APPENDIX H

Preliminary Geotechnical Evaluation

GCME

Memo

To: Ms. Soheila Sadough, P.E.

From: Partha Ghosh, P.E.

Date: January 21, 2020

Re: **State Road A1A Bridge over Sebastian Inlet Replacement Feasibility Assessment; CA322-TWO-006**

The information provided by your office was reviewed and analyzed for the subject project, and our evaluations are provided for your immediate use:

1. Exiting Information provided by your office:

   - As-built - Bridge Repair 2003
   - Bridge As-built – 1963
   - Bridge As-built - 1978

2. USCS Soil Report (Ref: Appendix – A)

   Research of the U.S. Department of Agriculture (USDA), Soil Conservation Service (SCS) Soil Survey of the Brevard County and Indian River County area indicates the presence of different soil map units along the roadway sections. The soil map units present along the project corridor are described in details in Appendix – A.

   Based on the soil map, there is no unsuitable soils in the area.

3. Existing Soil Profiles (Ref: Appendix – B)

   The existing bridge borings on land were drilled 70 feet to 85 feet below ground surface. The existing bridge borings in water were drilled 40 feet to 45 feet below mudline.

   The profiles generally indicated the site to be underlain with the interlayering of sands with shells to about elevation -5 feet, followed by interlayering of coquina rock and shell marl and limestone to about elevation -50 feet. The subsoils encountered plastic clay soils to about elevation -60 feet, and then followed by sands with shells to termination depths of exploration.

4. 18 and 24 – inch PSC Pile Capacity (Ref: Appendix - C)

We have considered 18-inch and 24-inch square, precast concrete piles of various lengths in order to provide a range of design compressive capacities. The capacities were estimated from a computer-generated analysis based on a method to predict Davisson vertical pile capacity versus depth in sand. Computer program "FB-Deep Version 2.06" developed by Florida Bridge Software Institute, University of Florida was utilized to perform the axial capacity analysis of the driven concrete piles. The analysis was done for two (2) representative existing boring drilled at the project site. The capacities (program outputs) for 18-inch and 24-inch square piles with reference to pile tip elevations at the boring locations for the bridge site are graphically presented in Appendix C.

5. 48 and 60 – inch Drilled Shaft Capacity (Ref: Appendix - D)

Drilled cast-in-place straight-sided concrete shafts are also a technically feasible foundation alternative for the project. Installation procedures for drilled shafts in cohesionless soils normally involve helical auger drilling in combination with bentonite slurry and sometimes steel casing for stabilization of borehole walls. Drilled shaft diameter 4 and 5 feet were considered for our analysis. Vertical (axial) capacity of drilled shafts is normally obtained through a combination of side shear and end bearing.

The ultimate vertical capacities were calculated by utilizing the computer program "FB-Deep, Version 2.06" developed by Florida Bridge Software Institute, University of Florida. The analysis was done using SPT N-values and subsoil information developed for two (2) representative existing boring drilled at the bridge site and with varying shaft lengths in order to provide a range of design compressive capacities.

The ultimate capacities for 48-inch and 60-inch diameter drilled shafts are graphically presented in Appendix D. The drilled shaft length mentioned in our analysis results indicates shaft length embedded in the ground at two (2) respective bridge boring location.

Thank you.

APPENDIX – A

USDA, SCS Soil Information

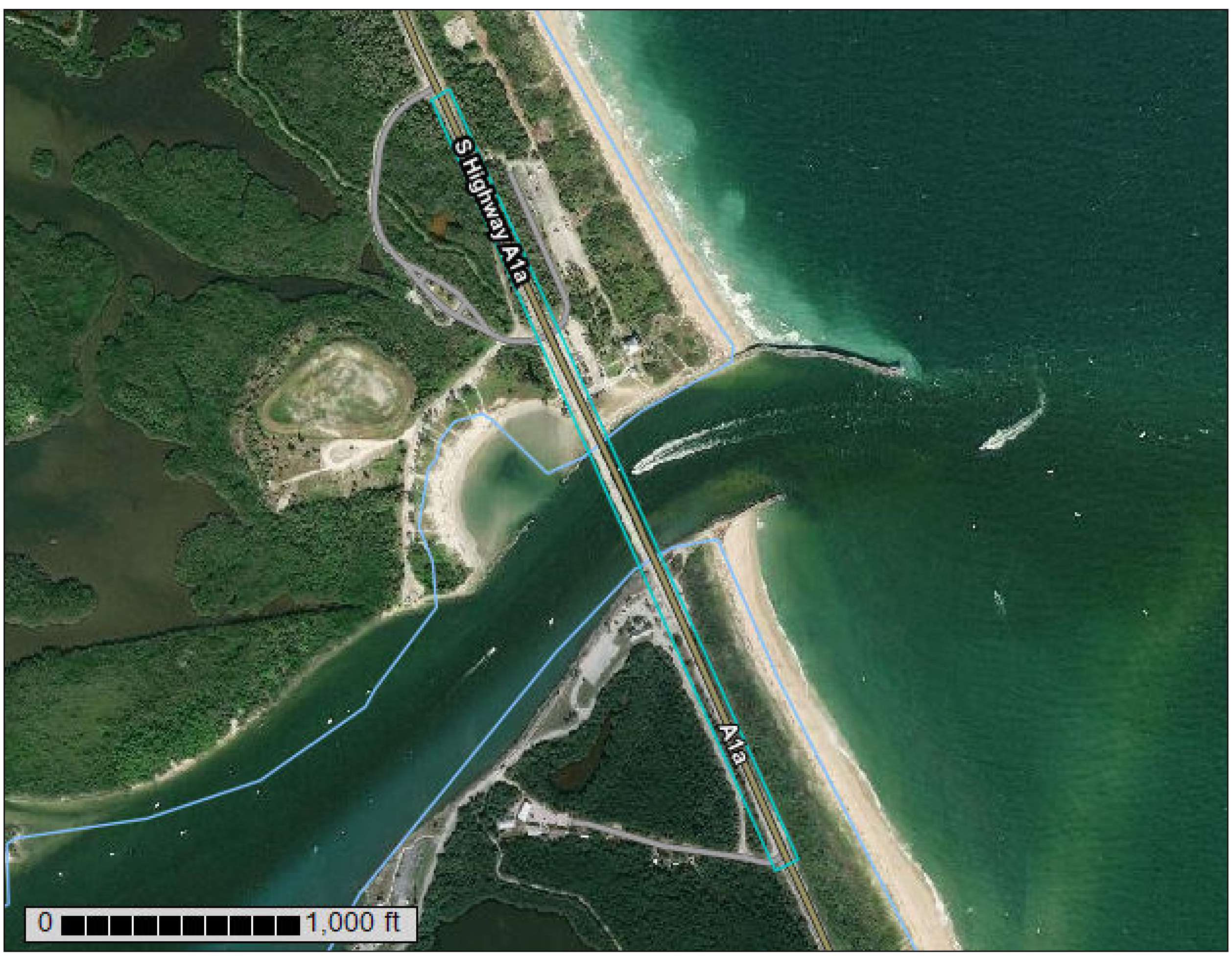
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Brevard County, Florida, and Indian River County, Florida



January 8, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:3,360 if printed on B portrait (11" x 17") sheet.

