Final Assessment Report

Howell Creek

Lake Howell Road to Howell Lane to SR436

Seminole County, Florida

February 2010

Inwood consulting engineers

Final Assessment Report

Howell Creek

Lake Howell Road to Howell Lane to SR436

Prepared for:

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

Seminole County
Public Works Department
Engineering Division

February 2010

Prepared by:

Inwood consulting engineers

February 26, 2010 SEM-032-03

Roland Raymundo, PE, CFM - Principal Engineer
Seminole County Public Works Engineering Division
520 West Lake Mary Boulevard, Suite 200
Sanford, Florida 32773-7424

Re: Final Creek Assessment Report for
Howell Creek Improvements Project
Lake Howell Road to SR 436
Howell Creek Basin
Seminole County, Florida

Dear Mr. Raymundo:

Inwood Consulting Engineers, Inc. (Inwood) is pleased to submit two (2) copies of the Final Report for the above referenced project. Inwood appreciates the opportunity to provide its services to Seminole County. If you have any questions regarding the attached, please contact us at 407-971-8850.

Very truly yours,

INWOOD CONSULTING ENGINEERS, INC.

Mark W. Ellard, PE, CFM
Water Resources Program Manager

Attachments:

Two (2) Bound Copies of Final Report

Final Assessment Report

Howell Creek

Lake Howell Road to Lake Howell Lane to State Road 436

Prepared for:

Department of Public Works

Engineering Division

Seminole County, Florida

February 2010

Prepared by:

Inwood consulting engineers

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1.0 INTRODUCTION

1.1 BACKGROUND

This report presents the results of an assessment of a portion of Howell Creek. Inwood Consulting Engineers, Inc (Inwood) was tasked by Seminole County to perform the study under the Master Stormwater Engineering Services Contract for the Howell Creek Basin.

1.2 SITE LOCATION

The project is focused on Howell Creek which is located in south central Seminole County. Howell Creek is the main feature within the Howell Creek Basin. This watershed originates in Orange County in Orlando, and includes areas of Winter Park, Maitland, and unincorporated Orange County. In Seminole County, the watershed includes through portions of Casselberry, Winter Springs, Oviedo, and unincorporated Seminole County before discharging into Lake Jesup. A project vicinity map is provided as Figure 1-1.

The specific project limits are the portion of Howell Creek located from Lake Howell Road to Lake Howell Lane (approximately 500') and then to the State Road 436 (approximately 1500'). The project limits are in Section 28 of Township 21 South, Range 30 East and within the jurisdiction of the St. Johns River Water Management District (SJRWMD). The project site location is shown on Figure 1-2. A low altitude aerial photograph is provided on Figure 1-3.

1.3 PROBLEM DESCRIPTION

The subject creek corridor is the primary drainage feature for south Seminole County draining a large area of mixed development residential and commercial areas. The overall drainage area upstream of State Road 436 is approximately 15 square miles. The contributing area upstream includes Lake Waumpi and extends well into Orange County through the Winter Park / Maitland chain of lakes and into Orlando. This large contributing area causes Howell Creek to carry an enormous flow on a regular basis. During significant storms creek stages flash quickly due to the predominance of development. As a result, high, erosive velocities can occur. Photos of typical sections of the creek are shown below after the Figures.

Slope and bend irregularities in the creek have over time resulted in issues with erosion, sedimentation, and bank stabilization. These conditions have been exasperated in the last couple of decades due to the rapid development in the project area as well as areas upstream. In recent years, the creek has experienced several extreme storm events starting with the Hurricanes Frances and Jeanne in September 2004 and more recently with Tropical Storm Fay in August 2008. As a result, additional severe erosion and sedimentation have occurred causing bank failure and deterioration of the creek bed. In addition, there are many areas where trash, debris and fallen trees are within the creek path which inhibits proper flow. Photos of typical sections of the creek from May 2009 are shown below after the Figures.

Since Howell Creek is a major tributary to Lake Jesup, the ongoing process of addressing Total Maximum Daily Loads (TMDLs) for Lake Jesup causes water quality to be a concern for Howell Creek by association. Although much of the more recently developed areas draining to the creek have some level of water quality treatment for stormwater runoff, additional pollutant load reduction strategies may be necessary to meet future regulatory requirements.

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

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Feet

LEGEND

PROJECT LIMITS

CITY LIMITS

ALTAMONTE SPRINGS

CASSELBERRY

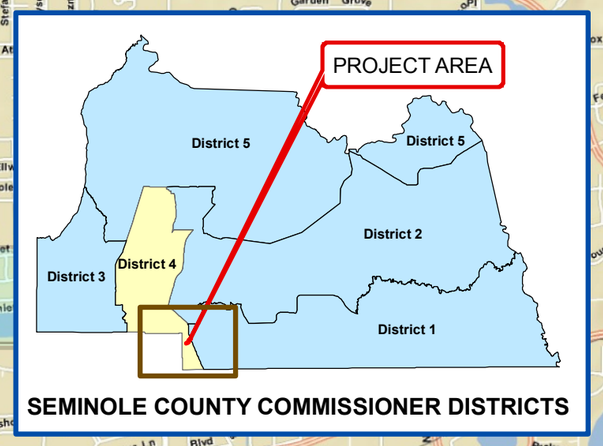
DATA SOURCES:
COMMISIONER DISTRICTS:
SEMINOLE COUNTY,2007
CITY LIMITS:SEMINOLE COUNTY,2008
BACKGROUND:ESRI WORLD STREETMAP,2009

FIGURE 1-1

PROJECT VICINITY MAP

Howell Creek Assessment

Lake Howell Road to SR 436



SEMINOLE COUNTY COMMISSIONER DISTRICTS

Inwood consulting engineers

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

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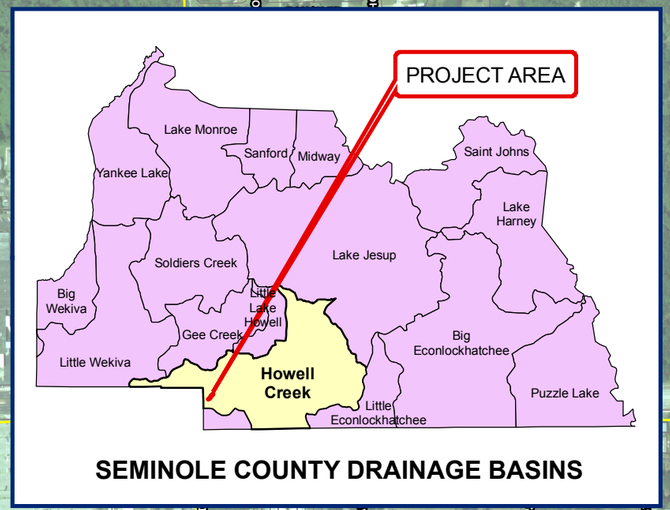
LEGEND

- PROJECT LIMITS
- HOWELL CREEK
- PARCELS
- S-T-R

DATA SOURCES:
DRAINAGE BASINS:
SEMINOLE COUNTY, 2008
S-T-R:SEMINOLE COUNTY,2008
PARCELS:SEMINOLE COUNTY,2008
STREETS: SEMINOLE COUNTY, 2008
AERIALS:SEMINOLE COUNTY,2008



SEMINOLE COUNTY DRAINAGE BASINS

FIGURE 1-2

SITE LOCATION MAP

Howell Creek Assessment

Lake Howell Road to SR 436

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SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

NOT TO SCALE

AERIAL SOURCE: maps.live.com

FIGURE 1-3

AERIAL MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

Typical view of Howell Creek 125 feet downstream of Lake Howell Road (April 2009)

View to the north along Howell Creek at the bridge under Lake Howell Lane (April 2009)

Typical view of Howell Creek 200 feet downstream of Lake Howell Lane (April 2009)

View to north of wooden bridge over Howell Creek at Lake Howell Square (April 2009)

View to southwest along Howell Creek at Lake Howell Square (April 2009)

View to the east along Howell Creek at the bridge at State Road 436 (April 2009)

1.4 GOALS

This report is intended as a needs assessment to meet the following goals:

1. Compile and review existing data associated with the project creek segment in order to properly characterize the project area and understand all stormwater management issues affecting the function of the creek. This data compilation would then serve as a resource during the development of improvement strategies in the future.
2. Collect field survey, geotechnical, and ecological data to assess the physical condition of the creek and identify problem areas and other deficiencies.
3. Conduct limited hydrological & hydraulic model analysis to evaluate hydraulic conveyance of the creek segment.
4. Provide recommendation for corrective actions to address the following:
    a. Trash and Debris
    b. Bank Stabilization
    c. Erosion & Sedimentation
    d. Structure Deficiencies
    e. Water Quality and Wetland Enhancement

1.5 REPORT ORGANIZATION

The report is organized into the following sections:

- **Section 1 – Introduction:** Provides an overview of the project location, problem description, and goals (this section);
- **Section 2 – Data Collection and Desktop Review:** Provides a summary of the various data collected and reviewed to support this assessment;
- **Section 3 – Field Assessment:** Provides a summary of the field investigation efforts including field inventory, survey, and geotechnical efforts;
- **Section 4 – Preliminary Ecological Assessment:** Provides a summary of field observations and data review pertaining to wetlands and sensitive species within the project area;
- **Section 5 – Hydrological & Hydraulic Model Refinement:** Provides a summary of efforts to refine the current Howell Creek Basin master model in the project vicinity;
- **Section 6 – Water Quality Evaluation:** Provides a review of current Best Management Practices (BMPs) present in the project area and identifies significant deficiencies;
- **Section 7 – Corrective Action Evaluation:** Based on the compiled data and assessments, provide a summary of identified needs for corrective action to address deficiencies associated with the creek in the project area;
- **Section 8 – Conclusions and Recommendations:** Summarizes conclusions and provides specific recommendations for future prioritized implementation of recommended projects to address identified deficiencies.

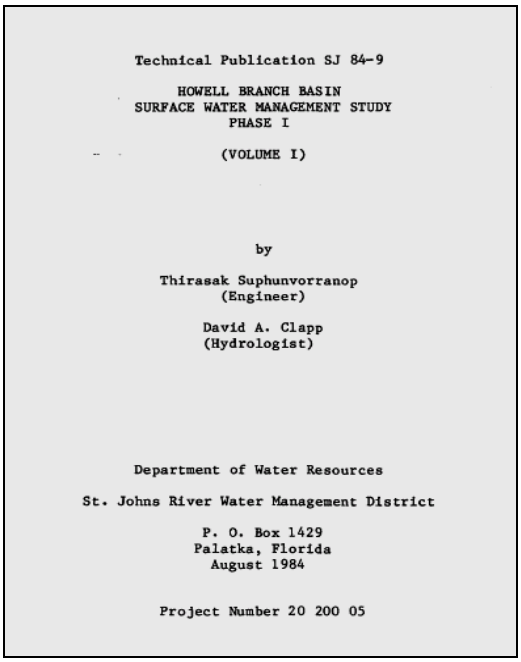
2.0 DATA COLLECTION AND DESKTOP REVIEW

2.1 PREVIOUS STUDIES

The Howell Creek Basin has been studied in detail in the past and currently. The following documents were reviewed for information relevant to this assessment study (copies of pertinent excerpts from the reports are included in Appendix A):

Technical Publication SJ84-9 - Howell Branch Basin Surface Water Management Study Phase I, SJRWMD, 1984 - SJRWMD conducted this study to determine flood elevations and floodplain areas under exiting and future land use conditions. The results were to then be used to develop a surface water management plans to reduce flooding and protect water resources in the Orange County and Seminole County portions of the basin. The HEC-1 program was used with the SCS methods to determine storm hydrographs and the HEC-2 program was used to generate water surface profiles. The study also evaluated the impact from modifications to the regulation schedule of the weirs at Lake Maitland and Lake Killarney in Orange County. This study was considered Phase I of a comprehensive study of the Howell Creek Basin, Phase II of which is described below.

The report includes hydraulic results for the creek at the SR 436, Lake Howell Lane and Lake Howell Road. No specific recommendations were made in the SJRWMD report for the project area addressed in this current report.



Technical Publication SJ 84-9

HOWELL BRANCH BASIN
SURFACE WATER MANAGEMENT STUDY
PHASE I

(VOLUME I)

by

Thirasak Suphunvorranop
(Engineer)

David A. Clapp
(Hydrologist)

Department of Water Resources

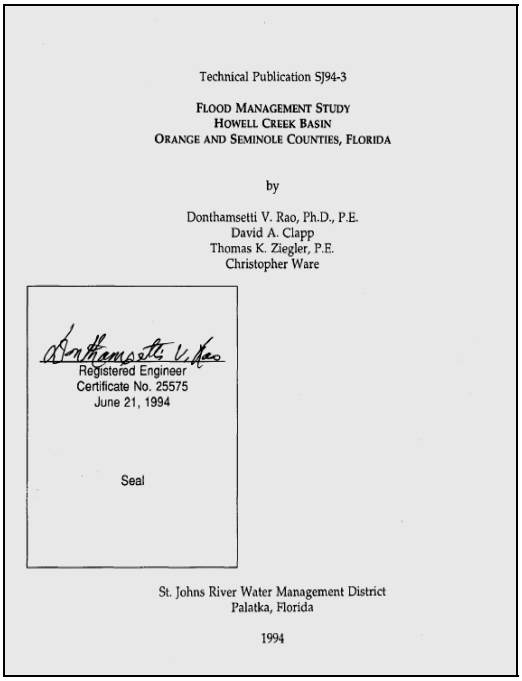
St. Johns River Water Management District

P. O. Box 1429
Palatka, Florida
August 1984

Project Number 20 200 05

Technical Publication SJ94-3 – Flood Management Study Howell Creek Basin Orange and Seminole Counties, SJRWMD, 1994 – SJRWMD conducted this study as Phase II of the overall comprehensive study of the Howell Creek Basin. This was an update to the 1984 study incorporating additional contributing area near Orlando and adjustments to lake stage and system storage assumptions. The HEC-1 program was used with the SCS methods to determine storm hydrographs and the HEC-2 program was used to generate water surface profiles. Potential flood damages were assessed and flood protection alternatives proposed. The study also included a water quality and wetland assessment.

The report includes hydraulic results for the creek at the SR 436, Lake Howell Lane and Lake Howell Road. This report provides a reference on a flood profile to a former dam structure that was present between Lake Howell Road and Lake Howell Lane. No specific recommendations were made in the SJRWMD report for the project area addressed in this current report other than generic recommendations for erosion control measures in area with high velocities that may cause scour.



Technical Publication SJ94-3

FLOOD MANAGEMENT STUDY
HOWELL CREEK BASIN
ORANGE AND SEMINOLE COUNTIES, FLORIDA

by

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David A. Clapp
Thomas K. Ziegler, P.E.
Christopher Ware

Registered Engineer
Certificate No. 25575
June 21, 1994

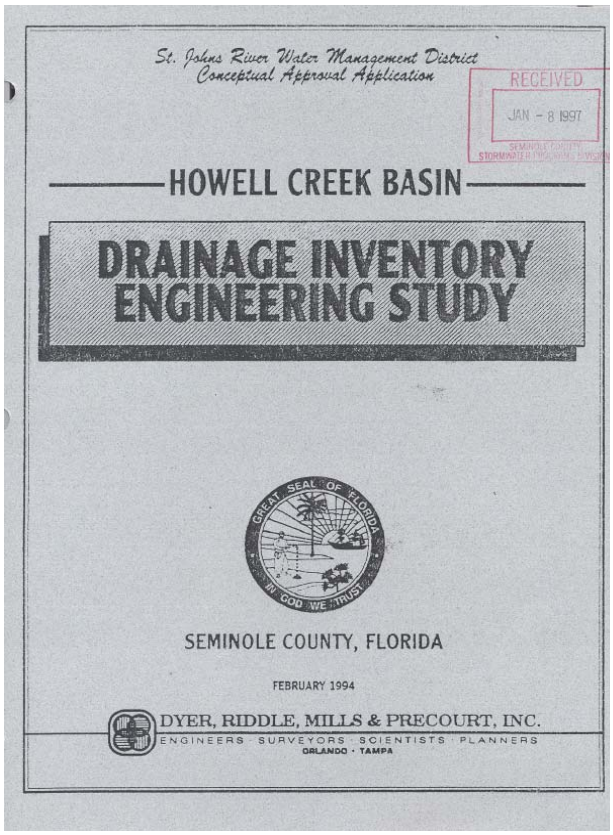
Seal

St. Johns River Water Management District
Palatka, Florida

1994

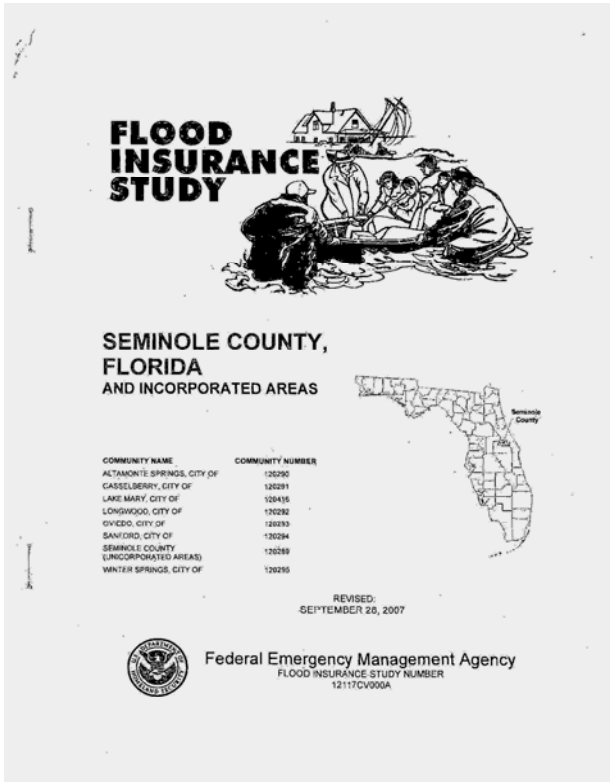
Howell Creek Basin Drainage Inventory Engineering Study, Dyer, Riddle, Mills, & Precourt, Inc. (DRMP), 1994 - The intent of this study was to identify drainage problems and deficient areas within the unincorporated Howell Branch Basin within Seminole County. Phase I of the project was a drainage inventory where key drainage facilities were identified and selected structures surveyed. Phase II of the study included a level of service (LOS) assessment of the primary drainage structures to determine level of performance relative to design criteria. This was accomplished by using a combination of the HEC-2 and AdICPR models. Each structure that was graded with a failing LOS was recommended for replacement / improvements as part of a prioritized basin specific capital improvements program. The report was submitted in the form of a conceptual permit application to the SJRWMD.

The report includes hydraulic results for the creek at the SR 436, Lake Howell Lane, Lake Howell Road and the Lake Howell Square bridges. This report provides a reference to and results for a former dam structure that was present between Lake Howell Road and Lake Howell Lane. No specific recommendations were made in the DRMP report for the project area addressed in this current report.

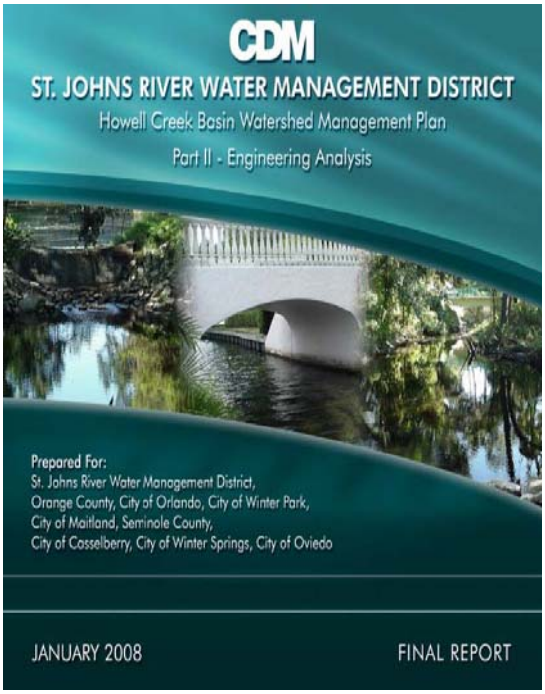


Flood Insurance Study, FEMA, 2007 – This study developed flood risk data for areas in Seminole County, Florida that are used to establish actuarial flood insurance rates.

The report includes hydraulic results for the creek at the SR 436 (flow and stage), Lake Howell Lane (stage only) and Lake Howell Road (stage only). The study also detailed floodway data for Howell Creek in the project area.



Howell Creek Basin Watershed Management Plan, CDM, 2007, 2008 – The study includes three parts and addresses the Howell Creek Basin in both Orange and Seminole Counties. Part I (completed in May 2007) was a system inventory which included additional field investigation and survey to build upon what had been developed in the past. It included an inventory of existing problem areas, physical characteristics, hydrological data, drainage structures data, water quality data, and wetlands. A preliminary model schematic was also developed based on collected data. Part II (completed in January 2008) was an engineering analysis which included design storm event modeling using ICPR of the primary drainage systems in the basin to establish level of service of primary drainage facilities and estimate floodplains. A continuous simulation model was also developed using the EPA SWMM model to examine the flood effects of a variable weir structure on Lake Maitland. Part III of the study has not commenced as of the date of this report but will address recommended improvements alternatives to address identified deficiencies in the basin.



The report included hydraulic results for the creek at the SR 436, Lake Howell Lane, Lake Howell Road and Lake Howell Square bridges. The Lake Howell Lane bridge was predicted to overtop during 100-year/24-hour design storm event by 0.1 feet.

2.2 PLANS & PERMIT REVIEW

Copies of construction or as-built plans for the adjacent and contributing areas to the subject portion of Howell Creek were obtained from Seminole County archives. Environmental Resource Permit (ERP) data was also obtained from the SJRWMD for the same areas. This data were used for the following purposes:

- Obtain information on general drainage patterns used for delineating the contributing area to the creek;
- Obtain information on drainage conveyance, storage, and treatment systems for infrastructure mapping purposes; and
- For areas immediately adjacent to the creek, obtain information on drainage and conservation easements.

Figure 2-1 displays the subdivisions and major developments in the project area based on Seminole County GIS data. Figure 2-2 displays locations of ERPs based on GIS data from the SJRWMD. A complete listing of the plans and ERPs reviewed is included in the references section of the report. The drainage infrastructure in the project area based on the plan and permits review is shown on Exhibit 1.

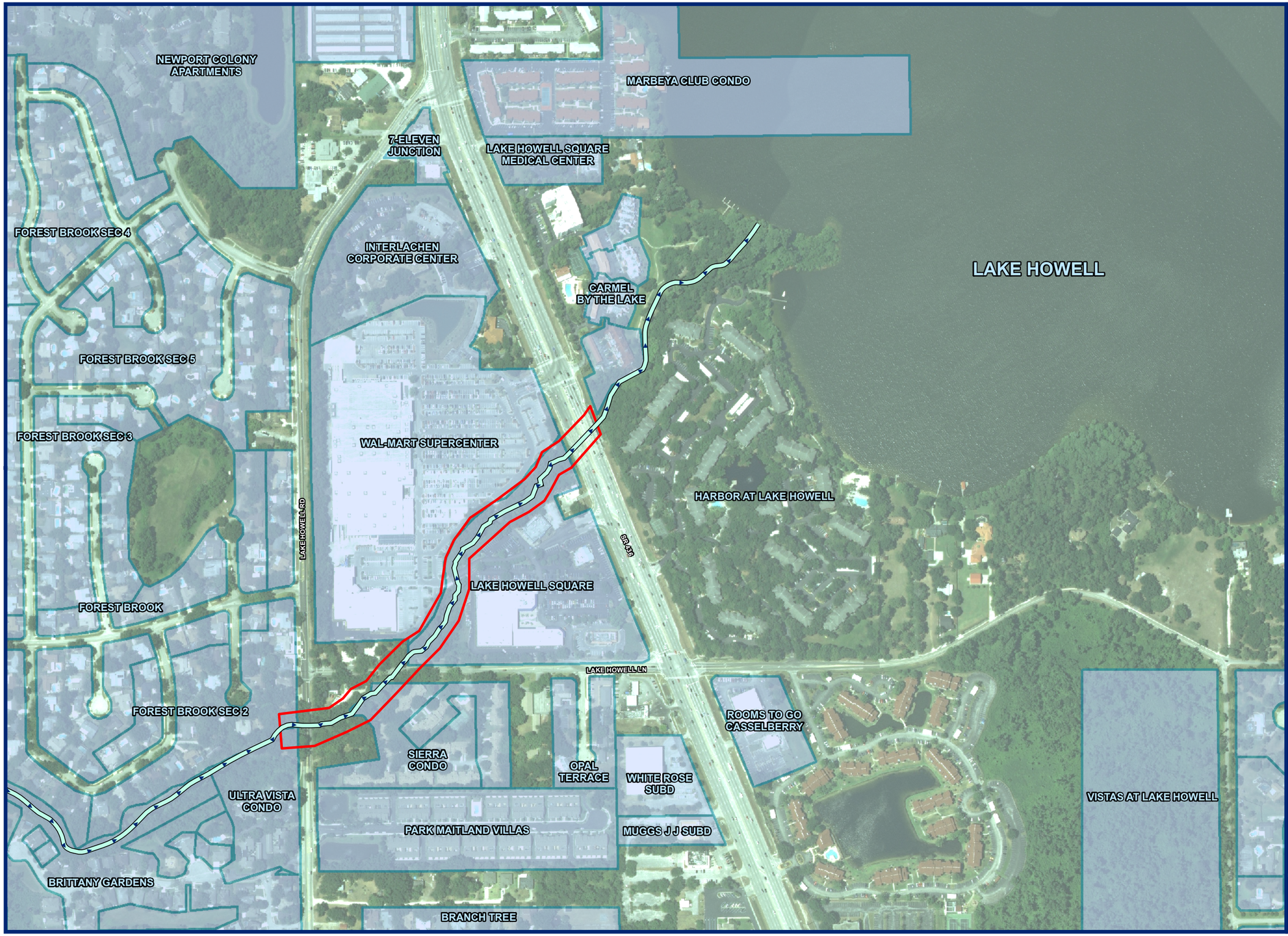
Some particular noteworthy items based on review of the plans and permits are as follows:

- **Lake Howell Road:** Construction of the road in its present form was completed circa 1975. The storm sewer system discharges directly into the creek at the

bridges, however, pollutant control structures (baffle boxes) were incorporated into the design.

- **Lake Howell Road Pedestrian Bridge:** This was constructed along the west side of the bridge circa 2004. Some minor improvements were completed to the west side of the bridge in conjunction with this project.
- **Lake Howell Lane:** Construction of the road in its present form was completed circa 1969. Runoff from the roadway discharges directly into Howell Creek through storm inlets and flumes.
- **Lake Howell Square / Wal-mart Supercenter:** The shopping plaza was initially constructed in the 1980s. This included the construction of the two wooden (timber span) bridges that connect the northwest and southeast portions of the shopping center across Howell Creek. Stormwater drains to Howell Creek after receiving detention pond treatment. The northwest portion of the site was modified circa 2003-2004 upgrading the Wal-mart to a Wal-mart Supercenter. The site drainage was revised including the addition of another stormwater pond on the north side of the property and the installation of an underground exfiltration storage system where an existing pond had been.
- **SR 436:** Widening of the roadway occurred in the early 1990s to bring it to its current configuration. Roadway drainage is discharged directly to Howell Creek at the bridge crossing. Other offsite flow (some treated and some not) also discharge at the location from other contributing areas.
- **Former Lake Howell Lane Dam:** A former dam existed just upstream of Lake Howell Lane. This was a concrete control structure, remnants of which still remain on the southeast bank as well as some rubble along the creek bed. No plans of structure details were found during the document review. This structure seem to have been in operation as late as the mid-1990s based on the its inclusion in the 1994 DRMP Basin modeling (see Section 2.1).
- **Lake Howell Road Water Control Structure:** Although outside the upstream project limits, it is worth noting that the water control structure (dam) just upstream of Howell Lake Road is currently undergoing re-construction as part of a NRCS emergency restoration action. It had a history of failure due to seepage and erosion. Construction is estimated to be complete on the project in late 2009.
- **Erosion Control Project at Carmel By the Lake:** Although outside the downstream project limits, it is worth noting the erosion control project that occurred to address severe erosion at the creek bend adjacent to the Carmel by the Lake condominiums. The improvement consisted of bank stabilization including gabion rock baskets, reno mattresses, and rubble rip-rap. The project was completed by Seminole County circa 2002.

Refer to Appendix B for plan sheet excerpts depicting the above referenced features as well as details of other drainage features including the bridges at Lake Howell Road, Lake Howell Lane, Wal-mart, and SR 436. Please refer to Exhibit 1 for a depiction of the drainage infrastructure described.



SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

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LEGEND

- HOWELL CREEK
- PROJECT LIMITS
- SUBDIVISIONS

DATA SOURCES:
SUBDIVISIONS:
SEMINOLE COUNTY, 2008
STREETS:SEMINOLE COUNTY,2008
AERIALS:SEMINOLE COUNTY,2008

FIGURE 2-1

DEVELOPMENTS & SUBDIVISIONS MAP

Howell Creek Assessment

Lake Howell Road to SR 436

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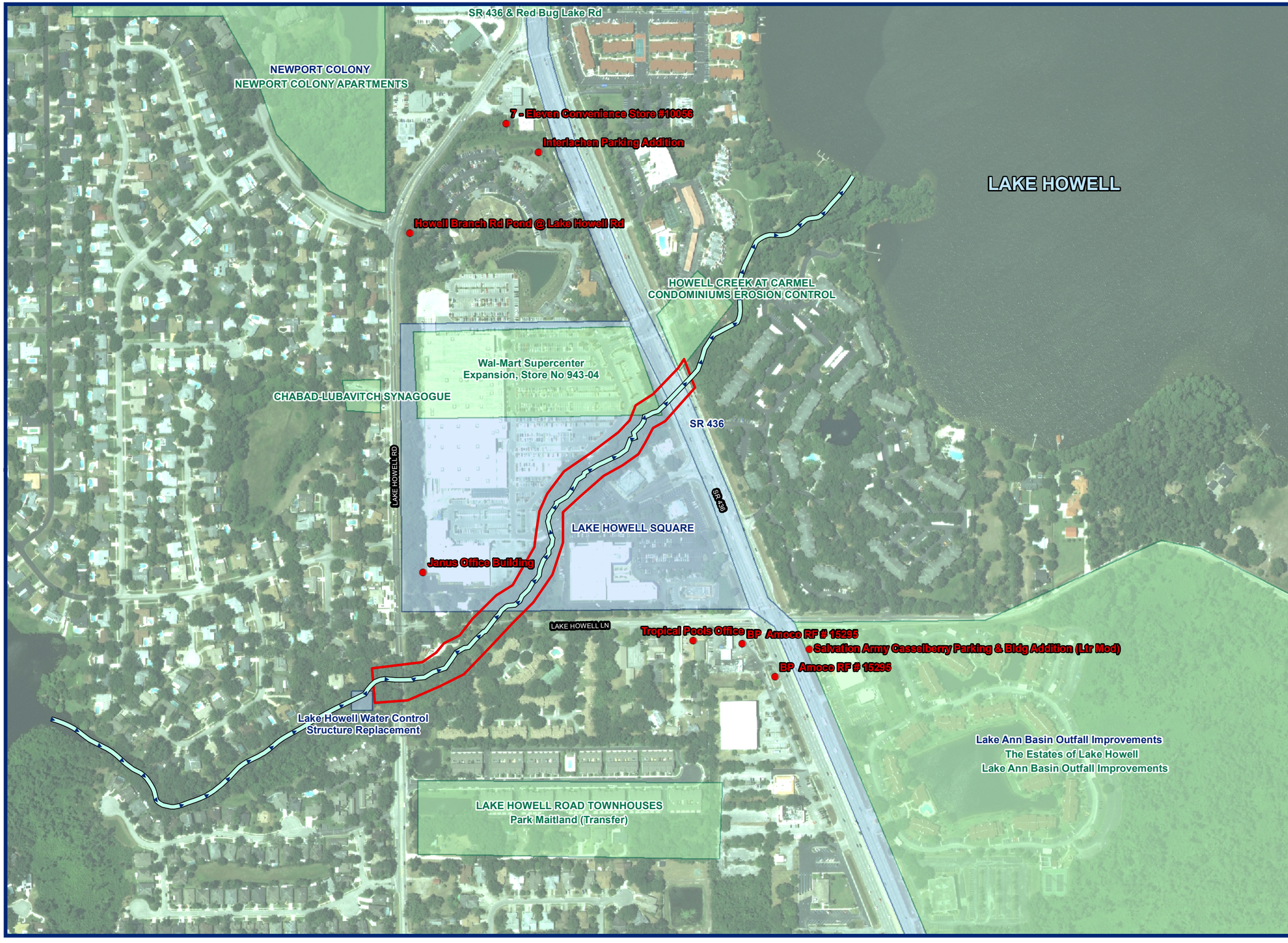

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

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LEGEND

- HOWELL CREEK
- PROJECT LIMITS

ERP

- STANDARD GENERAL
- INDIVIDUAL
- STORMWATER PERMIT

DATA SOURCES:
ERP: SJRWMD, 2009
STREETS:SEMINOLE COUNTY,2008
AERIALS:SEMINOLE COUNTY,2008

FIGURE 2-2

SJRWMD PERMITS MAP

Howell Creek Assessment

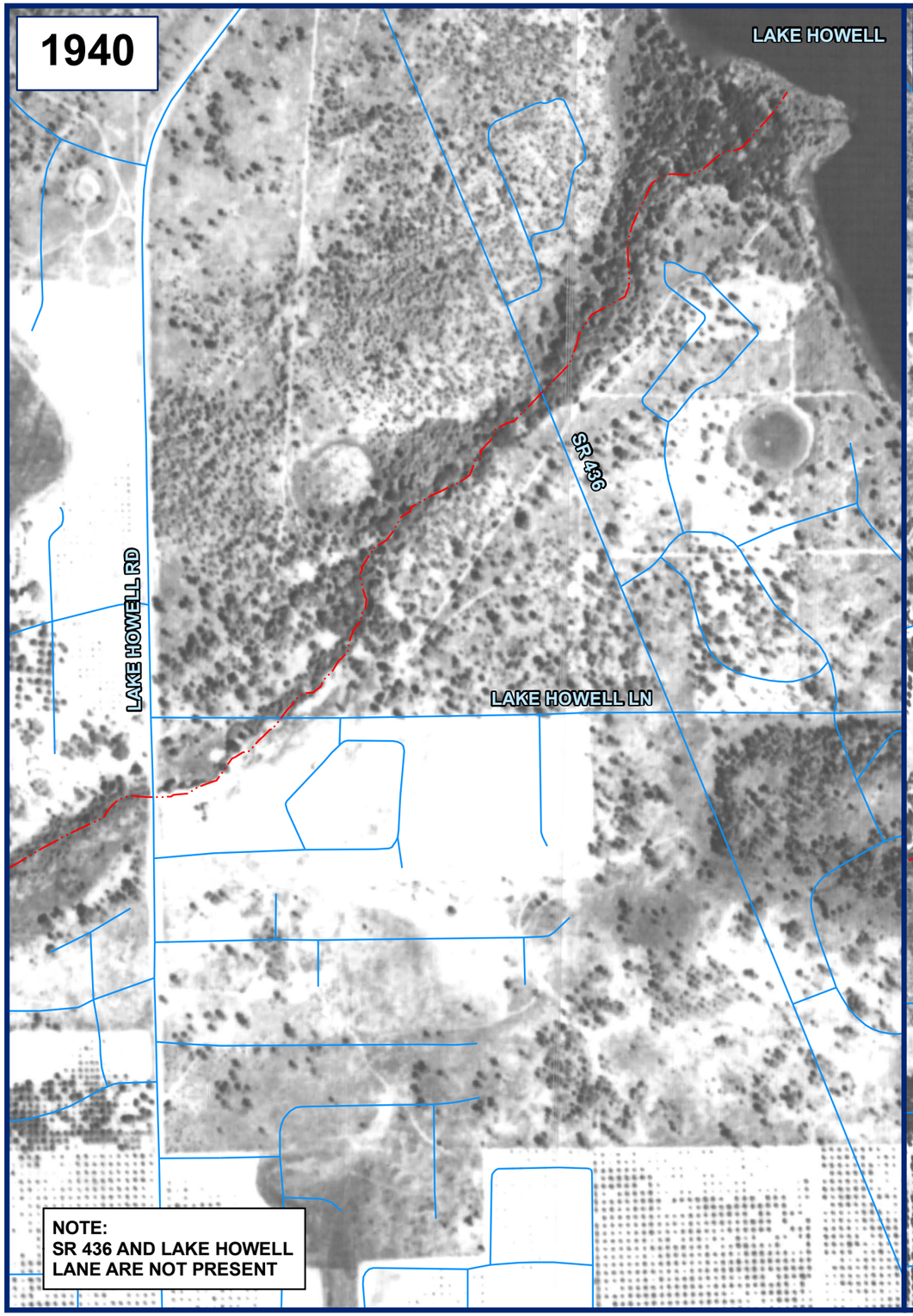
Lake Howell Road to SR 436

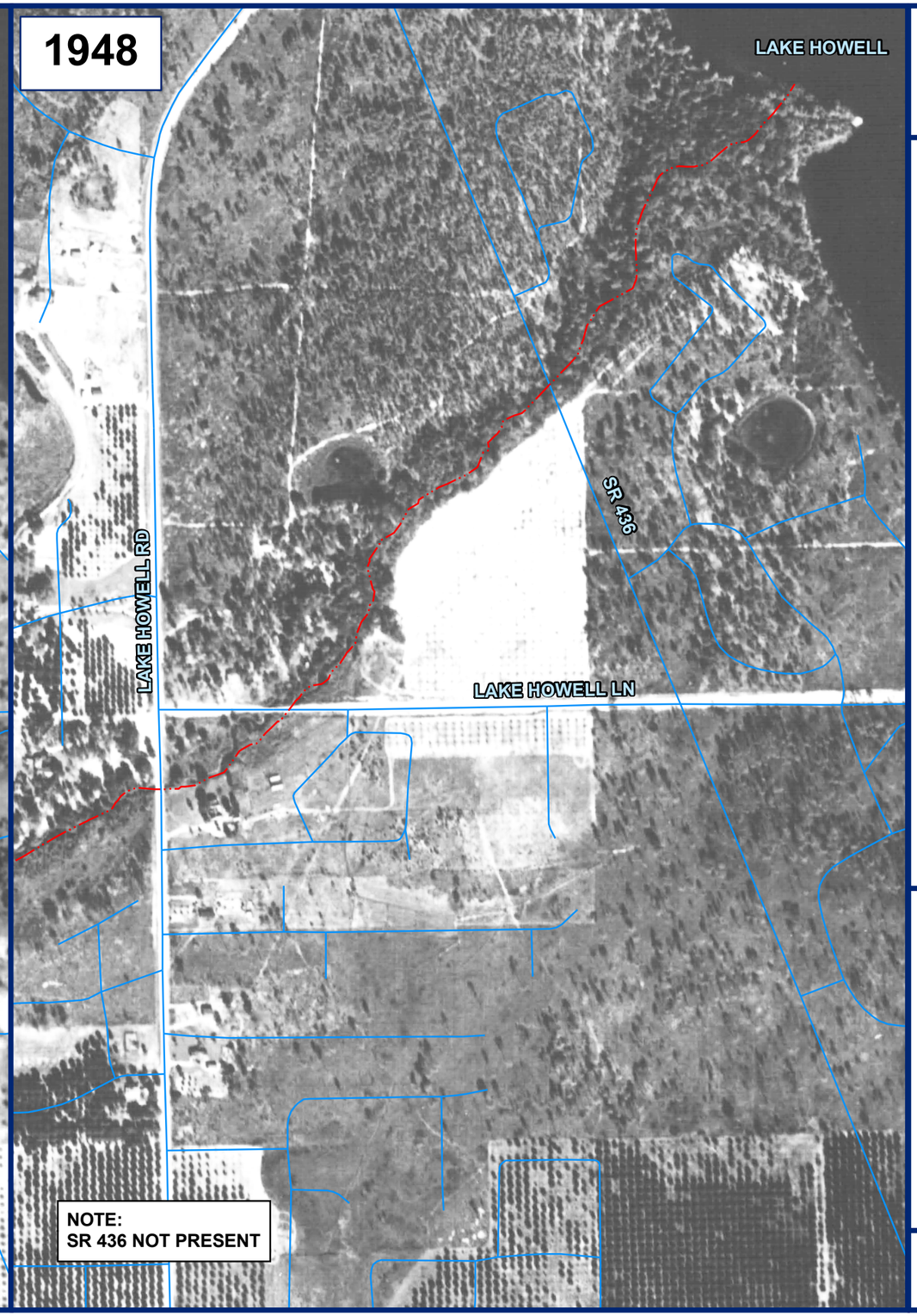
Inwood consulting engineers

2.3 HISTORICAL AERIALS

Historical aerials photos were obtained form Seminole County and reviewed for pertinent information regarding the characteristics of the creek corridor. The aerials were georeferenced in GIS and plotted along with the current streets data and path of Howell Creek on Figures 2-3 through 2-9. Pertinent observations from the aerials are summarized as follows:

- **1940 (Figure 2-3)** – At this time, Lake Howell Road was present but not Lake Howell Lane and SR 436. Howell Creek is clearly defined based on the tree line. No significant development is apparent.
- **1948 (Figure 2-3) –** This aerial appears very similar to the 1940 aerial with regard to Howell Creek. Lake Howell Lane is already present but not SR 436. There is still no significant development.
- **1957 (Figure 2-4) –** This aerial appears very similar to the 1940 and 1948 aerials with regard to Howell Creek. SR 436 is not yet present.
- **1968 (Figure 2-4)** – This aerial appears very similar to the older aerials with regard to Howell Creek. SR 436 is present. Some small residential development has appeared at the south of Lake Howell Lane.
- **1972 (Figure 2-5) –** This aerial appears very similar to the older aerials with regard to Howell Creek. Some more small residential development has appeared at the west of Lake Howell Road and north of Howell Creek at the future location of Forest Brook. Some significant clearing is evident south of Lake Howell Lane at the future locations of Carrington Park and Casselberry Commons.
- **1974 (Figure 2-5) –** This aerial is similar to 1972, with some more significant developments at the south of Lake Howell Lane near the future Casselberry Commons and at the west of Lake Howell Road in the future Forest Brook area.
- **1980 (Figure 2-6) –** Very similar to 1974 aerial, with some additional activity in the future Forest Brook area.
- **1984 (Figure 2-6) –** Significant developments are apparent at the south of Howell Creek where the future locations of Sierra Condo, Ultra Vista Condo and Branch Tree Subdivision. Additional significant development is also apparent at the north of Howell Creek where the future Carmel by the Lake is located.
- **1986 (Figure 2-7) –** Very similar to 1984 with some significant clearing near Howell Creek at the future locations of Lake Howell Square, Wal-mart and Interlachen Corporate Center.
- **1989 (Figure 2-7) –** Similar to 1986 with additional development in the aforementioned areas apparent.
- **1995 (Figure 2-8) –** Significant development has continued including the businesses near Opal Terrace and Casselberry Commons. Harbor at Lake Howell appears complete.
- **2000 (Figure 2-8) –** Very similar to 1995 with some additional activity within the commercial businesses area near Casselberry Commons along SR 436.
- **2004 (Figure 2-9) –** Very similar to 2000 with the completion of Park Maitland Villas at the south of Lake Howell Lane.
- **2008 (Figure 2-9) –** Similar to 2004 with the expansion of Wal-mart. The previous pond at the parking lot was transformed into an exfiltration treatment system and an additional pond north of the Wal-mart was also constructed.





SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

LEGEND

HOWELL CREEK 2009

STREETS 2009

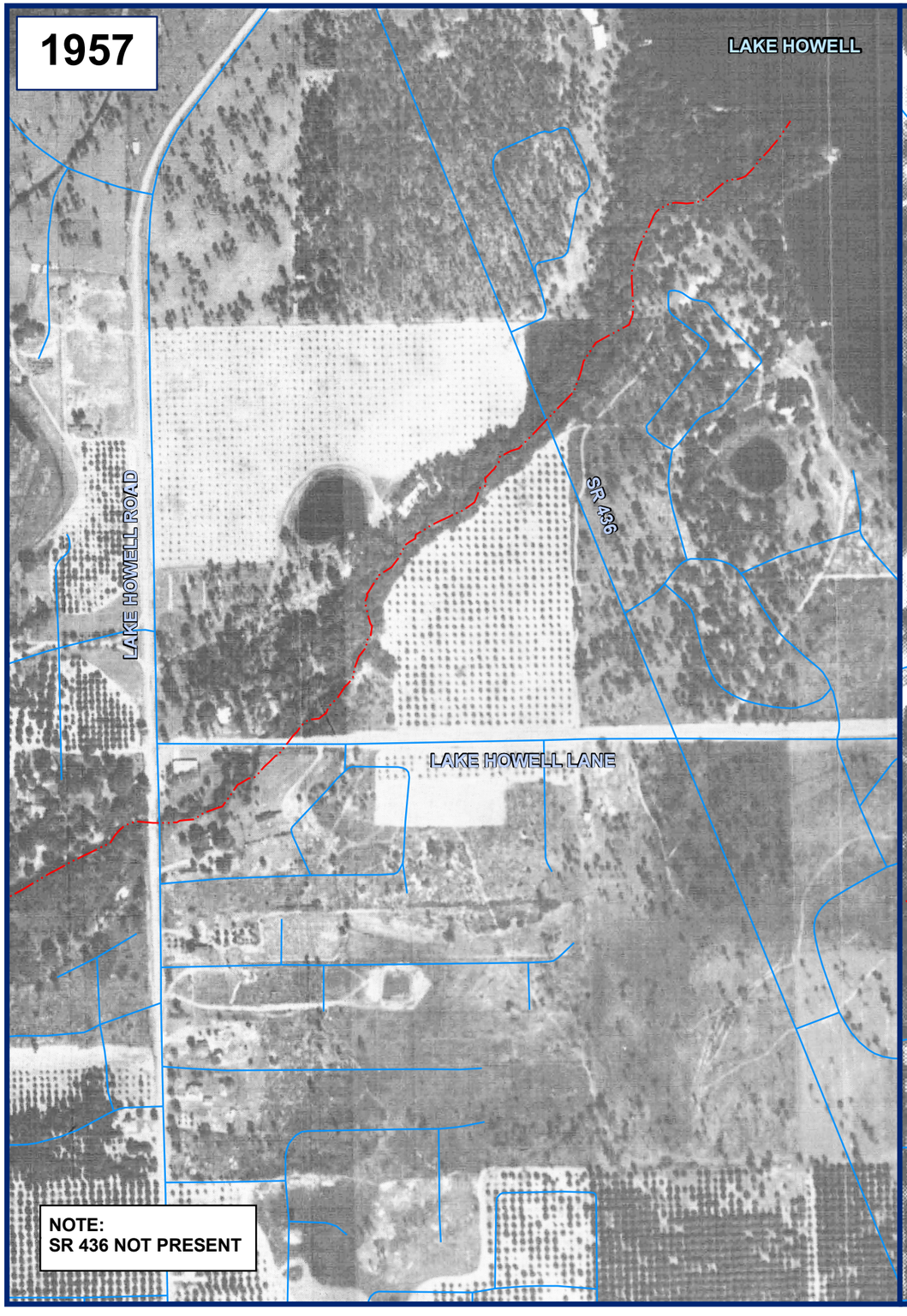
DATA SOURCES:
STREETS: SEMINOLE COUNTY, 2008
AERIALS: SEMINOLE COUNTY

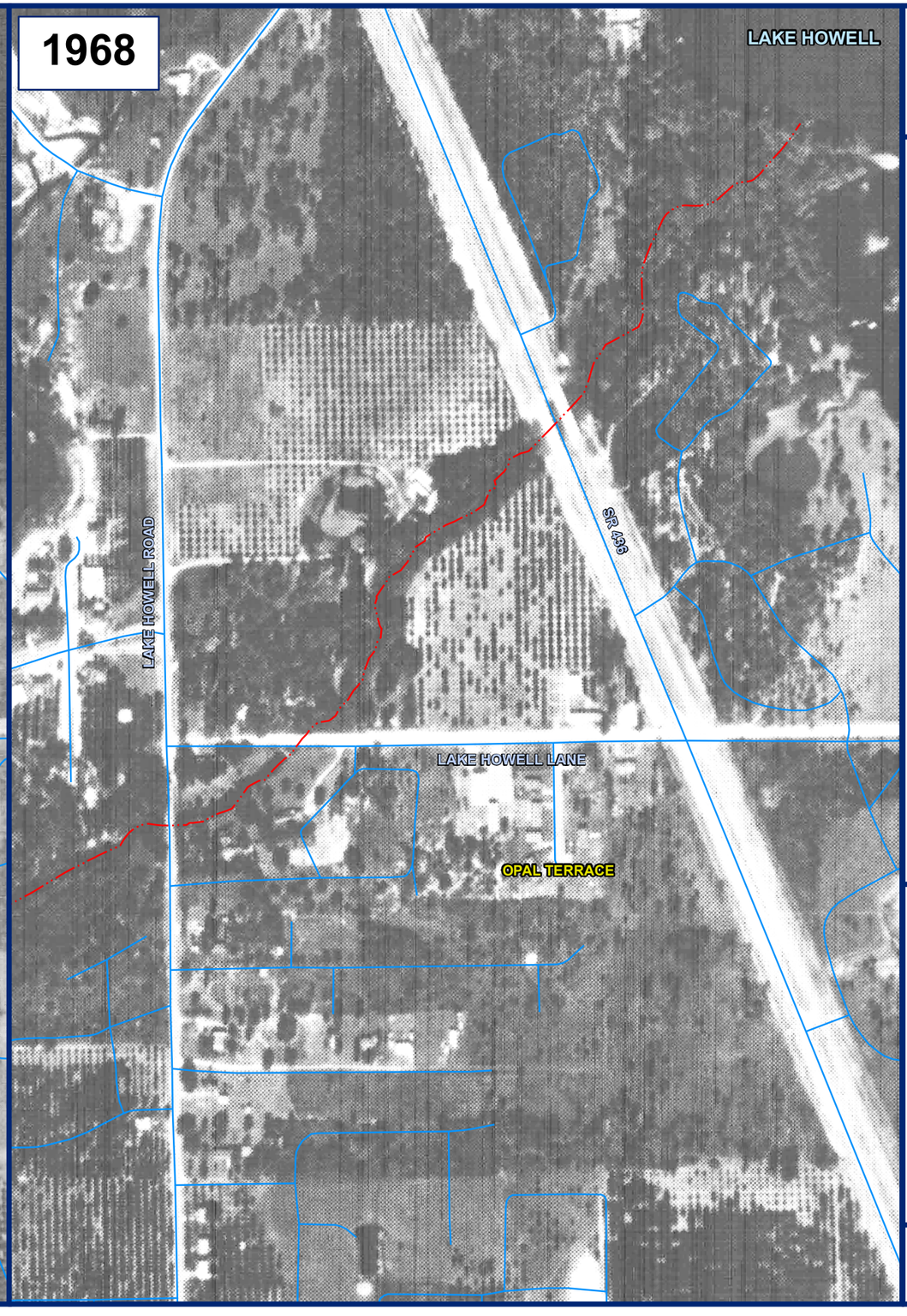
FIGURE 2-3
HISTORICAL AERIALS 1940 & 1948

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers





SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

0 200 400
Feet

LEGEND

HOWELL CREEK 2009

STREETS 2009

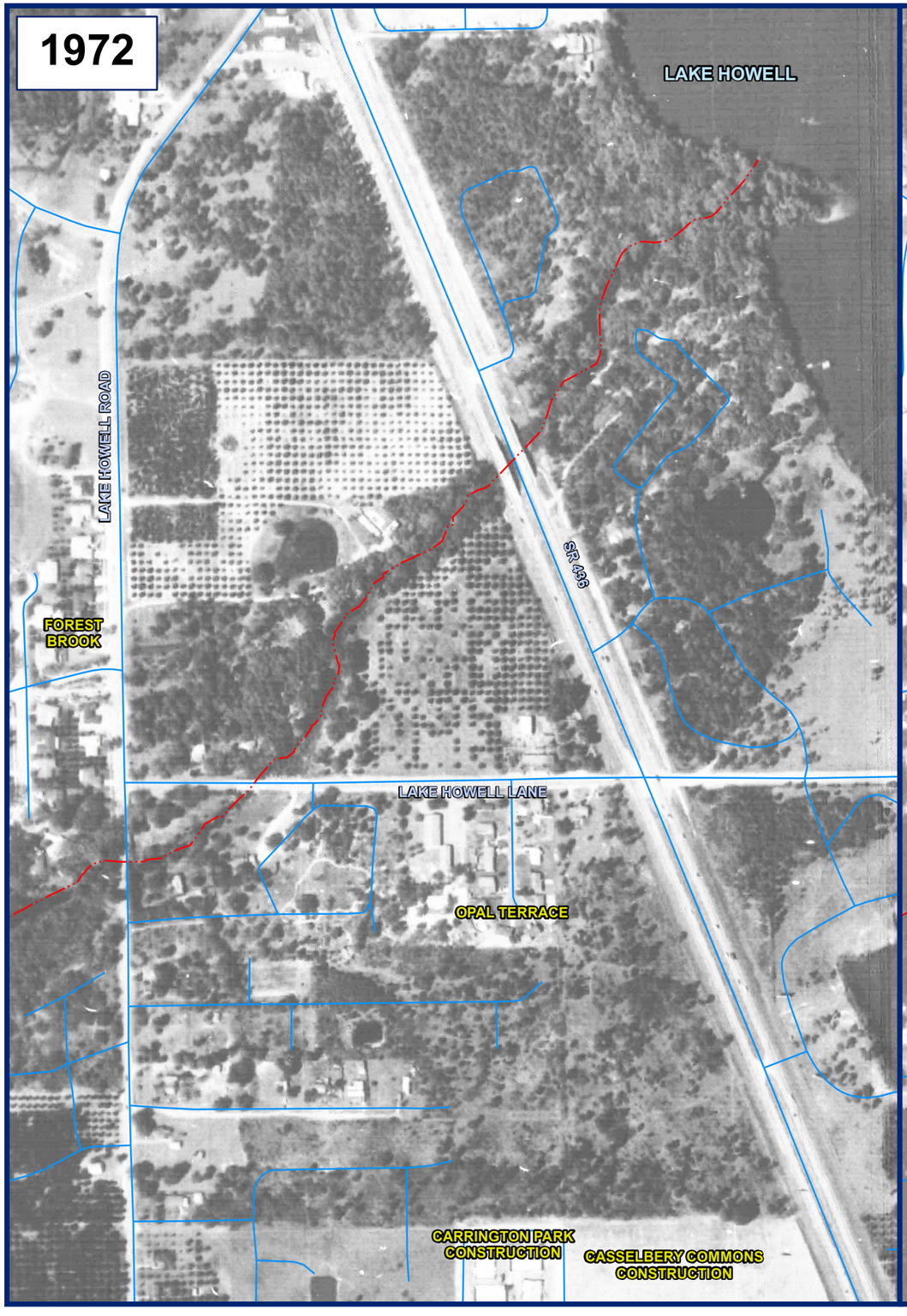
DATA SOURCES:
STREETS: SEMINOLE COUNTY, 2008
AERIALS: SEMINOLE COUNTY

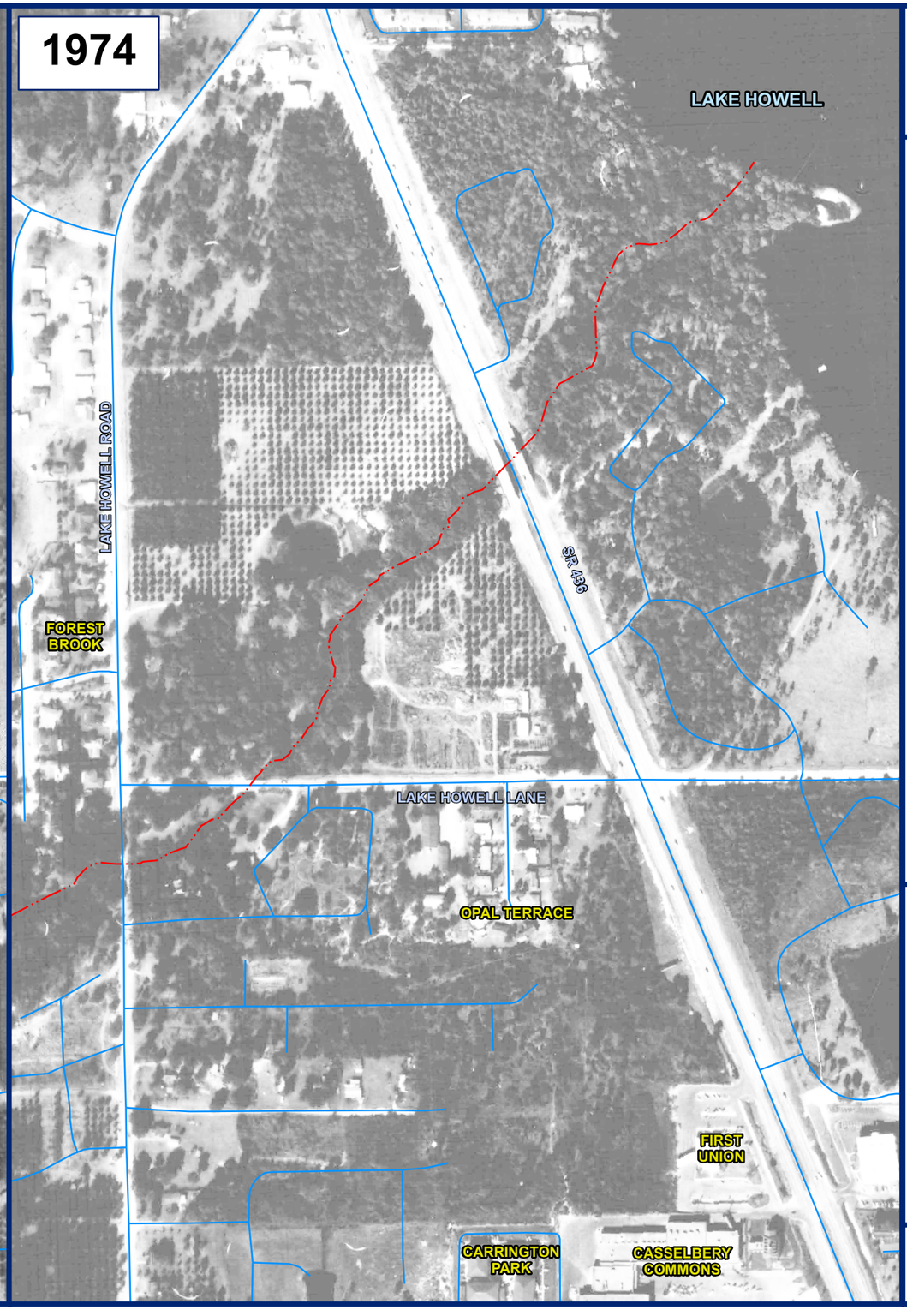
FIGURE 2-4
HISTORICAL AERIALS 1957 & 1968

Howell Creek Assessment

Tuskawilla Road to Red Bug Lake Road to Eagle's Landing

Inwood consulting engineers





SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

LEGEND

- HOWELL CREEK 2009
- STREETS 2009

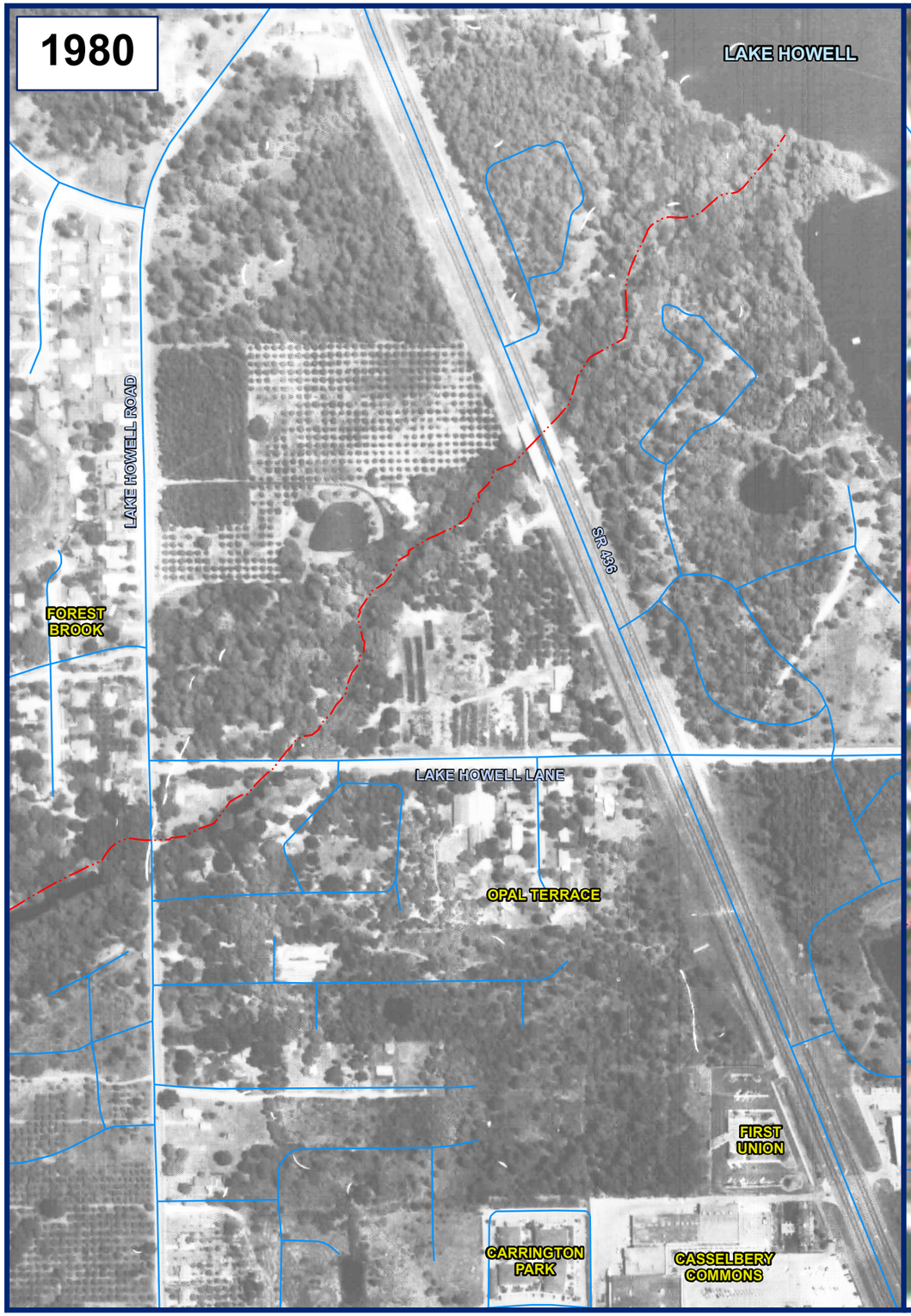
DATA SOURCES:
STREETS: SEMINOLE COUNTY, 2008
AERIALS: SEMINOLE COUNTY

FIGURE 2-5
HISTORICAL AERIALS 1972 & 1974

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers



SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

LEGEND

- HOWELL CREEK 2009
- STREETS 2009

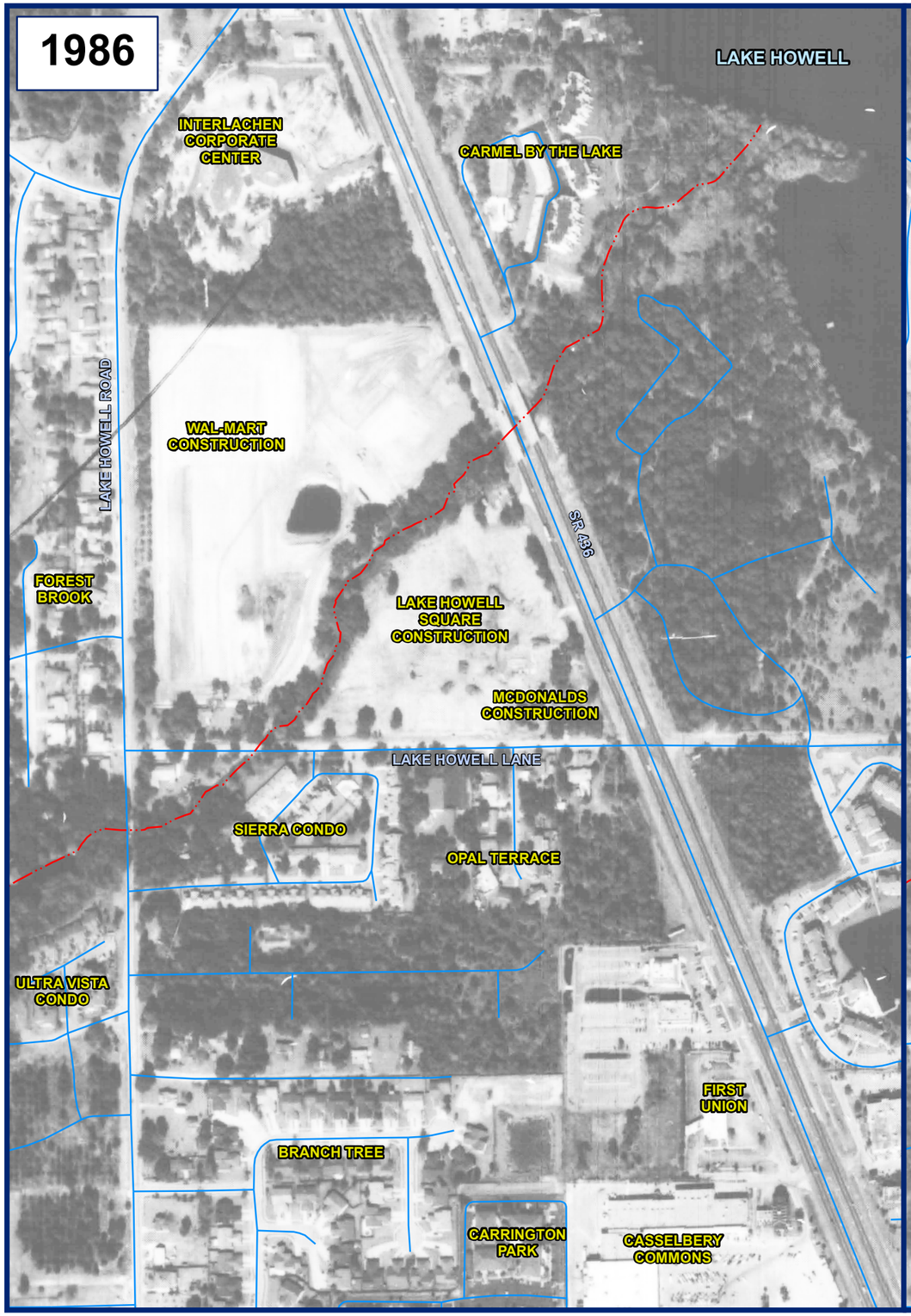
DATA SOURCES:
STREETS: SEMINOLE COUNTY, 2008
AERIALS: SEMINOLE COUNTY

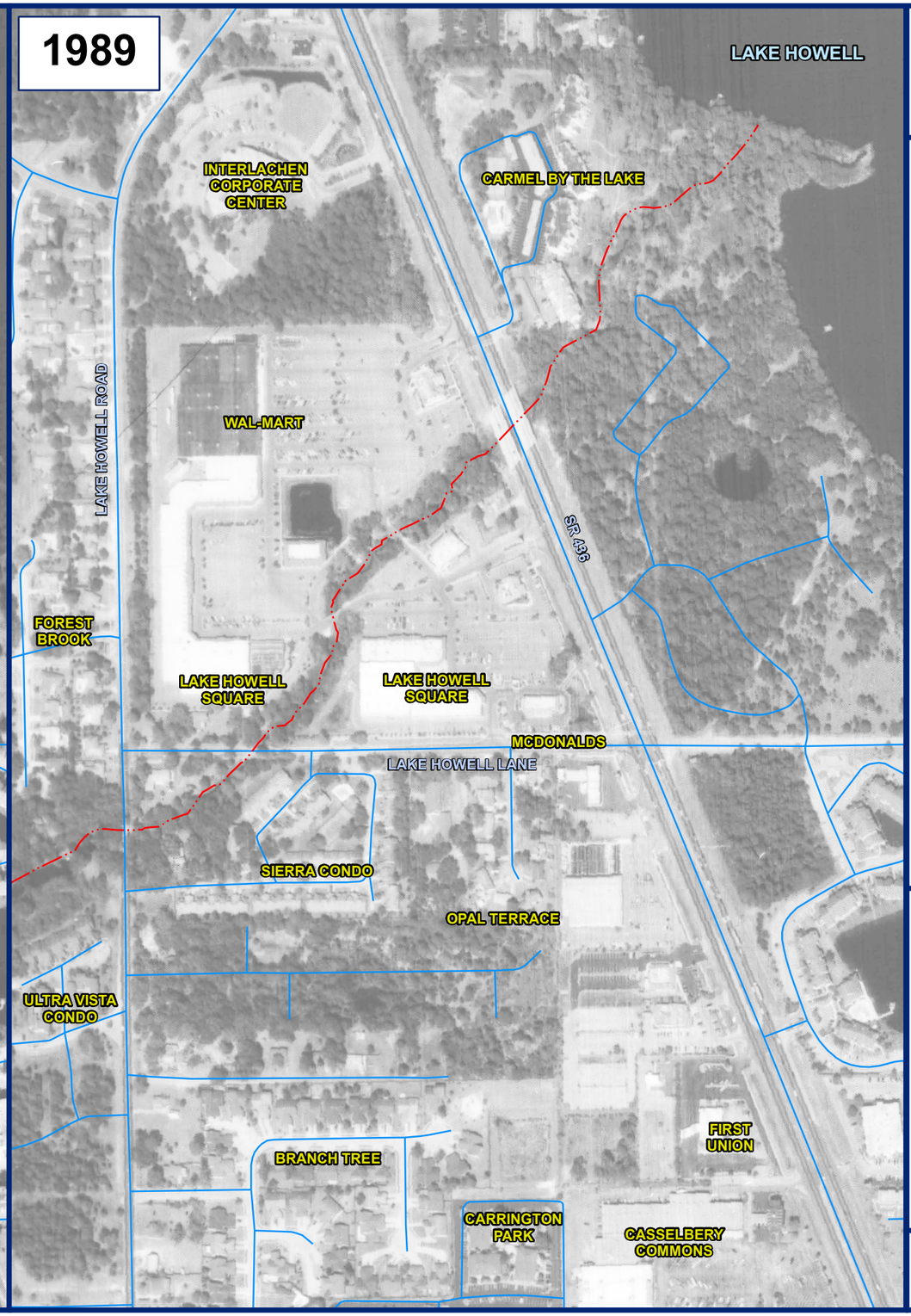
FIGURE 2-6
HISTORICAL AERIALS 1980 & 1984

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers





SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

LEGEND

HOWELL CREEK 2009

STREETS 2009

DATA SOURCES:
STREETS: SEMINOLE COUNTY, 2008
AERIALS: SEMINOLE COUNTY

FIGURE 2-7
HISTORICAL AERIALS 1986 & 1989

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

LEGEND

- HOWELL CREEK 2009
- STREETS 2009

DATA SOURCES:
STREETS: SEMINOLE COUNTY, 2008
AERIALS: SEMINOLE COUNTY

FIGURE 2-8
HISTORICAL AERIALS 1995 & 2000

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

LEGEND

- HOWELL CREEK 2009
- STREETS 2009

DATA SOURCES:
STREETS: SEMINOLE COUNTY, 2008
AERIALS: LABINS (2004), DOR (2008)

FIGURE 2-9
HISTORICAL AERIALS 2004 & 2008

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

2.4 TOPOGRAPHICAL DATA

Topographical data were compiled from several sources. USGS quadrangle maps were reviewed for general topographical and hydrographical data. A reproduction of the 7.5 minute quadrangle map for the project area is included as Figure 2-10. One-foot contour data and spot elevation data was acquired in digital GIS format from the SJRWMD. This was used to evaluate drainage patterns in more detail and is shown on Figure 2-11.

The one-foot contour data was sparse in much of the areas adjacent to the creek likely due to dense vegetation limiting the accuracy of the photogrammetry. Additional survey data was collected along the creek and adjacent overbank areas as described in Section 3.2 of this report. This survey data was converted in to GIS features and then blended with the SJRWMD one-foot contour and spot elevation data to create a digital ArcGIS format Terrain feature from which a Digital Elevation Model (DEM) of the project area was created. The DEM is shown on Figure 2-12 for informational purposes to provide a better representation of topography in the vicinity of the creek.

2.5 ENVIRONMENTAL DATA COMPILATION

Environmental data were collected from various sources in order to evaluate physical characteristics of the project area. The following relevant data was obtained:

- Soils data was obtained in GIS format from the SJRWMD – refer to Figure 2-13. This data is generally used to evaluate the surface infiltration potential of stormwater runoff based on the hydrological classification.
- Land use data was obtained in GIS format from the SJRWMD – see Figure 2-14. This data provides an indication of relative imperviousness of various land uses which affect stormwater runoff volume, and also wetland areas where surface hydrology is a concern.
- FEMA Floodplain maps were obtained – see Figure 2-15. This data provides a delineation of regulatory areas that store flood waters during extreme storm events. The project area is a floodplain zone “AE” which are areas where base flood elevations have been determined. There is also a regulatory floodway defined for Howell Creek in the project area. This floodway restricts the encroachment of development along the creek corridor.

