Report of Geotechnical Engineering Services

Bay Boulevard Bridge Evaluation

City of Port Richey Dredging Project

Port Richey, Florida

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

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The remaining permitted channels are in the North Bay Boulevard area (11 and 13). The remaining non-permitted channels are channels 12, 27, 28, and 30. The City of Port Richey has also asked **Taylor Engineering, Inc.** to evaluate the option of constructing a new bridge along Bay Boulevard and additional dredging to connect Channel 24 to Channels 11, 12 and 13. **Ardaman** performed a series of SPT borings in the Channels to provide data from which **Taylor Engineering, Inc.** could develop a responsible Opinion of Probable Cost for the dredging portion of the project's construction. The report presenting this data has been submitted under separate cover.

To assist **Taylor Engineering, Inc.** with their bridge cost evaluation, the boring at the north end of Channel 24 was extended to a depth of 55 feet. This report presents the collected data, our evaluation, and our recommendations regarding possible bridge foundation alternatives.

SITE LOCATION AND CONDITIONS

The Miller's Bayou is located in Port Richey, Florida. Specifically, the area investigated is immediately south of North Bay Boulevard, west of US-19 (see Figure 1 in the Appendix of this report). The proposed Bay Boulevard Bridge is to cross over Channel 24 on the north side of Miller's Bayou.

The boring was performed from a barge as close to the bridge as possible due to tidal conditions at the time of drilling. The schedule of the boring was based on tidal patterns so that the closest proximity could be achieved.

FIELD EXPLORATION

Boring Locations

The proposed location for Boring B-45 was provided by Taylor Engineering, Inc. The location of the boring was determined in the field by Ardaman based on existing site conditions. Coordinates were established in the field by **Ardaman & Associates** representatives using a Trimble GeoXH hand-held GPS with sub-meter accuracy. The elevation of the water levels were recorded twice daily from a nearby tide gauge (No.02310310). The elevation of the water level at the time of drilling was then estimated using published tidal information and referenced to MLW.

The boring location for B-45 is shown on the Test Location Plan (Figure 1) presented in the Appendix of this report and the coordinates are presented on the respective boring log, and should be considered accurate only to the degree implied by the method used.

Standard Penetration Test

One Standard Penetration Test (SPT) soil boring was drilled to evaluate the soil conditions within the vicinity of the proposed Bay Boulevard Bridge. The SPT soil boring was drilled with the use of a CME Power Drill Rig mounted on a barge. Soil sampling was performed in general accordance with the procedures outlined in ASTM Standard D-1586. These procedures are also summarized in the Appendix of this report.

LABORATORY TESTING

The field soil boring log and recovered soil samples were transported to our Tampa office following the completion of the field exploration activities. Each representative sample was examined by a geotechnical engineer in the field to identify the engineering classification of the soil and rock. The visual classification of the samples was performed using the current Unified Soil Classification System in general accordance with the procedures outlined in ASTM Standard D-2488. The classifications were based on visual observations with the results of the laboratory testing used to confirm the visual classification. The laboratory classification tests consisted of grain-size analysis and environmental corrosion tests on selected samples. The tests were performed on selected samples believed to be representative of the materials encountered. The laboratory test results and grain size curves are shown on Tables 1 and 2 in the Appendix.

Grain-Size Analysis

A grain-size analyses was conducted in general accordance with ASTM test designation D-422. The grain-size analysis test measures the percentage by weight of a dry soil sample passing a series of U.S. standard sieves, including the percentage passing the No. 200 Sieve. In this manner, the grain-size distribution of a soil is measured. The percentage by weight passing the No. 200 Sieve is the amount of silt and clay sized particles.

Corrosion Parameter Testing

Environmental corrosion tests were conducted in accordance with FDOT test designations FM5-550, FM 5-551, FM 5-552 and FM 5-553. These tests were performed on recovered soil samples obtained from the SPT boring. Environmental corrosion tests measure parameters such as pH, resistivity, sulfate content and chloride content.