Meters: 0, 45, 90, 180, 270

Feet: 0, 150, 300, 600, 900

N

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Brevard County, Florida
Survey Area Data: Version 18, Sep 16, 2019

Soil Survey Area: Indian River County, Florida
Survey Area Data: Version 18, Sep 16, 2019

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

MAP LEGEND

MAP INFORMATION

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Dec 23, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
9	Canaveral-Anclote complex, gently undulating	3.3	40.9%
100	Waters of the Atlantic Ocean	1.1	13.4%
Subtotals for Soil Survey Area		**4.3**	**54.4%**
Totals for Area of Interest		**8.0**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7	Palm Beach sand, 0 to 5 percent slopes	1.5	18.8%
17	Quartzipsamments, 0 to 5 percent slopes	1.8	22.2%
18	Captiva fine sand, frequently ponded, 0 to 1 percent slopes	0.0	0.1%
100	Waters of the Atlantic Ocean	0.4	4.5%
Subtotals for Soil Survey Area		**3.6**	**45.6%**
Totals for Area of Interest		**8.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Brevard County, Florida

9—Canaveral-Anclote complex, gently undulating

Map Unit Setting

National map unit symbol: 1lg2n
Elevation: 10 to 60 feet
Mean annual precipitation: 49 to 57 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Canaveral and similar soils: 60 percent
Anclote and similar soils: 30 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canaveral

Setting

Landform: Dunes on marine terraces, ridges on marine terraces
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 6 inches: sand
C - 6 to 12 inches: sand
C - 12 to 80 inches: coarse sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very high (19.98 to 50.02 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 6.0
Available water storage in profile: Very low (about 1.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A/D
Forage suitability group: Forage suitability group not assigned (G156BC999FL)
Hydric soil rating: No

Description of Anclote

Setting

Landform: Flats on marine terraces
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

A - 0 to 19 inches: sand
Cg - 19 to 72 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Very poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Low (about 5.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G156BC141FL)
Hydric soil rating: Yes

Minor Components

Palm beach

Percent of map unit: 5 percent
Landform: Dunes on marine terraces
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Pomello

Percent of map unit: 5 percent
Landform: Rises on marine terraces, flats on marine terraces
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Other vegetative classification: Sand Pine Scrub (R155XY001FL)
Hydric soil rating: No

100—Waters of the Atlantic Ocean

Map Unit Composition

Waters of the atlantic ocean: 100 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Indian River County, Florida

7—Palm Beach sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: tdfq
Elevation: 10 to 130 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Palm beach and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Palm Beach

Setting

Landform: Dunes on marine terraces, ridges on marine terraces
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Shells and sandy marine deposits

Typical profile

A - 0 to 4 inches: sand
C - 4 to 80 inches: sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very high (20.00 to 50.02 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 30 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Forage suitability group: Sandy soils on ridges and dunes of xeric uplands (G156BC111FL)
Hydric soil rating: No

Minor Components

Canaveral

Percent of map unit: 5 percent
Landform: Ridges on marine terraces, dunes on marine terraces
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

17—Quartzipsamments, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: tdg1
Elevation: 20 to 200 feet
Mean annual precipitation: 52 to 60 inches
Mean annual air temperature: 68 to 75 degrees F
Frost-free period: 350 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Quartzipsamments and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Quartzipsamments

Setting

Landform: Rises on marine terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy marine deposits

Typical profile

C - 0 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 4.0

Available water storage in profile: Very low (about 2.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Forage suitability group: Forage suitability group not assigned (G156BC999FL)
Hydric soil rating: No

Minor Components

Urban land

Percent of map unit: 5 percent
Landform: Marine terraces
Landform position (three-dimensional): Interfluve, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Unranked

Arents

Percent of map unit: 5 percent
Landform: Rises on marine terraces
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Pits

Percent of map unit: 5 percent
Landform: Marine terraces
Landform position (three-dimensional): Interfluve, dip
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Unranked

18—Captiva fine sand, frequently ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2x9d4
Elevation: 0 to 20 feet
Mean annual precipitation: 45 to 60 inches
Mean annual air temperature: 70 to 77 degrees F
Frost-free period: 360 to 365 days
Farmland classification: Not prime farmland

Map Unit Composition

Captiva and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Captiva

Setting

Landform: Drainageways on marine terraces
Landform position (three-dimensional): Tread, dip
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Sandy marine deposits

Typical profile

Akn - 0 to 6 inches: fine sand
Ckn - 6 to 30 inches: fine sand
Ckng - 30 to 80 inches: fine sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum in profile: 4 percent
Salinity, maximum in profile: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 15.0
Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Forage suitability group: Sandy soils on flats of mesic or hydric lowlands (G155XB141FL)
Other vegetative classification: Slough (R155XY011FL)
Hydric soil rating: Yes

Minor Components

Canaveral

Percent of map unit: 4 percent
Landform: Ridges on marine terraces, flats on marine terraces
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Interfluve, tread, talf
Down-slope shape: Convex, concave
Across-slope shape: Linear
Hydric soil rating: No

Kesson, tidal

Percent of map unit: 4 percent
Landform: Tidal marshes on marine terraces
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear, convex
Across-slope shape: Linear

Other vegetative classification: Salt Marsh (R155XY009FL)
Hydric soil rating: Yes

100—Waters of the Atlantic Ocean

Map Unit Setting

National map unit symbol: tqlc
Elevation: 0 to 200 feet
Farmland classification: Not prime farmland

Map Unit Composition

Waters of the atlantic ocean: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Soil Information for All Uses

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

Soil Physical Properties

This folder contains a collection of tabular reports that present soil physical properties. The reports (tables) include all selected map units and components for each map unit. Soil physical properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

Engineering Properties

This table gives the engineering classifications and the range of engineering properties for the layers of each soil in the survey area.

Hydrologic soil group is a group of soils having similar runoff potential under similar storm and cover conditions. The criteria for determining Hydrologic soil group is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Listing HSGs by soil map unit component and not by soil series is a new concept for the engineers. Past engineering references contained lists of HSGs by soil series. Soil series are continually being defined and redefined, and the list of soil series names changes so frequently as to make the task of maintaining a single national list virtually impossible. Therefore, the criteria is now used to calculate the HSG using the component soil properties and no such national series lists will be maintained. All such references are obsolete and their use should be discontinued. Soil properties that influence runoff potential are those that influence the minimum rate of infiltration for a bare soil after prolonged wetting and when not frozen. These properties are depth to a seasonal high water table, saturated hydraulic conductivity after prolonged wetting, and depth to a layer with a very slow water transmission rate. Changes in soil properties caused by land management or climate changes also cause the hydrologic soil group to change. The influence of ground cover is treated independently. There are four hydrologic soil groups, A, B, C, and D, and three dual groups, A/D, B/D, and C/D. In the dual groups, the first letter is for drained areas and the second letter is for undrained areas.

