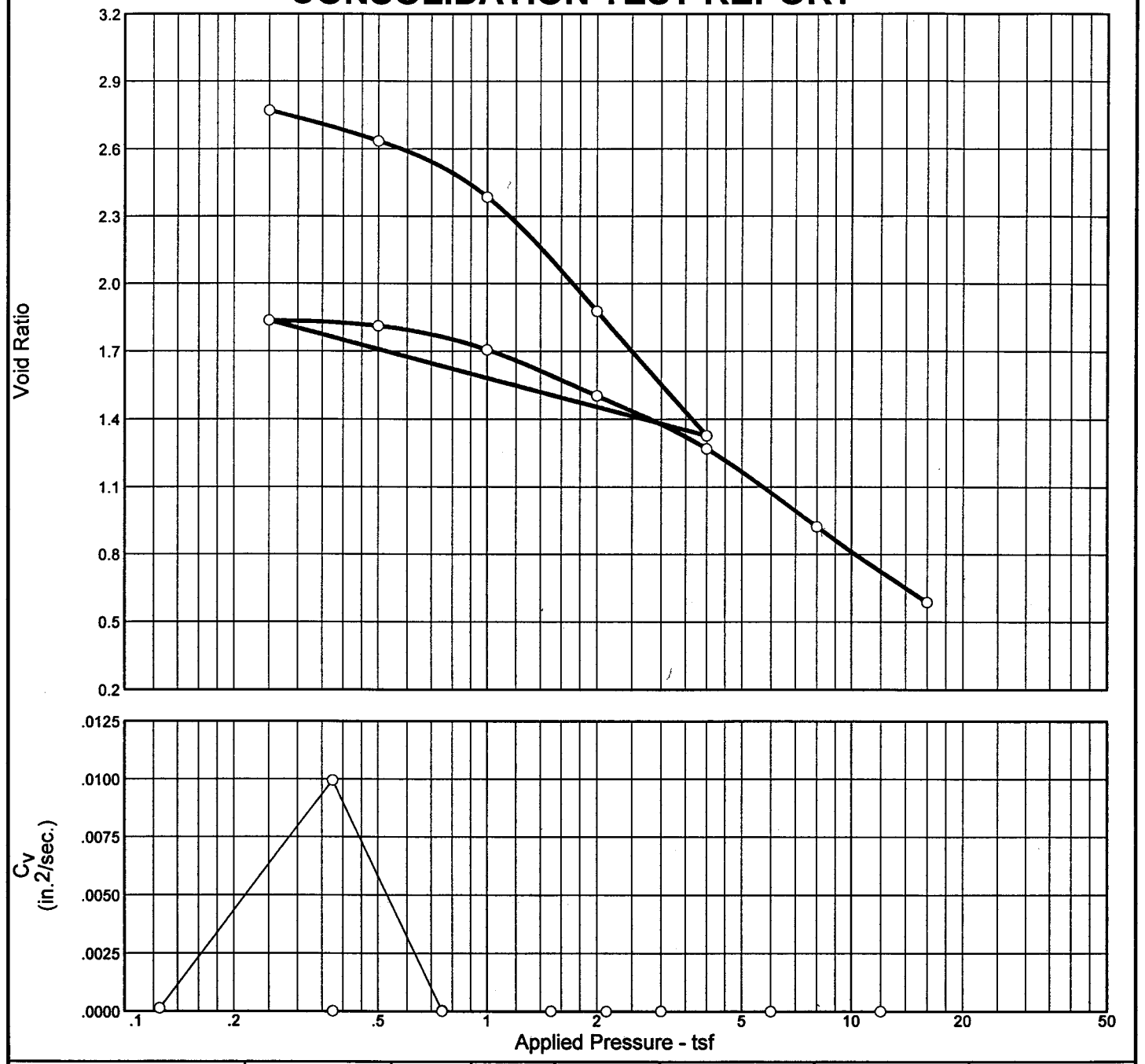
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 8

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	208.4 %	24.2	187	115	1.48			2.824

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 9 **Sample No.:** 25 - 27 feet

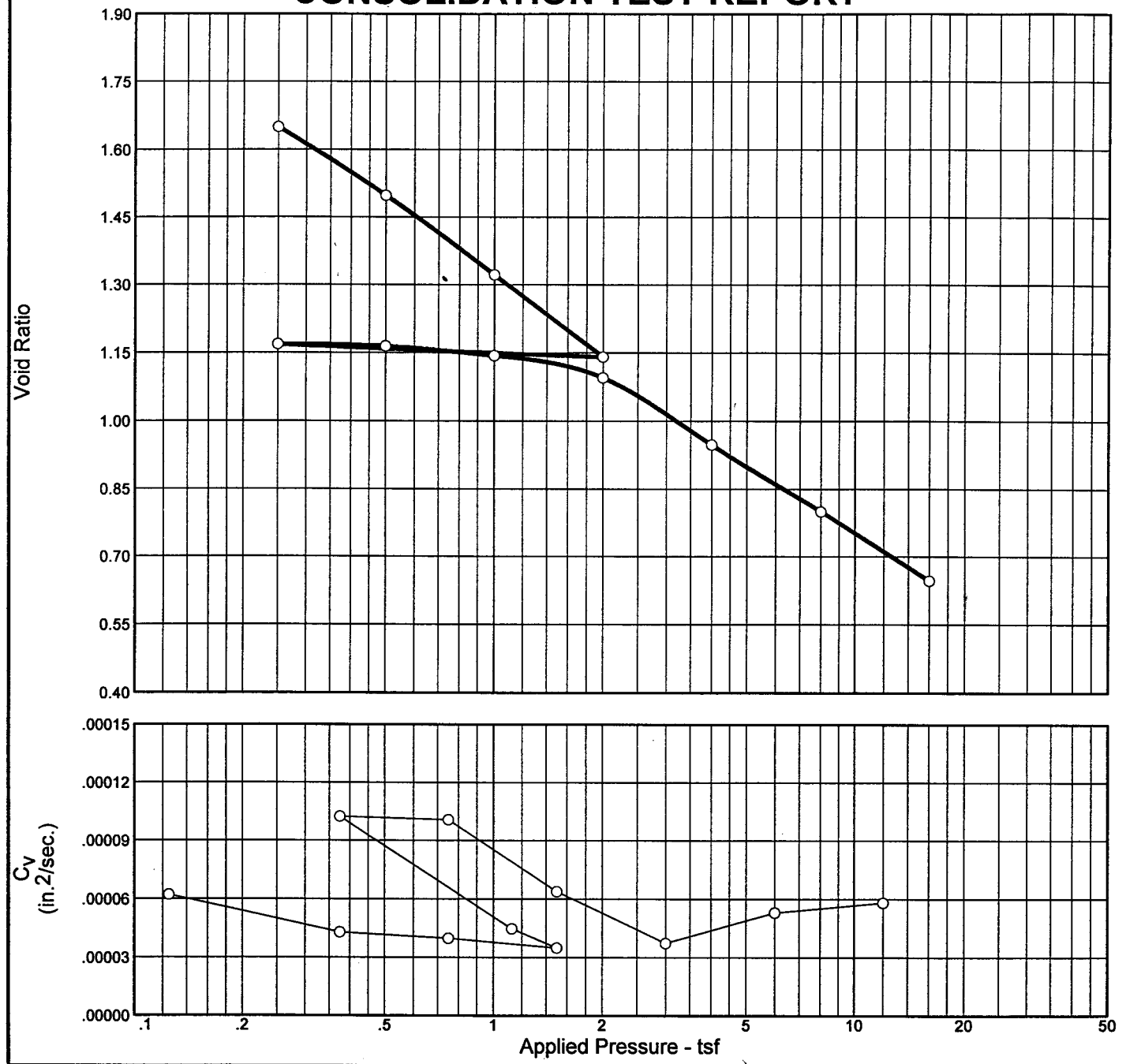
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 9

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	75.6 %	56.0	75	47	2.56			1.855

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 10 **Sample No.:** 8 - 10 feet