SUBSURFACE CONDITIONS

The delineation of the vertical extent of individual soil strata, the identification of pertinent soil engineering properties, where applicable, and a description of each geologic layer discovered in the course of this geotechnical study, is given in the soil boring profiles presented in the Appendix of this report. The soil boring log as prepared by a geotechnical engineer based upon a visual classification of the recovered soil samples. It should be noted that the stratification lines shown are used to indicate a transition from one soil type to another. The actual boundary between the illustrated soil strata may be gradual or indistinct. Consequently, the stratification boundary lines, shown on the soil boring logs, represent our best estimate of the location of the transition between distinct soil strata. They are in no way intended to designate a depth of exact geological change. Furthermore, the evaluation contained in this report is based on the contents of the soil boring log. While the boring is representative of subsurface conditions at its respective location and vertical reach, local variations which are characteristic of the subsurface materials of the region, or which may be due to man-made alteration of the native geologic conditions, may be encountered.

At the time of the start of drilling, 3 feet of water was encountered prior to the mudline. From a depth of 3 to 4.5 feet below water surface (bws), a very loose slightly silty sand with shell fragments was encountered. This was underlain by a very soft to soft limestone with N-values ranging from 3 blows per foot (bpf) to 18 bpf. Firm green clay with sand and limestone fragments was found from a depth of 10.5 to 16 feet bws. Light brown weathered limestone was encountered from a depth of 16 feet to termination of the boring at a depth of 55 feet bws. The N-values ranged from 18 to 53 bpf.

PRELIMINARY ENGINEERING EVALUATION

Foundation Alternatives for Bridge Structure

Foundation alternatives for the project considered the results of our preliminary field study and our experience. At this time, no preliminary design, scour depth, or loading information was available. Based on our experience with similar projects, we considered the following foundation alternatives:

Precast Prestressed Concrete Piles
Steel Pipe and H-Piles
Drilled Shafts

The following paragraphs discuss each of these alternatives briefly. The capacities curves generated for the viable options are attached to this report.

Precast Prestressed Concrete Piles

Square precast concrete driven piles are a feasible foundation alternative. They are a widely used and proven foundation system in central Florida. Precast prestressed piles are readily available and generally have a lower cost per ton of capacity than other pile types. The minimum size for prestressed concrete piles should be 18 inches. Analyses were performed for an 18 inch square pile and show an allowable capacity of 100 tons at an elevation of approximately -25 feet (see Figure A-1). This elevation would require significant penetration into the limestone stratum. The blowcounts in B-45 do not indicate that pile refusal would occur above this elevation but variations in rock strength across the bridge have not been evaluated at this time and pre-drilling may be required to reach a minimum tip elevation. Further, the close proximity of residential structures to the bridge may create problems relating to construction induced vibrations. The possible variation in bearing depth across the bridge has also not been evaluated. This variation could make determining production pile lengths difficult and result in significant pile cut-offs.

Steel Pipe Piles and H-Piles

Another option is the use of steel pipe piles or H-piles. Steel pipe piles and H-piles tend to be more costly than concrete piles but have the advantage of being easily spliced to account for variation in depth to bearing. The steel piles will also penetrate into the limestone without the need for predrilling. Steel piles typically result in less vibrations during driving but sometimes do have higher sound levels which can disturb nearby residents. A 12-3/4 inch diameter steel pipe pile (1/2 inch wall thickness), and a HP 12x74 H-pile have been evaluated for this bridge and the results are presented on Figure A-1.

Drilled Shafts

Drilled cast-in place straight sided concrete shafts are a feasible foundation alternative. Drilled shafts have the advantage of being able to develop high axial and lateral capacities in a single unit. However, the quality control of drilled shaft installation requires more engineering judgment and precaution compared with driven piles to ensure the specifications are complied with. This type of foundation system is a good alternative for sites where limestone or very firm bearing strata are present at a relatively shallow depth. Drilled shafts also do not have the associated noise and vibrations typical of driven piles.

Drilled shafts with diameters of 24 and 36 inches were evaluated and the results presented on Figure A-2. Based on the boring performed, the limestone does not appear to be ideal for drilled shaft installation since the strength and competency appears to vary over the boring depth.

