EXHIBIT M

SOIL INVESTIGATION
2001

EXHIBIT M - SOIL INVESTIGATION 2001

SUBSOIL INVESTIGATION

PROPOSED CULVERT & HEADWALL

RIGOLETS ESTATES (PHASE III)

ST. TAMMANY PARISH, LOUISIANA

PROJECT NO. 7763

FOR

THE ESTATE OF FREDERICK J. SIGUR

KREBS, LaSALLE, LeMIEUX CONSULTANTS, INC.
CONSULTING ENGINEERS
NEW ORLEANS, LOUISIANA

GORE ENGINEERING, INC.
SOIL AND FOUNDATION INVESTIGATIONS
METAIRIE, LOUISIANA

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GORE ENGINEERING, INC.

SOIL AND FOUNDATION INVESTIGATIONS

LAWRENCE W. GILBERT, D. ENGR.
REG. C.E.

BORINGS
ANALYSES

TESTING
REPORTS

3613 HESSMER AVENUE
P. O. BOX 8867
METAIRIE, LOUISIANA 70011

JAMES R. GORE
(1925 - 1991)

(504) 888-6690
FAX: (504) 888-6827

9 August, 2001

The Estate of Frederick J. Sigur
c/o Krebs, LaSalle, LeMieux Consultants, Inc.
P.O. Box 19688
New Orleans, Louisiana 70179

Subsoil Investigation
Proposed Culvert & Headwall
Rigolets Estates (Phase III)
St. Tammany Parish, Louisiana

Gentlemen:

Herein is our report on the results a subsoil foundation investigation made for the subject project.

Yours very truly,

GORE ENGINEERING, INC.

Lawrence W. Gilbert

LWG:jrt

SUBSOIL INVESTIGATION
PROPOSED CULVERTS & HEADWALL
RIGOLETS ESTATES (PHASE III)
ST. TAMMANY PARISH, LOUISIANA

INTRODUCTION

1. This report contains the results of a subsoil foundation investigation made at the subject site. Instructions to proceed with the investigation were received on June 14, 2001 from The Estate of Frederick J. Sigur. Krebs, LaSalle, LeMieux Consultants, Inc. are the Consulting Engineers for the project.

2. The study included the drilling of a soil test boring to determine subsurface conditions and stratification and the performance of soil mechanics laboratory tests on samples obtained from the boring to evaluate their physical characteristics. Engineering analyses were made, based on the boring and test data to develop criteria to be used in foundation design.

SOIL BORING

Field Exploration

3. One (1) undisturbed sample type soil test boring (B-4) was drilled to a depth of 60 ft. on July 18, 2001. The other borings planned for this study were unaccessible to our drill rig. The boring was made with a truck mounted drill rig at a designated location accessible to our drill rig and approximately as shown in plan on Figure 1. Undisturbed

sampling was performed continuously in all cohesive or semi-cohesive materials with a three inch diameter thin wall tube sampler. Representative samples were cut from the cores and placed in moisture proof containers for preservation until laboratory testing could be performed.

4. When cohesionless material was encountered, which could not be sampled by undisturbed methods, the Standard Penetration Test was performed. This test consists of driving a two inch diameter splitspoon sampler 1 ft. (after first seating it 6 inches) with a 140 lb. hammer falling 30 inches. The number of blows required to drive the sampler gives an indication of the density of the material.

LABORATORY TESTS

5. In order to develop the physical properties of the soils, soil mechanics laboratory tests were performed on samples obtained from the boring. This testing consisted primarily of Natural Moisture Content, Unit Weight and Unconfined Compression. Grain Size (percent passing the No. 200 Sieve) tests were performed on some of the more granular materials and Atterberg Limits were performed on selected cohesive samples. The results of all the laboratory tests are tabulated along side the boring log at the appropriate sample and depth on Figure 2.

6. The Unconfined Compression tests are used in analyses to determine soil bearing values for soil-supported foundations. The Atterberg Limits along with the Natural Moisture Content tests give an indication of the compressibility of the soils and are used empirically to estimate settlements. The Grain Size tests are used to classify the more granular soils.