The four hydrologic soil groups are described in the following paragraphs:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Depth to the upper and lower boundaries of each layer is indicated.

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

Classification of the soils is determined according to the Unified soil classification system (ASTM, 2005) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO, 2004).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to particle-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of particle-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Percentage of rock fragments larger than 10 inches in diameter and 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination. Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

References:

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties–Brevard County, Florida														
Map unit symbol and soil name	**Pct. of map unit**	**Hydrologic group**	**Depth**	**USDA texture**	**Classification**		**Pct Fragments**		**Percentage passing sieve number—**				**Liquid limit**	**Plasticity index**
					Unified	**AASHTO**	**>10 inches**	**3-10 inches**	**4**	**10**	**40**	**200**		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
9—Canaveral-Anclote complex, gently undulating														
Canaveral	60	A/D	0-6	Sand	SP	A-3	0- 0- 0	0- 0- 0	100-100-100	80-90-100	75-85-95	1- 2- 3	0-7 -14	NP
			6-12	Sand	SP	A-3	0- 0- 0	0- 0- 0	100-100-100	80-90-100	75-85-95	1- 2- 3	0-7 -14	NP
			12-80	Fine sand, sand, coarse sand	SP	A-3	0- 0- 0	0- 0- 0	90-93-95	80-88-95	50-68-75	1- 2- 3	0-7 -14	NP
Anclote	30	A/D	0-19	Sand	SP, SP-SM	A-3	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-92-98	2- 6- 10	0-7 -14	NP
			19-72	Sand, fine sand, loamy fine sand	SP, SP-SM	A-3	0- 0- 0	0- 0- 0	100-100-100	100-100-100	85-92-98	2- 6- 10	0-7 -14	NP

Engineering Properties–Indian River County, Florida														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			In				*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*	*L-R-H*
7—Palm Beach sand, 0 to 5 percent slopes														
Palm beach	95	A	0-4	Sand	SP, SW	A-1-b, A-2-4, A-3	0- 0- 0	0- 0- 0	100-100 -100	60-75-90	35-60-85	1- 3- 4	0-7 -14	NP
			4-80	Sand, gravelly sand, very gravelly sand	SP, SW	A-1-b, A-2-4, A-3	0- 0- 0	0- 0- 0	100-100 -100	60-75-90	35-60-85	1- 3- 4	0-7 -14	NP
17—Quartzipsamments, 0 to 5 percent slopes														
Quartzipsamments	85	A	0-80	Fine sand	SP, SP-SM	A-3	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	85-93-100	2- 6- 10	0-7 -14	NP
18—Captiva fine sand, frequently ponded, 0 to 1 percent slopes														
Captiva	92	A/D	0-6	Fine sand	SM, SP-SM	A-2-4, A-3	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	92-94-97	9-11- 14	0-0 -0	NP
			6-30	Sand, fine sand	SP-SM, SM	A-2-4, A-3	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	92-94-96	9-11- 13	0-0 -0	NP
			30-80	Sand, fine sand	SP-SM	A-3, A-2-4	0- 0- 0	0- 0- 0	100-100 -100	100-100 -100	94-94-96	9-10- 12	0-0 -0	NP

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

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United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

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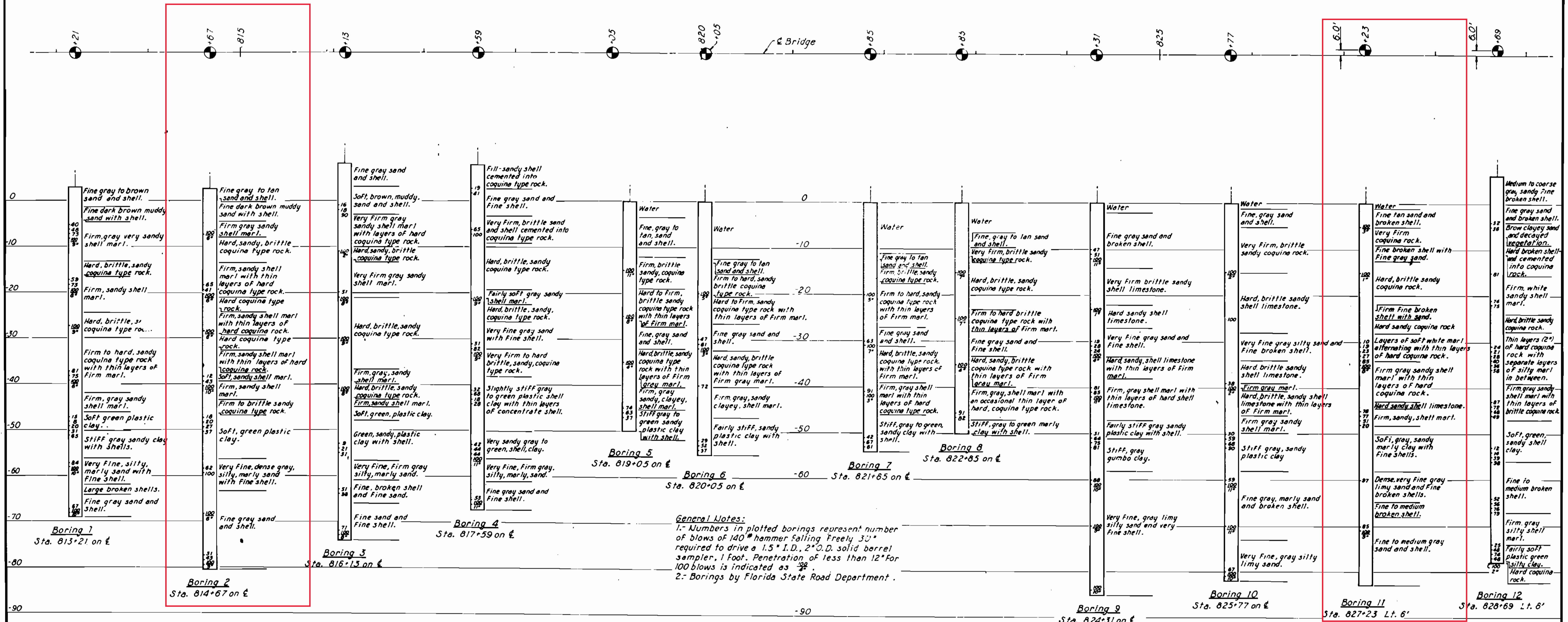
APPENDIX – B

