FORGE ENGINEERING INC
INNOVATIVE ENGINEERING SOLUTIONS

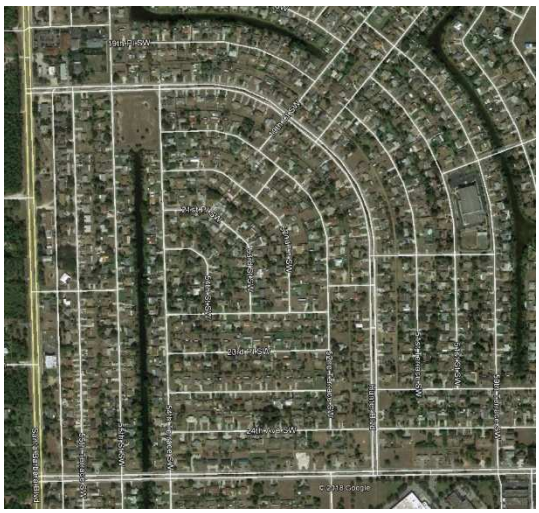
# Revised Report of Geotechnical Exploration

## GOLDEN GATE CITY
## STORMWATER IMPROVEMENTS

**Collier County Project Number 51029.7.2**

Northwest Quadrant
Golden Gate City, Collier County, Florida
Forge Engineering Project Number 135-051.01

August 2018



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August 10, 2018

**AGNOLI, BARBER, & BRUNDAGE, INC.**
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**Subject:** Revised Report of Geotechnical Exploration
**GOLDEN GATE CITY STORMWATER IMPROVEMENTS**
Collier County Project Number 51029.7.2
Northwest Quadrant
Golden Gate City, Collier County, Florida
Forge Engineering Project No. 135-051.01

Forge Engineering Inc. (FORGE) is pleased to present this revised report of geotechnical exploration for the proposed project. We have completed in general the services outlined in our proposal number 135-051.01P dated June 14, 2018 and authorized by you on June 27, 2018 via a fully executed Subconsultant Agreement. This revised report presents the project information provided to us, the findings of our exploration, together with our geotechnical evaluation and recommendations. At the request of Collier County, an additional boring was performed near the inlet structure S-1832 on Hunter Avenue.

## Purpose

The purpose of this geotechnical study was to explore the general soil conditions over the project area for the proposed Golden Gate City stormwater improvements and to provide geotechnical recommendations and site preparation. Environmental assessments or other studies were beyond the scope of our services.

This revised report has been prepared for Agnoli, Barber, and Brundage, Inc., Collier County Government, and their other sub-consultants for specific application to the proposed stormwater piping replacement project at the subject sites. FORGE has endeavored to comply with the

generally accepted geotechnical engineering practice common to the local area. FORGE makes no other warrants, express or implied.

## Project Information

Our understanding of this project is based on several e-mail transmittals from you that included a summary of requested services and project location plans. We understand this phase of the project consists of stormwater piping replacement in the northwest quadrant of Golden Gate City. You had provided FORGE with an overall location map for the requested boring locations used for the public information meeting on May 15, 2018. In addition, you provided several plan sheets with detailed descriptions of the piping in the vicinity of each boring from the civil plan set titled "Golden Gate City Stormwater Improvements, NW Quadrant" prepared by your firm dated December 2017.

FORGE understands the existing stormwater piping consists of 24- to 42-inch diameter Corrugated Metal Pipes (CMP). In locations where the piping passes beneath roadways, the CMP pipes will be replaced with Reinforced Concrete Pipes (RCP). The deepest excavations will reach a depth of 7- to 8-feet below existing site grade. You are aware that shallow caprock may be encountered during the replacement project, so Collier County has requested geotechnical work before the project goes to bid to determine the relative hardness of the caprock in several locations within the quadrant adjacent to piping replacement locations.

## Site Conditions

The project area can be described as narrow rural-style two-lane undivided roadways with minimal shoulder widths and various drainage swales. The Site Location Map (Figure 1) and the Site Vicinity Aerial Photograph (Figure 2) provided in the Appendix of this revised report present the site relative to its surroundings.

## Field Explorations

The subsurface soils were explored with six (6) Standard Penetration Test (SPT) borings. SPT tests were performed in general accordance with ASTM Procedure D-1586-11, "Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils". The SPT borings were extended to depths of 15-feet below the existing ground surface. Five of the SPT borings were conducted in the north bound lane to avoid utility locations and to allow for work to be completed in a manner that was the least inconvenient to local traffic. Boring B-6 was performed between the road and the inlet structure.

An engineer from FORGE classified soil samples taken from the borings. The boring logs summarizing our findings are presented in the Appendix of this revised report. We present a generalized profile of the subsurface conditions encountered in Table 1 on the following page.