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 500 1,000
Feet

LEGEND

PROJECT LIMITS

NOTE:
ELEVATIONS IN FEET NGVD 1929

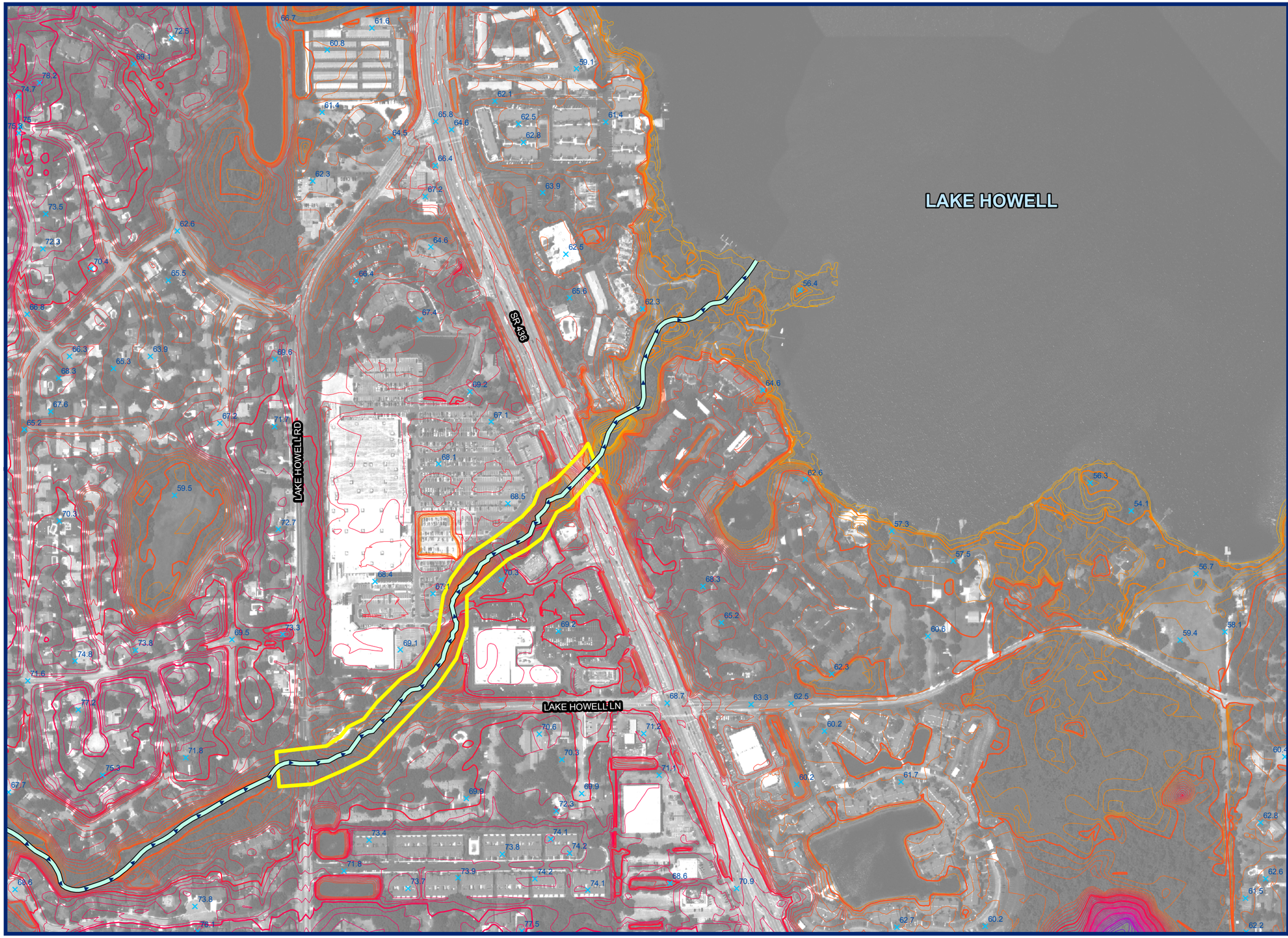
DATA SOURCES:
USGS: TOPOGRAPHIC 7.5 MINUTE QUADRANGLE MAP,CASSELBERRY AND ORLANDO EAST, 1980 (PHOTO REVISED 1997)

FIGURE 2-10
USGS TOPOGRAPHIC MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers



SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

LEGEND

- HOWELL CREEK
- PROJECT LIMITS
- SPOT ELEVATIONS

CONTOURS (FEET NGVD 1929)

- 45
- 50
- 55
- 60
- 70
- 75
- 80
- 85
- 90
- 95
- 100

DATA SOURCES:
CONTOURS AND SPOT ELEVATIONS:SJRWMD,2001
STREETS:SEMINOLE COUNTY,2008
AERIALS:SEMINOLE COUNTY,2008

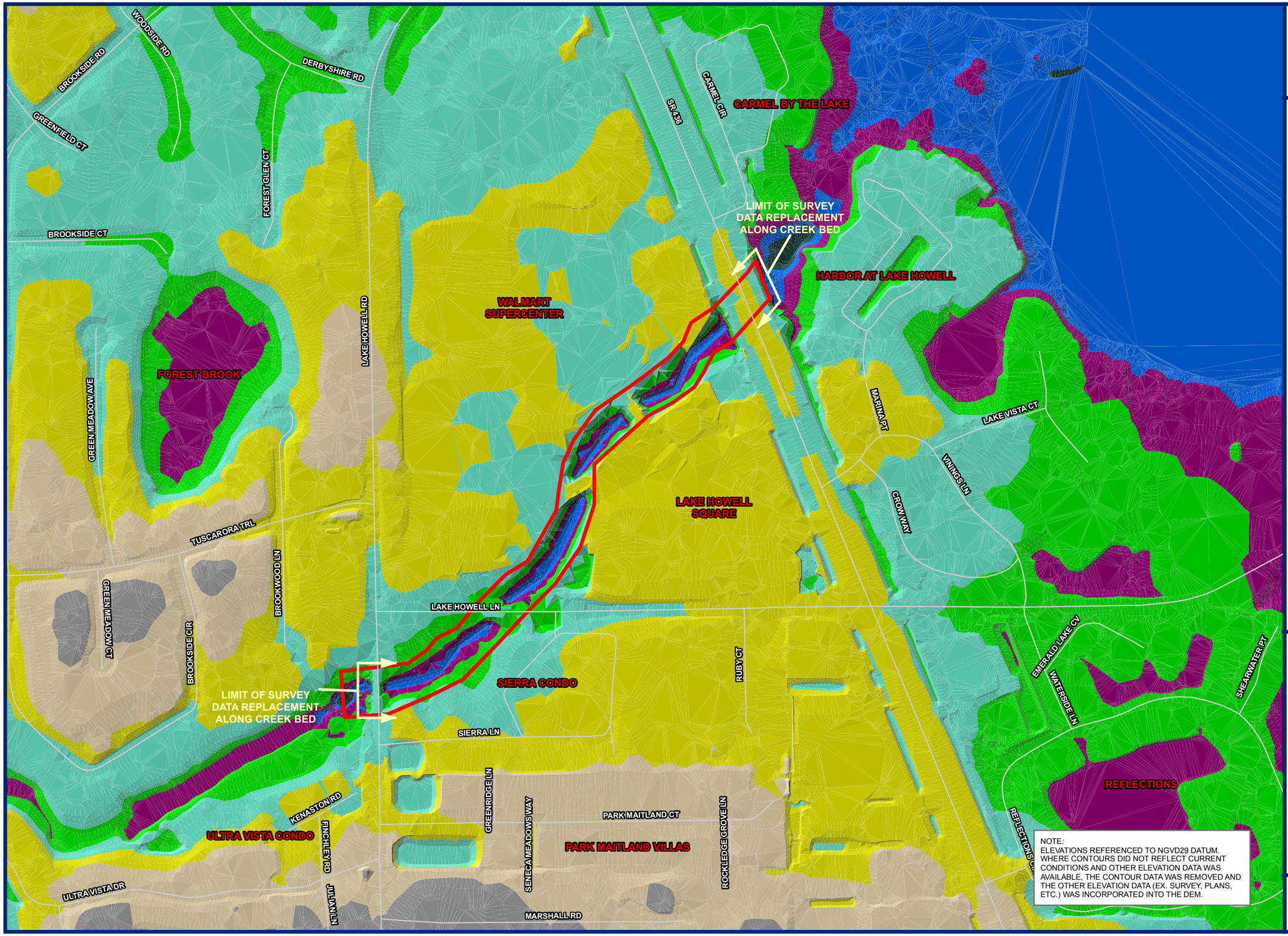
FIGURE 2-11

1' DIGITAL TOPOGRAPHIC CONTOUR MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers



SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 150 300
Feet

LEGEND

PROJECT LIMITS

ELEVATION (FEET NGVD 1929)

- 76 - 80
- 72 - 76
- 68 - 72
- 64 - 68
- 60 - 64
- 56 - 60
- 52 - 56
- 49 - 52

DATA SOURCES:
CONTOURS AND SPOT ELEVATIONS:
SJRWMD, 2001
STREETS:SEMINOLE COUNTY,2008

NOTE:
ELEVATIONS REFERENCED TO NGVD29 DATUM. WHERE CONTOURS DID NOT REFLECT CURRENT CONDITIONS AND OTHER ELEVATION DATA WAS AVAILABLE, THE CONTOUR DATA WAS REMOVED AND THE OTHER ELEVATION DATA (EX. SURVEY, PLANS, ETC.) WAS INCORPORATED INTO THE DEM.

FIGURE 2-12

TERRAIN MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

SOIL CODE	SOIL NAME	HYDRO GROUP
19	MYAKKA & EAUGALLIE FINE SANDS	B/D
23	BRIGHTON-SAMSULA & SANIBEL MUCKS	B/D
49	POMPANO FINE SAND - OCCASIONALLY FLOODED	D
52	OPEN WATER	WATER
68	BASINGER SAMSULA & HONTOON SOILS - DEPRESSIONAL	D
85	ARENTS 0-5% SLOPES	C
92	TAVARES-MILLHOPPER FINE SANDS 0-5% SLOPES	A
94	POMELLO FINE SAND 0-5% SLOPES & URBAN LAND 0-12% SLOPE	C
95	ASTATULA-APOPKA FINE SANDS 5-8% SLOPES	A

LAKE HOWELL

LAKE HOWELL RD

SR 436

LAKE HOWELL LN

NOTE:
The hydrological class segregates soil types with respect to their ability to infiltrate runoff. The letter classification is in order of decreasing infiltration ability from A (high infiltration - low runoff potential) to D (slow infiltration rate - high runoff potential). Soils in the D class may also be influenced by a naturally high water table or shallow impervious strata. Dual classification (i.e., B/D) indicates a soil, which exhibits a dual nature. The first value indicating the soil characteristics under well-drained conditions (dry season, low water table). The second value indicating characteristics under undrained conditions (wet season, high water table). For the purposes of stormwater runoff estimation, the D classification is generally used for a more conservative estimation of volume, which was implemented for this project.

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

LEGEND

HOWELL CREEK

PROJECT LIMITS

SOILS - HYDRO GROUP

- A
- B
- C
- A/D
- B/D
- D
- WATER

DATA SOURCES:
SOILS: SJRWMD, 2008
AERIALS:SEMINOLE COUNTY,2008

FIGURE 2-13

SOILS MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

LEGEND

HOWELL CREEK

PROJECT LIMITS

LANDUSE CODE AND DESCRIPTION

- 1100: Residential, low density - less than 2 dwelling units/acre
- 1200: Residential, medium density - 2-5 dwelling units/acre
- 1300: Residential, high density - 6 or more dwelling units/acre
- 1400: Commercial and services
- 3200: Shrub and brushland (wax myrtle or saw palmetto, occasionally scrub oak)
- 4110: Pine flatwoods
- 4340: Upland mixed coniferous/hardwood
- 5100: Streams and waterways
- 5200: Lakes
- 5300: Reservoirs - pits, retention ponds, dams
- 6170: Mixed wetland hardwoods
- 6300: Wetland forested mixed
- 6430: Wet prairies
- 6460: Mixed scrub-shrub wetland
- 8140: Roads and highways (divided 4-lanes with medians)

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 200 400
Feet

DATA SOURCES:
LANDUSE: SJRWMD, 2004
AERIALS:SEMINOLE COUNTY,2008

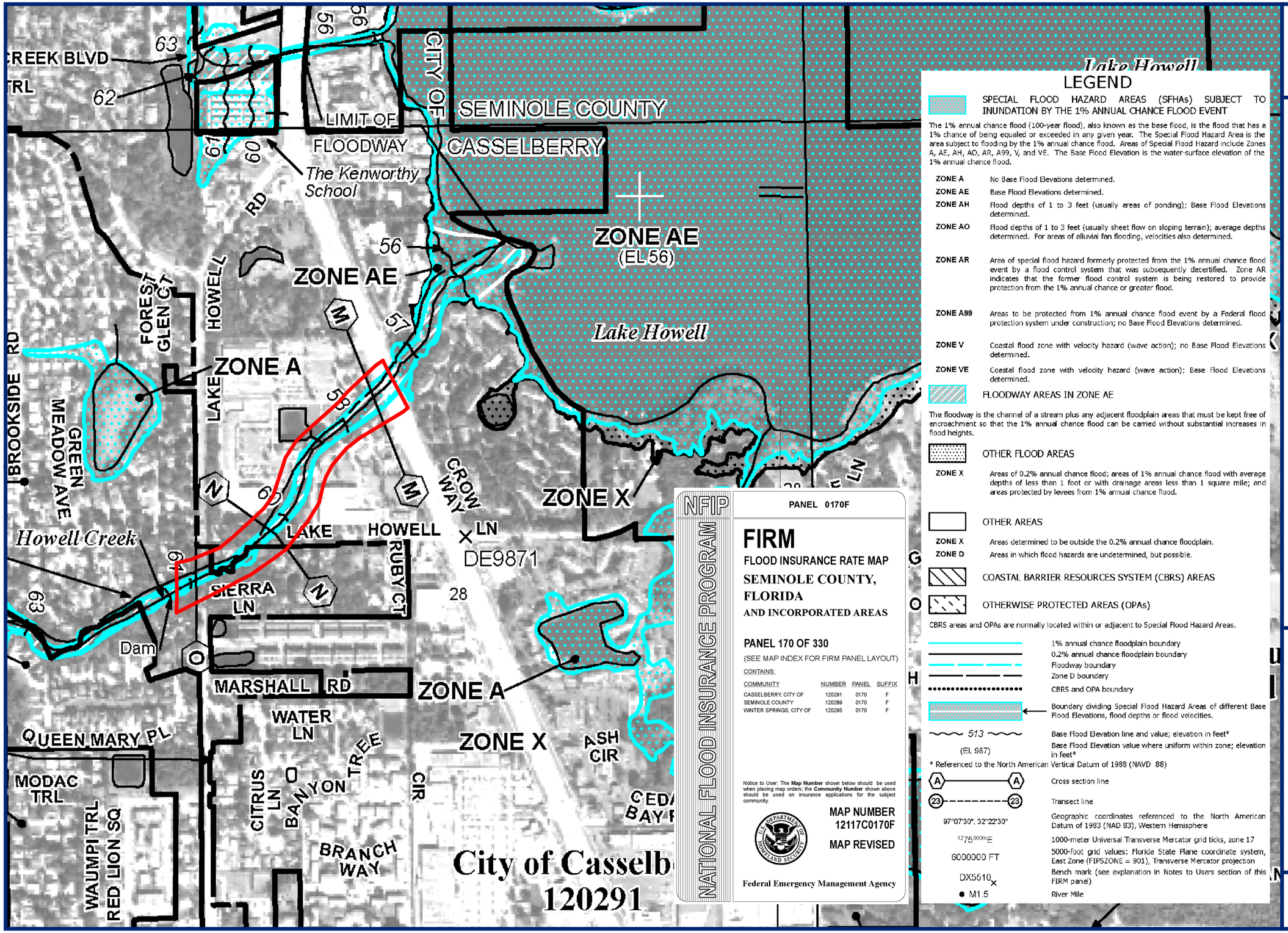
FIGURE 2-14

LANDUSE MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0170F

FIRM

FLOOD INSURANCE RATE MAP

SEMINOLE COUNTY, FLORIDA AND INCORPORATED AREAS

PANEL 170 OF 330

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CASSELBERRY, CITY OF	120291	0170	F
SEMINOLE COUNTY	120289	0170	F
WINTER SPRINGS, CITY OF	120295	0170	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
12117C0170F

MAP REVISED

Federal Emergency Management Agency

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD EVENT

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Areas to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 (EL 987) — Base Flood Elevation line and value; elevation in feet* / Base Flood Elevation value where uniform within zone; elevation in feet*
- * Referenced to the North American Vertical Datum of 1988 (NAVD 88)
- A — A — Cross section line
- 23 — 23 — Transect line
- 97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 1275000mE — 1000-meter Universal Transverse Mercator grid ticks, zone 17
- 6000000 FT — 5000-foot grid values: Florida State Plane coordinate system, East Zone (FIPSZONE = 901), Transverse Mercator projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 300 600
Feet

LEGEND

PROJECT LIMITS

DATA SOURCES:
FLOODPLAINS: FEMA
(SEE TITLE BLOCK ON MAP)

NOTE THAT ELEVATIONS REFERENCED IN NAVD 1988 DATUM. CONVERSION FOR PROJECT AREA IS NGVD - 1.06' = NAVD 1988.

FIGURE 2-15

FEMA FLOODPLAINS MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

2.6 HYDROLOGICAL DATA

An effort was undertaken to identify relevant hydrological data in the project area. The USGS maintains a gauging station on the downstream side of the bridge on Lake Howell Lane. From this gauge creek stage and discharge measurement are collected on a continuous basis. There is also a manually read staff gauge installed under the bridge on Lake Howell Lane. The gauge has been in operation since 1996. Photos of these are presented below.

Photograph looking towards the north at the USGS gauge on the south side of the Lake Howell Lane crossing of Howell Creek (April 2009).	
Photograph looking at the staff gauge under the bridge on Lake Howell Lane crossing of Howell Creek (April 2009).	

Daily data summaries were obtained from the USGS website for the hydrological gauge. This data are plotted on Figure 2-9 (stage data) and Figure 2-10 (discharge).

FIGURE 2-16
HISTORICAL STAGE DATA
HOWELL CREEK AT LAKE HOWELL LANE
USGS GUAGE 02234308 HOWELL CREEK NEAR ALTAMONTE SPRINGS, FL

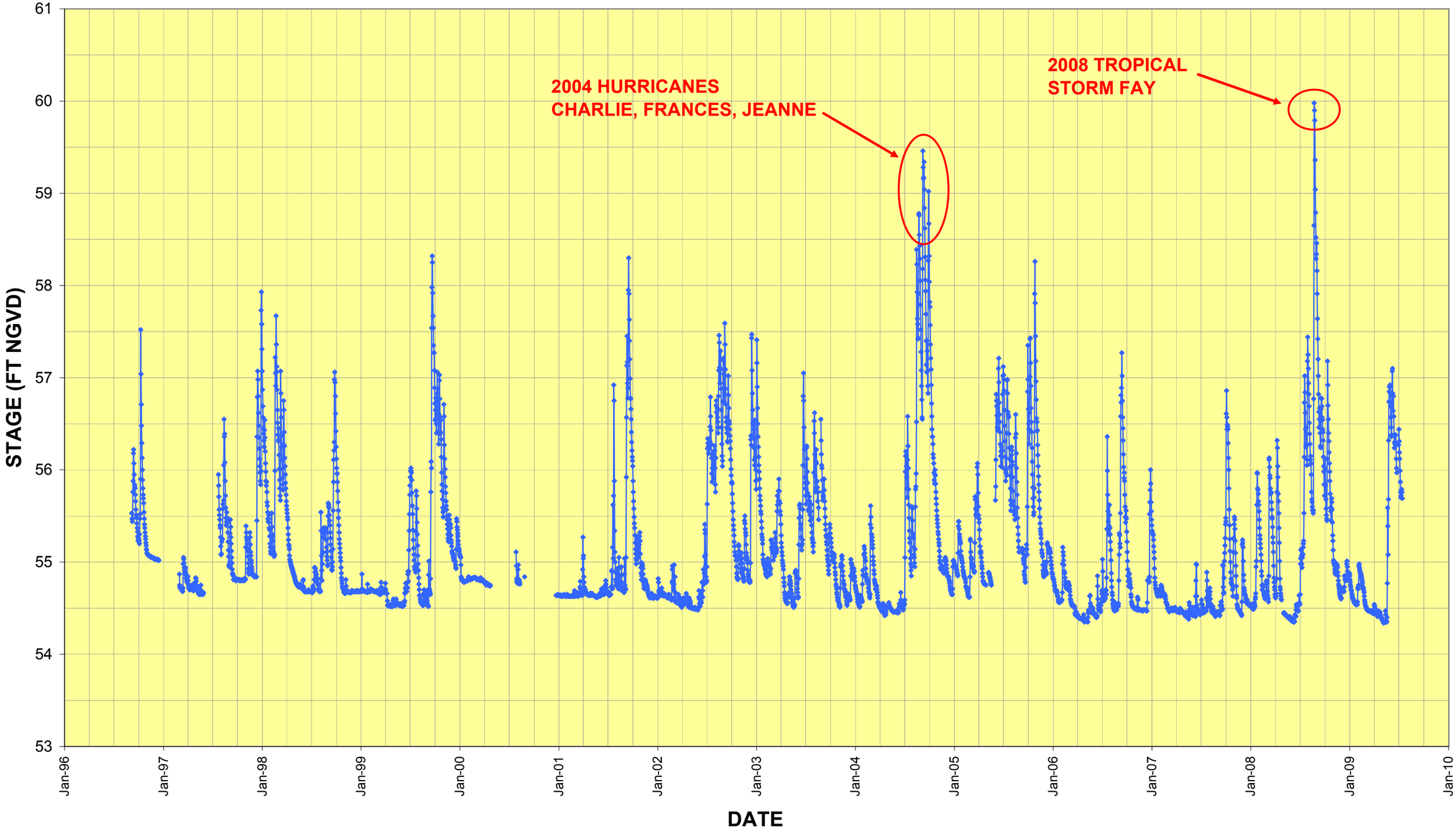
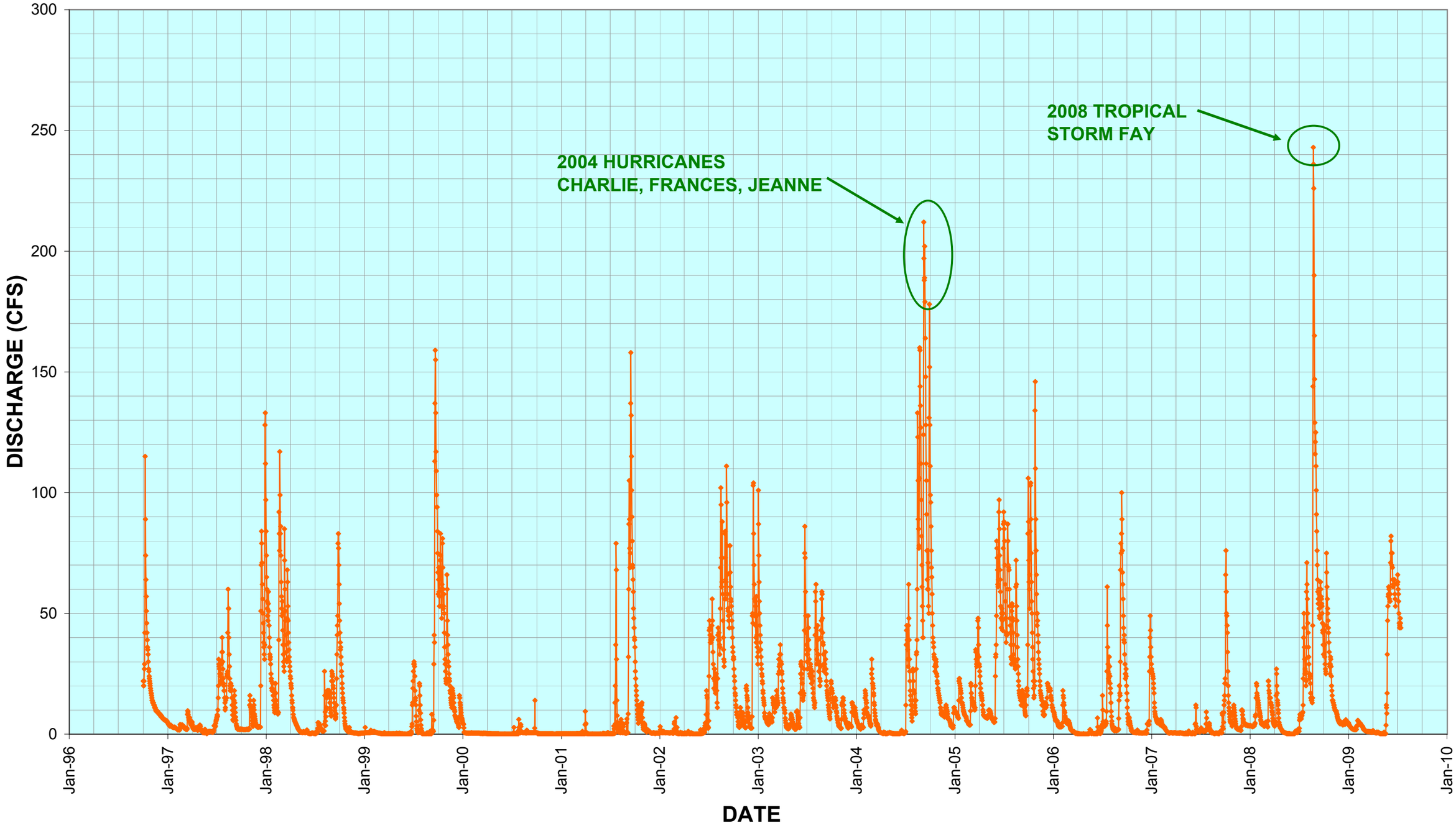


FIGURE 2-17
HISTORICAL DISCHARGE DATA

HOWELL CREEK AT LAKE HOWELL LANE

USGS GUAGE 02234308 HOWELL CREEK NEAR ALTAMONTE SPRINGS, FL



3.0 FIELD ASSESSMENT

3.1 FIELD INVESTIGATION

Inwood personnel conducted a detailed field investigation of the creek on April 29 and May 15, 2009 while the creek was still experiencing dry season base flow conditions. During these field visits personnel walked the creek collecting photographic evidence and noting severe erosion, bank failure and excessive debris. Coordinates of the approximate creek centerline were captured using a field GPS unit. Drainage outfalls discharging into the creek were also marked with GPS and photographed. Ecological data were also collected as described further in Section 4.

Data from the field investigation are shown on Exhibit 2 including photos of the creek centerline and other pertinent drainage features. Some representative photos of conditions in the creek are provided below.

Example of trash and algal bloom present in creek 30 feet downstream of south bridge of Wal-mart Supercenter parking lot. (April 2009)

Photo of fallen dead tree blocking creek 250 feet downstream of Lake Howell Road. (April 2009)

View of fallen tree debris and algal bloom present in creek 150 feet upstream of State Road 436 beside Wal-mart Supercenter parking lot. (April 2009)

Erosion under the north bridge of the Wal-mart Supercenter parking lot.

Photo of bank erosion and undercutting 160 feet downstream of Lake Howell Road. (April 2009). Note that this location is a shallow bank location in a non-critical area not threatening any active structures.

Example of bank erosion and undercutting upstream of culverts between Lake Howell Lane and south bridge of Wal-mart parking lot. (April 2009)

3.2 SURVEY DATA COLLECTION

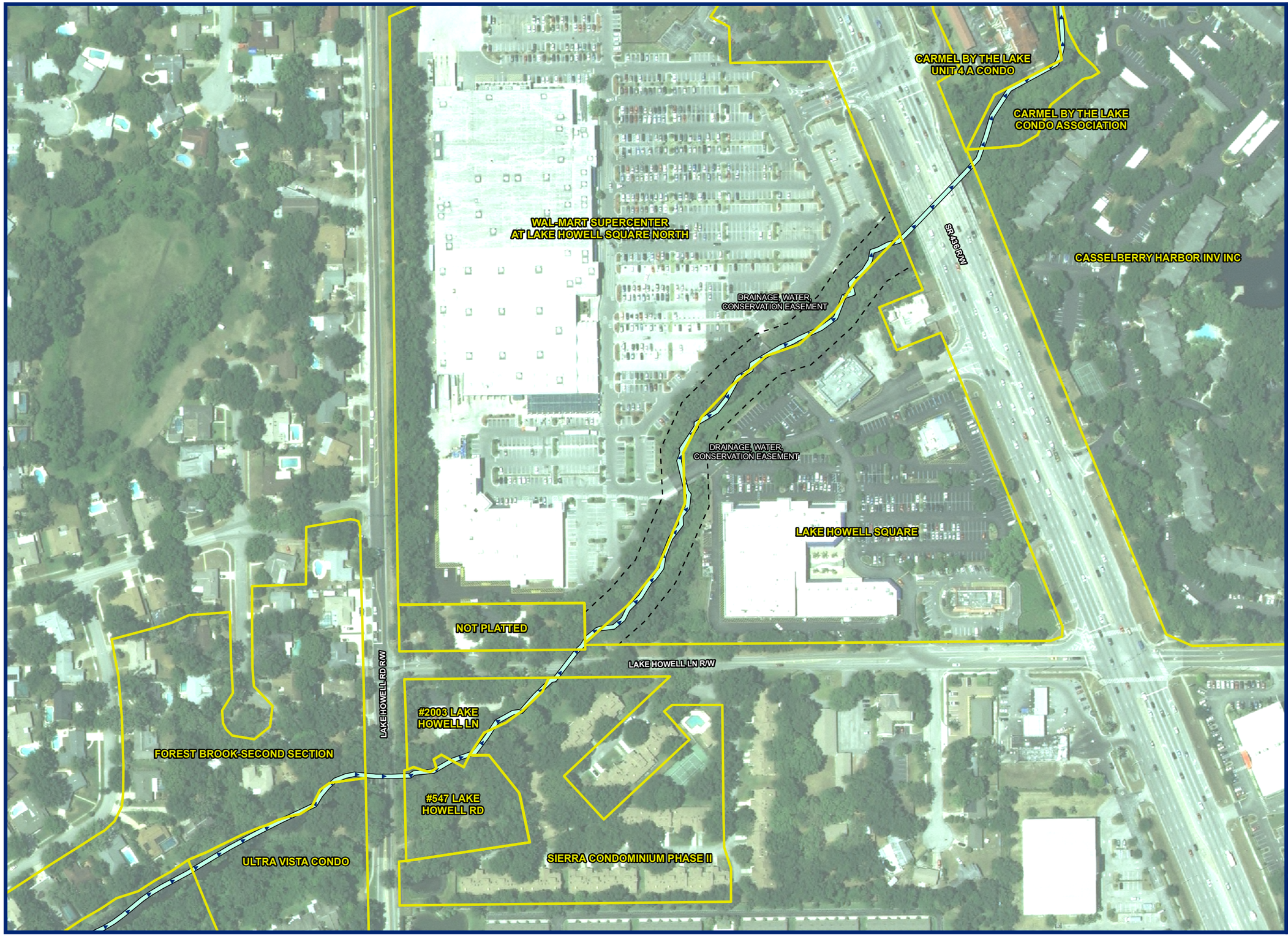
Topographical survey data were collected by Southeastern Surveying & Mapping Corporation (SSMC) in May through June of 2009. The scope of the survey included the following:

1. Collect creek channel cross-section and flow line elevation data at selected intervals in the project area;
2. Collect elevation of drainage structures intersecting the creek;
3. Provide detailed survey of the bridges on State Road 436, Lake Howell Road, Lake Howell Lane and the access bridges at Wal-mart Supercenter parking lot;
4. Details on property ownership and easements adjacent to the creek.

The survey data is included in Appendix C, which includes the survey plan plots and field notes of the drainage structures detailed. Included is data collected by SSMC for CDM's basin study efforts including details of the Wal-mart bridges. Also, in the field notes are details of the remnant dam just upstream of Lake Howell Lane. Adjacent property ownership and easement information is replicated on Figure 3-1. The cross-sectional data is shown on Exhibit 3.

3.3 GEOTECHNICAL EVALUATION

A geotechnical evaluation was conducted by Devo Seereeram, Ph.D., P.E. (Devo Engineering) in May 2009. The evaluation was visual in nature and focused on noting areas of concern with regard to erosion and bank stability which warrant corrective action. Several area of concern were noted and given a priority grading for corrective action. The results of this effort are included in the report in Appendix D. This report contains a large scale exhibit with sketch and photo documentation of areas of concern.



SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 100 200
Feet

LEGEND

- PROPERTY BOUNDARIES
- EASEMENT BOUNDARIES
- HOWELL CREEK

DATA SOURCES:
PROPERTY OWNERSHIP:
SSMC SURVEY, 2009
AERIALS:SEMINOLE COUNTY,2008

FIGURE 3-1

ADJACENT PROPERTY & EASEMENT MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

4.0 PRELIMINARY ECOLOGICAL ASSESSMENT

4.1 INTRODUCTION

Biologists from Inwood Consulting Engineers conducted an ecological assessment of the creek system in order to determine the overall health of the system, its ability to provide habitat for wetland-dependant wildlife in the area, the jurisdictional extent of wetlands, evidence of habitat utilization by state and federally protected species, and any State and Federal permitting requirements. Field reviews were conducted on April 29, 2009 and May 15, 2009.

4.2 EXISTING ENVIRONMENTAL CHARACTERISTICS

4.2.1 Soils

According to the US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Soils Conservation Service (SCS) SCS digital soils data, the proposed project location is comprised of three soil types: Pompano Fine Sand, Occasionally Flooded; Myakka and Eaugallie Fine Sands; and Tavares-Millhopper Fine Sands, 0-5% Slopes. The creek bed itself is the only portion of the study area that has not been developed and/or disturbed and retains its historical soil profile. Please refer to Figure 2-13 (Soils Map) and the geotechnical report (Appendix D) for the location and type of soils in the project area.

4.2.2 Existing Vegetative Communities and Land Use

Land use within the project area consisted of both natural and developed areas. Land use categories were defined by the Florida Department of Transportation (FDOT) Florida Land Use Cover and Forms Classification System (FLUCFCS). Please refer to Figure 2-14 (Land Use Map) for the distribution of each FLUCFCS type within the area surrounding the proposed project site. The area immediately surrounding the project site consists of the following land use types:

- FLUCFCS 1200 – Residential, Medium Density, 2-5 Dwelling Units per Acre: This designation is used to describe the developed residential areas to the west and south of the project area near Lake Howell Road and Lake Howell Lane. This area is comprised of single family homes and condominiums.
- FLUCFCS 1400 – Commercial and Services: This designation is used to describe commercial developments, specifically the shopping centers immediately to the north and south of the project area between Lake Howell Lane and SR 436.
- FLUCFCS 6300 – Mixed Wetland Forest: This designation is used to describe the creek bed and forested wetland areas along the stream. This category includes forested wetland areas where neither hardwood nor conifer species achieve a 66 percent canopy dominance.

4.3 WETLAND DESCRIPTION

4.3.1 Methodology

Prior to field reconnaissance, several site-specific mapping resources were reviewed. These included aerial photographs of the project area (2004 & 2008), USDA NRCS SCS; Soil Survey of Seminole County, Florida (1990), US Geologic Survey (USGS) 7.5 minute quadrangle maps;

Casselberry (3811), and the US Fish and Wildlife Service (USFS) National Wetlands Inventory (NWI) maps.

Subsequent to the review of all available materials, a field review was conducted on April 29, 2009 and May 15, 2009 in order to identify the presence of wetland vegetation, evidence of wetland hydrology, and hydric soil indicators within the project limits. The jurisdictional limits of wetlands were delineated using the criteria set in the *US Army Corps of Engineers Wetland Delineation Manual* (1987) with the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Atlantic and Gulf Coastal Plain Region* (2008) and in accordance with Chapter 62-340.300 of the Florida Administrative Code.

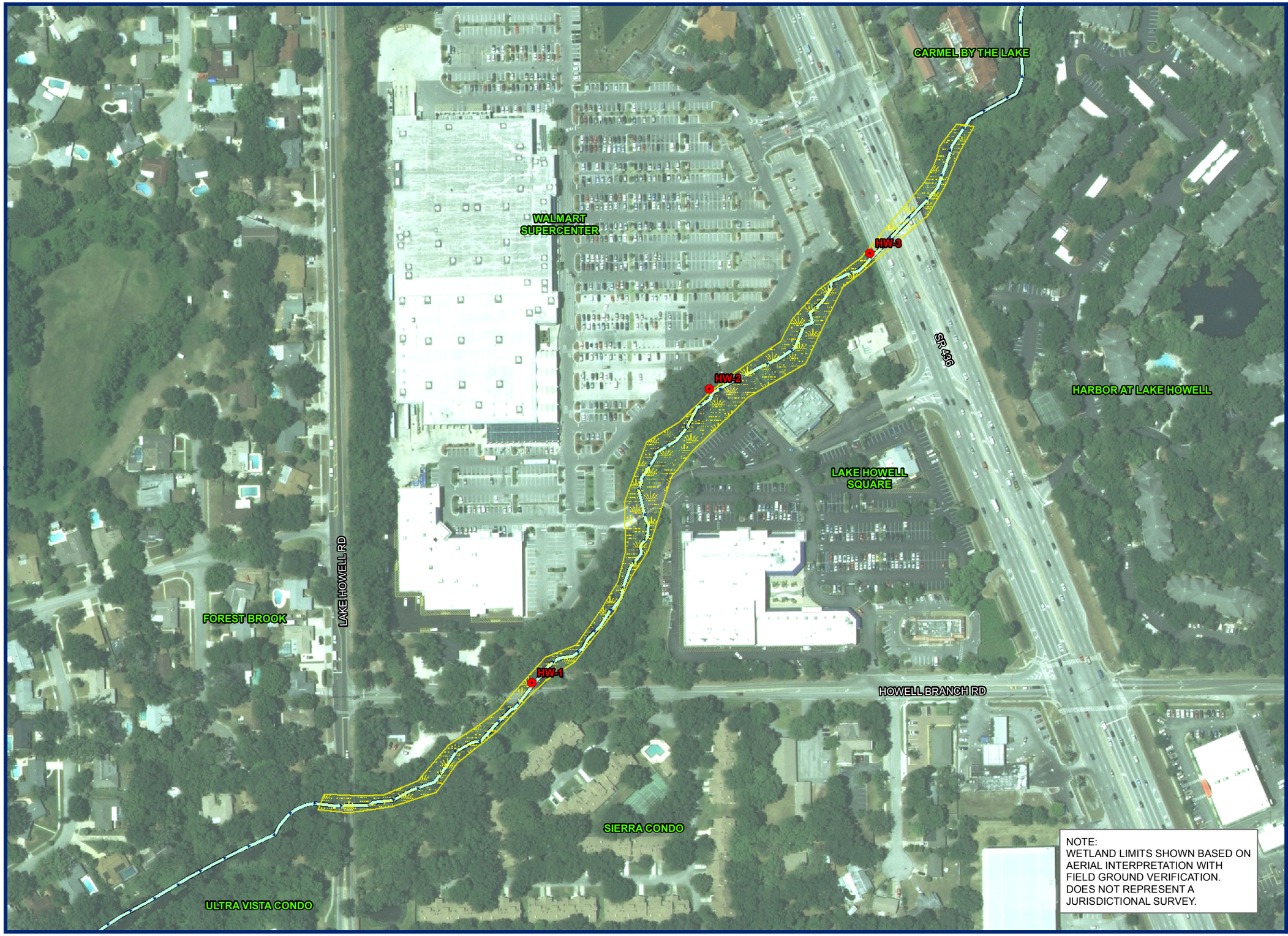
4.3.2 Wetland Vegetative Descriptions

There is one wetland or surface water habitat type, as defined by the FLUCFCS, within the project corridor: Mixed Wetland Forest (6300). For the purposes of this document, a vegetative description will be made to consider the overall creek and adjacent wetlands as one contiguous system.

Wetland habitat observed in the field included a canopy of laurel oak (*Quercus laurifolia*), live oak (*Quercus virginiana*), red maple (*Acer rubrum*), bald cypress (*Taxodium distichum*), earpod tree (*Enterolobium contortisiliquum*), and camphor (*Cinnamomum camphora*). Mid-story and shrub species included elderberry (*Sambucus nigra*), wax myrtle (*Myrica cerifera*), Brazilian pepper (*Schinus terebinthifolia*), Carolina willow (*Salix caroliniana*), and saw palmetto (*Serenoa repens*). Groundcover species included duckweed (*Lemna sp.*), maidencane (*Panicum sp.*), dog fennel (*Eupatorium capillifolium*), pineland lantana (*Lantana camara*), air-potato (*Dioscorea bulbifera*), wild grape (*Vitus sp.*), blackberry (*Rubus argutus*), wild taro (*Colocasia esculenta*), beggartick (*Bidens sp.*), water lily (*Nymphaea sp.*), and bahia grass (*Paspalum notatum*).

The canopy vegetation was consistent with the FLUCFCS type set by the St Johns River Water Management District in their 2004 land use and land cover data. Exotic and nuisance vegetation is present through the study area and is typical of urban wetland systems. Hydrology within the creek appears to be adequate as there was running water in the creek during both field reviews

High water levels were marked on three different locations along the creek. These marks were identified using biological indicators and staining as evidence of peak water levels within the creek. These locations were identified using GPS and photographs and were later surveyed. Please refer to the Wetland Location Map (Figure 4-1) and Exhibit 2 for the location of high water marks. Below are photographs and descriptions of high water marks set in the field.



SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 100 200
Feet

LEGEND

- High Water Marks
- Wetland Limits
- HOWELL CREEK

DATA SOURCES:
WETLAND LIMITS AND HIGH WATER MARKS:DESIGNATED BY INWOOD,2009
STREETS:SEMINOLE COUNTY,2008
AERIALS:SEMINOLE COUNTY,2008

NOTE:
WETLAND LIMITS SHOWN BASED ON AERIAL INTERPRETATION WITH FIELD GROUND VERIFICATION. DOES NOT REPRESENT A JURISDICTIONAL SURVEY.

FIGURE 4-1
WETLAND LOCATION MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

High water mark located on the west side of the SR 436 crossing. (April 2009)

High water mark on bridge piling adjacent to the Wal-Mart parking lot. (April 2009)

Staff Gauge showing high water elevation of 58.70 feet on bridge piling at Howell Lane. (April 2009)

4.4 WILDLIFE

The vegetative communities and current land use within and adjacent to the proposed project limits were evaluated in order to determine the potential use by listed species. Inwood biologists reviewed reference literature, aerial photography, and conducted field reconnaissance in order to determine if suitable protected species habitat exists within the project area.

4.4.1 Methodology

Prior to conducting field visits, a literature search was performed in order to determine if the presence of any protected species, or their habitats, had been documented within the project area. Project biologists consulted standard Florida references to gain insight into the characteristics of existing wildlife habitat. Literature referenced included the NWI maps, site-

specific aerial photographs, the USFWS's "Endangered and Threatened Species of the Southeast United States" (The Red Book, 1992), the Florida Fish and Wildlife Conservation Commission's (FWC) "Closing the Gaps in Florida's Wildlife Habitat Conservation System" (1994), Florida's Endangered Species, Threatened Species, and Species of Special Concern lists (2008), and a recent query of the Florida Natural Areas Inventory (FNAI) database of listed species for the surrounding area.

A general wildlife survey was conducted on April 29, 2009 and May 15, 2009 by an experienced Florida biologist in order to determine the potential for listed species or their habitat within the proposed project limits. Prior to the field survey, a base map of the study area was developed from aerial photographs.

Review of existing wildlife literature did not indicate the presence of any protected species or habitat within the project area.

A listing of Federal and State listed species which have the potential to occur in Seminole County is included as Table 4-1.

4.4.2 Results

4.4.2.1 Listed Floral Species

During the field review, no listed floral species were observed within the project limits.

4.4.2.2 Listed Faunal Species

During field reviews, one listed species was observed within the project limits. A wood stork (*Mycteria americana*) was observed foraging within the creek. This species is listed as Endangered by both the USFWS and FWC.

The following is a discussion of listed species that addresses those species that were not observed, but have at least a minimal potential of occurrence within the project limits.

A review of the FFWCC eagle nest locator website was conducted on May 19, 2009 for habitat surrounding and including the project area (Section 28, Township 21S, Range 30E). The results indicated that there are currently a total of eight eagle nests within five miles of the project, with the nearest (SE012) being 1.43 miles from the project. Bald eagles could utilize lake and marsh habitat both upstream and downstream of the proposed project location for foraging. However, it is anticipated that this project is not likely to have any adverse effect on the breeding success of an established nest.

Listed wading birds that could potentially use portions of the project area for foraging habitat include limpkin (*Aramus guarauna*), little blue heron (*Egretta caerulea*), snowy egret (*Egretta thula*), tricolored heron (*Egreatta tricolor*), and sandhill crane (*Grus Canadensis*). A review of the FFWCCC Waterbird colony Locator online database was conducted on May 19, 2009. No wading bird colonies have been recorded within the project limits.

The American alligator (*Alligator mississippiensis*) is federally-listed as Threatened to due to similarity in appearance to more endangered crocodilians and state-listed as a species of special concern. Foraging habitat for this species does occur within the proposed project limits.

Non-listed wildlife species, or evidence of utilization, observed within the project limits include northern cardinal (*Cardinalis cardinalis*), blue jay (*Cyanocitta cristata*), barred owl (*Strix varia*), turkey vulture (*Cathartes aura*), grey squirrel (*Sciuris carolinensis*), brown anole (*Anolis sagrei*), southern black racer (*Coluber constrictor*), and pig frog (*Rana grylio*).

Table 4-1 - Federal and State Listed Species with the Potential to Occur in Seminole County

GROUP	SCIENTIFIC NAME	COMMON NAME	USFWS	FFWCC	FDACS
Amphibian					
	Rana capito	Gopher frog		SSC	
Birds					
	Ajaia ajaja	Roseate Spoonbill		SSC	
	Aphelocoma coerulescens	Florida scrub jay	T	T	
	Aramus guarauna	Limpkin		SSC	
	Caracara cheriway	Crested caracara	T	T	
	Egretta caerulea	Little blue heron		SSC	
	Egretta thula	Snowy egret		SSC	
	Egretta tricolor	Tricolored heron		SSC	
	Eudocimus albus	White ibis		SSC	
	Falco pergrinus tundrius	Peregrine falcon		E	
	Falco sparverius paulus	Southeastern American kestrel		T	
	Grus canadensis	Sandhill crane		T	
	Haliaeetus leucocephalus	Southern bald eagle	T	T	
	Mycteria americana	Wood stork	E	E	
Fish					
	Pteronotropis welakea	Bluenose shiner	SSC		

Table 4-1 - Continued

GROUP	SCIENTIFIC NAME	COMMON NAME	USFWS	FFWCC	FDACS
Mammal					
	Podomys floridanus	Florida mouse		SSC	
	Sciurus niger shermani	Sherman's fox squirrel		SSC	
	Trichechus manatus latirostris	West Indian manatee	E	E	
	Ursus americanus floridanus	Florida black bear		T	
Plants					
	Carex chapmanii	Chapman's Sedge			E
	Centrosema arenicola	Sand butterfly pea			E
	Cucurbita okeechobeensis	Okeechobee gourd	E		E
	Dennstaedtia bipinnata	Cuplet fern			E
	Illicium parviflorum	Yellow anise tree			T
	Lechea cernua	Nodding Pinweed			T
	Lechea divaricata	Pine pinweed			E
	Nemastylis floridana	Celestial Lily			E
	Ophioglossum palmatum	Hand Fern			E
	Pecluma ptilodon	Swamp plume polypody			E
	Pteroglossaspis ecristata	Giant Orchid			T
	Salix floridana	Florida Willow			E
Reptile					
	Alligator mississippiensis	American alligator	T (S/A)	SSC	
	Drymarchon corais couperi	Eastern indigo snake	T	T	

Table 4-1 - Continued

GROUP	SCIENTIFIC NAME	COMMON NAME	USFWS	FFWCC	FDACS
Reptile (cont'd.)					
	Gopherus polyphemus	Gopher tortoise		T	
	Pituophis melanoleucus mugitus	Florida pine snake		SSC	
	Stilosoma extenuatum	Short-tailed snake		T	

USFWS = United States Fish and Wildlife Service
FFWCC = Florida Fish and Wildlife Conservation Commission
FDACS = Florida Department of Agriculture and Consumer Services

E = Endangered **SSC = Species of Special Concern**
T = Threatened **T(S/A) =Threatened due to Similarity of Appearance**

4.5 REGULATORY AGENCIES AND REQUIRED PERMITTING

As any work within the creek will impact wetlands regulated by the state and federal government, it will be necessary to submit an Environmental Resource Permit (ERP) application for Section 404 dredge and fill permit to the US Army Corps of Engineers (ACOE) and the St. Johns River Water Management District (SJRWMD). These permits address the proposed project's impact on wetlands including filling of jurisdictional wetlands, the effect of wetland habitat loss on listed species, and to help determine the mitigation necessary to offset the loss of wetlands resulting from this project.

ACOE and SJRWMD regulate wetlands impacts within this project area. The FDEP, USFWS, and the FWC review and comment on wetland permit applications. It is currently anticipated that the following permits will be required for any work within the creek itself or within adjacent wetlands:

Permit Type	**Issuing Agency**
Standard General Environmental Resource Permit (assuming permanent wetland impacts less than 1.0 acres)	SJRWMD
OR*	
Individual Environmental Resource Permit (assuming permanent wetland impacts greater than 1.0 acres)	SJRWMD
Section 404 General Dredge and Fill Permit (assuming wetland fill impacts less than 0.5 acres)	USACOE
OR*	
Section 404 Individual Dredge and Fill Permit (assuming wetland fill impacts greater than 0.5 acres)	USACOE

** The type of permit required for the project will depend on the amount of impacts to wetlands resulting from the proposed work.*

The FWC and the USFWS will consult with and provide comments to the SJRWMD and ACOE on the potential effect of any proposed wetland impacts on state and federal listed species. Their comments and/or objections will be noted in the sufficiency response from the ACOE.

Based on experience gained during the permitting process for the some previously completed projects in Howell Creek, the State of Florida may consider Howell Creek to be Sovereign Submerged Lands. Any construction activities within the creek itself will have to have approval from the Florida Department of Environmental Protection (FDEP). This coordination will occur during the permitting process.

SJRWMD: The complexity of the permitting process depends greatly on the degree of the impact to jurisdictional areas. The SJRWMD requires an ERP when construction of any project results in the creation of a water management system, impacts to waters of the State, or impacts to isolated wetlands. A Standard General permit will be required with mitigation for projects with proposed wetland impacts less than one acre with an Individual permit being required with proposed wetland impacts greater than one acre. Typically, SJRWMD can review and approve a Standard General ERP in 3-6 months and an Individual ERP in 3-9 months.

ACOE: For the ACOE, a General dredge and fill permit will be required if a project's wetland impacts are less than 0.5 acres, with an Individual permit being required with proposed wetland impacts greater than 0.5 acres. Both permits require compliance with Section 404(b)(1) guidelines, including verification that all impacts have first been avoided to the greatest extent possible, that unavoidable impacts have been minimized to the greatest extent practicable, and that unavoidable impacts have been mitigated in the form of wetlands creation, restoration, and/or enhancement. Review and issuance of a General ACOE permit typically takes 1-3 months and an Individual permit typically takes 3-6 months from the time the permit application is submitted.

4.6 ECOLOGICAL ASSESSMENT SUMMARY

The jurisdictional extent of wetlands within the project area is the stream bed itself from the top of bank on each side of the creek. Please refer to the Wetland Location Map (Figure 4-1) for the approximate extent of wetlands within the project area. Any construction activities occurring within the creek will be required to have an approved permit from both the SJRWMD and ACOE with approved mitigation provided for any permanent impacts to wetlands.

Suitable habitat exists within the project area for protected species, specifically protected wading birds. Due to surrounding development, however, the overall quality of the habitat is low. One wood stork was observed foraging within the creek during the field review by Inwood staff. Any proposed projects within the creek should consider the effects on listed species and provide adequate avoidance and minimization of impacts to listed species and their habitat.

Based on observations in the field, the wetlands appear to be adequately hydrated, though native wetland vegetation is lacking in many areas. The urbanization of the uplands surrounding the creek has lead to a decline in the overall abundance and diversity of native wetland vegetation and an increase in amount of nuisance/exotic species. Lack of suitable floodplain along the banks leaves little area for native vegetation to remain established and create the canopy normally associated with this type of system.

Any work taking place within wetlands associated with Howell Creek that will involve altering existing vegetation should consider the control/removal of exotic species. Species such a Brazilian pepper, air-potato, and cogongrass spread very quickly in stressed systems and typically out-compete natives for resources. The lack of any buffer between the creek system and surrounding vegetation will likely reduce the chance of success for most exotic control attempts. Removing large sections of exotic vegetation and establishing native species in large enough areas to allow a native "core" to be established that can compete for resource may help restore much needed wetland habitat for wildlife using the entire creek and lake system for foraging and cover.

5.0 HYDROLOGICAL & HYDRAULIC MODEL REFINEMENT

5.1 EXISTING MODEL

The ongoing CDM Howell Creek master study developed a hydrological & hydraulic model representation of the project area. The model's level of detail was regional in nature, building on the previous SJRWMD and DRMP modeling efforts with some additional refinements based on newly collected survey data of key drainage structures and creek cross-sections. As a result, the project area was generally represented with aggregated contributing areas divided along the creek. The bridges at Lake Howell Road, Lake Howell Lane, SR 436, as well as the two bridges in the Wal-mart parking lot were included in the model. Survey data for the Wal-mart bridges collected for this study is included in Appendix C for reference.

5.2 REFINED MODEL

This current project afforded the opportunity to collect more detailed survey data in the creek. In addition, detailed survey was collected for the bridges at Lake Howell Road, Lake Howell Lane, SR 436 and the Wal-mart Supercenter parking lot.

The current project efforts also allowed for a more detailed assessment of local drainage infrastructure through the plans, permit, and field review. This resulted in the refinement of the contributing areas to the subject creek segments. The refined contributing areas are shown on Figure 5-1, divided by which side of the creek (north versus south) to which they discharge.

Using the newly collected field survey data and the refined contributing areas, CDM updated their master model in the vicinity of the project limits to provide a more accurate assessment of flows and stages. The results of their efforts are included in a technical memorandum in Appendix E. The technical memorandum includes a figure showing the refined model area and a summary table of peak stage and average velocity results for the project creek section.

Peak stages and velocity data for the design storm events (mean annual, 10-year, 25-year, and 100-year) were adapted from the CDM information and are summarized graphically on the profile on Exhibit 3. This data were used when identifying creek restoration strategies summarized in Section 7 of this report.

A comparison summary of the most recent modeling results "CDM 2009" with various past results for the bridges at SR 436, Lake Howell Lane, Lake Howell Road and Lake Howell Square locations is presented on Table 5-1.

5.3 MODEL RESULTS UTILIZATION

Design storm stage information is useful when designing bank stabilization and/or erosion control measures to determine the vertical extent of such improvements. Typically bank stabilization measures are designed to a height equivalent to a 25 or 100 year design storm.

Velocity information is useful in determining areas susceptible to erosion under extreme storm events. Generally velocities in excess of 3 to 4 feet per second (fps) can transport sediment. Areas where the model results indicate high velocities with erosion confirmed by field observations may be candidates for some type of stream bed and/or bank protection or armoring.

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 300 600
Feet

LAKE HOWELL

CALLE DEL REY
WOODSIDE RD
DERBYSHIRE RD
FOREST GLEN CT
SR 436
CARMEL CIR
MARINA PT
BROOKSIDE CT
BROOKSIDE RD
GREEN MEADOW AVE
GREEN MEADOW CT
TUSCARORA TRL
BROOKSIDE CIR
LAKE VISTA CT
VININGS LN
CROW WAY
RUBY CT
WATERSIDE LN
SHEARWATER PT
JANE LN
LAKE HOWELL TRL
LAKE HOWELL LN
LONGBRANCH CT
LONGBRANCH RD
LONGHORN RD
RANCH RD
SIERRA LN
KENASTON RD
PARK MAITLAND CT
ULTRA VISTA DR
PENNY LN
QUEEN MARY PL
MARSHALL RD
WATER LN
REFLECTIONS CIR
ASH CIR
MEADOW AVE
SPRUCE CT
POPLAR CT
MODAC TRL
WAUMPI TRL
LAKE HOWELL RD
CITRUS LN
CAPER LN
BANYON TREE CIR
CEDAR BAY PT
TUSCALOOSA TRL
RED LION SQ
BRANCH WAY
ANACONDA TRL
HAYWOOD CT
COAWOOD CT
FLORENTINO LN
GALLIANO CIR
LAKE ANN LN
LAUREL PARK CT
SWEETWATER TRL
HOWELL BRANCH RD
SEMORAN NORTH CIR
GRANADA RUN
COBY PT
HOWJULEES CT
LAKEMONT AVE
CARRIGAN AVE
LEWFIELD CIR
TIMBERLINE DR
TAHOE CIR
ENSOR TER
ALLEN LN
SORRENTO CIR
NAUTICAL WAY
CAYMAN WAY
EXUMA WAY
BARBADOS DR
ANTILLES DR
WEEDY PT

LEGEND

HOWELL CREEK

CONTRIBUTING AREA

- NORTH
- SOUTH

NOTE:
CONTRIBUTING AREAS BASED ON INFRASTRUCTURE MAPPING REFERENCED FROM PLANS, PERMITS & FIELD REVIEW.

DATA SOURCES:
STREETS:SEMINOLE COUNTY,2008
AERIALS:SEMINOLE COUNTY,2008

FIGURE 5-1

CONTRIBUTING AREA MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

Table 5-1
Comparison of Historical Storm Discharge and Stage Information

Storm Data / Location	Discharge in Creek (cfs)*				Stage in Creek (Ft. NGVD)*			
	Mean Annual	10-year	25-year	100-year	Mean Annual	10-year	25-year	100-year
SR 436								
USACOE 1974 **	- -	440	- -	880	- -	57	- -	58.4
SJRWMD 1984	- -	550	740	1160	- -	56.5	57.2	58.5
SJRWMD 1994	- -	278	400	681	- -	56.38	56.95	58.07
DRMP 1994	- -	331	437	747	- -	56.75	57.26	58.75
FEMA FIS 2007 ***	- -	440	- -	880	- -	57.16	- -	58.56
CDM 2009	442	688	980	1522	56.7	57.3	57.8	58.7
Lake Howell Square / Wal-Mart Shopping Center (North)								
DRMP 1994	- -	615	418	724	- -	57.1	57.26	59.04
CDM 2009	443	688	981	1522	58.1	59.1	60	61.4
Lake Howell Square / Wal-Mart Shopping Center (South)								
DRMP 1994	- -	314	417	722	- -	57.66	58.21	59.64
CDM 2009	438	681	971	1536	58.5	59.5	60.5	61.9
Lake Howell Lane								
SJRWMD 1984	- -	- -	- -	- -	- -	60.7	61.1	61.9
SJRWMD 1994	- -	278	400	681	- -	56.45	57.04	58.15
DRMP 1994	- -	313	416	722	- -	58.16	58.76	60.26
FEMA FIS 2007 ***	- -	- -	- -	- -	- -	59.26	- -	60.76
CDM 2009	506	751	1058	1507	58.8	59.9	61	62.4
Lake Howell Road								
SJRWMD 1984	- -	- -	- -	- -	- -	61.3	62	63.5
SJRWMD 1994	- -	278	400	681	- -	59.78	60.28	61.03
DRMP 1994	- -	312	415	720	- -	58.82	59.45	60.81
FEMA FIS 2007 ***	- -	- -	- -	- -	- -	60.26	- -	62.16
CDM 2009	419	669	970	1505	59.1	60.3	61.3	62.7

Refer to Section 2.1 for description of previous SJRWMD, DRMP, and FEMA studies

- - Data not available

* Design storms all based on 24-hour duration

** Data originating in 1974 ACOE document but referenced from SJRWMD 1984 study

*** Data estimated from flood profile graphs from 2007 FEMA Flood Insurance Study. Values converted to NGVD from NAVD in the FIS (NGVD = NAVD + 1.06')

6.0 WATER QUALITY EVALUATION

6.1 WATER QUALITY REGULATIONS

The contributing area to the project creek corridor has been primarily developed since the early 1980s. Most of the development has been subsequent to the advent of various stormwater management rules required by the SJRWMD and Seminole County development regulations. These rules require the implementation of water quantity (attenuation) as well as water quality (pollutant reduction) engineering controls be incorporated into site design.

For water quantity, the requirements generally dictate that post-development discharge should be less than or equal to pre-development discharge and no net reduction in floodplain storage should take place. For water quality purposes, certain acceptable Best Management Practices (BMPs) should be implemented (i.e., wet detention, retention, exfiltration, swales, etc.) to reduce pollutants based on presumptive pollutant load reduction performance. Although not required to be monitored, the goal is that the implementation of BMPs will reduce pollutant discharges into receiving waters which in this case is Howell Creek and later Lake Jesup.

Lake Jesup is an impaired water body subject to Total Maximum Daily Load (TMDL) requirements. Based on impairment data from the Florida Department of Environmental Protection (FDEP), parameters of concern include nutrients (total nitrogen and phosphorus), fecal coliforms and dissolved oxygen (BOD). As a primary tributary to Lake Jesup, the water quality of Howell Creek is by association of specific concern to the County.

Note that no septic tank usage was identified in the project area, so leaching of contaminants from non-functioning or failed septic tanks through the groundwater into the creek does not appear to be a concern in the project area.

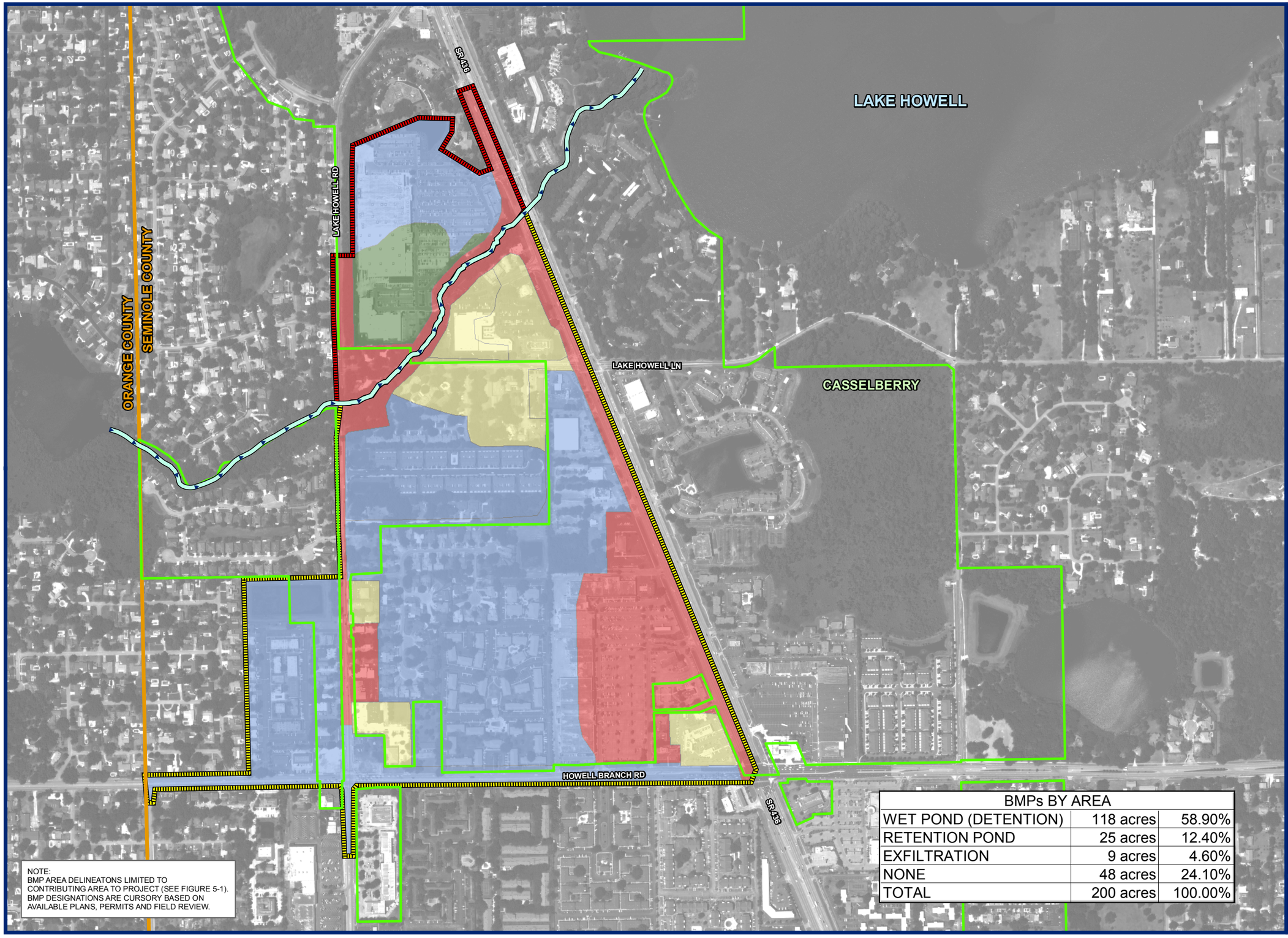
6.2 BMP EVALUATION

A cursory evaluation of BMPs in the contributing area to the project was conducted in an attempt to identify any specific areas that currently do not have stormwater BMPs in place. These areas could then be targeted in the future for some type of BMP if reduction of pollutant loading in this project area becomes important in the future.

Based on review of plans, permits, and field observations, each individual development in the contributing are was designated as having a currently operating BMP. In the project area the BMPs were distinguished between wet ponds (detention), dry ponds (retention) and exfiltration treatment. Figure 6-1 shows the results of this evaluation.

Based on Figure 6-1, the majority of the contributing area (~75%) is addressed with BMPs. The areas identified as having no BMPs are the stormwater system along State Road 436 and some portion of Lake Howell Road. Stormwater runoff from Casselberry Commons at the corner of State Road 436 and Howell Branch Road also appears to be untreated.

Since the effectiveness of the existing BMPs is based primarily on presumptive removal efficiencies, there would be opportunity to enhance existing treatment levels through the incorporation of additional BMPs through a “treatment train” of BMPs in series. This would generally require land acquisition, particularly for additional treatment pond sites. Due to the built out characteristics of this project area, there is little opportunity to acquire land for new BMPs without acquiring a currently occupied parcel. Therefore, options for increased pollutant reduction are limited.



BMPs BY AREA		
WET POND (DETENTION)	118 acres	58.90%
RETENTION POND	25 acres	12.40%
EXFILTRATION	9 acres	4.60%
NONE	48 acres	24.10%
TOTAL	200 acres	100.00%

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 300 600
Feet

LEGEND

- HOWELL CREEK
- CASSELBERRY CITY LIMIT
- COUNTY LIMITS

BMP

- WET POND (DETENTION)
- RETENTION POND
- EXFILTRATION
- NO BMP

CONTRIBUTING AREA

- NORTH
- SOUTH

DATA SOURCES:
CITY LIMITS:SEMINOLE COUNTY,2008
STREETS:SEMINOLE COUNTY,2008
AERIALS:SEMINOLE COUNTY,2008

FIGURE 6-1

BMP EVALUATION MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

7.0 CORRECTIVE ACTION EVALUATION

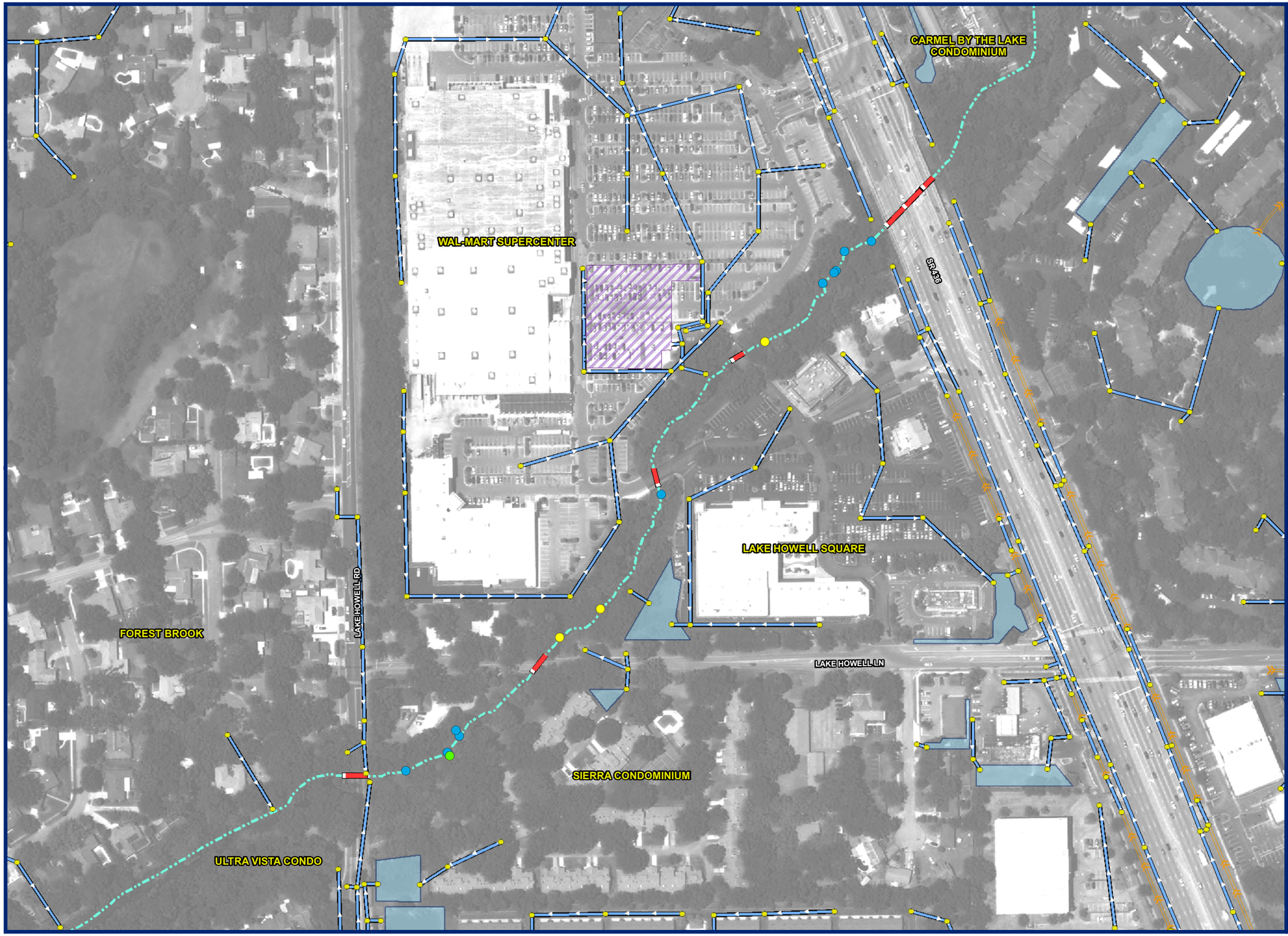
7.1 DEBRIS REMOVAL

7.1.1 Debris Evaluation

Based on the field assessment described in Section 3, there is an abundance of debris and trash in the creek which in some cases is blocking flow (limiting conveyance) and may be promoting bank sedimentation and undercutting. The removal of debris is warranted to restore proper conveyance and maintain a healthier environment.

Based on the field observations, Figure 7-1 (below following the photos) shows locations where debris removal is warranted. Debris were noted throughout the project creek section. The locations are categorized as either having trees (or dense vegetation) or trash. The categories are further classified as light or heavy. There are also several instances of trees and other vegetation having established itself in the flow line of the creek or at a high flow stage. The County would need to access the creek in several locations and conduct removal activities. Examples of the various debris are shown in the photos below:

Example of dense debris consisting of trees and other vegetation blocking flow path.
110 feet upstream of SR 436 (April 2009)



SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 100 200
Feet

LEGEND

- HOWELL CREEK
- PONDS
- EXFILTRATION AREA
- PIPES
- CHANNELS
- STRUCTURES
- BRIDGES

DEBRI TYPE

- LIGHT VEGETATION
- HEAVY VEGETATION
- TRASH
- LIGHT VEGETATION AND TRASH
- HEAVY VEGETATION AND TRASH

DATA SOURCE:
AERIALS:SEMINOLE COUNTY,2008

FIGURE 7-1

DEBRIS LOCATIONS MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

Example of light debris - tree in flow path. 240 feet downstream of Lake Howell Rd. (April 2009)

Example of a fallen tree across creek at a high flood stage.
195 feet downstream of Lake Howell Road (April 2009)

In many cases the trees and other vegetative materials have fallen in the creek bed affecting normal creek flow. In other cases, trees have fallen across the creek at a higher stage level which would not affect normal flows but could during extreme storm events. These higher level blockages could also become dislodged during extreme storm events and cause other blockage issues downstream. This could also be the case with other fallen trees that are currently perpendicular to flow and not causing issues – they may under extreme storm events dislodge and cause issues. For that reason all fallen trees should be removed.

This material could be addressed by hand with chainsaws and machetes. Due to the proximity of residential and commercial properties adjacent to the creek, it is likely not practical to

dispose of cuttings along the creek corridor so the material should be removed from the area. It is possible that some of the heavier debris may be used as toe of slope stabilization in areas of minor erosion or undercutting. However, care would need to be taken that the material be properly anchored to the channel bed to prevent it from becoming dislodged and impact creek conveyance. Note that care should be taken to not remove living material or disturb existing root systems. Since tree root systems provide for excellent bank stabilization, damage could result in tree mortality which could then lead to localized de-stabilization of creek banks.

Trash encounter consisted of shopping carts and other small debris (see typical photo below).

View of area of trash (shopping carts, etc.) inhibiting flow.
180 feet downstream of Lake Howell Lane (August 2009)

7.1.2 Debris Removal Recommendations

This material should be removed from the creek bed and disposed of in a proper manner. This would require setting up several collection stations at accessible areas of the creek which would then facilitate disposal in small dumpsters or vehicle mounted containers. The work should be done during the dry season when creek stages are minimal. Inspection and routine clean out of the creek should then be established under a maintenance schedule. This may be an opportunity for a special event volunteer clean-up activity; however, safety issues would need to be addressed due to the steep creek banks in many places.

Based on discussions with the SJRWMD in a permit determination meeting on January 28, 2010 (minutes included in Appendix F), no permit should be necessary to remove trash within creek as long as surrounding vegetation is not destroyed. Uprooting of living vegetation or moving soil would need to be evaluated on whether or not a permit would be necessary. No permit would be necessary to cut out dead limbs but the contractor would need to leave larger trunks / stumps that would provide a healthy habitat. Removing a large stump could require a dredge and fill permit.

7.2 BANK STABILIZATION

7.2.1 Bank Stabilization Background

Bank stabilization issues can occur under numerous circumstances including:

1. Areas where channel flow conditions are eroding or undercutting the bank, causing steeper slopes than soil type can support;
2. Areas where loss of natural vegetation (clearing, die-offs, etc.) removes natural bank protection and root support;
3. Areas where heavy loads are placed such as buildings or stockpiles;
4. Areas subject to lateral hydrostatic pressure from groundwater seepage.

Bank stabilization issues are closely related to erosion issues. This sub-section specifically addresses areas of impending bank slope failure whereas more minor erosion and sedimentation issues are addressed in the next sub-section.

7.2.2 Bank Stabilization Evaluation

No significant Circumstances 2 or 3 areas (listed above) were observed in the project corridor. A more intrusive geotechnical investigation would be required to confirm Circumstance 4 issues. Based on the foregoing, this report is focused on issues related to Circumstance 1.

7.2.3 Geotechnical Evaluation

Devo Engineering in their report (Appendix D) make several key observations regarding bank stability. Based on the soil types encountered:

- Side bank slopes of 2H:1V are likely to be stable for slope heights up to 8' provided that scour and erosion measures are in place;
- For higher slopes, the slope should not exceed 3H:1V; and
- Sheet piles if used to retain the side banks should have adequate penetration to avoid overturning (based on global stability analysis).

Based on their investigation, Devo Engineering identified six areas where observed distress warrants some type of bank stabilization measures. These were classified as having severe distress which warranted urgent attention in the short term. These locations are shown on Figure 7-2. Probable causes of the distress were noted including granular soils in the steep banks being eroded by stream flow which leads to bank collapse and loss of tree root support as well as inadequate scour protection in some areas. Four additional areas were classified as in moderate distress which could be retrofitted on a phased basis in the short to medium term. The probable causes of distress in these areas was similar, just not the same degree.

Recommended bank stabilization measure included gabion walls or sheet piles for side slope stabilization with either reno mattresses or rubble rip-rap for toe of slope and/or stream bed protection from erosion and scour. Articulated concrete mats (cable concrete) could also be considered if cost effective. Seminole County has used these types of stabilization measures on numerous projects in the past including others in Howell Creek.

Consideration for a more soft approach to bank stabilization may also be considered. This may include less structural features such as geotextiles with anchoring systems, terracing, using or reusing natural materials such as timber and stumps as buttresses or some combination therein. In many cases these approached may be more economical but would not provide as

high degree of stabilization strength as hard approach measures. Differentiation between the applicability of the approach would rely on the results of a more detailed and intrusive geotechnical analysis. As such, they can be further evaluated during a future design and permitting phase.

7.2.4 Bank Stabilization Recommendations

Each of these six areas (BS-1 to BS-6 on Figure 7-2) is recommended for further detailed evaluation and design analysis. To complete a design effort, detailed topographical surveying of the locations as well as an intrusive geotechnical investigation to properly quantify localized soil and groundwater properties (including seepage) should be conducted. The five areas north of Lake Howell Lane lay within drainage, water and conservation easements of Lake Howell Square, while the remaining locations south of Lake Howell Lane lay within the properties of #2003 Lake Howell Lane and #547 Lake Howell Road. Coordination with the SJRWMD should also be conducted to determine permit requirements.