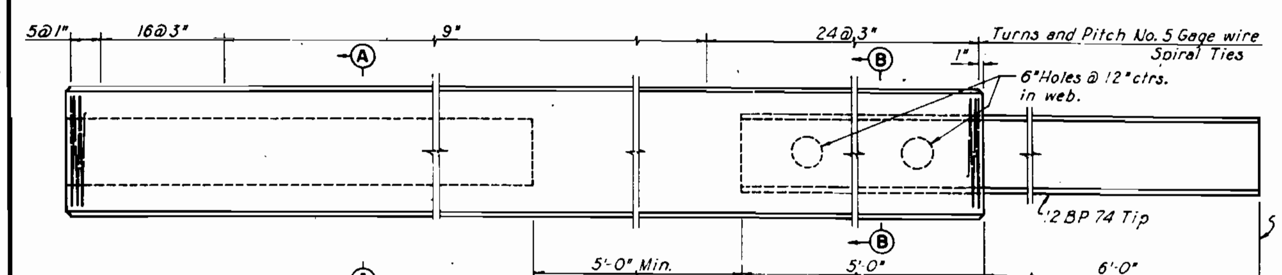
Existing Soil Profiles

STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.
FLA.		63	B3

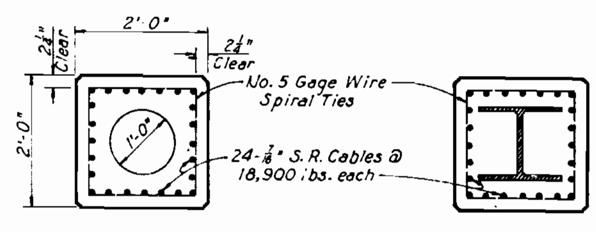


General Notes:
1.- Numbers in plotted borings represent number of blows of 140# hammer falling freely 30" required to drive a 1.5" I.D., 2" O.D. solid barrel sampler, 1 foot. Penetration of less than 12" for 100 blows is indicated as 100/4".
2.- Borings by Florida State Road Department.

BORING LOGS



ELEVATION



SECTION A-A

SECTION B-B

COMPOSITE PILE DETAILS

88005
Page No. 3

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
CONSULTING ENGINEERS
KANSAS CITY ORLANDO NEW YORK

STATE ROAD DEPARTMENT OF FLORIDA
BRIDGE DIVISION

BORING LOGS AND PILING DETAILS
SEBASTIAN INLET BRIDGE

ROAD NO.	COUNTY	STATE JOB NO.
A1A	BREVARD & INDIAN RIVER	88070-3502

	Names	Dates
Detailed by	L.I.B.	11-6-62.
Checked by	RGC	1-14-63
Quantities by		
Checked by		
Traced by		

REVISIONS: Dates | Descriptions

APPROVED BY
Engineer of Bridge Design
Assistant State Highway Engineer

Drawing No. 3 of 21

Index No. 7810

APPENDIX – C

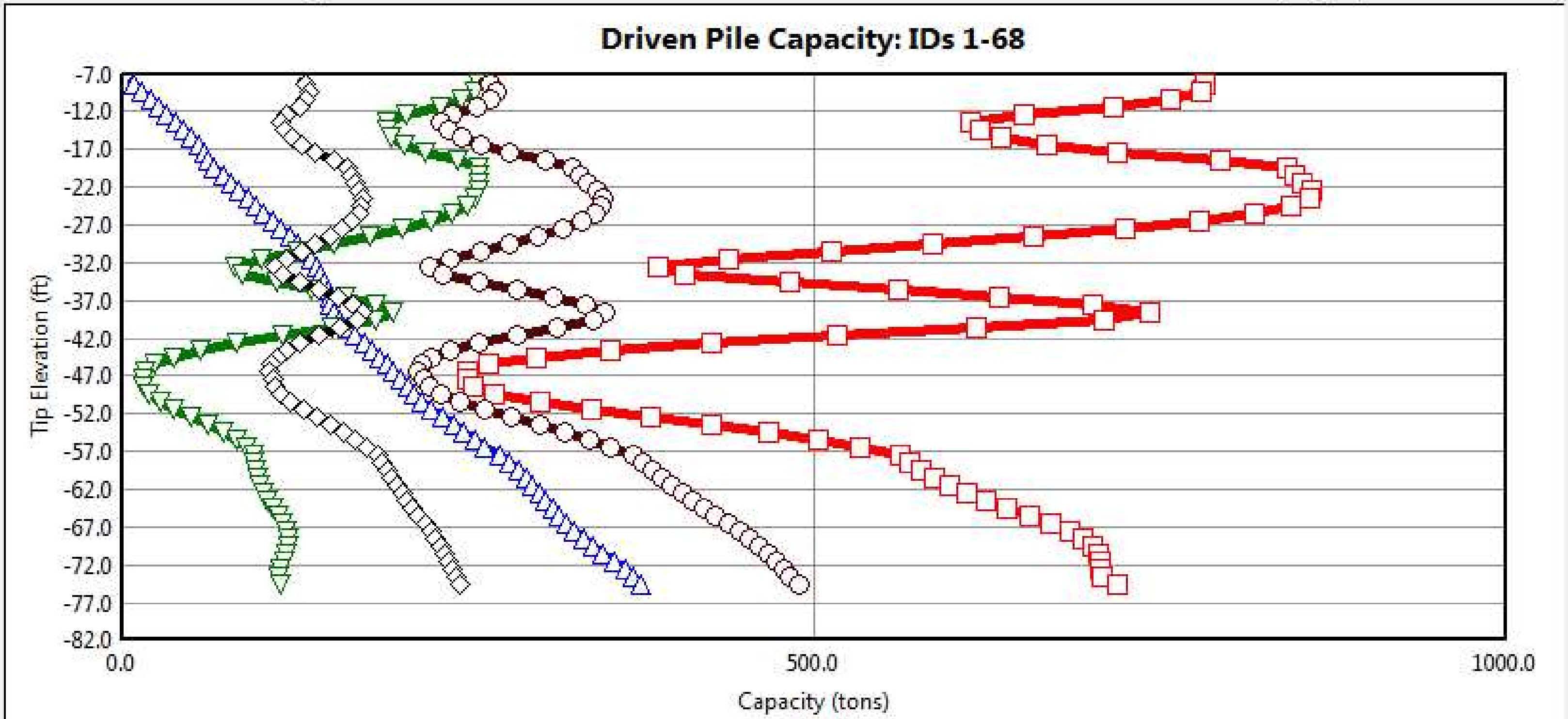
GRAPHS – VERTICAL CAPACITY ANALYSIS OF

PRECAST CONCRETE DRIVEN PILES

Plot Window

Job Name: BDI-DW Minor Project TWO#A

State Job (Project) #: 2000-01-18011



Curves

- ☑ Ultimate Side Friction
- ☑ Mobilized End Bearing
- ☑ Ultimate Pile Capacity
- ☑ Estimated Davisson Capacity
- ☑ Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-2	
Ground Surface Elevation	2.50	(ft)
Section:	Square	
Width	18.00	(in)