***Table 1: Generalized Subsurface Profile***

| GENERALIZED SUBSURFACE PROFILE | | | |
|---|---|---|---|
| **DEPTH (FT)** | | **SOIL DESCRIPTION** | **USC(1)** |
| **FROM** | **TO** | | |
| 0 | 1 | Asphaltic Concrete PAVEMENT and LIMEROCK | N/A |
| 1 | 4 | Very Loose to Medium Dense Gravelly to Silty SAND | SW, SP-SM, SM |
| 4 | 6 | Very Soft to Soft LIMESTONE (Severely Weathered to Weathered Limestone) | N/A |
| 6 | 15 | Very Soft LIMESTONE to Very Hard LIMESTONE(2) (Severely Weathered Limestone to Caprock) | N/A |

(1) Unified Soil Classification
(2) Very Hard Limestone (Caprock) stratum began at 5-feet in B-6

The groundwater level was encountered at depths ranging from 2.5- to 4.0-feet below the existing grade at the time of drilling. We anticipate the groundwater level will fluctuate due to seasonal rainfall variations, surface water runoff patterns, water levels in nearby canals, construction operations, and other interrelated factors. The designers should anticipate that the seasonal high ground water level will rise to near the existing ground surface.

## Results Summary

Underlying the asphaltic concrete pavement and LIMEROCK base material, the borings generally encountered various combinations of granular soils until reaching the caprock stratum beginning at 5- to 7-feet. In B-1 and B-4, the caprock was approximately 2-feet thick with a timed rate of drilling of 3-minutes from 6- to 8-feet. In B-6 the caprock was approximately 1-foot thick with a timed rate of drilling of 1-minute from 5- to 6-feet. From 8- to 10-feet a severely weathered LIMESTONE stratum was present. In B-2, the caprock was present from 7- to 15-feet, but timed rate of drilling was not necessary. In B-3 and B-5, the caprock stratum was not encountered, and a weathered to severely weathered LIMESTONE stratum was encountered in its place. A visual display of the strata is shown on the Soil Boring Summary in the Appendix.

The table on the following page outlines the boring locations in relation to existing pillbox and grate structures.

***Table 2: Boring Location Descriptions***

| BORING LOCATON DESCRIPTIONS | |
|---|---|
| **Boring No.** | **Location in Relation to Existing Pillbox and Grate Drainage Structures** |
| B-1 | 19-Feet North and 21-Feet West of S-1797 |
| B-2 | 15-Feet South and 24-Feet West of S-1800 |
| B-3 | 18-Feet North and 27-Feet West of S-2048 |
| B-4 | 8-Feet North and 23-Feet West of S-2038 |
| B-5 | 6-Feet South and 23-Feet West of S-1852 |
| B-6 | 7-Feet North and 9-Feet East of S-1832 |

## Evaluation and Recommendations

Our evaluation and recommendations are based on the project information provided to us, the findings of our field exploration program, and our experience in the area. The subsurface conditions will vary across the site. Should new information become available during design or the conditions encountered during construction be substantially different from the information presented in this revised report, please contact us so we may evaluate the new information.

### Utility Excavations

The surficial strata across the site consists of loose to medium dense granular soils. The shallow soils should be easily excavated but will offer little open trench sidewall stability, therefore excavations may require shoring to stabilize the sidewalls. FORGE recommends that all excavations be done in accordance with OSHA 1926 Subpart P – Excavations regulations.

The granular strata encountered in our test borings from existing ground surface to approximately 5-feet below grade is suitable for backfilling of utility excavations. If utilities are designed to bear within the very soft to soft LIMESTONE strata, they should bear on a 6-inch layer of compacted bedding material, such as No. 89 stone. The very hard LIMESTONE stratum beginning at 5- to 7-feet is not suitable for backfilling of utilities, and SAND should be used as backfilling material where this stratum is encountered. Additionally, the very hard LIMESTONE stratum will likely require large specialized excavation equipment during excavation to allow for the installation of the deeper utilities.

### Dewatering

With the water table encountered at depths ranging from 2.5- to 4.0-feet below existing grade within the vicinity of the proposed construction, dewatering will likely be required to install the new stormwater piping. Water levels should be maintained at least two feet below the bottom of all excavations. Depending on the size of the excavation and length of time required for construction,

various dewatering techniques could be employed. Dewatering methods such as sumps may be suitable for small and quick excavation work while larger and longer excavations will likely require well points. Mud slabs or compacted crushed stone base may also be required at the bottom of the excavation to provide a stable working platform.

Any proposed construction below the water table will require dewatering and should be performed prior to the construction of any elements at the ground surface to allow for the water table in the area to recharge. If construction of structures begins prior to the water table being recharged, soils may encounter greater pressures and increased settlement may occur.