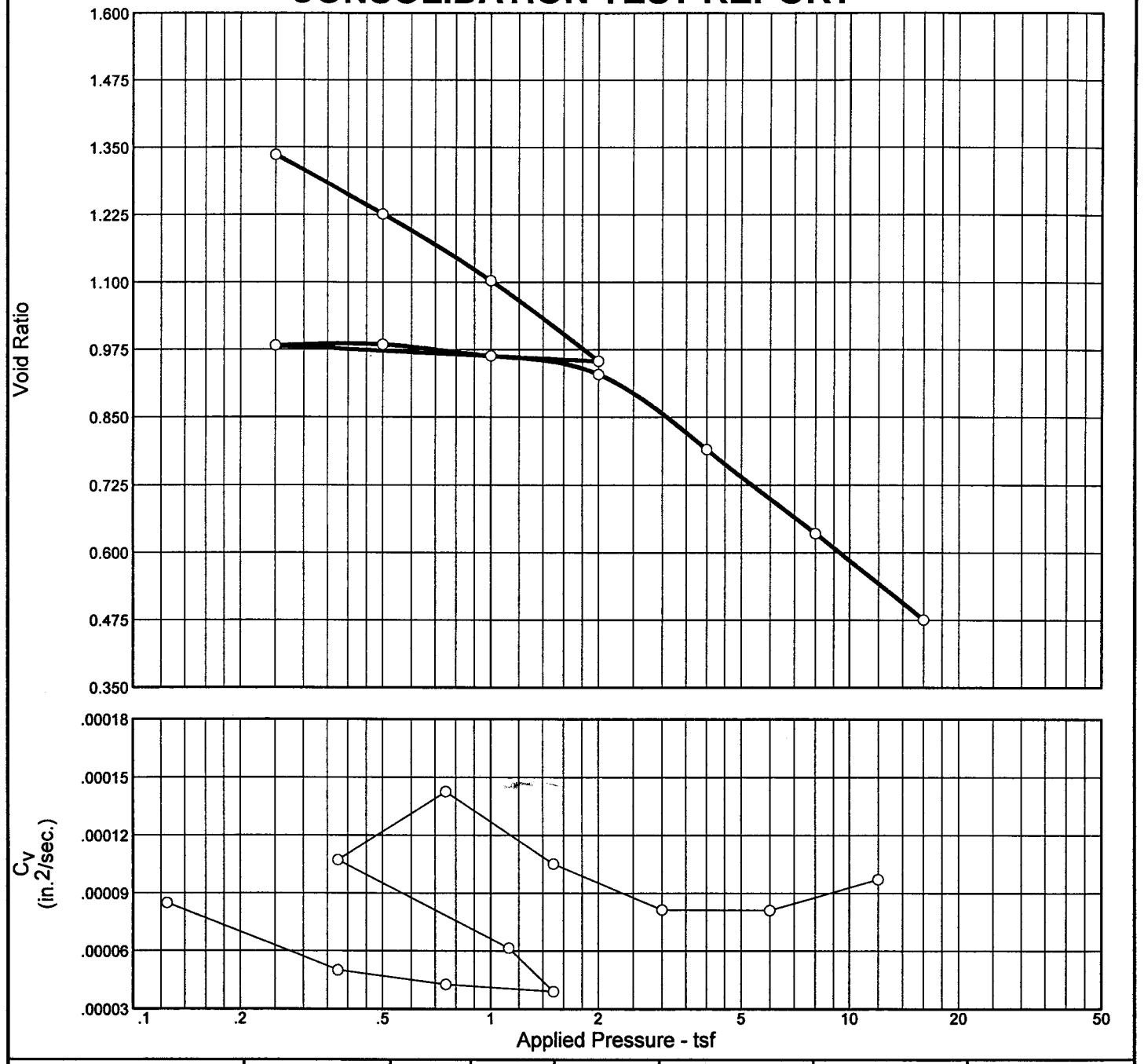
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 10

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	57.9 %	65.0	55	30	2.62			1.516

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 11 **Sample No.:** 9 - 11 feet

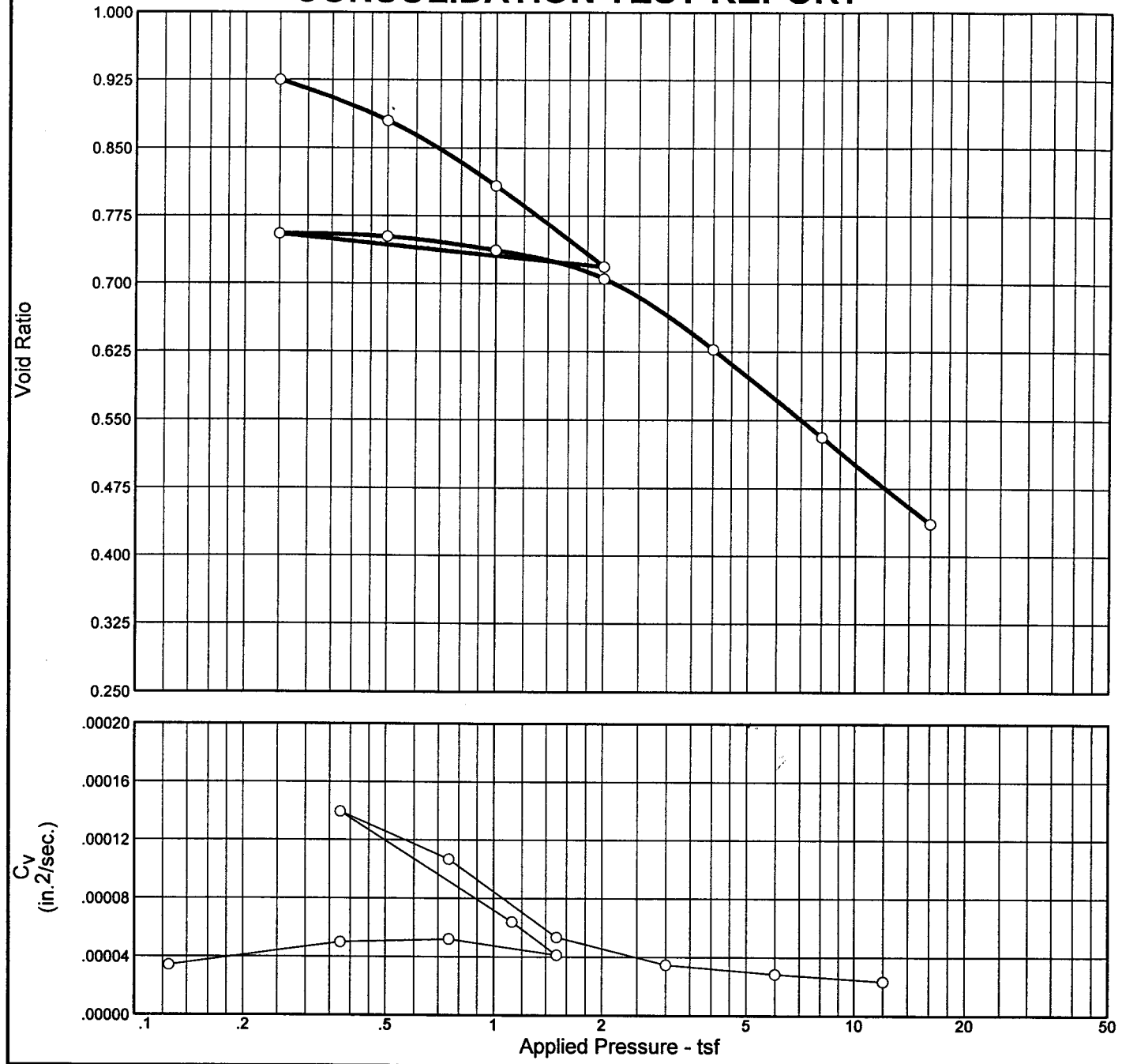
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

Figure Number 11

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
100.0 %	37.6 %	83.2	61	35	2.61			0.959

MATERIAL DESCRIPTION

Project No. 02-115 **Client:** State of Louisiana, Dept. of Natural Resources

Project: DNR Contract No. 2503-03-15
Geotechnical Investigation - Shoreline Protection/Marsh Creation in Lake Borgne, PO- 30