Project Data

File:	B-2_Void-10ft
Date:	Jan 07, 2020
Engineer:	ZP

Analysis Data

Analysis Type:	SPT

Plot Options

Customize | Update Plot | Print Plot | Print Window | Save To File

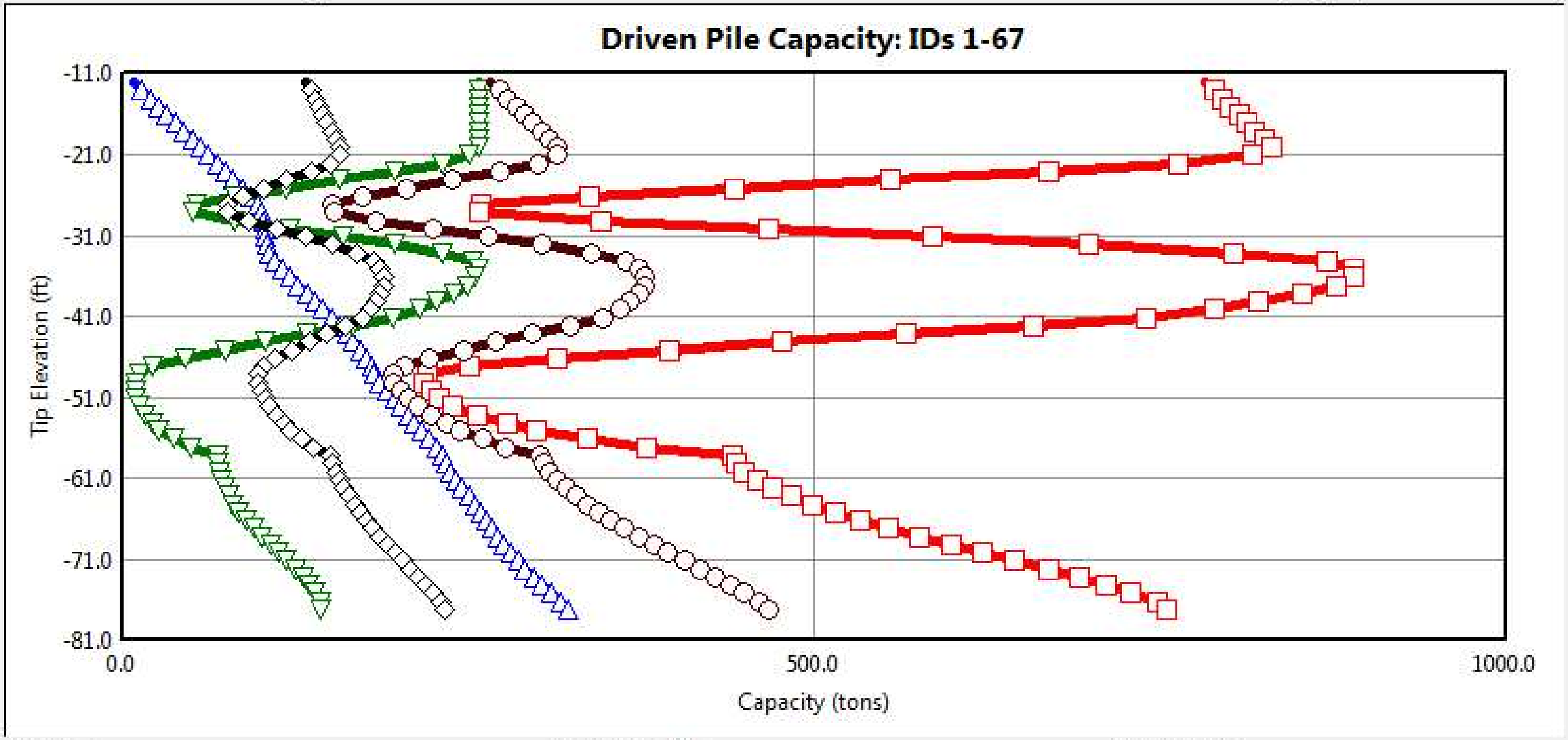
Close


Plot Window
Job Name: BDI-DW Minor Project TWO#A
State Job (Project) #: 2000-01-18011
Driven Pile Capacity: IDs 70-138
Tip Elevation (ft)
-7.0
-17.0
-27.0
-37.0
-47.0
-57.0
-67.0
-77.0
0.0
600.0
1200.0
1800.0
Capacity (tons)
Curves
Ultimate Side Friction
Mobilized End Bearing
Ultimate Pile Capacity
Estimated Davisson Capacity
Allowable Pile Capacity
*The 'Save to File' button saves the currently selected Curves to a text file.
Driven Pile Data
Boring Number: B-2
Ground Surface Elevation 2.50 (ft)
Section: Square
Width 24.00 (in)
Project Data
File: B-2_Void-10ft
Date: Jan 07, 2020
Engineer: ZP
Analysis Data
Analysis Type: SPT
Plot Options
Customize
Update Plot
Print Plot
Print Window
Save To File
Close

Plot Window

Job Name: BDI-DW Minor Project TWO#A

State Job (Project) #: 2000-01-18011



Curves

- ☑ Ultimate Side Friction
- ☑ Mobilized End Bearing
- ☑ Ultimate Pile Capacity
- ☑ Estimated Davisson Capacity
- ☑ Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-11	
Ground Surface Elevation	-1.10	(ft)
Section:	Square	
Width	18.00	(in)