## Site Preparation Recommendations

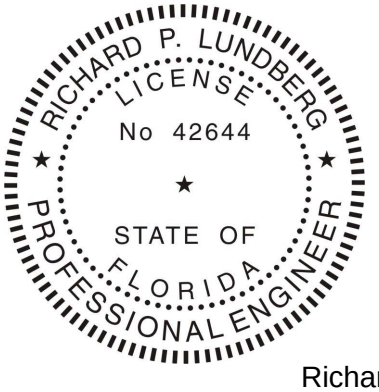
We recommend your earthwork specifications include site preparation sections similar to those presented below:

1. All excavation and placement work shall be completed in general accordance with Section 125 of the current issue of F.D.O.T. Standard Specifications for Road and Bridge Construction.
2. Soil shall be moisture conditioned to +/- 3% of the materials optimum moisture content defined by the maximum dry density.
3. Soil bedding and backfill shall be select sand with a Unified Soil Classification of SP or SP-SM, SP-SC, or SW.
4. When backfilling under wet conditions, procedures for section 125-8.3.4 shall be followed.
5. All soil backfill shall be placed in lifts not exceeding 12-inches in thickness. Lift height shall be reduced to 6-inches or less for material compacted with walk behind rollers or plate compactors. Each lift shall be compacted until a density of at least 95 percent of the modified Proctor maximum dry density is uniformly obtained.
6. Field density tests shall be conducted after compaction of the existing grade, at the bottom of all excavations, and in all backfill or fill locations to verify the specified degree of compaction is obtained.
7. The test frequency should be a minimum of one test per lift, per 100 linear feet.

## Closing

We appreciate working with you as your geotechnical consultant and look forward to working with you on the remainder of this and future projects. Please contact us when we may be of further assistance, or if you have any questions regarding this revised report.

Sincerely,
**Forge Engineering, Inc.**
*Certificate of Authorization No. 7544*




Digitally signed by Richard Lundberg
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Reason: THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY RICHARD P. LUNDBERG, P.E., ON THE DATE SHOWN. PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED AND THE SIGNATURE MUST BE VERIFIED ON ANY COPIES.
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Richard P. Lundberg, P.E.
Principal Engineer
Florida Registration No. 42644

Distribution: 1 – Addressee (via e-mail),
1 – File

Appendix: Figure 1: Site Location Map
Figure 2: Site Vicinity Aerial & Soil Borings Location Plan
Soil Boring Summary
Boring Logs
Key to Boring Logs Classification