SUBSOIL CONDITIONS

Subsoil Description

7. Reference to the log of boring B-4 shows that beginning at the ground surface there is 7 ft. of loose tan or gray silty fine sand (fill). This is followed by a highly compressible stratum of very soft gray or brown organic clay with humus that extends to the 13½ ft. depth. This is underlain by very soft brownish gray silty clay that continues to the 15 ft. depth where the geologically identified Pleistocene age soils were first encountered. These Pleistocene age soils consist of stiff light gray and reddish tan clay to the 23½ ft. depth and then medium dense light gray fine sand to 28 ft. Below this depth there is dense to very dense light gray silty fine sand that extends to at least the 60 ft. depth, the maximum depth penetrated by boring B-4.

8. Groundwater At the time of making the boring, groundwater was measured at a depth of 5 ft. below the existing ground surface elevation in boring B-4. Groundwater was measured shortly after making the boring and may not have become fully

static at the time of measurement. In any event, groundwater could fluctuate due to seasonal precipitation, drainage, prolonged drought, etc. If groundwater is important to construction, it should be measured at that time.

FOUNDATION ANALYSIS

9. It is understood that the proposed construction will consist of drainage culverts with concrete headwalls and a canal at the subject site. There will be two (2) 48 inch diameter RCP culverts with inverts at Elev. -4.8 and -7.4. After construction, the top of canal bank will be at about Elev. +6.0 and the canal bottom at Elev. -8.0. The existing ground surface elevation in the vicinity of the canal crossing on the western end of the project is at approximately Elev. +5.0. On the eastern end of the project, it is at approximately Elev. +7.0. The crown of the roadway crossing will be at Elev. +7.25 and the roadway embankment will slope down to Elev. +2.0 at the concrete headwalls. The normal low water level in the drainage canal will be at Elev. 0.0.

Drainage Culverts

10. As previously indicated, there will be two (2) 48 inch diameter RCP culverts with inverts at Elev. -4.8 and -7.4. Prior to installation of the culverts, the area of the canal crossing should be excavated of all poor quality and highly compressible very soft organic clay and silty clay, down to the more stable Pleistocene age soils that begin at the 15 ft. depth in boring B-1. This area should be backfilled with a good quality granular material

such as "pumped" sand or "sugar" sand having less than 10 percent fines passing the No. 200 Sieve. The existing silty fine sand fill that was encountered to the 7 ft. depth in boring B-4 could be used as backfill. For this case, the concrete headwall could be designed for an equivalent fluid (active) earth pressure of 67 lbs. per sq. ft. per foot of depth below the top of the headwall. This silty fine sand material could also be used to construct the roadway embankment in the area. For this case, a bedding of at least 12 inches of well graded limestone or crushed concrete could be used for support of the drainage culverts. Assuming good quality granular material is used for the roadway embankment, it could be relied on for a Westergaard Modulus of Subgrade Reaction of 125 lbs. per cubic inch for use in design of the pavement section.

11. It is understood that the proposed concrete headwall will be designed according to Louisiana Department of Transportation and Development Standards. This is believed to be adequate assuming that the backfill landward of the headwall is granular in character and that the base of the concrete headwall bypasses the very soft organic clay and silty clay and is seated in the underlying Pleistocene age soils that begin at the 15 ft. depth in boring B-4.

12. <u>Estimated Settlements</u> Assuming that the area of the canal crossing is initially excavated down to the Pleistocene age soils and that granular material is used for backfill and embankment construction, long term settlements of the roadway should be on the

order of 2 to 3 inches over a long period of time. This is due to the precompressed character of the Pleistocene age soils and the relatively incompressible character of the underlying granular soils. Much larger settlements would be expected to occur if the area is not excavated of all compressible material or if poor quality material is used for backfill. If either of these two cases arise, further consideration should be given to the design of the culvert and headwall foundations. This may necessitate the use of preload surcharge fill to induce the larger settlements prior to roadway construction.