The above analyses are for preliminary use only. Additional borings are required for final design. The additional sampling and testing should include rock coring and rock strength testing to fully evaluate the drilled shaft alterative as well as the need for predrilling of the pile holes. Once the final bridge configuration, scour depths, and loadings are known, a more complete analysis can be performed. It should be noted that based on the results of the additional borings, the possible foundation options may change.

CLOSURE

Regardless of the thoroughness of a geotechnical exploration, there is always a possibility that conditions between borings will be different from those at specific boring locations and that conditions will not be as anticipated by the contractors. This study is for preliminary design only and additional borings are required for the final design.

We appreciate the opportunity to be of service to **Taylor Engineering** on this important project. Should you have any questions in regards to this report, or if we can be of any further assistance, please contact this office.

Very truly yours,

ARDAMAN & ASSOCIATES, INC.
Florida Certificate of Authorization No. 00005950

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Attachment: Tables 1 – 2 Lab Test Results
Figure 1 – Test Location Plan
Soil Boring Log (B-45)
Capacity Curves
Grain Size Distribution Curve
Field Testing Procedures

Distribution: 3 – Client
1 – File

ATTACHMENTS

FIELD TESTING PROCEDURES

Prior to initiating the field activities, the Sunshine State One-Call of Florida, Inc. Call Center (Call Sunshine) was notified of our intent to perform soil test boring, utilizing a drill rig. The location, date, and other operation particulars were provided to allow participating utility companies the opportunity to mark the location of their buried lines, prior to our field activities. No conflicts with underground utilities were encountered at the boring locations.

STANDARD PENETRATION TEST

The Standard Penetration Test is a widely accepted method of in-situ testing of foundation soils (ASTM D 1586). A 2-foot long, 2-inch outside diameter (1-3/8-inch inside diameter), split-barrel ("spoon") sampler, attached to the end of drilling rods, is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each six inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load. The N-value is considered to be indicative of the relative density of cohesionless soils and the consistency of cohesive soils.

The tests are usually performed at 5-foot intervals. However, more frequent or continuous testing is done by our firm through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. Usually, the circulating fluid, which is a bentonite drilling mud, also serves to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or to prevent the loss of circulating fluid.

Representative split-spoon samples from soils at every 5 feet of drilled depth and from different stratum are brought to our laboratory in airtight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for at least 60 days prior to being discarded. After completion of a test boring, the hole is kept open until a steady state ground water level is recorded. The hole is then sealed if necessary, and backfilled.