# APPENDIX

# Figure 1: Site Location Map

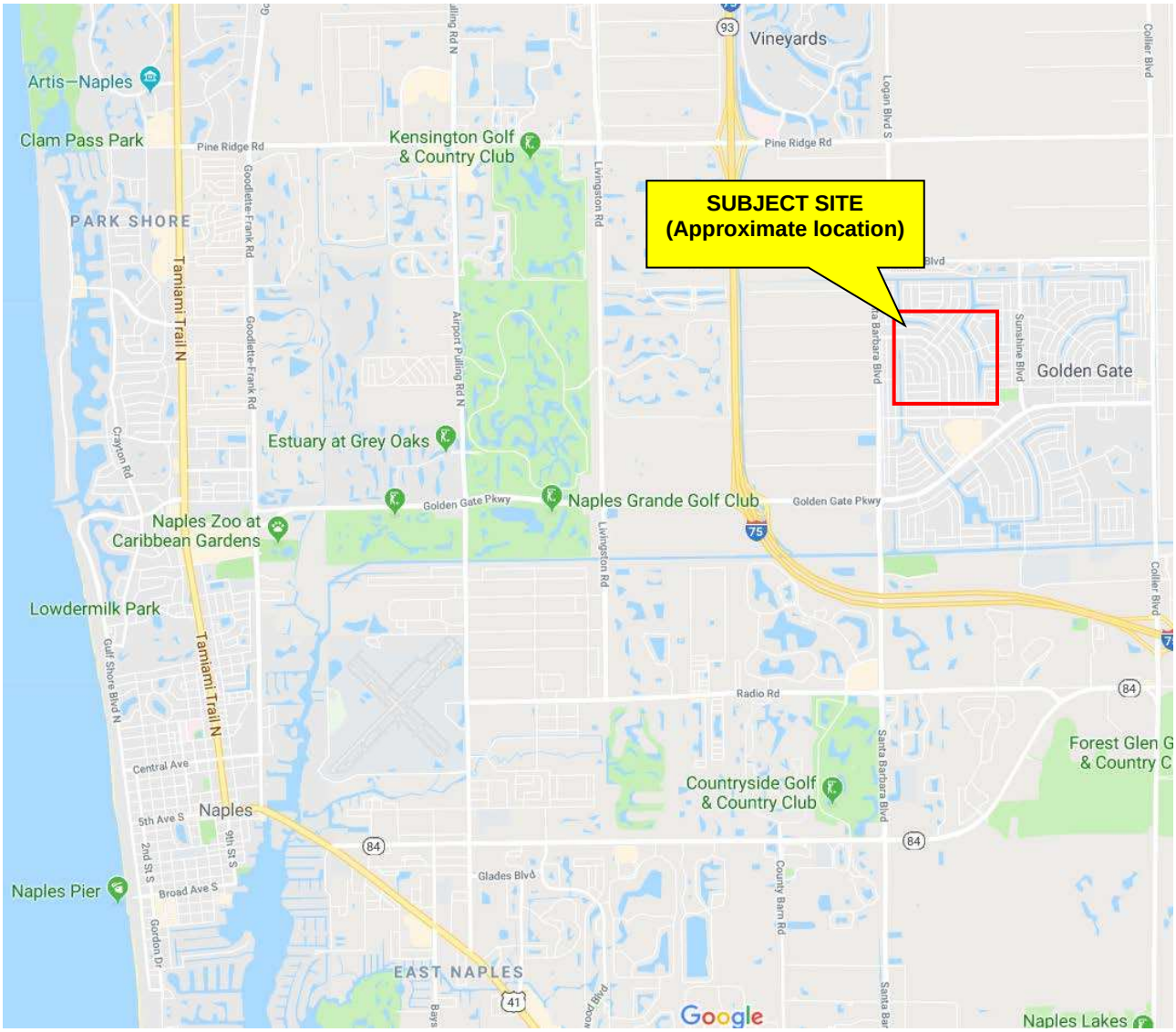


*Image from Google Maps.*

## GOLDEN GATE CITY
## STORMWATER IMPROVEMENTS

Northwest Quadrant
Golden Gate City, Collier County, Florida
FORGE Project No. 135-051.01

August 2018

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# Figure 2: Site Vicinity Aerial Photograph and Boring Location Plan


Image from Collier County Property Appraiser Website.

**B-1 Number and Approximate Soil Boring Location**

## GOLDEN GATE CITY
## STORMWATER IMPROVEMENTS

Northwest Quadrant
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**B-1**

| Depth,ft | | N, bpf | |
|---|---|---|---|
| 0.2 | PPP | | |
| 0.8 | LLL | | |
| | :*: | 17 | |
| 2.0 | :*: | | |
| | ::: | | TOB |
| | ::: | | |
| | ::: | 14 | |
| 4.0 | ::: | | |
| | :\|: | | |
| | :\|: | | |
| | :\|: | 10 | |
| 6.0 | :\|: | | |
| | ### | | |
| | ### | 50/5" | |
| | ### | | |
| 8.0 | ### | | |
| | #\|# | | |
| | #\|# | | |
| | #\|# | 6 | |
| 10.0 | #\|# | | |
| | ### | | |
| | ### | | LOSS |
| | ### | | |
| | ### | | |
| | ### | | |
| | ### | | |
| | ### | | |
| | ### | 50/0.5" | |
| | ### | | |
| 15.0 | ### | | |

**B-2**

| Depth,ft | | N, bpf | |
|---|---|---|---|
| 0.2 | PPP | | |
| 0.8 | LLL | | |
| | :\|: | 18 | |
| 2.0 | :\|: | | |
| | :*: | | |
| | :*: | | |
| | :*: | 20 | |
| 4.0 | :*: | | TOB |
| | #:# | | |
| | #:# | | |
| | #:# | 17 | |
| | #:# | | |
| | #:# | | |
| 7.0 | #:# | | |
| | ### | 50/3" | |
| | ### | | |
| | ### | | |
| | ### | 50/5" | |
| | ### | | |
| | ### | | |
| | ### | | |
| | ### | | |
| | ### | | |
| | ### | | |
| | ### | 50/0.5" | |
| | ### | | |
| 15.0 | ### | | |

**B-3**

| Depth,ft | | N, bpf | |
|---|---|---|---|
| 0.2 | PPP | | LOSS |
| 0.8 | LLL | | |
| | ::: | 23 | |
| 2.0 | ::: | | |
| | :\|: | | |
| | :\|: | | |
| | :\|: | 4 | |
| 4.0 | :\|: | | TOB |
| | #\|# | | |
| | #\|# | | |
| | #\|# | 2 | |
| | #\|# | | |
| | #\|# | | |
| 8.0 | #\|# | | |
| | #:# | | |
| | #:# | | |
| | #:# | 15 | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| 13.0 | #:# | | |
| | #\|# | | |
| | #\|# | | |
| | #\|# | 2 | |
| 15.0 | #\|# | | |

**B-4**

| Depth,ft | | N, bpf | |
|---|---|---|---|
| 0.2 | PPP | | |
| 0.8 | LLL | | |
| | ::: | 23 | |
| 2.0 | ::: | | |
| | ::: | | TOB |
| | ::: | | |
| | ::: | 8 | |
| 4.0 | ::: | | |
| | #:# | | |
| | #:# | | |
| | #:# | 14 | |
| | #:# | | |
| | ### | | |
| | ### | 50/1" | |
| | ### | | |
| 8.0 | ### | | |
| | #\|# | | LOSS |
| | #\|# | | |
| | #\|# | 4 | |
| | #\|# | | |
| | #\|# | | |
| | #\|# | | |
| | #\|# | | |
| | #\|# | | |
| 13.0 | #\|# | | |
| | #:# | | |
| | #:# | | |
| | #:# | 13 | |
| 15.0 | #:# | | |