Based on discussions with the SJRWMD in a permit determination meeting on January 28, 2010 (minutes included in Appendix F), any type of structural bank stabilization or works that would require regrading would most likely require a permit. Bank stabilization less than 1 acre would most likely be a staff issued permit. Bank stabilization is a conveyance related issue relative to a specific location that normally doesn't require an individual permit regardless of the upstream contributing area. SJRWMD would require that calculations be submitted that demonstrate Pre vs. Post conditions (u/s and d/s stages, creek capacity, velocities, etc.) are equivalent or better with no significant impacts.

Whether this segment of creek is considered Sovereign Submerged Lands (SSL) by the State of Florida may have a bearing on permitting. Since the Howell Creek Water Control Structure Replacement project adjacent to the upstream edge of this project corridor had a positive SSL determination, it may be likely that this segment of Howell Creek would also carry that designation. If the area is considered SSL, the impact to permitting may be increased if there is significant works waterward of the "Ordinary High Water" elevation. If so, easement from the Florida Department of Environmental Protection may be required. If waterward impacts are minimal, the SJRWMD may be able to issue the permit in-house. This determination of SSL and applicable Ordinary High Water elevation should be determined prior to proceeding with further design and permitting efforts.

#BS-6: BANK AND STREAM BED PROTECTION - GABION WALL AND RENO MATTRESS TO PREVENT EROSION AND STABILIZE STREAM BANKS

#BS-5: BANK AND STREAM BED PROTECTION - SHEETPILES WITH RUBBLE RIP RAP AT ITS BASE TO PREVENT SCOUR AND UNDER-MINING OF THE SLOPES

#BS-4: BANK AND STREAM BED PROTECTION - RUBBLE RIP RAP IN CHANNEL TO PREVENT UNDER-SCOUR OF STREAM BED TOGETHER WITH RENO MATTRESS ALONG BASE OF STREAM BANKS TO TRAIN THE FLOW

#BS-3: BANK AND STREAM BED PROTECTION - GABION WALL AND RENO MATTRESS TO PREVENT EROSION AND STABILIZE STREAM BANKS

#BS-2: BANK AND STREAM BED PROTECTION - SHEETPILES WITH RUBBLE RIP RAP AT ITS BASE TO PREVENT SCOUR AND UNDER-MINING OF THE OUTFALL STRUCTURE

#BS-1: BANK AND STREAM BED PROTECTION - GABION WALL AND RENO MATTRESS TO PROTECT AND STABILIZE STREAM BANKS

WAL-MART SUPERCENTER
FOREST BROOK
HARBOR AT LAKE HOWELL
LAKE HOWELL SQUARE
MCDONALDS
SUPERWASH
LAKE HOWELL BIBLE CHAPEL
SIERRA CONDO
OPAL TERRACE
PUBLIC STORAGE
LAKE HOWELL RD
TUSCARORA TRL
BROOKWOOD LN
LAKE HOWELL LN
SIERRA LN
RUBY CT
SR 439
MARINA PT
CROW WAY
VININGS LN

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 80 160
Feet

LEGEND

- HOWELL CREEK
- STRUCTURES
- BRIDGES
- PIPES
- CHANNELS
- PONDS
- EXFILTRATION AREA

DATA SOURCE:
AERIALS:SEMINOLE COUNTY,2008

FIGURE 7-2
BANK STABILIZATION AREAS MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

7.3 EROSION & SEDIMENTATION CONTROL

7.3.1 Erosion and Sedimentation Background

Erosion generally occurs when channel velocities are high enough to dislodge soil particles and transport them downstream. The degree of erosion depends on the properties of the soil and the geometry of the channel section. Cohesionless, small particle soils such as fine sands erode easily, while heavier particles such as gravel and boulders require more energy to suspend. Sand particles easily deposit once velocities are reduced. Cohesive soils such as clays tend to be less susceptible to eroding, but once suspended are more difficult to settle out due to the small particle size.

Geometric conditions in channels can enhance the effects of erosion. These include areas where channel slopes steepen or the channel cross-section decreases causing velocities to increase over short distances. This generally causes stream bed erosion where sediments are suspended and carried downstream. Also, areas with sharp bends tend to increase velocities and directional forces causing erosion to the outside of the turn.

Scour effects can also occur where geometric irregularities are present, particularly associated with man-made structures such as bridge piers, water control structures, or downstream of culverts. Areas where debris or dense vegetation collects in the channel can also cause localized erosion as stream flow is forced towards the channel banks and cause undercutting and or bank failure.

Common engineering techniques to reduce erosion and sedimentation include the following:

1. **Grade Control Structures** – These are in-line structures which act to flatten the creek slope in localized areas creating a stair step effect. The result is lower relative velocities which reduce erosion and sedimentation. These are typically constructed as weirs of concrete or rubble rip-rap. They can be designed to promote a pooling effect upstream of the structure which may promote sediment settling and enhanced habitat for aquatic species and wading birds. They are typically designed to be submerged during storm stage flows so that head loss effects are minimal to prevent upstream flooding. If the design includes enough of a drop to promote mixing of the creek flow, then aeration can occur which promotes increases in dissolved oxygen. Often the same dissolved oxygen entrainment can be achieved at a grade control structure than can be achieved over several thousand feet of gradually sloping channel. Design of these structures is hydraulic modeling intensive and care should be taken to provide scour protection. Improvements can be localized and would not generally require land acquisition and therefore may be more economical when compared with other improvement measures. Grade control could be feasible in the tight corridor; however, the vertical drop through the segment is only 1.5 feet. This makes grade control impractical for this project.

2. **Sedimentation Basins** – These basins are typically constructed off-line and function by diverting portions of normal creek flow into a settling basin where sediment can be captured. The flow then returns to the creek corridor through a control structure. These systems are typically fitted with a high level by-pass structure in the main creek channel to allow storm flows to pass downstream

avoiding head loss and stage impacts upstream. The disadvantage of sedimentation basins is that they can be land intensive, which is difficult to come by in an established urban creek. Design of these basins is hydraulic modeling intensive and a long term maintenance schedule for clean out should be established. Unless designed with grade control features, these improvements are more focused on sedimentation removal that direct erosion reduction. These improvements can be costly, particularly when significant land acquisition is involved. For the project corridor from Lake Howell Road to SR 436, available land is limited and generally at a higher relative grade. As such, the application of a sedimentation basin improvement is unfeasible.

3. **Creek Bed Meandering & Diversioning** – When compared with linear creeks, meandering creeks provide for gentler slopes over the same vertical drop. This results in lower relative channel velocities which in turn reduces the occurrence of erosion and sedimentation. The more natural corridor can also provide for habitat enhancement. The disadvantage of meandering is that it is land intensive and typically not feasible for an established urban creek. Meandering can be implemented on the main channel or can be in the form of the installation of diversionary channels. Design of these features is hydraulic modeling intensive. This type of improvement can be costly, particularly when significant land acquisition is involved. For the project corridor from Lake Howell Road to SR 436, available land is limited and generally at a higher relative grade. As such, the application of a meandering improvement is unfeasible.
4. **Creek Bed & Bank Armoring** - This category includes common solutions such as rubble rip-rap, gabion rock baskets, reno mattresses, articulated concrete mats (cable concrete). These are installed to armor the stream grade and prevent erosion and sedimentation from occurring by holding sediments in-place. These installations have an advantage over concrete ditch lining in that the improvements are porous and allow for the establishment of vegetation and allow for passage of groundwater seepage preventing the buildup of hydrostatic pressures. When installed and anchored properly, they can provide long-term stabilization. Care must be taken to address any velocity increases due the lower channel roughness. However, the high cost of these improvements over a large area makes widespread utilization impractical. Rather they are more suited to localized improvement solutions where there is a higher cost-benefit. If the channel cross-section and stream bed elevations are maintained, then hydraulic modeling may not be necessary for design. These improvements can be adapted to the various physical characteristics of the subject Howell Creek section and would be considered applicable for implementation.

7.3.2 Erosion and Sedimentation Evaluation

An evaluation of physical characteristics of the creek which may effect or promote the occurrence of erosion and sedimentation were evaluated based on the field observations, field survey, and hydraulic modeling discussed in previous report sections. A summary of key points is proved as follows:

- Based on the survey data and the profile plot on Exhibit 3, the channel drops approximately 54.5’ NGVD to 53’ NGVD (~1.5’) drop over approximately 1900’

from the downstream side of Lake Howell Road to the upstream side of SR 436 (slope of ~0.0008 ft/ft).

- Cross-sections
  - Cross-sections in the segment between Lake Howell Road and Lake Howell Lane are fairly shallow with bank heights on the order of 4 to 6 feet and main channel widths on the order of 30 to 40 feet wide.
  - Downstream of Lake Howell Lane the banks deepen with heights on the order of 15 to 20 feet through Lake Howell Square, with the channel width expanding to approximately 120 feet.
  - Closer to SR 436 the cross-section widens near the bridge with bank heights down closer to 10 feet high and channel widths expanding to upwards of 180 feet.
- Based on the velocity results from the modeling data:
  - Design storm velocities in the segment between Lake Howell Road and Lake Howell Lane are on average in the 3 to 4 feet per second (fps) range (see Exhibit 3 and Appendix E). These are considered to be moderately erosive, higher than typical allowable design velocities for fine sands and sandy loams of ~1.5 to 2 fps for average flow depths of approximately 3 feet. Peak velocities upstream of Lake Howell Road reach slightly higher.
  - As the flow reaches the bridge at Lake Howell Lane, velocities decrease into the 2 to 3 fps range for a short distance as the creek cross-section widens. These velocities would generally be considered marginally erosive.
  - As flow approaches the western Lake Howell Square bridge, velocities increase slightly to the erosive 3 to 5 fps range due to bridge hydraulics and the changes in creek cross-section.
  - As flow reaches the eastern Lake Howell Square bridge, velocities increase up to the 6 fps level which are typically highly erosive.
  - As the flow approached SR 436, the velocity ranges are wider on the order of 3 to 7 fps which is typically erosive. The wider range is likely due to the rapid decrease in cross-section downstream of SR 436.
- Based on the profile plots, localized areas of scour are apparent (Exhibits 3):
  - Upstream of Lake Howell Lane near a bend in the creek. This location is just upstream of where the former dam structure was present which may have contributed to the scour in this area.
  - Just upstream of the eastern Lake Howell Square bridge. This location appears to correspond to a location of velocity increase in the creek as it passes underneath the bridge.

- Significant undercutting erosion is present at changes in creek direction including numerous locations between Lake Howell Road and Lake Howell Lane (particularly where the creek bends) and bend locations near the Lake Howell Square bridges. These are evidenced by bank undercutting with root exposure on the outside of the bend as well as sediment deposition on the inside of the bend.

Based on the foregoing, general erosion and sedimentation issues occur throughout the project creek corridor. Addressing the erosion is a significant concern in this corridor due to the proximity of the residences and commercial businesses along the sides of the creek. Several of the more severe areas of erosion and bank undercutting near bends and structures in the creek that warrant immediate corrective action were addressed under the Bank Stabilization sub-section.

7.3.3 Geotechnical Evaluation

Devo Engineering in their report (Appendix D) makes several key observations regarding erosion and sedimentation. Based on the soil types encountered, soils in the area tend to be fine sands which are easily erodible and scour protection is recommended. There were many areas where erosion was observed; particularly undercutting the bank bottoms exposing roots. Other details were discussed previously in sub-section 7.2.3.

7.3.4 Erosion and Sedimentation Recommendations

Implementing Stream bank armoring is considered warranted for localized fixes at the stream bank problem areas addressed in the bank stabilization recommendations in sub-section 7.2. Developing improvement solutions for these areas should address the primary deficiencies noted in the report. It is recommended to revisit the issue of general erosion and sedimentation in the creek corridor subsequent to implementation and several years of monitoring these improvements to determine whether additional measures are warranted in the future.

Permitting for these improvements would likely be necessary with the SJRWMD. Refer to the general discussion of permitting requirements and sovereign submerged land issues discussed previously in Section 7.2.4.

7.4 STRUCTURE EVALUATION

During the field inspection, observations were made of drainage structures along the project corridor and deficiencies noted. The inspection was limited to the bridges and pipe outfalls entering the creek. The goal was to identify any visual evidence of erosion or imminent structural collapse which may impact the outfalls to the creek or the creek itself and which warranted corrective actions. Note that the inspection was not a structural integrity evaluation (i.e., no intrusive testing) - rather it was based solely on visual observation at the time of field inspections.

7.4.1 Outfalls

Pond outfalls and storm sewer system discharge points enter the creek at several locations. These include the following locations:

SR 436	
#S1: Outfall pipe from the SR 436 (northbound) storm sewer system on the north side of the creek – location within SR 436 Right-of-Way (April 2009). No structure or wash-out issues observed – minor clearing of vegetation, debris, and sediments warranted. Placement of rip-rap recommended to dissipate velocities.	
#S2 Outfall pipe from SR 436 (northbound) storm sewer system on the south side of the creek – location within SR 436 Right-of-Way (April 2009). No structure or wash-out issues observed – minor clearing of vegetation, debris, and sediments warranted. Placement of rip-rap recommended to dissipate velocities.	

SR 436 - continued

#S3: Outfall pipe from SR 436 (southbound) storm sewer system on the north side of the creek – location within SR 436 Right-of-Way (April 2009). No structure or wash-out issues observed – minor clearing of vegetation, and sediments warranted. Placement of rip-rap recommended to dissipate velocities.	
#S4: Southwest outfall pipe from SR 436 (southbound) storm sewer system on the south side of the creek upstream – location within SR 436 Right-of-Way (April 2009). No structure or wash-out issues observed – minor clearing of vegetation warranted. Placement of rip-rap recommended to dissipate velocities.	

Lake Howell Square	
#S5: Outfall pipe from the exfiltration system of Wal-mart Supercenter on the north side of the creek – location within Lake Howell Square drainage, water and conservation easement (August 2010). No structure or wash-out issues observed – moderate clearing of vegetation warranted.	
#S6: Outfall pipe from Lake Howell Square pond at the north of Lake Howell Lane (westbound) on the east side of the creek – location within Lake Howell Square drainage, water and conservation easement (August 2010). No structure or wash-out issues observed – moderate clearing of vegetation and maintenance of riprap warranted.	

Lake Howell Lane

#S7: Outfall pipe from Lake Howell Lane storm sewer and Sierra Condo pond on the east side of the creek north of Lake Howell Lane (westbound) – location within Lake Howell Lane Right-of-Way and the Lake Howell Square drainage, water, conservation easement (April 2009).

No structure or wash-out issues observed at the pipe end, however, washout and deterioration noted at bottom of flume – moderate clearing of vegetation warranted. Maintenance of flume and rip-rap recommended to dissipate velocities from pipe.

Lake Howell Road

#S8: North outfall pipe from Lake Howell Road storm sewer system on the north side of the creek – location within Lake Howell Road Right-of-Way (April 2009).

No structure or wash-out issues observed – minor clearing of vegetation warranted. Placement of rip-rap recommended to dissipate velocities at drop from outfall.

Lake Howell Road - continued	
#S9: South outfall pipe from Lake Howell Road storm sewer system on the south side of the creek – location within Lake Howell Road Right-of-Way (April 2009). No structure or wash-out issues observed. Placement of rip-rap recommended to dissipate velocities at drop from outfall.	

These locations are shown on Exhibits 1 & 2 and on Figure 7-4 later in this report section.

7.4.2 Bridges / Culverts

Florida Department of Transportation (FDOT) bridge inspection reports were obtained for the bridges on Lake Howell Lane and Lake Howell Road to determine the presence of any structural concerns that may impact the project recommendations. These reports were not readily available for the SR 436 bridges. Both these locations are maintained by Seminole County. Note that Inwood did not perform a structural evaluation of the bridges and culverts, just general field observations focused on erosion and sedimentation. Review of the documents indicates the following:

- **Lake Howell Road Bridge (2008 Inspection):** It was noted that the bridge was constructed in 1942 and later widened. Overall, the bridge was noted to be in good condition structurally with only minor issues with cracking. Recommendations were made to backfill and stabilize the undermining of the sand cement bags at both abutments as well as stabilizing some erosion on the southeast and southwest channel slopes.
- **Lake Howell Lane (2008 Inspection):** It was noted that the bridge was constructed in 1961. Overall, the bridge was noted to be in good condition structurally with only minor issues with vegetation and recommendations to address cracking, delamination, and voids associated with the abutments / wingwalls. Recommendations were also made to repair the undermining at the northwest drainage flume and southeast approach sidewalk.

Inwood's field observations support the FDOTs observations regarding conditions of vegetation, undermining, and erosion stabilization. Photos of these locations are provided below. These locations are also noted on Figure 7-3.

#S10: Panoramic view to east (downstream) towards Howell Lake Road bridge (December 2008) – pedestrian bridge in foreground. Note sediment build up on southwest bank due to approach angle of creek. Note also slight linear distortion along bridge deck due to photographic rendering.

#S10: View to west (upstream) Lake Howell Road bridge (May 2009). Note PVC utility crossing. Note also turbidity barrier placed due to upstream water control structure construction.

#S11: View to southwest (upstream) under Lake Howell Lane bridge (May 2009).

#S11: View to northeast (downstream) under Lake Howell Lane bridge (May 2009). Note primary creek flow through the east span.

Pertinent details of Inwood's inspection of the bridges in Lake Howell Square and at SR 436 are depicted in the photos below:

#S12: View to northeast (downstream) at western wood span bridge in Lake Howell Square. Note bend in creek causing erosion and undercutting (see also photo below) on outside bank in creek and depositing sediments on inside bank. (April 2009)

#S12: View to southwest (upstream) at western wood span bridge in Lake Howell Square. Note separation failure of the fabric-form concrete bank stabilization on left (south) side of creek. (May 2009)

#S13: View to northeast (downstream) at eastern wood span bridge in Lake Howell Square. Note bend in creek causing erosion and undercutting (see also photo below) on outside bank in creek and depositing sediments on inside bank. (April 2009)

#S13: View to northeast (downstream) at eastern wood span bridge in Lake Howell Square. Note separation failure of the fabric-form concrete bank stabilization on left (south) side of creek. (April 2009)

#S14: View to northeast (downstream) at southbound side of SR 436 bridge. Note widened creek cross-section. No major erosion issues observed, but minor sedimentation present. (April 2009)

#S14: View to southwest (upstream) at northbound side of SR 436 bridge. Note widened creek cross-section. No major erosion issues observed, but minor sedimentation present. (April 2009)

7.4.3 Miscellaneous Structure Issues

During the field reconnaissance, three miscellaneous items were noted that should be addressed. These are summarized below:

#S15: Just few feet downstream of the Lake Howell Lane bridge, an exposed utility line is present traversing the creek bed. This appears to be ductile iron force main and may be water or sanitary. Efforts should be made to provide protection to maintain the integrity of the utility. (April 2009)	
#S16: Just 60 feet upstream of Lake Howell Lane, the remnants of an old dam are present (as mentioned previously in Sections 2 and 3 of this report). The remaining concrete walls along the south bank and the debris in the creek bed should be removed so that they do not inhibit flow in the creek. (April 2009)	
#S17:Just 160 feet Downstream of Lake Howell Road, a circular brick structure is present on the south bank which has been undermined and is slipping into the creek. The purpose of this structure is uncertain. This structure should be removed or if repaired if it is determined to serve a specific purpose. (April 2009)	

7.4.4 Structure Recommendations

Based on the foregoing, the following recommendations are provided regarding structures along the creek corridor:

- Pipe Outfalls
  - General vegetation clearing and rip-rap stabilization where indicated for #S1 to #S9. This can be conducted as part of a routine maintenance program.
  - Repair of the flume on the northeast side of Lake Howell Lane (#S7) should be addressed. This could be accomplished in conjunction with the bank stabilization measures recommended for this area in Section 7.2.
- Bridges & Culverts
  - *Lake Howell Road (#S10)* – minor repairs to address undermining at the abutments and erosion & sedimentation along the creek banks
  - *Lake Howell Lane (#S11)* – address undermining issues associated with the northeast drainage flume (as mentioned above under outfalls)
  - *Western wood span bridge at Lake Howell Square (#S12)* – repairs to bank stabilization under the bridge on the south side of the creek. This could be accomplished in conjunction with the bank stabilization measures recommended for this area in Section 7.2.
  - *Eastern wood span bridge at Lake Howell Square (#S13)* – repairs to bank stabilization under the bridge on the south side of the creek. This could be accomplished in conjunction with the bank stabilization measures recommended for this area in Section 7.2.
  - *SR 436 (#S14)* – no specific recommendations.
- Miscellaneous Structures
  - Address exposed utility crossing traversing creek bed (#S15). This could be accomplished in conjunction with the bank stabilization measures recommended for this area in Section 7.2.
  - Remove former dam structure (#S16)
  - Remove circular brick structure (#S17)

These recommendations are shown geographically on Figure 7-3 (S-1 through S-17).

Potential permitting requirements for these activities were discussed with the SJRWMD in a permit determination meeting on January 28, 2010. In general, many activities associated with maintenance of structures do not require a permit. Review of rule 40C-4.041 "Permits Required" indicates that these spot fixes generally do not trip the thresholds requiring permits for overall project size or impervious area addition individually. If many of the projects are done at the same time, the accumulated area may trip the thresholds. However, a permit is generally required for projects located wholly or partially on wetlands or other surface waters which these improvements would be considered. There is an exclusion for "construction and alteration of outfall pipes less than 20 feet in length in wetlands or other surface waters, associated headwalls, erosion control devices, and energy dissipation structures" under which much of the recommended work may fall. Confirmation of permit requirements should be revisited and confirmed with SJRWMD once the improvements are scheduled for implementation. Refer to Appendix F for the SJRWMD meeting minutes.

#S14: NO RECOMMENDATIONS.

#S1: CLEAR VEGETATION, DEBRIS, & SEDIMENTS. ADD RIP-RAP.

#S3: CLEAR VEGETATION, DEBRIS, & SEDIMENTS. ADD RIP-RAP.

#S13: ADDRESS EROSION AND SEDIMENTATION, REPAIR FABRI-FROM CONCRETE BANK PROTECTION

#S4: CLEAR VEGETATION, ADD RIP-RAP.

#S2: CLEAR VEGETATION, DEBRIS, & SEDIMENTS. ADD RIP-RAP.

WAL-MART SUPERCENTER

HARBOR AT LAKE HOWELL

#S5: CLEAR VEGETATION.

FOREST BROOK

LAKE HOWELL RD

SR 439

MARINA PT

#S12: ADDRESS EROSION AND SEDIMENTATION, REPAIR FABRI-FROM CONCRETE BANK PROTECTION

#S15: PROVIDE PROTECTION FOR EXPOSED UTILITY LINE TRAVERSING CREEK BED

CROWWAY

VININGS LN

#S11: ADDRESS UNDERMINING OF NORTHEAST DRAINAGE FLUME (SEE #S7)

#S6: CLEAR VEGETATION, MAINTENANCE OF RIP-RAP.

TUSCARORA TRL

#S17: REMOVE FAILING CIRCULAR BRICK STRUCUTRE

LAKE HOWELL SQUARE

BROOKWOOD LN

#S7: CLEAR VEGETATION, ADDRESS WASH-OUT AT BOTTOM OF FLUME. ADD RIP-RAP.

MCDONALDS

LAKE HOWELL LN

#S8: CLEAR VEGETATION, ADD RIP-RAP.

SIERRA LN

#S10: ADDRESS UNDERMINING AT ABUTMENTS, AND EROSION ON SOUTHERN BANKS

LAKE HOWELL BIBLE CHAPEL

SUPERWASH

SIERRA CONDO

RUBY CT

#S16: REMOVE CONCRETE WALL AND RUBBLE FROM FORMER DAM

#S9: ADD RIP-RAP.

OPAL TERRACE

PUBLIC STORAGE

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

N

0 80 160
Feet

LEGEND

- HOWELL CREEK
- STRUCTURES
- BRIDGES
- PIPES
- CHANNELS
- PONDS
- EXFILTRATION AREA

DATA SOURCE:
AERIALS:SEMINOLE COUNTY,2008

FIGURE 7-3
STRUCTURE EVALUATION LOCATIONS MAP

Howell Creek Assessment

Lake Howell Road to SR 436

Inwood consulting engineers

7.5 WATER QUALITY

7.5.1 Contributing Area

Most of the surrounding area was developed since water quality regulations have been in place in the County and SJRWMD permitting programs. Based on the analysis in Section 6, the vast majority of surrounding developments appear to have water quality BMPs in place to treat runoff from the contributing area prior to discharge to Howell Creek. This is primarily in the form of wet detention and dry or under-drained retention ponds.

Based solely on areal BMP coverage, there does not appear to be any significant locations in the contributing area which do not have some type of current treatment. As a result, no specific recommendations are being made for additional BMPs in the contributing areas. The following should be noted, however, which may warrant consideration of additional BMPs in the future.

- The BMPs were in general permitted with presumptive treatment efficiency criteria. For example a wet detention pond may remove 50-80% of pollutants when certain runoff is detained for a prescribed period of time. More recently, studies have indicated that effective treatment may need more detailed engineering to support desired treatment levels taking into account long term storm loads, residence times, and even geometrical configuration. If conditions in the future warrant more detailed accounting of pollutant reduction, that may lead to the need for BMP performance enhancement and/or the implementation of additional BMPs to meet reduction goals.
- Retention systems operating with underdrain systems or exfiltration systems degrade over time through clogging of the filter media. This results in reduced stage recovery and accordingly reduced treatment volumes. This effects storm attenuation as well as water quality. Retrofit or replacement of these types of systems may be warranted at some time in the future if a more detailed accounting of pollutant loads reductions is required.

7.5.2 Creek Corridor

The presence of trash and other waste products in the creek is a water quality concern as chemicals and other pollutants may be introduced to the stream. The recommended debris removal measures in sub-section 7.1 should address this concern adequately as long as it is addressed regularly.

In the creek, erosive velocities can scour and suspend sediments. The transport of these sediments downstream to Lake Howell are a concern particularly if the particles have associated contaminants with them (adsorbed metals, hydrocarbons, nutrients, etc.). The stabilization measures proposed above in sub-sections 7.2 should address this adequately at this time.

Addressing pollutant loads originating upstream of this project area that pass through the subject corridor is not directly covered in this scope.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 ASSESSMENT SUMMARY

This report presents the results of an assessment of the portion of Howell Creek between Lake Howell Road and SR 436. The purpose of the report was to gain a general understanding of the project area through the collection, compilation, and evaluation of drainage infrastructure, physical characteristics, environmental & ecological, and water quality related data. This effort will result in the development of a baseline data set that can be used as the basis for more detailed assessment and corrective action measures in the future. In addition, intrusive field investigation and survey was also conducted to evaluate the creek segment with regards to hydraulic capacity, erosion & sedimentation, and structural conditions.

8.2 CONCLUSIONS

Based on the results of these efforts, the following conclusions with regard to the project area are provided:

- Lake Howell Road to Lake Howell Lane:
  - Erosion and sedimentation are promoted in this segment due to moderate velocities and the presence of several bends.
  - Debris (vegetation and trash) are present in many areas of the segment inhibiting proper conveyance. The localized debris and channel irregularities are promoting scour to occur in at least one location.
  - An area of severe bank de-stabilization was observed downstream of Lake Howell Road with bank undercutting exposing tree roots.
  - There are some minor deficiencies with the bank and abutment protection at the Lake Howell Road bridge.
  - A remnant dam structure is present just upstream of Lake Howell Lane which is mostly deteriorated and is no longer functioning. A failing brick structure is also present on the south bank.
- Lake Howell Lane to SR 436:
  - Erosion and sedimentation are also promoted in this segment due to moderate velocities and the presence of several bends.
  - Debris (vegetation and trash) are present in many areas of the segment inhibiting proper conveyance. The localized debris and channel irregularities are promoting scour to occur in at least one location.
  - The fabric formed concrete banks protection under the two wood span bridges in Lake Howell Square have failed in several places.
  - Five areas of severe bank de-stabilization exist – one at just downstream of Lake Howell Lane, one at the approach to the west Lake Howell Square bridge, under each Lake Howell Square bridge, and then downstream between the east Lake Howell Square bridge and SR 436.

- Minor maintenance issues exist at the various outfall pipes entering the creek including removing sediments (de-silting) clearing of vegetation and the need for rip-rap for velocity dissipation.
- An exposed utility line exists in the stream bed on the downstream side of Lake Howell Lane.

- Ecological Observations:
  - Jurisdictional wetlands exist along the creek in the project area.
  - Wetlands generally appear healthy but indications of stress are present and native wetland vegetation is lacking in many areas.
  - The urbanization of the uplands surrounding the creek has lead to a decline in the overall abundance and diversity of native wetland vegetation and an increase in amount of nuisance/exotic species.
  - Lack of suitable floodplain along the banks leaves little area for native vegetation to remain established and create the canopy normally associated with this type of system.
  - The high velocity flow through the creek corridor inhibits proper hydration of some portions of the wetlands.
  - The area provides habitat, but quality is low due to surrounding urbanization.
  - Any future restoration or improvement work in the project area would be considered a wetland impact and would require permitting from SJRWMD and the ACOE.
- Water Quality Observations:
  - The majority of the contributing area to the creek in the project area has some form of BMP to reduce pollutant loads prior to discharge to the creek. The pollutant load reduction of these BMPs is generally based on presumptive criteria.
  - Future pollutant load reduction goals established as part of TMDL efforts the Lake Jesup BMAP (which affects Lake Howell by association) may direct the County to evaluate the implementation of additional BMPs or enhancements to existing BMPs.
- Corrective Action Evaluation Observations:
  - The presence of vegetative and trash debris in the creek warrant clean up.
  - The six areas of identified severe bank de-stabilization warrant addressing.
  - Implementing erosion and sedimentation measures as part of the bank stabilization efforts should help to further address deficiencies.
  - Structure maintenance is warranted primarily to clear vegetation and add rip-rap.

8.3 RECOMMENDATIONS

Based on the above stated conclusions and the evaluations presented in Section 7 of this report, the following recommendations are made:

1. Conduct a ***debris removal*** effort through either County in-house maintenance staff or through a contractor. A Debris Management Plan should be developed to address vegetative debris management and safety issues.
2. Proceed with design and permitting efforts to implement ***bank stabilization*** efforts at the six identified locations. The improvements should consider the use of hard armoring options such as gabions, reno mattresses, sheet piles, rubble rip-rap, and/or articulated concrete mats (cable concrete) as cost effective solution alternatives. Soft approaches to bank stabilization such as geotextiles, terracing, or vegetative buttresses could also be evaluated for cost effectiveness if strength requirements area met. The problems are considered location-specific issues, so implementation could occur all at once or incrementally based on available funding. It is recommended that these be implemented from upstream to downstream so that newly improved areas are not negatively impacted by upstream construction.
3. Proceed with ***de-silting, vegetation removal, and stabilization measures*** for the various pipe outfalls entering the creek. This could be performed through either County in-house maintenance staff or through a contractor. A Structure Maintenance Management Plan should be developed to address these actions as well as safety issues.
4. Note that some of the areas discussed in the above bullets lay outside of County property and/or easements so legal property access should be investigated.

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Appendix A
Report Excerpts

SJRWMD 1984

Technical Publication SJ 84-9

HOWELL BRANCH BASIN SURFACE WATER MANAGEMENT STUDY PHASE I

(VOLUME I)

by

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St. Johns River Water Management District

P. O. Box 1429
Palatka, Florida

August 1984

Project Number 20 200 05

TABLE 6. Comparison of Peak Discharges under Existing Conditions and Future Development.

LOCATION	DRAINAGE AREA (Sq. Mi.)	PEAK DISCHARGE (cfs) EXISTING CONDITIONS 25-yr 6-hr	10-yr 24-hr	25-yr 24-hr	100-yr 24-hr	FUTURE DEVELOPMENT 25-yr 6-hr	10-yr 24-hr	25-yr 24-hr	100-yr 24-hr
HOWELL CREEK									
At the Osceola Chain of Lakes	5.85	50	70	105	185	60	80	115	200
At Park Lake	3.60	140	125	185	350	160	145	210	375
At Lake Minnehaha	1.64	65	75	110	190	75	85	120	205
At Lake Maitland Weir	13.16	185	220	335	615	215	245	370	665
At SR 436	14.74	605	550	740	1160	730	665	870	1320
At Lake Howell	19.95	460	510	715	1310	520	570	800	1420
At Tuskawilla Road	21.11	530	535	750	1380	580	605	840	1510
At Subbasin H15	22.63	1000	920	1270	2300	1120	1040	1410	2490
At Confluence with Bear Creek	24.32	1350	1230	1680	2900	1480	1360	1820	3070
At SR 419	43.50	3180	2910	3970	6600	3540	3260	4390	7130
At Mouth of Howell Creek	45.51	3170	3060	4180	6930	3570	3410	4590	7460

TABLE 8. Continued . . .

STATION	IDENTIFICATION	FLOOD ELEVATION (ft.) EXISTING CONDITIONS 10-yr 24-hr	25-yr 24-hr	100-yr 24-hr	25-yr 6-hr	FUTURE DEVELOPMENT 10-yr 24-yr	25-yr 24-hr	100-yr 24-hr	25-yr 6-hr
333 + 15	Dodd Road (HS-17)	47.7	48.1	49.3	47.7	47.8	48.2	49.6	47.7
377 + 50	Dam at Jericho Drive (HS-19)	56.3	57.0	58.1	56.3	56.5	57.2	58.3	56.4
429 + 00	Lake Howell	56.4	57.1	58.4	56.4	56.6	57.3	58.6	56.5
481 + 00	SR 436 (HS-24)	56.5	57.2	58.5	56.4	56.7	57.4	58.7	56.6
494 + 45	Lake Howell Lane (HS-25)	60.7	61.1	61.9	60.8	60.9	61.4	62.1	61.1
498 + 45	Lake Howell Road (HS-27)	61.3	62.0	63.5	61.5	61.7	62.5	64.1	61.9
516 + 00	Mouth of Lake Waumpi	62.0	62.7	64.2	62.2	62.4	63.2	64.7	62.6
558 + 75	Temple Trail	65.9	66.5	67.3	66.0	66.2	66.7	67.5	66.3
575 + 45	Lake Maitland Weir	67.4	67.8	68.6	67.2	67.5	67.9	68.7	67.4
605 + 60	Lake Maitland	67.7	68.3	69.1	67.5	67.8	68.5	69.2	67.7
660 + 90	Palmer Avenue	67.9	68.5	69.3	67.6	68.0	68.6	69.4	67.8
681 + 20	Lake Osceola	67.9	68.5	69.4	67.6	68.0	68.7	69.5	67.8
708 + 20	Osceola Avenue	67.9	68.5	69.4	67.6	68.0	68.7	69.5	67.8
733 + 00	Lake Virginia	67.9	68.5	69.4	67.6	68.0	68.7	69.5	67.9
756 + 10	Stirling Avenue	68.1	68.7	69.9	67.7	68.2	68.9	70.1	68.0
776 + 90	Pennsylvania Avenue	68.3	68.9	70.1	67.9	68.4	69.1	70.3	68.1
805 + 50	Lake Sue	73.3	73.7	74.5	73.2	73.4	73.8	74.6	73.4

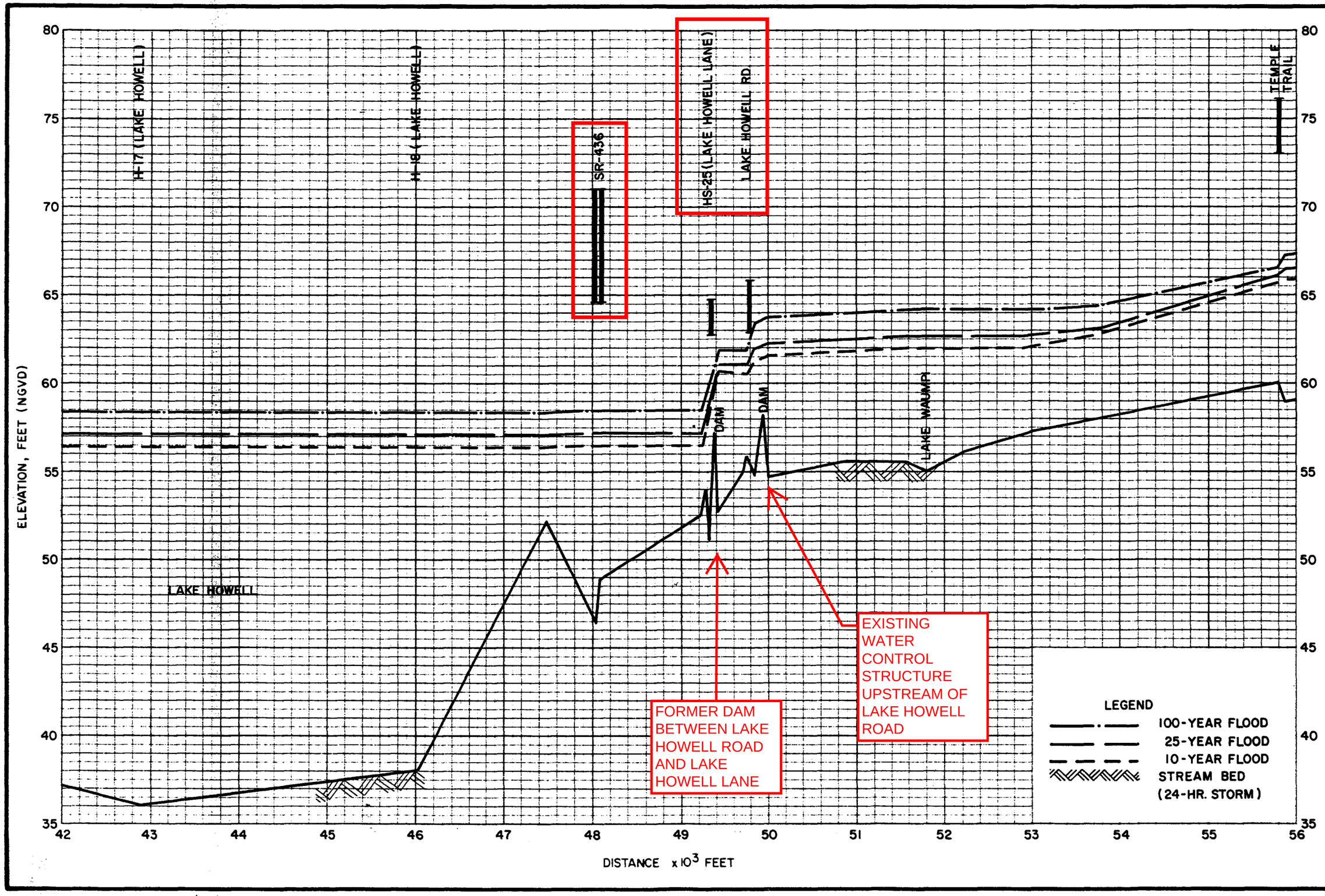
Upstream

Downstream

FIGURE 5. Howell Creek at State Road 436.

TABLE 9. Comparison of Flood Elevations under Existing Conditions as Estimated by SJRWMD and USACOE.

LOCATION	FLOOD ELEVATION (ft) 10-YEAR SJRWMD	10-YEAR USACOE	100-YEAR SJRWMD	100-YEAR USACOE
HOWELL CREEK				
At Lake Jessup	8.1	8.1	9.8	9.8
At SR 419	11.6	13.9	14.9	15.3
At Confluence with Bear Creek	15.6	15.1	19.1	18.4
At Tuskawilla Road	40.0	39.2	42.9	43.5
At Lake Howell	56.4	55.2	58.4	56.6
At SR 436	56.5	57.0	58.5	58.4
At Lake Waumpi	62.0	61.6	64.2	63.5
At Lake Maitland	67.7	67.7	69.1	68.3
At Lake Osceola	67.9	67.7	69.4	68.3
At Lake Virginia	67.9	67.7	69.4	68.3
At Lake Mizell	67.9	67.7	69.4	68.3
At Lake Minnehaha	68.2	67.7	70.1	68.3
At Lake Berry	70.8	70.7	71.8	71.7
At Lake Sue	73.3	73.7	74.5	74.8
At Lake Rowena	73.5	73.7	74.9	74.8
At Park Lake	72.4	71.9	76.0	72.7
At Lake Killarney	84.9	84.2	86.3	85.4
At Lake Bell	90.3	90.8	91.4	92.4
BEAR CREEK				
At Bear Gully Lake	51.9	51.2	53.3	53.3
At Garden Lake	55.8	55.2	57.2	55.7



FLOOD PROFILES OF HOWELL CREEK UNDER EXISTING CONDITIONS (STATION 420 TO STATION 560)

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
PALATKA, FLORIDA

FIGURE C-1d

SJRWMD 1994

Technical Publication SJ94-3

FLOOD MANAGEMENT STUDY
HOWELL CREEK BASIN
ORANGE AND SEMINOLE COUNTIES, FLORIDA

by

Donthamsetti V. Rao, Ph.D., P.E.
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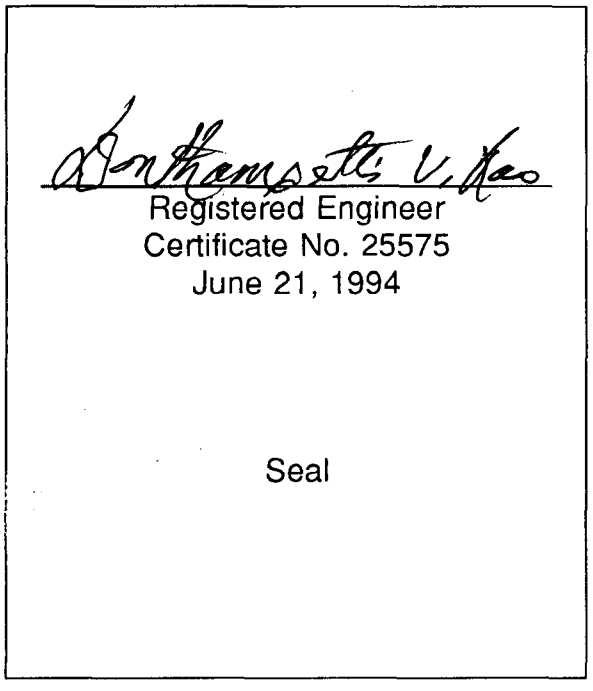


St. Johns River Water Management District
Palatka, Florida

1994

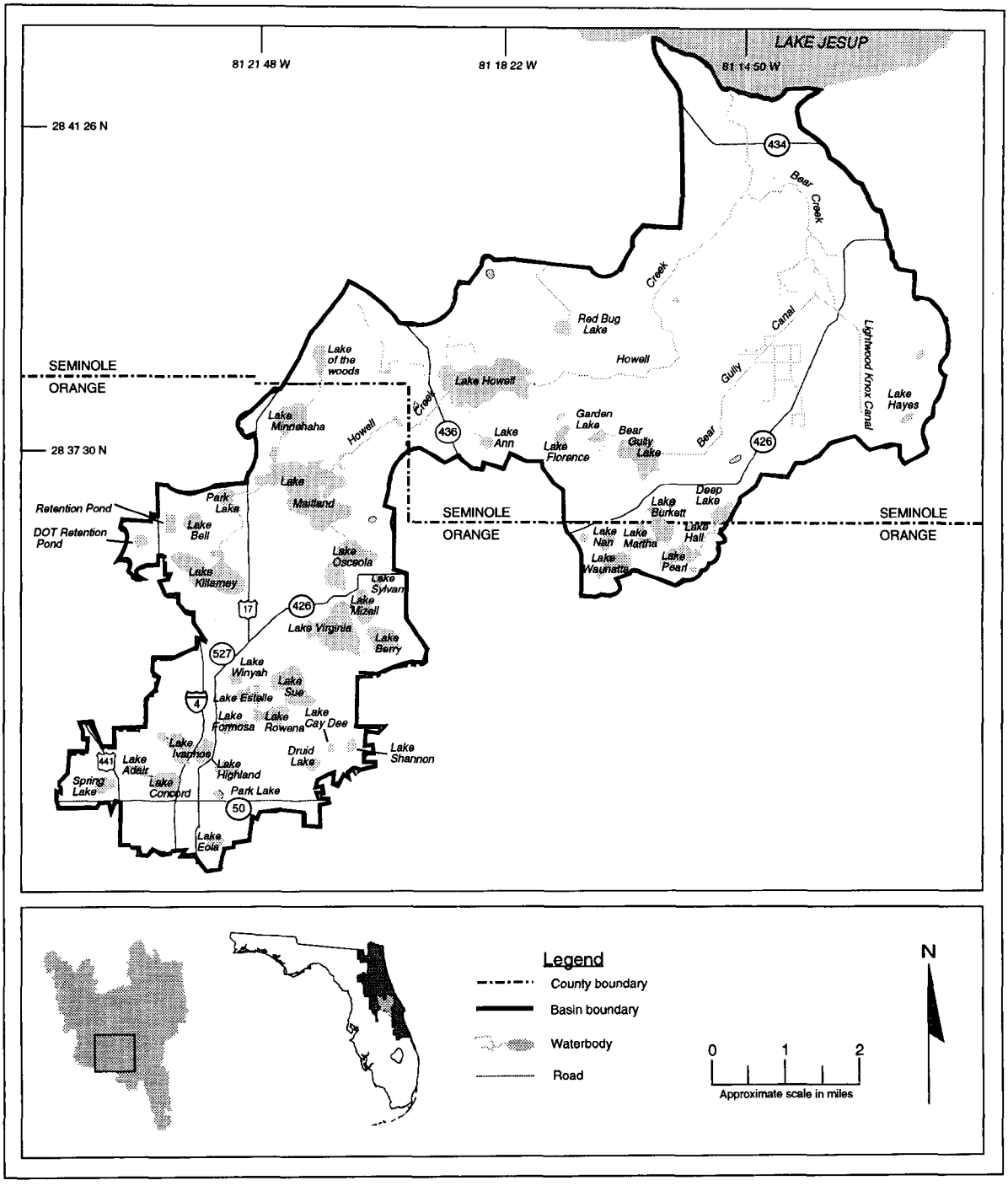


Figure 2. The Howell Creek Basin

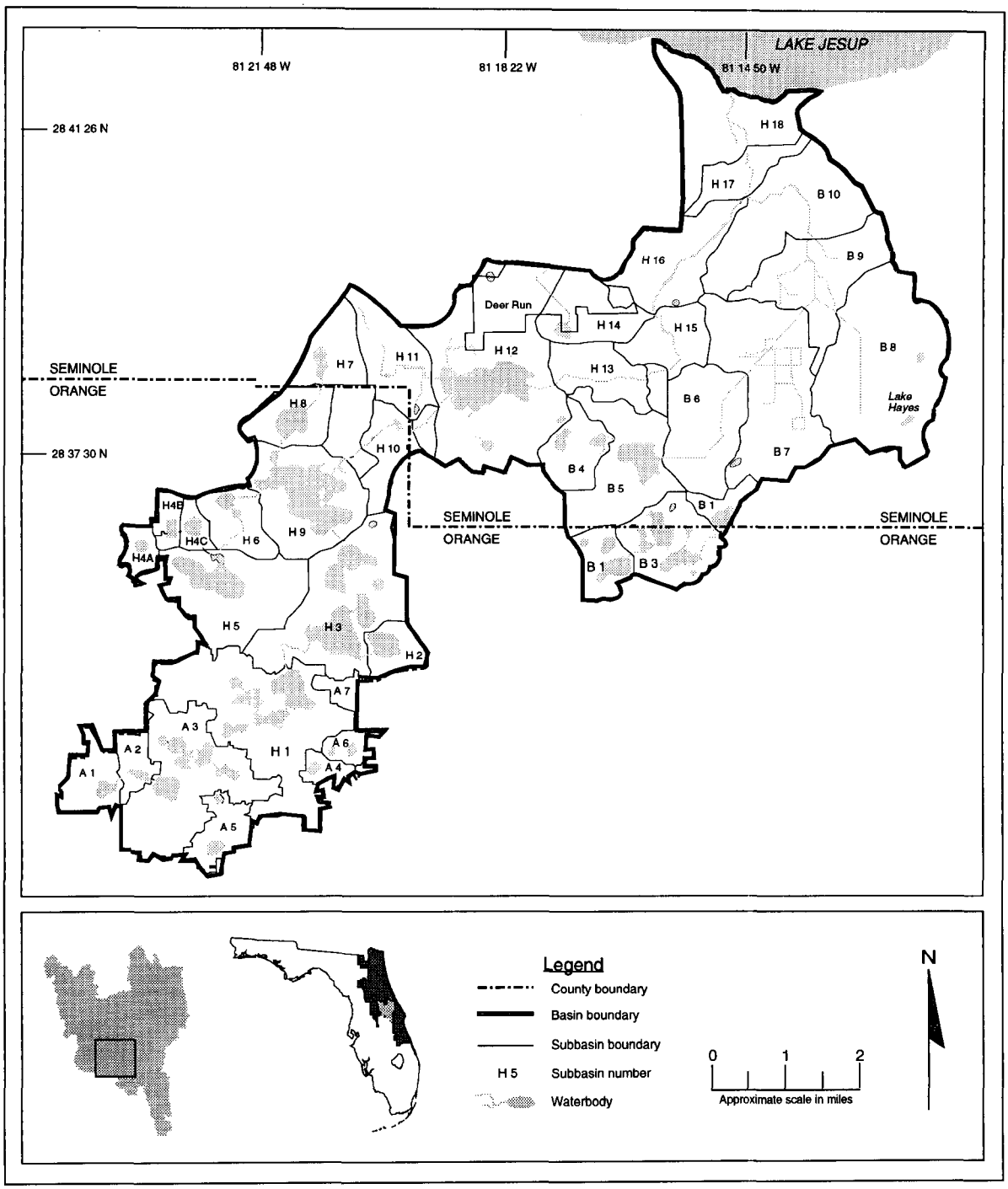


Figure 3. Subbasin delineation in the Howell Creek Basin

Table 8—*Continued*

Station	Location	Discharge (cfs)			Elevation (ft NGVD)			Velocity (fps)		
		10-Yr	25-Yr	100-Yr	10-Yr	25-Yr	100-Yr	10-Yr	25-Yr	100-Yr
429 + 00	Lake Howell	502	664	1090	56.36	56.92	58.03	0.02	0.02	0.03
480 + 98	S.R. 436 (HS-24)	278	400	681	56.38	56.95	58.07	0.32	0.42	0.60
493 + 40	Lake Howell Lane (HS-25)	278	400	681	56.45	57.04	58.15	2.20	2.67	3.43
497 + 97	Lake Howell Road (HS-27)	278	400	681	59.78	60.28	61.03	4.17	5.22	7.43
499 + 59	Channel*	278	400	681	61.75	62.23	63.00	0.74	0.96	1.40
516 + 00	Mouth of Lake Waumpi	278	400	681	62.95	63.54	64.53	0.28	0.36	0.51
537 + 00	Channel*	278	400	681	63.01	63.59	64.58	1.24	1.36	1.38
557 + 65	Temple Trail	285	404	686	63.56	64.14	65.03	3.13	3.75	5.08
573 + 25	Channel*	289	408	695	64.63	65.32	66.48	1.85	2.05	2.49
574 + 91	Lake Maitland Weir	289	408	695	67.10	67.33	67.84	5.48	6.17	7.38
605 + 10	Lake Maitland	197	260	440	67.79	68.23	69.09	0.01	0.01	0.02
659 + 60	Channel*	214	289	455	67.95	68.39	69.20	2.25	2.68	3.44
660 + 40	Palmer Avenue	214	289	455	67.97	68.41	69.21	2.07	2.58	3.55
680 + 70	Lake Osceola	214	289	455	68.09	68.57	69.49	0.07	0.09	0.12
707 + 70	Osceola Avenue	214	289	455	68.09	68.57	69.49	1.52	1.86	2.49
732 + 50	Lake Virginia	214	289	455	68.09	68.57	69.49	0.00	0.01	0.01
755 + 47	Stirling Avenue	258	337	572	68.69	68.90	71.14	4.02	4.82	2.94
767 + 00	Channel*	258	337	572	69.37	69.92	71.18	2.10	2.40	3.12
776 + 42	Pennsylvania Avenue	258	337	572	70.21	70.76	72.05	2.66	3.13	4.33
779 + 30	Footbridge	258	337	572	70.68	71.37	73.06	3.76	4.11	4.51
786 + 00	Channel*	258	337	572	70.93	71.65	73.33	2.31	2.45	2.76
788 + 65	Footbridge	258	337	572	71.01	71.72	73.38	3.21	3.32	3.56
791 + 75	Footbridge	258	337	572	71.21	71.93	73.61	2.82	2.43	2.01
796 + 85	Footbridge	258	337	572	73.02	73.68	75.24	1.91	1.87	1.81
800 + 26	Lake Shore Drive	258	337	572	74.28	74.80	75.72	2.79	3.12	4.20
805 + 00	Lake Sue				74.72	75.30	76.19			
832 + 46	Lakeside Drive				74.72	75.30	76.19			
836 + 50	Lake Rowena				74.72	75.30	76.19			
863 + 90	Mills Street				74.72	75.30	76.19			
884 + 00	Lake Formosa				74.72	75.30	76.19			
	Lake Ivanhoe				79.24	79.88	81.10			

DRMP 1994

St. Johns River Water Management District
Conceptual Approval Application

RECEIVED
JAN - 8 1997
SEMINOLE COUNTY
STORMWATER PROGRAMS DIVISION

HOWELL CREEK BASIN

DRAINAGE INVENTORY ENGINEERING STUDY

SEMINOLE COUNTY, FLORIDA

FEBRUARY 1994

DYER, RIDDLE, MILLS & PRECOURT, INC.
ENGINEERS · SURVEYORS · SCIENTISTS · PLANNERS
ORLANDO · TAMPA

F. Sub-Basin 6

This sub-basin, which contains 651 acres, lies immediately south of Prairie Lake and is essentially bordered by U.S. Highway 17-92 to the west and the Seminole County line on the south. A portion of this sub-basin also lies between the north-south segment of the Seminole County line and Lake Howell Road.

Elevations vary throughout the basin, ranging from a high of 95 feet NGVD in the easternmost portion of the sub-basin to a low of 65 feet NGVD in the vicinity of that portion of Howell Creek that flows into Lake Howell. Development in this sub-basin is very heavy and ranges from high density single and multi-family development to both small and large commercial businesses.

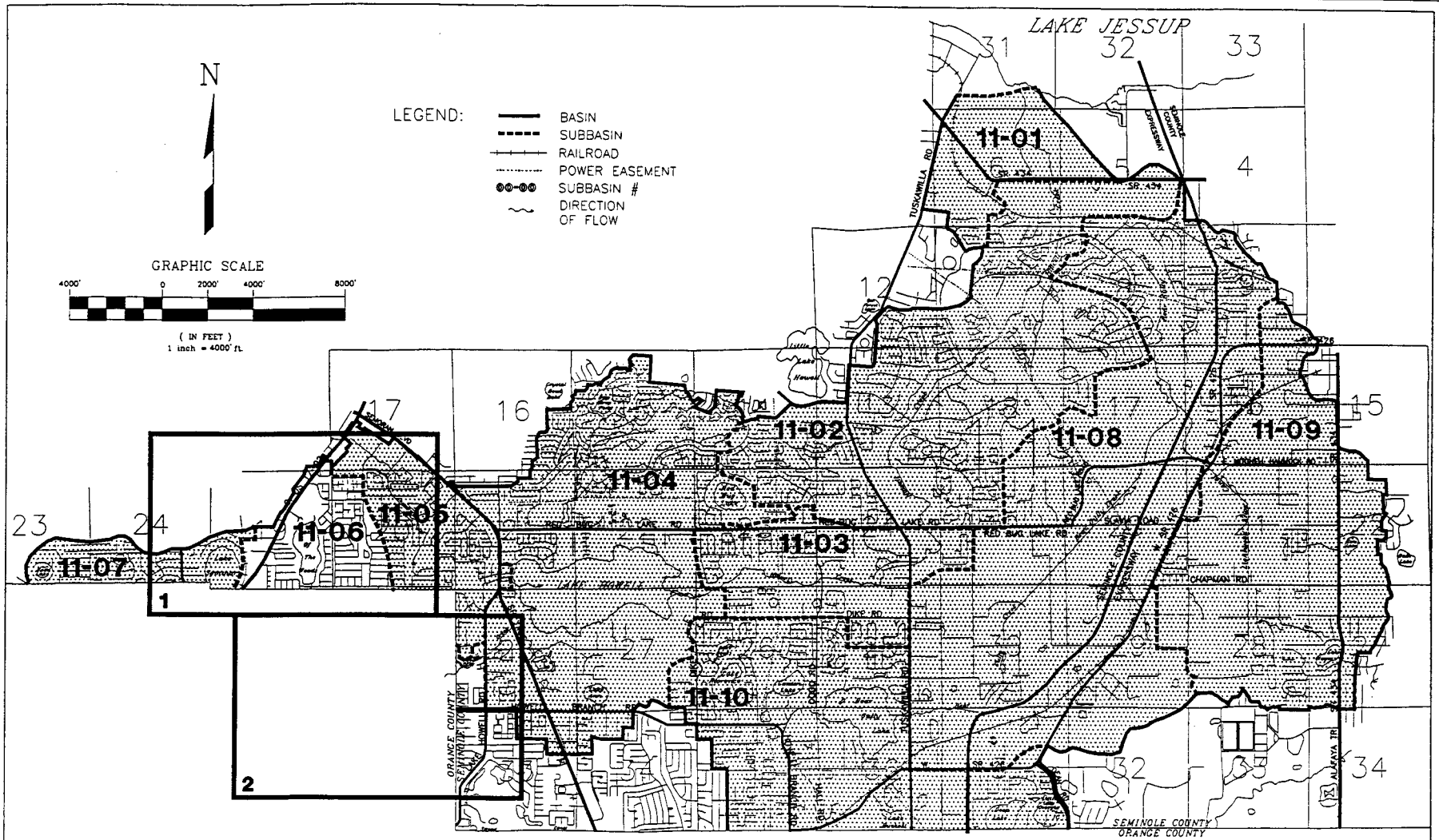
Table III.F

Land Use	Area (acres)	% of Total
Residential	395	60
Commercial/Industrial	116	18
Open Space/Woods	88	14
Ponds/Lakes	52	8
TOTAL	651	100

Seminole County maintains or is affected by 3 structures within this basin. Table IV.B.2 outlines these structures and their existing LOS.

Soil types vary throughout the basin but can be classified within two general soil families. The majority of the soils fall within the Urban Land-Astatula-Apopka soils family. This group makes up approximately 70% of the soil types within Sub-Basin 6. These soils are associated with upland areas and are considered to be moderately to well drained soils, hydrologic soil Group A. While these soils are considered to be well drained, urban development provides an impervious cover which creates increased runoff from this group; therefore, areas with a high degree of development may exhibit soil characteristics which resemble Group D soils rather than Group A soils.

The remainder of the soils, approximately 30%, belong to the Urban Land-Tavares-Millhopper family. These soils are also associated with upland areas and are moderately to well drained, hydrologic Group A.



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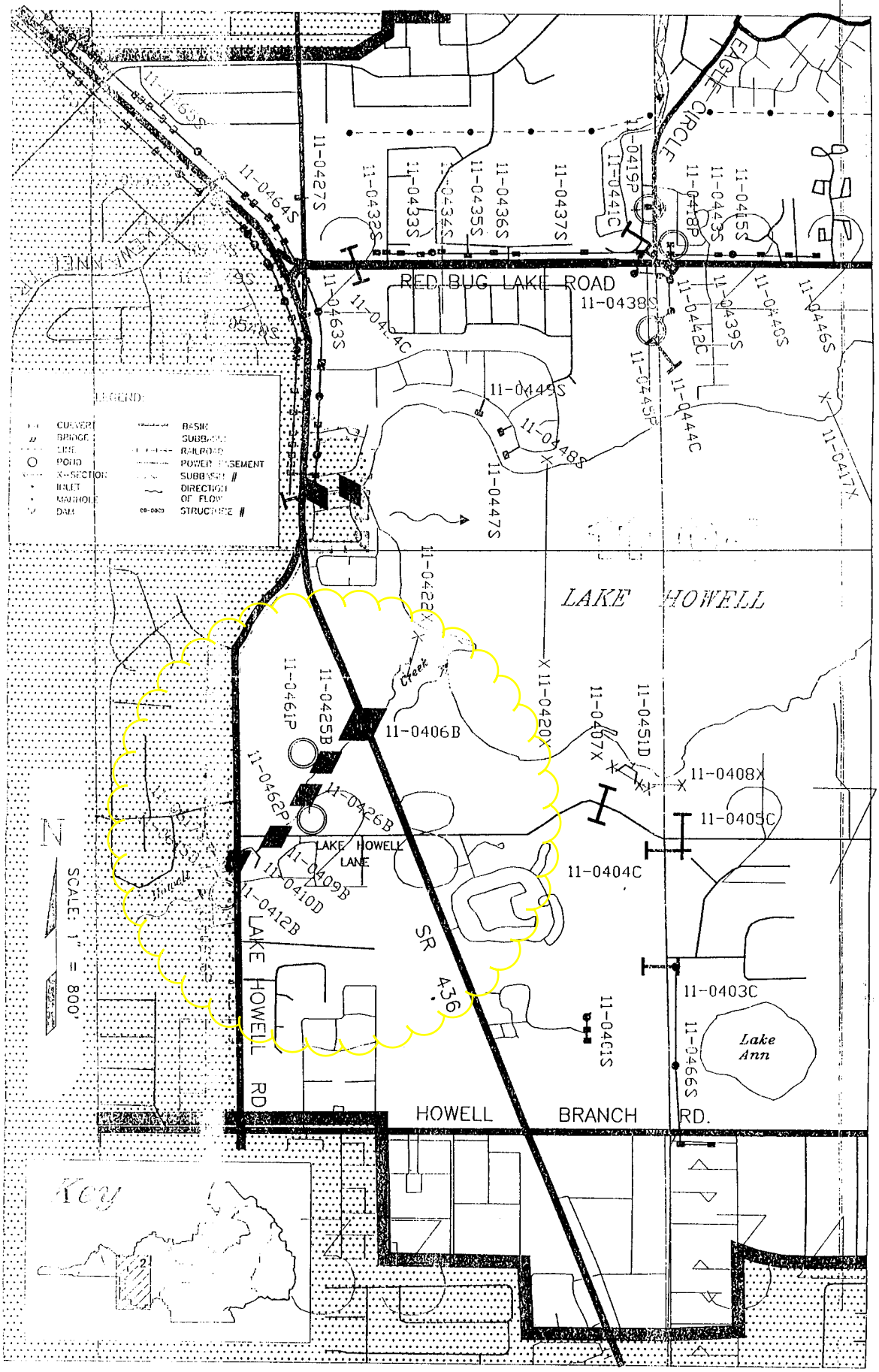
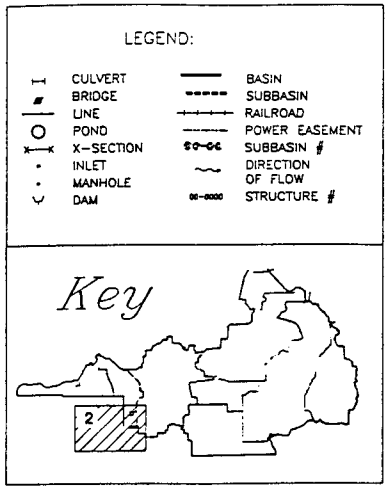
HOWELL BRANCH BASIN - SUB BASIN 11-06 - KEY MAP

EXHIBIT 21

SH06.DWG 1/21/94 GCR


RED BUG LAKE ROAD
EAGLE CIRCLE
LAKE HOWELL
LAKE HOWELL LANE
LAKE HOWELL RD
SR 436
HOWELL BRANCH RD.
Lake Ann
Creek
11-0427S
11-0464S
11-0463S
11-0424C
11-0432S
11-0433S
11-0434S
11-0435S
11-0436S
11-0437S
11-0419P
11-0441C
11-0415S
11-0418P
11-0443S
11-0438S
11-0442C
11-0439S
11-0440S
11-0446S
11-0445P
11-0444C
11-0449S
11-0448S
11-0447S
11-0417X
11-0422X
11-0420X
11-0461P
11-0425B
11-0406B
11-0462P
11-0426B
11-0409B
11-0410D
11-0412B
11-0407X
11-0451D
11-0408X
11-0405C
11-0404C
11-0403C
11-0401S
11-0466S
LEGEND
CULVERT
BRIDGE
SITE
POND
X-SECTION
INLET
MANHOLE
DAM
BASIN
SUBBASIN
RAILROAD
POWER EASEMENT
SUBBASIN #
DIRECTION OF FLOW
STRUCTURE #
N
SCALE 1" = 800'
Key



N

SCALE: 1" = 800'

EXHIBIT 23B

Table IV.A - Summary of Flows and Elevations for Existing Conditions

Section ID#	Location	Discharge (cfs)			Elevation (ft. NGVD)		
		10-year	25-year	100-year	10-year	25-year	100-year
HOWELL CREEK (East of Lake Howell)							
SJ-1	Mouth of Howell Creek	1572	1885	2507	8.10	8.70	9.80
SJ-3315	Channel	1554	1861	2470	8.11	8.71	9.81
11-0203B	S.R. 434	1554	1861	2470	9.39	9.83	10.39
11-0206B	Railroad Bridge	1522	1827	2419	13.08	13.50	14.17
11-0209B	Northern Way	1513	1815	2410	15.04	15.74	16.95
11-0272X	Confluence w/Bear Gully Creek	1513	1814	2408	15.90	16.73	18.17
11-0212B	Winter Springs Boulevard	772	1003	1299	16.46	17.23	18.57
11-0241B	Golf Cart Bridge	772	1003	1299	17.53	18.27	19.36
11-0242B	Golf Cart Bridge	772	1003	1299	18.66	19.43	20.37
11-0215B	Tuscawilla Country Club	772	1003	1299	20.30	20.99	21.86
11-0243B	Golf Cart Bridge	772	1003	1299	20.76	21.56	22.55
11-0244B	Golf Cart Bridge	748	934	1260	23.82	24.70	25.64
11-0219X	Channel	748	934	1260	23.85	24.72	25.67
11-0218B	Northern Way	748	934	1260	24.46	25.27	26.26
11-0204X	Channel	748	934	1260	26.08	26.79	27.81
11-0224B	Dyson Drive	610	771	1238	26.88	27.62	28.69
11-0270X	Channel	499	694	1273	31.09	31.75	33.22
11-0267X	Channel	499	694	1273	33.28	34.16	35.92
11-0236C	Red Bug Lake Road	499	694	1273	35.64	36.91	40.44
11-0318B	Wooden Bridge	499	694	1273	37.53	38.69	42.20
11-0319X	Channel	499	694	1273	38.09	39.47	42.67
11-0303B	Tuskawilla Road	499	695	1276	39.85	40.76	42.91
11-0305D	Dam	499	695	1276	44.38	45.54	47.16
SJ-30840	Channel	499	695	1276	44.70	45.85	47.58
11-0309B	Dodd Road	499	695	1276	46.40	47.43	49.39
11-0310X	Channel	499	695	1276	48.90	49.63	51.29
11-0311X	Channel	499	695	1276	49.99	50.69	52.33
11-0312X	Channel	499	695	1276	50.54	51.23	52.86
11-0313X	Channel	499	695	1276	50.85	51.56	53.21
11-0308D	Dam at Jericho Drive	499	695	1276	55.16	55.66	56.93
11-0413X	Channel	510	714	1310	56.46	57.14	58.39
11-0414X	Channel	510	714	1310	56.61	57.31	58.65
11-0411X	Lake Howell	510	714	1310	56.68	57.40	58.81
HOWELL CREEK (West of Lake Howell)							
11-0422X	Lake Howell	331	437	747	56.60	57.10	58.60
11-0406B	S.R. 436	331	437	747	56.75	57.26	58.75
11-0425B	Lake Howell Square	615	418	724	57.10	57.62	59.04
11-0426B	Lake Howell Square	314	417	722	57.66	58.21	59.64
11-0409B	Lake Howell Lane	313	416	722	58.16	58.76	60.26
11-0410D	Dam	313	416	722	57.94	58.51	60.08
11-0412B	Lake Howell Road	312	415	720	58.82	59.45	60.81
SJ-615D	Dam	312	415	720	61.26	61.58	62.35

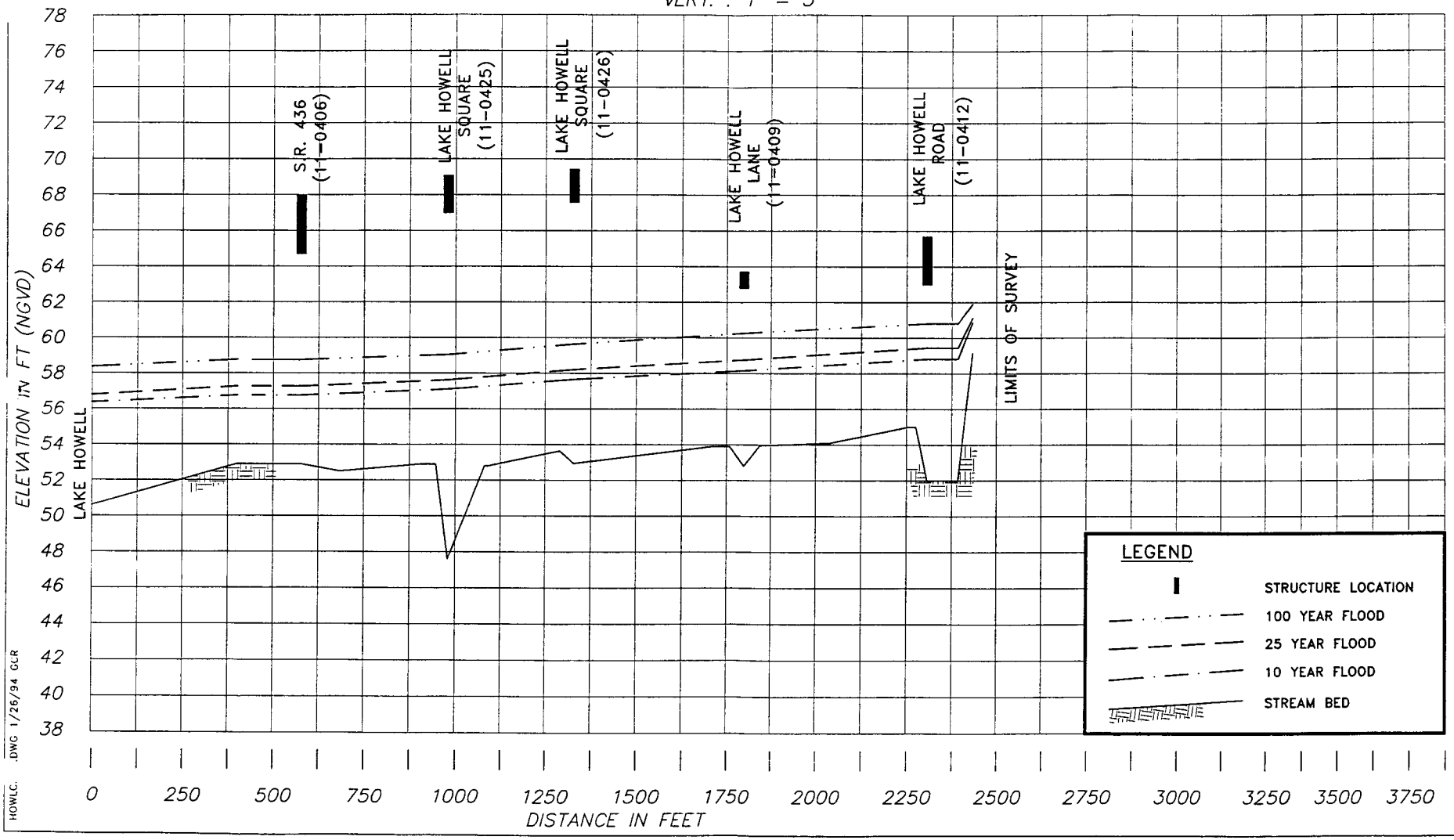
FORMER DAM

SJ - Indicates data obtained from SJRWMD Howell Branch Drainage Study.