Construction Conditions

13. Excavation Cofferdam It is our opinion that the methods, means and sequence of the construction excavation should be the responsibility of the general contractor who should be experienced in this type construction. No detailed type analyses were made with regard to the construction excavation cofferdam. However, considering the loose density of the upper sand fill and the very soft consistency of the underlying organic clay and silty clay, consideration should be given to sheeting the construction excavation to assure good stability and the minimize lateral movements. The excavation should be internally braced, as needed to provide good lateral stability. In any event, the design of the construction excavation should be the responsibility of the contractor and their engineers.

14. Dewatering It is our opinion that the methods, means and sequence of dewatering should also be the responsibility of the general contractor who should be

experienced in this type construction. However, the following general discussion with regard to dewatering is offered. The near surface silty fine sand (fill) and the underlying sand that begins at the 23½ ft. depth are highly permeable materials and would require positive dewatering to assure a dry excavation and good stability of the excavation bottom. A forced dewatering system, well points, wells, etc. should be considered to dewater the deeper sand to assure good stability with regard to excavation bottom heave. For this case, the piezometric head in these permeable soils should be maintained at or below the elevation of the excavation bottom. Lack of adequate groundwater control could affect the stability of the excavation and the concrete headwalls. It could also result in greater post-construction settlements. In any event, it is recommended that all excavations be backfilled as soon as possible to avoid long term pumping which could result in a general lowering of the water table and associated areal settlements.

GORE ENGINEERING, INC.

Lawrence W. Gilbert

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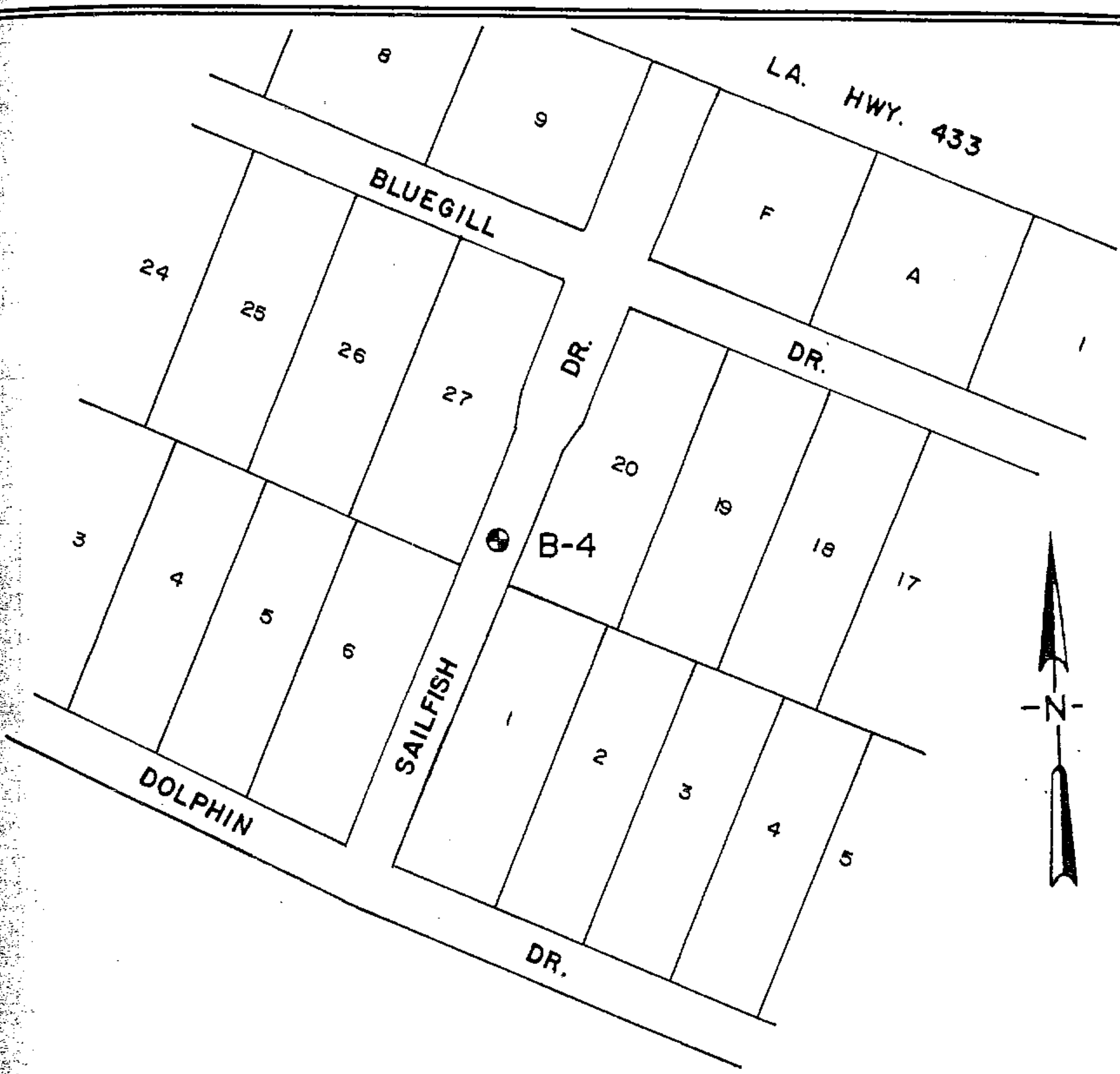