Project Data

File:	B-11_Void-10ft
Date:	Jan 07, 2020
Engineer:	ZP

Analysis Data

Analysis Type:	SPT

Plot Options

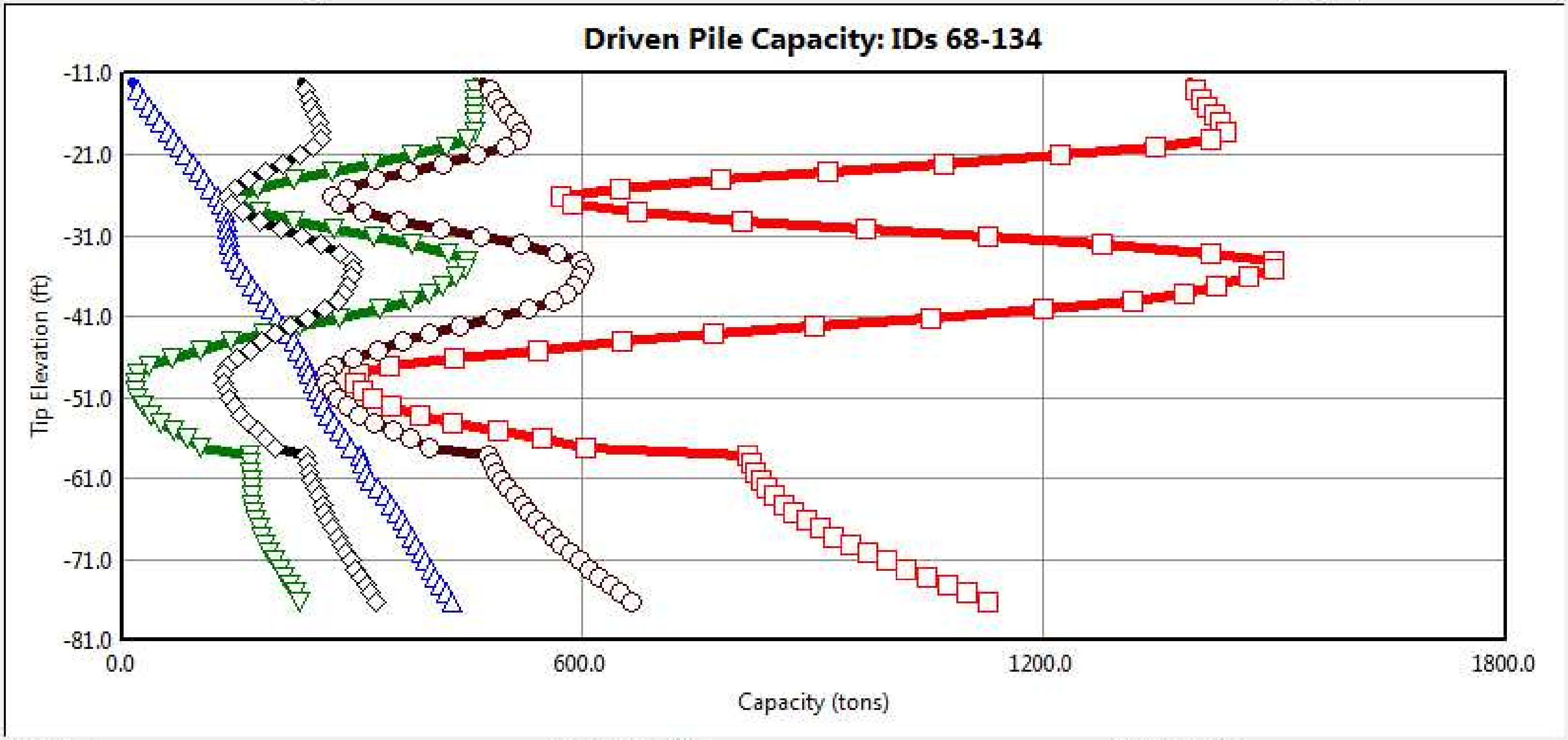
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: BDI-DW Minor Project TWO#A

State Job (Project) #: 2000-01-18011



Curves

- ☑ Ultimate Side Friction
- ☑ Mobilized End Bearing
- ☑ Ultimate Pile Capacity
- ☑ Estimated Davisson Capacity
- ☑ Allowable Pile Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Driven Pile Data

Boring Number:	B-11	
Ground Surface Elevation	-1.10	(ft)
Section:	Square	
Width	24.00	(in)

Project Data

File:	B-11_Void-10ft
Date:	Jan 07, 2020
Engineer:	ZP

Analysis Data

Analysis Type:	SPT

Plot Options

Customize | Update Plot | Print Plot | Print Window | Save To File

Close

APPENDIX – D

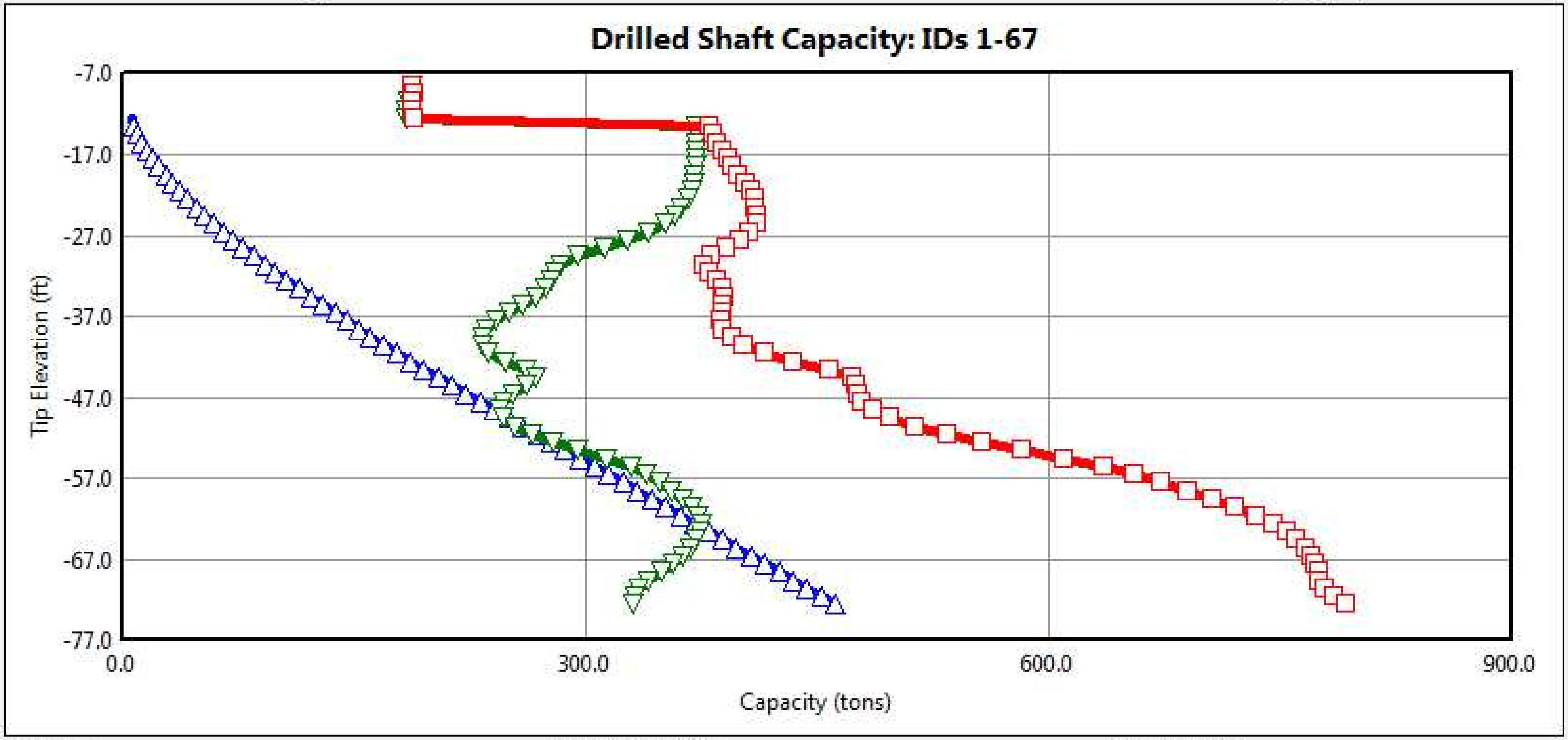
GRAPHS – VERTICAL CAPACITY ANALYSIS OF

DRILLED SHAFTS

Plot Window

Job Name: BDI-DW Minor Project TWO#A

State Job (Project) #: 2000-01-18011



Curves

- ☑ Ultimate Side Friction
- ☑ Mobilized End Bearing
- ☑ Ultimate Shaft Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Drilled Shaft Data