C:\wrfiles\930064mk\sum-howl.xls

HOWELL CREEK (W. OF S.R. 436) FLOOD PROFILE

HORIZ. : 1" = 250'
VERT. : 1" = 5'



HOWLC. .DWG 1/26/94 GCR

EXHIBIT 46

AREA	Structure	Location	Structure Size	Overtopping Elevation	25yr/24hr Stage	LOS
LAKE HOWELL	11-0402C	Lake Howell Lane	36" RCP	58.35	58.57	D
	11-0403C	Lake Ann Lane	42"x72" CMAP	61.59	61.78	D
	11-0404C	Lake Ann Lane	24"x36" ERCP	58.20	58.97	D
	11-0405C	Lake Howell Lane	2-18" RCP	59.20	58.97	A
	11-0406B	SR 436	2-185' Bridges	67.99	57.26	A
	11-0409B	Lake Howell Lane	52' Bridge	64.06	58.76	A
FORMER DAM →	11-0410D	Lake Howell Lane	Concrete Dam	58.19	58.51	C
	11-0412B	Lake Howell Road	24' Bridge	65.68	59.45	A
	11-0421C	Eagle Circle	2-60" CMP	68.42	63.69	B
	11-0424C	Red Bug Lake Road	2-24" RCP	72.85	73.29	D
	11-0425B	Lake Howell Square	56' Bridge	68.29	57.62	A
	11-0426B	Lake Howell Square	66' Bridge	68.17	58.21	A
	11-0441C	Eagle Circle	48"x76" ERCP	n/a	62.69	C/D
	11-0442C	Eagle Circle	2-72" RCP	66.40	58.62	A
	11-0451D	Ditch S of Lake Howell from 11-0402C	Concrete Dam	53.62	56.88	C
CASSEL CREEK	11-0501B	Lake Howell Condos	58' Bridge	59.09	57.10	A
	11-0502B	Lake Howell Condos	53' Bridge	65.05	57.10	A
	11-0503C	SR 436	6'x8' CBC	64.92	64.84	C**
	11-0505D	Cassel Creek Boulevard	Concrete Dam	56.73	65.04	C
	11-0506C	Cassel Creek Boulevard	4-96" CMP	63.23	64.99	D**
	11-0507D	E of Cassel Creek Apts.	Concrete Dam	58.85	65.05	C
	11-0508D	E of Cassel Creek Apts.	Concrete Dam	59.56	65.08	C
	11-0509D	NE Corner Cassel Creek Apts.	Concrete Dam	61.73	65.60	C
	11-0514D	E of Maitland WWTP	Concrete Dam	78.85	84.78	C
	11-0515B	Kewanee Trail	43' Bridge	87.27	86.23	A
	11-0518C	Talbot Road	3-60" CMP	87.31	83.34	A
	11-0521C	Graham Road	3-40"x66" CMAP	90.37	88.91	A
	11-0524C	Waverly Drive	3-31"x50" CMAP	93.20	90.72	A
	11-0527C	Fern Park Boulevard	36" CMP	94.25	92.38	A
	11-0530C	Fern Park Boulevard	2-48" CMP	93.80	92.93	A
	11-0531C	Oxford Road	42" CMP	93.95	90.48	A
	11-0533C	Oxford Road	42" CMP/RCP	93.95	94.12	D
LAKE OF WOODS	11-0603C	Derbyshire Road	2-48" RCP	80.79	79.60	A

* To be improved with 434 realignment
**No Level of Service set for cross sections.
***Improving 11-0503C corrects 11-0506C
****Improving 11-1024C corrects 11-1033C

APPENDIX D

Basin Map and Structure List

LEGEND
D.P. = Dedicated by Plat
D.E. = Drainage Easement
P = Private Property
RB = Resolution Book

BASIN 11

STRUCTURES
SC = Seminole County
D.O.T. = Department of Transportation
R.R. = Rail Road

WS = City of Winter Springs
C = City of Casselberry
O = Oviedo City Limits

STRUCTURE NUMBER	DESCRIPTION	LOCATION	SECTION-TOWNSHIP-RANGE	CCD	PLAT BOOK/ PAGE	EASEMENT/ TRACT	REMARK
11-0310X	Cross Section	Howell Creek West of Dodd Road	23-21-30	1			P
11-0311X	Cross Section	Howell Creek Southwest of Nodding Pines Court	23-21-30	1			P
11-0312X	Cross Section	Howell Creek South of Sutters Mill	23-21-30	1			P
11-0313X	Cross Section	Howell Creek North of Treatment Plant at F.P.C. Easement	23-21-30	1	27/96		Conserv.
11-0314P	Weir-36" RCP Pond Outfall	Nodding Pines Way - F.P.C. Easement	23-21-30	1	25/12	Tract "A"	D.P.
11-0315P	Weir-24" RCP Pond Outfall	Sutters Mill Court	23-21-30	1	24/6	Tract "A"	D.P.
11-0316P	Weir-24" CMP Pond Outfall	Whispering Point at Creeks Bend	23-21-30	1	27/96	D.E.	D.P.
11-0318B	Wooden Bridge	Howell Creek Northeast of Tuskawilla Road	24-21-30	1			P
11-0319X	Cross Section	Howell Creek adjacent to 11-0318B	24-21-30	1			P
11-0320C	(2) 36" RCP	Willa Springs Drive	24-21-30	1	40/61	D.E.	1325/1504
11-0321P	Weir-18" RCP Pond Outfall	Howell Creek Park Phase 1	23-21-30	1	43/48	D.E.	P
11-0322P	Weir-30" CMP Pond Outfall	Adjacent to Howell Creek Park Phase 1	23-21-30	1			P
11-0323P	Weir-18" RCP Pond Outfall	Country Lake Village	24-21-30	1	2037/556	D.E.	SC
11-0324P	Weir-18" RCP Pond Outfall	Country Lake Village	24-21-30	1	2037/556	D.E.	SC
11-0325X	Cross Section	Howell Creek, East of Dodd Road	24-21-30	1			P
11-0401S	48" CMP Storm Sewer System	S.R. 436 West of Lake Ann Lane	28-21-30	1			D.O.T.
11-0402C	42" CMP	Lake Howell Lane, West of Lake Ann Lane	28-21-30	1		R/W	SC
11-0403C	42" x 72" CMPA	Lake Ann Lane	27-21-30	1		R/W	SC
11-0404C	24" x 36"RCP	Lake Howell Lane and Lake Ann Lane	27-21-30	1		R/W	SC
11-0405C	(2) 18" RCP	Lake Howell Lane and Lake Ann Lane	27-21-30	1		R/W	SC
11-0406B	Concrete Bridge	S.R. 436 at Howell Creek, D.O.T. Bridge 770007	28-21-30	4		R/W	D.O.T.
11-0407X	Cross Section	South of Lake Howell	28-21-30	1			P
11-0408X	Cross Section	South of Lake Howell	27-21-30	1			P
11-0409B	Concrete Bridge	Lake Howell Lane at Howell Creek	28-21-30	4		R/W	SC
11-0410D	Concrete Dam	Lake Howell Lane at Howell Creek	28-21-30	4	R.B.	D.E.	1477/1531
11-0411X	Cross Section	Howell Creek East of Lake Howell	27-21-30	1			P
11-0412B	Concrete Bridge	Lake Howell Road at Howell Creek	28-21-30	1		R/W	SC
11-0413X	Cross Section	Howell Creek at Howell Cove 3rd Section	26-21-30	1			P
11-0414X	Cross Section	Howell Creek at Howell Cove 3rd Section	26-21-30	1			P
11-0415S	60" RCP	Red Bug Lake Road	22-21-30	1		R/W	SC
11-0416X	Cross Section	Lake Howell	22-21-30	1			
11-0417X	Cross Section	Lake Howell	22-21-30	1			
11-0418P	Weir-24" x 38" RCP Pond Outfall	Northwest Corner Red Bug Lake Road and Eagle Circle	22-21-30	1	29/17	Tract "A"	D.P.
11-0419P	Weir-36" RCP Pond Outfall	Eagle Circle at Hunter's Chase	21-21-30	1	29/17	Tract "A" & R/W	D.P.
11-0420X	Cross Section	Lake Howell at San Pablo Avenue	21-21-30	1			In Lake
11-0421C	(2) 60" CMP	Eagle Circle Deer Run Unit 6	15-21-30	1	25/94	Tract "A" & R/W	D.P.
11-0422X	Cross Section	Lake Howell at Howell Creek	28-21-30	4			In Lake
11-0424C	(2) 24" RCP	Red Bug Lake Road	21-21-30	1		R/W	SC
11-0425B	Wooden Bridge	Lake Howell Square at Howell Creek	28-21-30	4	34/36	D.E.	D.P.
11-0426B	Wooden Bridge	Lake Howell Square at Howell Creek	28-21-30	4	34/36	D.E.	D.P.
11-0427S	48" RCP Storm Sewer Outfall	Winter Park Road, North of Red Bug Lake Road	21-21-30	1		R/W	SC
11-0428C	(2) 24" CMP	S. R. 436 at Red Bug Lake Road	21-21-30	4		R/W	D.O.T.
11-0429C	36" CMP	S. R. 436 North of Red Bug Lake Road	21-21-30	1		R/W	D.O.T.
11-0430C	36" CMP	S. R. 436 North of Red Bug Lake Road	21-21-30	1		R/W	D.O.T.
11-0431C	36" CMP	S. R. 436 North of Red Bug Lake Road	21-21-30	1		R/W	D.O.T.
11-0432S	30" RCP Storm Sewer System	North Right of Way, Red Bug Lake & Winding Ridge Roads	21-21-30	1		R/W	SC

APPENDIX E

Structure List with Elevations and Flows

BASIN 11

STRUCTURES

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Notes:

1) DOT - No LOS Set
2) Pond - No LOS Set
3) Private - No LOS Set
4) Private - Does Not Cross Howell Creek or a Major Tributary
5) Could Not Locate
6) DOT / Municipality
7) X-Sect - No LOS Set
8) System Has Been Removed
9) Outside Study Area
10) Permitted by SJRWMD

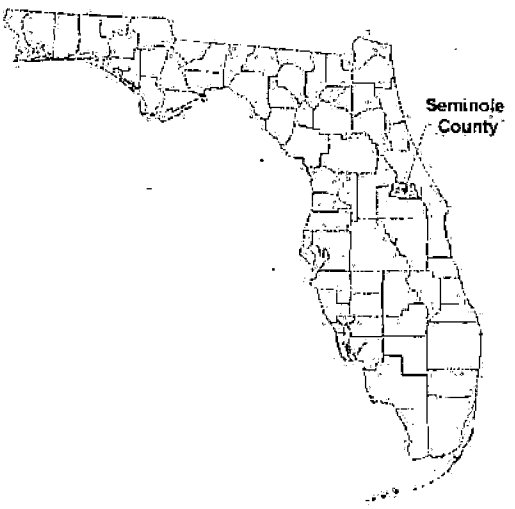
STRUCTURE NUMBER	DESCRIPTION	LOCATION	SECTION-TOWNSHIP-RANGE	DISCHARGE (cfs)			ELEVATION (ft NGVD)			LOS
				10-YR	25-YR	100-YR	10-YR	25-YR	100-YR	
11-0405C	(2) 18" RCP	Lake Howell Lane and Lake Ann Lane	27-21-30	120	151	151	58.81	58.97	58.97	A
11-0406B	Concrete Bridge	S.R. 436 at Howell Creek, D.O.T. Bridge 770007	28-21-30	331	437	747	56.75	57.26	58.75	A
11-0407X	Cross Section	South of Lake Howell	28-21-30	(4)	(4)	(4)	(4)	(4)	(4)	(4)
11-0408X	Cross Section	South of Lake Howell	27-21-30	(4)	(4)	(4)	(4)	(4)	(4)	(4)
11-0409B	Concrete Bridge	Lake Howell Lane at Howell Creek	28-21-30	313	416	722	58.16	58.76	60.26	A
11-0410D	Concrete Dam	Lake Howell Lane at Howell Creek	28-21-30	313	416	722	57.94	58.51	60.08	C
11-0411X	Cross Section	Howell Creek East of Lake Howell	27-21-30	510	714	1310	56.68	57.40	58.81	(7)
11-0412B	Concrete Bridge	Lake Howell Road at Howell Creek	28-21-30	312	415	720	58.82	59.45	60.81	A
11-0413X	Cross Section	Howell Creek at Howell Cove 3rd Section	26-21-30	510	714	1310	56.46	57.14	58.39	(7)
11-0414X	Cross Section	Howell Creek at Howell Cove 3rd Section	26-21-30	510	714	1310	56.61	57.31	58.65	(7)
11-0415S	System Has Been Removed	Red Bug Lake Road East of Eagle Circle	26-21-30	(8)	(8)	(8)	(8)	(8)	(8)	(8)
11-0416X	Cross Section (Lake Bottom Soundings)	Lake Howell	22-21-30	(4)	(4)	(4)	(4)	(4)	(4)	(4)
11-0417X	Cross Section (Lake Bottom Soundings)	Lake Howell	22-21-30	(4)	(4)	(4)	(4)	(4)	(4)	(4)
11-0418P	Weir-24"X 38" RCP Pond Outfall	Northwest corner Red Bug Lake Road and Eagle Circle	22-21-30	(2)	(2)	(2)	(2)	(2)	(2)	(2)
11-0419P	Weir-36" RCP Pond Outfall	Eagle Circle at Hunter's Chase	21-21-30	(2)	(2)	(2)	(2)	(2)	(2)	(2)
11-0420X	Cross Section (Lake Bottom Soundings)	Lake Howell (Boat Ramp to Lake Howell)	21-21-30	(4)	(4)	(4)	(4)	(4)	(4)	(4)
11-0421C	(2) 60" CMP	Eagle Circle Deer Run Unit 6	15-21-30	149	194	194	63.05	63.69	63.69	B
11-0422X	Cross Section	Lake Howell at Howell Creek	28-21-30	331	437	747	56.60	57.10	58.60	(7)
11-0424C	(2) 24"RCP	Removed per F.D.O.T. Plans	21-21-30	(90)	(112)	(148)	(73)	(73)	(74)	(1)
11-0425B	Wooden Bridge	Lake Howell Square at Howell Creek	28-21-30	315	418	724	57.10	57.62	59.04	A
11-0426B	Wooden Bridge	Lake Howell Square at Howell Creek	28-21-30	314	417	722	57.66	58.21	59.64	A
11-0427S	48" RCP Storm Sewer Outfall	Winter Park Road, North of Red Bug Lake Road	21-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0428C	(2) 24" CMP	Removed per F.D.O.T. Plans	21-21-30	(1)	(1)	(1)	(1)	(1)	(1)	(1)
11-0429C	36" CMP	Removed per F.D.O.T. Plans	21-21-30	(1)	(1)	(1)	(1)	(1)	(1)	(1)
11-0430C	36" CMP	Removed per F.D.O.T. Plans	21-21-30	(1)	(1)	(1)	(1)	(1)	(1)	(1)
11-0431C	36" CMP	Removed per F.D.O.T. Plans	21-21-30	(1)	(1)	(1)	(1)	(1)	(1)	(1)
11-0432S	30" RCP Storm Sewer System	North right of way, Red Bug Lake Road & Winding Ridge Roa	21-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0433S	36" RCP Storm Sewer System	North right of way, Red Bug Lake Road & Winding Ridge Roa	21-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0434S	42" RCP Storm Sewer System	North right of way, Red Bug Lake Road & Winding Ridge Roa	21-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0435S	54" RCP Storm Sewer System	North right of way, Red Bug Lake Road & Winding Ridge Roa	21-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0436S	36" RCP Storm Sewer System	Red Bug Lake Road & Mark David Boulevard	21-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0437S	60" RCP Storm Sewer System	Red Bug Lake Road	21-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0438S	66" RCP Storm Sewer System	South right of way Red Bug Road Lake Road	22-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0439S	66" RCP Storm Sewer System	North right of way, Red Bug Road Lake Road	22-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0440S	42" RCP Storm Sewer System	North right of way, Red Bug Road Lake Road	22-21-30	(3)	(3)	(3)	(3)	(3)	(3)	(3)
11-0441C	48" X 76" RCP	Eagle Circle and Red Bug Lake Road	22-21-30	25	41	41	62.18	62.69	62.69	C/D
11-0442C	(2) 72" RCP	Eagle Circle and Red Bug Lake Road	22-21-30	25	41	65	58.23	58.62	58.47	A

200

FEMA FLOOD INSURANCE RATE STUDY 2007

FLOOD INSURANCE STUDY

SEMINOLE COUNTY, FLORIDA
AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
ALTAMONTE SPRINGS, CITY OF	120290
CASSELBERRY, CITY OF	120291
LAKE MARY, CITY OF	120416
LONGWOOD, CITY OF	120292
OVIEDO, CITY OF	120293
SANFORD, CITY OF	120294
SEMINOLE COUNTY (UNICORPORATED AREAS)	120289
WINTER SPRINGS, CITY OF	120295

REVISED:
SEPTEMBER 28, 2007

Federal Emergency Management Agency
FLOOD INSURANCE STUDY NUMBER
12117CV000A

TABLE 3. SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. mi.)	PEAK DISCHARGES (cfs) 10-percent	2-percent	1-percent	0.2-percent
GRASSY LAKE DRAINAGE CHANNEL TO TRIPLET LAKE					
At Sunset Drive	1.6	93	145	179	289
At U.S. Route 17-92	1.4	28	41	46	56
HOWELL CREEK					
At Lake Jesup	27.2	2,080	4,630	6,420	12,140
At State Route 419	26.4	2,030	4,500	6,240	11,750
At Cross Section G	23.5	680	1,410	2,110	3,880
At Lake Howell	20.1	500	800	1,200	1,800
At State Route 436	19.0	440	710	880	1,410
LITTLE ECONLOCKHATCHEE RIVER					
At Lockwood Road	*	3,250	*	6,440	*
At State Route 520	*	4,760	*	8,520	*
At Orange County boundary	*	4,720	*	8,360	*
LITTLE HOWELL CREEK					
At mouth	2.4	450	1,150	1,370	3,110
LITTLE WEKIVA RIVER					
At State Route 434	33.8	920	1,500	1,800	2,580
At Montgomery Road	31.1	780	1,280	1,520	2,070
At CSX Transportation	27.6	700	1,140	1,370	1,830
At State Route 431	25.4	550	880	1,050	1,610
SIX MILE CREEK					
At Lake Jesup	4.5	430	780	950	1,530
SIX MILE CREEK TRIBUTARY					
At mouth	2.4	230	480	560	820

* Data not available

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Howell Creek								
A	3,960	600	2,600	1.1	8.7	8.5[2]	8.9	0.4
B	5,200	314	1,195	5.4	13.4	13.4	14.1	0.7
C	7,250	239	1,938	3.2	15.7	15.7	16.5	0.8
D	9,600	158	1,520	1.5	17.6	17.6	18.2	0.6
E	13,200	108	597	3.8	18.2	18.2	18.8	0.6
F	15,600	67	380	6.0	24.3	24.3	24.8	0.5
G	19,000	131	950	2.4	30.8	30.8	31.8	1.0
H	19,450	200	610	3.4	31.6	31.6	32.5	0.9
I	24,800	85	400	2.2	42.4	42.4	42.6	0.2
J	27,100	57	450	2.7	42.6	42.6	43.4	0.8
K	31,250	65	520	2.3	50.7	50.7	50.8	0.1
L	36,400	222	610	2.0	55.5	55.5	55.5	0.0
M	50,100	148	650	1.6	57.3	57.3	58.3	1.0
N	51,325	52	270	3.9	59.6	59.6	59.9	0.3
O	51,720	40	250	4.2	61.3	61.3	61.9	0.6

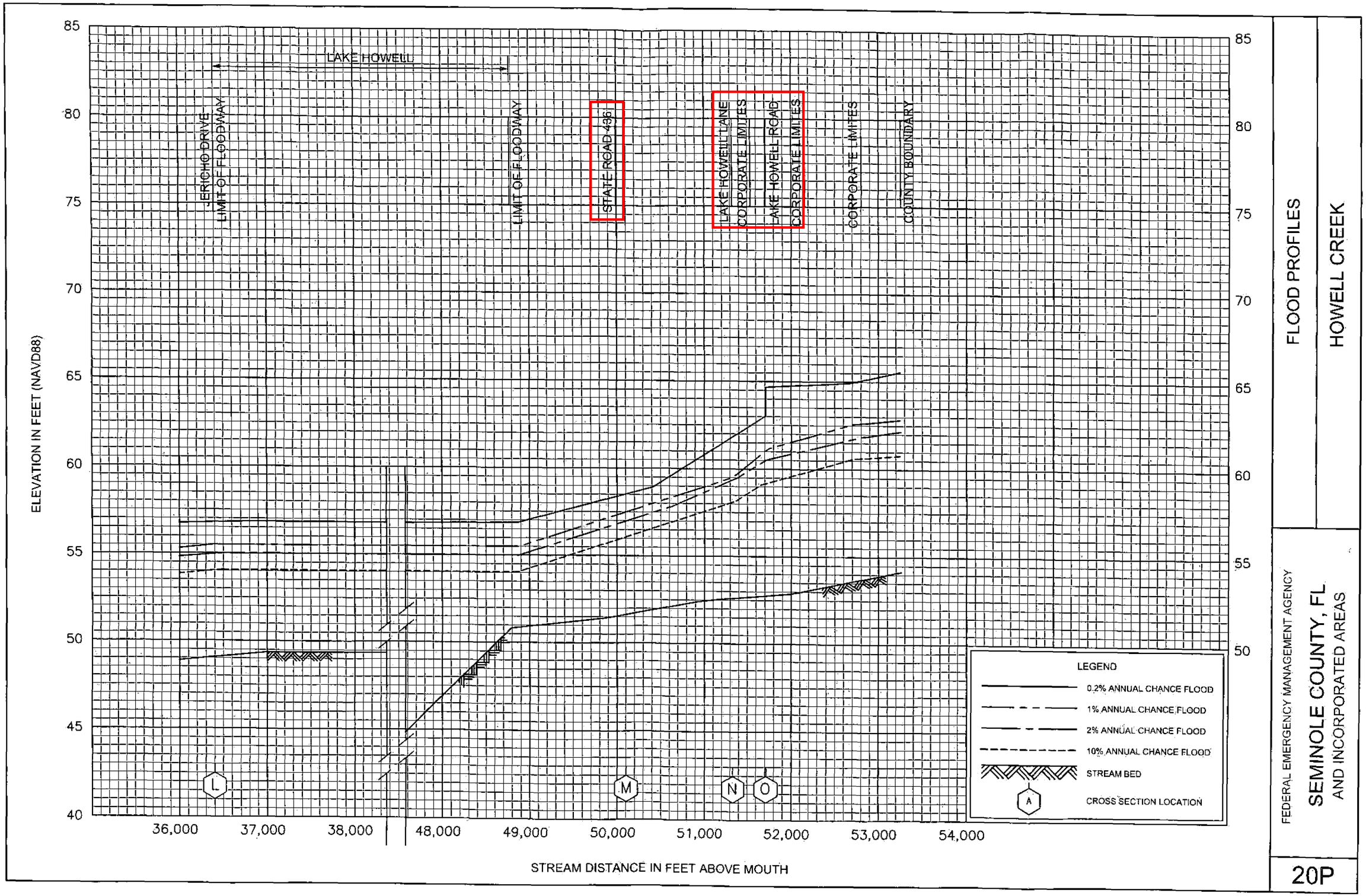
[1] Feet above mouth
[2] Elevation computed without consideration of backwater effects from Lake Jesup

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY
SEMINOLE COUNTY, FL
AND INCORPORATED AREAS

FLOODWAY DATA

HOWELL CREEK



FLOOD PROFILES

HOWELL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

SEMINOLE COUNTY, FL
AND INCORPORATED AREAS

20P

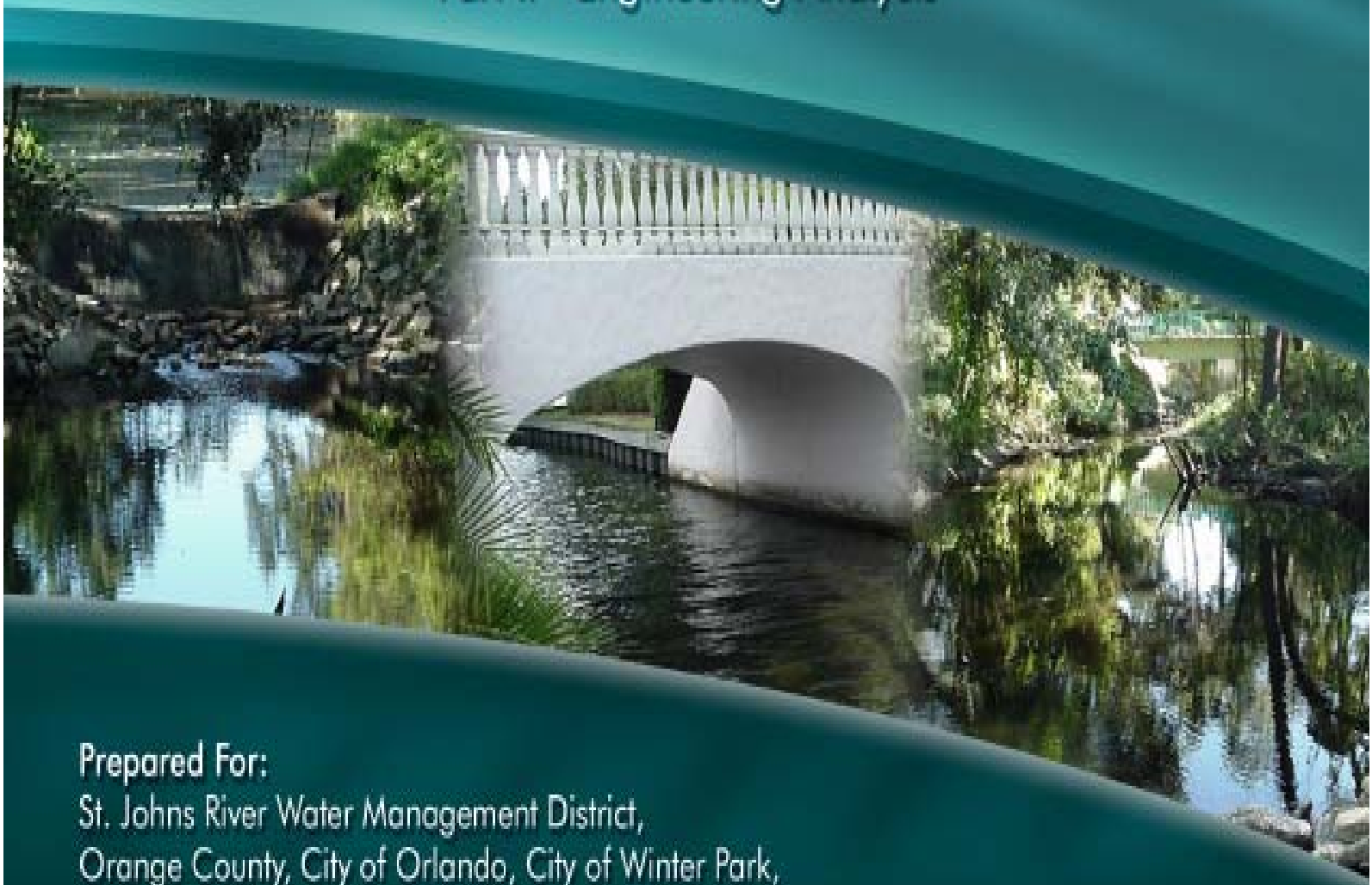
CDM 2008

CDM

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Howell Creek Basin Watershed Management Plan

Part II - Engineering Analysis



Prepared For:
St. Johns River Water Management District,
Orange County, City of Orlando, City of Winter Park,
City of Maitland, Seminole County,
City of Casselberry, City of Winter Springs, City of Oviedo

JANUARY 2008

FINAL REPORT

honourdm

1/07/08

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Winter Springs

Casselberry

Maitland

Winter Park

Lake Kathryn

Lake Tony

Little Lake Howell

Lake Howell

Lake of the Woods

Lake Seminary

Lake Minnehaha

Maitland Chain of Lakes

Winter Park Chain of Lakes

Lake Killarney

LAKE JESUP

Howell Creek

Bear Gully Creek

Red Bug Lake

Lake Florence

Bear Gully Lake

LAKE MAITLAND

LAKE SYBELIA

LAKE CATHERINE

LAKE EULALIA

LAKE HOPE

LAKE FAITH

LAKE MINNEHAHA

PARK LAKE

LAKE OSCEOLA

DEEP LAKE

LAKE BURKETT

LAKE PEARL

LAKE GEORGIA

LAKE WAUNATTA

Pearl-Deep-Georgia

Lightwood Knox Canal

Bear Gully Creek

Howell Creek

State Hwy 434

State Hwy 436A

US Hwy 17-92

County Rd 419

County Rd 434

LEGEND

- Subbasins
- County Boundary

Model Nodes

Type

- Linking
- Storage
- Control Structure
- Bridge
- Pipe
- Overland Flow
- Open channel

Drainage Wells

- Abandoned
- Active
- Capped
- Clogged
- Inaccessible
- Inactive
- Lost
- Needs Work
- Plugged
- Pump in Well
- Pump Installed

- Major Roads
- Streets
- Railroad
- PSMS Lakes

Municipal Boundaries

- Altamonte Springs
- Casselberry
- Oviedo
- Winter Springs
- Eatonville
- Maitland
- Orlando
- Winter Park

N

W E

S

0 900 1,800 3,600

Feet

SJRWMD
Howell Creek Basin Watershed Management Plan

Aerial Imagery Source: St. Johns River Water Management District, 2004 DOQQs

CDM

Figure 4-6 (2 of 2)
Model Schematic (Seminole County)

honourdm

3/13/07

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Mean Annual Flooding

Model_ID	Assigned LOS	US Node	DS Node	Critical Elev. (ft)	Mean Annual Stage (ft)	Depth of Flooding (ft)
AW-0010DS	25	AW-0010	AW-0020	56.0	56.1	0.1
AW-0130X	25	AW-0130	AW-0140	36.3	38.1	1.8
AW-0140C	25	AW-0140	AW-0150	37.3	38.1	0.8
AW-0150X	25	AW-0150	AW-0160	31.2	32.7	1.5
BGC-0030X	25	BGC-0030	BGC-0050	42.0	42.8	0.8
BGC-0050C	25	BGC-0050	BGC-0060	42.6	42.8	0.2
BGC-0060X	25	BGC-0060	BGC-0070	38.0	38.2	0.2
BGC-0070C	25	BGC-0070	BGC-0080	38.0	38.2	0.2
BGC-0107C	25	BGC-0107	BGC-0108	37.0	38.0	1.0
BGC-0108X	25	BGC-0108	BGC-0109	33.0	34.7	1.7
BGC-0109C	25	BGC-0109	BGC-0110	34.0	34.7	0.7
BGC-0126X	25	BGC-0126	BGC-0127	31.0	32.6	1.6
BGC-0160B	25	BGC-0160	BGC-0180	31.2	31.7	0.5
BGC-0280X	25	BGC-0280	BGC-0300	19.2	20.8	1.6
BGC-0290C1	25	BGC-0290	BGC-0300	18.2	20.8	2.6
BGC-0290C2	25	BGC-0290	BGC-0300	18.2	20.8	2.6
BGC-0320C1	25	BGC-0320	BGC-0310	22.4	22.7	0.3
BGC-0320C2	25	BGC-0320	BGC-0310	22.4	22.7	0.3
CC-0059C	10	CC-0059	CC-0060	91.0	91.6	0.6
CC-0170W	10	CC-0170	CC-0180	67.0	67.2	0.2
DR-0033X	10	DR-0033	DR-0035	68.0	68.3	0.3
DR-0034X	10	DR-0034	DR-0035	68.0	68.3	0.3
DR-0035X	10	DR-0035	DR-0036	67.0	67.1	0.1
DR-0036C	10	DR-0036	DR-0037	67.0	67.1	0.1
DR-0170C	25	DR-0170	DR-0180	40.0	41.0	1.0
LH-0010C	25	LH-0010	LH-0030	62.0	62.5	0.5
LH-0020C	25	LH-0020	LH-0030	62.0	62.3	0.3
LKC-0010X	25	LKC-0010	LKC-0020	32.0	32.9	0.9
LKC-0017X	25	LKC-0017	LKC-0020	32.0	32.9	0.9
LKC-0019X	25	LKC-0019	LKC-0020	32.0	32.9	0.9
LKC-0060C	25	LKC-0060	LKC-0070	27.0	28.9	1.9
LKC-0063C	25	LKC-0063	LKC-0064	62.0	62.7	0.7
LKC-0064C	25	LKC-0064	LKC-0065	61.0	62.2	1.2
LKC-0066X	25	LKC-0066	LKC-0067	30.0	30.8	0.8
LKC-0067C	25	LKC-0067	LKC-0068	26.8	30.8	4.0
LKC-0068X	25	LKC-0068	LKC-0069	28.3	28.9	0.6
LKC-0069C	25	LKC-0069	LKC-0070	26.0	28.9	2.9
LKC-0073C	10	LKC-0073	LKC-0074	38.0	41.0	3.0
LKC-0074C	10	LKC-0074	LKC-0075	39.0	41.0	2.0
LKC-0075X	25	LKC-0075	LKC-0076	29.0	29.2	0.2
LKC-0076C	25	LKC-0076	LKC-0077	27.3	29.2	1.9
OVI-0020X	25	OVI-0020	OVI-0030	44.3	44.6	0.3
OVI-0030C	25	OVI-0030	OVI-0040	44.3	44.6	0.3
OVI-0040X	25	OVI-0040	OVI-0050	40.2	41.3	1.1

10-Year Flooding

Model_ID	Assigned LOS	US Node	DS Node	Critical Elev. (ft)	10-Year Stage (ft)	Depth of Flooding (ft)
AW-0030DS	25	AW-0030	AW-0040	50.5	50.5	0.0
BGC-0016X	25	BGC-0016	BGC-0020	46.8	47.2	0.4
BGC-0020C	25	BGC-0020	BGC-0030	46.8	47.2	0.4
BGC-0110X	25	BGC-0110	BGC-0130	33.0	33.5	0.5
BGC-0127C	25	BGC-0127	BGC-0128	33.0	33.5	0.5
BGC-0130C	50	BGC-0130	BGC-0140	33.0	33.5	0.5
BGC-0140X	25	BGC-0140	BGC-0160	32.0	32.6	0.6
BGL-0020C1	25	BGL-0020	BGL-0030	54.6	54.6	0.00
BGL-0020C2	25	BGL-0020	BGL-0030	54.6	54.6	0.00
BGL-0057C	25	BGL-0057	BGL-0058	57.3	57.4	0.1
BGL-0059C	25	BGL-0059	BGL-0060	54.0	54.6	0.6
DR-0037C	10	DR-0037	DR-0038	67.0	67.3	0.3
DR-0038C	10	DR-0038	DR-0040	66.0	66.4	0.4
DR-0040C1	10	DR-0040	DR-0050	65.4	65.7	0.3
DR-0040C2	10	DR-0040	DR-0050	65.4	65.7	0.3
DR-0040C3	10	DR-0040	DR-0050	65.4	65.7	0.3
DR-0110X	10	DR-0110	DR-0120	66.3	66.8	0.5
DR-0120C1	25	DR-0120	DR-0130	66.3	66.8	0.5
DR-0120C2	25	DR-0120	DR-0130	66.3	66.8	0.5
DR-0130X	25	DR-0130	DR-0150	48.2	48.3	0.1
HC-0320X	25	HC-0320	HC-0330	23.2	24.0	0.8
HC-0360X	25	HC-0360	HC-0370	19.0	19.7	0.7
LH-0030X	25	LH-0030	LH-0040	58.2	58.6	0.4
LH-0039C	25	LH-0039	LH-0040	58.9	59.1	0.2
LH-0040C	25	LH-0040	LH-0050	58.2	58.6	0.4
LHa-0010X	25	LHa-0010	LKC-0012	42.9	43.0	0.1
LKC-0012C1	25	LKC-0012	LKC-0013	42.9	43.0	0.1
LKC-0012C2	25	LKC-0012	LKC-0013	42.9	43.0	0.1
LKC-0070X	25	LKC-0070	LKC-0080	29.0	29.8	0.8
OVI-0080C	25	OVI-0080	OVI-0090	29.3	29.8	0.5

25-Year Flooding

Model_ID	Assigned LOS	US Node	DS Node	Critical Elev. (ft)	25-Year Stage (ft)	Depth of Flooding (ft)
AW-0100C	25	AW-0100	AW-0130	42.0	42.0	0.0
AW-0180X	25	AW-0180	AW-0190	34.0	34.3	0.3
AW-0190X	50	AW-0190	BGC-0110	34.0	34.3	0.3
BGC-0015C	25	BGC-0015	BGC-0016	57.5	58.2	0.7
BGC-0100X	25	BGC-0100	BGC-0110	34.0	34.3	0.3
BGC-0125C	50	BGC-0125	BGC-0126	34.0	34.4	0.4
BGC-0128C	25	BGC-0128	BGC-0129	33.8	34.4	0.6
BGC-0129X	25	BGC-0129	BGC-0130	34.0	34.3	0.3
HC-0280X	25	HC-0280	HC-0290	25.7	26.4	0.7
HC-0340X	25	HC-0340	HC-0350	22.0	22.4	0.4
LKC-0015X	25	LKC-0015	LKC-0016	36.0	36.3	0.3
LKC-0016C	25	LKC-0016	LKC-0017	36.0	36.3	0.3
LKC-0018C	25	LKC-0018	LKC-0019	34.0	34.0	0.0
LKC-0040X	25	LKC-0040	LKC-0050	30.0	30.8	0.8
LKC-0049X	25	LKC-0049	LKC-0050	30.0	30.8	0.8
LKC-0050X	25	LKC-0050	LKC-0060	30.0	30.8	0.8
LKC-0077X	25	LKC-0077	OVI-0090	30.0	30.8	0.8
LKC-0078C	25	LKC-0078	LKC-0079	29.9	30.8	0.9
LKC-0079X	25	LKC-0079	LKC-0080	30.0	30.8	0.8
OVI-0050C	25	OVI-0050	OVI-0060	43.0	43.4	0.4
OVI-0060X	25	OVI-0060	OVI-0070	30.4	30.8	0.4
OVI-0070X	25	OVI-0070	OVI-0080	30.0	30.8	0.8
OVI-0090X	25	OVI-0090	LKC-0078	29.9	30.8	0.9

100-Year Flooding

Model_ID	Assigned LOS	US Node	DS Node	Critical Elev. (ft)	100-Year Stage (ft)	Depth of Flooding (ft)
BGC-0220B	100	BGC-0220	BGC-0230	26.1	26.4	0.3
HC-0085B	100	HC-0085	HC-0090	63.6	63.7	0.1
HC-0250B	100	HC-0250	HC-0260	34.0	36.8	2.8

LEGEND

Predicted Flooding
Design Storm Event
- Mean Annual
- 10-Year
- 25-Year
- 100-Year

EX_OpenChan_LOS
Pred_Flood
- Mean Annual
- 10-Year
- 25-Year
- Model Nodes

- Control Structure
- Bridge
- Pipe
- Overland Flow
- Open channel
- Predicted Problem Areas
- Subbasins
- Hydrologic Units

N S E W

0 900 1,800 3,600 5,400 7,200 Feet

SJRWMD
Howell Creek Basin Watershed Management Plan

Aerial Imagery Source: St. Johns River Water Management District, 2004 DOQQs

CDM

Figure 5-1
ICPR Modeling Results - Existing Conditions
Seminole County (2 of 2)

Appendix J
Howell Creek Basin Watershed Management Plan
Level of Service
Open Channels - Existing Conditions

		Critical Elevation					Mean Annual		10 Year 24 Hour Storm		25 Year 24 Hour Storm		100 Year 24 Hour Storm		
Problem Area No.	Model ID	TOB D/S	LOS Used	Design Return Period	U/S Node	D/S Node	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (cfs)	Current Level of Protection
	DR-0068X	64.0	Seminole County	10	DR-0068	DR-0069	62.9	100	63.5	143	64.1	198	65.0	285	10 Yr
	DR-0069X	65.3	Seminole County	10	DR-0069	DR-0070	60.5	95	61.1	126	61.7	162	64.8	221	100 Yr
	DR-0090X	58.0	Seminole County	25	DR-0090	LH-0090	54.5	168	55.4	219	56.3	267	58.0	615	25 Yr
	DR-0095X	67.9	Seminole County	10	DR-0095	DR-0100	66.1	117	67.0	124	67.5	215	68.5	116	25 Yr
15E	DR-0110X	66.3	Seminole County	10	DR-0110	DR-0120	65.4	259	66.8	365	67.0	510	67.2	726	Mean Annnual
15E	DR-0130X	48.2	Seminole County	25	DR-0130	DR-0150	47.2	238	48.3	331	49.3	471	51.0	701	Mean Annnual
	DR-0160X	42.9	Seminole County	25	DR-0160	DR-0170	41.0	325	41.6	436	42.1	563	42.8	756	100 Yr
	DR-0180X	37.0	Seminole County	25	DR-0180	HC-0240	31.8	469	32.7	435	33.5	562	36.9	755	100 Yr
	HC-0010X	69.0	Orange County	25	HC-0010	HC-0020	67.2	38	67.5	42	67.9	51	68.5	68	100 Yr
	HC-0080X	63.0	Seminole County	25	HC-0080	HC-0085	60.7	426	61.5	571	62.3	735	63.7	1064	25 Yr
	HC-0090X	66.3	Seminole County	25	HC-0090	HC-0100	60.2	474	61.0	629	61.7	804	63.0	1154	100 Yr
	HC-0110X	66.6	Seminole County	25	HC-0110	HC-0120	58.6	474	59.3	629	60.0	804	61.3	1154	100 Yr
	HC-0130X	65.5	Seminole County	25	HC-0130	HC-0140	54.6	474	55.6	629	56.5	804	58.3	1154	100 Yr
	HC-0150X	58.4	Seminole County	25	HC-0150	LH-0090	54.5	470	55.4	624	56.3	797	58.0	1143	100 Yr
	HC-0160X	56.0	Seminole County	25	HC-0160	HC-0170	49.1	1063	49.7	1431	50.3	1828	51.2	2519	100 Yr
	HC-0180X	50.0	Seminole County	25	HC-0180	HC-0200	42.9	1210	44.1	1665	45.1	2124	46.8	2928	100 Yr
	HC-0210X	44.0	Seminole County	25	HC-0210	HC-0220	33.5	1055	34.6	1412	35.8	1788	38.0	2462	100 Yr
	HC-0230X	37.0	Seminole County	25	HC-0230	HC-0240	31.8	961	32.7	1333	33.5	1716	36.9	2433	100 Yr
	HC-0240X	34.0	Seminole County	25	HC-0240	HC-0250	30.5	1136	31.7	1603	32.7	2094	36.8	3005	25 Yr
	HC-0260X	30.3	Seminole County	25	HC-0260	HC-0270	25.3	1217	26.6	1743	27.7	2316	29.1	3281	100 Yr
16E	HC-0280X	25.7	Seminole County	25	HC-0280	HC-0290	24.0	1233	25.4	1757	26.4	2331	27.7	3262	10 Yr
	HC-0300X	29.0	Seminole County	25	HC-0300	HC-0310	22.6	1320	24.1	1845	25.0	2457	26.0	3557	100 Yr
16E	HC-0320X	23.2	Seminole County	25	HC-0320	HC-0330	22.4	1288	24.0	1842	24.8	2453	25.7	3543	Mean Annnual
	HC-0340X	22.0	Seminole County	25	HC-0340	HC-0350	20.0	1285	21.3	1840	22.4	2451	23.6	3534	10 Yr
16E	HC-0360X	19.0	Seminole County	25	HC-0360	HC-0370	18.8	1283	19.7	1837	20.5	2447	21.8	3512	Mean Annnual
	HC-0380X	22.0	Seminole County	25	HC-0380	HC-0390	16.0	1283	17.4	1825	18.7	2426	20.3	3438	100 Yr
	HC-0400X	20.1	Seminole County	25	HC-0400	HC-0410	15.7	1373	17.1	1605	18.4	2099	20.0	2957	100 Yr
	HC-0410X	21.9	Seminole County	25	HC-0410	HC-0420	13.6	2387	14.6	3345	15.6	4362	17.0	5912	100 Yr
	HC-0430X	25.6	Seminole County	25	HC-0430	HC-0440	10.7	2425	11.4	3399	12.1	4433	13.1	6088	100 Yr
	HC-0450X	25.6	Seminole County	25	HC-0440	HC-0460	9.4	2425	9.8	3398	10.1	4432	10.5	6085	100 Yr
	HC-0470X	10.0	Seminole County	25	HC-0470	LJ-0010	4.8	0	7.2	0	8.3	0	10.0	0	100 Yr
	LA-0010X	85.4	Orlando	10	LA-0010	LA-0020	82.8	28	83.5	43	84.1	60	85.7	83	25 Yr
	LAn-0010X	63.0	Seminole County	25	LAn-0010	LH-0010	62.5	98	62.8	462	63.0	525	63.2	666	25 Yr
	LBk-0010X	67.0	Orange County	10	LBk-0010	LBk-0020	64.4	5	64.7	23	64.9	31	65.2	33	100 Yr
	LBk-0030X	67.2	Orange County	10	LBk-0030	LBk-0040	62.5	5	62.6	7	62.9	12	63.8	27	100 Yr
	LBk-0050X	61.0	Orange County	25	LBk-0050	LBk-0080	55.4	5	56.2	7	57.0	12	58.3	27	100 Yr
13E	LH-0030X	58.2	Seminole County	25	LH-0030	LH-0040	57.1	72	58.6	201	59.1	346	60.9	649	Mean Annnual
	LH-0050X	61.3	Seminole County	25	LH-0050	LH-0060	55.5	93	56.9	211	59.0	467	60.9	691	100 Yr
30E	LHa-0010X	42.9	Seminole County	25	LHa-0010	LKC-0012	42.7	56	43.0	83	43.1	110	43.3	160	Mean Annnual
31EF	LKC-0010X	32.0	Seminole County	25	LKC-0010	LKC-0020	32.9	60	33.8	82	34.8	106	36.3	143	Submerged
	LKC-0013X	40.0	Seminole County	25	LKC-0013	LKC-0014	39.2	91	39.4	134	39.6	181	40.0	188	25 Yr
31EF	LKC-0015X	36.0	Seminole County	25	LKC-0015	LKC-0016	34.3	132	35.3	184	36.3	239	37.5	352	10 Yr
31EF	LKC-0017X	32.0	Seminole County	25	LKC-0017	LKC-0020	32.9	144	33.8	190	34.8	233	36.3	355	Submerged
31EF	LKC-0019X	32.0	Seminole County	25	LKC-0019	LKC-0020	32.9	24	33.8	36	34.8	47	36.3	97	Submerged
	LKC-0020X	37.5	Seminole County	25	LKC-0020	LKC-0030	31.1	158	32.2	205	33.5	254	35.5	314	100 Yr
32E	LKC-0040X	30.0	Seminole County	25	LKC-0040	LKC-0050	29.0	194	29.8	254	30.8	313	32.4	402	10 Yr
	LKC-0046X	35.2	Seminole County	25	LKC-0046	LKC-0047	32.7	63	33.0	67	33.4	70	33.9	75	100 Yr

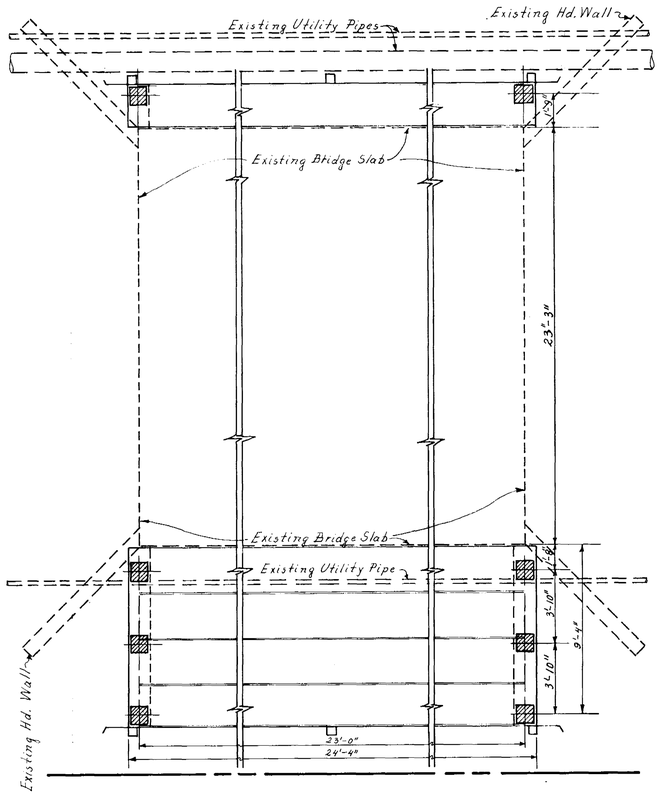
Appendix J
Howell Creek Basin Watershed Management Plan
Level of Service
Culverts/Bridges - Existing Conditions

		Critical Elevation					Mean Annual		10 Year 24 Hour Storm		25 Year 24 Hour Storm		100 Year 24 Hour Storm		
Problem Area No.	Model ID	U/S Node	LOS Used	Design Return Period	U/S Node	D/S Node	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (cfs)	Stage (ft)	Flow (cfs)	Current Level of Protection
	CC-0030CE	93.9	Seminole County	10	CC-0030	CC-0040	91.3	41	92.0	48	93.2	61	94.8	77	25 Yr
	CC-0030CW	93.9	Seminole County	10	CC-0030	CC-0040	91.3	38	92.0	46	93.2	61	94.8	77	25 Yr
	CC-0040C	94.0	Seminole County	10	CC-0040	CC-0050	90.9	79	91.7	94	92.6	104	94.1	155	25 Yr
	CC-0049C	94.0	Seminole County	10	CC-0049	CC-0050	89.3	24	90.2	41	91.0	57	91.7	73	100 Yr
10E	CC-0059C	91.0	Seminole County	10	CC-0059	CC-0060	91.6	53	91.8	53	92.1	52	92.8	51	Submerged
	CC-0070C	92.0	Seminole County	10	CC-0070	CC-0080	90.1	169	91.2	208	92.0	238	92.7	280	25 Yr
	CC-0090C	91.0	Seminole County	10	CC-0090	CC-0100	89.6	173	90.6	213	91.2	237	91.4	408	10 Yr
	CC-0110C	90.0	Seminole County	10	CC-0110	CC-0120	84.0	271	85.2	365	86.7	454	88.5	522	100 Yr
	CC-0120B	90.0	Seminole County	10	CC-0120	CC-0130	82.9	294	83.4	448	83.8	593	84.4	816	100 Yr
11E	CC-0170W	67.0	Seminole County	10	CC-0170	CC-0180	67.2	63	69.2	70	70.9	75	73.2	82	Submerged
	CC-0180W	67.0	Seminole County	10	CC-0180	CC-0190	63.3	338	64.5	520	65.6	692	67.5	953	25 Yr
	CC-0190C	64.0	Seminole County	10	CC-0190	CC-0200	61.7	333	63.4	511	64.7	675	67.0	749	10 Yr
	CC-0210C	67.0	Seminole County	50	CC-0210	CC-0220	61.6	313	63.2	451	64.6	601	66.9	814	100 Yr
	CC-0220B	65.0	Seminole County	100	CC-0220	CC-0230	55.5	494	56.1	653	56.7	825	58.1	1155	100 Yr
	CC-0240B	60.0	Seminole County	100	CC-0240	LH-0090	54.6	493	55.3	652	56.5	1310	57.9	1159	100 Yr
	DL-0010C	59.0	Seminole County	25	DL-0010	LP-0010	57.1	2	57.6	3	58.2	3	58.9	4	100 Yr
	DDP-0010C	71.0	Seminole County	25	DDP-0010	DR-0030	66.7	19	68.5	21	70.5	22	72.0	23	25 Yr
	DR-0020C1	68.4	Seminole County	10	DR-0020	DR-0030	64.9	49	66.0	82	67.1	108	68.5	141	25 Yr
	DR-0020C2	68.4	Seminole County	10	DR-0030	DR-0050	64.8	49	65.8	82	66.3	108	66.8	142	100 Yr
12E	DR-0036C	67.0	Seminole County	10	DR-0036	DR-0037	67.1	75	67.3	78	67.5	82	67.7	82	Submerged
12E	DR-0037C	67.0	Seminole County	10	DR-0037	DR-0038	66.6	90	67.3	78	67.4	74	67.6	72	Mean Annnual
12E	DR-0038C	66.0	Seminole County	10	DR-0038	DR-0040	65.4	75	66.4	84	66.8	80	67.2	72	Mean Annnual
12E	DR-0040C1	65.4	Seminole County	10	DR-0040	DR-0050	64.7	72	65.7	87	66.3	98	66.8	117	Mean Annnual
12E	DR-0040C2	65.4	Seminole County	10	DR-0040	DR-0050	64.7	65	65.7	83	66.3	97	66.8	117	Mean Annnual
12E	DR-0040C3	65.4	Seminole County	10	DR-0040	DR-0050	64.7	72	65.7	87	66.3	98	66.8	117	Mean Annnual
	DR-0060C	65.8	Seminole County	10	DR-0060	DR-0070	64.6	102	65.5	138	66.2	166	66.7	185	10 Yr
	DR-0070C1	65.3	Seminole County	25	DR-0070	DR-0090	60.5	93	61.1	119	61.7	143	64.8	306	100 Yr
	DR-0070C2	65.3	Seminole County	25	DR-0070	DR-0090	60.5	75	61.1	100	61.7	124	64.8	309	100 Yr
	DR-0091C	68.0	Seminole County	10	DR-0091	DR-0092	65.8	11	66.3	16	66.8	19	67.7	20	100 Yr
	DR-0092C	68.5	Seminole County	10	DR-0092	DR-0093	65.7	11	66.1	16	66.7	19	67.6	20	100 Yr
	DR-0093C	68.0	Seminole County	10	DR-0093	DR-0094	65.4	11	66.0	16	66.7	19	67.5	24	100 Yr
	DR-0094DS	69.0	Seminole County	25	DR-0094	DR-0095	65.3	11	65.9	23	66.7	33	67.5	42	100 Yr
	DR-0100C1	68.8	Seminole County	10	DR-0100	DR-0110	66.1	11	67.0	21	67.5	26	68.5	31	100 Yr
	DR-0100C2	68.8	Seminole County	10	DR-0100	DR-0110	66.1	11	67.0	21	67.5	26	68.5	31	100 Yr
15E	DR-0120C1	66.3	Seminole County	25	DR-0120	DR-0130	65.4	128	66.8	155	67.0	160	67.2	164	Mean Annnual
15E	DR-0120C2	66.3	Seminole County	25	DR-0120	DR-0130	65.4	123	66.8	151	67.0	156	67.2	160	Mean Annnual
	DR-0150C	51.5	Seminole County	25	DR-0150	DR-0160	47.2	325	48.3	436	49.3	563	51.0	756	100 Yr
15E	DR-0170C	40.0	Seminole County	25	DR-0170	DR-0180	41.0	242	41.6	243	42.1	243	42.8	243	Submerged
	GL-0010C	63.0	Seminole County	25	GL-0010	GL-0020	62.0	25	62.4	28	62.5	29	63.3	37	25 Yr
	GL-0020C	58.6	Seminole County	25	GL-0020	BGL-0010	55.1	59	55.8	75	56.4	88	57.5	115	100 Yr
	GmL-0020C	54.0	Oviedo	25	GmL-0020	GmL-0030	49.0	0	49.2	0	51.8	31	54.3	68	25 Yr
	HC-0020W	69.0	Orange County	50	HC-0020	HC-0040	67.2	201	67.5	308	67.9	427	68.5	682	100 Yr
	HC-0040B	67.9	Orange County	50	HC-0040	HC-0050	61.6	234	62.4	308	63.2	427	64.5	682	100 Yr
	HC-0062W	65.0	Seminole County	25	LWu-0010	HC-0070	61.5	426	62.4	571	63.2	734	64.5	1063	100 Yr
	HC-0070B	66.0	Seminole County	100	HC-0070	HC-0080	61.3	426	62.2	571	63.0	734	64.3	1063	100 Yr
14E	HC-0085B	63.6	Seminole County	100	HC-0085	HC-0090	60.7	427	61.5	572	62.3	736	63.7	1065	25 Yr
	HC-0100B	67.2	Seminole County	100	HC-0100	HC-0110	60.2	474	61.0	629	61.7	804	63.0	1154	100 Yr
	HC-0120B	66.8	Seminole County	100	HC-0120	HC-0130	58.6	474	59.3	629	60.0	804	61.3	1154	100 Yr
	HC-0140B	68.0	Seminole County	100	HC-0140	HC-0150	54.6	474	55.6	629	56.5	804	58.3	1154	100 Yr

Appendix B
Plans & Permits Excerpts

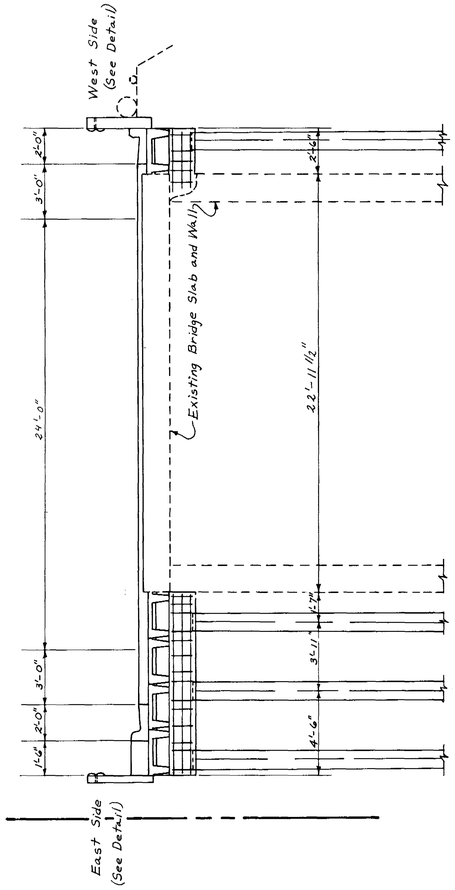
LAKE HOWELL ROAD

SEMINOLE COUNTY ENGINEERING DEPARTMENT
SEMINOLE COUNTY, FLORIDA
LAKE HOWELL ROAD ASBUILT
DRAWN BY R.D.M.
DATE 6-25-75 SCALE 1" = 50'
APPROVED BY
COUNTY ENGINEER DATE
DISTRICT NO.
FIELD BOOK 58
DRAWING NO.
SHEET 3 OF 8
Scale : 1" = 50'
SEC. 28, TWP. 21, RGE. 30
N
FORREST BROOK
UNIT 2, P.B. 15, P.G. 31
PLAN VIEW
30" Inflow Pipe
36" Outfall Pipe
Baffle
18" Outfall Pipe
18" Inflow Pipe
Inlet
SECTION 'A-A'
POLLUTION CONTROL
STRUCTURE (A)
Traffic Wt. M.H. Covers
El. 63.00
El. 61.50
El. 60.00
El. 62.50
SECTION 'B-B'
POLLUTION CONTROL
STRUCTURE (B)
El. 61.20
El. 60.20
El. 58.70
Const. Manhole Pair with inlets
Const. 36"x15" R.C.P.
30' R.C.P.
Pollution Control Structure (A) See Detail
12" Pipe
36" R.C.P.
4" Pipe
3" Pipe
Board Fence
Widen Bridge (See Bridge Detail Sheet)
Pollution Control Structure (B) (See Detail)
HOWELL CREEK
LAKE HOWELL LANE
TUSCARORA TERRACE
4" H.P. Gas
Const. Manhole with inlet
Const. 40'x15" R.C.P.
Const. inlet
Gas Box
Radii = 35'
Radii = 25'
Conc. Mon.
Conc. D/W
Dirt D/W
B.M. # 3
Spike in Power Pole
18' Lt. of Sta. 76+52
Elev. 67.21
PLAN
PROFILE
Bill Evans
R.D.M.
NOTE BOOK No. 58
550' V.C.
S = -1.32%
S = -1.68%
S = -1.09%
S = +0.60%
S = +1.06%
600' x 30" R.C.P.
36" x 15" R.C.P.
225' x 36" R.C.P.
250' x 18" R.C.P.
235' x 18" R.C.P.
Existing 15" Pipe
F.L. 73.08
F.L. 63.00
F.L. 62.50
F.L. 60.85
F.L. 61.00
F.L. 61.20
F.L. 65.00
Stream Bed
65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
V: 1" = 5'
H: 1" = 50'



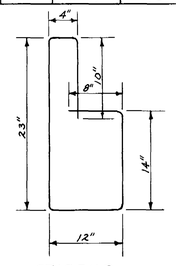
PLAN VIEW
AND
SIDE VIEW

Scale : 1/4" = 1'-0"



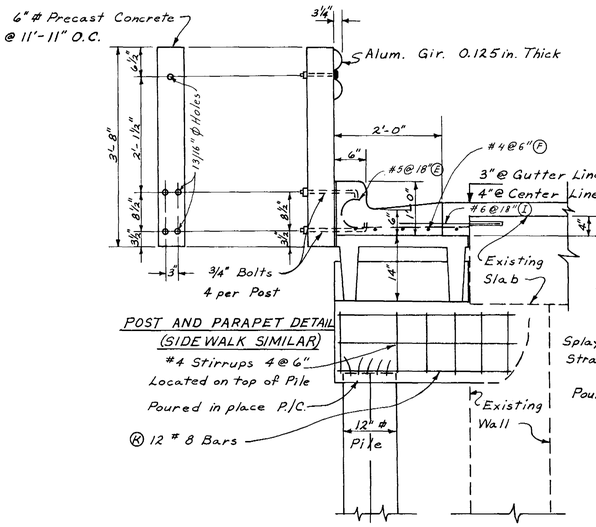
SIDE VIEW
(LOOKING SOUTH)
Scale : 1/4" = 1'-0"

BILL OF REINFORCING STEEL						
Location	Mark	Size	Length	Quantity	Shape	Weight
West Pile Cap	K	#8	3'-6"	24	——	224
East Pile Cap	L	#8	10'-6"	24	——	673
Stirrups		#4	5'-11"	40	See Dia.	157

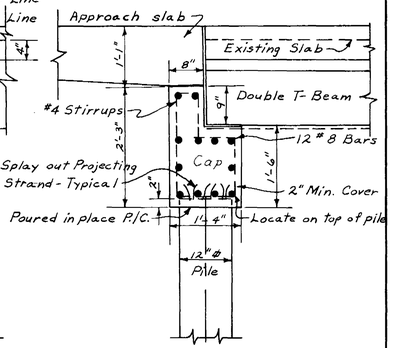


STIRRUP
(Dimensions are out to out)

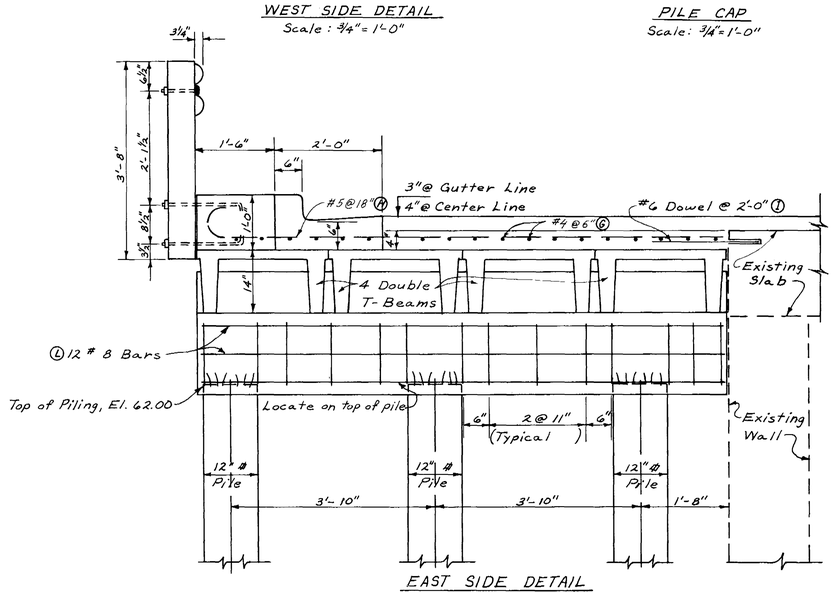
TOTAL : 1054 lbs.



WEST SIDE DETAIL
Scale : 3/4" = 1'-0"



PILE CAP
Scale: 3/4" = 1'-0"



EAST SIDE DETAIL
Scale : 3/4" = 1'-0"

Revised: 12/18/1974 R.D.M.

SEMINOLE COUNTY ENGINEERING DEPARTMENT
SEMINOLE COUNTY, FLORIDA

LAKE HOWELL ROAD BRIDGE OVER HOWELL CREEK

DRAWN BY R.E.H. | DISTRICT NO. 1
DATE 6/17/1974 | SCALE As shown | FIELD BOOK S.B. 33
APPROVED BY | DRAWING NO. 73-C-8
COUNTY ENGINEER DATE | SHEET 7 OF 8

251-T-74

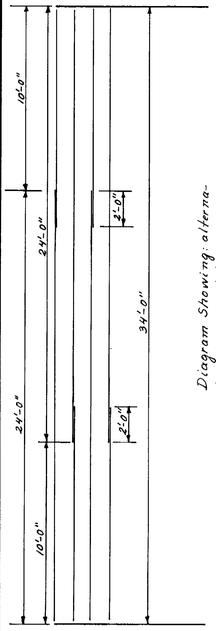
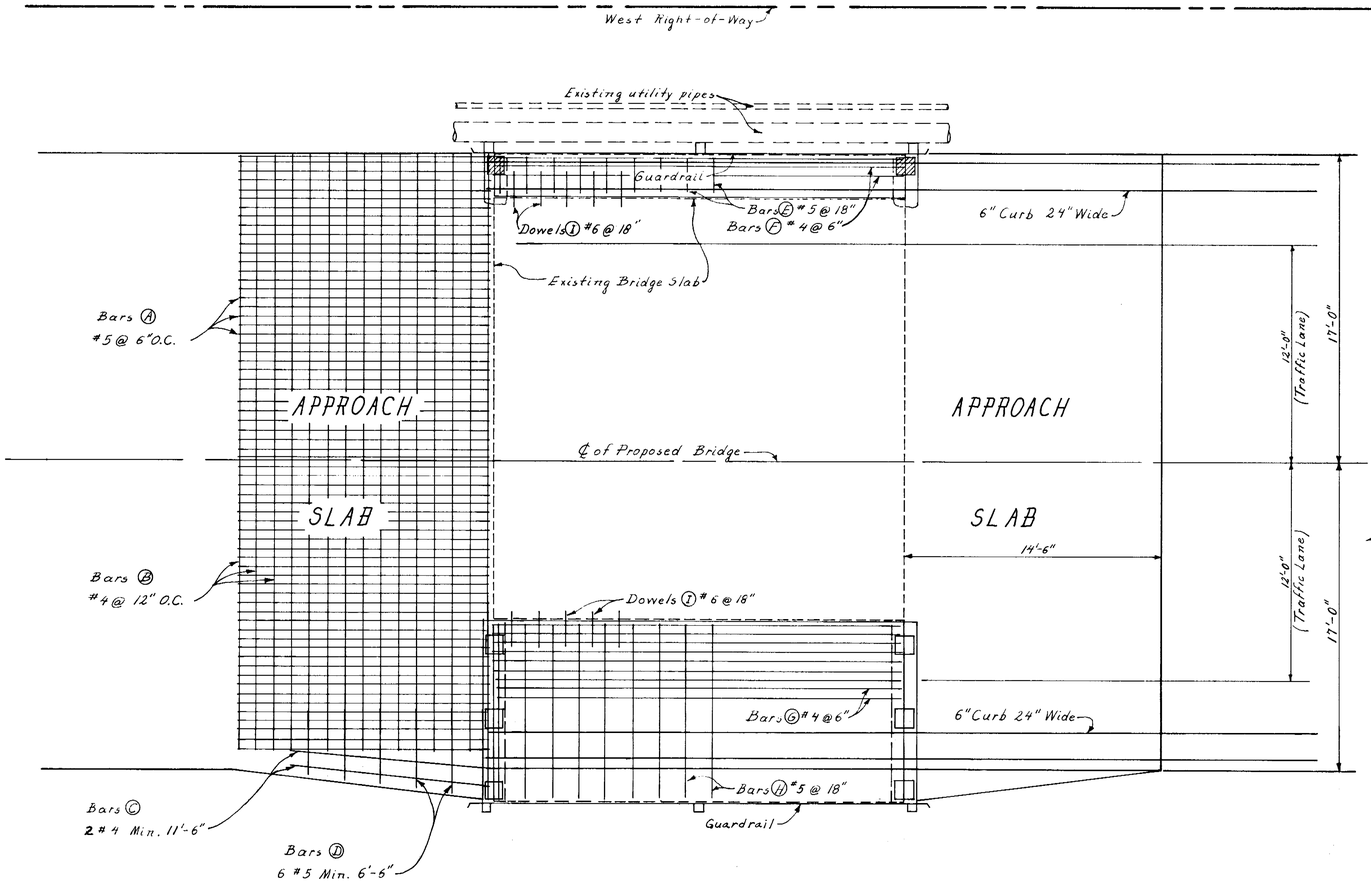


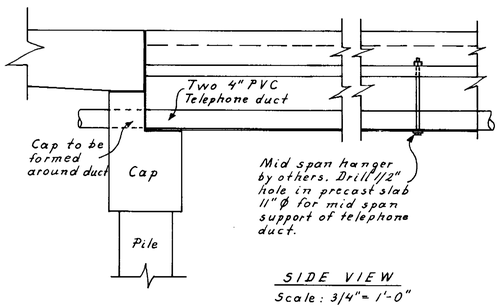
Diagram Showing alternating bars (cut to 24' and 12') and laps for 34' length.
Scale: 1/4"=1'-0"



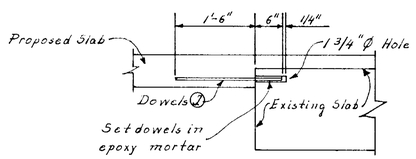
PLAN VIEW
Scale: 1/4"=1'-0"

BILL OF REINFORCING STEEL						
Location	Mark	Size	Length	Quantity	Shape	Weight
App. Slab	A	#5	14'-3"	132	—	1962
App. Slab	B	#4	36'-0"	30	—	721
App. Slab	C	#4	11'-6"	4	—	31
App. Slab	D	#5	5'-0"	12	—	63
West Side	E	#5	3'-9"	16	⌐	63
West Side	F	#4	22'-9"	5	—	76
East Side	G	#4	22'-9"	20	—	304
East Side	H	#5	11'-3"	16	⌐	187
Dowels	I	#6	2'-0"	30	—	90

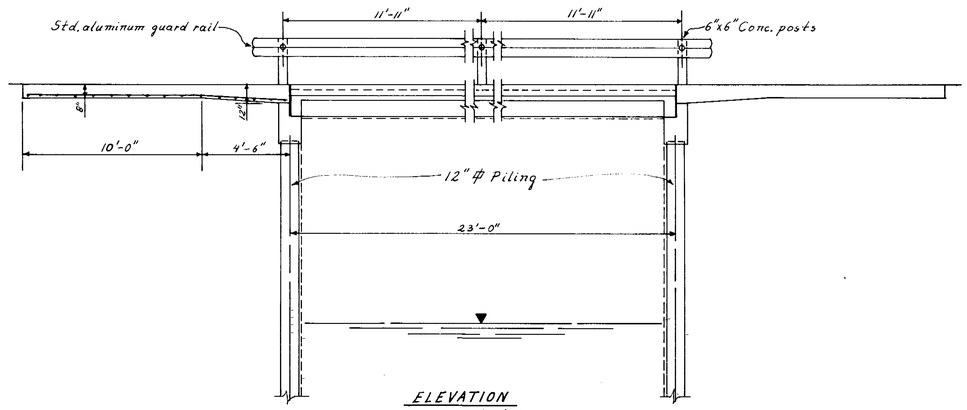
TOTAL: 3470 lbs.



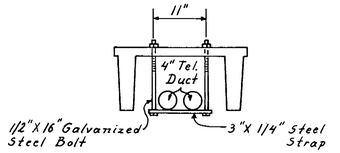
SIDE VIEW
Scale: 3/4"=1'-0"



Section Showing Dowels between existing and proposed slab.
Scale: 3/4"=1'-0"



ELEVATION
Scale: 1/4"=1'-0"



HANGER DETAIL

Revised: 12/19/1974 R.D.M.