BORING LOCATION
Scale: 1" = 200'

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763

Fig. 1

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GORE ENGINEERING, INC.

Job No. 7763

Soil and Foundation Investigations
Metairie, Louisiana

B-4

LOG OF BORING AND TEST RESULTS

Date Boring Drilled: 18 July 2001

ROPOSED CULVERT & HEADWALL - RIGOLETS ESTATES (PHASE III) - ST. TAMMANY PARISH, LOUISIANA
OR: THE ESTATE OF FREDERICK J. SIGUR
REBS, LaSALLE, LeMIEUX CONSULTANTS, INC. - CONSULTING ENGINEERS - NEW ORLEANS, LOUISIANA

Recorded By: Alex Jaramillo

SAMPLE pth in Feet		STRATUM Depth in Feet	VISUAL CLASSIFICATION	*Blows per Foot	Symbol Log	Scale (feet)	UNCONFINED COMPRESSION (Qu) (lbs./sq.ft.)	WATER CONTENT (percent)	UNIT WEIGHT (lbs./cu.ft.)		ATTERBERG LIMITS		
m	To	.0				0			DRY	WET	L.L.	P.L.	P.I.
5	3.0	5.0	LOOSE TAN SILTY FINE SAND (FILL)			5							
5	6.0	7.0	LOOSE GRAY SILTY FINE SAND (FILL)					24.9					
5	9.0	10.5	VERY SOFT GRAY ORGANIC CLAY W/ SILT			10	165	127.9	35.7	81.3	162	41	121
5	12.0	13.5	VERY SOFT BROWN ORGANIC CLAY W/ HUMUS				385	127.0	35.4	80.3	278	104	174
5	15.0	15.0	VERY SOFT BROWNISH GRAY SILTY CLAY			15	405	36.0	82.0	111.5			
5	20.0	23.5	STIFF LIGHT GRAY & REDDISH TAN CLAY			20	2240	25.2	99.3	124.3			
5	25.0	28.0	MEDIUM DENSE LIGHT GRAY FINE SAND	13		25		21.7				(4)	
5	30.0		DENSE TO VERY DENSE LIGHT GRAY SILTY FINE SAND	30 = .1'		30							
5	35.0			30 = .2'		35		27.1					
5	40.0			30 = .9'		40							
5	45.0			30 = .9'		45		19.3				(24)	
	50.0			30 = .8'		50							
	55.0			30 = .9'		55		18.8					
	60.0	60.0		30 = .9'		60							

NOTE: VALUES IN PARENTHESES ( ) INDICATE PERCENT PASSING NO. 200 SIEVE.

SILT SAND ORGANIC

Type Bold. Modifying Type Light.

*140 lb. hammer dropped 30 inches on 2 inch splitspoon sampler after first being seated 6 inches.

REMARKS: Water Table Depth = 5.0 ft (See Text)

Fig. 2