**B-5**

| Depth,ft | | N, bpf | |
|---|---|---|---|
| 0.2 | PPP | | |
| 0.8 | LLL | | |
| | :*: | 26 | |
| | :*: | | |
| | :*: | | |
| | :*: | | |
| | :*: | 14 | |
| | :*: | | TOB |
| | :*: | | |
| | :*: | | |
| | :*: | 6 | |
| 6.0 | :*: | | |
| | #:# | | |
| | #:# | | |
| | #:# | 36 | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | 17 | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | 23 | |
| 15.0 | #:# | | |

**B-6**

| Depth,ft | | N, bpf | |
|---|---|---|---|
| 0.5 | TTT | | |
| | :*: | | |
| | :*: | 32 | |
| | :*: | | |
| | :*: | | TOB |
| | :*: | | |
| | :*: | 15 | |
| | :*: | | |
| | :*: | | |
| 5.0 | ### | 68 | |
| 5.5 | ### | 50/2" | |
| 6.0 | #\|# | | |
| | #\|# | | |
| | #\|# | 8 | |
| 8.0 | #\|# | | |
| | #:# | | |
| | #:# | | |
| | #:# | 19 | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #:# | | |
| | #\|# | | |
| | #\|# | | |
| | #\|# | 3 | |
| 15.0 | #\|# | | |

## Soil Boring Summary

### GOLDEN GATE CITY STORMWATER IMPROVEMENTS

Northwest Quadrant
Golden Gate City, Collier County, Florida

**Forge Engineering Project No. 135-051.01**

August 2018

**LEGEND**

| | |
|---|---|
| TTT | TOPSOIL, Trace Small Roots |
| PPP | Asphaltic Concrete PAVEMENT |
| LLL | LIMEROCK |
| :*: | Medium Dense to Dense Gravelly SAND |
| ::: | Loose to Medium Dense SAND |
| :\|: | Very Loose to Medium Dense Silty SAND |
| #\|# | Very Soft LIMESTONE (Severely Weathered Limestone) |
| #:# | Soft LIMESTONE (Weathered Limestone) |
| ### | Hard to Very Hard LIMESTONE (Caprock) |

**LOSS** Loss of drilling fluid
**TOB** Groundwater depth at **T**ime **O**f **B**oring

| Depth (feet) | Strength | Primary >50% | Secondary >12% | Tertiary >5% | Color | Remarks | Elev. (feet) | Groundwater | Unified | AASHTO | Symbol | N B/F | N (blows per foot) 0 10 20 30 40 50 | Water Content, % | Fines Content, % | Organic Content, % | Liquid Limit, % | Plasticity Index, % | Time Rate of Drilling (minutes:seconds) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2 | | PAVEMENT | | | black | | | | | | PPP | | | | | | | | |
| 0.8 | | LIMEROCK | | | gray | Limerock | | | | | LLL | | | | | | | | |
| | Medium Dense | | | | | | | | | | :*: | 17 | »»»»»»»»»» | | | | | | |
| 2.0 | | SAND | Gravel | | brown | | | | SW | | :*: | | | | | | | | |
| | | | | | | | | TOB | | | ::: | | | | | | | | |
| | | | | | | | | | | | ::: | | | | | | | | |
| | Medium Dense | | | | | | | | | | ::: | 14 | »»»»»»»» | | | | | | |
| 4.0 | | SAND | | silt | brown | | | | SP-SM | | ::: | | | | | | | | |
| | | | | | | | | | | | :\|: | | | | | | | | |
| | | | | | | | | | | | :\|: | | | | | | | | |
| | Loose | | | | | | | | | | :\|: | 10 | »»»»»» | | | | | | |
| 6.0 | | SAND | Silt | gravel | brown | Trace Small Roots | | | SM | | :\|: | | | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | 3:00 |
| | Very Hard | | | | | | | | | | ### | 50/5" | »»»»»»»»»»»»»»»»»»»»»»»»»»»»»»+ | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| 8.0 | | LIMESTONE | | | gray | Caprock | | | | | ### | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | Very Soft | | | | | | | | | | #\|# | 6 | »»» | | | | | | |
| 10.0 | | LIMESTONE | Silt | | gray | Weathered Limestone | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| | | | | | | | | LOSS | | | ### | | | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
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| | | | | | | | | | | | ### | | | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| | Very Hard | | | | | | | | | | ### | 50/0.5" | »»»»»»»»»»»»»»»»»»»»»»»»»»»»»»+ | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| 15.0 | | LIMESTONE | | | gray | | | | | | ### | | | | | | | | |
| | | | | | | Boring Terminated at 15.0 ft. | | | | | | | | | | | | | |