ATTACHMENTS

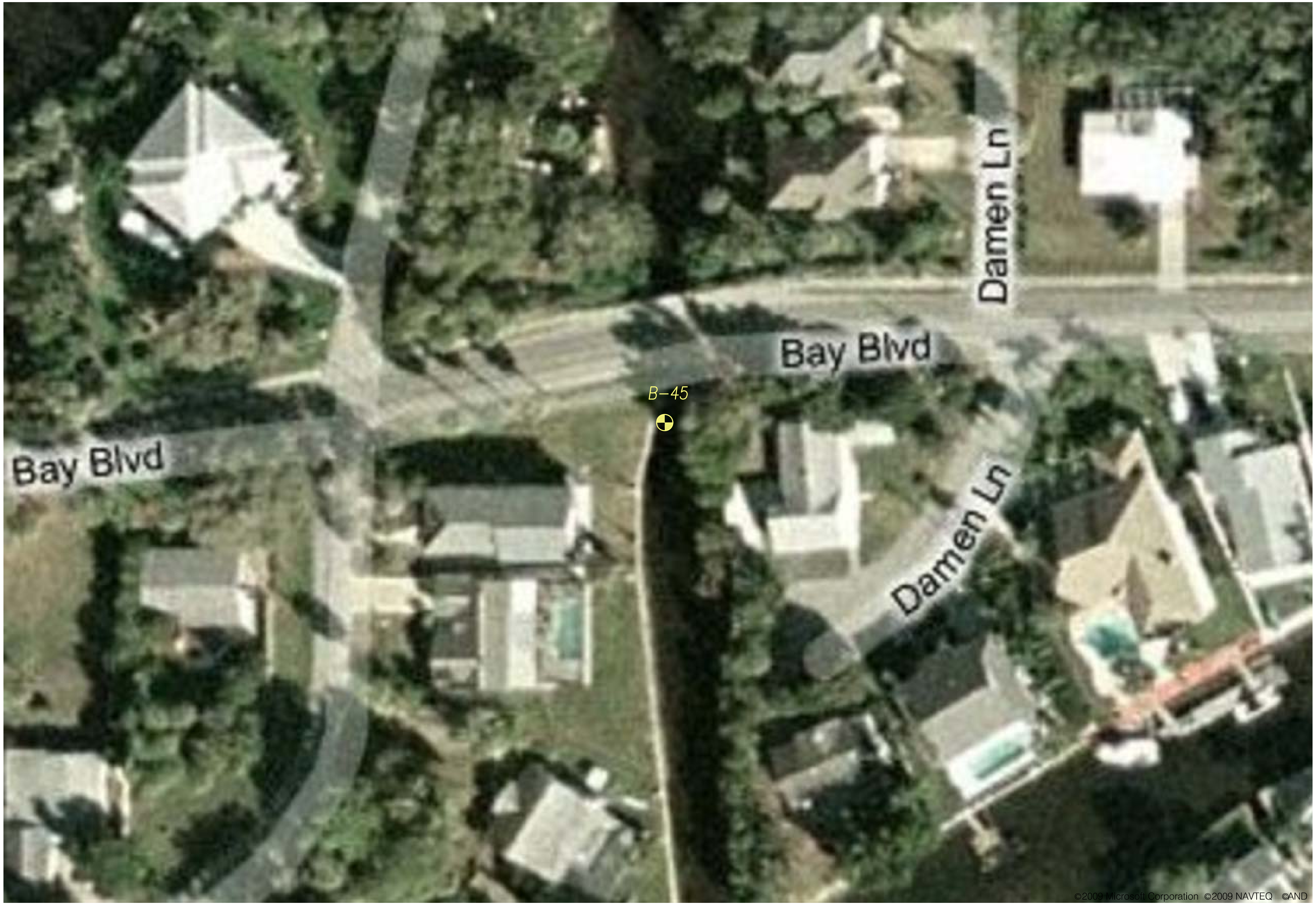
TABLE 1
SUMMARY OF LABORATORY TEST RESULTS
BAY BOULEVARD BRIDGE EVALUATION
PORT RICHEY, FLORIDA
A&A PROJECT NO. 09-9661

Boring Number	Elevation (Feet), MLW	Percent Passing U.S. STANDARD SIEVES								Moisture Content (%)	USCS CLASS.
		3/4"	3/8"	#4	#10	#40	#60	#100	#200		
B-45	-8.4 to -9.9	100	100	99	97	91	88	85	75	47	CH/CL

TABLE 2
SUMMARY OF CORROSION SERIES TESTING
BAY BOULEVARD BRIDGE EVALUATION
PORT RICHEY, FLORIDA
A&A PROJECT NO. 09-9661

Boring Number	Elevation (Feet), MLW	Resistivity (ohms-cm)	Chlorides (ppm)	Sulfates (ppm)	pH	Environmental Classification
B-45	-9.9 to -11.4	210	3,600	921	8	Concrete - Extremely Aggressive (chloride>2,000) Steel - Extremely Aggressive (chloride>2,000)

Note: Environmental Classification is based on FDOT Structures Design Guidelines



LEGEND

APPROXIMATE LOCATION OF SPT BORING

0 25 50
SCALE: 1"= 50'

BRIDGE STUDY

TEST LOCATION PLAN

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

CITY OF PORT RICHEY DREDGING PROJECT
(MILLER'S BAYOU AND COTEE RIVER CHANNELS)
CITY OF PORT RICHEY, PASCO COUNTY, FLORIDA

DRAWN BY: ajd	CHECKED BY: WMA	DATE: 10/15/09
FILE NO. 09-9661	APPROVED BY:	FIGURE: 1

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