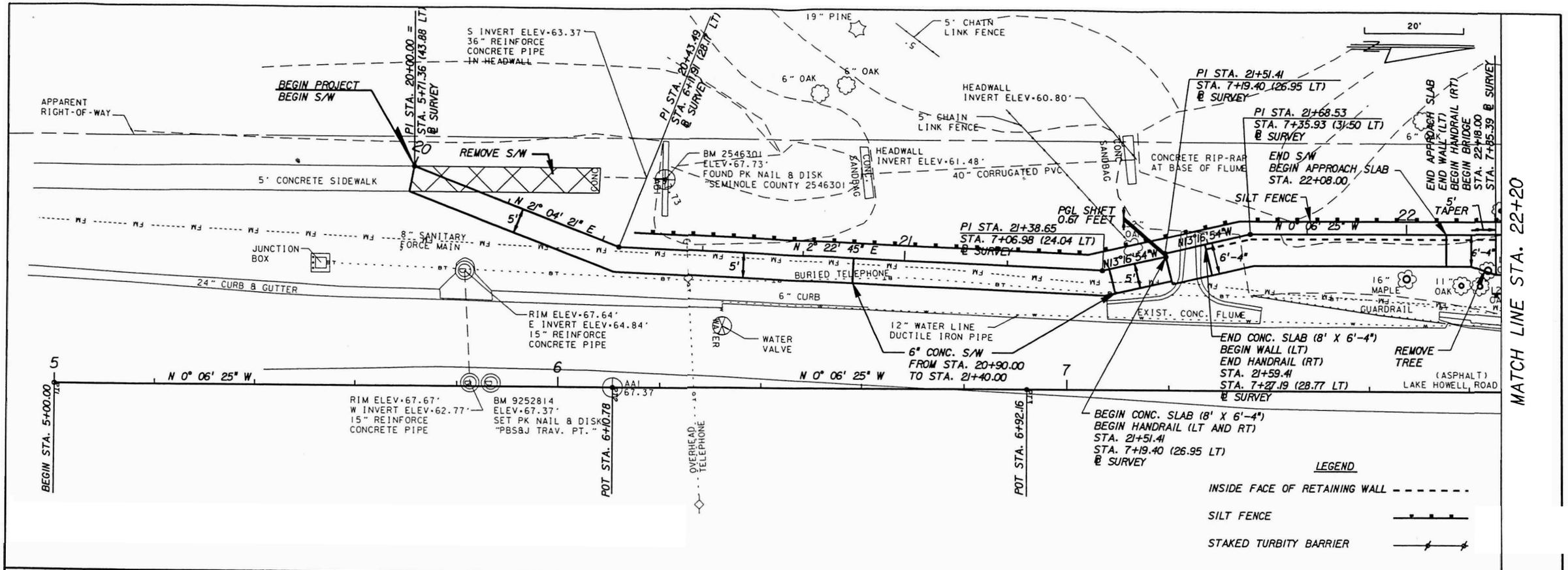
SEMINOLE COUNTY ENGINEERING DEPARTMENT
SEMINOLE COUNTY, FLORIDA

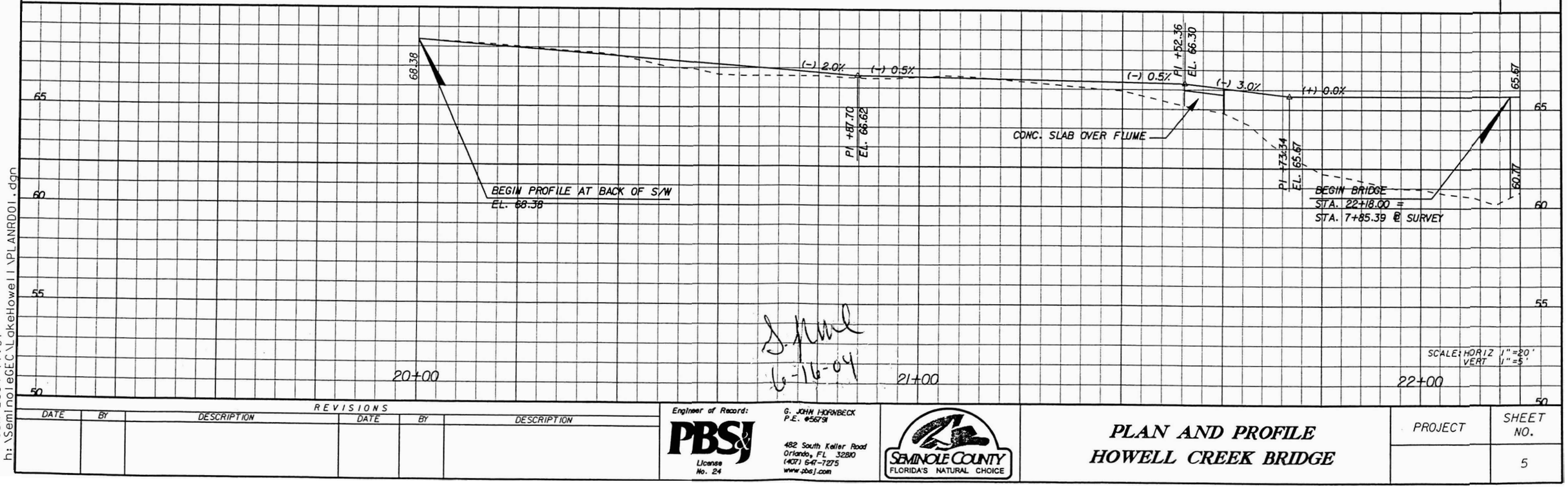
LAKE HOWELL ROAD BRIDGE
OVER HOWELL CREEK

DRAWN BY A.E.A. DISTRICT NO. 1
DATE 6/17/1974 SCALE As shown FIELD BOOK S.B. 33
APPROVED BY W. Bush, Jr. 8/16/74 DRAWING NO. 73-C-8
COUNTY ENGINEER DATE SHEET 8 OF 8

251-8-74

LAKE HOWELL ROAD PEDESTRIAN BRIDGE





D. Hand
6-16-04

REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Engineer of Record:
G. JOHN HORNBECK
P.E. #56791
PBSJ
License No. 24
482 South Keller Road
Orlando, FL 32810
(407) 647-7275
www.pbsj.com

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

PLAN AND PROFILE
HOWELL CREEK BRIDGE

PROJECT

SHEET NO. 5

11-JUN-2004 11:31
h:\SeminoleGEC\LakeHowell\PLANRD01.dgn

MATCH LINE STA. 22+20

12" TWIN OAK
TOP OF BANK
BOTTOM OF BANK
BA3 59.98
REMOVE TREE
8" OAK
28" OAK
℄ BRIDGE AND ℄ S/W
APPARENT RIGHT-OF-WAY
HOWELL CREEK
BOTTOM OF BANK
TOP OF BANK
BA4 61.95
END BRIDGE
BEGIN APPROACH SLAB
BEGIN WALL (LT AND RT)
STA. 22+78.00
STA. 8+45.39 ℄ SURVEY
END WALL (LT)
END HANDRAIL (LT)
STA. 23+28.06
END APPROACH SLAB
BEGIN S/W
STA. 22+88.00
END WALL (RT)
END HANDRAIL (RT)
STA. 22+92.00
PI STA. 23+28.06
STA. 8+95.45 (31.50 LT)
℄ SURVEY
PI STA. 23+43.94
STA. 9+11.33 (32.00 LT)
℄ SURVEY
PI STA. 23+78.39
STA. 9+45.77 (32.00 LT)
℄ SURVEY
END PROJECT
END S/W
20'
14" OAK
6" OAK
N 0° 06' 25" W
8'
STAKED TURBIDITY BARRIER
S/W TAPER 5'
6'-4"
23
SILT FENCE
N 1°53'55" W
N 0°06'25" W
5'
APPARENT RIGHT-OF-WAY
4' CONCRETE SIDEWALK
CONCRETE DRIVEWAY
REMOVE TREE
32" OAK
32" OAK
CONCRETE DRIVEWAY
BARRIER WALL
RETAINING WALL
12" SQUARE BRIDGE COLUMNS
GUARDRAIL
24" CURB & GUTTER
6" CURB
8" SANITARY FORCE MAIN
12" WATER LINE DUCTILE IRON PIPE
BARRIER WALL
MATCH EXIST. DRIVEWAY CROSS SLOPE
12" WATER LINE DUCTILE IRON PIPE
BM 9254436
ELEV=68.85'
SET PK NAIL & DISK
"PBSBJ TRAV. PT."
AA3
BA6
65.85
8
9
10
N 0° 06' 25" W
END STA. 10+22.61
FOR LIMITS OF SAND CEMENT RIP-RAP SEE BRIDGE PLANS, B-3.
EXISTING TREE TO REMAIN
RIM ELEV=65.43'
E INVERT ELEV=61.25'
15" REINFORCE CONCRETE PIPE

65.67
MATCH EXIST. GRADE
65.93
(+) 0.0%
(-) 1.0%
(+) 0.5% (AVG.)
PI +81.50
EL. 65.56'
PI +30.00
EL. 65.58
65
60
55
50
40' FLOODWAY
100-Year Flood Elevation = 62.0'
10-Year Flood Elevation = 60.5'
60.77
END BRIDGE
STA. 22+78.00 =
TA. 8+45.39 ℄ SURVEY
END PROJECT
STA. 23+78.39 =
STA. 9+45.77 ℄ SURVEY
23+00
SCALE: HORIZ 1"=20'
VERT 1"=5'

6-16-04

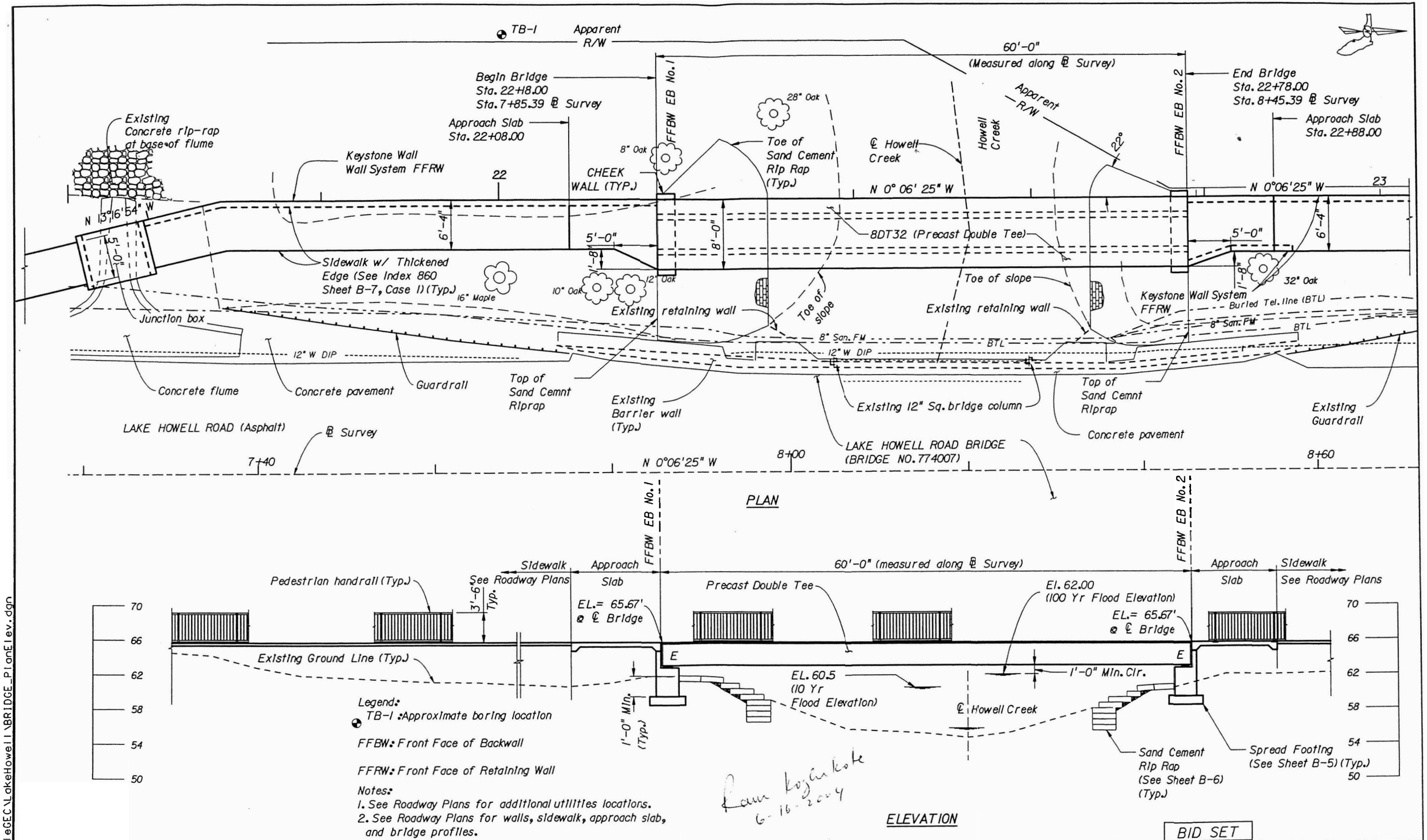
REVISIONS					
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION

Engineer of Record: G. JOHN HOFKNECK P.E. #56791
PBS&J License No. 24
482 South Keller Road Orlando, FL 32810 (407) 647-7275 www.pbsj.com
SEMINOLE COUNTY FLORIDA'S NATURAL CHOICE

PLAN AND PROFILE HOWELL CREEK BRIDGE

PROJECT	SHEET NO.
	6

11-JUN-2004 11:29
H:\SeminoleEC\LakeHowell\PLANRD02.dgn



Ram Kozhikote 6-16-2004

BID SET

REVISIONS						
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION	

	Names	Dates
Drawn by	JF/TN	6/2004
Checked by	KTZ	6/2004
Designed by	KTZ	6/2004
Checked by	DT	6/2004
Approved by		

Engineer of Record: Ram Kozhikote P.E. # 44022
PBS&J Certificate of Authorization No. 24
482 South Keller Road Orlando, FL 32810 (407) 647-7275 www.pbsj.com

SEMINOLE COUNTY FLORIDA'S NATURAL CHOICE

BRIDGE PLAN AND ELEVATION

HOWELL CREEK PEDESTRIAN BRIDGE

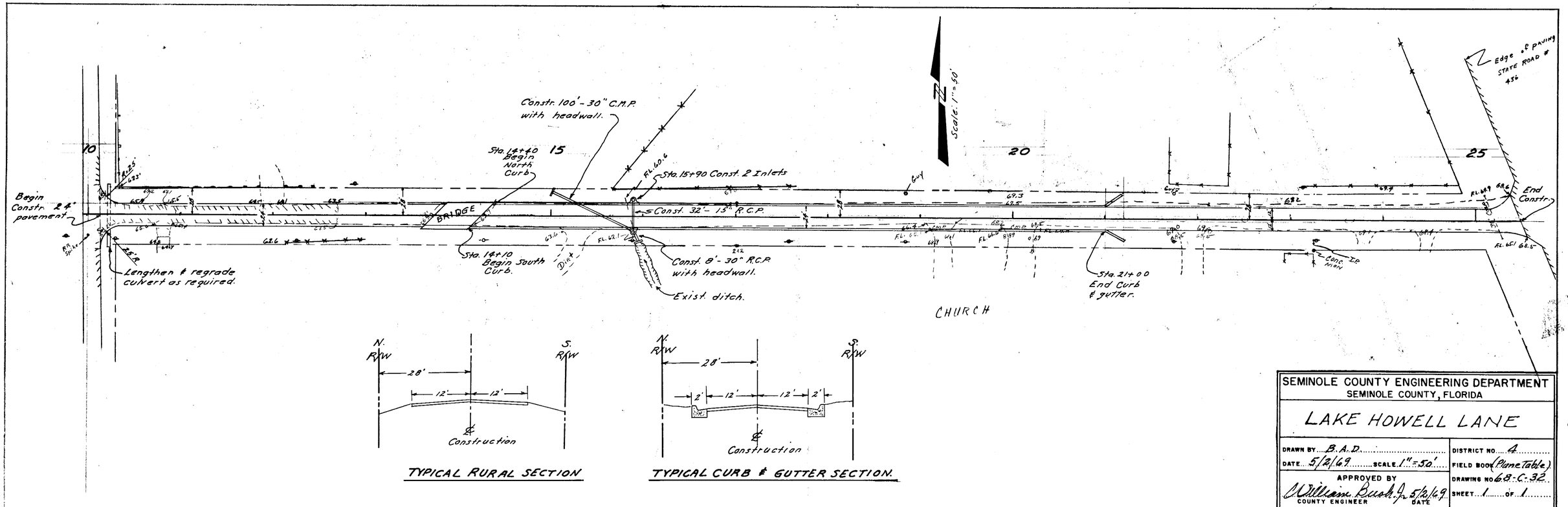
PROJECT

SHEET NO. B-3

15-JUN-2004 09:48
H:\Seminole\CEC\LakeHowell\BRIDGE_PlanElev.dgn

LAKE HOWELL LANE

PLAN — SURVEYED / NOTE BOOK / ALIGNMENT CHECKED / RT. OF WAY CHECKED / NO. / DATE / BY

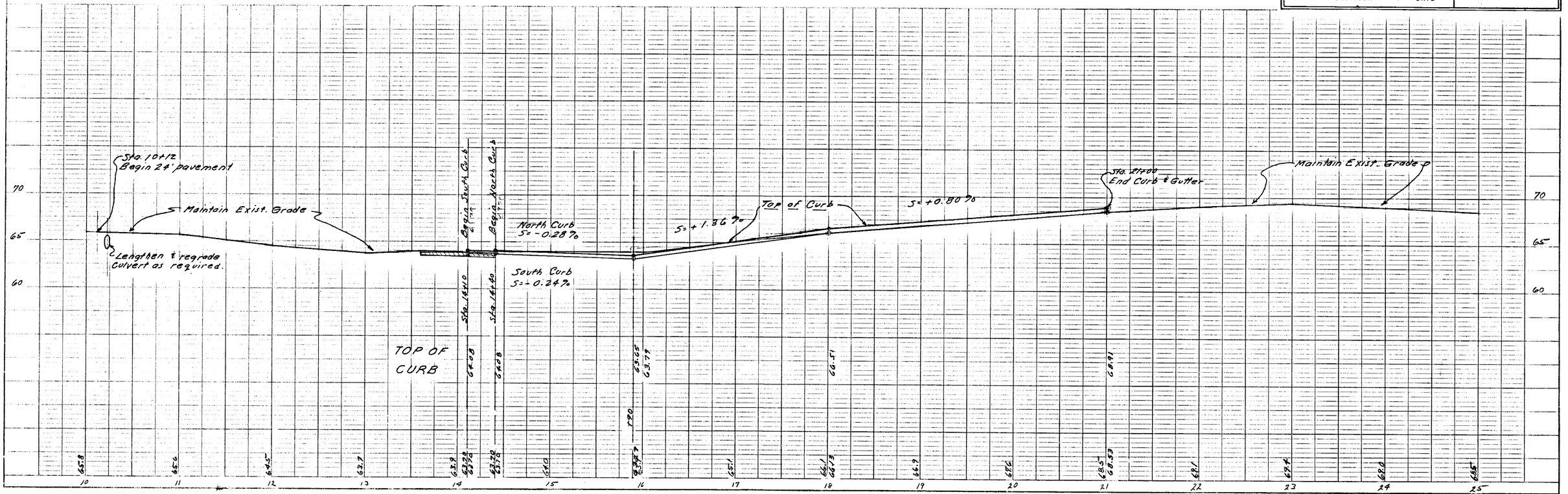


TYPICAL RURAL SECTION

TYPICAL CURB & GUTTER SECTION.

SEMINOLE COUNTY ENGINEERING DEPARTMENT SEMINOLE COUNTY, FLORIDA	
LAKE HOWELL LANE	
DRAWN BY B.A.D. DATE 5/2/69 SCALE 1"=50'	DISTRICT NO. 4 FIELD BOOK (Plane Table)
APPROVED BY C. William Burch Jr. 5/2/69 COUNTY ENGINEER DATE	DRAWING NO. 68-C-32 SHEET 1 OF 1

PROFILE — SURVEYED / NOTE BOOK / ALIGNMENT CHECKED / NO. / DATE / BY



181-1-69

K&E PLATE 1, PLAN-PROFILE KEUFFEL & ESSER CO. 48 7008 ALBANENE TRACING PAPER MADE IN U.S.A.

LAKE HOWELL LANE

171

N

Paved Road

20'

25'

R/W Line

1+00

2+00

3+00

4+00

5+00

STA. 0+00
℄ S.R. 436 (Nail)

STA 3+44 =
℄ Existing Canal

20'

50'

℄ LAKE HOWELL LANE

Unpaved Road

HOWELL CREEK

R/W Line

℄ S.R. 436

HOWELL CREEK

STA. 4+34.2–STADIA "A"
Hub in ℄ Lake Howell Lane

REVISION NO.		BY	DATE

SEMINOLE COUNTY ROAD DEPARTMENT
OFFICE OF COUNTY ENGINEER

HOWELL CREEK
AT LAKE HOWELL LANE

PROJ. NO. 4-1 | DISTRICT NO. 4

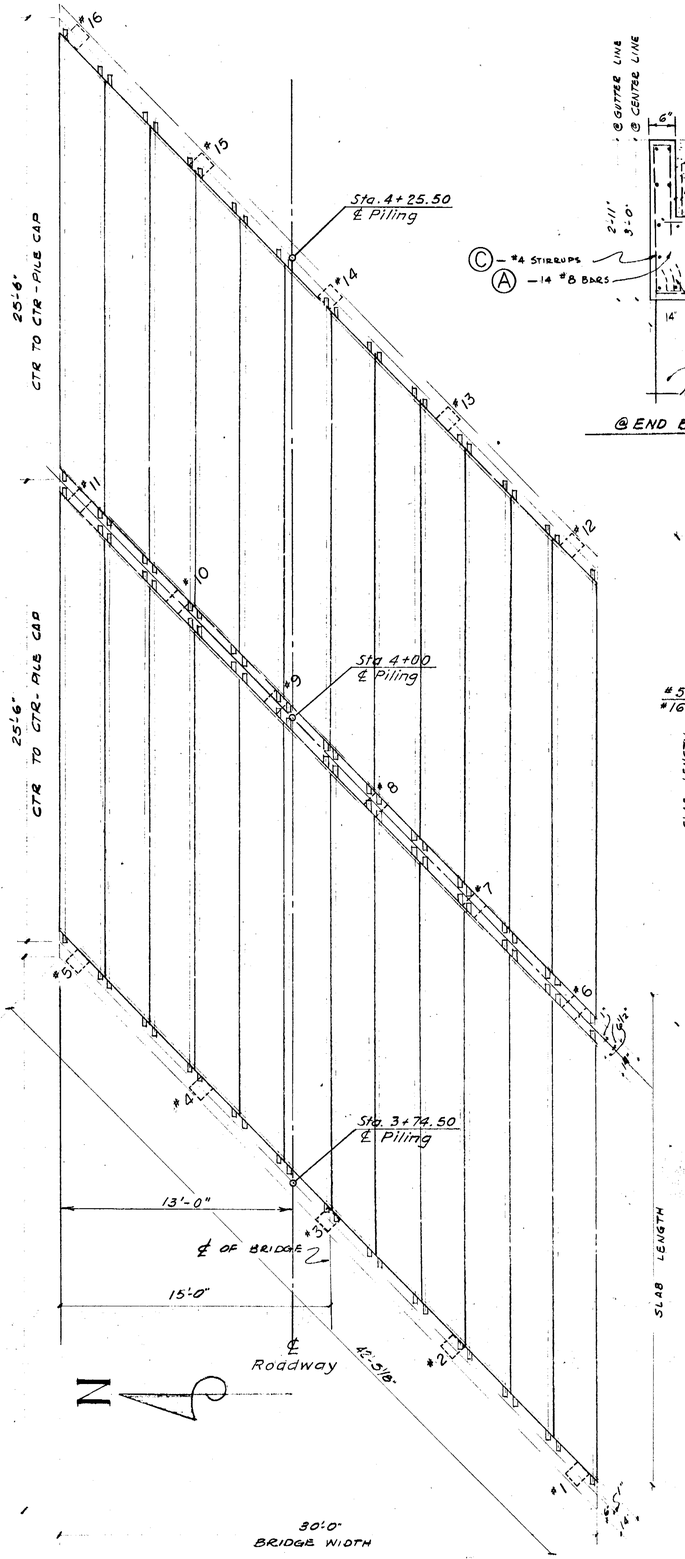
DRAWN BY L.S.
DATE 1-27-61
SCALE 1" = 20'

APPROVED BY:
COUNTY ENGINEER

DWG. NO. 108
FIELD BOOK NO. 11
SHEET 1 OF 2

027-1-61

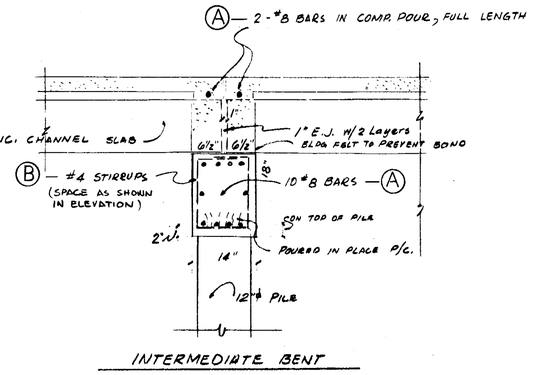
Howell Creek at Lake Howell L
1 of 2



PLAN OF SPANS

Scale: 1"=4'-0"

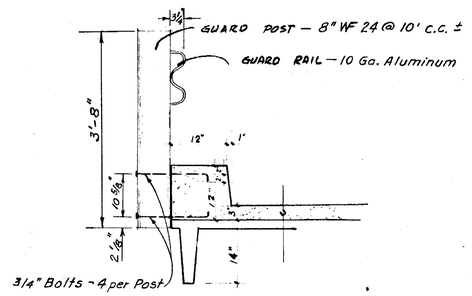
@ END BENT



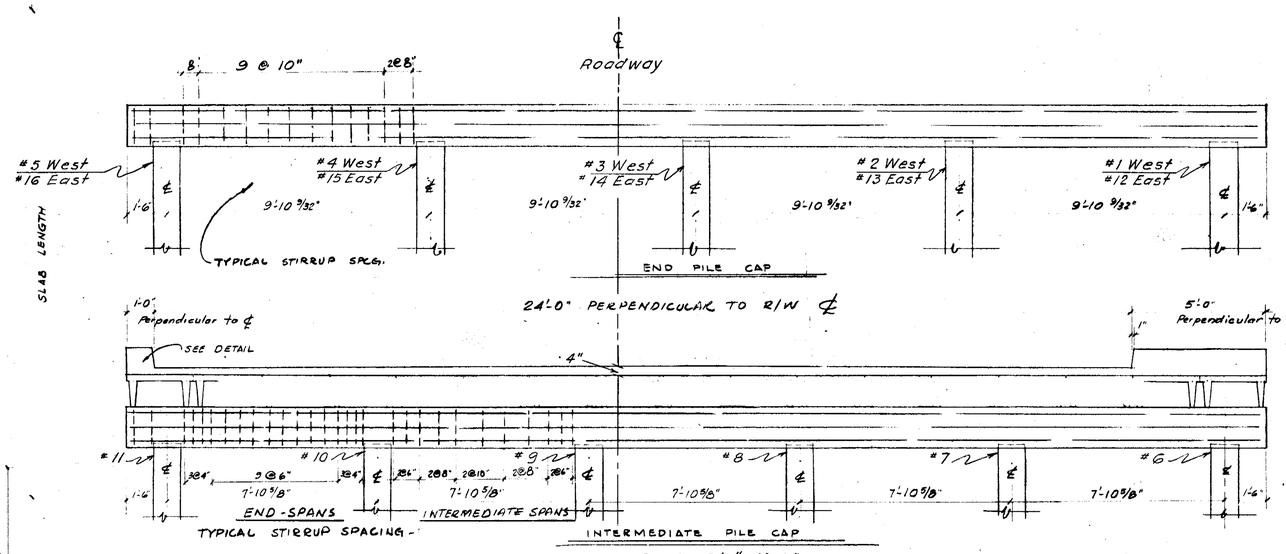
INTERMEDIATE BENT

TYPICAL SECTIONS

Scale ¾"=1'-0"



PARAPET DETAIL



Scale: 3/8"=1'-0"

NOTE:

Pile length is 50 feet
Drive to 30 Ton Bearing.

CONTROL ELEVATIONS		
PILE No	PILE CUT-OFF	SLAB SEAT
1	62.87	64.21
2	62.84	64.17
3	62.80	64.14
4	62.77	64.10
5	62.73	64.07
6	62.75	64.08
7	62.72	64.05
8	62.69	64.02
9	62.66	64.00
10	62.63	63.97
11	62.61	63.94
12	62.62	63.95
13	62.58	63.92
14	62.55	63.88
15	62.51	63.85
16	62.48	63.81

BAR LIST					
MARK	QUANTITY	SIZE	LENGTH	SHAPE	WEIGHT
A	40	#8	42'-0"	Strt.	4,485
B	250	#4	2'-10"	10" 7'-2" 10"	473
C	112	#4	5'-3"	2'-7" 4" 10"	393

REVISION NO.		BY	DATE
1	Control Elev. changed	L.S	4-18-61

SEMINOLE COUNTY ROAD DEPARTMENT
OFFICE OF COUNTY ENGINEER

HOWELL CREEK AT LAKE HOWELL LANE

PROJ. NO. 4-1 DISTRICT NO. 4

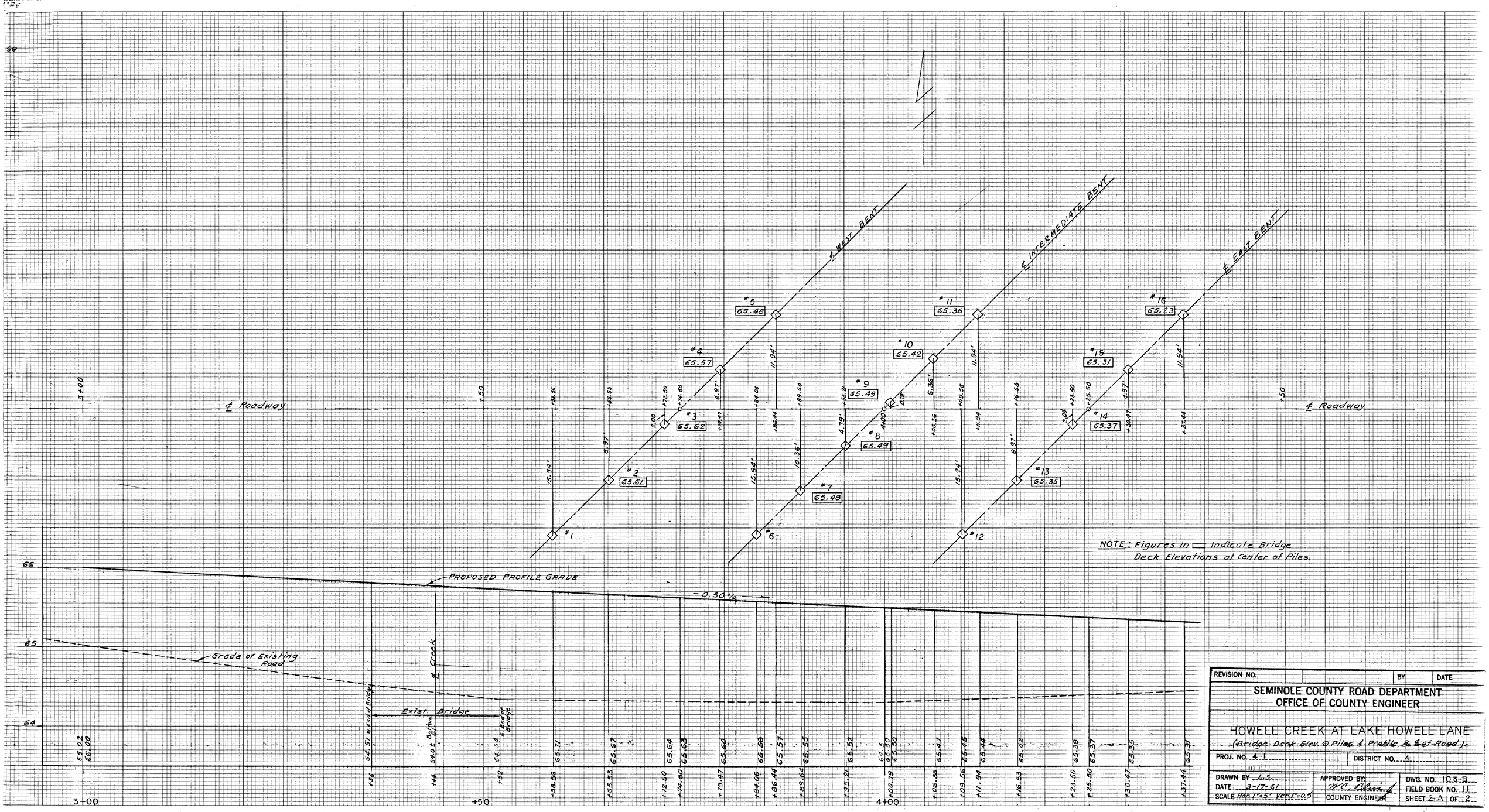
DRAWN BY D.L.S.
DATE 3-7-61
SCALE As shown

APPROVED BY: M. C. Bloss
COUNTY ENGINEER

DWG. NO. 108-A
FIELD BOOK NO.
SHEET 2 OF 2

027-2-61

KEUFFEL & ESSER CO
MADE IN U.S.A.
K&E STANDARD ® CROSS SECTION
30X10 TO THE INCH



REVISION NO.		BY	DATE

SEMINOLE COUNTY ROAD DEPARTMENT
OFFICE OF COUNTY ENGINEER

HOWELL CREEK AT LAKE HOWELL LANE
(Bridge Deck Elev. @ Piles & Profile @ ℄ of Road)

PROJ. NO. 4-1 DISTRICT NO. 4

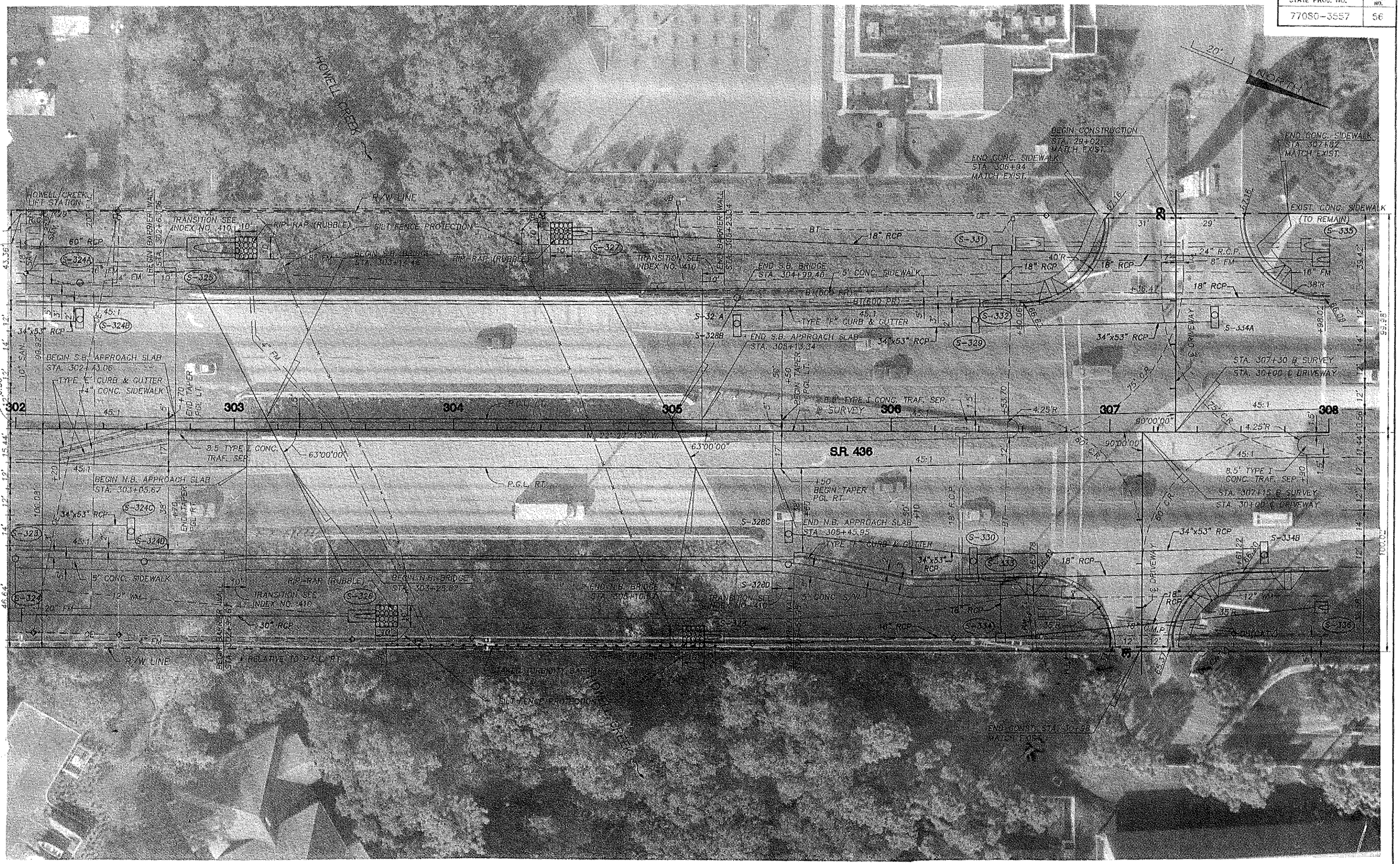
DRAWN BY C.S.	APPROVED BY: W.C. Ellis Jr.	DWG. NO. 108-B
DATE 3-17-61	COUNTY ENGINEER	FIELD BOOK NO. 11
SCALE Hor.1"=5' Vert.1"=0.5		SHEET 2-A OF 2

027-2A-61

Howell Creek at Lake Howell Ln.
2A of 2

SR 436

STATE PROJ. NO.	SHEET NO.
77080-3557	56



"SION: 24 02/17/93 B.T.
E: 1=20 09/13/91

S.R. 436 SEMINOLE

1102.850

REVISIONS									PHOTOGRAPHY DATA							FLORIDA DEPARTMENT OF TRANSPORTATION		PLAN
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION	FLOWN BY Kucera South Inc.		NAME	DATE		NAME	DATE	APPROVED BY	Kisinger Campo & Associates Corporation	
25 MAR. 93	D.T.	ADDED UG (CATV)							PHOTO DATE 9/25/91	DESIGNED BY	M.Q.	10/91	DRAWN BY	C.A.B.	10/91			
25 MAR. 93	S.B.A.	REV. 18" SAN. & 12" WM							PHOTO IDENTIFICATION NO. 33672-50	CHECKED BY	J.E.D.	10/91	CHECKED BY	J.E.D.	10/91			
										SUPERVISED BY J. DI STEFANO		DATE 10/91				DATE		

STATE PROJ. NO.	SHEET NO.
77080-3557	77

BEGIN S.B. BRIDGE STA. 303+14.46
BEGIN N.B. BRIDGE STA. 303+25.67
END S.B. BRIDGE STA. 304+99.46
END N.B. BRIDGE STA. 305+10.67

P.I. RT. & LT. (+50) NO V.C. 68.54 RT. 68.73 LT.
P.I. RT. & LT. (+50) NO V.C. 68.27 RT. 68.46 LT.
P.I. RT. & LT. (+00) NO V.C. 67.49 LT. 67.49 RT.

68.57 LT. 68.35 RT.

P.G.L. LT. +0.3279%
P.G.L. RT. +0.3775%
PROFILE GRADE LINE LT. (−)0.0914%
PROFILE GRADE LINE RT. (−)0.0914%
PROFILE GRADE LINE LT. (−)0.3863%
PROFILE GRADE LINE RT. (+)0.3103%

AIR RELEASE VALVE ASSEM. W/ BOX BY OTHERS
EXISTING GRADE @ SURVEY
RELOCATED 8" PVC F.M. BY OTHERS

S-323 S-324 S-325 S-326 S-327 S-328 S-331 S-332 S-333 S-334 S-335 S-336

D.P.I. LT. +20.00 63.00
D.P.I. RT. +00.00 61.09
D.P.I. LT. +86.00 62.90
D.P.I. RT. +40.00 61.88
D.P.I. LT. +80.00 62.41
D.P.I. LT. +50.00 62.00
D.P.I. LT. +00.00 62.13
D.P.I. RT. +00.00 61.96

BT (LT) BT (LT)
SPECIAL DITCH LT. (−)0.15%
SPECIAL DITCH RT. +0.13%
SPECIAL DITCH LT. (−)0.24%
BT (600PR) BT (600PR)
4" F.M. (RT)
8" F.M. (LT) 8" F.M. (LT)
16" F.M.(LT) 16" F.M.(LT)
61.70 Vvh
60.85 Vvh
59.00 Vvh
58.46 Vvh
55.06 Vvh
55.73 Vvh
53.88 Vvh
59.98 Vvh
62.01 Vvh WATER VALVES
60" RCP (LT)
30" RCP (RT)
12" WM
12" WM
20" F.M. (RT)
FL. 56.40(LT)
FL. 54.80(RT)
FL. 54.90(RT)
FL. 55.50(LT)
FL. 55.40(RT)
18" RCP (LT)
18" RCP (RT)
18" RCP (LT)
18" RCP (RT)
18" RCP (W)
4" FM
FL. 55.50(RT)
FL. 55.60(LT)
FL. 55.70(LT)
FL. 55.60(RT)
FL. 62.00(LT)
FL. 61.80(RT)

+20 BEGIN SPECIAL DITCH LT.
+86 END SPECIAL DITCH LT.
+40 END SPECIAL DITCH RT.
+80 BEGIN SPECIAL DITCH LT.
+50 END SPECIAL DITCH LT.
+00 BEGIN SPECIAL SPECIAL DITCH LT. & RT.

NO DITCH LT.
NO DITCH LT.
NO DITCH RT.
NO DITCH LT.

67.23
68.00

302 303 304 305 306 307 308

SCALE: 1"= 20' HORIZ.
1"= 2' VERT.

SCALE: 1=20 09/13/91 CAB S.R. 436 SEMINOLE
110258QQ

REVISIONS								
DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION	DATE	BY	DESCRIPTION
3/25/93	RLB	REPLOT 12" WM & RELOCATE 8" FM						

PHOTOGRAPHY DATA
FLOWN BY Kucera South Inc.
PHOTO DATE 9/25/91
PHOTO IDENTIFICATION NO. 33612

	NAME	DATE		NAME	DATE
DESIGNED BY	M.Q.	10/91	DRAWN BY	C.A.B.	10/91
CHECKED BY	J.F.D.	10/91	CHECKED BY	J.I.D.	10/91

SUPERVISED BY J. DI SILVANO DATE 10/91

FLORIDA DEPARTMENT OF TRANSPORTATION
APPROVED BY
DATE

Kisinger Campo & Associates Corporation

PROFILE

LAKE HOWELL SQUARE / WAL-MART SUPERCENTER

(30)

BEST AVAILABLE COPY

NOTE: SIDES TO BE SODDED.

SECTION D-D
N.T.S.

SECTION A-A

TYPICAL PIPE ENCASEMENT

1. ENCASE PIPELINE BEING CONSTRUCTED IF DEPTH OF COVER IS LESS THAN 30" WHERE NOTED ON DRAWINGS.
2. ENCASE SEWER LINE IF WATER LINE CROSSES UNDER SEWER LINE OR IF WATER LINE CROSSES OVER SEWER LINE WITH A VERTICAL CLEARANCE OF 18" OR LESS. ENCASEMENT TO EXTEND 10 FEET EACH WAY OF CROSSING.

CURB & GUTTER TRANSITION DETAIL

SECTION A-A

SECTION - BB

HEAVY DUTY CONCRETE PAVEMENT SECTION (TRUCK WELL AREA)

SUMP DETAIL

POP-OFF DETAIL
F.D.O.T. TYPE 'C' INLET
W/NON TRAFFIC BEARING GRATE

SIDE VIEW

TOP VIEW

SKIMMER DETAIL

PLAN

ELEVATION

UNDERDRAIN DETAIL

DISSIPATOR DETAIL

NOTE UNDERDRAIN PVC PIPE SHALL BE SURROUNDED BY 6" OF COURSE AGGREGATE (F.D.O.T. 56/57). THE COURSE AGGREGATE SHALL BE COMPLETELY WRAPPED IN A FILTER FABRIC & BACKFILLED W/MIN. OF 2' OF FINE AGGREGATE.

LEGEND
- EXISTING PAVEMENT
- PROPOSED LIGHT DUTY PAVEMENT
- PROPOSED HEAVY DUTY PAVEMENT
- PROPOSED BOMANITE
- 64 EXISTING CONTOUR
- 70 PROPOSED CONTOUR
- 69.51 EXISTING ELEVATION
- 70.00 PROPOSED ELEVATION
- PROPOSED STORM SEWER W/INLET
- PROPOSED OFF-SITE PAVEMENT
- PROPOSED HEAVY-DUTY CONCRETE

SCALE: 1" = 60'

TYPICAL ISLAND DETAIL

ISLAND DRAINAGE OPENING DETAIL

FLUSH HEADER CURB

FLUSH HEADER CURB LOCATION

℄ SOUTH BRIDGE

℄ NORTH BRIDGE

EXTRUDED CURB

NOTE ALL CURBING SHALL BE EXTRUDED CURB UNLESS OTHERWISE NOTED.

NOTE: EXTRUDED CURB TO BE USED AT PAVEMENT EDGES AND AROUND PARKING ISLANDS.

SECTION B-B

NOTE: SIDES TO BE SODDED BOTTOM TO BE SEEDED & MULCHED (TYPICAL ALL PONDS).

SECTION C-C

SECTION E-E
N.T.S.

TYP. DRIVEWAY & D.W.C.E. SLOPE DETAIL

AS BUILT PLAN
PHASES 1, 2 & 3

100 YR. FL. EL. 58.7

LAKE HOWELL

NOTE: STORM SEWER (UNLESS OTHERWISE NOTED) TO BE CONST. BY LAKE HOWELL SQUARE CONTRACTOR.

LAKE BENCH MARK INFORMATION:

A.) TOP OF BRASS DISK D.O.T. NORTH END OF BRIDGE THAT CROSSES HOWELL CREEK AT WEST R/W OF 436 (SEMORAN BLVD.) ELEV. 70.79.

B.) BRASS CAP IN FIRST HEADWALL NORTH OF LAKE HOWELL BRANCH LANE AND EAST SIDE OF S.R. 436; ELEV. 66.76..

C.) BRASS CAP IN HEADWALL 150± SOUTH OF LAKE HOWELL BRANCH LANE AND EAST SIDE OF S.R. 436; ELEV. 66.55.

VERTICAL INFORMATION BASED ON STATE ROAD DEPT. BENCH MARKS.

NO.	DATE	REVISION
16	9-29-86	REVISE PARKING ISLANDS (SHEET 3A)
15	5-20-86	REV. LK. HOWELL LN. WIDENING IMPROVEMENTS
14	2-28-86	REMOVED TURN LANES, REV. ENTRANCE TO LK. HOWELL LN.
13	2-24-86	REV. TURN LANE ON LK. HOWELL LN.
12	2-21-86	REV. LENGTHS & SLOPES ON STORM PIPES BET. INLETS 4-4-5-22-23-27-POND B
11	2-3-86	REV. GRADING AROUND WAL-MART TRUCK WELL
10	1-28-86	REV. GRADING BEHIND RETAILS A & B
9	1-29-86	REV. TURN LANES ON LK HOWELL LN.
8	1-24-86	REVISED TURN LANE AT SEMORAN BLVD. & LAKE HOWELL LANE
7	1-13-86	AS BUILT REVISIONS AROUND POND B
6	12-30-85	ADD LEFT TURN LANE AT SEMORAN BLVD. & LAKE HOWELL LANE
5	11-19-85	REVISED GRADING AROUND RETAILS A & B
4	11-14-85	FINAL PRECONSTRUCTION REVISIONS
3	11-19-85	REVISED PLAN AS PER SEMINOLE CO. COMMENTS
2	9-24-85	REVISED PER DRC COMMENTS
1	9-11-85	ADDED PARKING TO BIG POND PER ARCHITECT

DESIGN PM | APPROVED HH
DRAWN NC | SCALE 1"=60'
CHECKED NN | F.B. NO.

PREPARED FOR
RICHLAND PROPERTIES OF FLORIDA INC.
4230 W. KENNEDY BLVD.
SUITE 749
TAMPA, FL 33609

HL&A HARLING, LOCKLIN & ASSOCIATES, INC.
CONSULTING ENGINEERS SURVEYORS & PLANNERS
850 COURTLAND STREET • ORLANDO, FLORIDA 32804 • 305-425-1061

LAKE HOWELL SQUARE
SEMINOLE COUNTY, FLORIDA

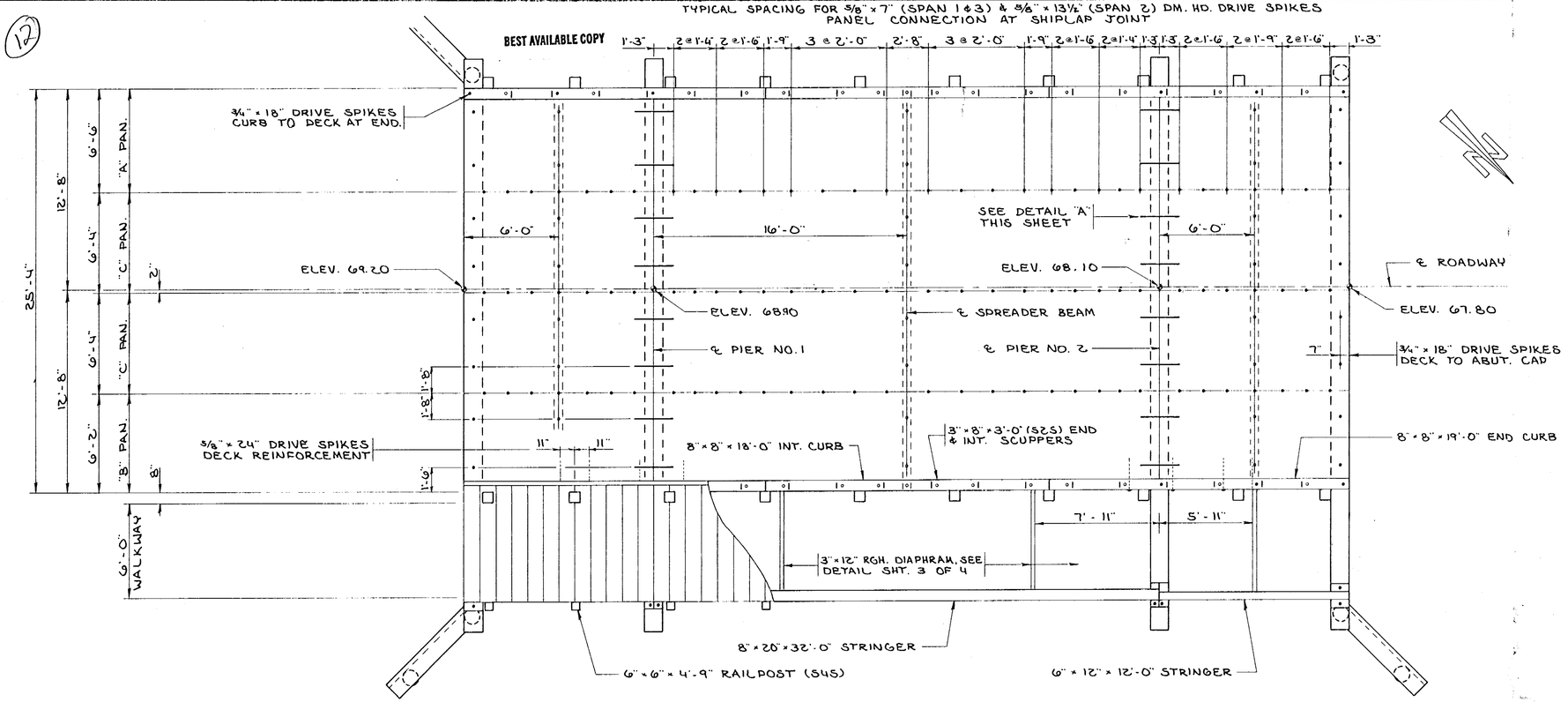
GRADING & DRAINAGE PLAN

JOB NO. 84-124
DATE AUGUST, '85
SHEET 3 OF 7

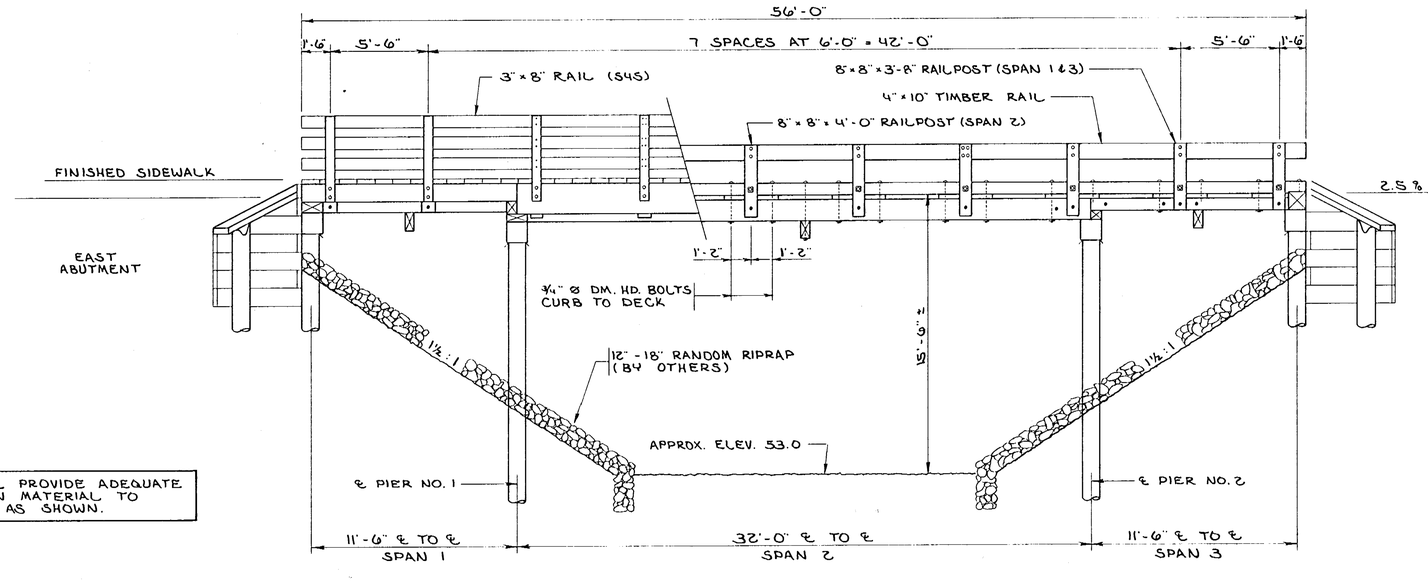
(12)

BEST AVAILABLE COPY

TYPICAL SPACING FOR 5/8" x 7" (SPAN 1 & 3) & 5/8" x 13½" (SPAN 2) DM. HD. DRIVE SPIKES
PANEL CONNECTION AT SHIPLAP JOINT



GENERAL PLAN



ELEVATION

CONTRACTOR SHALL PROVIDE ADEQUATE SLOPE PROTECTION MATERIAL TO MAINTAIN SLOPES AS SHOWN.

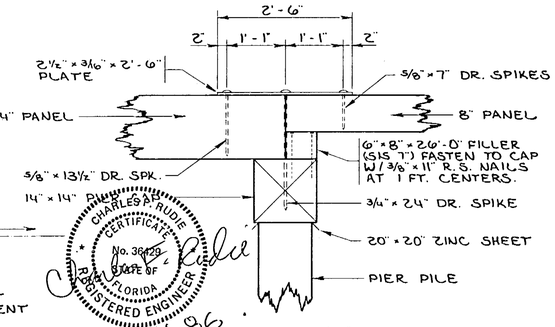
SPECIFICATIONS

ALL PILING AND TIMBER SHALL BE CREO. PRESSURE TREATED AS PER CURRENT STATE AND/OR AASHTO SPEC'S.
PILING SHALL MEET STATE AND/OR AASHTO SPEC'S.
ALL TIMBER TO BE DOUGLAS FIR (COAST REGION) AND TO BE GRADED AS PER NFPA 1982 NAT'L. DESIGN SPEC'S.
FLOOR LAMINATIONS SHALL BE AS PER PAR. 1238, 1500 P.S.I. AND BE (S1S) TO 4" H.M. BALANCE OF TIMBER TO BE 1200 P.S.I.
ALL TIMBER IS ROUGH UNLESS OTHERWISE NOTED.
ALL TIMBER CUT IN FIELD SHALL BE TREATED WITH 3 COATS OF HOT CREOSOTE BRUSHING OIL.
ALL HARDWARE TO BE GALVANIZED AS PER CURRENT STATE AND/OR AASHTO SPECIFICATION M232 CONFORM TO STATE SPECIFICATIONS.
ALL TIMBER TO BE CUT TO EXACT LENGTH, DRESSED TO SIZE REQUIRED AND ALL PRACTICAL FRAMING TO BE DONE PRIOR TO TREATMENT.
DESTROY ALL THREADS ON ALL BOLTS AT NUT, AFTER TIGHTENING, WITH A CENTER PUNCH.
BRIDGE IS DESIGNED FOR HS 20-44 LOADING

BRIDGE RATING:	12' SPAN	32' SPAN
	OPER. H.S. 27.61	OPER. H.S. 28.93
	INV. H.S. 20.34	INV. H.S. 20.16

CONSTRUCTION NOTES

PANEL "A" IS THE FIRST TO BE PLACED IN ITS FINAL POSITION ON THE CAPS AND THEN 1/16" ø HOLES ARE TO BE DRILLED THRU. THE DECK AND CAPS AT LOCATIONS SHOWN.
DRIVE THE ¾" ø x 18" DOME HEAD DRIVE SPIKES IN THIS SECTION. NEXT PLACE PANEL "C" SO UPPER SPLICE BLOCK IS OVER SPLICE BLOCK ON PANEL "A" AND DRAW TIGHT TOGETHER WITH COFFING HOIST. THEN DRILL HOLES THRU LOWER SPLICE BLOCK AND DRIVE THE 5/8" ø x 7" & 13½" DOME HEAD DRIVE SPIKES, THEN DRILL HOLES THRU DECK AND CAP AND DRIVE THE ¾" ø x 18" DRIVE SPIKES. THEREAFTER SUCCESSIVELY PLACE PANELS "C" AND "B" IN THE SAME MANNER USING COFFING HOIST TO DRAW EACH PANEL UP TIGHT TO THE OTHER.
ALL HOLES DRILLED IN THE FIELD WHERE DM. HD. DR. SPKS. ARE USED, ARE TO BE 1/16" ø SMALLER THAN SPIKE SIZE.
HOLES DRILLED FOR BOLTS ARE TO BE 1/16" ø LARGER THAN BOLT SIZE.
ABUTMENTS TO BE BACKFILLED WITH A CLEAN GRANULAR FILL.
ALL DECK PLANKS SHALL BE PREDRILLED PRIOR TO TREATMENT. DECK PANELS SHALL BE ASSEMBLED WITH 15" RING SHANK DOWELS



DETAIL "A"

"TIMBER FABRICATOR SHALL PROVIDE PREFRAMING DETAILS TO OWNER PRIOR TO TREATMENT OF MATERIALS."

SEMINOLE COUNTY, FLORIDA
LAKE HOWELL SQUARE NORTH BRIDGE

12'-32'-12' CREO. TREATED TIMBER SPANS
24' CLEAR ROADWAY

FOR PLANNING & ENGINEERING DEPT. OF PUBLIC WORKS SEMINOLE COUNTY

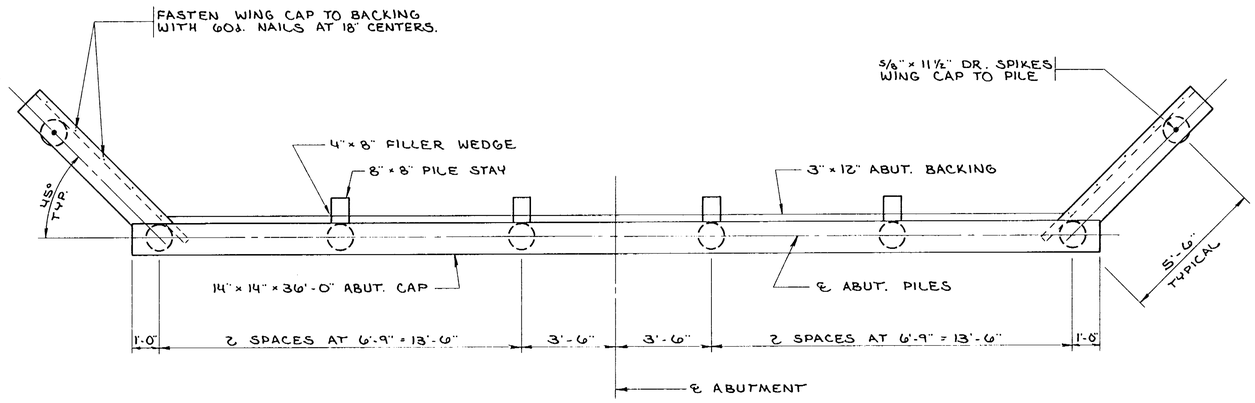
GENERAL PLAN & ELEVATION

WHEELER CONSOLIDATED, INC.

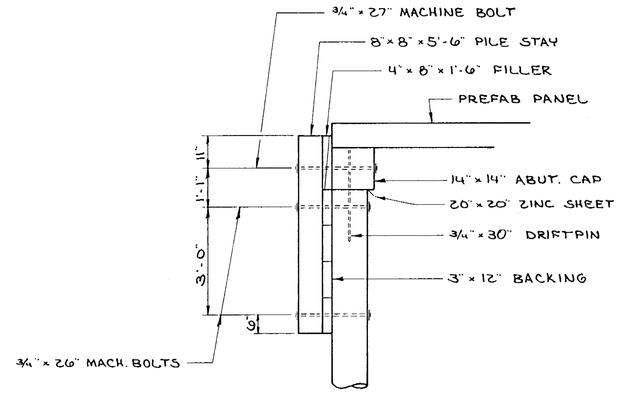
DATE: 1-21-86 DWN. BY: T.J.S.
SHEET NO. 1 OF 4 CHK. BY: T.M.O.

(B)

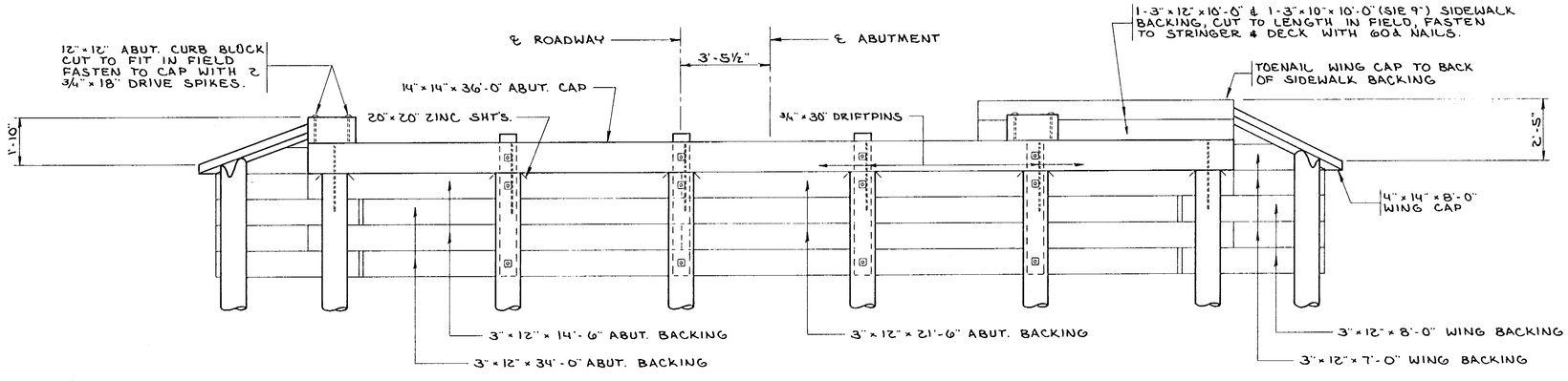
BEST AVAILABLE COPY



ABUTMENT PLAN



SECTION THRU ABUTMENT



ABUTMENT ELEVATION

WEST ABUT. SHOWN
EAST ABUT. OPPOSITE

PILE NOTES

4 - CREO. TEST PILES	75 FT. LONG
10 - CREO. ABUT. PILES	65 FT. LONG
10 - CREO. PIER PILES	65 FT. LONG
4 - CREO. WING PILES	45 FT. LONG

DRIVE ALL PILES TO A MINIMUM OF 20 TONS BEARING EACH. (EXCEPT WING PILES)

SEMINOLE COUNTY, FLORIDA
LAKE HOWELL SQUARE NORTH BRIDGE

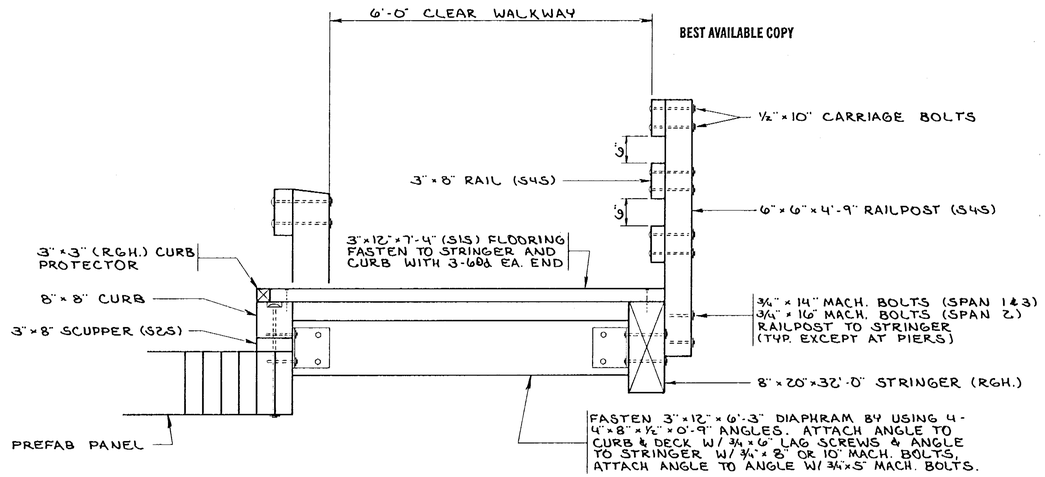
12'-32'-12' CREO. TREATED TIMBER SPANS
24' CLEAR ROADWAY

ABUTMENT PLAN & ELEVATION
WHEELER CONSOLIDATED, INC.

DATE: 1-22-86 DWN: T.J.S.
SHEET 2 OF 4 CHK: T.M.O.

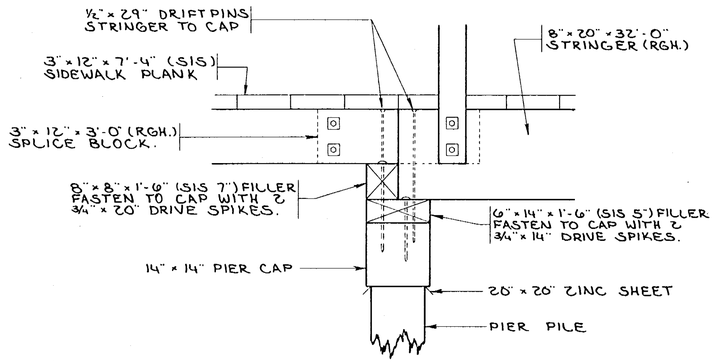
14

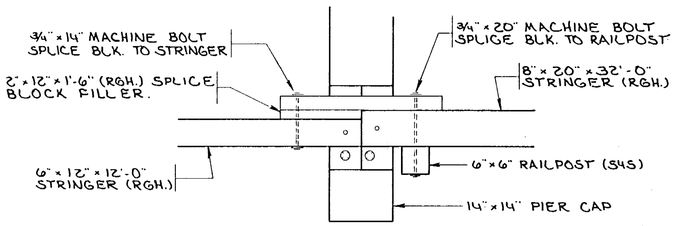
BEST AVAILABLE COPY



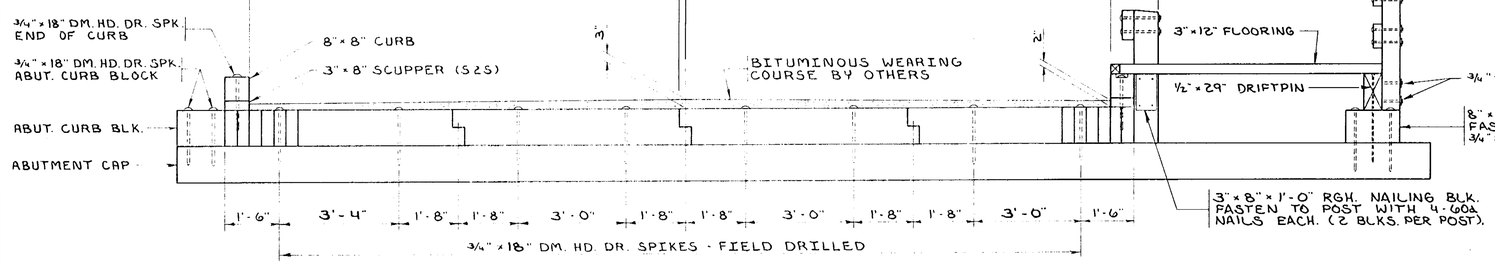
SECTION THRU SIDEWALK AT DIAPHRAM

SPAN 2 SHOWN

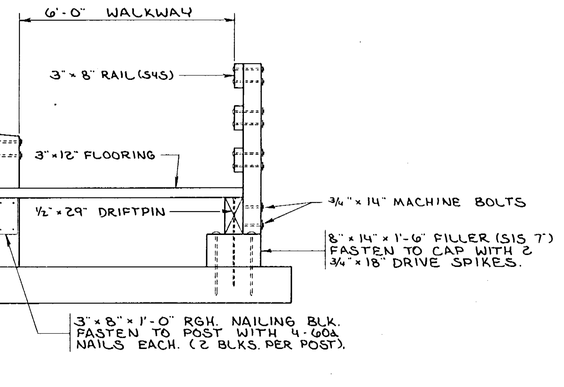


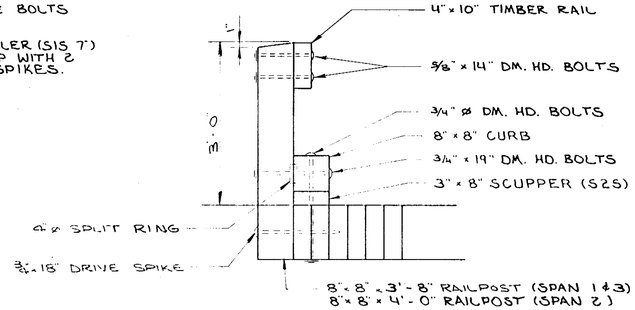


STRINGER SPLICE AT PIER DETAIL

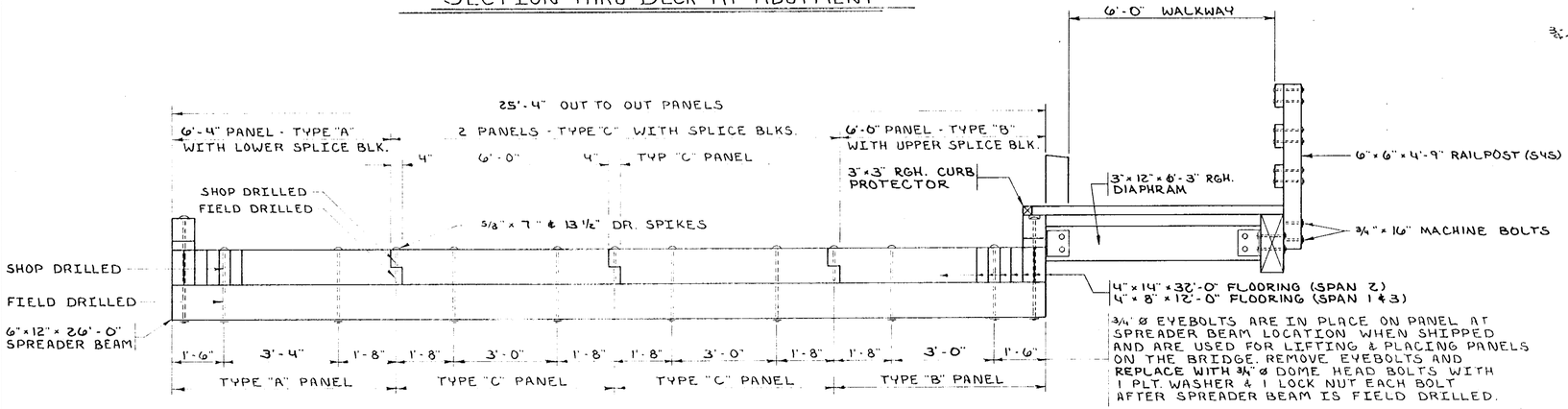


SECTION THRU DECK AT ABUTMENT





SECTION THRU CURB AT RAILPOST



SPREADER BEAM DETAIL

SHOWING PANEL LOCATION

SEMINOLE COUNTY, FLORIDA

LAKE HOWELL SQUARE NORTH BRIDGE

12'-32'-12' CREO. TREATED TIMBER SPANS
24' CLEAR ROADWAY

FEB 04 1986
ENGINEERING DEPT. OF PUBLIC WORKS SEMINOLE COUNTY

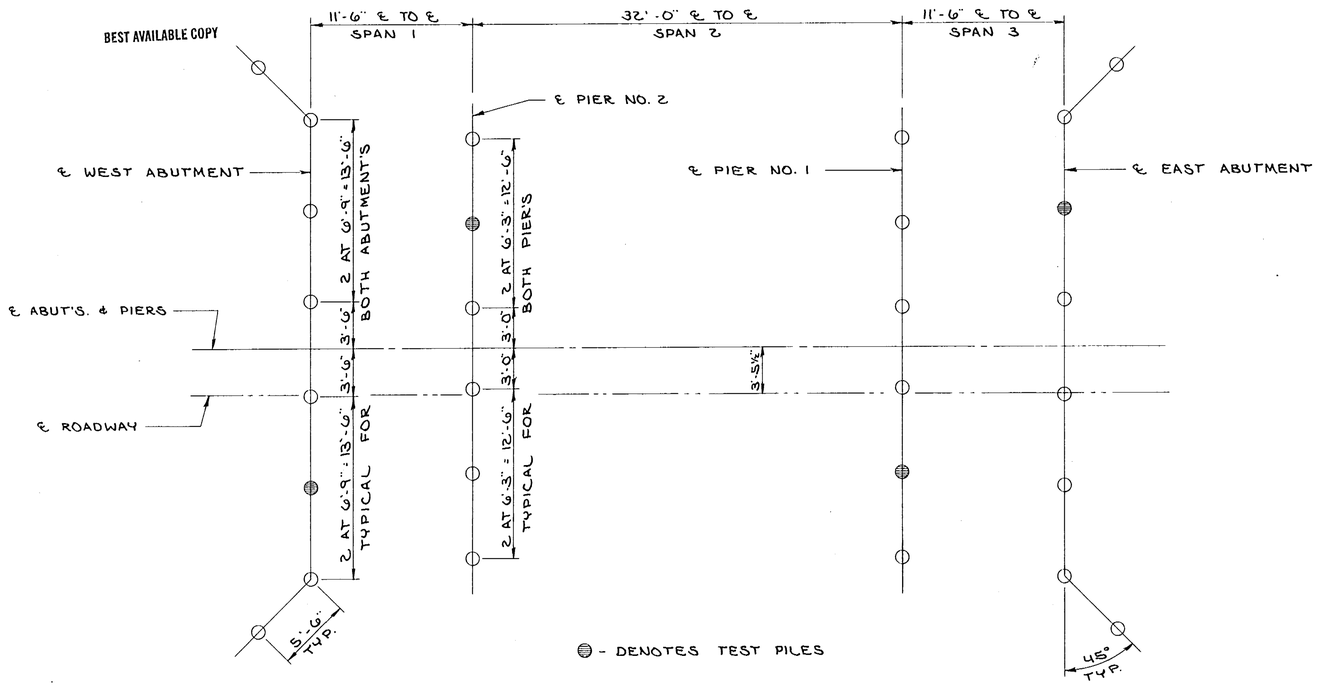
MISCELLANEOUS DETAILS

WHEELER CONSOLIDATED, INC.

DATE: 1-17-86 DWN: T.J.S.
SHEET 3 OF 4 SHEETS CHK: T.M.O.

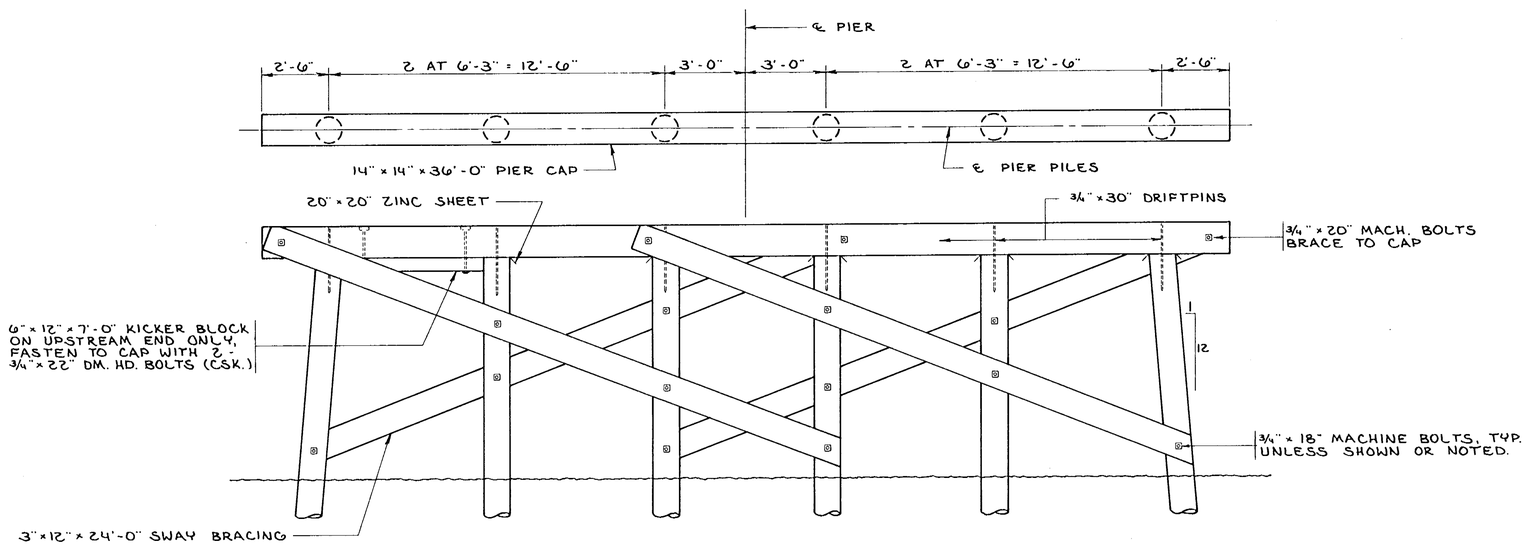
(15) Lake Howell Square
Wooden Brgs. (To be Studied)

BEST AVAILABLE COPY



PILE DRIVING DIAGRAM

PILE CUTOFF ELEV'S.	
WEST ABUT.	65.72
PIER NO. 2	65.52
PIER NO. 1	66.32
EAST ABUT.	67.12



PIER DIAGRAM

FEB 04 1986
ENGINEERING
DEPT. OF PUBLIC WORKS
SEMINOLE COUNTY

SEMINOLE COUNTY, FLORIDA
LAKE HOWELL SQUARE NORTH BRIDGE

12'-32'-12' CREO. TREATED TIMBER SPANS
24' CLEAR ROADWAY

FEB 04 1986
ENGINEERING
DEPT. OF PUBLIC WORKS
SEMINOLE COUNTY

PIER & PILE DRIVING

WHEELER CONSOLIDATED, INC.

DATE: 1-17-86 DWN: T.J.S.

SHEET 4 OF 4 CHK: T.M.O.