**F**orge Engineering, Inc.
Naples, Florida

Sheet 1 of 1

Project Name: Golden Gate City Stormwater
Job Number: 135-051.01

Boring Number: B-1
Date Drilled: 7/5/2018

| Depth (feet) | Strength | Primary >50% | Secondary >12% | Tertiary >5% | Color | Remarks | Elev. (feet) | Groundwater | Unified | AASHTO | Symbol | N B/F | N (blows per foot) 0 10 20 30 40 50 | Laboratory Test Results: Water Content, % | Fines Content, % | Organic Content, % | Liquid Limit, % | Plasticity Index, % | Time Rate of Drilling (minutes:seconds) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2 | | PAVEMENT | | | black | | | | | | PPP | | | | | | | | |
| 0.8 | | LIMEROCK | | | gray | Limerock | | | | | LLL | | | | | | | | |
| | Medium Dense | | | | | | | | | | :\|: | 18 | »»»»»»»»»»» | | | | | | |
| 2.0 | | SAND | Silt | | orange | | | | SM | | :\|: | | | | | | | | |
| | | | | | | | | | | | :*: | | | | | | | | |
| | | | | | | | | | | | :*: | | | | | | | | |
| | Medium Dense | | | | | | | | | | :*: | 20 | »»»»»»»»»»»» | | | | | | |
| 4.0 | | SAND | Gravel | | brown | | | TOB | SW | | :*: | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | Soft | | | | | | | | | | #:# | 17 | »»»»»»»»»» | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| 7.0 | | LIMESTONE | Sand | | gray | Weathered Limestone | | | | | #:# | | | | | | | | |
| | Very Hard | | | | | | | | | | ### | 50/3.8" | »»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»+ | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| | Very Hard | | | | | | | | | | ### | 50/5" | »»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»+ | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
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| | | | | | | | | | | | ### | | | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| | Very Hard | | | | | | | | | | ### | 50/0.5" | »»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»+ | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| 15.0 | | LIMESTONE | | | gray | Caprock | | | | | ### | | | | | | | | |
| | | | | | | Boring Terminated at 15.0 ft. | | | | | | | | | | | | | |

**Forge Engineering, Inc.**
Naples, Florida

Sheet 1 of 1

Project Name: Golden Gate City Stormwater
Job Number: 135-051.01

Boring Number: B-2
Date Drilled: 7/5/2018

| Depth (feet) | Strength | Primary >50% | Secondary >12% | Tertiary >5% | Color | Remarks | Elev. (feet) | Groundwater | Unified | AASHTO | Symbol | N B/F | N (blows per foot) 0 10 20 30 40 50 | Laboratory Test Results: Water Content, % | Fines Content, % | Organic Content, % | Liquid Limit, % | Plasticity Index, % | Time Rate of Drilling (minutes:seconds) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2 | | PAVEMENT | | | black | | | LOSS | | | PPP | | | | | | | | |
| 0.8 | | LIMEROCK | | | gray | Limerock | | | | | LLL | | | | | | | | |
| | Medium Dense | | | | | | | | | | ::: | 23 | »»»»»»»»»»»»» | | | | | | |
| 2.0 | | SAND | | | orange | | | | SP | | ::: | | | | | | | | |
| | | | | | | | | | | | :\|: | | | | | | | | |
| | | | | | | | | | | | :\|: | | | | | | | | |
| | Very Loose | | | | | | | | | | :\|: | 4 | »» | | | | | | |
| 4.0 | | SAND | Silt | gravel | brown | | | TOB | SM | | :\|: | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | Very Soft | | | | | | | | | | #\|# | 2 | » | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | Very Soft | | | | | | | | | | #\|# | 6 | »»» | | | | | | |
| 8.0 | | LIMESTONE | Silt | | gray | Severely Weathered Limestone | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | Soft | | | | | | | | | | #:# | 15 | »»»»»»»» | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| 13.0 | | LIMESTONE | Sand | | gray | Weathered Limestone | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | Very Soft | | | | | | | | | | #\|# | 2 | » | | | | | | |
| 15.0 | | LIMESTONE | Silt | | gray | Severely Weathered Limestone | | | | | #\|# | | | | | | | | |
| | | | | | | Boring Terminated at 15.0 ft. | | | | | | | | | | | | | | |