Source: Boring 12 **Sample No.:** 14 - 16 feet

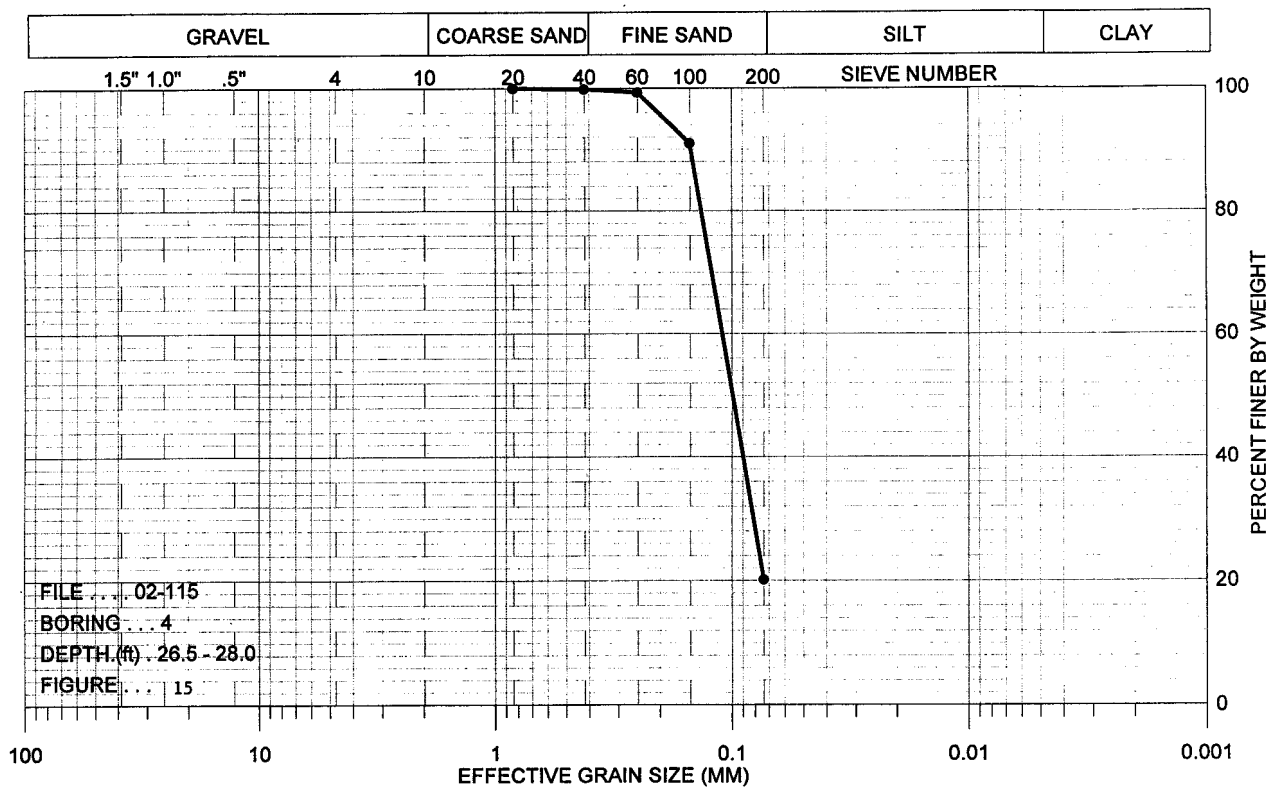
CONSOLIDATION TEST REPORT

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.

Remarks:

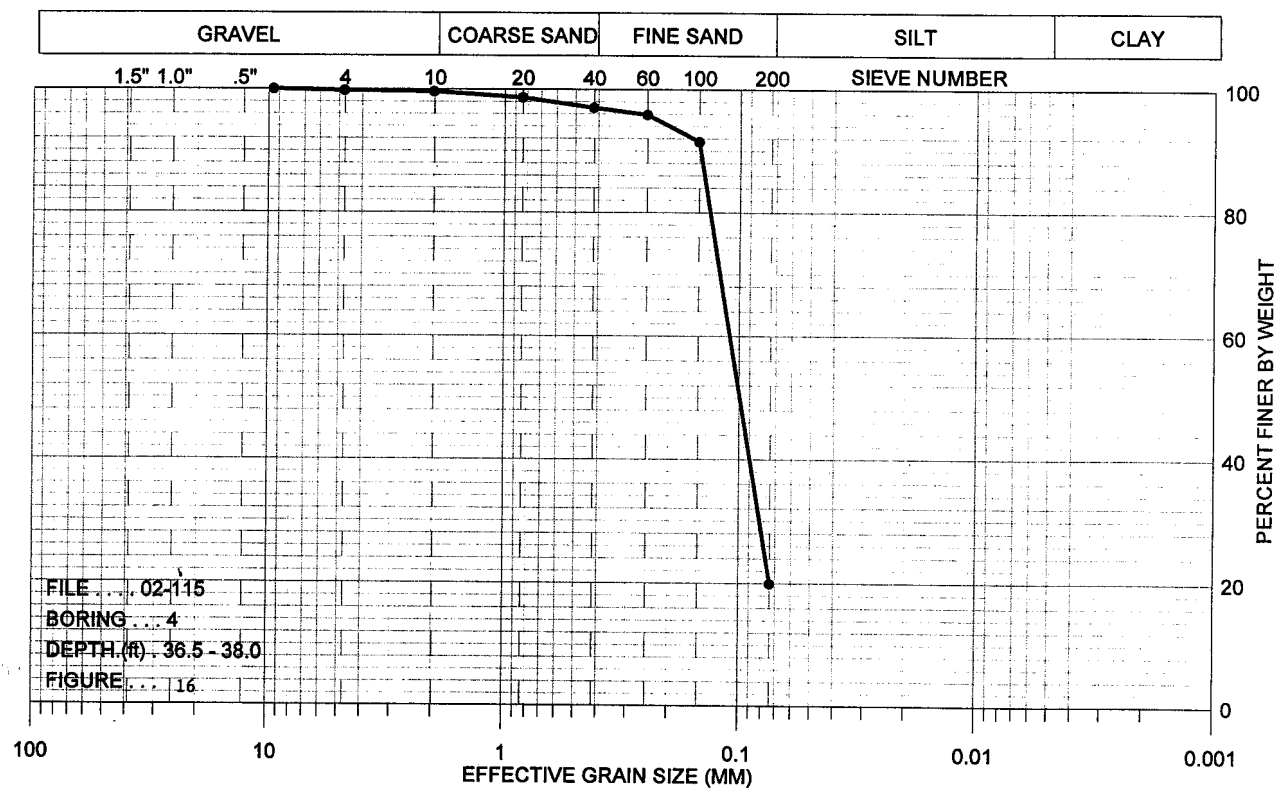
Figure Number 12

GRAIN SIZE CURVE



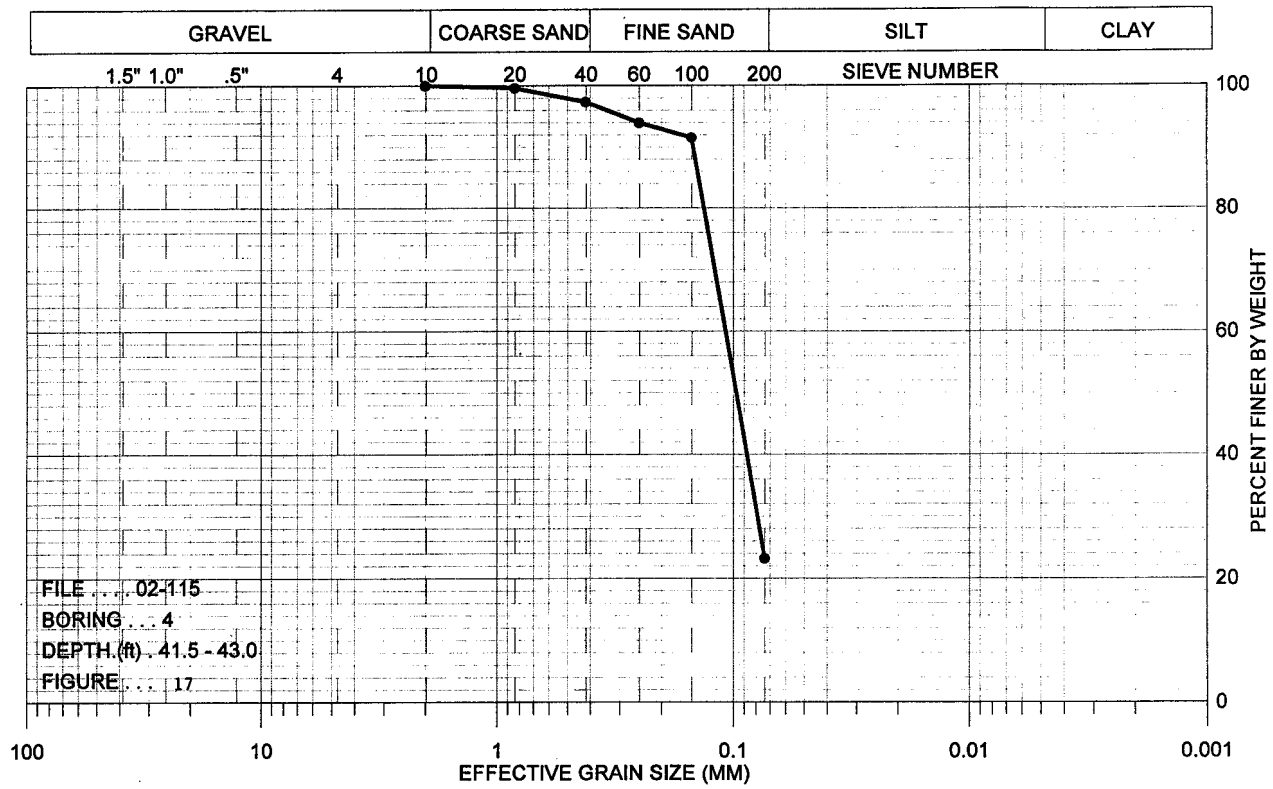
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