STORM SEWER SCHEDULE

- (S-1) TYPE E INLET, FDOT INDEX NO. 232
  TOP ELEVATION 66.90
  N.E. FL. 61.90
- (S-2) 62' ~ 18" RCP @ 0.32%
- (S-3) TYPE P MANHOLE (4' Ø), FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 67.70
  S.W. FL. 61.70
  N. FL. 61.70
- (S-4) 65' ~ 18" RCP @ 0.31%
- (S-5) TYPE E INLET, FDOT INDEX NO. 232
  TOP ELEVATION 65.90
  S. FL. 61.50
  N.E. FL. 61.50
- (S-6) 158' ~ 24" RCP @ 0.32%
- (S-7) TYPE E INLET, FDOT INDEX NO. 232
  TOP ELEVATION 66.70
  S.W. FL. 61.00
  N. FL. 61.00
- (S-8) 124' ~ 30" RCP @ 0.32%
- (S-9) TYPE E INLET, FDOT INDEX NO. 232
  TOP ELEVATION 67.20
  W. FL. 61.10
- (S-10) 145' ~ 18" RCP @ 0.34%
- (S-11) TYPE E INLET, FDOT INDEX NO. 232
  TOP ELEVATION 66.70
  S. FL. 60.60
  E. FL. 60.60
  N. FL. 60.60
- (S-12) 175' ~ 30" RCP @ 0.34%
- △2 (S-13) TYPE 4 INLET, FDOT INDEX NO. 210
  WITH J BOTTOM PER FDOT INDEX NO. 200
  TOP ELEVATION 67.00
  S.W. FL. 60.00
  W. FL. 54.20
- (S-14) 258' ~ 36" RCP @ 0.31%
- (S-15) TYPE E INLET, FDOT INDEX NO. 232
  TOP ELEVATION 66.60
  N. FL. 61.50
- (S-16) 125' ~ 18" RCP @ 0.32%
- (S-17) TYPE E INLET, FDOT INDEX NO. 232
  TOP ELEVATION 66.60
  S. FL. 61.10
  N. FL. 61.10
- (S-18) 124' ~ 24" RCP @ 0.32%
- (S-19) TYPE E INLET, FDOT INDEX NO. 232
  WITH J BOTTOM PER FDOT INDEX NO. 200
  TOP ELEVATION 66.60
  S. FL. 60.70
  E. FL. 53.40
  N.W. FL. 53.40
- (S-20) 222' ~ 42" RCP @ 0.32%
- (S-21) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 66.58 (FIELD VERIFY)
  N. FL. 62.93 (EXISTING 30" RCP, FIELD VERIFY)
- (S-22) EXISTING STORM PIPE TO REMAIN
  30" RCP @ 0.60% (FIELD VERIFY)
- (S-23) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 66.36 (FIELD VERIFY)
  S. FL. 61.65 (EXISTING 30" RCP, FIELD VERIFY)
  N. FL. 61.28 (EXISTING 30" RCP, FIELD VERIFY)
- (S-24) EXISTING STORM PIPE TO REMAIN
  30" RCP @ 0.30% (FIELD VERIFY)
- (S-25) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 66.15 (FIELD VERIFY)
  S. FL. 60.55 (EXISTING 30" RCP, FIELD VERIFY) (TO REMAIN)
  E. FL. 60.57 (EXISTING 30" RCP) (PLUG)
  N.E. FL. 59.00 (PROPOSED 30" RCP)
  EXISTING STORM PIPE AT E. CONNECTION SHALL BE REMOVED & CONNECTION PLUGGED. CONTRACTOR SHALL CORE BORE & CONNECT PROPOSED S-26 (30" RCP) TO EXISTING STRUCTURE. GROUT SEAL TO ENSURE A WATERTIGHT CONNECTION.
- (S-26) 58' ~ 30" RCP @ 0.34%
- (S-27) TYPE F INLET, FDOT INDEX NO. 233
  WITH J BOTTOM PER FDOT INDEX NO. 200
  TOP ELEVATION 66.40
  S.W. FL. 58.80
  E. FL. 58.80
- (S-28) 174' ~ 36" RCP @ 0.32%
- (S-29) TYPE E INLET, FDOT INDEX NO. 232
  TOP ELEVATION 66.30
  W. FL. 58.25
  E. FL. 58.25
- (S-30) 120' ~ 42" RCP @ 0.29%
- (S-31) TYPE E INLET, FDOT INDEX NO. 232
  WITH J BOTTOM PER FDOT INDEX NO. 200
  TOP ELEVATION 66.30
  W. FL. 56.00
  S.E. FL. 56.00
  N.E. FL. 49.40
- (S-32) 203' ~ 38" X 60" ERCP @ 0.19%
- (S-33) CONCRETE MITERED END SECTION PER FDOT INDEX 272 (2:1 SLOPE) FL 49.00
- (S-34) OUTLET CONTROL STRUCTURE
  TYPE H INLET PER FDOT INDEX NO. 232
  WITH SKIMMER (REFER TO DETAIL, SHEET C-16)
  S. FL. 58.50
- (S-35) 137' ~ 18" RCP @ 0.22%
- (S-36) TYPE P MANHOLE (4' Ø) FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 68.00
  N. FL. 58.20
  S.E. FL. 58.20
- (S-37) 208' ~ 18" RCP @ 0.17%
- (S-38) TYPE P MANHOLE (4' Ø) FDOT INDEX NO.'S 200 &201
  RIM ELEVATION 67.30
  N.W. FL. 57.85
  S.E. FL. 57.85
- (S-39) 208' ~ 18" RCP @ 0.19%
- (S-40) TYPE P MANHOLE (4' Ø) FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 67.90
  N.W. FL. 57.45
  S. FL 57.45
- (S-41) 124' ~ 18" RCP @ 0.16%
- (S-42) TYPE P MANHOLE (4' Ø) FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 67.9
  N. FL. 57.25
  S.W. FL. 57.25
- (S-43) 58' ~ 18" RCP @ 0.17%
- (S-44) TYPE P MANHOLE (4' Ø) FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 67.10
  N.E. FL. 57.15
  S.E. FL. 57.15
- (S-45) 30' ~ 18" RCP @ 0.17%
- (S-46) OUTLET CONTROL STRUCTURE
  J-BOX STRUCTURE W/ TYPE 1 MANHOLE FRAME AND COVER PER FDOT INDEX NO.'S 200 & 201 (REFER TO DETAIL, SHEET C-9)
  RIM ELEVATION 68.30
  N. FL. 57.10
  S. FL. 57.10
  W. FL. 62.80
- (S-47) 37' ~ 14" X 23" ERCP @ 0.27%
- (S-48) TYPE P MANHOLE (4' Ø) FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 67.50
  N. FL. 57.00
  S.E. FL. 57.00
- (S-49) 53' ~ 18" RCP @ 0.32%
- (S-50) CONCRETE MITERED END SECTION PER FDOT INDEX 272 (2:1 SLOPE) FL 56.80
- (S-51) EXISTING STRUCTURE SHALL BE MODIFIED TO INCORPORATE PROPOSED F.L. CONNECTIONS OR REPLACE W/ TYPE F INLET PER FDOT INDEX NO. 233 IF UNABLE TO ACHIEVE NEW STORM PIPE DESIGN.
  TOP ELEVATION 67.62 (TO REMAIN)(FIELD VERIFY)
  N. FL. 64.05
  S. FL. 64.05
- (S-51A) 30' ~ 18" RCP @ 0.17%
- (S-51B) TRUCK WELL DRAIN PIPE. 2' ~ STORM PIPE @ 2.5% TO 10" C.O. W/ BEND @ F.L. 64.10
- (S-52) SAWCUT & REMOVE EXISTING STORM PIPE AS REQUIRED TO INSTALL PROPOSED TYPE P MANHOLE (4' Ø) PER FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 68.60
  N. FL. 63.90 (PROPOSED)
  S. FL. 63.90± (EXISTING)(FIELD VERIFY)
  E. FL. 64.00 (PROPOSED)
- (S-52A) 90' ~ 18" RCP @ 0.17%
- (S-52B) EXISTING STORM PIPE TO REMAIN, 125' ~ 18" RCP @ 0.6% (FIELD VERIFY)
- (S-52C) 47' ~ 15" RCP @ 0.43%
- (S-52D) TYPE F INLET, FDOT INDEX NO. 233
  TOP ELEVATION 67.15
  W. FL. 64.10
  N. FL. 64.10
- (S-52E) 79' ~ 15" RCP @ 0.38%
- (S-52F) TYPE F INLET, FDOT INDEX NO. 233
  TOP ELEVATION 67.40
  S. FL. 64.40
- (S-53) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 67.48 (FIELD VERIFY)
  N. FL. 63.18 (EXISTING 18" RCP, FIELD VERIFY)
  S. FL. 62.78 (EXISTING 18" RCP, FIELD VERIFY)
- (S-54) EXISTING STORM PIPE TO REMAIN, 18" RCP @ 0.7 % (FIELD VERIFY)
- (S-55) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 67.22 (FIELD VERIFY)
  N. FL. 61.29 (EXISTING 18" RCP, FIELD VERIFY)
  E. FL. 60.87 (EXISTING 24" RCP, FIELD VERIFY)
- (S-56) EXISTING STORM PIPE TO REMAIN, 24" RCP @ 0.3 % (FIELD VERIFY)
- (S-57) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 67.2 (FIELD VERIFY)
  W. FL. 59.88 (EXISTING 24" RCP, FIELD VERIFY)
  N.E. FL. 59.75 (EXISTING 24" RCP, FIELD VERIFY)
- (S-58) EXISTING STORM PIPE TO REMAIN, 24" RCP @ 1.1%
- (S-59) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 66.37
  S.W. FL. 57.60 (EXISTING 24" RCP, FIELD VERIFY)
  N. FL. 56.91 (EXISTING 24" RCP, FIELD VERIFY)
- (S-60) EXISTING STORM PIPE TO REMAIN, 24" RCP @ 0.4%
- (S-61) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 66.40 (FIELD VERIFY)
  N.E. FL. 63.20 (EXISTING 15" RCP, FIELD VERIFY)
- (S-62) EXISTING STORM PIPE TO REMAIN, 15" RCP @ 2.3%
- (S-63) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 66.39
  S. FL. 56.27 (EXISTING 24" RCP, FIELD VERIFY)
  S.W. FL. 58.39 (EXISTING 15" RCP, FIELD VERIFY)
  N.E. FL. 55.81 (EXISTING 36" RCP, FIELD VERIFY)
- (S-64) EXISTING STORM PIPE TO REMAIN, 36" RCP @ 0.6%
- (S-65) CONVERT EXISTING STORM INLET TOP TO TYPE "6" CURB INLET FDOT INDEX NO. 211
  TOP ELEVATION 66.95
  S.W. FL. 62.55 (EXISTING 15" RCP, FIELD VERIFY)
- (S-66) EXISTING STORM PIPE TO REMAIN, 15" RCP @ 3.1%
- △1 (S-67) REMOVE EXISTING STORM STRUCTURE AND REPLACE WITH TYPE F INLET WITH J BOTTOM PER FDOT INDEX NO.'S 233 & 201. CONTRACTOR SHALL REMOVE OR EXTEND EXISTING STORM PIPE (S-66 & S-64) AS REQUIRED FOR CONNECTION TO NEW STRUCTURE LOCATION. (REFER TO DETAIL, SHEET C-16)
  TOP ELEVATION 67.25
  S.W. FL. 54.78± (EXISTING 36" RCP, FIELD VERIFY)
  N.E. FL. 57.95± (EXISTING 15" RCP, FIELD VERIFY)
  W. FL. 63.10 (2 ~ 19" X 30" ERCP)
- (S-68) 180' ~ 19" X 30" ERCP @ 0.11%
  177' ~ 19" X 30" ERCP @ 0.11%
- (S-69) 6' X 8' J-BOTTOM BOX STRUCTURE W/ TYPE 1 MANHOLE FRAME & COVER PER FDOT INDEX NO. 200 & 201
  RIM ELEVATION 68.30
  E. FL. 62.90 (2 ~ 19" X 30" ERCP)
  N. FL. 62.90
- (S-70) 36" ALUMINIZED CORRUGATED TYPE 2 STEEL HEADER PIPE 16 GAUGE, PERFORATED 360°
- (S-71) TYPE P MANHOLE (4' Ø) FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 68.45
  S. FL. 62.90
- (S-72) 10' ~ 18" RCP @ 1%
- (S-73) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 67.87
  S.W. FL. 64.06 (EXISTING 18" CMP, FIELD VERIFY) (TO REMAIN)
  N.W. FL. 64.02 (EXISTING 18" RCP, FIELD VERIFY) (REPLACED)
  EXISTING STORM PIPE @ N.W. CONNECTION SHALL BE REMOVED & REPLACED W/ S-74 (18" RCP) W/ NEW ALIGNMENT @ N.W. F.L. 64.00
- (S-74) 91' ~ 18" CMP @ 0.26%
- (S-75) TYPE P MANHOLE (4' Ø) FDOT INDEX NO.'S 200 & 201
  RIM ELEVATION 68.00
  S. FL. 63.70
  N. W. FL. 63.70
- (S-76) 44' ~ 18" CMP @ 0.22%
- (S-77) EXISTING STRUCTURE TO REMAIN
  TOP ELEVATION 66.94
  S.E. FL. 63.59 (EXISTING 18" RCP) (PLUG)
  N.W. FL. 62.04 (EXISTING 18" RCP, FIELD) (TO REMAIN)
  E. FL. 63.50 (PROPOSED 18" RCP)
  EXISTING STORM PIPE AT S.E. CONNECTION SHALL BE REMOVED & CONNECTION PLUGGED. CONTRACTOR SHALL CORE BORE & CONNECT PROPOSED S-76 (18" RCP) TO EXISTING STRUCTURE. GROUT SEAL TO ENSURE A WATERTIGHT CONNECTION.
- (S-78) TRUCK WELL DRAIN PIPE. CONNECT PROPOSED 14' ~ STORM PIPE @ 20.07% TO EXISTING 30" STORM PIPE (S-24) W/ "INSERTA TEE" OR AN APPROVED EQUAL @ F.L. 61.34±
- (S-79) GARDEN CENTER STORM SEWER CONNECTION POINT 8" ~ TWO-WAY CLEAN OUT @ FL. 65.80. REFER TO ARCH./MEP PLANS FOR CONTINUATION. CONNECT TO C.O. W/ (65' ~ 8" STORM PIPE @ 8.46%)
- (S-80) CONNECT PROPOSED 8" STORM PIPE TO EXISTING STORM PIPE (S-62) W/ "INSERTA TEE" OR AN APPROVED EQUAL @ F.L. 60.30±
- △2 (S-81) EXISTING CURB INLET SHALL BE REMOVED AND RELOCATED TO NEW STRUCTURE LOCATION SHOWN. EXISTING STORM PIPES SHALL BE EXTEND OR SAWCUT AND REMOVED AS REQUIRED TO CONNECT TO NEW STRUCTURE WITH MAINTAINING THE ALIGNMENT & SLOPE OF EXISTING PIPES.
  TYPE 6 INLET, FDOT INDEX NO. 211
  TOP ELEVATION 67.00
  E. (2) 10" PVC
  W. 18" RCP
- (S-82) TYPE E INLET, FDOT INDEX NO. 232. CONTRACTOR SHALL SAWCUT & REMOVE EXISTING 15" RCP AS REQUIRED FOR CONNECTION TO PROPOSED STRUCTURE.
  TOP ELEVATION 67.30
  N.E. FL. 63.45± (FIELD VERIFY)

EROSION AND SEDIMENTATION CONTROL NOTES

MAINTENANCE OF EROSION CONTROL MEASURES IS OF PARAMOUNT IMPORTANCE TO WAL-MART. THE CONTRACTOR IS RESPONSIBLE FOR COMPLYING WITH ALL EROSION CONTROL MEASURES SHOWN ON THE PLANS. THE EROSION CONTROL SYSTEM DESCRIBED WITHIN THE CONSTRUCTION DOCUMENTS SHOULD BE CONSIDERED TO REPRESENT THE MINIMUM ACCEPTABLE STANDARDS FOR THIS PROJECT. ADDITIONAL EROSION CONTROLS MEASURES MAY BE REQUIRED DEPENDENT UPON THE STAGE OF CONSTRUCTION, THE SEVERITY OF THE RAINFALL EVENT AND/OR AS DEEMED NECESSARY AS A RESULT OF ON-SITE INSPECTIONS BY THE OWNER, THEIR REPRESENTATIVES OR THE JURISDICTIONAL AUTHORITIES. THESE ADDITIONAL MEASURES SHALL BE INSTALLED AT NO ADDITIONAL COST TO THE OWNER. IT IS THE CONTRACTOR'S ULTIMATE RESPONSIBILITY TO ASSURE THAT THE STORM WATER DISCHARGE FROM THE SITE DOES NOT EXCEED THE TOLERANCES ESTABLISHED BY ANY OF THE JURISDICTIONAL AUTHORITIES.

PROPOSED STORM SYSTEM NOTES:

1. ALL PIPES IN LEGEND SPECIFIED AS "STORM PIPE" SHALL BE SELECTED FROM THOSE LISTED IN THE GENERAL GRADING NOTES, NOTE 12, SHEET C-4.
2. PIPE LENGTHS ASSOCIATED WITH MITERED END SECTIONS DO NOT INCLUDE SEGMENT TO BE INCLUDED UNDER UNIT PRICE FOR M.E.S. (A.K.A. DIMENSION F, F.D.O.T. INDEX NO. 272)
3. ALL STRUCTURE INVERTS SHALL BE CONSTRUCTED PER F.D.O.T. INDEX NO. 201.
4. ALL STRUCTURES WITH TYPE J BOTTOMS SHALL BE CONSTRUCTED PER F.D.O.T. INDEX NO. 200.
5. ALL DRAINAGE STRUCTURES, INCLUDING CLEAN-OUTS, SHALL BE INSTALLED WITH TRAFFIC BEARING GRATES, TOPS, RINGS AND COVERS, ETC. AS APPLICABLE.
6. ALL PROPOSED INLET GRATES SHALL BE RETICULINE STEEL.
7. THE PRESENCE OF GROUNDWATER SHOULD BE ANTICIPATED ON THIS PROJECT. CONTRACTOR'S BID SHALL INCLUDE CONSIDERATION FOR ADDRESSING THIS ISSUE.

FLOOD PLAIN:

ACCORDING TO THE NATIONAL FLOOD INSURANCE PROGRAM, FLOOD INSURANCE RATE MAP (FIRM) COMMUNITY PANEL NO. 12117C0140 E EFFECTIVE DATE APRIL 17, 1995, THIS PROPERTY LIES IN ZONE "X", NOT A SPECIAL FLOOD HAZARD AREA. THE 100 YEAR FLOOD PLAIN IS @ 58.7 ELEVATION AND RUNS ALONG THE BANKS OF HOWELL CREEK. THERE IS A 100 FOOT PROTECTIVE BUFFER THAT RUNS ALONG THE CENTERLINE OF THE CREEK (50 FOOT ON BOTH SIDES OF THE CENTERLINE) AND THE 100 YEAR FLOOD ELEVATION LIES WITHIN THAT BUFFER. REFER TO THIS SHEET FOR APPROXIMATE LOCATION.

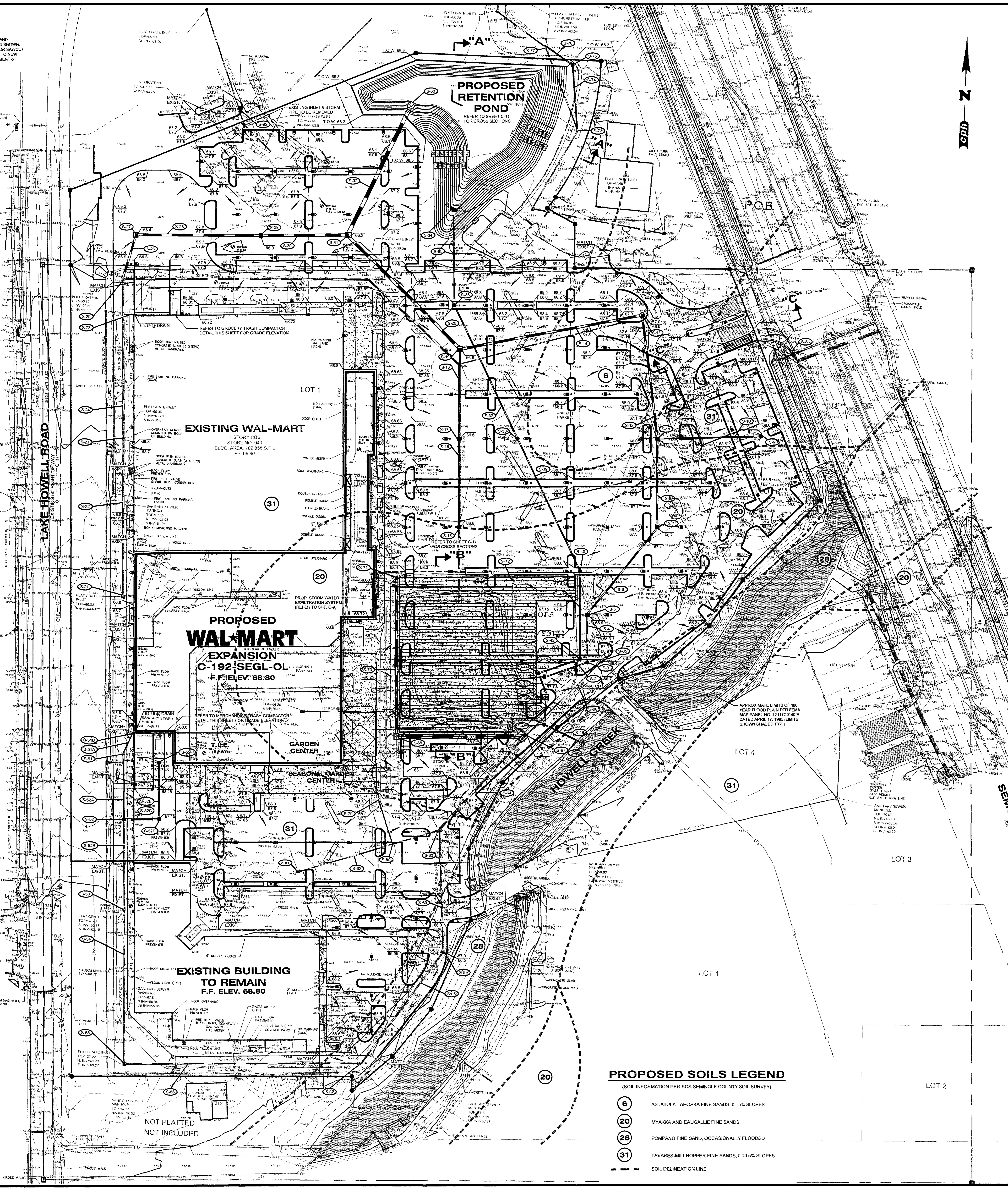
NOTES:

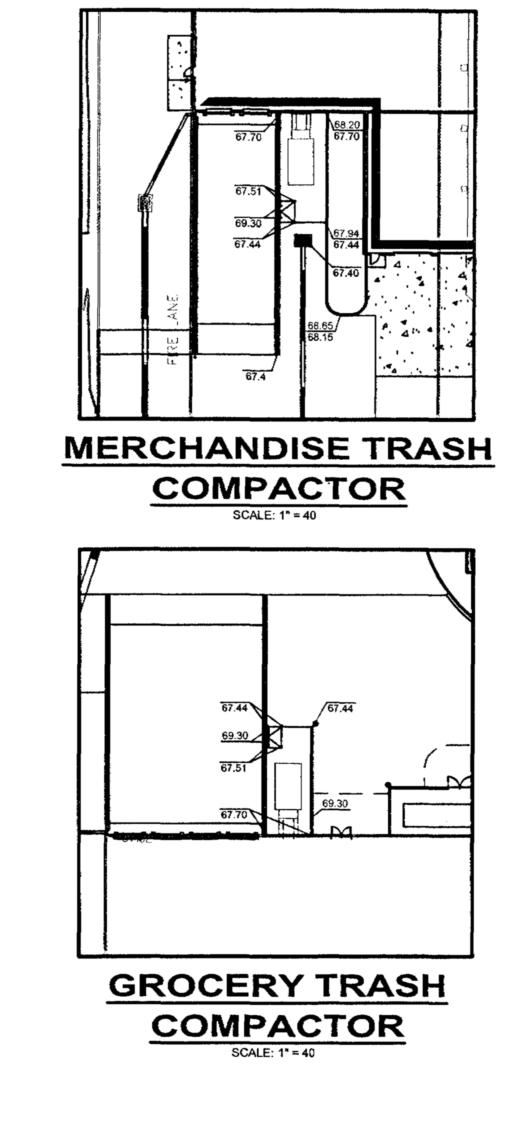
1. REFER TO SHEET C-4 FOR GENERAL SITE GRADING NOTES.
2. REFER TO SHEET C-11 FOR CROSS SECTIONS.
3. REFER TO SHEET C-12 FOR PROPOSED SILT FENCE LOCATIONS & SPECIFICATIONS.
4. REFER TO SHEET C-9 FOR EXFILTRATION SPECIFICATIONS.

LEGEND

(T.C.) / (E.P.)	TOP OF CURB / EDGE OF PAVEMENT
→	PROP. FLOW DIRECTION
49	PROP. CONTOUR
▬	PROP. STORM PIPE

CONTRACTOR SHALL CONTACT SUNSHINE STATE ONE-CALL OF FLORIDA, INC. @ 1-800-432-4770 FOR LOCATION OF ALL UTILITIES, AT LEAST 72 HOURS PRIOR TO BEGINNING CONSTRUCTION





PROPOSED SOILS LEGEND

(SOIL INFORMATION PER SCS SEMINOLE COUNTY SOIL SURVEY)

6	ASTATULA - APOPKA FINE SANDS 0 - 5% SLOPES
20	MYAKKA AND EAUGALLIE FINE SANDS
28	POMPANO FINE SAND, OCCASIONALLY FLOODED
31	TAVARES-MILLHOPPER FINE SANDS, 0 TO 5% SLOPES
- - -	SOIL DELINEATION LINE

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55557

Sheet No. **C-8**

GRADING & STORM DRAINAGE PLAN

WAL★MART SUPERCENTER

STORE NO. 943-04, EXPSC (BENDERSON SITE) - CASSELBERRY, FLORIDA

Activity	Name	Date
Designed by:	J.K.B.	2/03
Drawn by:	J.K.B.	2/03
Checked by:	G.D.	2/03
Approved by:	H.L.W.	2/03

Certificate of Authorization No. 3215

No.	Date	Revision	Approved
1	3/12/03	PER S.J.R.W.M.D. COMMENTS	H.L.W.
2	4/25/03	PER WAL-MART COMMENTS	H.L.W.

Scale: 1" = 60'
Date: FEB. 2003
Job No. W13191
File: W13191-SGP
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Landscape Architects
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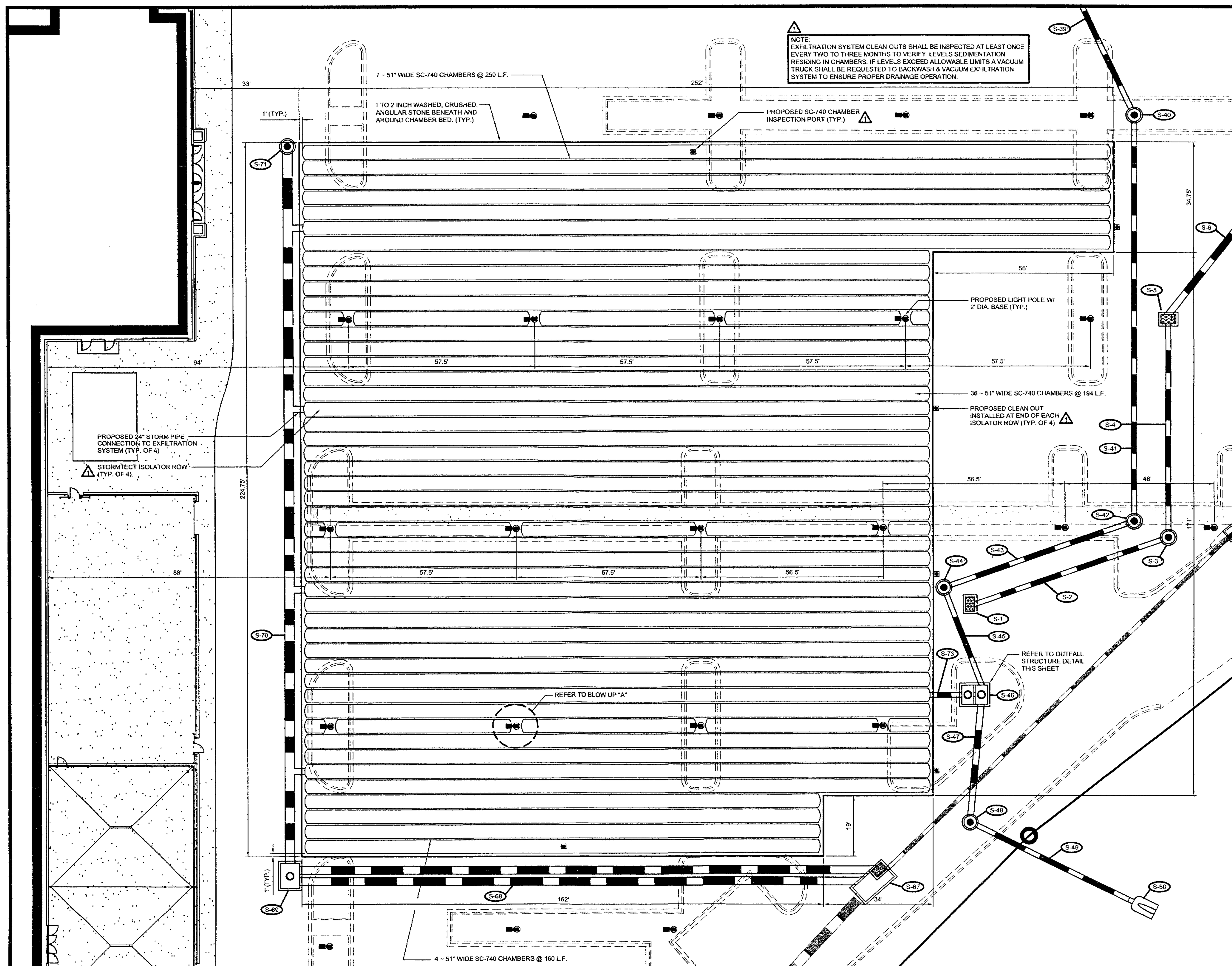
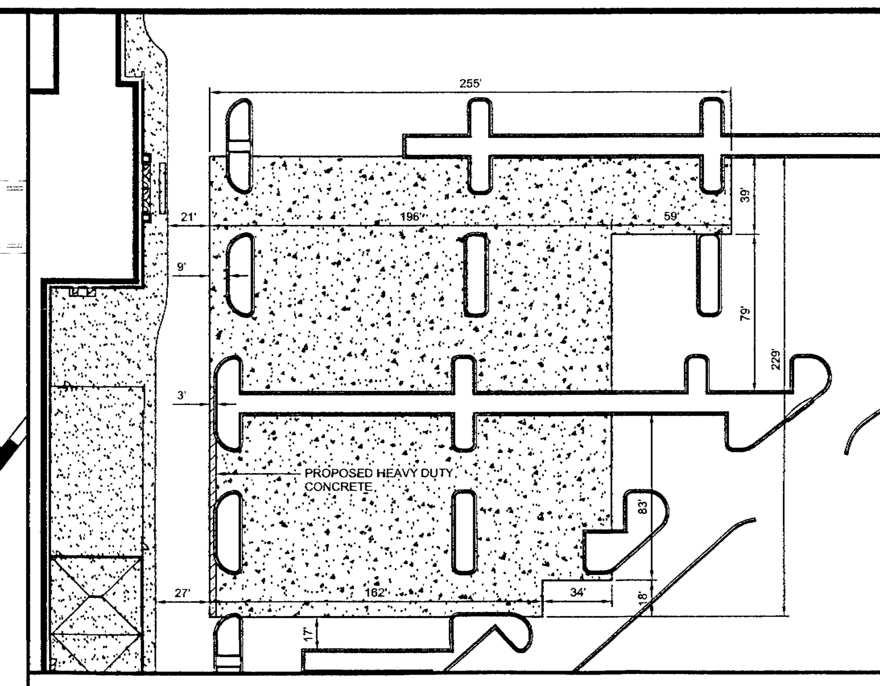
www.cphengineers.com
500 West Fulton Street, Sanford, FL 32771 P.O. Box 2808, Sanford, FL 32772-2808
Phone 407.322.6841 Fax 407.330.0639

rbolks, Arch E1 - 30 x 42 in., 1:1



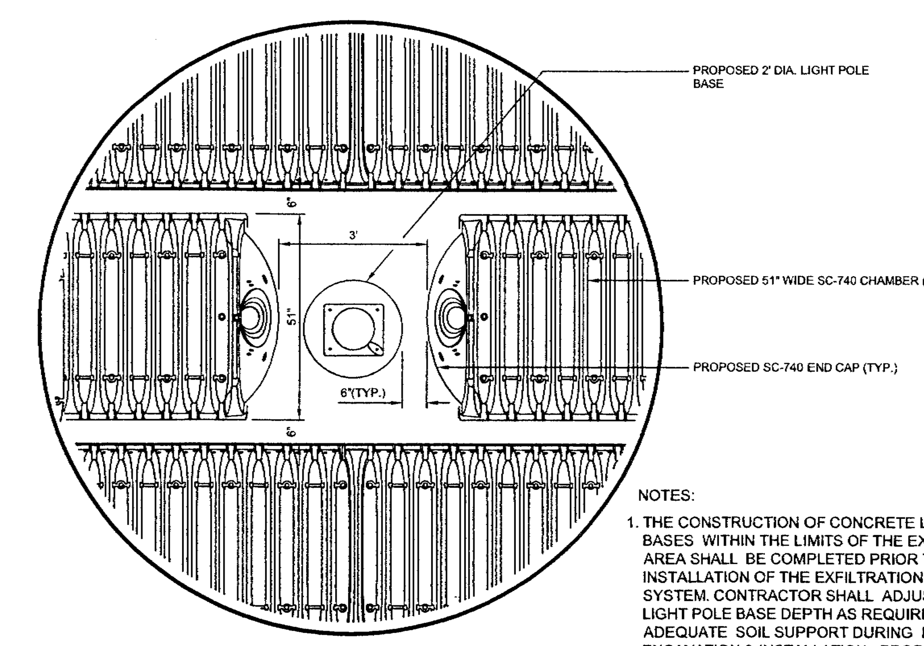
PLAN VIEW

SCALE: 1" = 20'



EXFILTRATION CONCRETE AREA

SCALE: 1" = 60'



BLOW UP "A"

NOT TO SCALE

NOTES:

1. THE CONSTRUCTION OF CONCRETE LIGHT POLE BASES WITHIN THE LIMITS OF THE EXFILTRATION BED AREA SHALL BE COMPLETED PRIOR TO THE INSTALLATION OF THE EXFILTRATION CHAMBER SYSTEM. CONTRACTOR SHALL ADJUST STANDARD LIGHT POLE BASE DEPTH AS REQUIRED TO ENSURE ADEQUATE SOIL SUPPORT DURING EXFILTRATION BED EXCAVATION & INSTALLATION. PROPOSED LIGHT POLES & FIXTURES SHALL NOT BE INSTALLED UNTIL EXFILTRATION BED AREA IS BACKFILLED AND COMPACTED TO MANUFACTURE SPECIFICATIONS.

2. THE INSTALLATION OF ELECTRICAL CONDUIT FOR THE SITE LIGHTING & IRRIGATION LINES WITHIN THE LIMITS OF THE EXFILTRATION SYSTEM BED AREA SHALL BE INSTALLED IN THE PAVEMENT SUB-BASE ONLY.

GENERAL NOTES

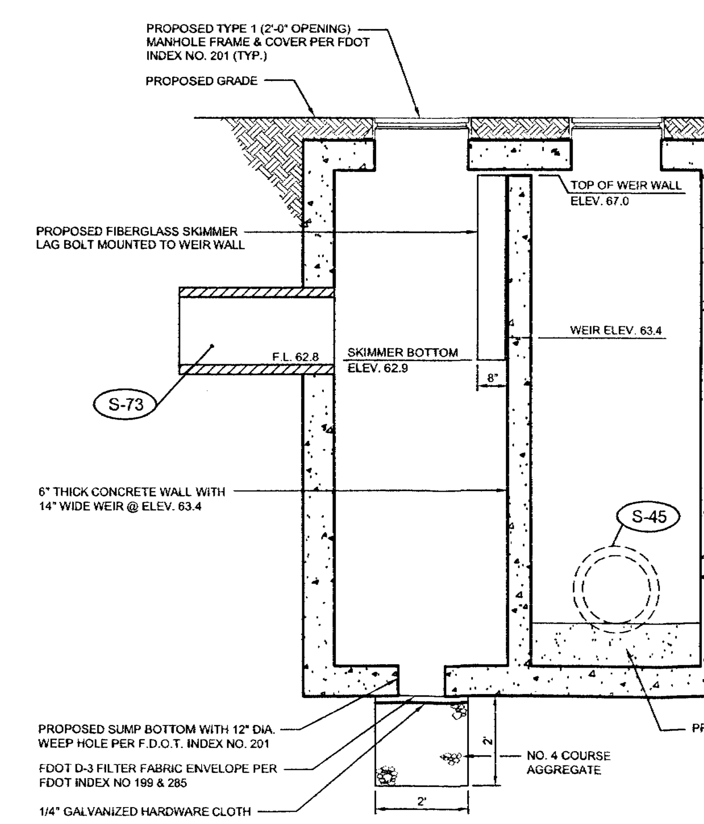
1. STORMTECH, INC. ("STORMTECH") REQUIRES INSTALLING CONTRACTORS TO USE AND UNDERSTAND STORMTECH'S LATEST INSTALLATION INSTRUCTIONS PRIOR TO BEGINNING SYSTEM INSTALLATION.
2. STORMTECH'S TECHNICAL SERVICES DEPARTMENT OFFERS INSTALLATION CONSULTATIONS TO INSTALLING CONTRACTORS. CONTACT STORMTECH'S TECHNICAL SERVICE REPRESENTATIVES AT LEAST 30 DAYS PRIOR TO SYSTEM INSTALLATION TO ARRANGE A PRE-INSTALLATION CONSULTATION. STORMTECT'S REPRESENTATIVES CAN THEN ANSWER QUESTIONS OR ADDRESS COMMENTS ON THE STORMTECH CHAMBER SYSTEM AND INFORM THE INSTALLING CONTRACTOR OF THE MINIMUM INSTALLATION REQUIREMENTS BEFORE BEGINNING THE SYSTEM'S CONSTRUCTION. CALL 1-888-892-2694 TO SPEAK TO A TECHNICAL SERVICE REPRESENTATIVE OR VISIT WWW.STORMTECH.COM TO RECEIVE A COPY OF STORMTECH'S INSTALLATION INSTRUCTIONS.
3. STORMTECH'S REQUIREMENTS FOR SYSTEMS WITH PAVEMENT DESIGN (ASPHALT, CONCRETE PAVERS, ETC.): MINIMUM COVER IS 18-INCHES NOT INCLUDING PAVEMENT; MAXIMUM COVER IS 96-INCHES INCLUDING PAVEMENT DESIGN. THE DESIGN ENGINEER MUST APPROVE ANY REVISIONS TO STORMTECH MINIMUM RECOMMENDATIONS.
4. THE CONTRACTOR MUST REPORT ANY DISCREPANCIES WITH CHAMBER FOUNDATION MATERIALS BEARING CAPACITIES TO THE DESIGN ENGINEER.
5. AASHTO M288 CLASS 2 NON-WOVEN GEOTEXTILE (FILTER FABRIC) MUST BE USED AS INDICATED IN THE PROJECT PLANS.
6. STONE PLACEMENT BETWEEN CHAMBER ROWS AND AROUND PERIMETER MUST FOLLOW INSTRUCTIONS AS INDICATED IN THE MOST CURRENT VERSION OF STORMTECH'S INSTALLATION INSTRUCTIONS IN ORDER TO MAINTAIN ROW SEPARATION DISTANCES AND PREVENT CHAMBER DISPLACEMENT.
7. BACKFILLING OVER THE CHAMBERS MUST FOLLOW REQUIREMENTS AS INDICATED IN THE MOST CURRENT VERSION OF STORMTECH'S INSTALLATION INSTRUCTIONS.
8. THE CONTRACTOR MUST REFER TO STORMTECH'S INSTALLATION INSTRUCTIONS FOR A TABLE OF ACCEPTABLE VEHICLE LOADS AT VARIOUS DEPTHS OF COVER. THIS INFORMATION IS ALSO AVAILABLE AT STORMTECH'S WEBSITE; WWW.STORMTECH.COM. THE CONTRACTOR IS RESPONSIBLE FOR PREVENTING VEHICLES THAT EXCEED STORMTECH'S REQUIREMENTS FROM TRAVELING ACROSS OR PARKING OVER THE STORMWATER SYSTEM. TEMPORARY FENCING, WARNING TAPE AND APPROPRIATELY LOCATED SIGNS ARE COMMONLY USED TO PREVENT UNAUTHORIZED VEHICLES FROM ENTERING SENSITIVE CONSTRUCTION AREAS.
9. THE CONTRACTOR MUST APPLY EROSION AND SEDIMENT CONTROL MEASURES TO PROTECT THE STORMWATER SYSTEM DURING ALL PHASES OF SITE CONSTRUCTION PER LOCAL CODES AND DESIGN ENGINEER'S SPECIFICATIONS.
10. STORMTECH PRODUCT WARRANTY IS LIMITED. SEE CURRENT PRODUCT WARRANTY FOR DETAILS. TO ACQUIRE A COPY, CALL STORMTECH AT 1-888-892-2694 OR VISIT WWW.STORMTECH.COM.

STORMTECH PRODUCT SPECIFICATIONS

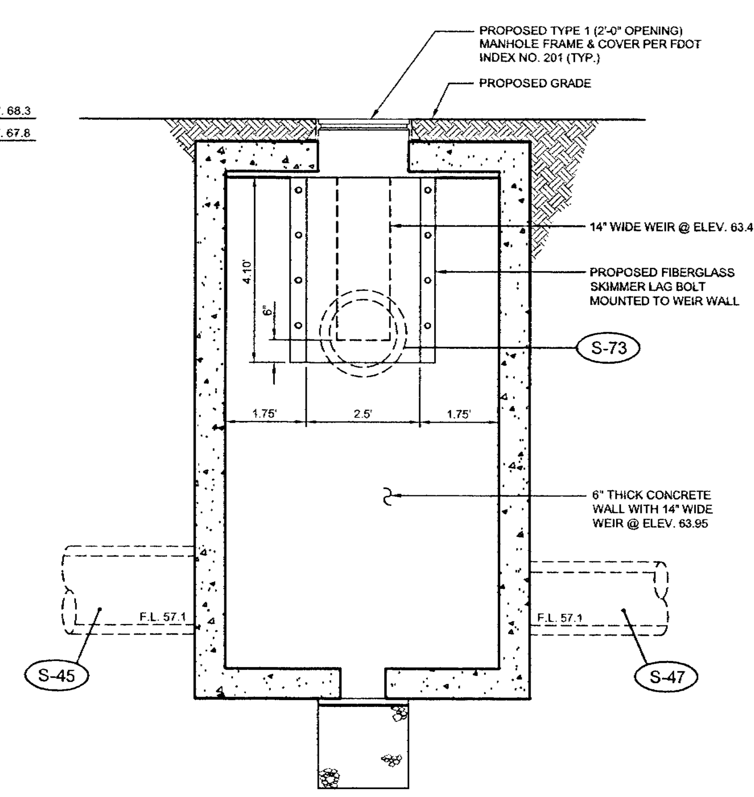
1. STORMTECH CHAMBERS ARE DESIGNED TO CONTROL STORMWATER RUNOFF. AS A SUBSURFACE RETENTION SYSTEM, STORMTECH CHAMBERS RETAIN AND ALLOW EFFECTIVE INFILTRATION OF WATER INTO THE SOIL. AS A SUBSURFACE DETENTION SYSTEM, STORMTECH CHAMBERS DETAIN AND ALLOW FOR THE METERED FLOW OF WATER TO AN OUTFALL.
2. CHAMBER PARAMETERS.
3. THE CHAMBER SHALL BE INJECTION MOLDED OF POLYPROPYLENE RESIN TO BE INHERENTLY RESISTANT TO ENVIRONMENTAL STRESS CRACKING (ESCR), AND TO MAINTAIN ADEQUATE STIFFNESS THROUGH HIGHER TEMPERATURES EXPERIENCED DURING INSTALLATION AND SERVICE.
4. THE NOMINAL CHAMBER DIMENSIONS OF THE STORMTECH SC-740 SHALL BE 30.0-INCHES TALL, 51.0-INCHES WIDE AND 90.7-INCHES LONG. THE INSTALLED LENGTH OF A JOINED CHAMBER SHALL BE 85.4-INCHES.
5. THE CHAMBER SHALL HAVE A CONTINUOUSLY CURVED SECTION PROFILE.
6. THE CHAMBER SHALL BE OPEN-BOTTOMED.
7. THE CHAMBER SHALL INCORPORATE AN OVERLAPPING CORRUGATION JOINT SYSTEM TO ALLOW CHAMBER ROWS OF ALMOST ANY LENGTH TO BE CREATED. THE OVERLAPPING CORRUGATION JOINT SYSTEM SHALL BE EFFECTIVE WHILE ALLOWING A CHAMBER TO BE TRIMMED TO SHORTEN ITS OVERALL LENGTH.
8. THE NOMINAL STORAGE VOLUME OF A JOINED STORMTECH SC-740 CHAMBER SHALL BE 74.9 CUBIC FEET PER CHAMBER WHEN INSTALLED PER STORMTECH'S TYPICAL DETAILS (INCLUDES THE VOLUME OF CRUSHED ANGULAR STONE WITH AN ASSUMED 40 RATIO). THIS EQUATES TO 2.2 CUBIC FEET OF STORAGE/SQUARE FOOT OF BED.
9. THE CHAMBER SHALL HAVE FORTY-EIGHT ORIFICES PENETRATING THE SIDEWALLS TO ALLOW FOR LATERAL CONVEYANCE OF WATER.
10. THE CHAMBER SHALL HAVE TWO ORIFICES NEAR ITS TOP TO ALLOW FOR EQUALIZATION OF AIR PRESSURE BETWEEN ITS INTERIOR AND EXTERIOR.
11. THE CHAMBER SHALL HAVE BOTH OF ITS ENDS OPEN TO ALLOW FOR UNIMPEDED HYDRAULIC FLOWS AND VISUAL INSPECTIONS DOWN A ROW'S ENTIRE LENGTH.
12. THE CHAMBER SHALL HAVE 14 CORRUGATIONS.
13. THE CHAMBER SHALL HAVE A CIRCULAR, INDENTED, FLAT SURFACE ON THE TOP OF THE CHAMBER FOR AN OPTIONAL 4-INCH INSPECTION PORT OR CLEAN-OUT.
14. THE CHAMBER SHALL BE ANALYZED AND DESIGNED USING AASHTO METHODS FOR THERMOPLASTIC CULVERTS CONTAINED IN THE LRFD BRIDGE DESIGN SPECIFICATIONS, 2ND EDITION, INCLUDING INTERIM SPECIFICATIONS THROUGH 2001. DESIGN LIVE LOAD SHALL BE THE AASHTO HS20 TRUCK. DESIGN SHALL CONSIDER EARTH AND LIVE LOADS AS APPROPRIATE FOR THE MINIMUM TO MAXIMUM SPECIFIED DEPTH OF FILL.
15. THE CHAMBER SHALL BE MANUFACTURED IN AN ISO 9001:2000 CERTIFIED FACILITY.

END CAP PARAMETERS

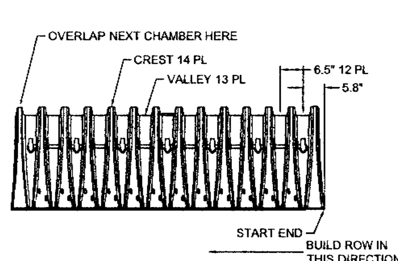
1. THE END CAP SHALL BE INJECTION MOLDED OF POLYPROPYLENE RESIN TO BE INHERENTLY RESISTANT TO ENVIRONMENTAL STRESS CRACKING (ESCR), AND TO MAINTAIN ADEQUATE STIFFNESS THROUGH HIGHER TEMPERATURES EXPERIENCED DURING INSTALLATION AND SERVICE.
2. THE END CAP SHALL BE DESIGNED TO FIT INTO ANY CORRUGATION OF A CHAMBER, WHICH ALLOWS; CAPPING A CHAMBER THAT HAS ITS LENGTH TRIMMED; SEGMENTING ROWS INTO STORAGE BASINS OF VARIOUS LENGTHS; USE AS A BAFFLE PLATE OR WEIR CONTROL DEVICE AT ANY LOCATION IN A ROW.
3. THE END CAP SHALL HAVE SAW GUIDES TO ALLOW EASY CUTTING FOR VARIOUS DIAMETERS OF PIPE THAT MAY BE USED TO INLET THE SYSTEM.
4. THE END CAP SHALL HAVE EXCESS STRUCTURAL ADEQUACIES TO ALLOW CUTTING AN ORIFICE OF ANY SIZE AT ANY INVERT ELEVATION.
5. THE PRIMARY FACE OF AN END CAP SHALL BE CURVED OUTWARD TO RESIST HORIZONTAL LOADS GENERATED NEAR THE EDGES OF BEDS.
6. THE END CAP SHALL BE MANUFACTURED IN AN ISO 9001:2000 CERTIFIED FACILITY.



SECTION "A" - "A"

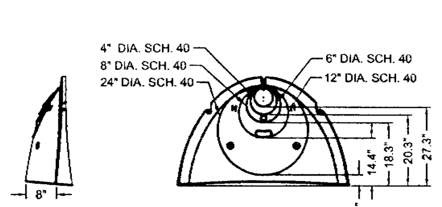


SECTION "B" - "B"



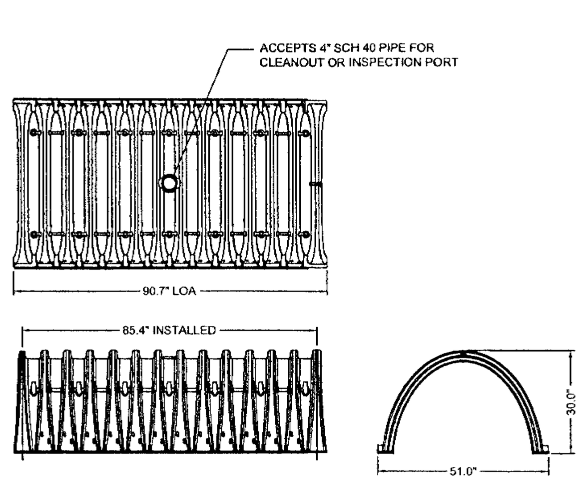
STORMTECH SC-740 CHAMBER CORRUGATION DETAIL

NOT TO SCALE



STORMTECH SC-740 CHAMBER END CAP DETAIL

NOT TO SCALE

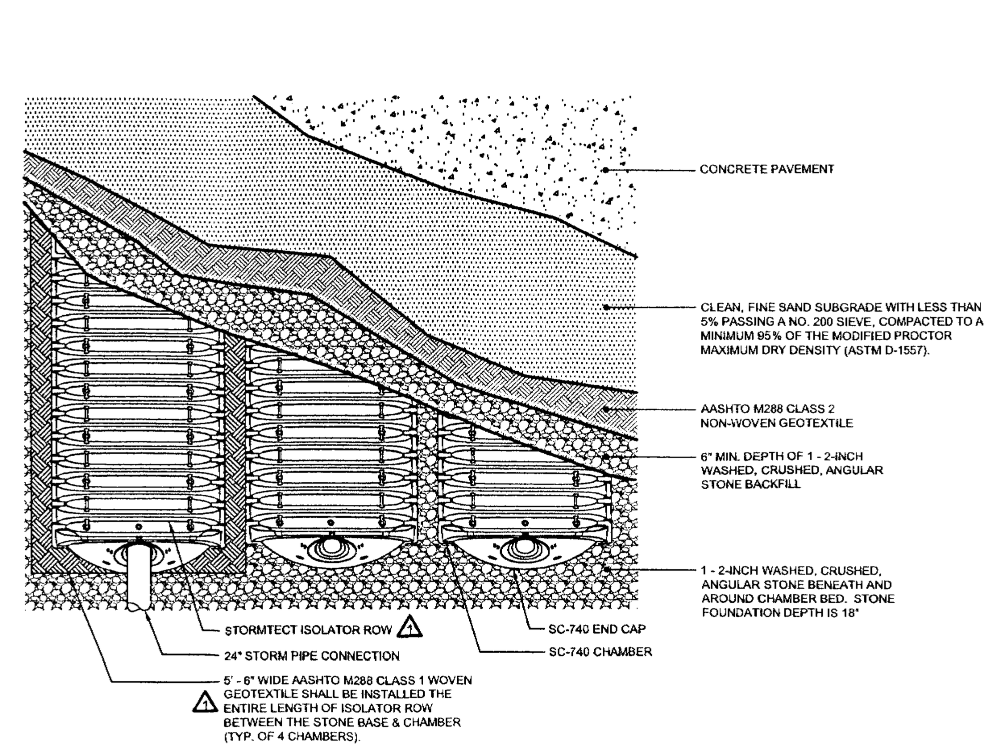


STORMTECH SC-740 CHAMBER

NOT TO SCALE

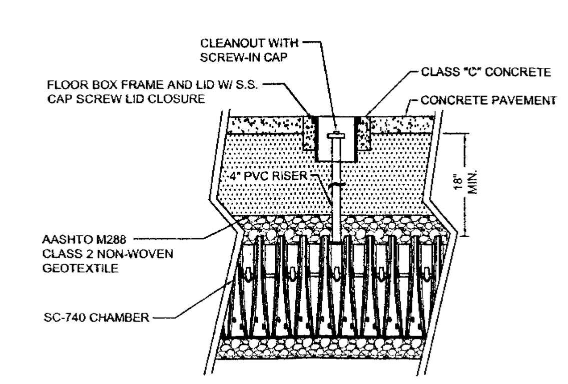
NOMINAL CHAMBER SPECIFICATIONS:

SIZE (W x H x INSTALLED LENGTH):	51.0" x 30.0" x 85.4"
CHAMBER STORAGE:	45.9 CUBIC FEET
MINIMUM INSTALLED STORAGE W/ 18" FOUNDATION DEPTH:	86.4 CUBIC FEET
WEIGHT:	75 LBS.



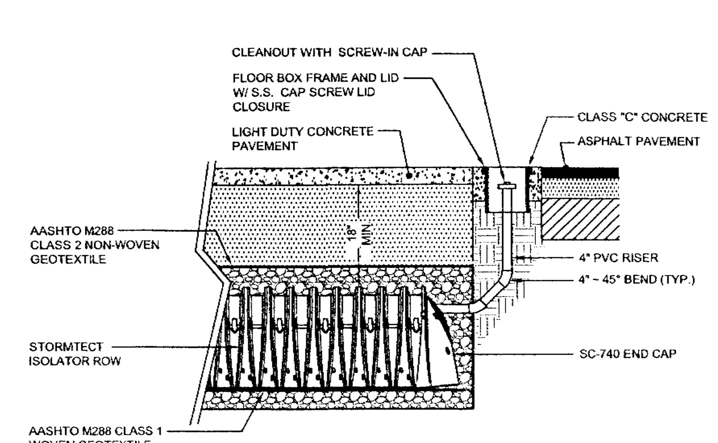
STORMTECH SC-740 CHAMBER SYSTEM PLAN VIEW DETAIL

NOT TO SCALE



STORMTECH SC-740 CHAMBER SYSTEM INSPECTION PORT DETAIL

NOT TO SCALE



STORMTECH SC-740 ISOLATOR ROW CLEAN OUT DETAIL

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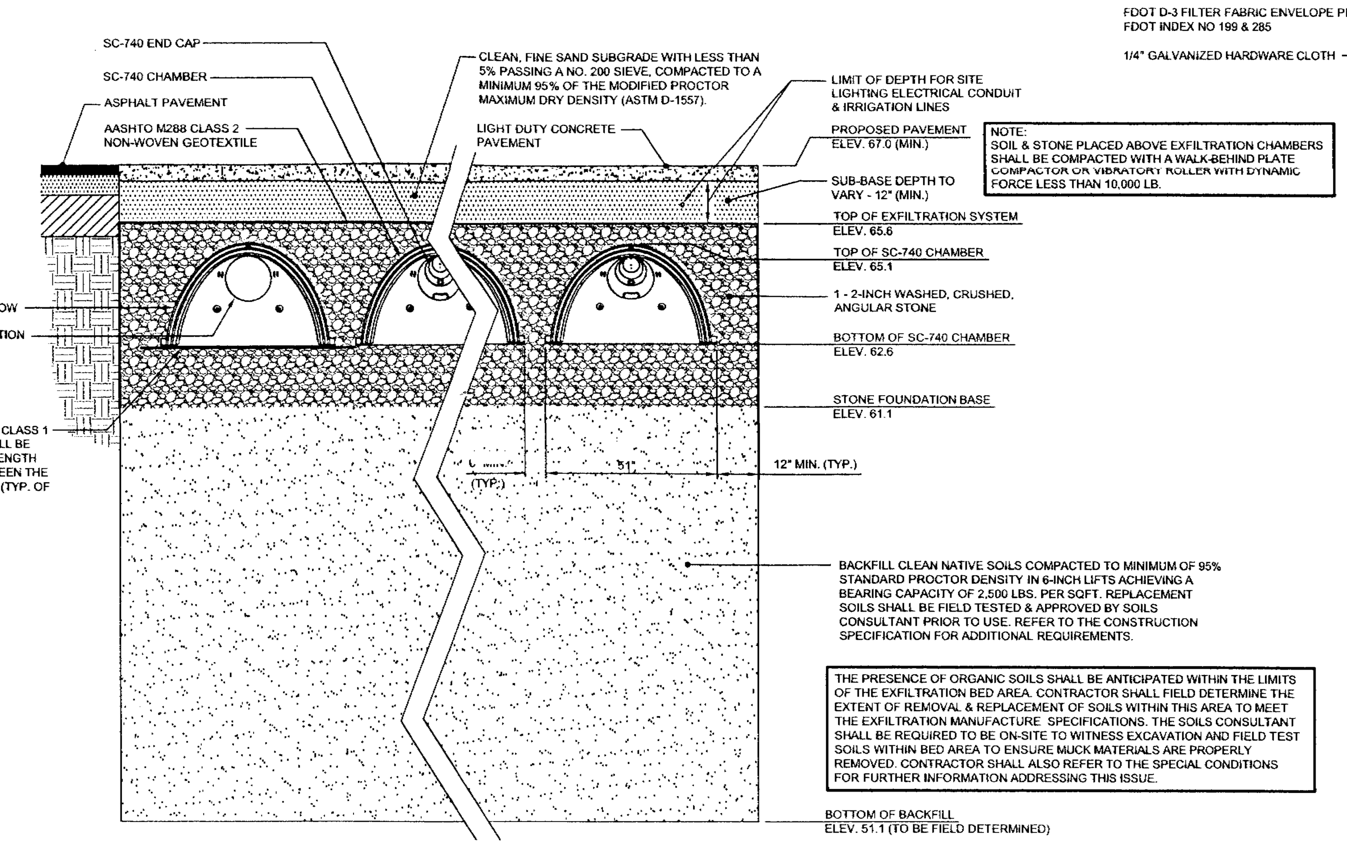
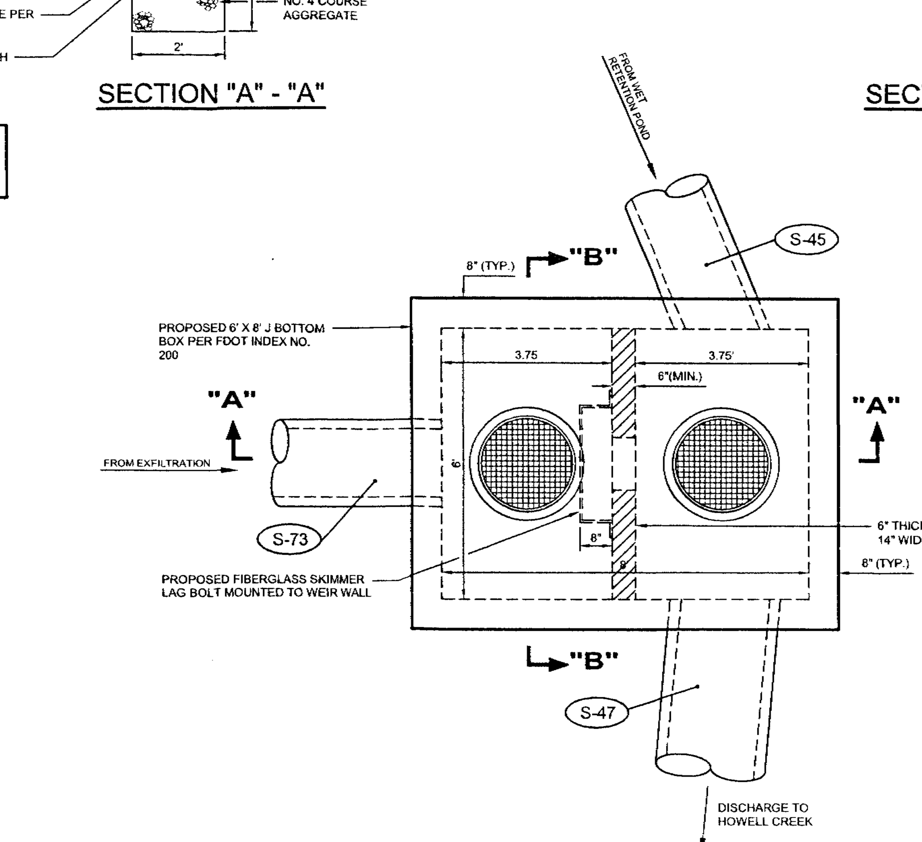


STORMTECH SC-740 CHAMBER SYSTEM TYPICAL CROSS SECTION DETAIL

NOT TO SCALE



OUTFALL STRUCTURE NO. S-46 DETAIL

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Scale:	AS NOTED
Date:	FEB. 2003
Job No.	W13191
File:	EXFILTRATION
Approved H.L.W.	© 2003

No.	Date	Revision
1	3/12/03	PER S.J.R.W.M.D. COMMENTS
2		
3		
4		
5		

Activity	Name	Date
Designed by:	G.D./J.K.B.	2/03
Drawn by:	J.K.B.	2/03
Checked by:	G.D.	2/03
Approved by:	H.L.W.	2/03

Certificate of Authorization No. 3215

EXFILTRATION SHEET

WAL★MART SUPERCENTER

STORE NO. 943-04, EXPSC (BENDERSON. SITE) - CASSELBERRY, FLORIDA

Sheet No. C-9

Appendix C
Survey Data

SEE SHEET 2 OF 4

LAKE HOWELL LANE
R/W VARIES
P.B. 34, PGS. 36–37

APPARENT CENTER LINE OF LAKE HOWELL LANE
APPARENT R/W LINE
CENTER LINE
BRIDGE CENTER LINE
NORTH LINE, NE 1/4 OF SW 1/4 SEC 28, TWP 21 S, RGE 30 E
25.00'
35.00'
10.00'
33.00' P.B. 15, PG. 31
40.00' P.B. 67, PGS. 6–15

SITE BENCHMARK
SET NAIL AND DISK
STAMPED "SSMC TRAV. PT."
ELEVATION = 67.16
N 1562770.25
E 552135.94

SITE BENCHMARK
SET NAIL AND DISK
STAMPED "SSMC TRAV. PT."
ELEVATION = 64.69
N 1562774.00
E 552533.69

LAKE HOWELL LANE

Bridge ID	28–001B
Bridge Width ft	41
Low Chord Elev ft	61.95
Upstream Invert ft	54.08
Downstream Invert ft	53.57
Street Crossing	Lake Howell Lane
Min Crown Elev ft	63.86
S T R	28, 21, 30
Jurisdiction	SEM

PARCEL ID. NO.
28–21–30–300–0500–0000
#2003 LAKE HOWELL LANE

LOT 109
FOREST BROOK – SECOND SECTION
PLAT BOOK 15, PAGE 31

PARCEL IDENTIFICATION NUMBER
28–21–30–505–0000–1090
LA ROSA, ERIKA M
568 LAKE HOWELL ROAD

LOT 110
FOREST BROOK – SECOND SECTION
PLAT BOOK 15, PAGE 31
PARCEL IDENTIFICATION NUMBER
28–21–30–505–0000–1100
KWONG, SHUI H
558 LAKE HOWELL ROAD

1 STORY
MASONRY RESIDENCE
FINISHED FLOOR = 65.22

APPARENT RIGHT OF WAY
EAST LINE, NW 1/4 OF SW 1/4 SEC 28, TWP 21 S, RGE 30 E
APPARENT CENTER LINE
APPARENT R/W LINE

CURB INLET
TOP=64.29
E. INV=60.11
15" RCP
CURB INLET
TOP=64.40
E. INV.=59.94

HAND RAIL
3' BARRIER WALL
RIP-RAP
ELEVATED CONCRETE WALK
EDGE OF PAVEMENT
ASPHALT PAVEMENT
CONCRETE WALL ON CONCRETE BASE
W

CROSS SECTION LINE "A"
CROSS SECTION LINE "B"
CROSS SECTION LINE "C"
CROSS SECTION LINE "D"
CROSS SECTION LINE "E"
CROSS SECTION LINE "F"
CROSS SECTION LINE "G"

LAKE HOWELL ROAD
50' HALF RIGHT OF WAY
PLAT BOOK 26, PAGE 78

30.00' P.B. 28, PG. 33

BROKEN CONCRETE
HAND RAIL
CONCRETE SPILLWAY
EDGE OF PAVEMENT
42" ABS INVERT=59.60
MASONRY HEADWALL TOP = 63.77
42" ABS INV.=60.27
MASONRY HEADWALL TOP=64.66
APPARENT RIGHT OF WAY
59' ±
DIRT DRIVE
EAST LINE, NW 1/4 OF SW 1/4 SEC 28, TWP 21 S, RGE 30 E
BRIDGE CENTER LINE

ULTRA VISTA A CONDOMINIUM
PHASE I
PLAT BOOK 26, PAGE 78

SIERRA CONDOMINIUM PHASE II
P.B. 28, PGS. 33–36

SIERRA CONDOMINIUM PHASE I
P.B. 26, PG. 73

PARCEL ID. NO.
28–21–30–300–0490–0000
#547 LAKE HOWELL ROAD

STA1 56.4
STA2 56.4
STA3 56.1
STA4 54.9
STA5 53.7

LEGEND AND ABBREVIATIONS:

@	= WEEP HOLE IN BRIDGE WALL
	= MANHOLE
●	= IRON ROD
	= LIGHT POLE
○	= NAIL W/DISC
Ac	= AIR CONDITIONING UNIT
	= FLAT GRATE INLET
	= MITERED END SECTION
A.K.A.	= ALSO KNOWN AS
BLVD	= BOULEVARD
SSMC	= SOUTHEASTERN SURVEYING & MAPPING CORP.
TRAV PT	= TRAVERSE POINT
ELEV	= ELEVATION
P.B.	= PLAT BOOK
PG(S)	= PAGES
–WL–	= WATER LINE
INV	= INVERT
ELEV	= ELEVATION
TB	= TOP OF BANK
TS	= TOE OF SLOPE
PD	= WATER ELEVATION
SPL	= SPILLWAY
EP	= EDGE OF PAVEMENT
GU	= GUTTER
BW	= BACK OF WALK
FW	= FRONT OF WALK
HW	= HEADWALL
RW	= RETAINING WALL
PVC	= POLYVINYL CHLORIDE PIPE
RCP	= REINFORCED CONCRETE PIPE
RCPE	= REINFORCED CONCRETE PIPE (ELLIPTICAL)
CMP	= CORRUGATED METAL PIPE
ABS	= BLACK PLASTIC PIPE
ID.	= IDENTIFICATION
EC	= EDGE OF CONCRETE
R/W	= RIGHT OF WAY
CN	= CONCRETE
NO.	= NUMBER
O.R.B.	= OFFICIAL RECORDS BOOK
S.R.	= STATE ROAD
	= WETLAND FLAG
FT	= FEET
STA1	= WETLAND FLAG (TYPICAL)
MIN	= MINIMUM
S T R	= SECTION, TOWNSHIP, RANGE
SEC	= SECTION
TWP	= TOWNSHIP
RGE	= RANGE
SEM	= SEMINOLE COUNTY
CAS	= CITY OF CASSELBERRY
FT	= FEET
NAVD	= NORTH AMERICAN VERTICAL DATUM OF 1988
NGVD	= NATIONAL GEODETIC VERTICAL DATUM OF 1929

SITE BENCHMARK
SET IRON ROD AND CAP
STAMPED "SSMC TRAV. PT."
ELEVATION = 65.59

SHEET 1 OF 4
NOT VALID WITHOUT
SHEETS 2 THROUGH 4

1" = 20'
GRAPHIC SCALE
0 10 20 40

DESCRIPTION:

A portion of Section 28, Township 21 South, Range 30 East, Seminole County, Florida and a portion of the following Subdivisions:
Lake Howell Square, Plat Book 34, Pages 36 and 37, Public Records of Seminole County, Florida;
Sierra Condominium Phase II, Plat Book 28, Pages 33 through 36, Public Records of Seminole County, Florida;
Wal–Mart Supercenter at Lake Howell Square North, Plat Book 67, Pages 6 through 15,
Public Records of Seminole County, Florida.

SURVEYOR'S REPORT:

1. Vertical information shown hereon refers to Seminole County Benchmark, designation 2546301, being a Nail & Disk in the center of a concrete headwall ± 24 feet west of the back of curb of Lake Howell Road, ± 195 feet south of the center line of the bridge over Howell Creek, ± 0.45 miles north of Howell Branch Road, Published Elevation = 67.726 feet, NGVD29 Datum.
2. NOTE:
THE VERTICAL CONVERSION FACTOR FOR THIS PROJECT WILL BE NGVD29 –1.05 FEET = NAVD88.
3. Utility locations if shown hereon are based on field location of markings by Utility Company representatives, surface features and construction plans furnished to the surveyor. Additional sub–surface utilities may exist that have not been field located.
4. Easements or rights of way that appear on recorded plans or that have been furnished to the surveyor or by others have been incorporated into this drawing with appropriate notation. Other easements may be discovered by a search of the Public Records.
5. Measurement methods used for this survey meet MINIMUM TECHNICAL STANDARDS FOR LAND SURVEYING CH. 61G17–6 requirements.
6. Not valid without the signature and raised seal of a Florida Licensed Surveyor and Mapper.
7. Features shown by symbol as indicated in the legend are not to scale.
8. Based on the National Flood Insurance Program FIRM Map No. 12117C0165F, dated 09/28/2007, the above described property is within Zones "A", "AE", and "X".
9. The electronic image of this map contains horizontal positions for all features shown relative to NAD83/90, State Plane Coordinate System, Florida East Zone.
10. This Survey was performed without benefit of an abstract, title search, title opinion or title commitment. A title search may reveal additional information affecting the Parcel as shown.
11. Unless shown, only those visible features in the immediate vicinity of the above described parcel boundary have been located.
12. Dimensions are shown in feet and decimals thereof.

NOTICE OF LIABILITY:

This survey is certified to those individuals shown on the face thereof. Any other use, benefit or reliance by any other party is strictly prohibited and restricted. Surveyor is responsible only to those certified and hereby disclaims any other liability and hereby restricts the rights of any other individual or firm to use this survey, without express written consent of the surveyor.

Southeastern Surveying

Topographic Survey

Survey Date:	Drawing Number	Scale:	Drawn By:
May 7, 2009	54106005	1" = 20'	DM

For: Inwood Consulting Engineers

Howell Creek at Howell Lane Creek Assessment 54106005

SOUTHEASTERN SURVEYING & MAPPING CORP.
6500 All American Boulevard
Orlando, Florida 32810–4350
(407) 292–8580 Cert. No. LB2108
e–mail: info@southeasternsurveying.com

GARY B. KRICK
Registered Land Surveyor No. 4245

NOTE: PLOTTED AT REDUCED SCALE FOR REPORT PURPOSES. REFER TO DATA DVD FOR FULL SIZE REPRESENTATION.

SEE SHEET 3 OF 4

SEE SHEET 3 OF 4

LOT 1
WAL–MART SUPERCENTER AT
LAKE HOWELL SQUARE NORTH
P.B. 67, PGS. 6–15

100' DRAINAGE, WATER, CONSERVATION EASEMENT P.B. 34, PGS. 36–37

100.00'

ASPHALT PAVEMENT

BRIDGE CENTER LINE

WAL–MART PLAZA SOUTH	
Bridge ID	28–002B
Bridge Width ft	125
Low Chord Elev ft	67.04
Upstream Invert ft	55.28
Downstream Invert ft	55.54
Street Crossing	Wal–Mart Plaza
Min Crown Elev ft	68.25
S T R	28, 21, 30
Jurisdiction	CAS

SITE BENCHMARK
SET NAIL AND DISK
STAMPED "SSMC TRAV. PT."
ELEVATION = 68.64
N 563157.25
E 552797.47

CROSS SECTION LINE "J"

CROSS SECTION LINE "I"

CROSS SECTION LINE "H"

CROSS SECTION LINE "G"

STA9 68.4

STA8 55.2

STA7

STA6 54.0

SPL–57.42
CONCRETE SPILLWAY
18" RCP INV.=59.5

INLET TOP=66.5 INV.=62.2
1.0' x 0.5' METAL SKIMMER

24" RCP INV.=62.4

HOWELL CREEK

LOT 2
WAL–MART SUPERCENTER AT
LAKE HOWELL SQUARE NORTH
P.B. 67, PGS. 6–15

NOT PLATTED

LOT 1
LAKE HOWELL SQUARE
P.B. 34, PGS. 36–37

1" = 20'
GRAPHIC SCALE
0 10 20 40

NOT VALID WITHOUT
SHEETS 1,3, & 4

SOUTHEASTERN SURVEYING & MAPPING CORP.
6500 All American Boulevard
Orlando, Florida 32810–4350
(407) 292–8580 fax: (407) 292–0141
email: info@southeasternsurveying.com

SEE SHEET 1 OF 4

SEE SHEET 1 FOR SURVEYOR'S NOTES AND LEGEND

Rev.		
Sheet 2 of 4	Drawing No. 54106006	Date: May 7, 2009

NOTE: PLOTTED AT REDUCED SCALE FOR REPORT PURPOSES. REFER TO DATA DVD FOR FULL SIZE REPRESENTATION.

WAL–MART PLAZA NORTH	
Bridge ID	28–003B
Bridge Width ft	32
Low Chord Elev ft	66.57
Upstream Invert ft	54.24
Downstream Invert ft	53.38
Street Crossing	Wal–Mart Plaza
Min Crown Elev ft	67.80
S T R	28, 21, 30
Jurisdiction	CAS

SITE BENCHMARK
SET NAIL AND DISK
STAMPED "SSMC TRAV. PT."
ELEVATION = 67.71
N 1563597.03
E 553050.46

LOT 1
WAL–MART SUPERCENTER AT
LAKE HOWELL SQUARE NORTH
P.B. 67, PGS. 6–15

LOT 4
LAKE HOWELL SQUARE
P.B. 34, PGS. 36–37

100' DRAINAGE, WATER, CONSERVATION EASEMENT
P.B. 34, PGS. 36–37

BRIDGE CENTER LINE

HOWELL CREEK

ASPHALT PAVEMENT

SEASONAL HIGH WATER ELEVATION 56.1 + MAY 6, 2009

STA10 59.1

STA11 54.4

STA12 53.7

1" = 20'
GRAPHIC SCALE
0 10 20 40

NOT VALID WITHOUT SHEETS 1,2, & 4

SEE SHEET 1 FOR SURVEYOR'S NOTES AND LEGEND

Southeastern Surveying
SOUTHEASTERN SURVEYING & MAPPING CORP.
6500 All American Boulevard
Orlando, Florida 32810–4350
(407) 292–8580 fax (407) 292–0141
email: info@southeasternsurveying.com

Rev.	
Sheet 3 of 4	Drawing No. 54106007 Date: May 7, 2009

SEE SHEET 2 OF 4
SEE SHEET 2 OF 4
SEE SHEET 4 OF 4

NOTE: PLOTTED AT REDUCED SCALE FOR REPORT PURPOSES. REFER TO DATA DVD FOR FULL SIZE REPRESENTATION.