**Forge Engineering, Inc.**
Naples, Florida

Sheet 1 of 1

Project Name: Golden Gate City Stormwater
Job Number: 135-051.01

Boring Number: B-3
Date Drilled: 7/5/2018

| Depth (feet) | Strength | Primary >50% | Secondary >12% | Tertiary >5% | Color | Remarks | Elev. (feet) | Groundwater | Unified | AASHTO | Symbol | N B/F | N (blows per foot) 0 10 20 30 40 50 | Water Content, % | Fines Content, % | Organic Content, % | Liquid Limit, % | Plasticity Index, % | Time Rate of Drilling (minutes:seconds) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2 | | PAVEMENT | | | black | | | | | | PPP | | | | | | | | |
| 0.8 | | LIMEROCK | | | gray | Limerock | | | | | LLL | | | | | | | | |
| | Medium Dense | | | | | | | | | | ::: | 23 | »»»»»»»»»»»»»» | | | | | | |
| 2.0 | | SAND | | | light brown | | | | SP | | ::: | | | | | | | | |
| | | | | | | | | TOB | | | ::: | | | | | | | | |
| | | | | | | | | | | | ::: | | | | | | | | |
| | Loose | | | | | | | | | | ::: | 8 | »»»»» | | | | | | |
| 4.0 | | SAND | | silt | brown | | | | SP-SM | | ::: | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | Soft | | | | | | | | | | #:# | 14 | »»»»»»»» | | | | | | |
| 6.0 | | LIMESTONE | Sand | | gray | Weathered Limestone | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | |
| | Very Hard | | | | | | | | | | ### | 50/1" | »»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»+ | | | | | | |
| | | | | | | | | | | | ### | | | | | | | | 3:00 |
| 8.0 | | LIMESTONE | | | gray | Caprock | | | | | ### | | | | | | | | |
| | | | | | | | | LOSS | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | Very Soft | | | | | | | | | | #\|# | 4 | »» | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #\|# | | | | | | | | |
| 13.0 | | LIMESTONE | Silt | | gray | Severely Weathered Limestone | | | | | #\|# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | | | | | | | | | | | #:# | | | | | | | | |
| | Soft | | | | | | | | | | #:# | 13 | »»»»»»» | | | | | | |
| 15.0 | | LIMESTONE | Sand | | gray | Weathered Limestone | | | | | #:# | | | | | | | | |
| | | | | | | Boring Terminated at 15.0 ft. | | | | | | | | | | | | | | |

**Forge Engineering, Inc.**
Naples, Florida

Sheet 1 of 1

Project Name: Golden Gate City Stormwater
Job Number: 135-051.01

Boring Number: B-4
Date Drilled: 7/5/2018

| Depth (feet) | Material Description: Strength | Primary >50% | Secondary >12% | Tertiary >5% | Color | Remarks | Elev. (feet) | Groundwater | Unified | AASHTO | Symbol | N B/F | N (blows per foot) 0 10 20 30 40 50 | Laboratory Test Results: Water Content, % | Fines Content, % | Organic Content, % | Liquid Limit, % | Plasticity Index, % | Time Rate of Drilling (minutes:seconds) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.2 | | PAVEMENT | | | black | | | | | | PPP | | | | | | | | |
| 0.8 | | LIMEROCK | | | gray | Limerock | | | | | LLL | | | | | | | | |
| | Medium Dense | | | | | | | | | | :*: | 26 | »»»»»»»»»»»»»»»» | | | | | | |
| | Medium Dense | | | | | | | TOB | | | :*: | 14 | »»»»»»»» | | | | | | |
| | Loose | | | | | | | | | | :*: | 6 | »»» | | | | | | |
| 6.0 | | SAND | Gravel | | brown | | | | SW | | :*: | | | | | | | | |
| | Soft | | | | | | | | | | #:# | 36 | »»»»»»»»»»»»»»»»»»»»»»» | | | | | | |
| | Soft | | | | | | | | | | #:# | 17 | »»»»»»»»»» | | | | | | |
| | Soft | | | | | | | | | | #:# | 23 | »»»»»»»»»»»»» | | | | | | |
| 15.0 | | LIMESTONE | Sand | | gray | Weathered Limestone | | | | | #:# | | | | | | | | |
| | | | | | | Boring Terminated at 15.0 ft. | | | | | | | | | | | | | |

**Forge Engineering, Inc.**
Naples, Florida

Sheet 1 of 1

Project Name: Golden Gate City Stormwater
Job Number: 135-051.01

Boring Number: B-5
Date Drilled: 7/6/2018

| Depth (feet) | Strength | Primary >50% | Secondary >12% | Tertiary >5% | Color | Remarks | Elev. (feet) | Groundwater | Unified | AASHTO | Symbol | N B/F | N (blows per foot) 0 10 20 30 40 50 | Laboratory Test Results: Water Content, % | Fines Content, % | Organic Content, % | Liquid Limit, % | Plasticity Index, % | Time Rate of Drilling (minutes:seconds) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | | TOPSOIL | | | brown | Trace Small Roots | | | | | TTT | | | | | | | | |
| | Dense | | | | | | | | | | :*: | 32 | »»»»»»»»»»»»»»»»»»»» | | | | | | |
| | Medium Dense | | | | | | | TOB | | | :*: | 15 | »»»»»»»» | | | | | | |
| 5.0 | | SAND | Gravel | | brown | | | | SW | | :*: | | | | | | | | |
| | Hard | | | | | | | | | | ### | 68 | »»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»+ | | | | | | |
| 6.0 | Very Hard | LIMESTONE | | | light brown | Caprock | | | | | ### | 50/2" | »»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»+ | | | | | | 1:00 |
| | Very Soft | | | | | | | | | | #\|# | 8 | »»»»» | | | | | | |
| 8.0 | | LIMESTONE | Silt | | light brown | Severely Weathered Limestone | | | | | #:# | | | | | | | | |
| | Soft | | | | | | | | | | #:# | 19 | »»»»»»»»»»» | | | | | | |
| 13.0 | | LIMESTONE | Sand | | light brown | Weathered Limestone | | | | | #:# | | | | | | | | |
| | Very Soft | | | | | | | | | | #\|# | 3 | » | | | | | | |
| 15.0 | | LIMESTONE | Silt | | light brown | Severely Weathered Limestone | | | | | #\|# | | | | | | | | |

Hand Augered From 0 To 1 Foot Below Existing Grade
Boring Terminated at 15.0 ft.