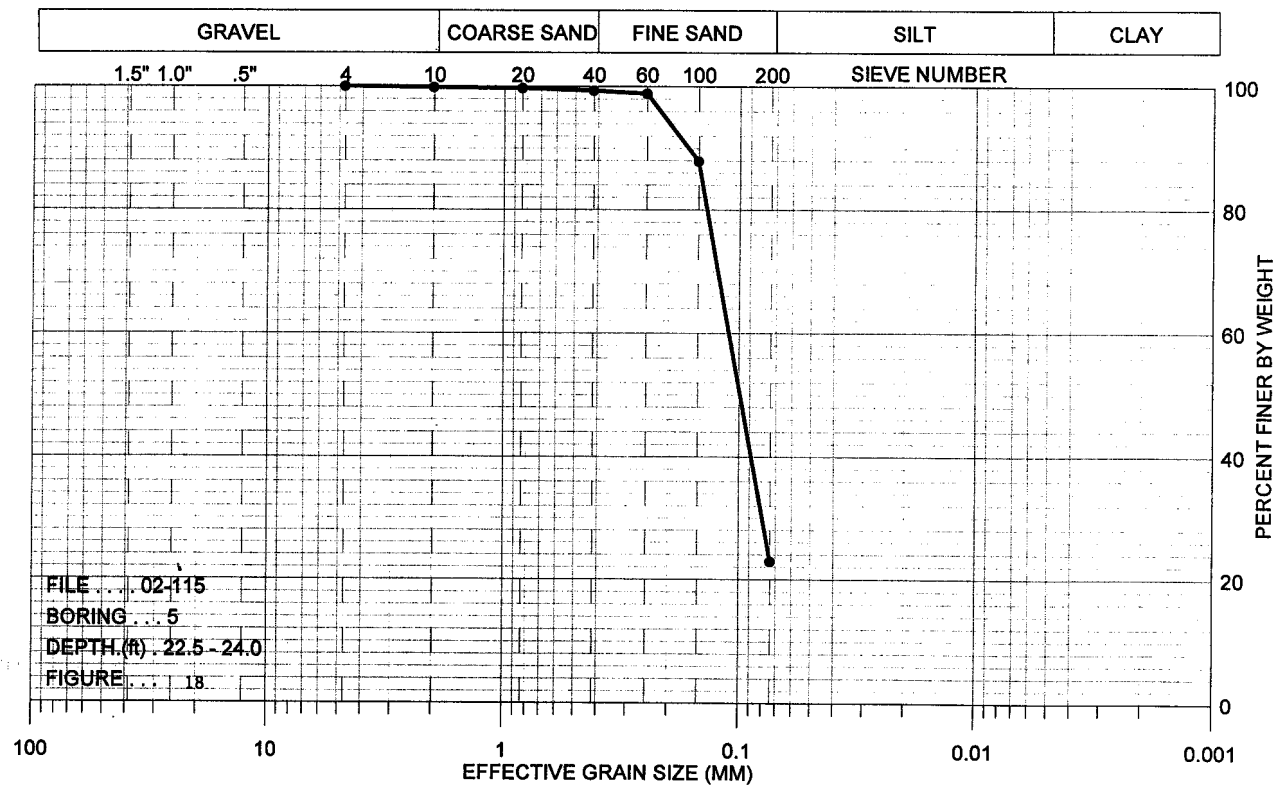
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



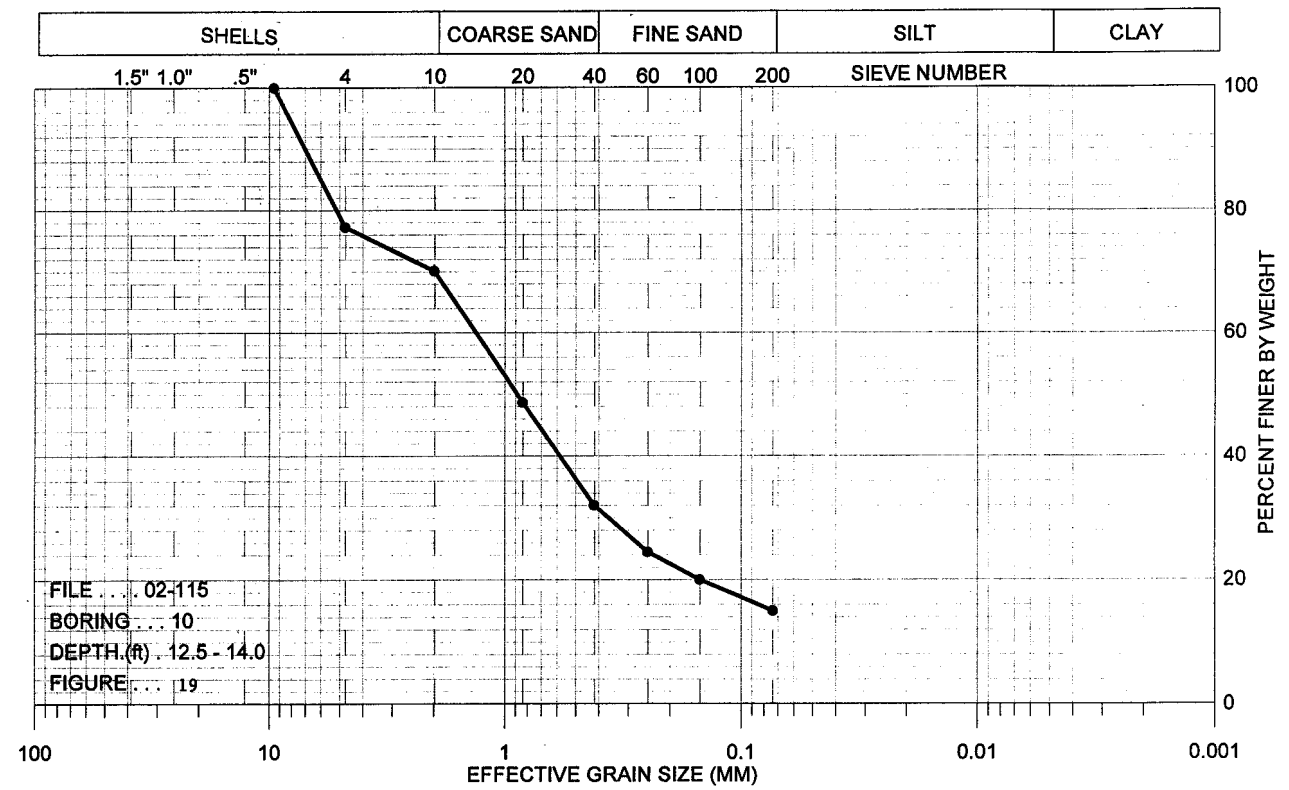
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



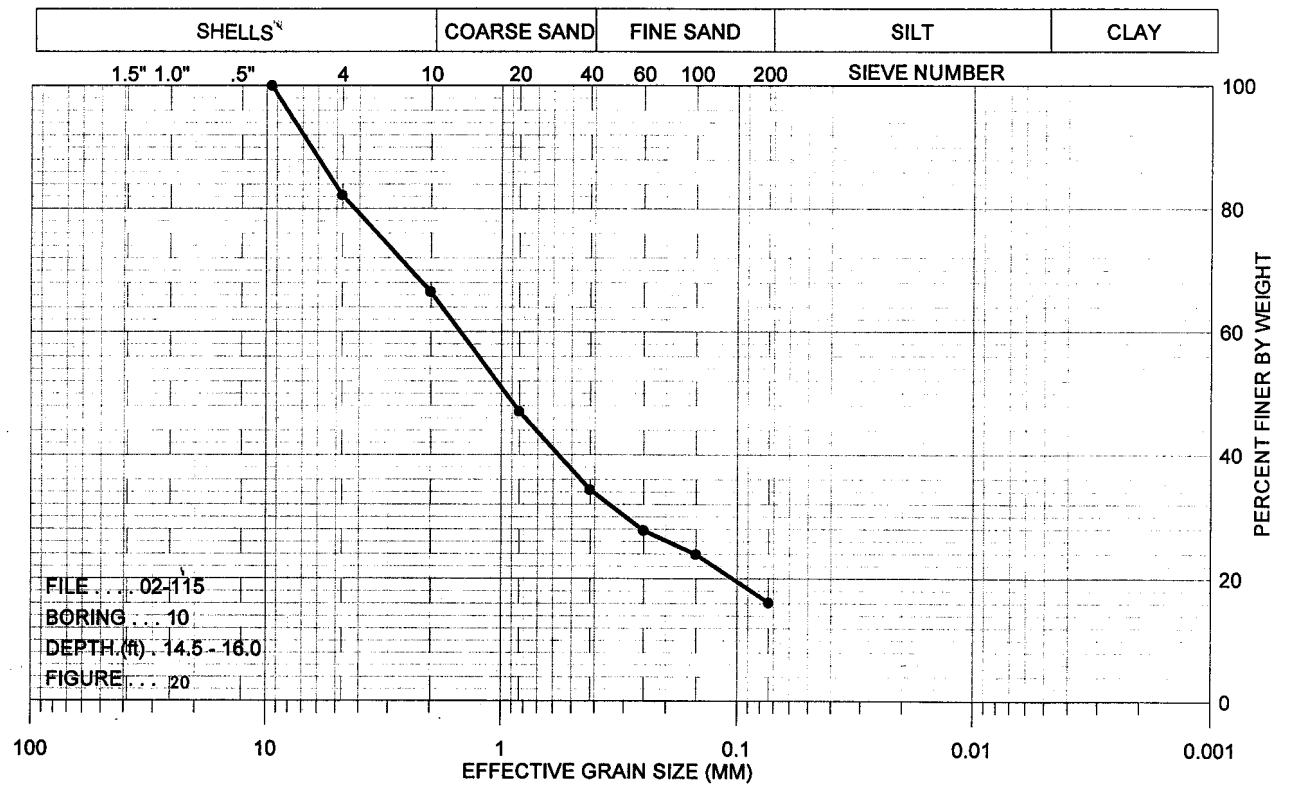
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