SEE SHEET 3 OF 4

HOWELL CREEK

LOT 4
LAKE HOWELL SQUARE
P.B. 34, PGS. 36-37

S.R. 436 LIFT STATION SITE
SOUTH SEMINOLE AND
ORANGE COUNTY WASTEWATER
NORTH TRANSMISSION AUTHORITY
O.R.B. 2089, PGS. 0277-0278

APPARENT R/W LINE

ASPHALT PAVEMENT

CONCRETE PAVEMENT

EDGE OF PAVEMENT

EDGE OF CONCRETE

5' CONCRETE WALK

CONCRETE WALK

CONCRETE MEDIAN

0.8' WIDE X 3' HIGH CONCRETE WALL

0.8' WIDE X 2' HIGH CONCRETE WALL WITH 3' RAILING

4" PVC WEEP HOLES (TYPICAL)

18" RCP INV=55.66

30" RCP INV=55.99

18" RCP INV=55.07

30" RCP INVERT=54.75

STA 13

STA 14

STA 15

SITE BENCHMARK
STAMPED "SSMC TRAV PT 7"
ELEV = 68.27
N 1563825.08
E 553279.71

SITE BENCHMARK
NAIL AND DISK
STAMPED "LS 2700"
ELEVATION = 68.22
N 1563818.59
E 553366.33

STATE ROAD NO. 436
S.R. 436 E. SEMORAN BLVD
A.K.A. 200' RIGHT OF WAY
P.B. 67, PGS. 6-15

APPARENT CENTER LINE S.R. 436

ASPHALT PAVEMENT

EAST LINE, NW 1/4 SEC 28, TWP 21 S, RGE 30 E

NOT VALID WITHOUT
SHEETS 1 THROUGH 3

SEE SHEET 1 FOR SURVEYOR'S NOTES AND LEGEND

GRAPHIC SCALE
0 10 20 40
1" = 20'

Southeastern Surveying and Mapping Corp.
SOUTHEASTERN SURVEYING & MAPPING, CORP.
6500 All American Boulevard
Orlando, Florida 32810
(407) 292-8580 fax (407) 292-0141
email: info@southeasternsurveying.com

Rev.			
Sheet # of #	Drawing No. 541008DB	Date: May 7, 2009	

NOTE: PLOTTED AT REDUCED SCALE FOR REPORT PURPOSES. REFER TO DATA DVD FOR FULL SIZE REPRESENTATION.

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 05MAY09

M. KUTERAS

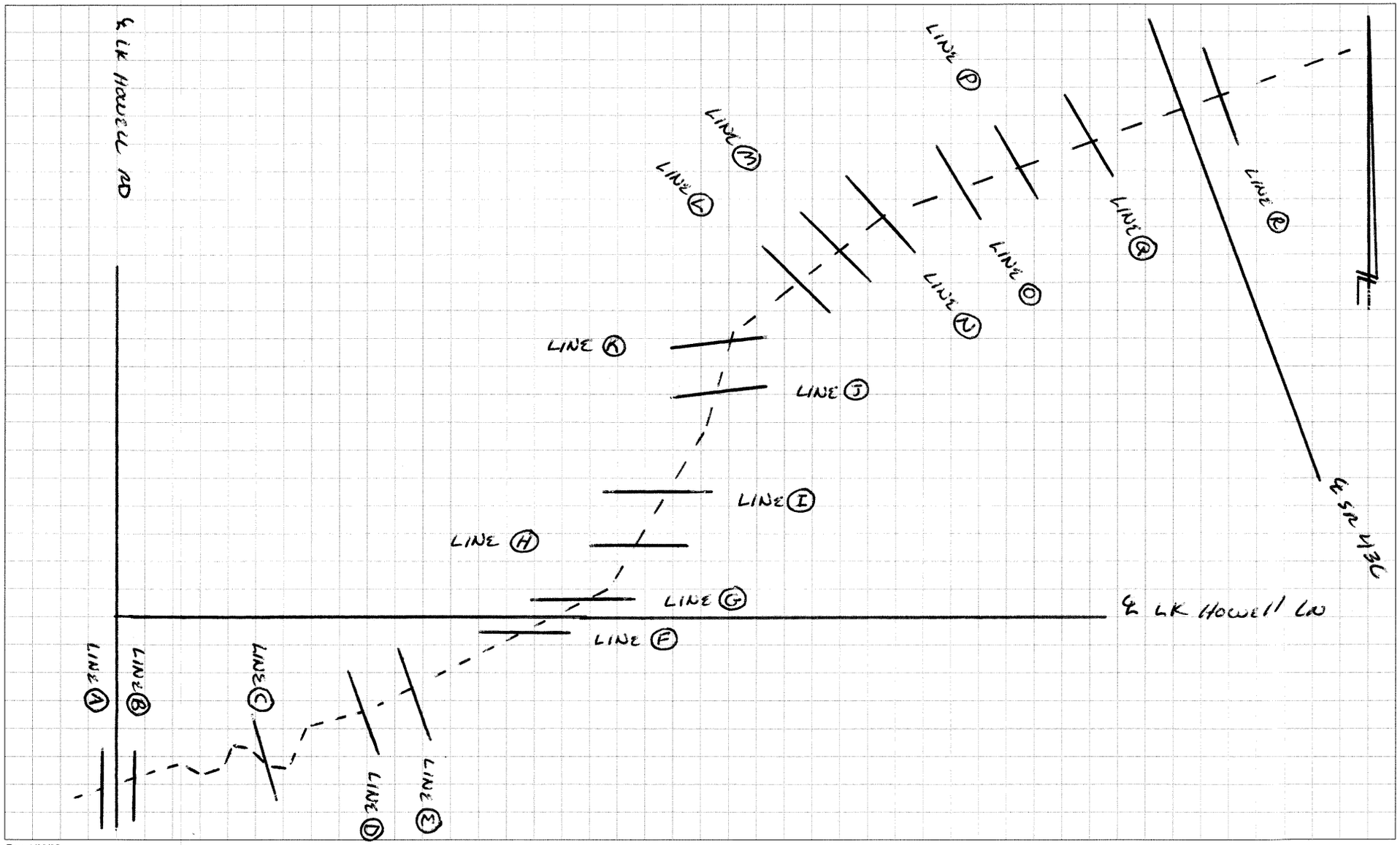
Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK

ASSESSMENT CROSS SECTION OVERALL

Team A. BELL

Page 3 of 20

Southeastern Surveying



Rev. 1/08/02

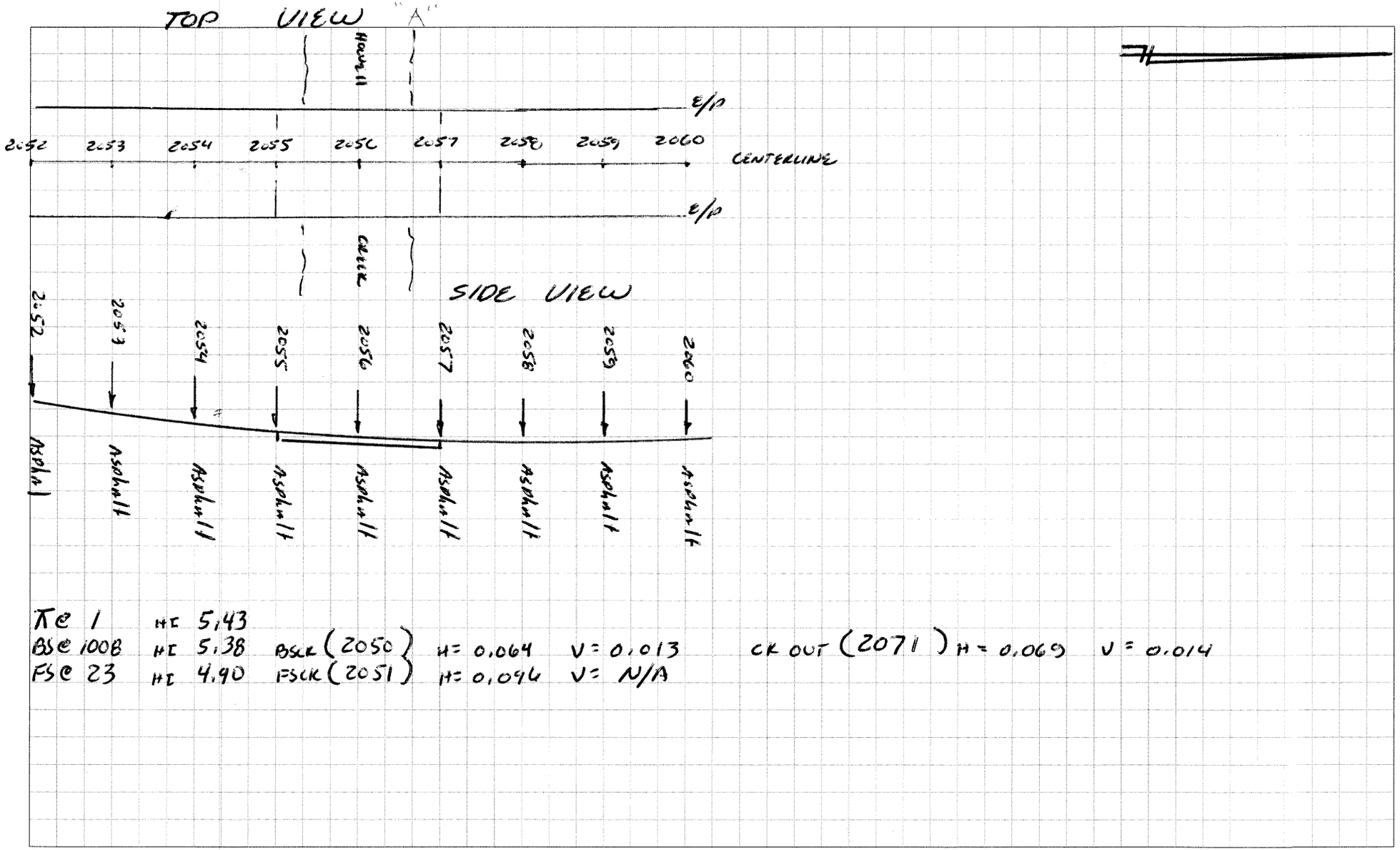
Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 06 MAY 09

Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK ASSESSMENT LAKE HOWELL ROAD BRIDGE CENTERLINE

Team M. KUHENS A. BELL

Page 4 of 20

Southeastern Surveying®



TE 1 HI 5.43

BS @ 100B HI 5.38 BSCK (2050) H = 0.064 V = 0.013 CK OUT (2071) H = 0.069 V = 0.014

FS @ 23 HI 4.90 FSCK (2051) H = 0.096 V = N/A

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 06 MAY 09 M. KLATES

Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK ASSESSMENT CROSS SECTION LINE "B"

Team A. BELL

Page 5 of 20

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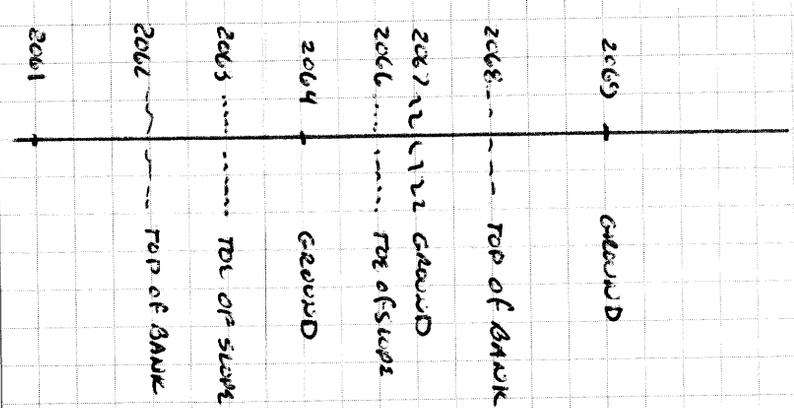
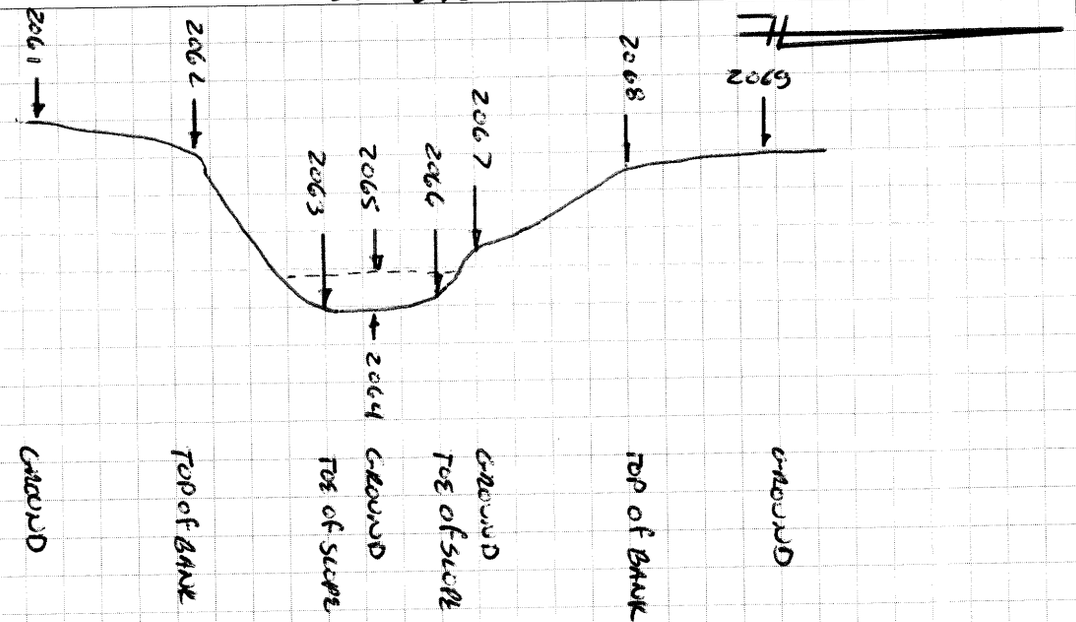
TOP VIEW



SIDE VIEW



TE 1 HI 5.43
BSE 1008 HI 5.38 BSCK (2050) H = 0.064 V = 0.013 CK OUT (2071) H = 0.069 V = 0.014
FSE 23 HI 4.90 FSCK (2051) H = 0.090 V = N/A

NOTE:

① SHOT # 2065 IS WATER ELEVATION

② SHOT # 2070 IS WETLANDS JURISDICTION STA-1 - FOUND ORANGE RIBBON TIED TO FOLIAGE

③ SET POINTS 1400/1401 H = 0.000 V = 0.000, 1402/1403 H = 0.010 V = 0.001 BOTH SET GOD NAIL

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 06 MAY 09 MIKE AERS

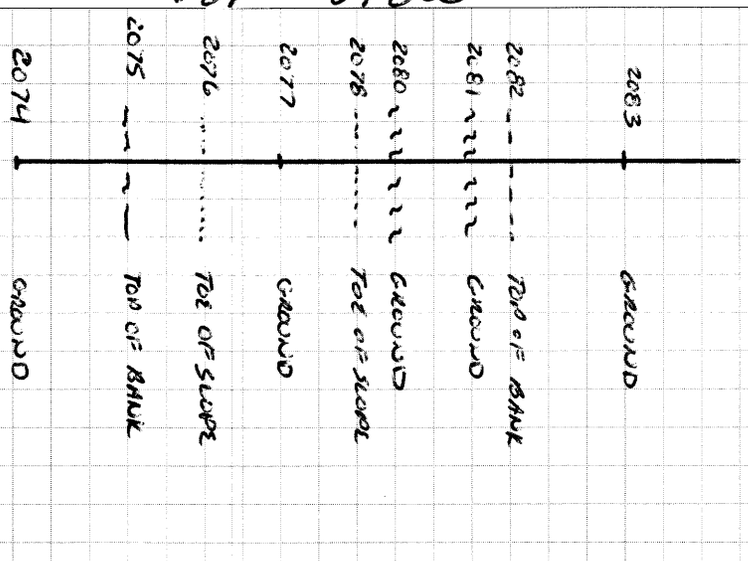
Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK ASSESSMENT CROSS SECTION LINE "C"

Team A. BELL

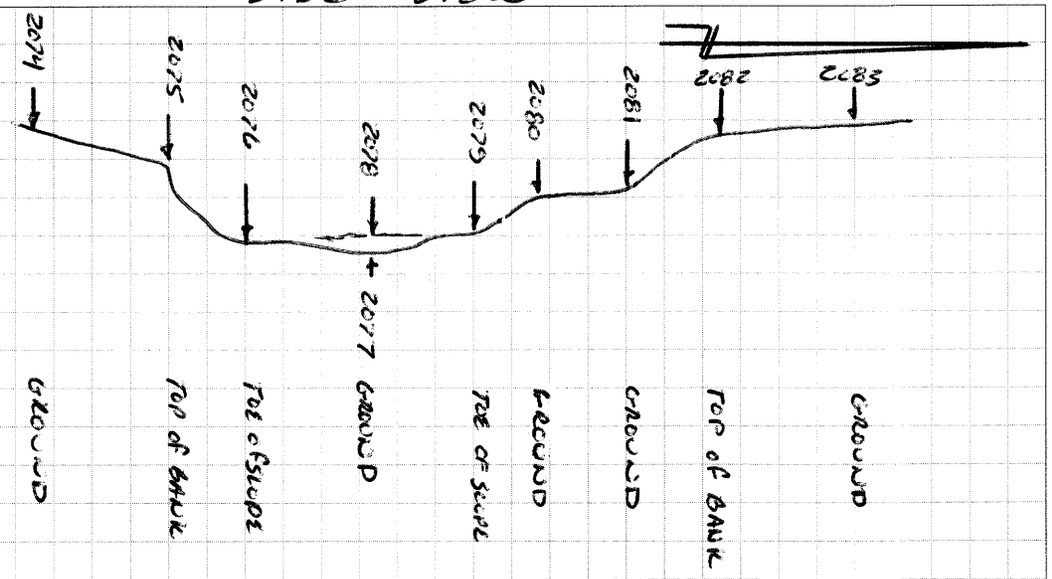
Page 6 of 20

Southeastern Surveying

TOP VIEW



SIDE VIEW



TE 1400 HI 5.38

BSE 1 HI 5.24 BSLK (2072) H = 0.004 V = 0.015

FSE 1402 HI 4.90 FSLK (2073) H = 0.028 V = 0.005

CK OUT (2085) H = 0.001 V = 0.021

NOTES:

① SHOT # 2078 is WATER ELEVATION

② SHOT # 2084 is WETLANDS JURISDICTION STA-2 - FOUND ORANGE RIBBON TIED TO FOLIAGE

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 06 MAY 99 M. KUYERS

Task Description HOWELL CREEK AT LAKE HOWELL/LAKE CREEK ASSESSMENT CROSS SECTION LINE "D" Team A. BELL

Page 7 of 20

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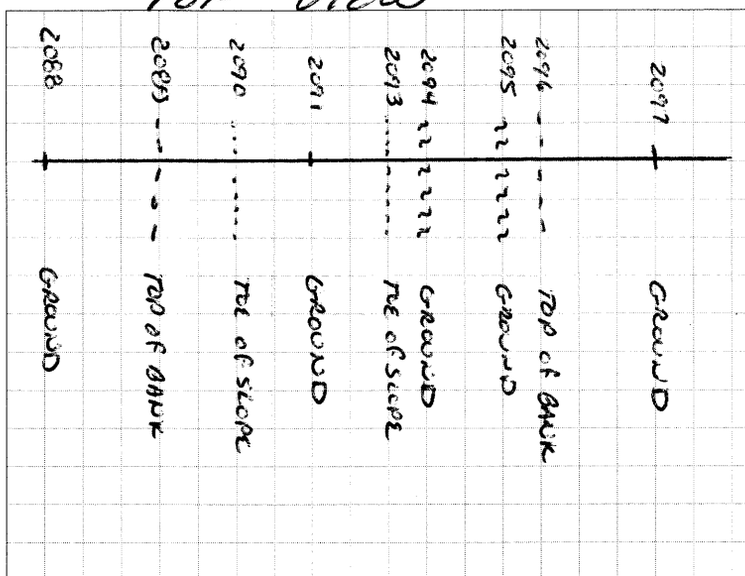
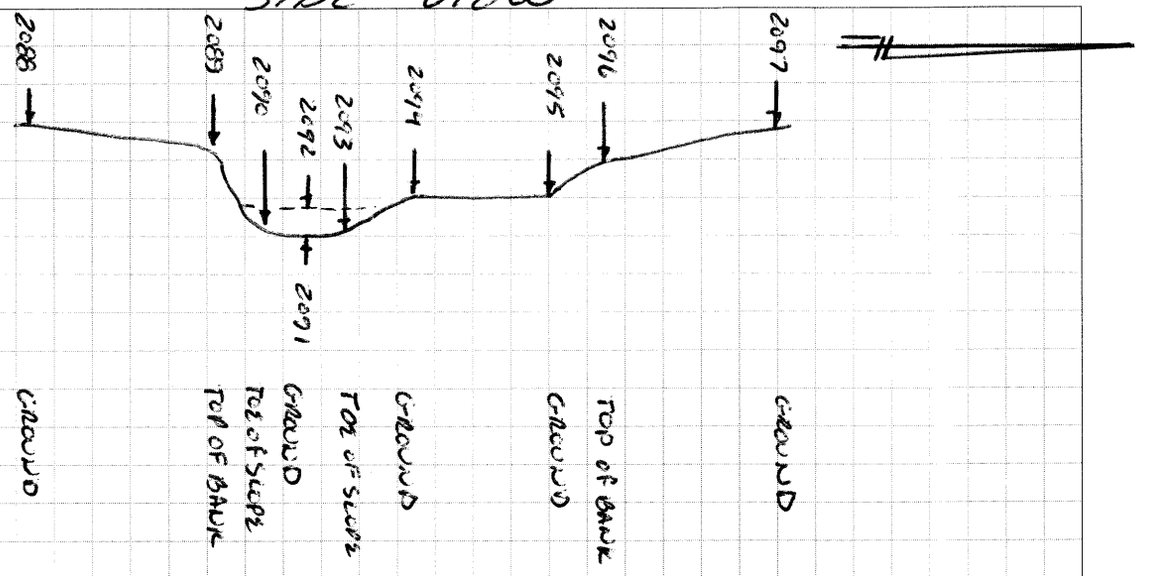
TOP VIEW



SIDE VIEW



TBC 1402 HI 5.45
BSC 1 HI 5.24 BSCK (2086) H = 0.017 V = 0.027 CK OUT (2099) H = 0.017 V = 0.023
FSC 1400 HI 5.26 FSCK (2087) H = 0.023 V = -0.006

NOTES:

① SHOT # 2092 is WATER ELEVATION

② SHOT # 2098 is WETLANDS JURISDICTION STA - 3 - FOUND ORANGE RIBBON TIED TO FOLIAGE

Job No. 541060 Work order No. 82054 Proj. Manager. TOM Date 05 MAY 09

Team M. KLAERS A. BELL

Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK ASSESSMENT - LINE "E"

Page 8 of 20

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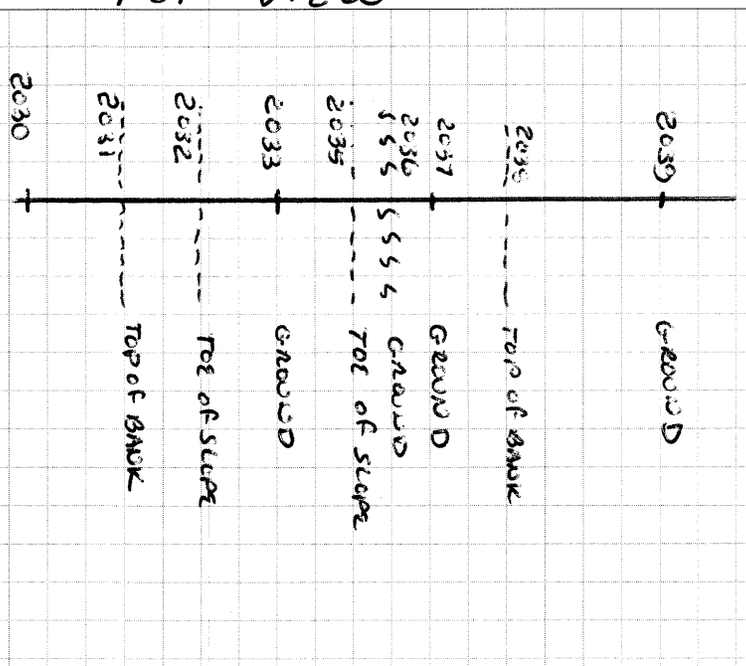
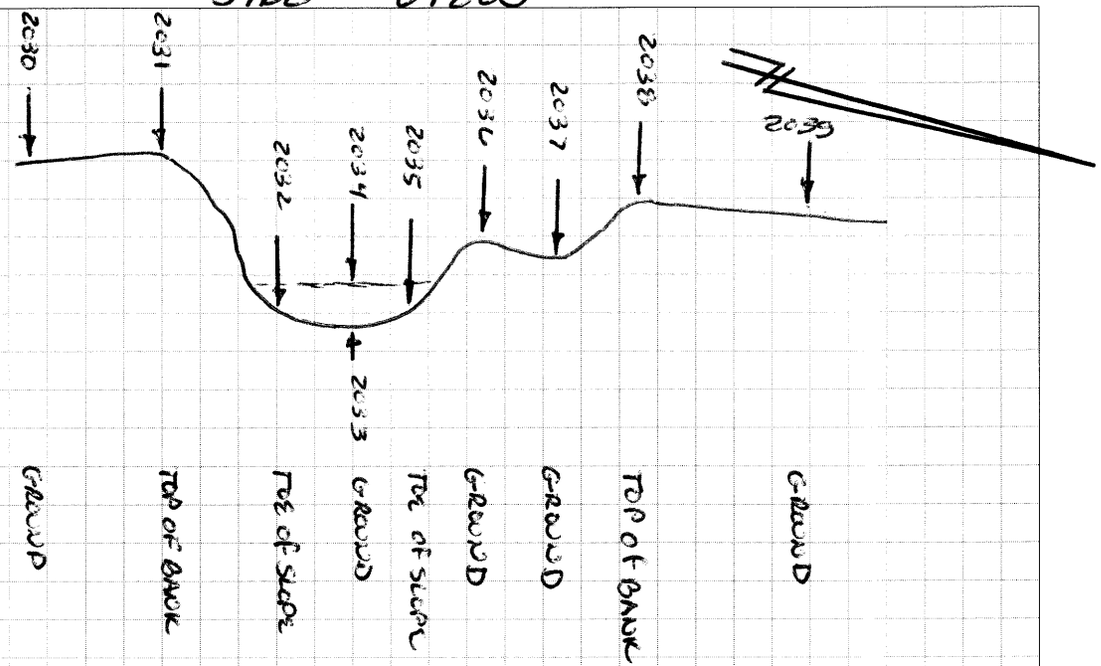
TOP VIEW



SIDE VIEW



TP	1004	HI 5.41'					
BS	1006	HI 5.57'	BSCK (2000)	HE 0.024	V = 0.014	CK OUT (2049)	H = 0.014 V = 0.025
FS	1008	HI 4.90'	FSCK (2001)	H = 0.118	V = 0.024		

NOTES: ① SHOT 2034 IS WATER ELEVATION

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 05 MAY 09

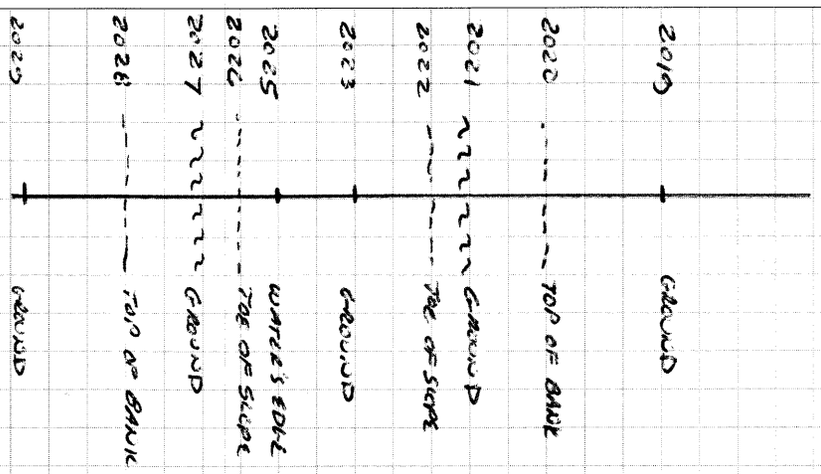
Team M. KLAERS A. BELL

Task Description HOWELL CREEK AT LAKE HOWELL LAND CREEK ASSESSMENT CROSS SECTION LINE "F"

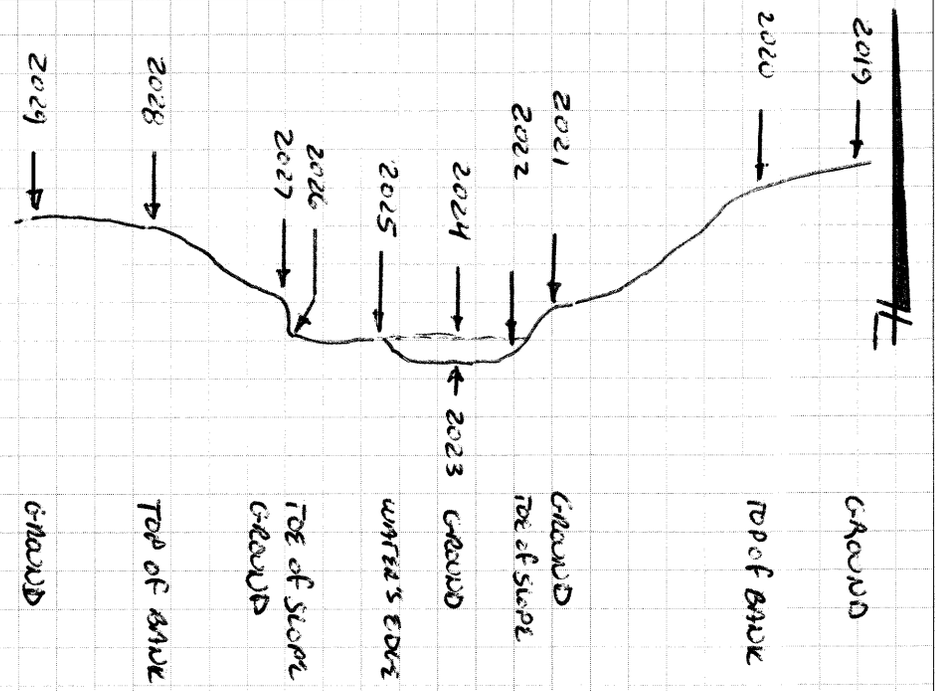
Page 9 of 20

Southeastern Surveying®

TOP VIEW



SIDE VIEW



T@ 1004 HI 5.41'

BS@ 1006 HI 5.57' BSCK (2000) H = 0.024 V = 0.014 CL OUT (2049) H = 0.014 V = 0.025

FS@ 1008 HI 4.90' FSCK (2001) H = 0.118 V = 0.024

NOTES:

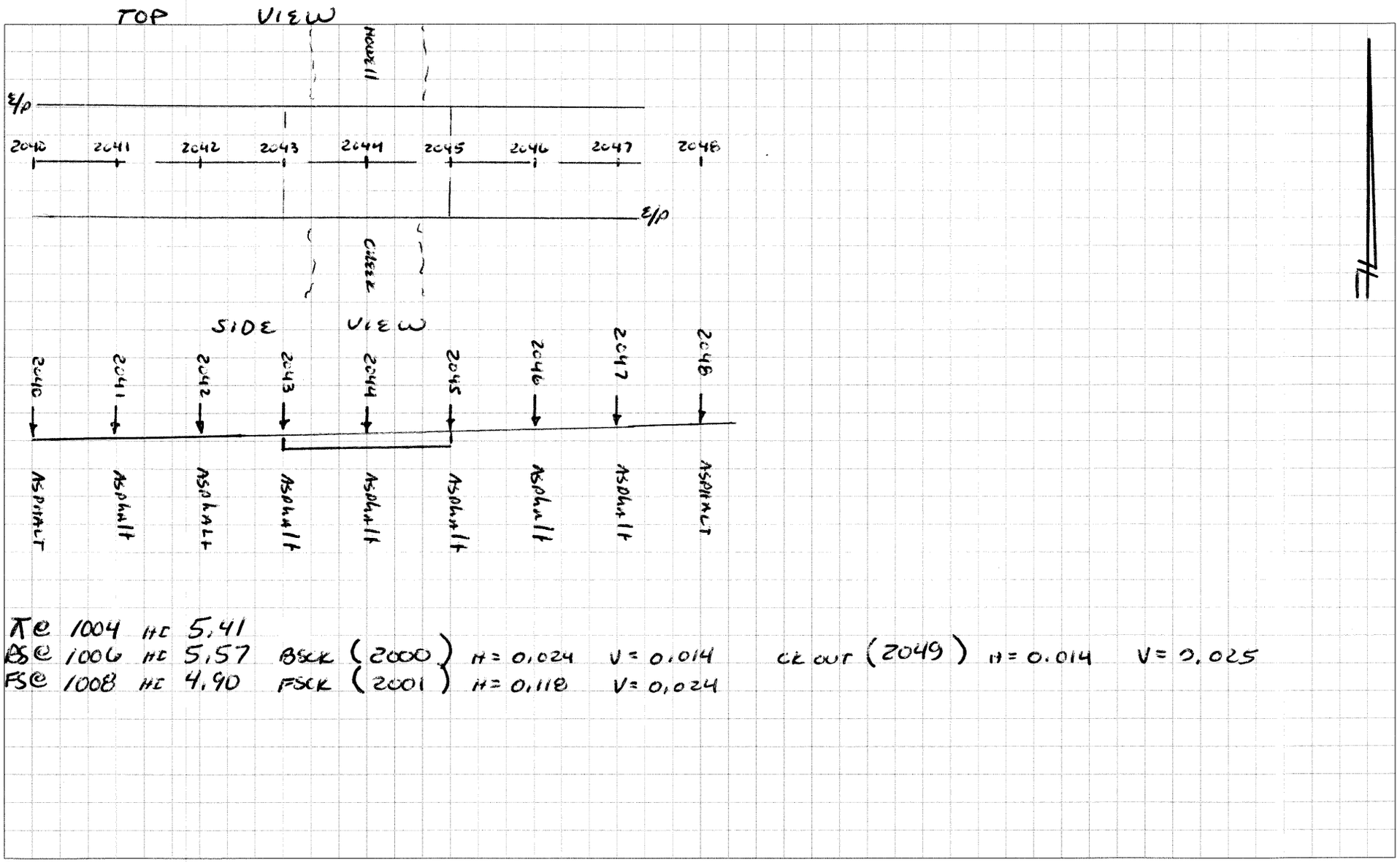
① SHOT 2024 IS A WATER ELEVATION

② SHOT 2018 IS WETLANDS JURISDICTION STA - 4 - ORANGE RIBBON TIED TO FOLIAGE

Rev. 1/08/02

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 05 MAY 09
M. KLAERS
Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK
ASSESSMENT LAKE HOWELL LANE BRIDGE CENTERLINE
Team A. BELL
Page 10 of 20

Southeastern Surveying®



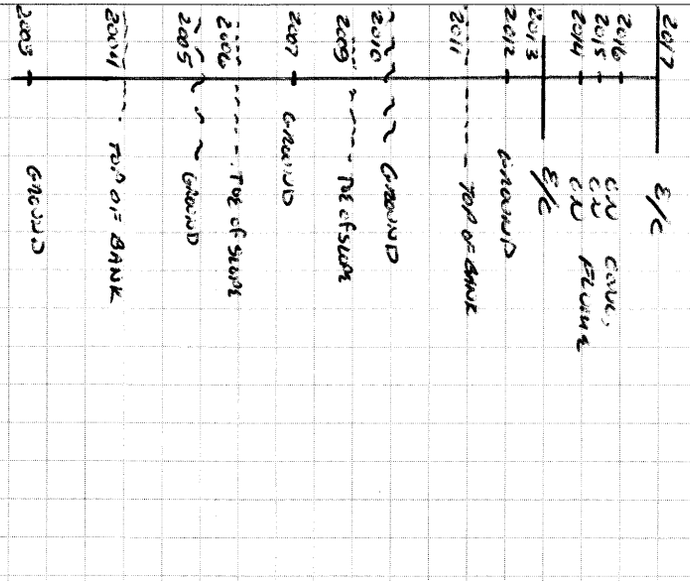
TE @ 1004 HI 5.41
BS @ 1006 HI 5.57 BSCK (2000) H = 0.024 V = 0.014 CK OUT (2049) H = 0.014 V = 0.025
FS @ 1008 HI 4.90 FSCK (2001) H = 0.118 V = 0.024

Rev. 1/08/02

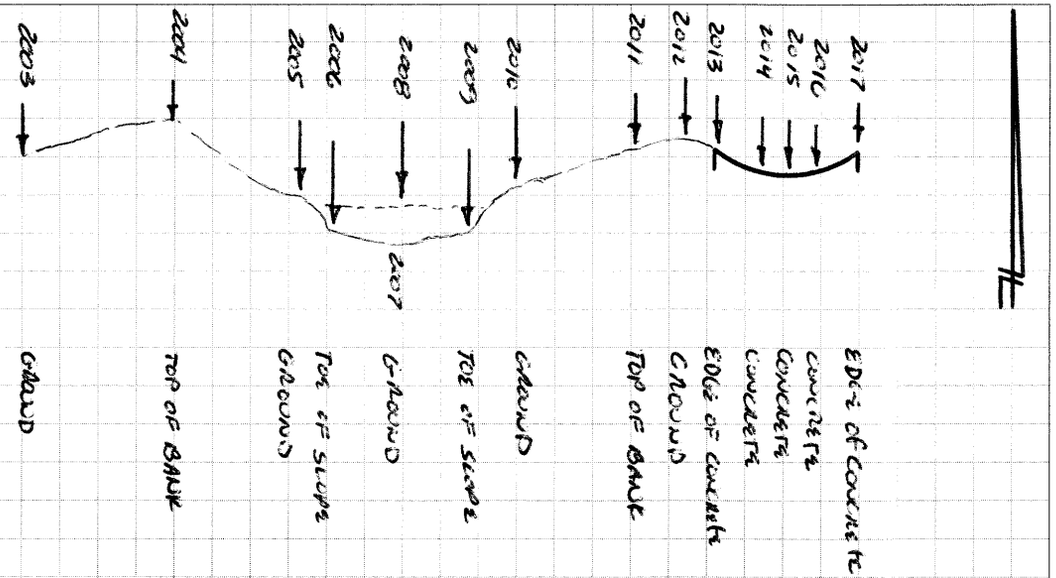
Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 05 MAY 09
M. KLAERS
Task Description HOWELL CREEK AT LAKE HOWELL LAKE CREEK
ASSESSMENT CROSS SECTION LINE "G" Team A. BELL
Page 11 of 20

Southeastern Surveying®

TOP VIEW



SIDE VIEW



TP 1004 HI 5.41
BS @ 1006 HI 5.57 BSCK (2000) H = 0.024 V = 0.014 CL OUT (2049) H = 0.014 V = 0.025
FS @ 1008 HI 4.90 FSCK (2001) H = 0.118 V = 0.024

NOTE: ① SHOT # 2002 is WETLANDS JURISDICTION STA - 5 - ORANGE RIBBON TIED ON FOLIAGE

② SHOT # 2008 is WATER ELEVATION

Job No. 541106 Work order No. 82054 Proj. Manager. TOM Date 06 MAY 09 M.LLAERS

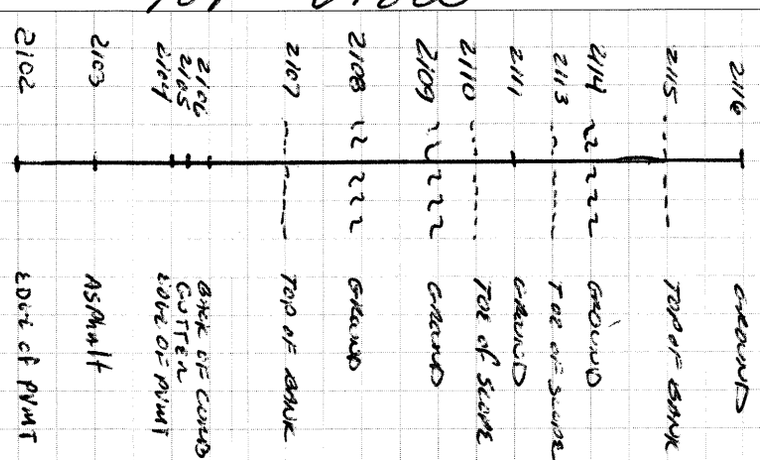
Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK ASSESSMENT CROSS SECTION LINE "H"

Team AISELL

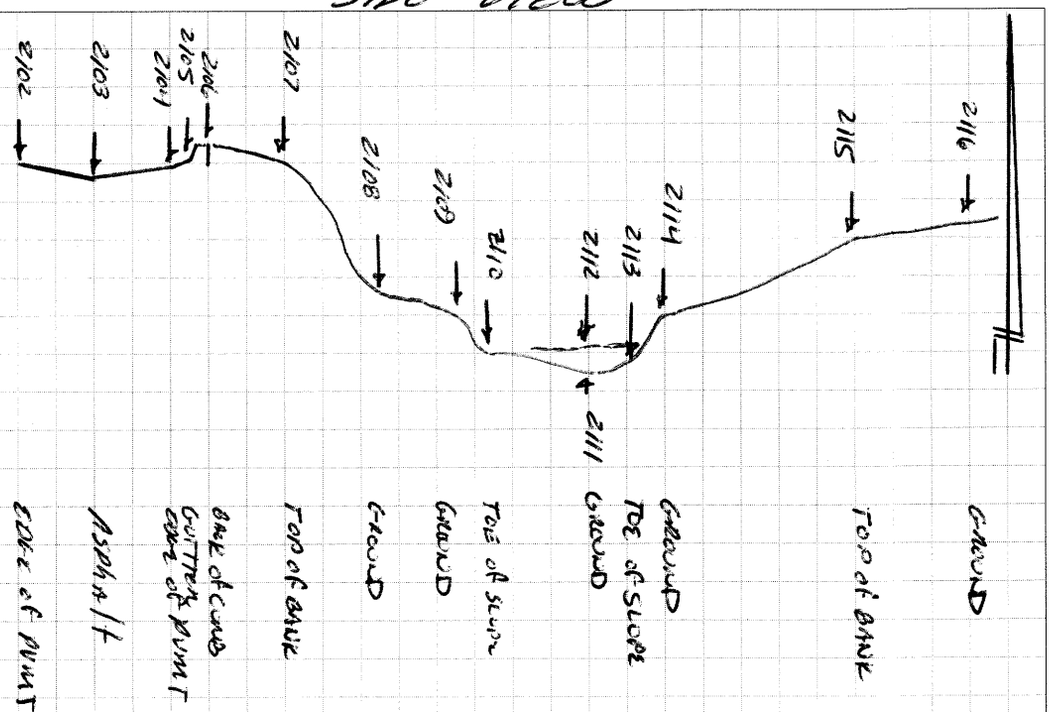
Page 12 of 20

Southeastern Surveying®

TOP VIEW



SIDE VIEW



TE @ 1010 HI 5.49

BSE @ 1014 HI 5.21 BSCK (2100) H = 0.021 V = 0.029

FSE @ 1012 HI 5.03 FSCK (2101) H = 0.043 V = 0.019

CK OUT (2146) H = 0.022 V = 0.023

NOTES:

① SHOT # 2112 IS WATER ELEVATION

② SHOT # 2117 IS WETLANDS JUSIDICTION STA-6 - FOUND ORANGE RIBBON TIED TO FOLIAGE

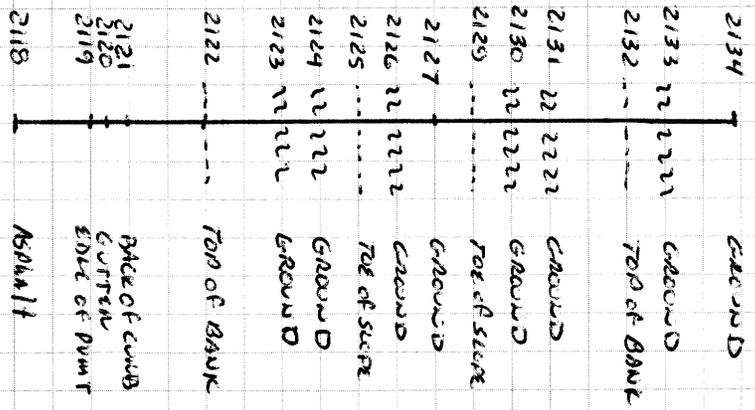
Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 06MAY09

M. KLEMENS

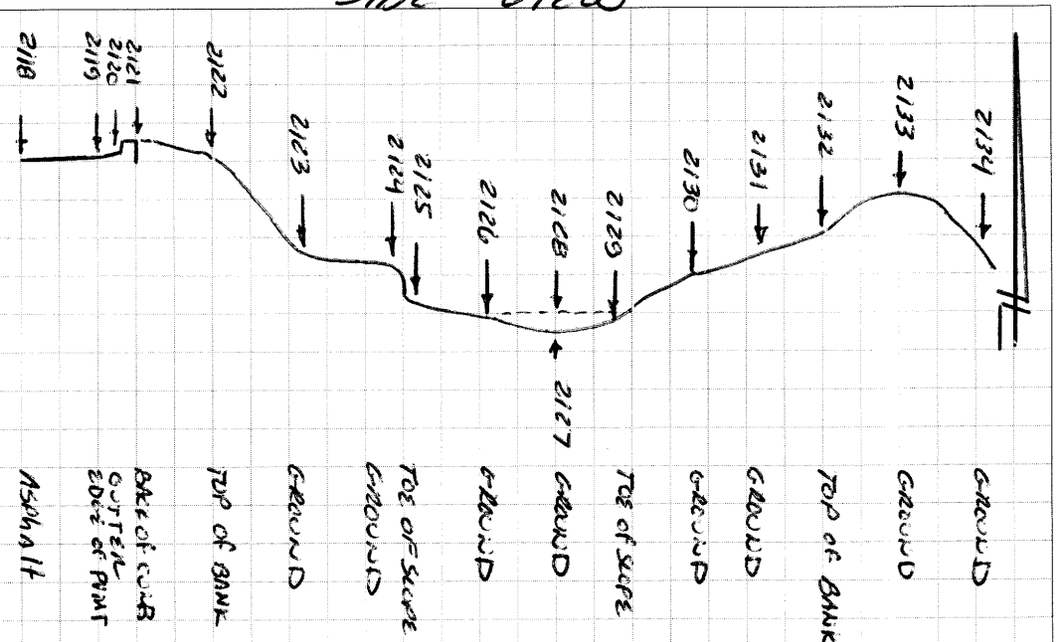
Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK ASSESSMENT CROSS SECTION LINE "E" Team M. BELL

Southeastern Surveying®

TOP VIEW



SIDE VIEW



TBE 1010 HI 5.49'
BSE 1014 HI 5.21' BSCK (2100) H = 0.021 V = 0.029
FSE 1012 HI 5.03' FSCK (2101) H = 0.043 V = 0.019

CL CUT (2146) H = 0.022 V = 0.023

NOTE:

① SHOT # 2128 IS WATER ELEVATION

② SHOT # 2135 IS WETLANDS JURISDICTION STA - 7 - FOUND ORANGE RIBBON TIED TO FOLIAGE

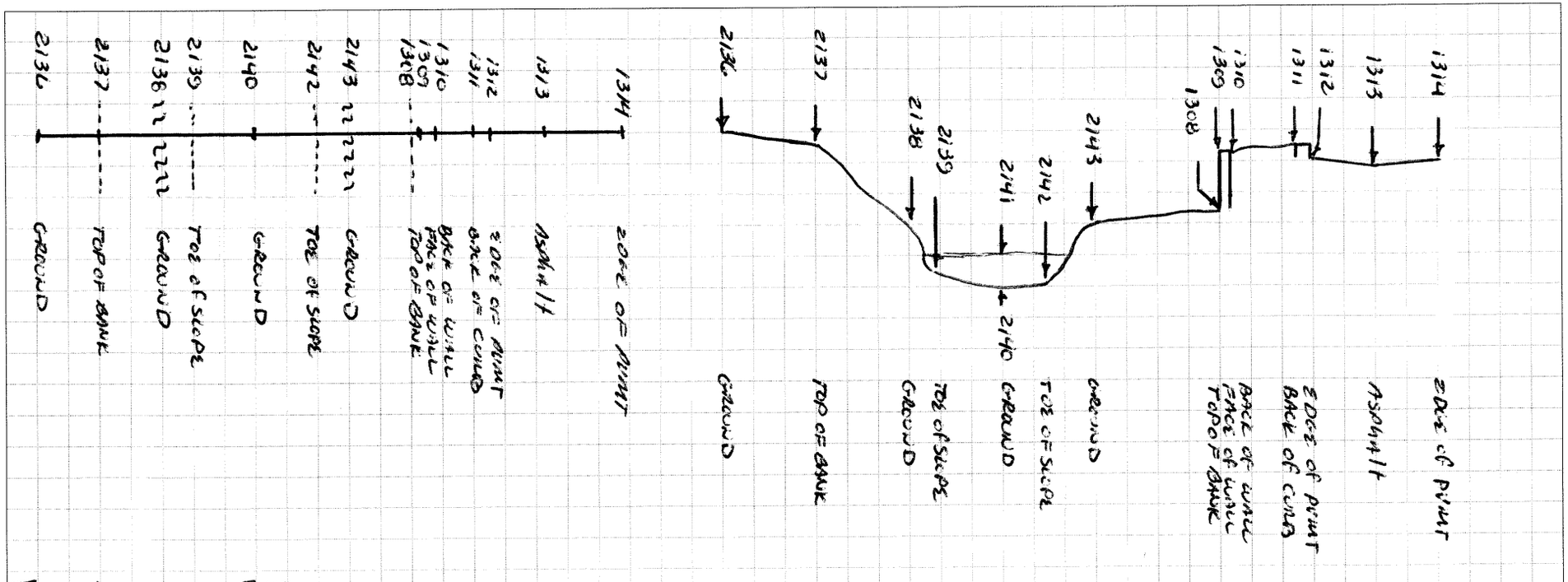
Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 26 MAY 09 M. KLINGERS

Task Description HOWELL CREEK AT LAKE HOWELL LAND CREEK ASSESSMENT CROSS SECTION LINE "J"

Team A. BELL

Page 14 of 20

Southeastern Surveying®



TP 1010 HI 5.49
BS@ 1014 HI 5.21 BSCK (2100) H = 0.021 V = 0.029 CK OUT (2146) H = 0.022 V = 0.023
FS@ 1012 HI 5.03 FSCK (2101) H = 0.043 V = 0.019

NOTES:

① SHOT # 2141 is WATER ELEVATION

② SHOT # 2144 is WETLANDS JURISDICTION STA - 8 - FOUND ORANGE RIBBON TIED TO FOLIAGE

③ SHOT # 2145 is WETLANDS JURISDICTION STA - 9 - FOUND ORANGE RIBBON TIED TO BRUSH PYLON

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 07 MAY 09

Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK ASSESSMENT SR436 BRIDGE TOP VIEW

M. KLAERS
Team A. BELL

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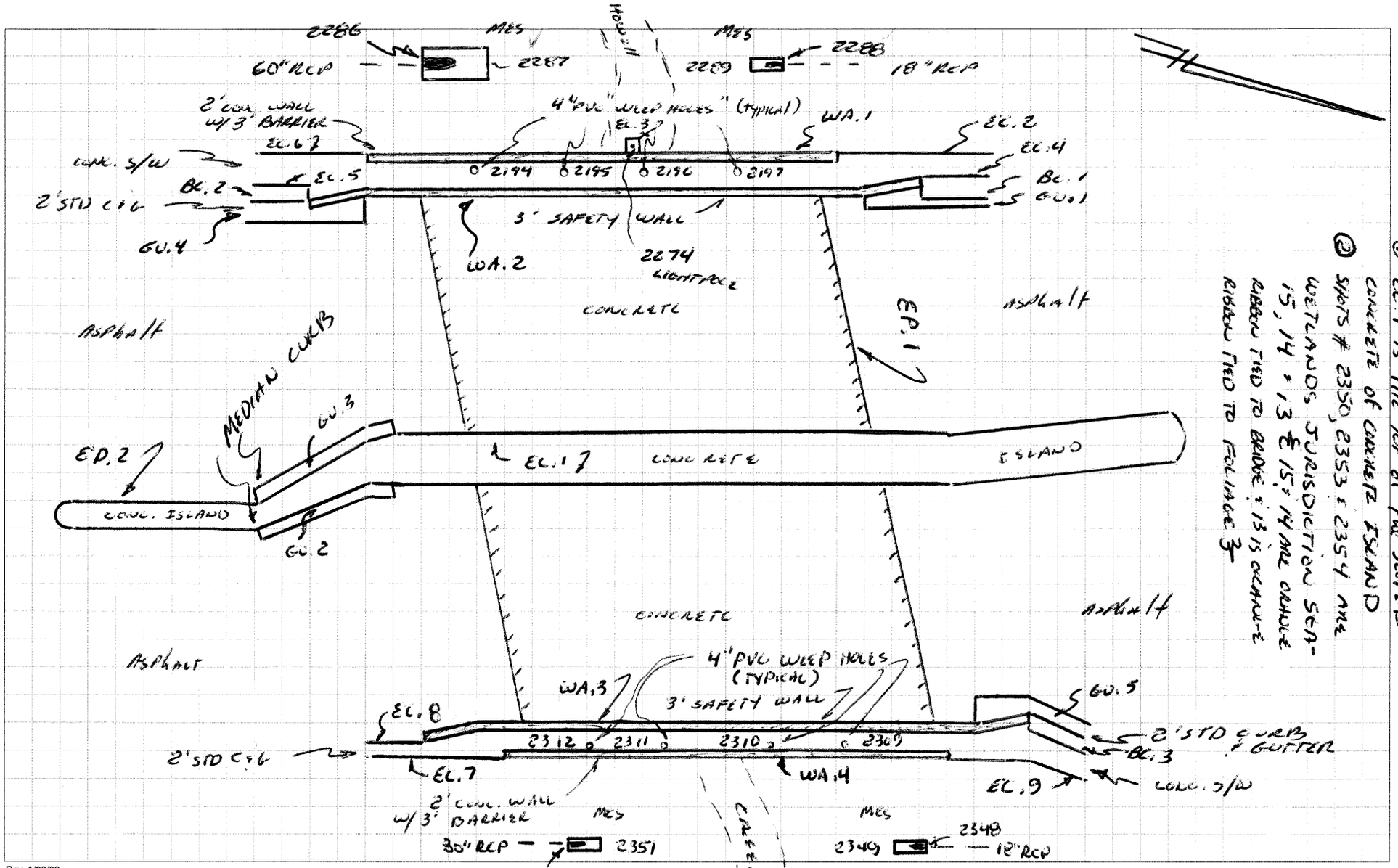
Southeastern Surveying



NOTES:

1. EL. 1 IS THE TOP OF THE SLOPED CONCRETE OF CONCRETE ISLAND
2. SHOTS # 2350, 2353 & 2354 ARE WETLANDS JURISDICTION SEAMS, 14 & 13 & 15, 14 ARE CHANGE RIBBON TIED TO BRIDGE & 13 IS CHANGE RIBBON TIED TO FOLIAGE

Rev. 1/08/02

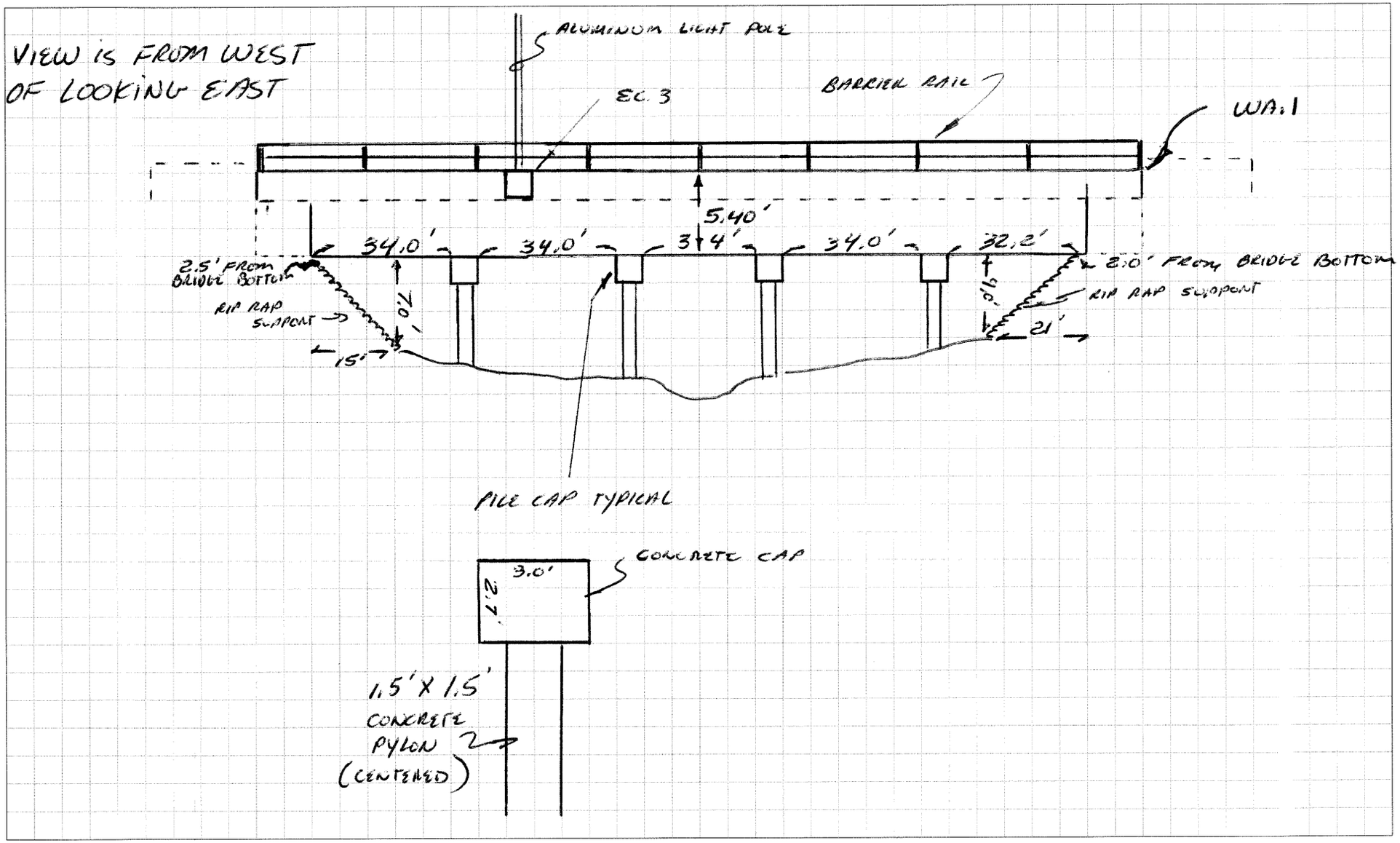
Job No. 541106 Work order No. 82054 Proj. Manager. TOM Date 07 MAY 09

Task Description HOWELL CREEK AT LAKE HOWELL LANE CREEK ASSESSMENT WEST SIDE SR 436 BRIDGE

Team M. KLUTENE A. BELL

Page 16 of 20

Southeastern Surveying®



Job No. 54106 Work order No. 820541 Proj. Manager. TOM

Task Description HOWELL CREEK AT LAKE HOWELL/LAKE CREEK ASSESSMENT EAST SIDE SR 436 BRIDGE

Date 07 MAY 09

Team M. RIVERS A. BELL

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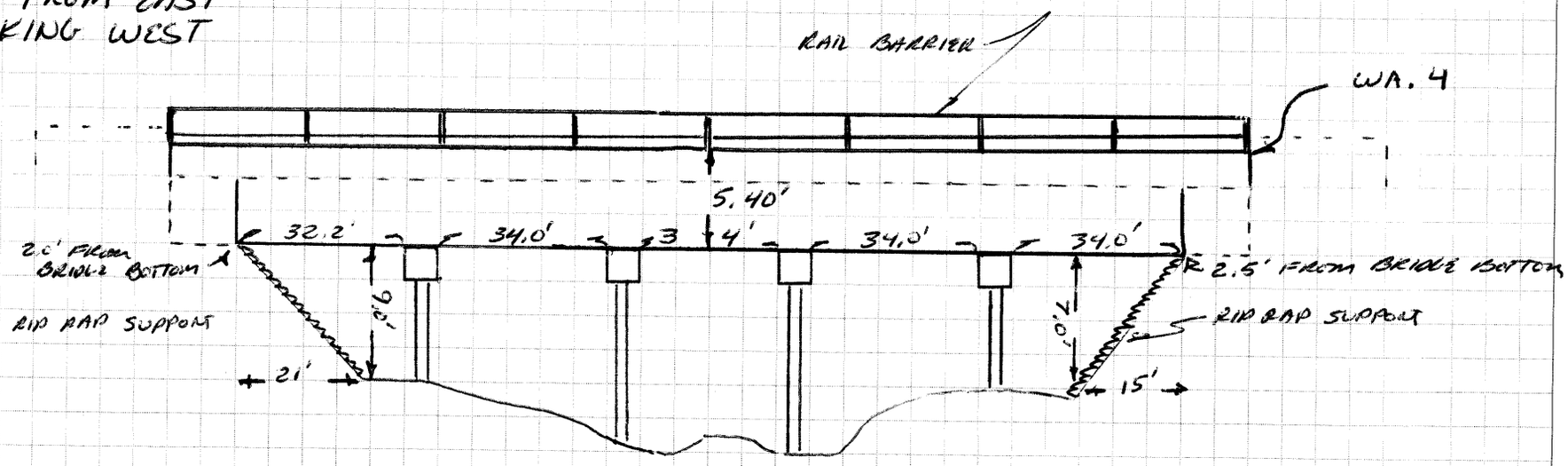
Southeastern Surveying

VIEW IS FROM EAST OF LOOKING WEST



Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 07MAY08

Task Description Howell Creek at Lake Howell Lane Creek Assessment
Pile Caps & Pylon Overall SR 436 Bridge

Team M.KLAENS A.BELL

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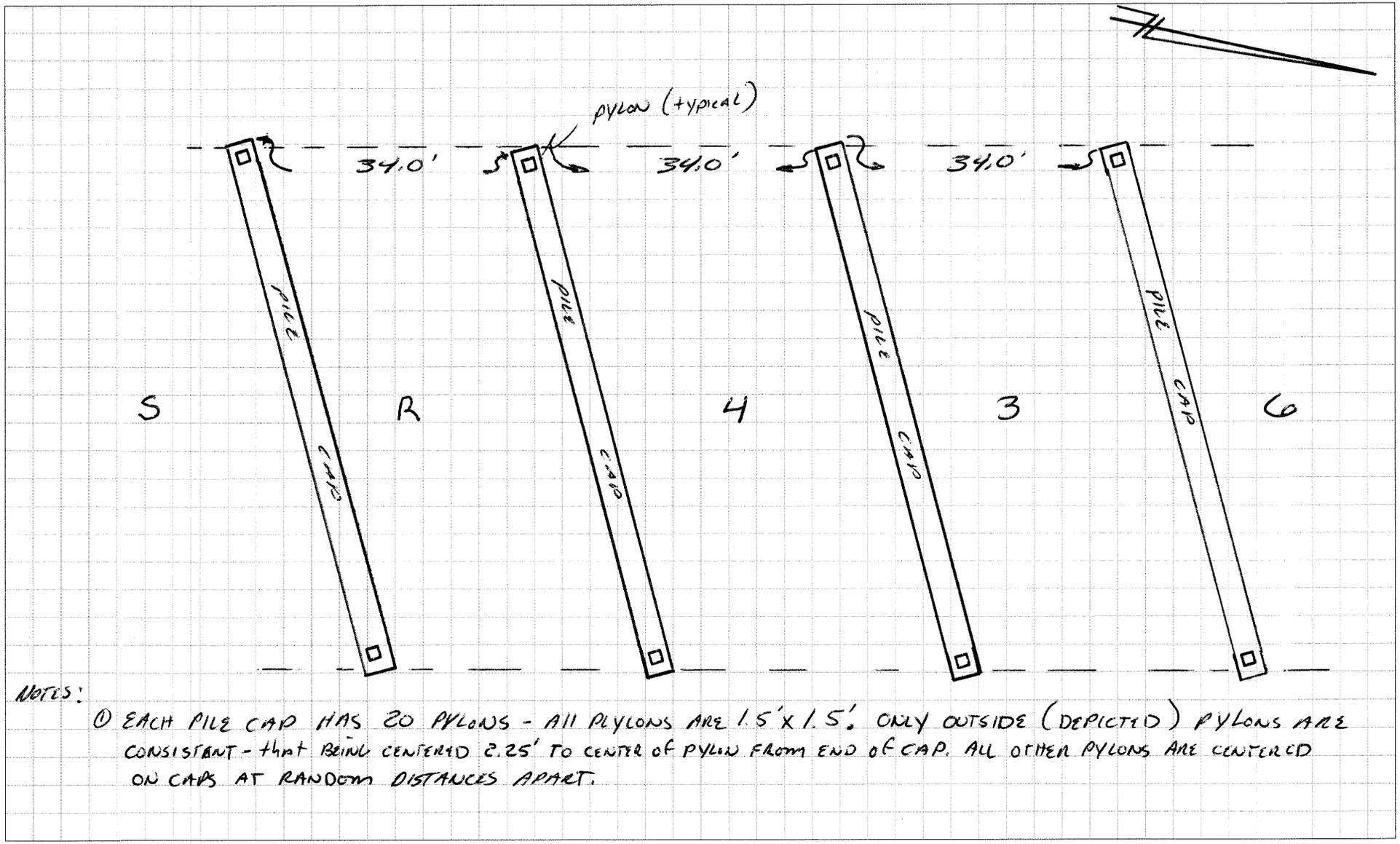
Southeastern Surveying



NOTES:

① EACH PILE CAP HAS 20 PYLONS - ALL PYLONS ARE 1.5'X1.5'. ONLY OUTSIDE (DEPICTED) PYLONS ARE CONSISTENT - that BEING CENTERED 2.25' TO CENTER OF PYLON FROM END OF CAP. ALL OTHER PYLONS ARE CENTERED ON CAPS AT RANDOM DISTANCES APART.