Boring Number:	B-2	
Ground Surface Elevation:	2.50	(ft)
Diameter	48.00	(in)
Bell Diameter	48.00	(in)
Bell Length	0.00	(ft)
Case Length	6.00	(ft)

Project Data

File:	B-2_48in_Void-10ft	
Date:	Jan 07, 2020	
Engineer:	ZP	
Water Table Elevation:	0.00	(ft)

Analysis Data

Analysis Type: SPT

Plot Options

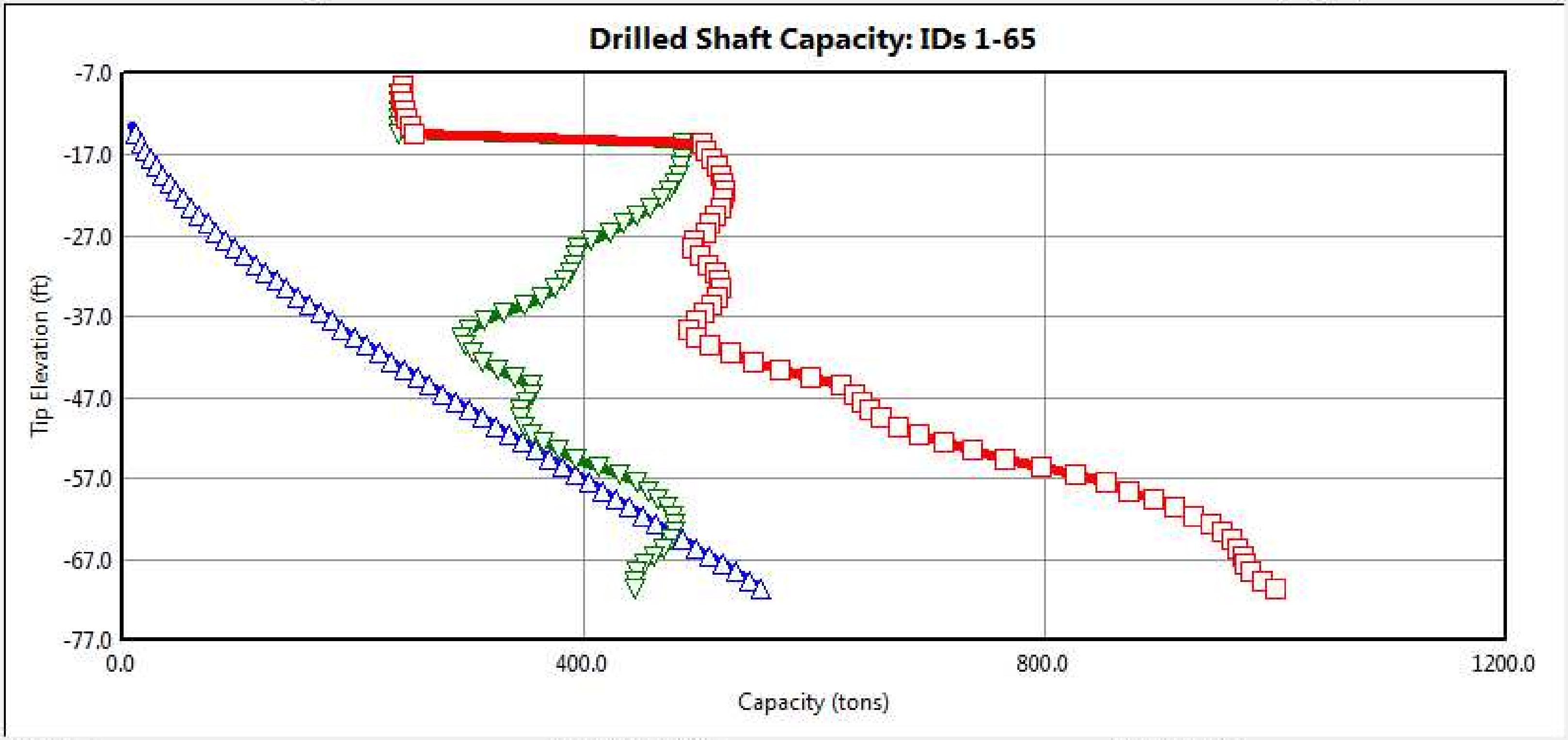
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: BDI-DW Minor Project TWO#A

State Job (Project) #: 2000-01-18011



Curves

- ☑ Ultimate Side Friction
- ☑ Mobilized End Bearing
- ☑ Ultimate Shaft Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Drilled Shaft Data

Boring Number:	B-2	
Ground Surface Elevation:	2.50	(ft)
Diameter	60.00	(in)
Bell Diameter	60.00	(in)
Bell Length	0.00	(ft)
Case Length	6.00	(ft)

Project Data

File:	B-2_60in_Void-10ft	
Date:	Jan 07, 2020	
Engineer:	ZP	
Water Table Elevation:	0.00	(ft)

Analysis Data

Analysis Type: SPT

Plot Options

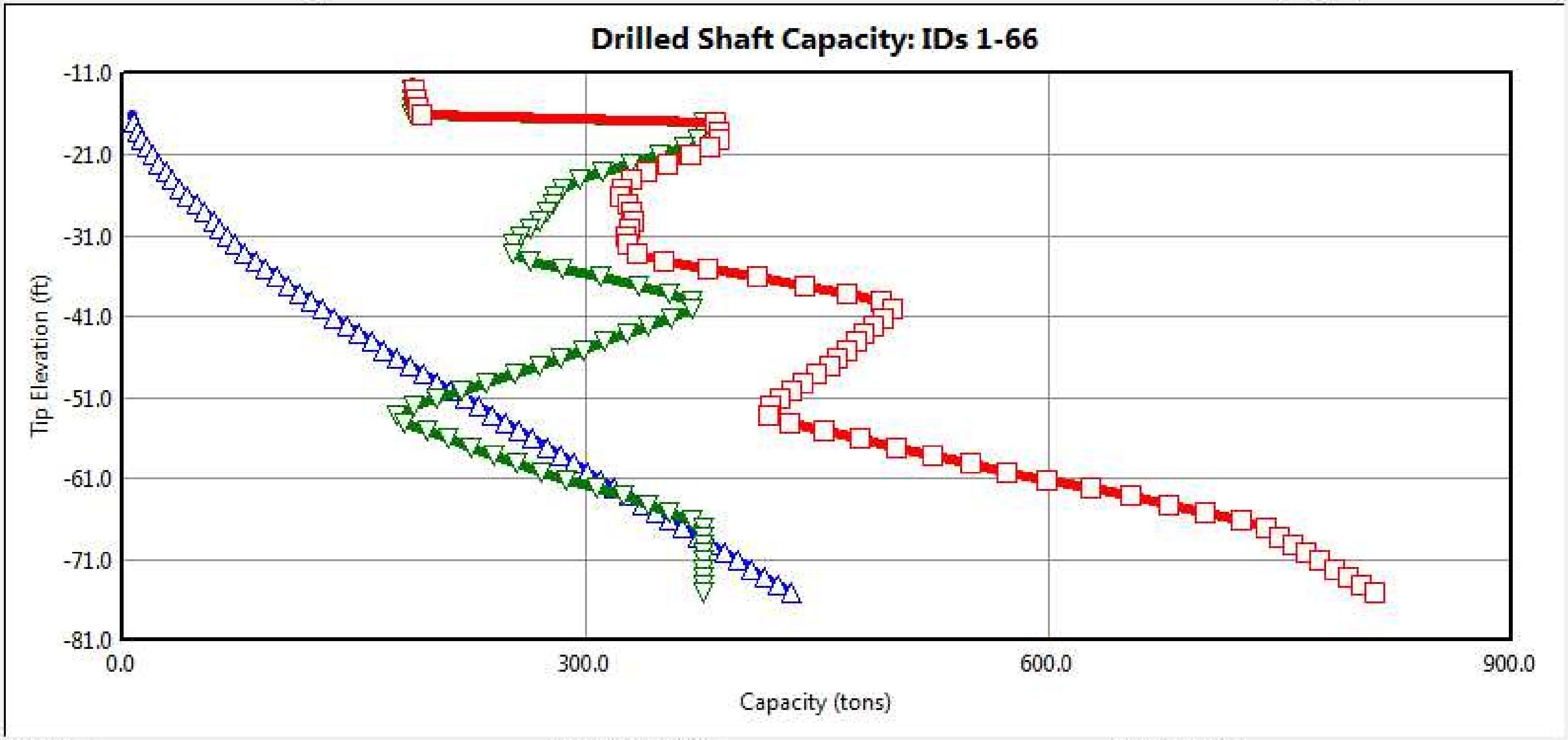
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: BDI-DW Minor Project TWO#A