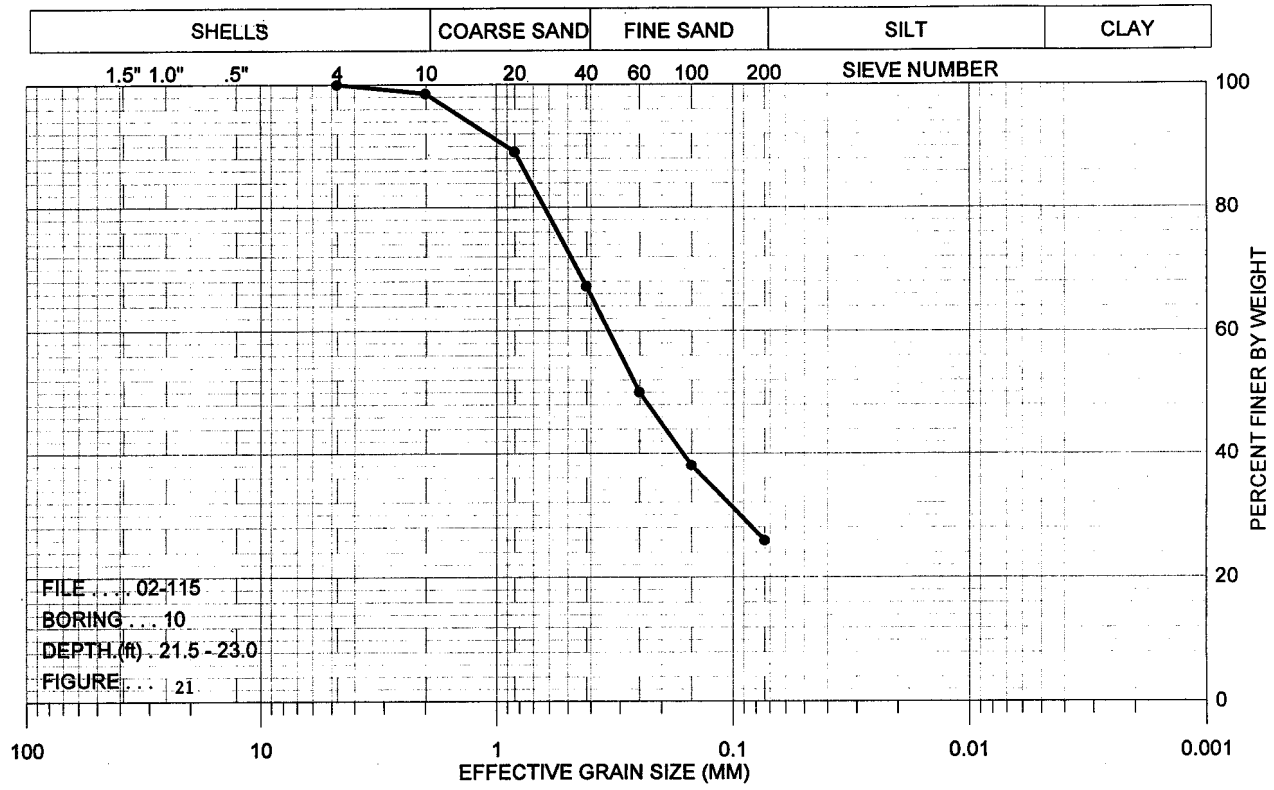
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



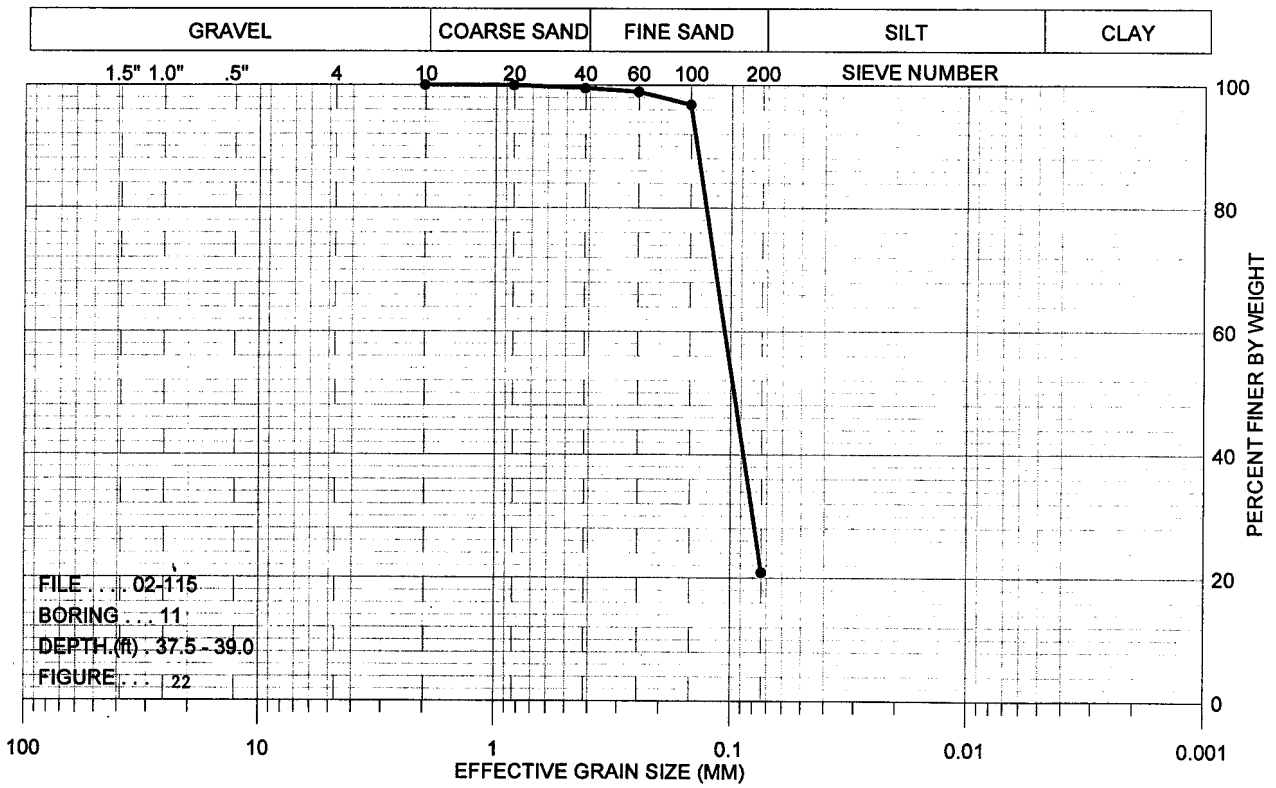
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