**Forge Engineering, Inc.**
Naples, Florida

Sheet 1 of 1

Project Name: Golden Gate City Stormwater
Job Number: 135-051.01

Boring Number: B-6
Date Drilled: 8/9/2018

| Depth (feet) | Material Description: Strength | Primary >50% | Secondary >12% | Tertiary >5% | Color | Remarks | Elev. (feet) | Groundwater | Unified | AASHTO | Symbol | N B/F | N (blows per foot) 0 10 20 30 40 50 | Laboratory Test Results: Water Content, % | Fines Content, % | Organic Content, % | Liquid Limit, % | Plasticity Index, % | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

**Primary soil type**: Over 50% of soil by visual estimation or laboratory test

**Secondary soil type**: Between 12% and 50% of soil by visual estimation or laboratory test

**Tertiary soil type**: Between 5% and 12% of soil by visual estimation or laboratory test

**N:** Standard Penetration Resistance.
Number of blows to drive a standard split-spoon sampler one foot using a 140 pound hammer dropping 30 inches

**woh:** Split-spoon penetrated soil under weight of 140 pound hammer only.

**wor:** Split-spoon penetrated soil under weight of drill rods only.

Table of Strength Descriptions

| N | Sand / Gravel | Silt / Clay | Limestone / Sandstone |
|---|---|---|---|
| 0 | Very Loose | Very Soft | Very Soft |
| 2 | Very Loose | Very Soft | Very Soft |
| 3 | Very Loose | Soft | Very Soft |
| 4 | Very Loose | Soft | Very Soft |
| 5 | Loose | Firm | Very Soft |
| 8 | Loose | Firm | Very Soft |
| 9 | Loose | Stiff | Very Soft |
| 10 | Loose | Stiff | Very Soft |
| 11 | Medium Dense | Stiff | Soft |
| 15 | Medium Dense | Stiff | Soft |
| 16 | Medium Dense | Very Stiff | Soft |
| 30 | Medium Dense | Very Stiff | Soft |
| 31 | Dense | Hard | Soft |
| 50 | Dense | Hard | Soft |
| 51 | Very Dense | Hard | Hard |
| 60 | Very Dense | Hard | Hard |
| 100 | Very Dense | Hard | Very Hard |
| 100+ | Very Dense | Hard | Very Hard |

Symbol Key

| | |
|---|---|
| GRAVEL | * |
| SAND | : |
| SILT | \| |
| CLAY | / |
| LIMESTONE | # |
| DEBRIS | D |
| FILL | F |
| PEAT | ~ |
| ORGANIC | ~ |
| LIMEROCK | L |
| PAVEMENT | P |
| CONCRETE | C |
| WATER | W |
| VOID | V |

Laboratory Test Summary

**Water Content:** Weight of Water / Weight of all Dry Soil

**Fines Content:** Weight of Dry Soil Finer than No. 200 Sieve / Weight of all Dry Soil

**Organic Content:** Weight of Organics Lost by Ignition / Weight of all Dry Soil

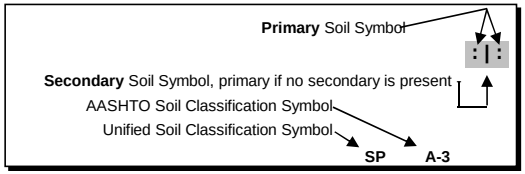
**Liquid Limit:** Moisture content of a soil at the transition between liquid and plastic states. (ASTM D-4318)

**Plastic Limit:** Moisture content of a soil at the transition between plastic and semisolid states. (ASTM D-4318)

**Plasticity Index:** Liquid Limit - Plastic Limit

**15.0** Depth of soil change. The transition between materials may be gradual. Soil conditions will vary between boring locations.

All descriptions are based on the visual examination of the retrieved soil samples, unless laboratory data is indicated. Therefore, estimates of material types and concentrations should be considered approximate.




Representative Material Description Definitions

| | |
|---|---|
| **SAND** | Material that pass a No. 4 and is retained on a No. 200 sieve. |
| **SILT** | Low plasticity material that passes a No. 200 sieve. |
| **CLAY** | Moderate to high plasticity soil that passes a No. 200 sieve. |
| **LIMESTONE** | Natural occurring rock with at least 50% calcium carbonate. |
| **SANDSTONE** | Natural occurring rock of hardened (not by calcium carbonate) sand-size particles. |
| **LIMEROCK** | Mined or processed limestone used as a fill or pavement base. |
| **ORGANIC** | Containing partially decomposed material that can be ignited when dried. |

Groundwater Symbols

| | |
|---|---|
| **TOB** | Initial groundwater level at time of boring |
| **GWL** | Groundwater level measured a day or more after drilling |
| **LOSS** | Drill fluid circulation loss |

**F**orge Engineering, Inc.
Naples, Florida

# Key To Boring Log Classification