State Job (Project) #: 2000-01-18011



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Shaft Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Drilled Shaft Data

Boring Number:	B-11	
Ground Surface Elevation:	-1.10	(ft)
Diameter	48.00	(in)
Bell Diameter	48.00	(in)
Bell Length	0.00	(ft)
Case Length	6.00	(ft)

Project Data

File:	B-11_48in_Void-10ft
Date:	Jan 07, 2020
Engineer:	ZP
Water Table Elevation:	0.00 (ft)

Analysis Data

Analysis Type: SPT

Plot Options

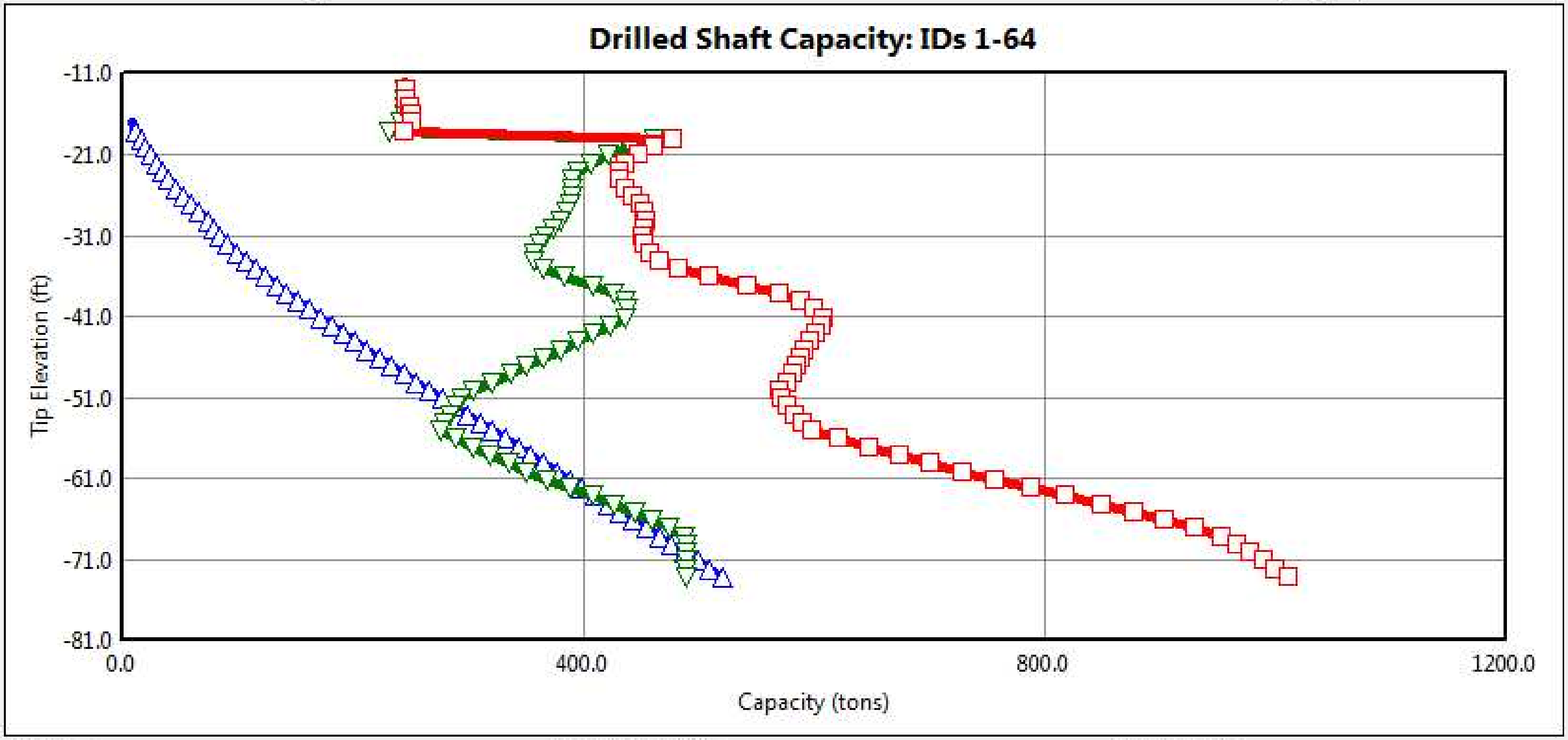
Customize | Update Plot | Print Plot | Print Window | Save To File

Close

Plot Window

Job Name: BDI-DW Minor Project TWO#A

State Job (Project) #: 2000-01-18011



Curves

- Ultimate Side Friction
- Mobilized End Bearing
- Ultimate Shaft Capacity

*The 'Save to File' button saves the currently selected Curves to a text file.

Drilled Shaft Data

Boring Number:	B-11	
Ground Surface Elevation:	-1.10	(ft)
Diameter	60.00	(in)
Bell Diameter	60.00	(in)
Bell Length	0.00	(ft)
Case Length	6.00	(ft)

Project Data

File:	B-11_60in_Void-10ft	
Date:	Jan 07, 2020	
Engineer:	ZP	
Water Table Elevation:	0.00	(ft)

Analysis Data

Analysis Type:	SPT

Plot Options

Customize | Update Plot | Print Plot | Print Window | Save To File

Close