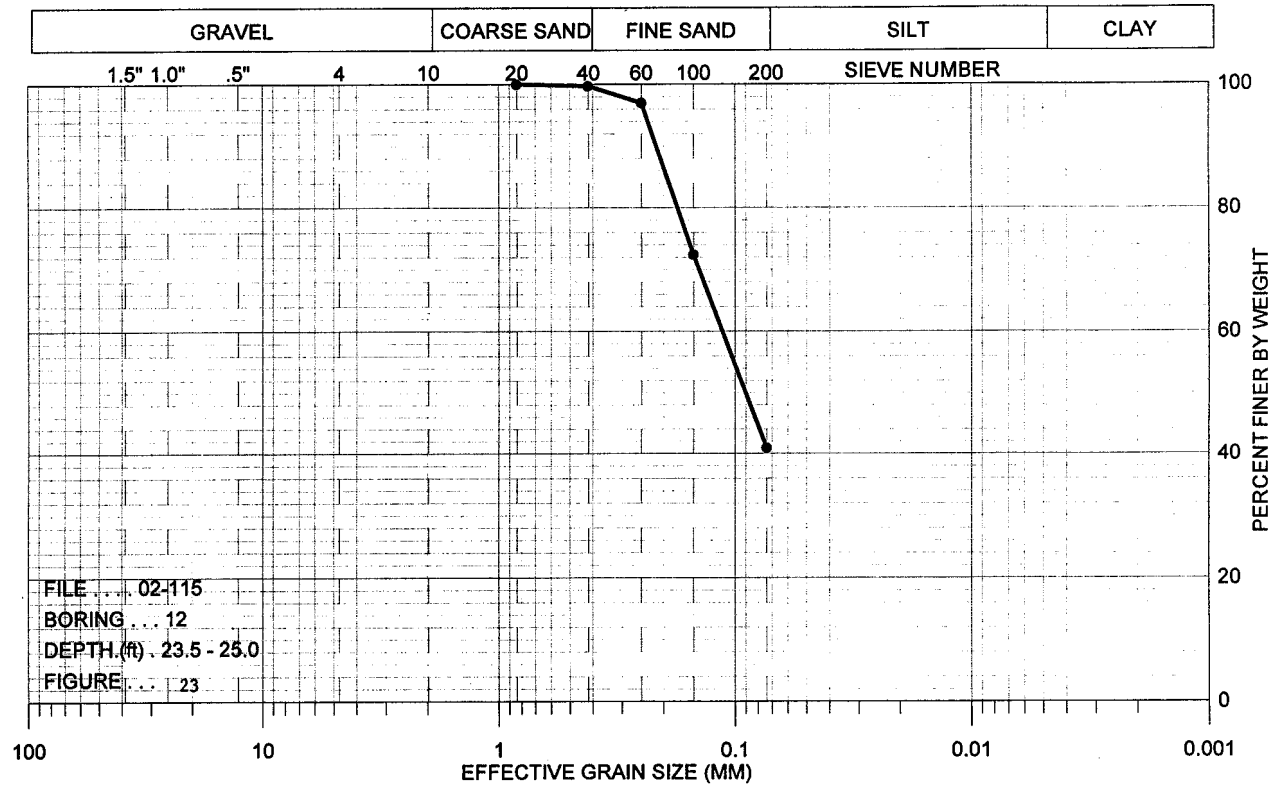
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



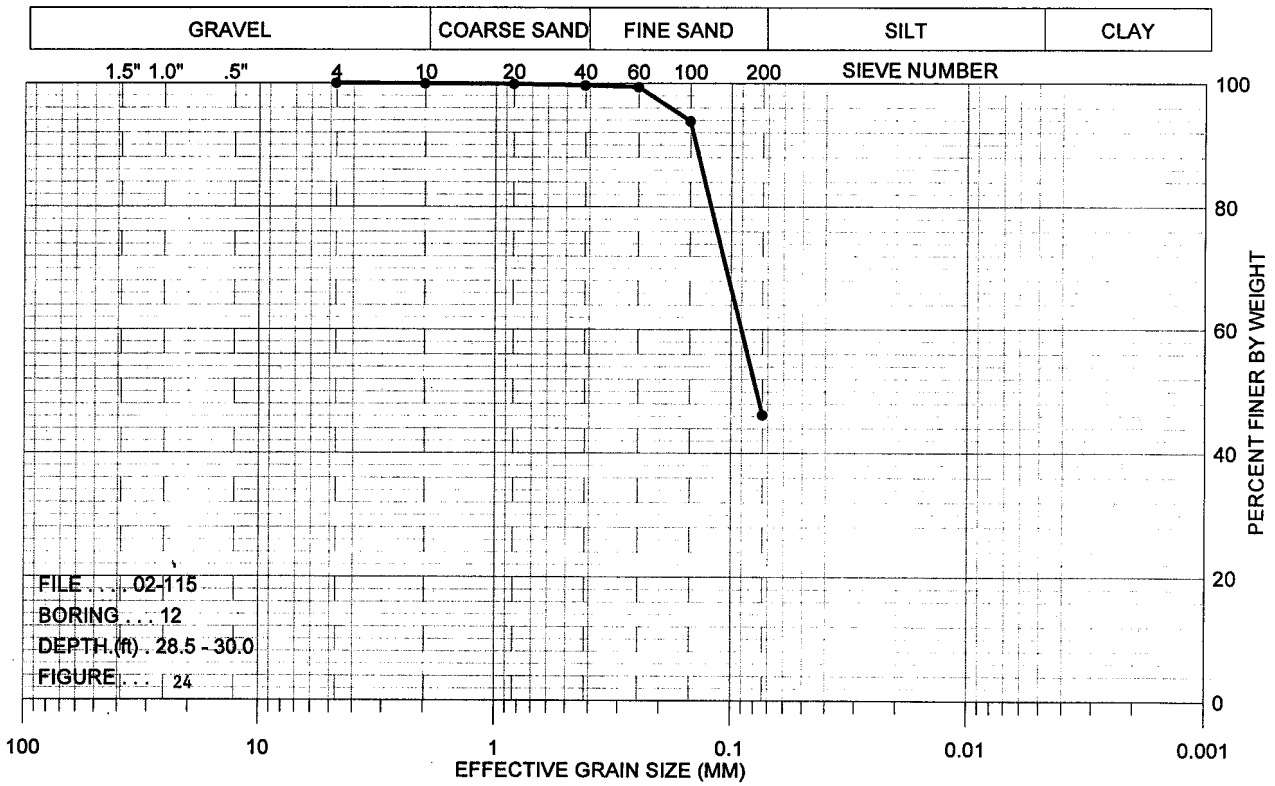
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



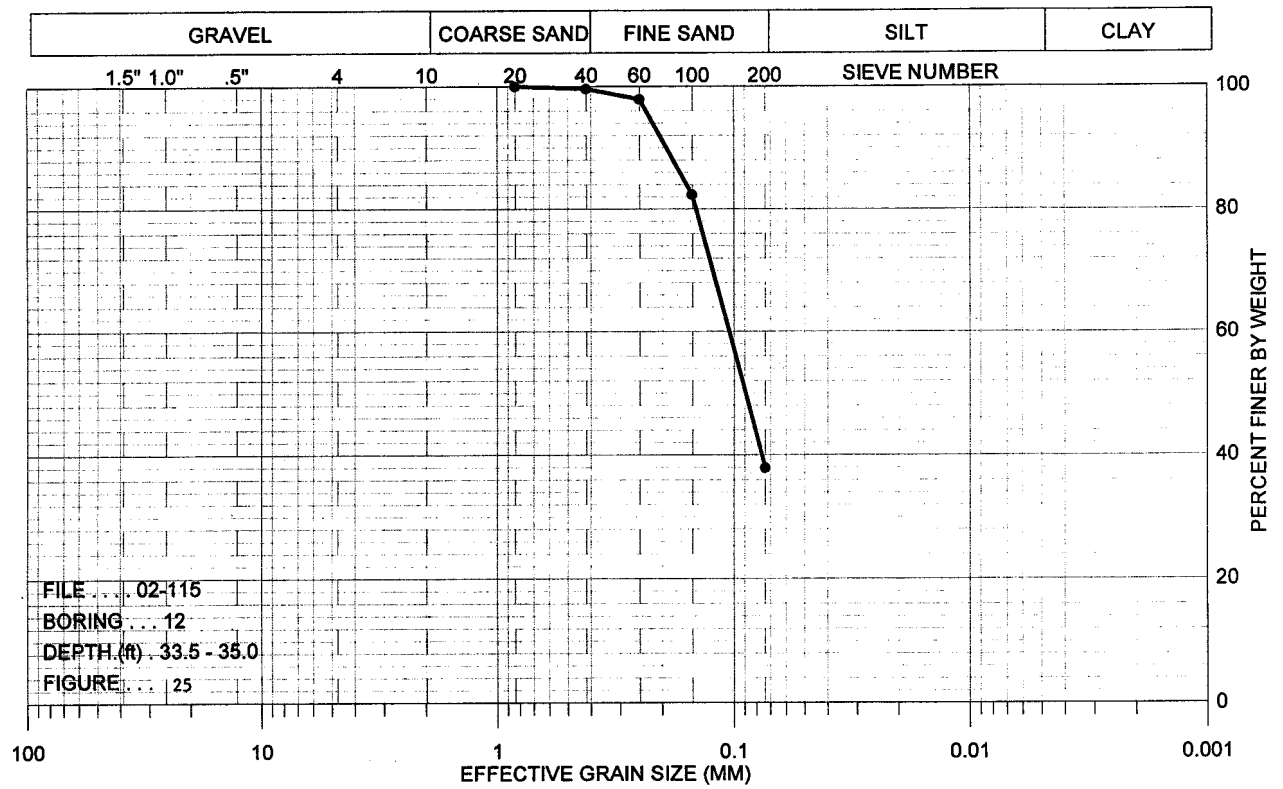
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



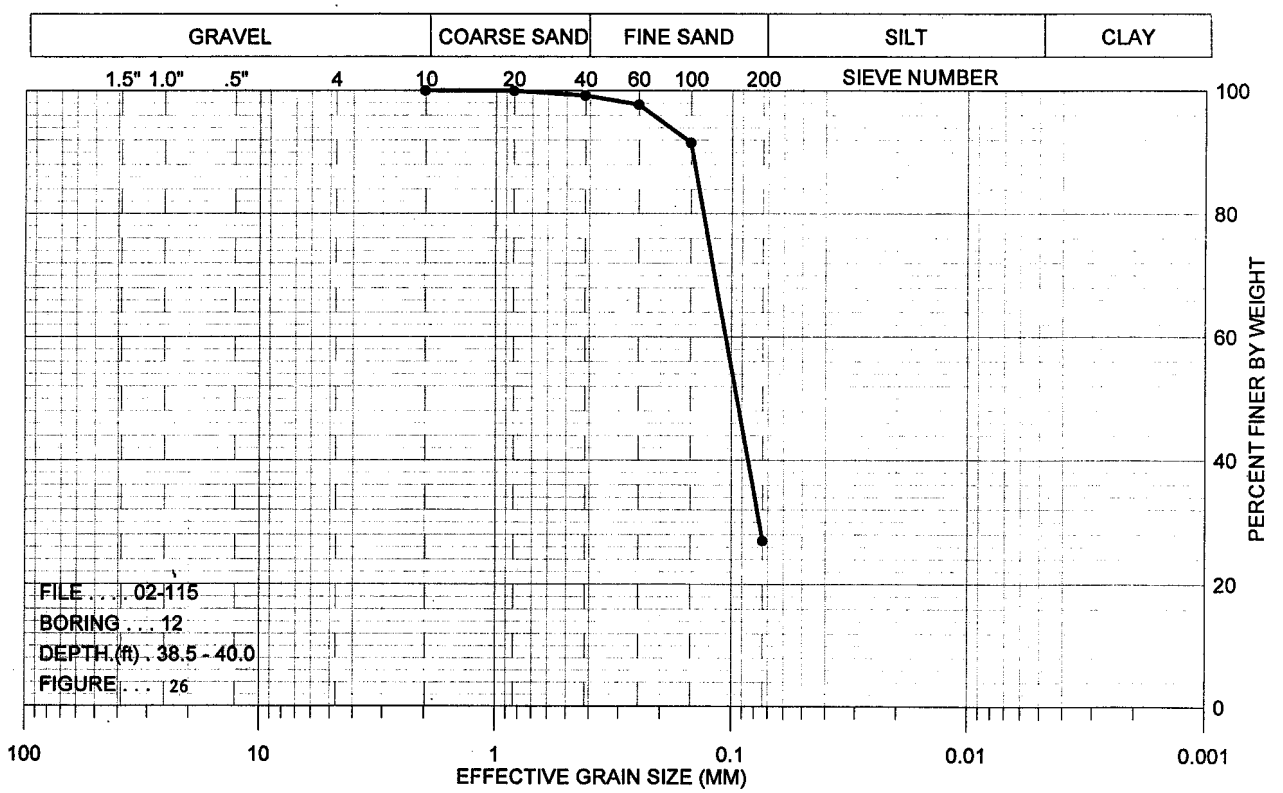
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



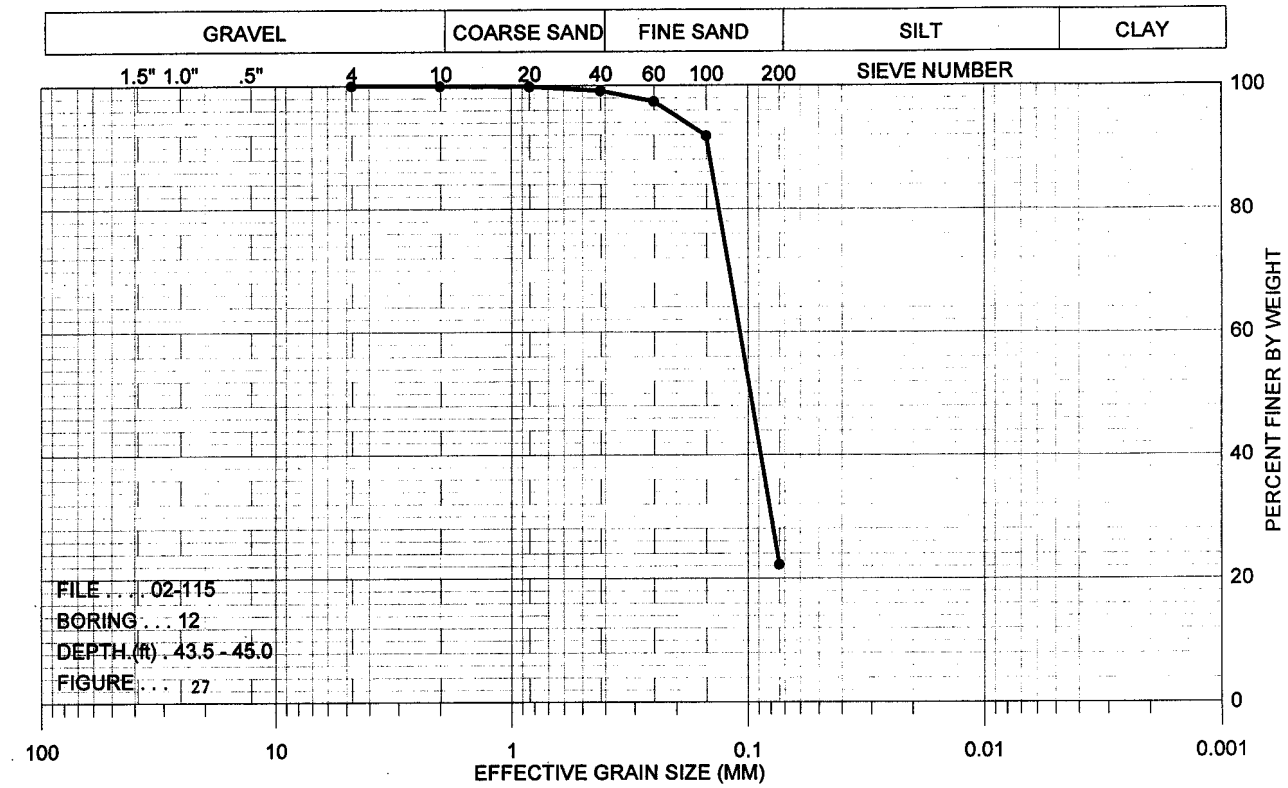
Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

GRAIN SIZE CURVE



Louis J. Capozzoli and Associates, Inc.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 1
File: 02-115
Date: 12-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
◫ Classification Sample
(SLS) Slickensided

N 29° 57' 27.90"
W 89° 50' 48.00"

Boring Depth: 23 Feet

Depth Feet	SAMPLES	
0		2 feet top of casing to top of barge deck
		4 feet top of barge deck to water surface
5		2 feet water surface to mudline
	■	Very soft brown organic clay
10	■	Very soft brown organic clay
	■	Very soft brown organic clay
15	■	Very soft brown organic clay
	■	Very soft brown peat
20		
	■	Very soft gray organic clay
25		

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 2
File: 02-115
Date: 12-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
◫ Classification Sample
(SLS) Slickensided

N 29° 57' 8.52"
W 89° 50' 36.24"

Boring Depth: 42 Feet

Depth Feet	SAMPLES	
0		2 feet top of casing to top of barge deck
		4 feet top of barge deck to water surface
5		2 feet water surface to mudline
	■	Very soft brown organic clay
10	■	Very soft brown peat
	■	Very soft brown peat
15	■	Very soft brown peat
	■	Very soft clay
20		
	■	Very soft gray slightly organic clay
25		
	■	Very soft gray slightly organic clay
30		
	■	Very soft gray slightly organic clay
35		
	■	Very soft gray slightly organic clay
40		
	■	Very soft gray slightly organic clay
45		

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 3
File: 02-115
Date: 13-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
◫ Classification Sample
(SLS) Slickensided

N 29° 56' 38.10"
W 89° 50' 20.22"

Boring Depth: 73 Feet

Depth Feet	SAMPLES		
0		2 feet top of casing to top of barge deck	
		6 feet top of barge deck to water surface	
5			
10			
15		15 feet water surface to mudline	
20			
25	■	Very soft brown organic clay	
	■	Very soft gray slightly organic clay	
	■	Very soft gray clay	
30	■	Very soft gray silty clay with 2 inch fine sand layer	
	■	Firm gray clayey sand with organic matter traces	
35			
	■	Very soft gray slightly organic clay	(SLS)
40			
	■	Very soft gray silty clay	
45			
	■	Soft gray clay	
50			

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 3
File: 02-115
Date: 13-Nov-02
Technician: JH

Undisturbed Sample
Standard Penetration Test
Classification Sample
(SLS) Slickensided

Boring Depth: 73 Feet

Depth Feet	SAMPLES		
50	■	Soft gray slightly organic clay	
55	■	Soft gray slightly organic clay	
60	⊠	Firm gray fine sand with silt traces	18 blows per foot (8/8/10)
65		Alternating layers of clay and fine sand	
	■	Firm gray clayey sand with shells	
70		Alternating layers of clay and sand	
	⊠	Dense gray clayey fine sand	34 blows per foot (10/17/17)
75			

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 4
File: 02-115
Date: 13-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
◫ Classification Sample
(SLS) Slickensided

N 29° 56' 28.02"
W 89° 49' 58.02"

Boring Depth: 43 Feet

Depth Feet	SAMPLES		
0		2 feet top of casing to top of barge deck	
		4 feet top of barge deck to water surface	
5		2 feet water surface to mudline	
	■	Very soft brown slightly organic clay	
10	■	Very soft brown peat	
	■	Very soft brown peat	
15	■	Very soft brown peat	
	■	Very soft gray organic clay	
20			
	■	Very soft gray clay with sand traces	
25			
	⊠	Firm gray silty fine sand	12 blows per foot (5/6/6)
30			
	■	Firm gray silty fine sand	
35			
	⊠	Loose gray silty fine sand	6 blows per foot (2/2/4)
40			
	⊠	Loose gray clayey fine sand	9 blows per foot (2/4/5)

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 5
File: 02-115
Date: 14-Nov-02
Technician: JH

Undisturbed Sample
Standard Penetration Test
Classification Sample
(SLS) Slickensided

N 29° 56' 15.36"
W 89° 49' 37.92"

Boring Depth: 24 Feet

Depth Feet	SAMPLES	
0		2 feet top of casing to top of barge deck
		4 feet top of barge deck to water surface
5		3 feet water surface to mudline
		Very soft brown slightly organic clay
10		Very soft brown organic clay
		Very soft gray slightly organic clay
15		Firm gray silty fine sand with clay streaks
20		
		Loose gray silty fine sand — 7 blows per foot (3/3/4)
25		

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 6
File: 02-115
Date: 12-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
◫ Classification Sample
(SLS) Slickensided

N 29° 52' 17.34"
W 89° 41' 55.82"

Boring Depth: 25 Feet

Depth Feet	SAMPLES	
0		2 feet top of casing to top of barge deck
		5 feet top of barge deck to water surface
5		3 feet water surface to mudline
10	■	Very soft brown organic clay
	■	Very soft brown organic clay
15	■	Very soft gray slightly organic clay
	■	Very soft gray clay with organic matter
	■	Very soft dark gray organic clay
20		
	■	Very soft gray clay with organic matter
25		

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 7
File: 02-115
Date: 12-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
▯ Classification Sample
(SLS) Slickensided

N 29° 51' 59.20"
W 89° 40' 54.87"

Boring Depth: 45 Feet

Depth Feet	SAMPLES	
0		2 feet top of casing to top of barge deck
		5 feet top of barge deck to water surface
5		3 feet water surface to mudline
10	■	Very soft brown organic clay
	■	Very soft brown organic clay
15	■	Very soft brown peat
	■	Very soft brown organic clay
	■	Very soft brown peat
20		
25	■	Very soft brown organic clay
30	■	Very soft brown organic clay
35	■	Very soft gray slightly organic clay with sand lenses and sand streaks
40	■	Very soft brown peat
45	■	Very soft gray slightly organic clay

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 8
File: 02-115
Date: 12-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
▯ Classification Sample
(SLS) Slickensided

N 29° 51' 57.39"
W 89° 40' 35.66"

Boring Depth: 25 Feet

Depth Feet	SAMPLES	
0		2 feet top of casing to top of barge deck
		6 feet top of barge deck to water surface
5		
		2 feet water surface to mudline
10	■	Soft gray slightly silty clay with organic matter
	■	Soft gray clay with sand streaks and 1 1/2 inch sand layer
15	■	Soft gray organic clay
	■	Very soft gray slightly organic clay
	■	Very soft gray clay with shells
20		
	■	Soft gray slightly organic clay
25		

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 9
File: 02-115
Date: 14-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
◫ Classification Sample
(SLS) Slickensided

N 29° 52' 01.42"
W 89° 40' 17.46"

Boring Depth: 47 Feet

Depth Feet	SAMPLES	
0		2 feet top of casing to top of barge deck
		4 feet top of barge deck to water surface
5		
		6 feet water surface to mudline
10		
	■	Very soft gray clay with organic matter and shells
15	■	Soft gray slightly sandy clay with sand streaks, organic matter, and shells
	■	Very soft gray clay with organic matter
	■	Very soft gray clay with 2 inch fine sand layer
20	■	Firm gray fine sand
25	■	Soft gray clay with 3 inch organic clay layer
30	■	Soft gray slightly organic clay
35	■	Soft gray slightly silty clay with 3 inch fine sand layer, organic matter, and shells
40	■	Soft gray clay with silt lenses
45	■	Soft gray clay with silt lenses

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 10
File: 02-115
Date: 11-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
▯ Classification Sample
(SLS) Slickensided

N 29° 51' 50.63"
W 89° 39' 49.78"

Boring Depth: 22 Feet

Depth Feet	SAMPLES		
0		2 feet top of casing to top of barge deck	
		4 feet top of barge deck to water surface	
5		2 feet water surface to mudline	
	■	Very soft gray slightly organic clay	
10	⊠	Very loose gray shells with sand traces	2 blows per foot (1/1/1)
	⊠	Very loose gray sand with shells and silt traces	2 blows per foot (1/1/1)
15	⊠	Loose gray shells and sand with silt traces	3 blows per foot (1/2/1)
	⊠	Loose gray shells with sand traces	4 blows per foot (1/2/2)
20	⊠	Loose gray clayey sand with organic matter	9 blows per foot (6/4/5)
25			

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 11
File: 02-115
Date: 11-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
◫ Classification Sample
(SLS) Slickensided

N 29° 51' 41.37"
W 89° 39' 19.45"

Boring Depth: 44 Feet

Depth Feet	SAMPLES	
0		2 feet top of casing to top of barge deck
		4 feet top of barge deck to water surface
5		3 feet water surface to mudline
	■	Very soft gray clay with organic matter
10	■	Firm gray slightly organic silt with clay traces
	■	Firm gray sandy silt
15	■	Very soft gray slightly silty clay
	■	Very soft gray organic clay
20		
	■	Very soft brown peat
25		
	■	Soft gray very silty clay
30		
	■	Firm gray clayey fine sand
35		
	⊠	Loose gray silty fine sand — 6 blows per foot (2/2/4)
40		
	■	Soft gray clay (SLS)
45		

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers

LOG OF BORING

Project: Shoreline Protection/Marsh Creation at Lake Borgne
DNR Contract No. 2503-03-15 PO-30
For: State of Louisiana, Department of Natural Resources
c/o Sigma Consulting Group, Inc.

Boring: 12
File: 02-115
Date: 14-Nov-02
Technician: JH

■ Undisturbed Sample
⊠ Standard Penetration Test
▯ Classification Sample
(SLS) Slickensided

N 29° 56' 9.78"
W 89° 49' 27.06"

Boring Depth: 45 Feet

Depth Feet	SAMPLES		
0		2 feet top of casing to top of barge deck	
		6 feet top of barge deck to water surface	
5			
		2 feet water surface to mudline	
10	■	Soft gray clay with shells	
	■	Medium gray clay	
15	■	Soft gray clay with silt streaks	(SLS)
	■	Soft tan silty clay	
	■	Soft gray clay	
20			
	⊠	Very loose gray clayey fine sand	2 blows per foot (2/1/1)
25			
	⊠	Loose gray clayey fine sand	5 blows per foot (2/2/3)
30			
	⊠	Firm gray clayey fine sand	14 blows per foot (10/5/9)
35			
	⊠	Firm gray clayey fine sand	28 blows per foot (12/13/15)
40			
	⊠	Very dense gray silty fine sand with clay traces	69 blows per foot (27/30/39)
45			

LOUIS J. CAPOZZOLI & ASSOCIATES, INC.
Geotechnical Engineers