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 07 MAY 09 M. KLINGERS

Task Description HOWELL CREEK AT LAKE HOWELL LAND CREEK ASSESSMENT SET UP SHEET SR 436 BRIDGE

Team A. BELL

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Southeastern Surveying®

AT @ 1018 HI 5.40
BS @ 1020 HI 5.40 BSCK (2147) H = 0.029 V = 0.013 CKOUT (2356) H = 0.030 V = 0.019
FS @ N/A - TREE ONLINE UNABLE TO SIGHT

LINNEAR FEATURES

CODES	NUMBER
EP	(1)(2)
BC	(1)(2)(3)
GU	(1)(2)(3)(4)(5)
EC	(1)(2)(3)(4)(5)(6)(7)(8)(9)
WA	(1)(2)(3)(4)

Photographs:

① JOB NAME, JOB NUMBER & WORK ORDER NUMBER

② WEST LOOKING EAST AT CREEK CROSSING

③ SOUTH LOOKING NORTH ON WEST SIDE

④ FROM WEST SIDE LOOKING WEST

⑤ FROM EAST SIDE LOOKING EAST

⑥ NORTH LOOKING SOUTH ON EAST SIDE

⑦ EAST LOOKING WEST ON EAST SIDE

Job No. 54106 Work order No. 82054 Proj. Manager. TOM Date 07 MAY 09

Task Description Howell Creek at Lake Howell Lane Creek Assessment
Dilapidated Water Control Structure

Team M. KLAERS A. BELL

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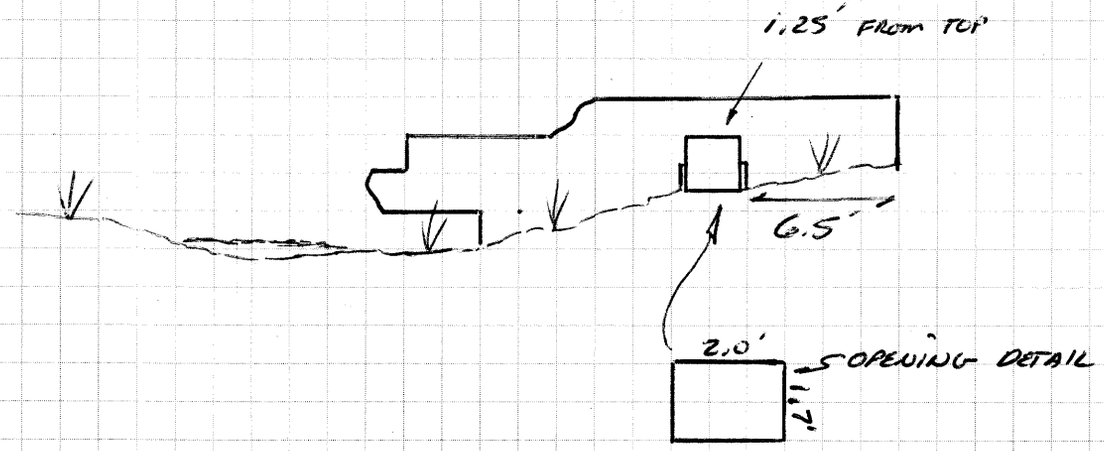
Southeastern Surveying

VIEW FROM UPSTREAM



TOP VIEW

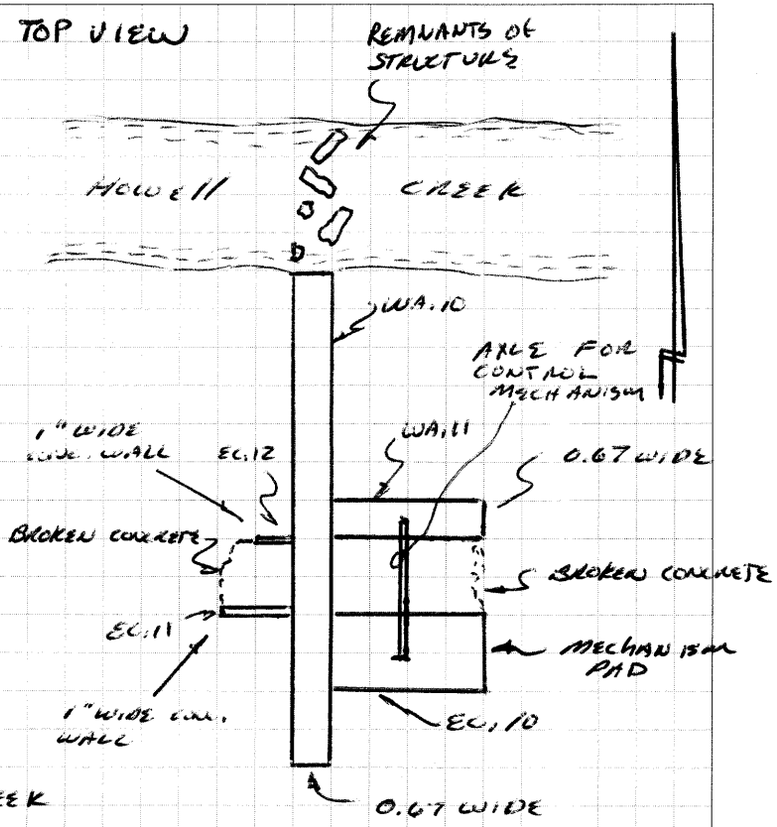


Photo GRAPHS
- (8) FROM UPSTREAM LOOKING AT STRUCTURE
- (9) VIEW FROM SOUTH SHOWING MECHANISM PAD
- (10) FROM DOWNSTREAM LOOKING AT STRUCTURE
- (11) VIEW FROM NORTH SHOWING COLLAPSED DEBRIS IN CREEK
- (12) JOB NAME, JOB NUMBER & WORK ORDER NUMBER

TP 1004 HI 5.19
BS 1008 HI 5.08 BSCK (2361) H= 0.031 V= 0.038 CK OUT (2396) H= 0.035 V= 0.021
FS 1006 HI 4.90 FSCK (2362) H= 0.039 V= N/A

Rev. 1/08/02

Howell Creek X-SECTIONS
East & West of 436 Bridge

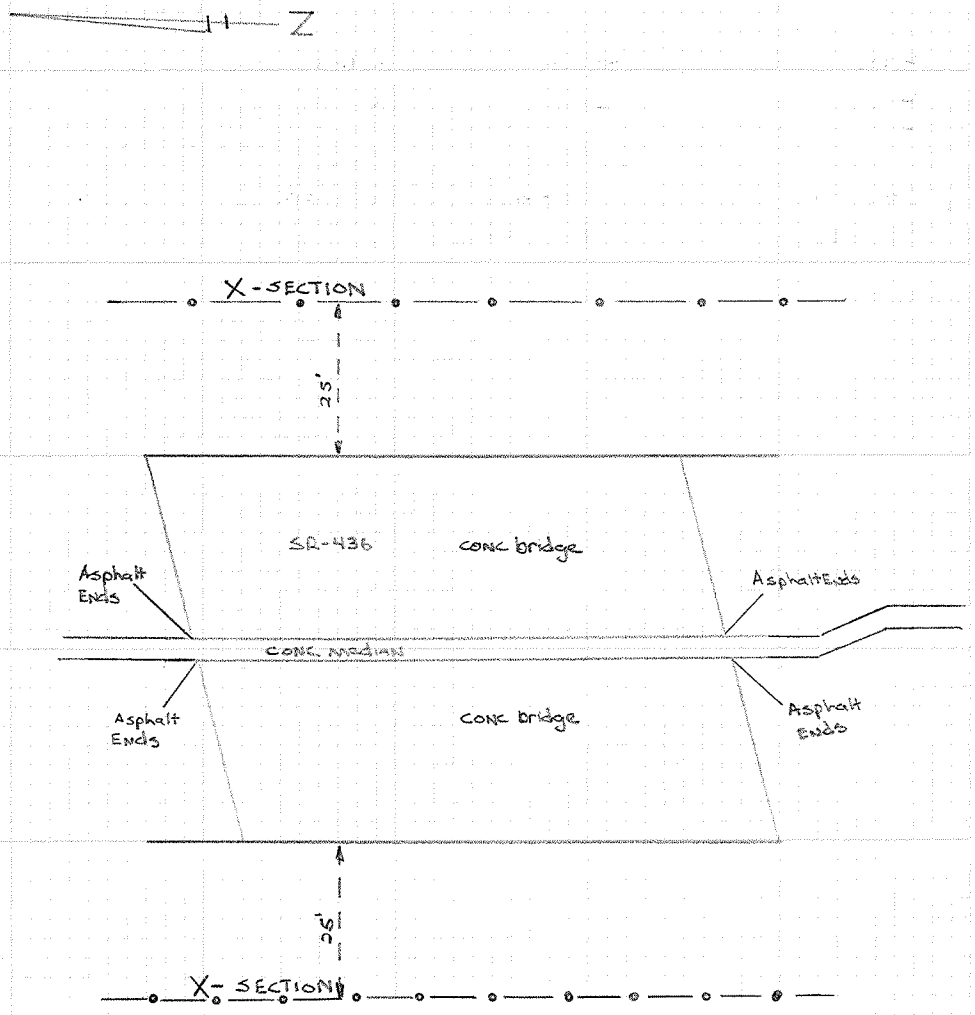
5-6-09
GB-SP

BS 1020 FS 1016
HI 5.14 HI 5.08

HD= 0.044 DHT= 0.024
HD= 0.162 DHT= 0.070

TOPO X-SECTIONS

HD=0.049 DHT= 0.026



Howell Creek x-sections — 5-6-09

Walmart Plaza between 436 Bridge & Walmart Bridge North — GB-SP

BS 1012 — FS 1014

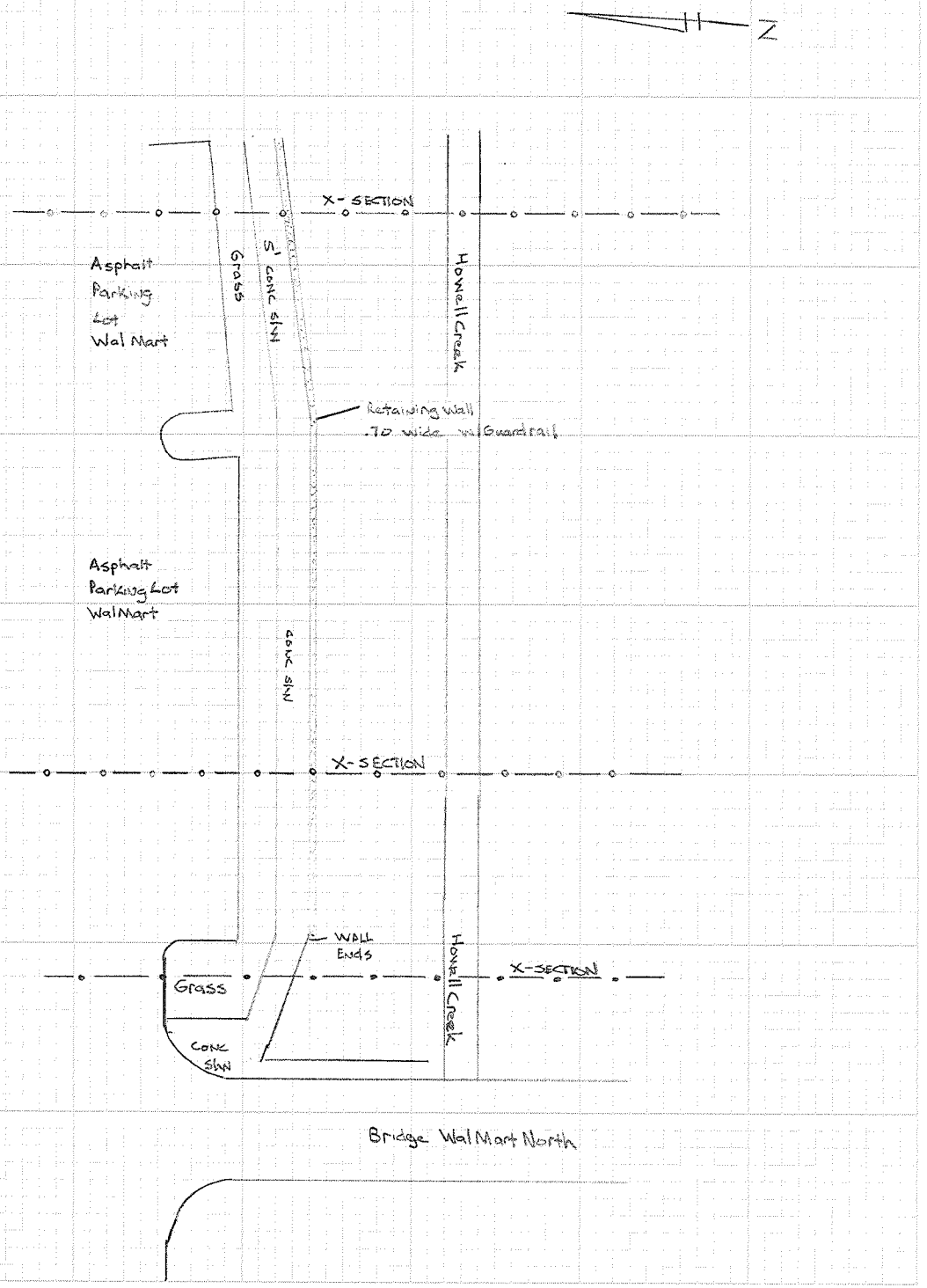
HI 5.03 — HI 5.21

HD: 0.012 — DHT: 0.073

HD: 0.041 — DHT: 0.017

TOPO X-SECTIONS

HD: 0.025 — DHT: 0.161



Howell Creek X-sections 5-6-09

Wal Mart Plaza between Bridges North & South GB-SP

BS 1016 FS 1012

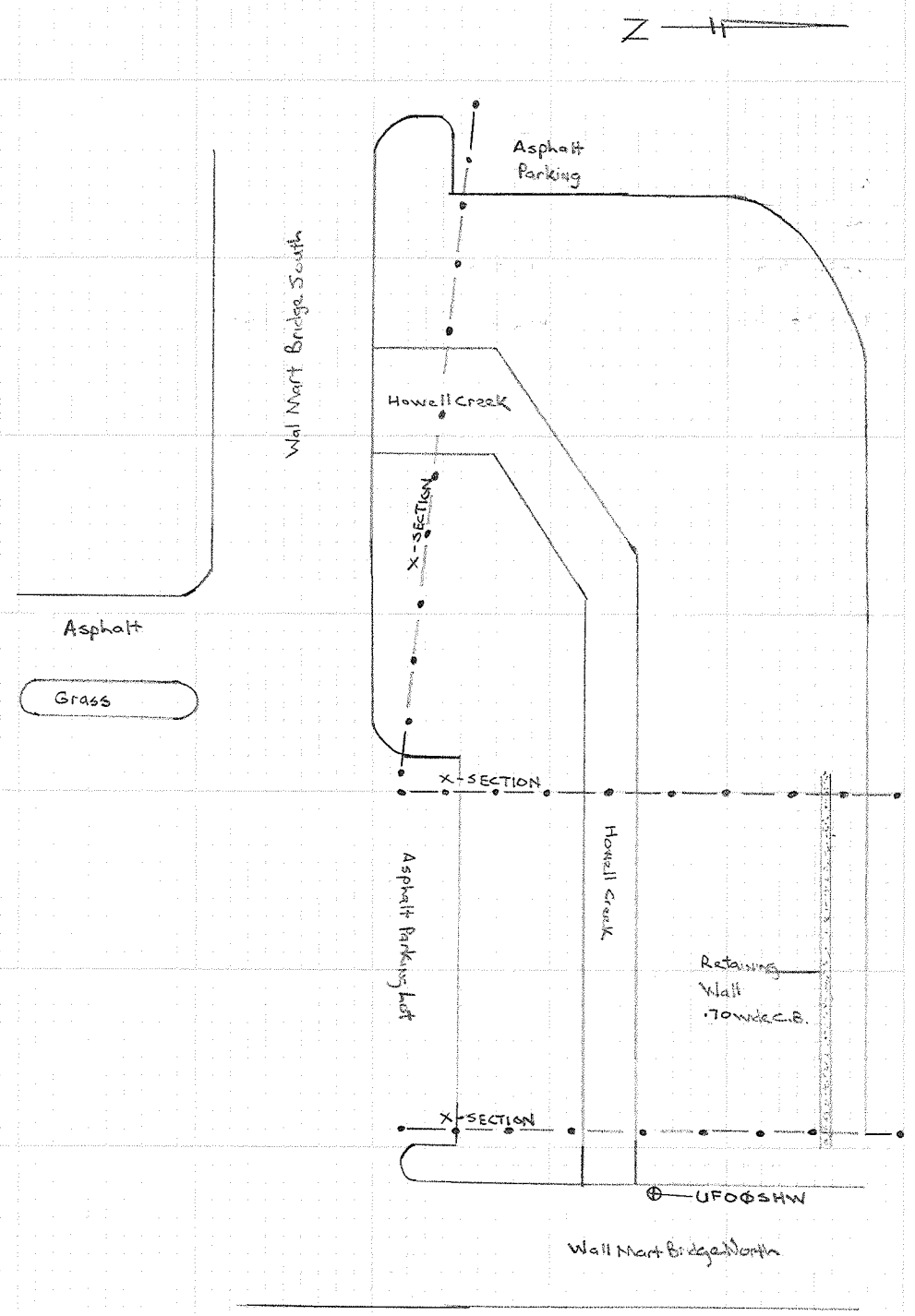
HI 5.35 HI 5.03

HD: 0.004 DHT: 0.034

HD: 0.043 DHT: 0.013

X-SECTION HOWELL CREEK

HD: 0.006 DHT: 0.031



Howell Creek
OUTFALL LOCATION
Lake Howell Layout Howell Creek

5-7-09
GB-SF-JW

BS 1008
HI 5.18

HD= 0.11
HD= 0.085

LOCATION

HD= .10

BS 1004
HI 5.02

HD= 0.024
MES 24" RCP
HD= 0.029

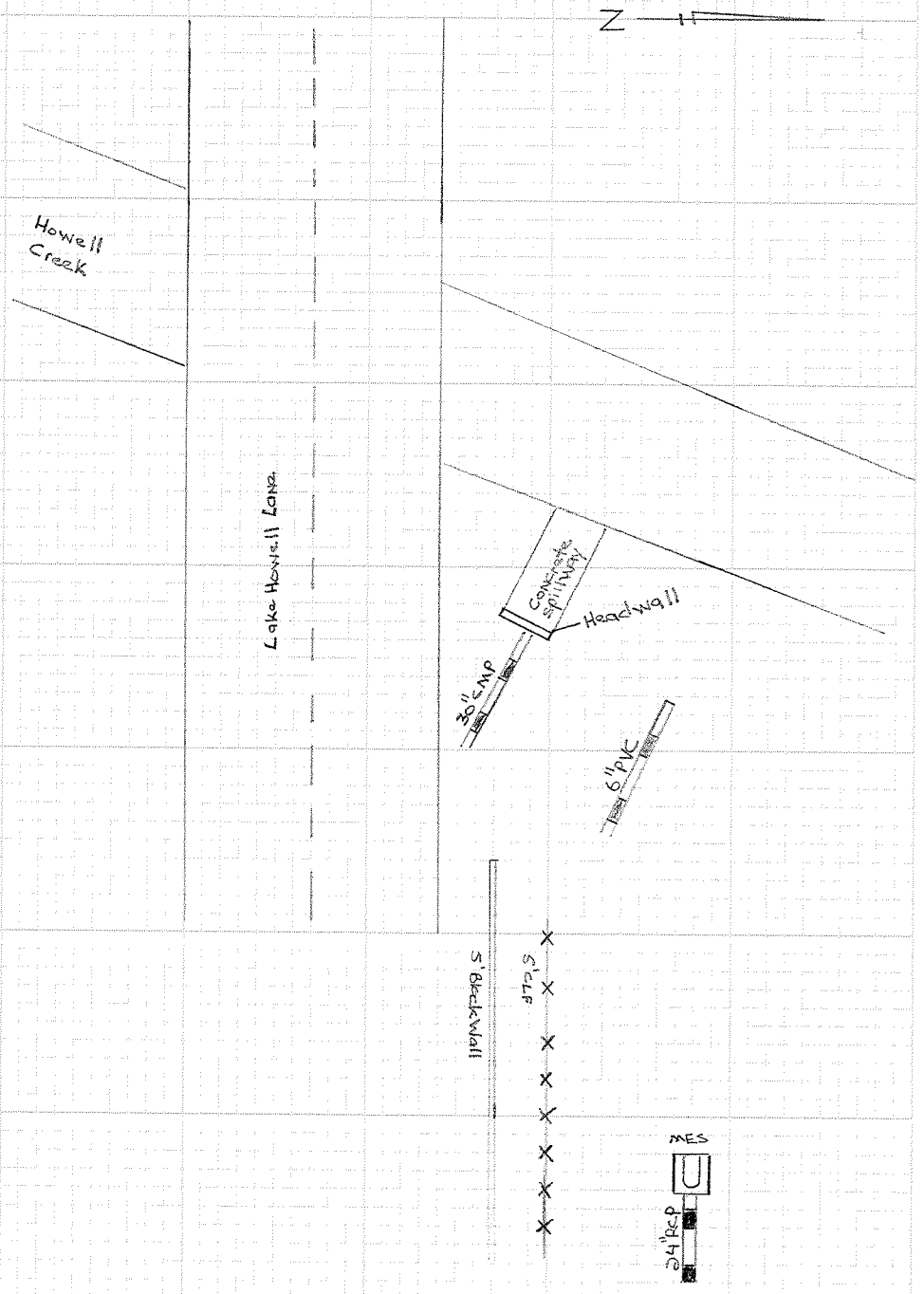
BS 1006
HI 5.08

DHT= 0.016
Horizontal Check Only

DHT= 0.028

DHT= 0.015

DHT= 0.015



Howell Creek
Outfall Location

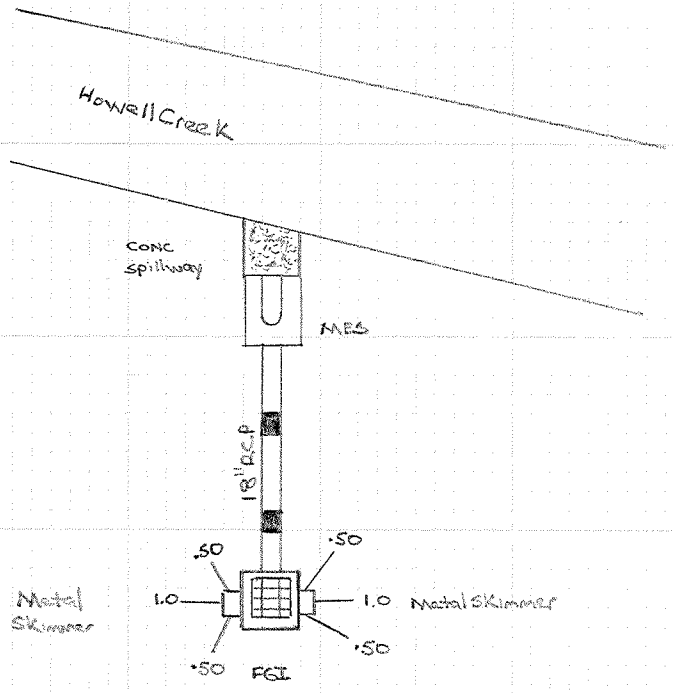
5-7-09
GB-SP-TW

BS 1014 | FS 1012
HI 5.25 | HI 5.08
HD=0.030 | DHT=0.044
HD=0.033 | DHT=0.027
Location of outfall

HD=0.030 | DHT=0.053

100-199

N



12" cutout on both sides
2.5 to top weir
3.5 to inv of 12" cutout
Typical both sides

-4.25 INV to 18" RCP

Howell Creek
Outfall Location

5-7-09
GB-SP-JW

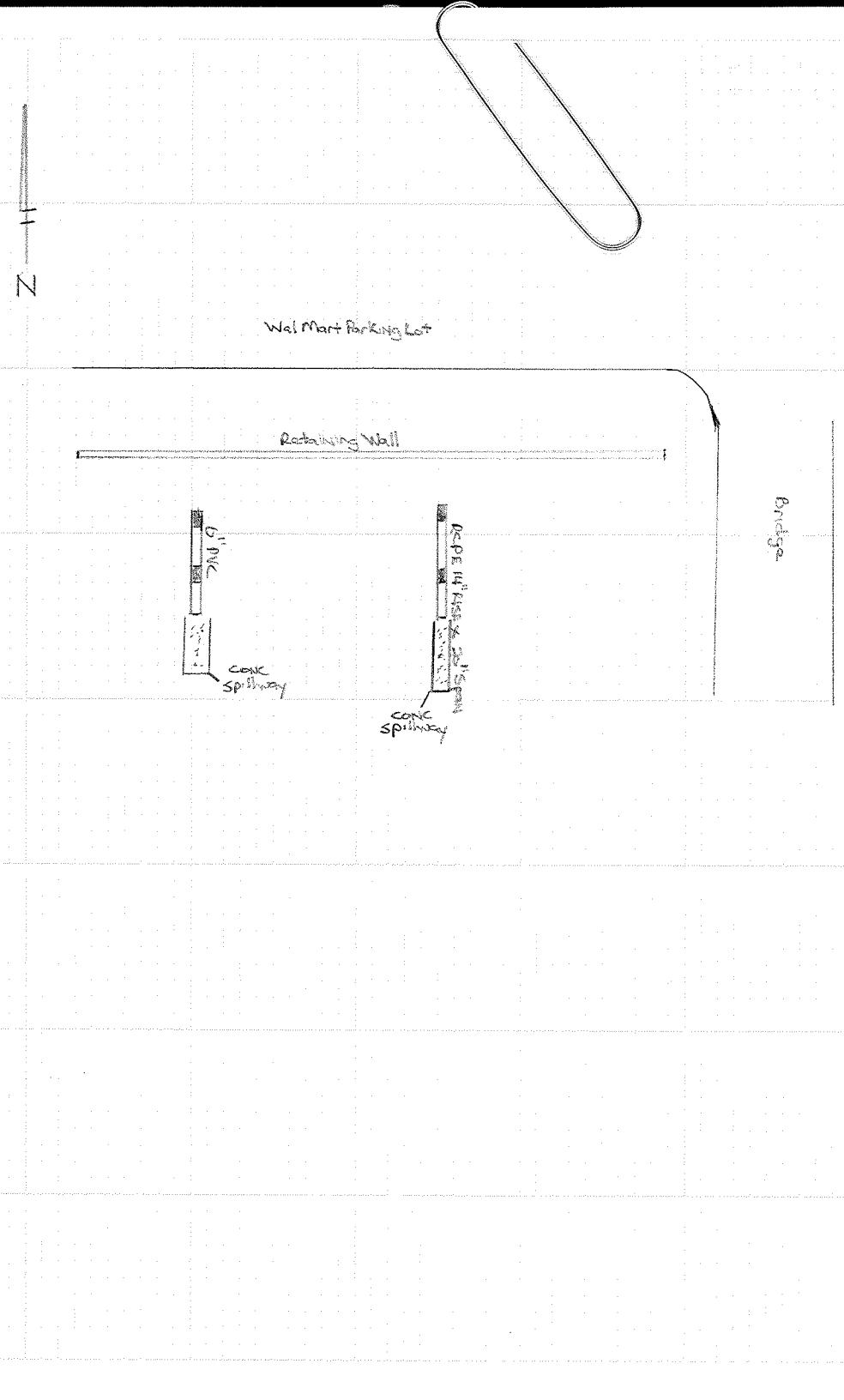
BS 10:10 | FS 10:13
HI 5.15 | HI 5.08

HD= 0.033 | DHT= 0.163
HD= 0.043 | DHT= 0.110

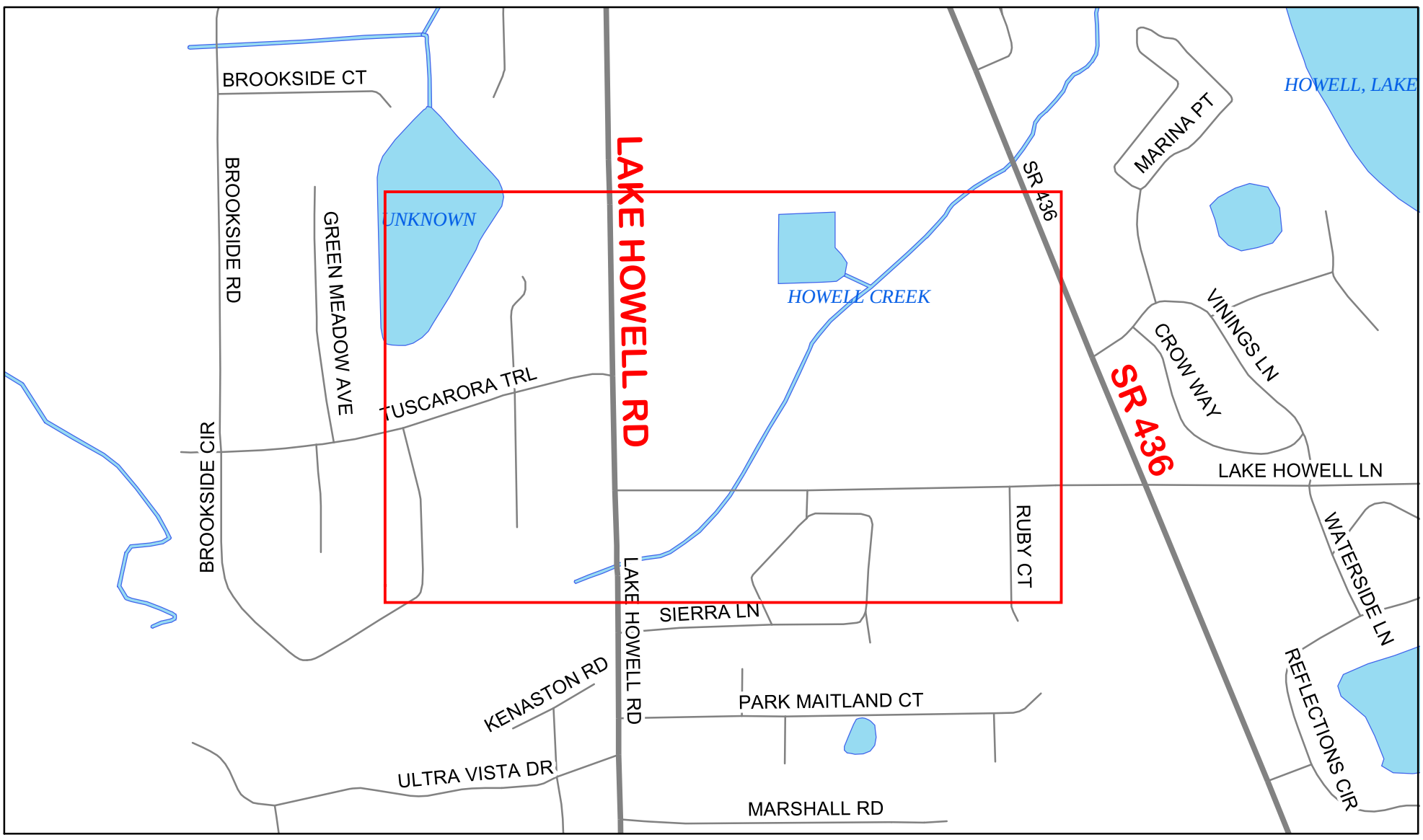
Location of outfall

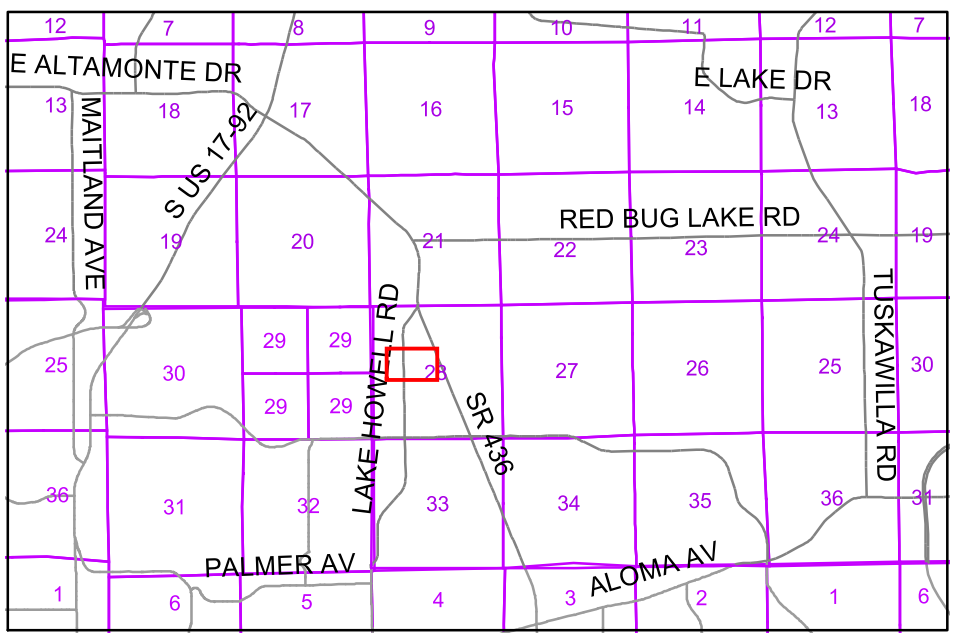
HD= 0.033 | DHT= 0.189

00-203



SOUTHEASTERN SURVEYING
DATA COLLECTED FOR
2007 CDM
HOWELL CREEK BASIN STUDY

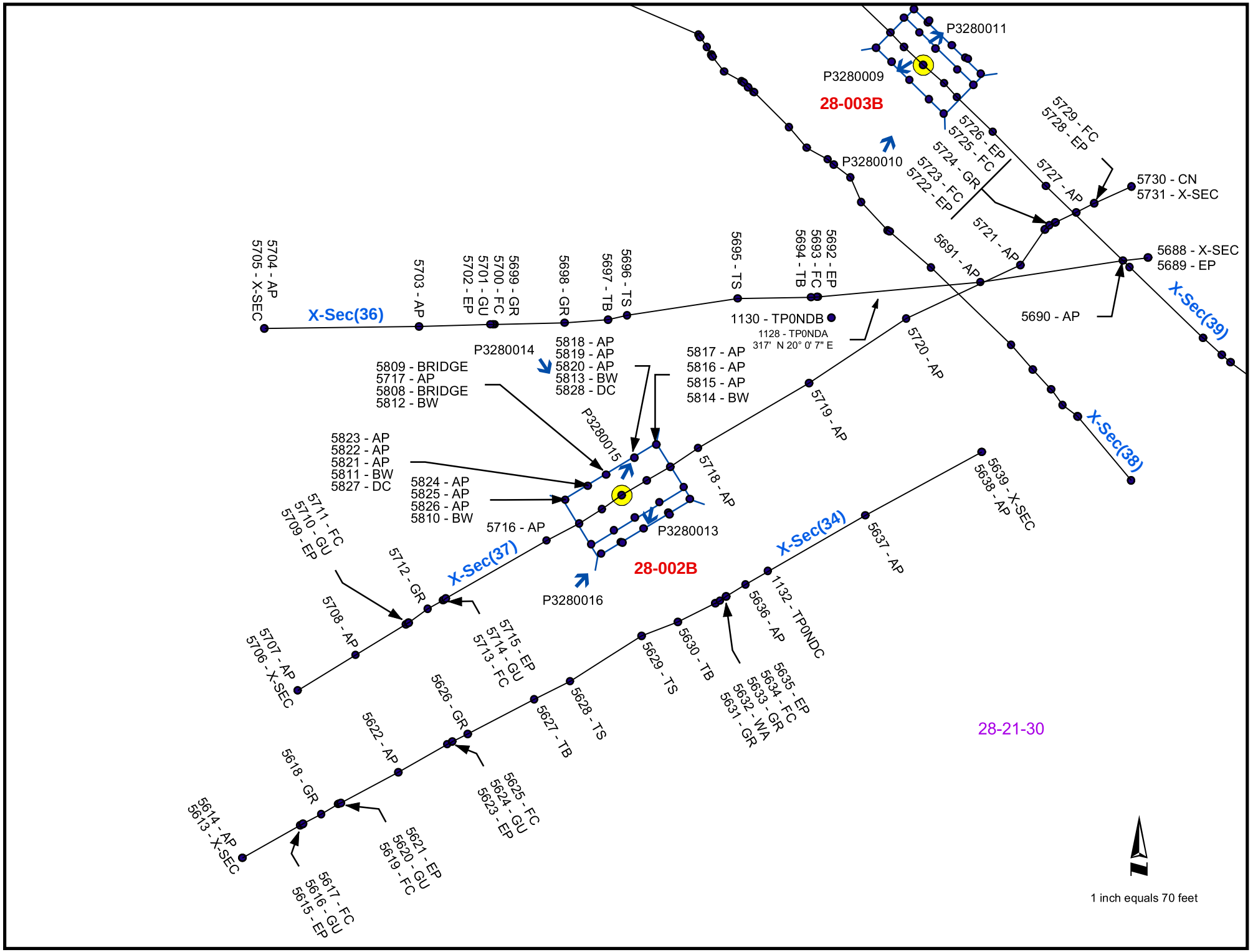




Howell Creek Study Recon Map
Seminole County / 28-21-30 2 of 2

NOTES:

28-002CS Broad Crested Weir
28-003B
28-002B


P3280011
P3280009
28-003B
P3280010
5729 - FC
5728 - EP
5726 - EP
5725 - FC
5724 - GR
5723 - FC
5722 - EP
5727 - AP
5730 - CN
5731 - X-SEC
5721 - AP
5691 - AP
5688 - X-SEC
5689 - EP
X-Sec(39)
5690 - AP
5704 - AP
5705 - X-SEC
X-Sec(36)
5703 - AP
5702 - EP
5701 - GU
5700 - FC
5699 - GR
5698 - GR
5697 - TB
5696 - TS
5695 - TS
5694 - TB
5693 - FC
5692 - EP
1130 - TP0NDB
1128 - TP0NDA
317° N 20° 0' 7" E
P3280014
5818 - AP
5819 - AP
5820 - AP
5813 - BW
5828 - DC
5817 - AP
5816 - AP
5815 - AP
5814 - BW
5809 - BRIDGE
5717 - AP
5808 - BRIDGE
5812 - BW
5720 - AP
5719 - AP
P3280015
X-Sec(38)
5823 - AP
5822 - AP
5821 - AP
5811 - BW
5827 - DC
5824 - AP
5825 - AP
5826 - AP
5810 - BW
5718 - AP
5711 - FC
5710 - GU
5709 - EP
5716 - AP
P3280013
5639 - X-SEC
5638 - AP
X-Sec(37)
X-Sec(34)
5637 - AP
5712 - GR
28-002B
P3280016
1132 - TP0NDC
5636 - AP
5708 - AP
5715 - EP
5714 - GU
5713 - FC
5630 - TB
5629 - TS
5635 - EP
5634 - FC
5633 - GR
5632 - WA
5631 - GR
5707 - AP
5706 - X-SEC
5626 - GR
5628 - TS
5627 - TB
5622 - AP
5618 - GR
5625 - FC
5624 - GU
5623 - EP
5614 - AP
5613 - X-SEC
5621 - EP
5620 - GU
5619 - FC
5617 - FC
5616 - GU
5615 - EP
28-21-30
1 inch equals 70 feet

Bridge_ID	28-002B
Bridge_Width_ft	125
Low_Chord_Elev_ft	67.039
Upstream_Invert_ft	55.282
Downstream_Invert_ft	55.542
Street_Crossing	Wal-Mart Plaza
Min_Crown_Elev_ft	68.253
S_T_R	28,-21,30
Jurisdiction	CAS

PID	*Northing*	*Easting*	*Elevation*	*Code*	*Datafile*
1128	1563596.99	553050.48	67.61	TP0NDA	52162JG
1130	1563298.76	552941.92	70.34	TP0NDB	52162JG
1132	1563150.55	552904.90	69.70	TP0NDC	52162JG
5808	1563181.73	552826.93	68.77	BRIDGE	52162JH
5809	1563206.59	552810.09	68.73	BRIDGE	52162JH
5810	1563160.42	552807.23	69.14	BW	52162JH
5811	1563167.15	552818.84	69.45	BW	52162JH
5812	1563175.14	552832.13	69.56	BW	52162JH
5813	1563184.46	552846.44	70.09	BW	52162JH
5814	1563192.41	552859.22	70.38	BW	52162JH
5815	1563199.35	552855.53	69.53	AP	52162JH
5816	1563211.35	552847.79	69.45	AP	52162JH
5817	1563224.38	552839.50	69.48	AP	52162JH
5818	1563216.68	552826.71	69.24	AP	52162JH
5819	1563203.35	552833.92	69.09	AP	52162JH
5820	1563190.62	552841.45	69.13	AP	52162JH
5821	1563174.30	552814.70	68.47	AP	52162JH
5822	1563186.53	552807.73	68.49	AP	52162JH
5823	1563200.14	552799.44	68.54	AP	52162JH
5824	1563191.90	552786.20	68.31	AP	52162JH
5825	1563178.16	552794.33	68.25	AP	52162JH
5826	1563166.17	552801.49	68.19	AP	52162JH
5827	1563166.92	552819.60	67.20	DC	52162JH
5828	1563183.26	552847.22	67.81	DC	52162JH

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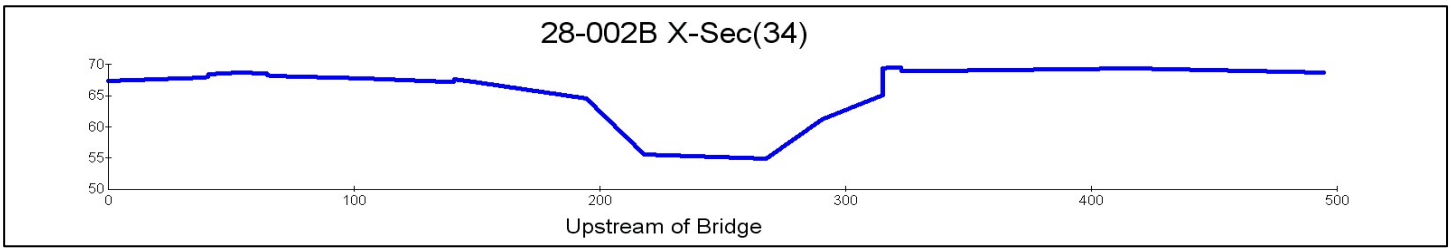
STR:	28,-21,30
Datafile:	52162JH



PID	*Northing*	*Easting*	*Elevation*	*Code*	*Station*
5613	1562982.40	552597.12	67.35	X-SEC	0+00
5614	1562982.38	552597.09	67.35	AP	0+00
5615	1563001.52	552631.08	67.96	EP	0+39.00
5616	1563002.24	552632.37	68.05	GU	0+40.00
5617	1563002.41	552632.71	68.44	FC	0+41.00
5618	1563008.05	552643.29	68.66	GR	0+53.00
5619	1563013.86	552653.25	68.62	FC	0+64.00
5620	1563014.01	552653.57	68.26	GU	0+65.00
5621	1563014.59	552654.83	68.21	EP	0+66.00
5622	1563032.44	552688.35	67.74	AP	1+04.00
5623	1563048.81	552717.15	67.29	EP	1+37.00
5624	1563050.18	552719.85	67.28	GU	1+40.00
5625	1563050.41	552720.29	67.65	FC	1+41.00
5626	1563054.99	552729.04	67.07	GR	1+51.00
5627	1563075.33	552768.00	64.54	TB	1+95.00
5628	1563085.75	552788.97	55.59	TS	2+18.00
5629	1563112.40	552830.83	54.98	TS	2+67.00
5630	1563120.61	552852.07	61.26	TB	2+90.00
5631	1563131.51	552874.01	65.12	GR	3+14.00
5632	1563131.39	552874.06	69.38	WA	3+14.00
5633	1563132.89	552876.97	69.52	GR	3+18.00
5634	1563135.45	552880.24	69.53	FC	3+22.00
5635	1563135.55	552880.46	69.04	EP	3+22.00
5636	1563142.53	552891.87	68.94	AP	3+35.00
5637	1563182.84	552961.81	69.40	AP	4+16.00
5638	1563220.01	553030.01	68.65	AP	4+94.00
5639	1563220.00	553030.03	68.65	X-SEC	4+94.00

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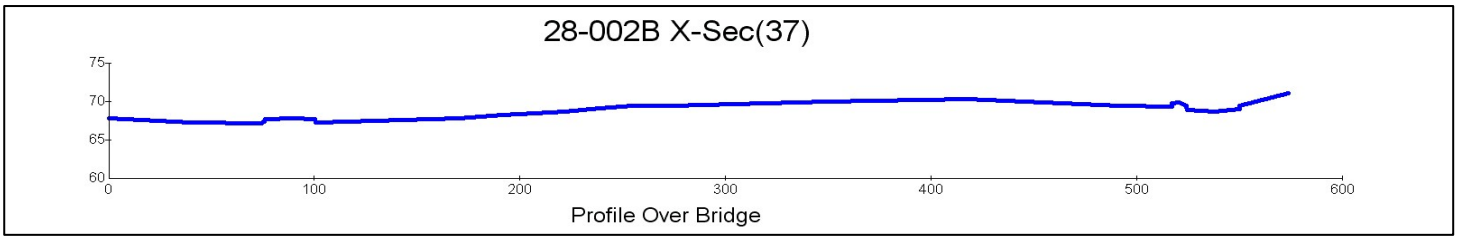

PID	*Northing*	*Easting*	*Elevation*	*Code*	*Station*
5706	1563080.35	552629.65	67.77	X-SEC	0+00
5707	1563080.35	552629.61	67.78	AP	0+00
5708	1563101.14	552663.47	67.26	AP	0+40.00
5709	1563119.03	552692.88	67.19	EP	0+74.00
5710	1563120.01	552694.18	67.32	GU	0+76.00
5711	1563120.17	552694.40	67.70	FC	0+76.00
5712	1563128.21	552705.71	67.78	GR	0+90.00
5713	1563133.19	552714.61	67.72	FC	1+00.00
5714	1563133.46	552715.03	67.30	GU	1+01.00
5715	1563134.27	552716.15	67.28	EP	1+02.00
5716	1563168.23	552775.38	67.82	AP	1+70.00
5717	1563194.69	552819.21	68.71	AP	2+21.00
5718	1563222.23	552864.11	69.43	AP	2+74.00
5719	1563260.49	552928.97	69.93	AP	3+49.00
5720	1563298.20	552985.86	70.24	AP	4+18.00
5721	1563329.63	553052.70	69.39	AP	4+91.00
5722	1563350.41	553066.98	69.29	EP	5+14.00
5723	1563350.56	553067.10	69.77	FC	5+14.00
5724	1563352.77	553069.80	69.87	GR	5+18.00
5725	1563354.35	553072.96	69.41	FC	5+21.00
5726	1563354.48	553073.12	68.92	EP	5+21.00
5727	1563360.23	553085.39	68.67	AP	5+35.00
5728	1563365.69	553095.94	68.98	EP	5+47.00
5729	1563365.72	553096.16	69.45	FC	5+47.00
5730	1563375.46	553117.85	71.10	CN	5+70.00
5731	1563375.48	553117.82	71.10	X-SEC	5+70.00

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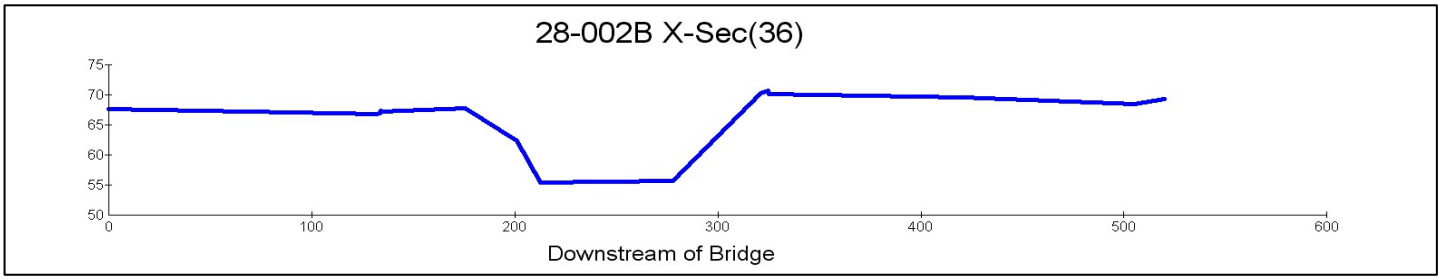
Datafile:	52162JH



PID	*Northing*	*Easting*	*Elevation*	*Code*	*Station*
5705	1563292.33	552610.16	67.71	X-SEC	0+00
5704	1563292.33	552610.10	67.71	AP	0+00
5703	1563293.58	552700.60	67.11	AP	0+90.00
5702	1563294.75	552742.29	66.91	EP	1+32.00
5701	1563294.73	552743.72	67.00	GU	1+34.00
5700	1563294.76	552744.02	67.38	FC	1+34.00
5699	1563294.82	552744.95	67.26	GR	1+35.00
5698	1563295.68	552785.90	67.78	GR	1+76.00
5697	1563297.50	552811.22	62.35	TB	2+01.00
5696	1563300.04	552822.49	55.41	TS	2+12.00
5695	1563309.86	552887.07	55.69	TS	2+77.00
5694	1563310.50	552930.13	70.34	TB	3+20.00
5693	1563310.95	552933.71	70.72	FC	3+24.00
5692	1563310.83	552933.96	70.25	EP	3+24.00
5691	1563319.54	553029.30	69.65	AP	4+20.00
5690	1563332.20	553112.64	68.54	AP	5+04.00
5689	1563333.84	553127.43	69.30	EP	5+19.00
5688	1563333.83	553127.42	69.30	X-SEC	5+19.00

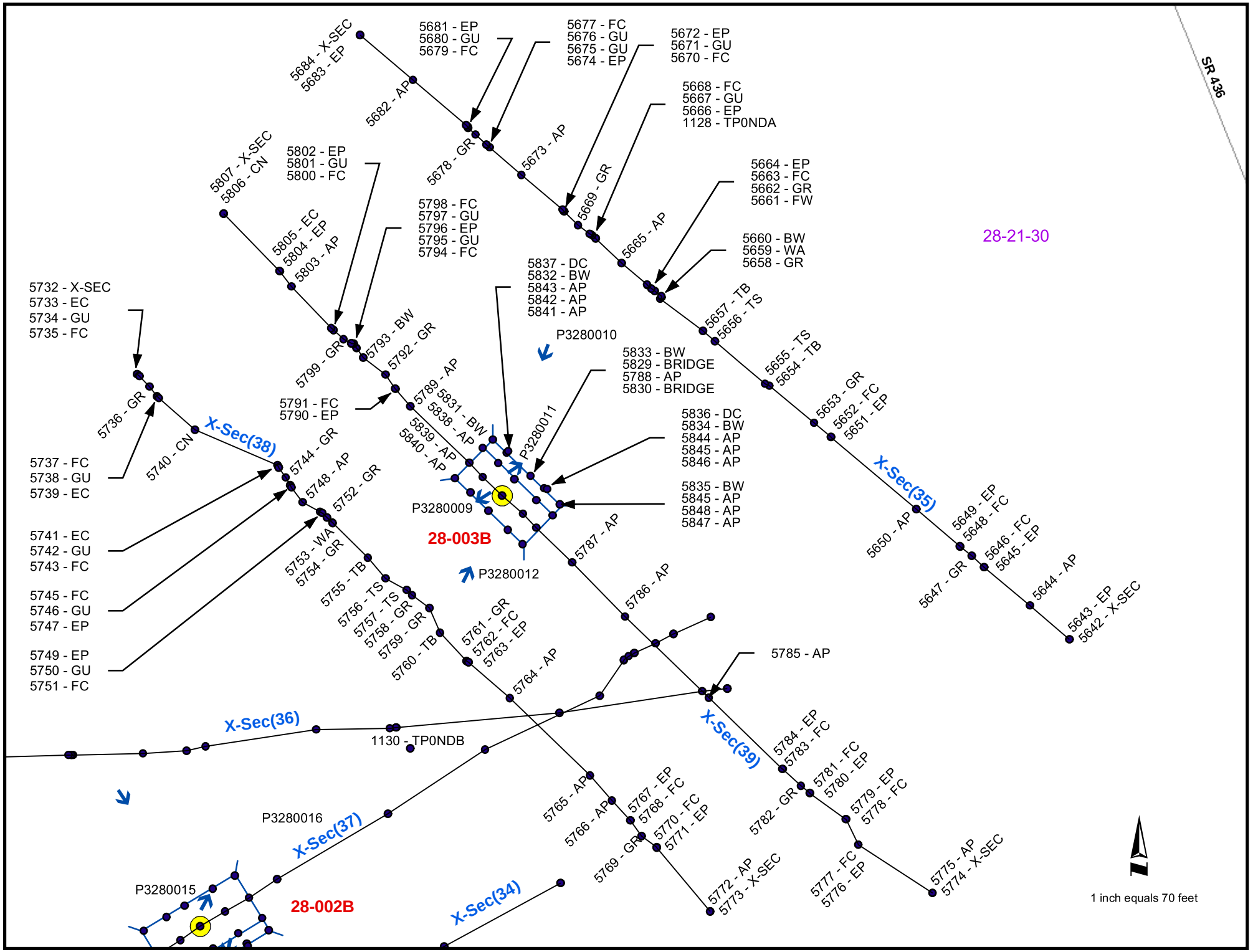
P3280016.jpg— Upstream of 28-002B
Looking downstream

P3280013.jpg— On the deck of 28-002B
Looking upstream

P3280015.jpg— On the deck of 28-002B
Looking downstream

P3280014.jpg— Downstream of 28-002B
Looking upstream

North
TYP
64.00
Asphalt
30.15'
8.00
2.80
Height of Rail From Asphalt
DROP From Asphalt to walk.
TYP
wooden walkway
7.60
3.50
Height of Rail
TYP
1.85 Height of Rail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X-Sec(35)
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5797 - GU
5796 - EP
5795 - GU
5794 - FC
5799 - GR
5793 - BW
5792 - GR
5791 - FC
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5789 - AP
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5842 - AP
5841 - AP
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5788 - AP
5830 - BRIDGE
5831 - BW
5838 - AP
5839 - AP
5840 - AP
P3280011
5836 - DC
5834 - BW
5844 - AP
5845 - AP
5846 - AP
5835 - BW
5845 - AP
5848 - AP
5847 - AP
P3280009
28-003B
P3280012
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5786 - AP
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5735 - FC
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5740 - CN
X-Sec(38)
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5748 - AP
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5743 - FC
5745 - FC
5746 - GU
5747 - EP
5749 - EP
5750 - GU
5751 - FC
5753 - WA
5754 - GR
5755 - TB
5756 - TS
5757 - TS
5758 - GR
5759 - GR
5760 - TB
5761 - GR
5762 - FC
5763 - EP
5764 - AP
X-Sec(36)
1130 - TP0NDB
X-Sec(39)
5784 - EP
5783 - FC
5781 - FC
5780 - EP
5782 - GR
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5776 - EP
5775 - AP
5774 - X-SEC
5765 - AP
5766 - AP
5767 - EP
5768 - FC
5770 - FC
5771 - EP
5769 - GR
5772 - AP
5773 - X-SEC
P3280016
X-Sec(37)
P3280015
28-002B
X-Sec(34)
1 inch equals 70 feet

Bridge_ID	28-003B
Bridge_Width_ft	32
Low_Chord_Elev_ft	66.569
Upstream_Invert_ft	54.242
Downstream_Invert_ft	53.379
Street_Crossing	Wal-Mart Plaza
Min_Crown_Elev_ft	67.796
S_T_R	28,-21,30
Jurisdiction	CAS

PID	*Northing*	*Easting*	*Elevation*	*Code*	*Datafile*
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1132	1563150.55	552904.90	69.70	TP0NDC	52162JG
5829	1563456.34	553002.95	68.26	BRIDGE	52162JH
5830	1563437.79	552987.68	68.41	BRIDGE	52162JH
5831	1563479.37	552990.36	68.67	BW	52162JH
5832	1563471.64	552998.52	69.02	BW	52162JH
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5834	1563450.91	553020.34	69.73	BW	52162JH
5835	1563441.56	553029.47	70.07	BW	52162JH
5836	1563450.33	553022.13	67.52	DC	52162JH
5837	1563472.65	552999.47	66.72	DC	52162JH
5838	1563474.35	552984.50	67.78	AP	52162JH
5839	1563465.70	552976.61	67.80	AP	52162JH
5840	1563456.66	552968.25	67.80	AP	52162JH
5841	1563448.53	552977.30	67.43	AP	52162JH
5842	1563457.34	552984.44	68.09	AP	52162JH
5843	1563465.52	552993.53	68.00	AP	52162JH
5844	1563443.96	553015.69	68.86	AP	52162JH
5845	1563435.91	553008.08	68.84	AP	52162JH
5846	1563426.67	552999.10	68.86	AP	52162JH
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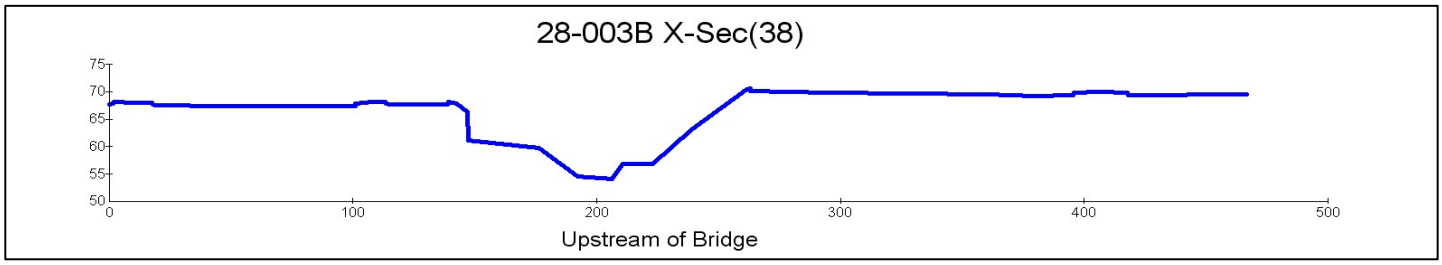

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5736	1563510.36	552789.47	68.00	GR	0+10.00
5737	1563504.73	552794.06	68.05	FC	0+17.00
5738	1563504.46	552794.22	67.64	GU	0+18.00
5739	1563503.68	552795.10	67.59	EC	0+19.00
5740	1563485.25	552816.20	67.43	CN	0+47.00
5741	1563464.40	552864.32	67.34	EC	0+98.00
5742	1563463.18	552864.99	67.45	GU	0+99.00
5743	1563463.02	552865.12	67.82	FC	0+99.00
5744	1563457.14	552869.17	68.22	GR	1+06.00
5745	1563452.79	552871.77	68.20	FC	1+10.00
5746	1563452.38	552871.83	67.77	GU	1+11.00
5747	1563451.30	552872.53	67.69	EP	1+12.00
5748	1563442.79	552879.18	67.71	AP	1+22.00
5749	1563437.22	552889.44	67.71	EP	1+34.00
5750	1563436.50	552890.53	67.76	GU	1+35.00
5751	1563436.30	552890.77	68.13	FC	1+35.00
5752	1563433.73	552893.31	67.82	GR	1+39.00
5753	1563430.75	552896.45	66.26	WA	1+43.00
5754	1563430.64	552896.82	61.13	GR	1+44.00
5755	1563410.34	552917.31	59.68	TB	1+72.00
5756	1563398.08	552927.61	54.49	TS	1+88.00
5757	1563391.39	552940.00	53.99	TS	2+02.00
5758	1563388.25	552943.31	56.82	GR	2+06.00
5759	1563380.97	552953.22	56.79	GR	2+19.00
5760	1563366.52	552959.59	63.14	TB	2+33.00
5761	1563349.85	552974.87	70.47	GR	2+55.00
5762	1563349.07	552975.99	70.56	FC	2+57.00
5763	1563349.08	552976.20	70.11	EP	2+57.00
5764	1563328.13	553000.33	69.87	AP	2+89.00
5765	1563282.90	553047.24	69.55	AP	3+54.00
5766	1563268.32	553059.97	69.20	AP	3+73.00
5767	1563256.56	553070.69	69.44	EP	3+89.00
5768	1563256.60	553070.87	69.92	FC	3+89.00
5769	1563247.62	553077.34	70.03	GR	4+00.00
5770	1563240.95	553086.10	69.84	FC	4+11.00
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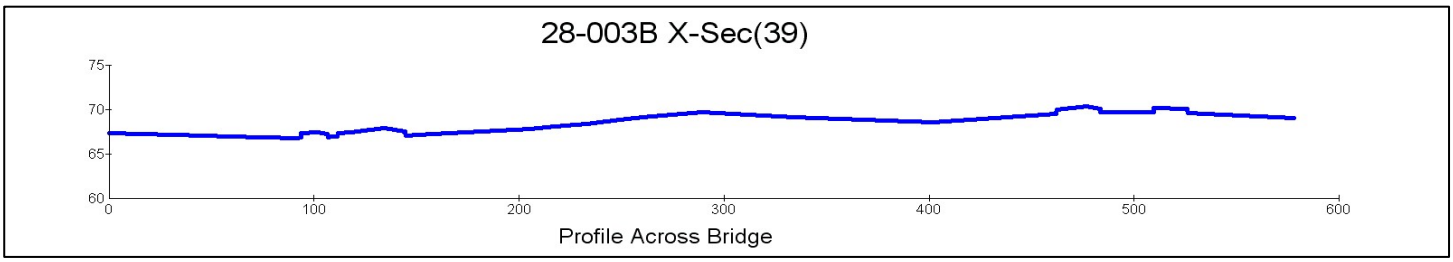

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5804	1563577.68	552865.71	67.07	EP	0+47.00
5803	1563568.94	552872.57	66.96	AP	0+58.00
5802	1563544.65	552895.89	66.81	EP	0+92.00
5801	1563543.54	552897.16	66.92	GU	0+94.00
5800	1563543.52	552897.33	67.34	FC	0+94.00
5799	1563538.13	552903.06	67.45	GR	1+02.00
5798	1563535.85	552907.46	67.29	FC	1+06.00
5797	1563535.59	552907.80	66.88	GU	1+07.00
5796	1563535.45	552909.10	66.96	EP	1+08.00
5795	1563533.00	552910.64	66.96	GU	1+11.00
5794	1563532.64	552910.85	67.39	FC	1+11.00
5793	1563527.40	552914.58	67.43	BW	1+17.00
5792	1563517.35	552927.48	67.96	GR	1+34.00
5791	1563509.16	552933.23	67.55	FC	1+43.00
5790	1563508.83	552933.46	67.11	EP	1+44.00
5789	1563498.83	552942.03	67.24	AP	1+57.00
5788	1563446.77	552995.73	68.43	AP	2+32.00
5787	1563407.51	553036.63	69.75	AP	2+88.00
5786	1563375.84	553067.62	69.21	AP	3+33.00
5785	1563328.40	553116.62	68.57	AP	4+01.00
5784	1563286.78	553159.62	69.52	EP	4+61.00
5783	1563286.73	553159.88	69.99	FC	4+61.00
5782	1563276.99	553170.62	70.40	GR	4+75.00
5781	1563272.58	553175.68	70.07	FC	4+82.00
5780	1563272.52	553175.73	69.75	EP	4+82.00
5779	1563257.21	553196.81	69.75	EP	5+08.00
5778	1563257.22	553196.98	70.22	FC	5+08.00
5777	1563242.44	553204.10	70.09	FC	5+24.00
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5775	1563214.13	553247.48	69.08	AP	5+74.00
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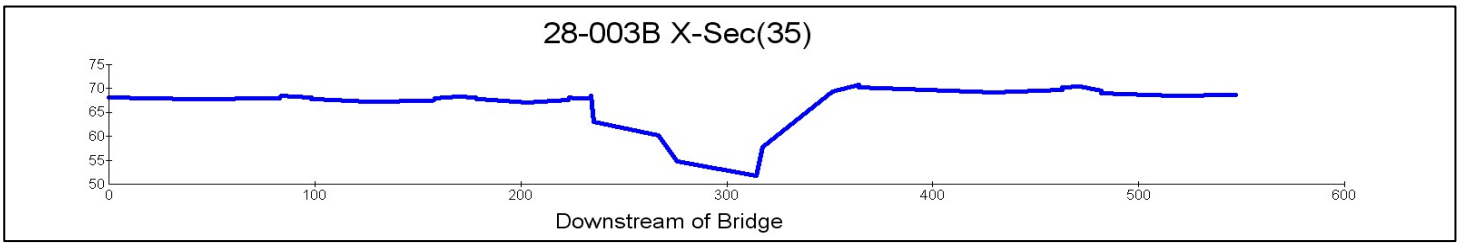

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5681	1563663.27	552974.68	67.97	EP	0+82.00
5680	1563662.26	552975.68	68.06	GU	0+83.00
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5678	1563657.60	552980.34	68.36	GR	0+90.00
5677	1563651.89	552986.51	68.18	FC	0+98.00
5676	1563651.55	552986.85	67.78	GU	0+98.00
5675	1563651.61	552986.82	67.78	GU	0+98.00
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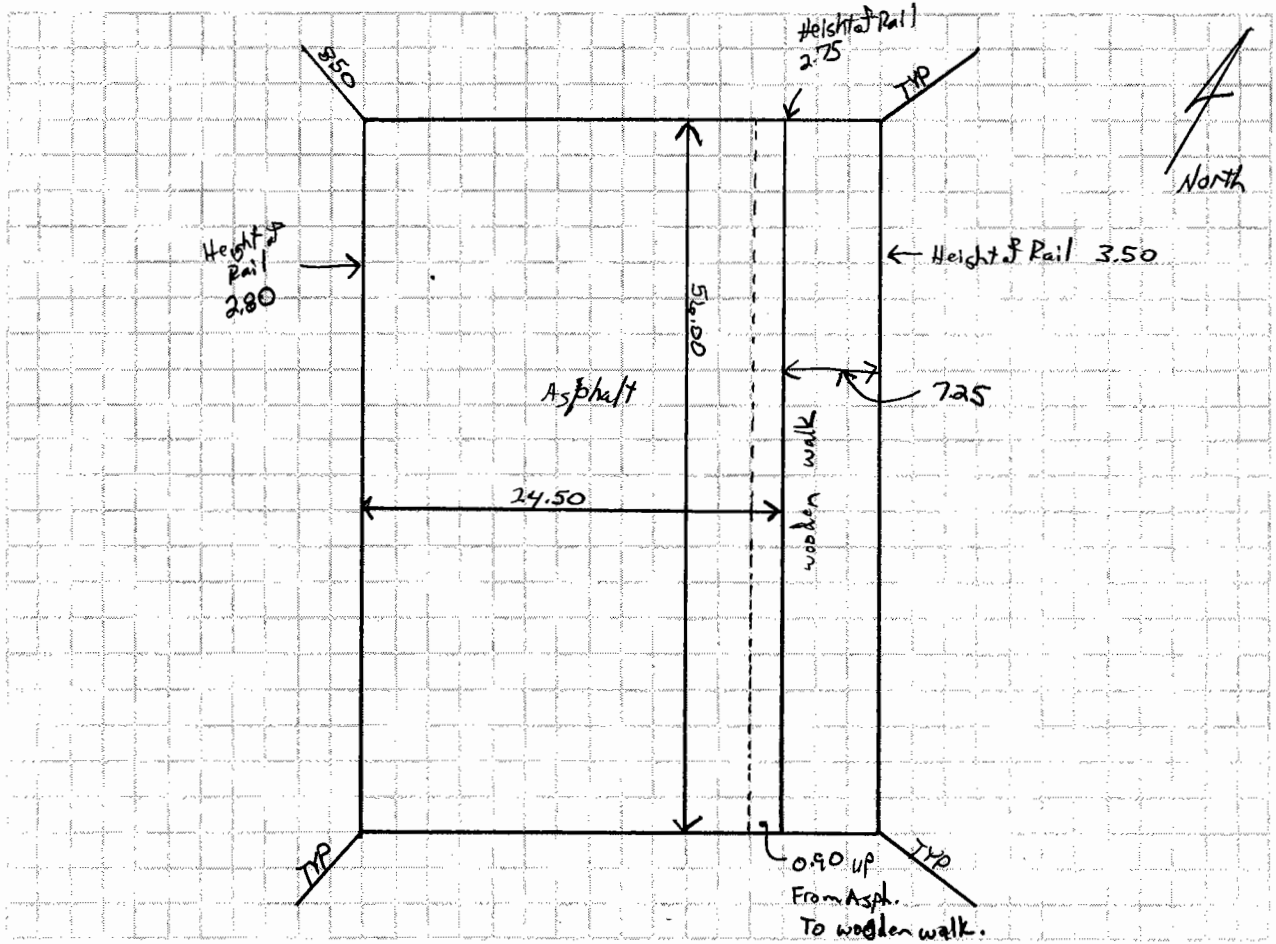
5673	1563634.20	553007.04	67.33	AP	1+25.00
5672	1563613.76	553031.08	67.47	EP	1+57.00
5671	1563613.00	553031.92	67.53	GU	1+58.00
5670	1563612.74	553032.14	67.97	FC	1+58.00
5669	1563604.73	553040.27	68.34	GR	1+69.00
5668	1563599.65	553047.08	68.21	FC	1+78.00
5667	1563599.34	553047.59	67.78	GU	1+78.00
5666	1563598.69	553048.60	67.71	EP	1+80.00
5665	1563582.68	553065.56	67.19	AP	2+03.00
5664	1563570.00	553080.57	67.63	EP	2+23.00
5663	1563569.66	553080.85	68.13	FC	2+23.00
5662	1563567.80	553083.15	68.01	GR	2+26.00
5661	1563566.30	553085.08	67.99	FW	2+28.00
5660	1563563.15	553088.95	68.07	BW	2+33.00
5659	1563562.59	553089.20	68.44	WA	2+34.00
5658	1563561.71	553088.30	63.08	GR	2+34.00
5657	1563543.01	553113.13	60.19	TB	2+65.00
5656	1563536.84	553120.16	54.89	TS	2+74.00
5655	1563511.96	553149.53	51.87	TS	3+13.00
5654	1563510.70	553152.11	57.87	TB	3+16.00
5653	1563489.20	553178.25	69.44	GR	3+49.00
5652	1563480.95	553187.99	70.76	FC	3+62.00
5651	1563480.74	553188.15	70.27	EP	3+62.00
5650	1563438.77	553237.90	69.15	AP	4+27.00
5649	1563416.97	553263.45	69.71	EP	4+61.00
5648	1563416.86	553263.58	70.21	FC	4+61.00
5647	1563411.51	553270.29	70.45	GR	4+70.00
5646	1563404.76	553277.65	69.52	FC	4+80.00
5645	1563404.76	553277.71	69.05	EP	4+80.00
5644	1563382.26	553304.54	68.43	AP	5+15.00
5643	1563362.55	553327.55	68.75	EP	5+45.00
5642	1563362.51	553327.58	68.75	X-SEC	5+45.00

P3280012.jpg— Upstream of 28-003B
Looking downstream

P3280009.jpg— On the deck of 28-003B
Looking upstream

P3280011.jpg— On the deck of 28-003B
Looking downstream

P3280010.jpg— Downstream of 28-003B
Looking upstream


3.50
Height of Rail 2.75
TYP
North
Height of Rail 2.80
Height of Rail 3.50
59.00
Asphalt
.725
walk
24.50
wooden
TYP
TYP
0.90 up
From Asph.
To wooden walk.

Appendix D
Geotechnical Report

Preliminary Inspection and Conceptual Retrofit Measures for ...

Howell Creek - Repair & Armoring of Streambank Erosion From Upstream of Lake Howell Road to Downstream of State Road 436

Seminole County, Florida

Prepared by

DEVO Engineering

CONSULTING GEOTECHNICAL ENGINEERS

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Prepared for

Inwood Consulting Engineers
3000 Dovera Drive, Suite 200
Oviedo, FL 32765

MAY 2009

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Date: May 21, 2009	Devo's Project No: 09-610.26

To:
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Oviedo, FL 32765
407.971.8850; 407.971.8955 fax; mellard@inwoodinc.com

attention: **Mark W. Ellard, P.E.**
Associate Principal/Water Resources Project Manager

Re:
Preliminary Inspection and Conceptual Retrofit Measures for ...

Howell Creek - Repair & Armoring of Streambank Erosion
From Upstream of Lake Howell Road to Downstream of State Road 436

Seminole County, Florida

Dear Mr. Ellard:

Attached is our inspection report on the section of Howell Creek from just upstream of Lake Howell Road to downstream of State Road 436. Also included are preliminary conceptual retrofit measures and other general recommendations.

We trust that this inspection, data provided, assessment and preliminary recommendations are adequate to guide Inwood and Seminole County on planning of future detailed inspections and remedial works. Please call us if there are any questions.

Sincerely
Devo Seereeram
Devo Seereeram, Ph.D., P.E.
Principal Engineer

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Figure 1: Field Observations (April 2009)

Background Information

Seminole County (Fl) is proposing to repair localized areas of the Howell Creek stream bank which were further eroded by the high flow rates during and following Tropical Storm Fay in August 2008.

Inwood Consulting Engineers is the prime consultant, with Devo Engineering as the geotechnical engineering subconsultant.

A preliminary assessment of Howell Creek stream banks extended from the bridge at Lake Howell Road to just downstream of State Road 436. This segment length of the creek is approximately 2,000 lineal feet as shown in Exhibit A.

This preliminary evaluation was based strictly on visual inspection and probes of the stream bank and did not involve any intrusive investigation such as boreholes. Recommendations for stabilization and armoring of the channel banks are conceptual in nature.

Exhibit A. Portion of Howell Creek Side Bank Investigated

NRCS Soil Map Units

The Natural Resources Conservation Service (NRCS), an agency of the US Department of Agriculture, has mapped and published descriptions of the shallow soils (i.e., within 80 inches of land surface) in Seminole County (Fl). In undeveloped areas (without the addition of impervious areas, the establishment of drainage systems, and/or site grading), the NRCS soil mapping is usually fairly reliable but it is much less reliable in development areas. Since there is no site-specific geotechnical data, the NRCS soil map units are reviewed for preliminary guidance.

Figure 1 (attached) also shows the published NRCS soils map unit boundaries for the subject section of the creek. Review of this figure shows that there are the following four (4) NRCS soil units within the area of interest:

- Myakka and EauGallie fine sands (#20).
- Pompano fine sand, occasionally flooded (28).
- Tavares-Millhopper fine sands, 0 to 5% slopes (#31).
- Urban land (#34).

The area directly along the section of creek alignment covered in this investigation is mapped generally with the nearly level, poorly drained soil, Pompano fine sand, occasionally flooded (#28). The land area off the eastern bank is mapped with the poorly drained, Myakka and EauGallie fine sands (#20) and the moderately well drained, Tavares-Millhopper fine sands, 0 to 5% slopes (#31). The land area off the western bank is mapped with Urban land (#34), Myakka and EauGallie fine sands (#20) and Tavares-Millhopper fine sands, 0 to 5% slopes (#31).

Key NRCS characterization data for these four soil map units are presented in Tables 1 through 4. Note in Tables 1 through 4, the layers of soils shown for each map unit are generally sands, except in the case of Myakka and EauGallie fine sands (#20) and Tavares-Millhopper fine sands, 0 to 5% slopes (#31), where there are layers of clay loam, sandy loam and loamy sands in the 40 inch to 80 inch depth range.

Table 1. Key NRCS Data for Myakka and EauGallie fine sands (#20)

The soils in this map unit are nearly level and poorly drained. These soils are on broad plains on the flatwoods. During most years, the soils in this map unit have a seasonal high water table within 12 inches of the surface for 1 month to 4 months.		
Hydrologic Soil Group		B/D
Typical Soil Profile		
Depth	Soil Color & Texture	Permeability
Myakka		
0 - 5 in	black fine sand	12 to 40 ft/day
5 - 28 in	light gray fine sand	
28 - 30 in	black fine sand	1.2 to 12 ft/day
30 - 45 in	dark brown fine sand	
45 - 80 in	brown fine sand	12 to 40 ft/day
EauGallie		
0 - 5 in	dark gray fine sand	12 to 40 ft/day
5 - 18 in	light gray fine sand	
18 - 37 in	black and dark brown fine sand	1.2 to 12 ft/day
37 - 41 in	light brownish gray fine sand	12 to 40 ft/day
41 - 60 in	very pale brown sandy clay loam	.12 to 4 ft/day
60 - 80 in	light brownish gray loamy sand	1.2 to 12 ft/day

Table 2. Key NRCS Data for Pompano fine sand, occasionally flooded (#28)

This soil is nearly level and poorly drained. It is on the flood plains and is occasionally flooded following prolonged high intensity rains. In most years, this soil has a seasonal high water table within 12 inches of the surface for 2 to 6 months. This soil is subject to occasionally periods of flooding, which normally occurs during rainy periods. The duration and extent of flooding are variable and are directly related to the frequency and intensity of rainfall.		
Hydrologic Soil Group		D
Typical Soil Profile		
Depth	Soil Color & Texture	Permeability
0 -4 in	gray fine sand	12 to 40 ft/day
4 - 80 in	pale brown and light gray fine sand	

Table 3. Key NRCS Data for Tavares-Millhopper fine sands, 0 to 5% slopes (#31)

The soils in this map unit are nearly level to gently sloping and moderately well drained. These soils are on low ridges and knolls on the uplands. The soils in this map unit have a seasonal high water table at a depth of 36 to 60 inches for 2 to 6 months.		
Hydrologic Soil Group		A
Typical Soil Profile		
Tavares		
Depth	Soil Color & Texture	Permeability
0 - 6 in	very dark grayish brown fine sand	> 12 ft/day
6 - 80 in	yellowish, light yellowish brown, & pale brown fine sand	
Millhopper		
Depth	Soil Color & Texture	Permeability
0 - 7 in	gray fine sand	12 to 40 ft/day
7 - 45 in	very pale brown fine sand	
45 - 54 in	very pale brown sandy loam	.12 to 4 ft/day
54 - 80 in	light gray sandy clay loam	

Table 4. Key NRCS Data for Urban Land (#34)

This miscellaneous area is covered by urban facilities, such as shopping centers, parking lots, industrial buildings, houses, streets, sidewalks, airports, and related structures. The natural soil can not be observed. The slopes are dominantly less than 2 percent but range to 12 percent. Depth to the seasonal high water table is dependent upon the functioning of the drainage system.		
Hydrologic Soil Group		D
Typical Soil Profile		
Depth	Soil Color & Texture	Permeability
0 - 80 in	n.a.	n.a.

Proximate Geotechnical Data

Devo Engineering performed a geotechnical investigation for the replacement of the Howell Creek Water Control Structure located along Howell Creek just west of Lake Howell Road. This area of investigation is just west of the section of creek we inspected. A geotechnical investigation of this structure was performed over the period December 2008 to January 2009 and included several shallow hand auger and deep Standard Penetration Test (SPT) borings.

The shallow soil borings generally disclosed surficial layers of very loose fine sands underlain by layers of soft muck and very loose mucky sands, 0.5 ft to 1.5 ft thick, followed by layers of mostly loose and some medium dense fine sands, some with traces of roots. There was an exception to this generalized stratigraphy as mucky sand was disclosed in one of the borings from 4.0 ft to greater than 12 ft depth.

The deep SPT borings disclosed somewhat variable soil stratigraphy. The boring drilled on the northern bank of the creek disclosed layers of very loose and loose fine underlain by very loose clayey fine sand and very soft clay and then layers of very loose and loose fine sand and slightly silty fine sands. The boring on the southern bank of the creek, disclosed layers of very loose and loose fine sands from the ground surface to 6.5 ft depth followed by very loose mucky sand to 14.5 ft depth and then layers of very loose and loose fine sands, silty fine sands and clayey fine sands and then some medium dense clayey fine sand and silty fine sand with some shell fragments.

The grain size analyses disclosed D_{50} values of 0.21 mm and 0.25 mm on samples taken in the 6 ft to 8.2 ft depth range. The recommended D_{50} value for scour computation for this project was 0.225 mm. The soils were generally erodible and scour protection was recommended along the stream bed and banks in the vicinity of the structure.

Field Inspection Program

The field inspection program included the following:

- ☞ Visual inspection of the creek banks by our project geotechnical engineer and geotechnician.
- ☞ Identification and mapping of locations with moderate to severe erosion, areas of slope collapse and sedimentation.
- ☞ Identification of areas where there are fallen trees and other forms of debris that affect free flow of the canal.
- ☞ Taking of photographic records and recording of other pertinent data.

Presentation of Data

Figure 1.1 presents an overall aerial image of the site with pertinent inspection notes and inset photographs of areas where notable erosion, sedimentation or obstacles were observed. The severity of bank erosion and the degree of obstruction caused by fallen trees and other forms of debris are variable, and therefore, these are categorized according in accordance with the descriptions below and appropriate color codes are used on the aerial map as follows:

- ✎ **Low Distress Areas** - Coded green - Little or no stream bank erosion and no blockage or fallen trees in stream. No immediate action required.
- ✎ **Moderate Distress Areas** - Coded yellow - Erosion and some localized stream blockage observed. Some action would be required in the near future to maintain proper alignment and flow.
- ✎ **High Distress Areas** - Coded red - Loose subsoils and significant bank erosion and obstruction to flow by fallen trees and other forms of debris. Significant remedial work needed.

Erodibility of Soils

Based on visual observations made during the site visit and a review of published NRCS data over the creek alignment in the area, the soils are essentially fine sands. In addition, grainsize distribution tests performed on samples from the adjacent Howell Creek Water Control Structure location disclosed D_{50} values of 0.21 and 0.225 mm. Soils of this size are fairly easily erodible and therefore, scour protection would be required.

Note however that soils that are cohesive, such as clayey sands, sandy clay and clays, would be more resistant to erosion/scour. Of the four (4) NRCS soil map units present in the area, two of these units, Myakka and EauGallie fine sands (#20) and Tavares-Millhopper fine sands, 0 to 5% slopes (#31) typically have buried layers of cohesive soils in the 40 inch to 80 inch depth range. Depending on the actual bank location and slope some cohesive soils might be exposed. These soil layers that would be somewhat resistant to erosion are shaded green, where present, in Tables 1 through 4, while the other more erodible soil layers are shaded yellow.

Slope Stability Considerations

Based on the type of sandy soils observed during the site visit, data from an adjacent project and published NRCS soils data, side bank slopes of 2H:1V are likely to be stable for slope heights for up to 8 ft provided that scour and erosion measures are in place. For higher slopes, the slope angle should not be steeper than 3H:1V.

Sheet piles, if used to retain side banks, will have to have adequate penetration to avoid over turning. With the type of soils present, it is envisaged that for an 8 ft high wall, a minimum penetration of 12 ft would be required. Global stability analyses should be performed with verifiable soil strength parameters when designing slopes and retaining systems.

Recommended Methods of Stabilization

As noted on Figure 1, there are six (6) locations where severe distress was noted. Following are our location specific recommendations for retrofitting these areas:

Location	Recommended Method of Stabilization
H1	Gabion Walls and Reno Mattresses to protect and stabilize stream banks.
H2	Sheetpiles with rubble rip rap at base to prevent scour and undermining of the outfall structure.
H3	Gabion Walls and Reno Mattresses to protect and stabilize stream banks.
H4	Rubble rip rap in channel to prevent under-scour of stream bed together with Reno Mattresses along base of stream banks to train the channel flow.
H5	Sheetpiles with rubble rip rap at its base to prevent scour and undermining of slopes
H6	Gabion Walls and Reno mattresses to protect and stabilize stream banks.

Note that these are preliminary recommendations that are strictly of a conceptual nature and precursory to a design-level investigation. Apart from the stabilization methods recommended in the table above, clearing of fallen trees and removal of other forms of debris will also be required.

FIGURES

NORTH

GRAPHIC SCALE
1 INCH = 100 FEET
50 0 25 50 100 200

FLOW

FENCE

AREA L7
End of study area.
Stream is aligned closer to north bank (no issues)

AREA L6
Stream narrows down here (no issues)

S.R.436

AREA L5
Stream meanders under bridge by influence from storm culvert inflow (no issues)

AREA L4
Obstruction to flow by debris and tree limbs. Narrow stream here with heavy vegetation

AREA H6
Large fallen tree and bank erosion is severe shifting stream ℄ from the original ℄. Flow splits at high flow rates.

Sta. 17+00
Sta. 16+00
Sta. 15+00
Sta. 14+00
Sta. 13+00
Sta. 12+00
Sta. 11+00
Sta. 10+00
Sta. 9+00
Sta. 8+00
Sta. 7+00
Sta. 6+00
Sta. 5+00
Sta. 4+00
Sta. 3+00
Sta. 2+00
Sta. 1+00
Sta. 00+00

AREA M4
Stream meanders, undermining tree roots and erosion along banks ℄ of stream is aligned closer to south bank

AREA M3
Large pool below bridge. Fabri-form has been undermind and fallen away. Water depth may be deepened by stream flow??

NORTH PLAZA BRIDGE

AREA H5
Severe erosion on east bank has under -mined fabri-form at bridge pilings. ℄ is working to east . Thick vegetation to north impeding flow

SOUTH PLAZA BRIDGE

AREA H4
Heavy vegetation along this winding part of stream. Flow path very narrow with high flow velocity

AREA H3
Severe blockage by fallen trees. Bank erosion on opposite side of wash out from parking lot depositing sand in bed of creek

AREA L3
Stream is in good condition. No blockage. Storm water flume is in rough condition. Limited access.

LAKE HOWELL LANE

AREA M2
Minor debris in creek. Flow curves and has eroded outer bank. Trees tilted from under-mining of roots. ℄ is moving east

AREA H2
Severe erosion and under mining at base of outfall structure. Sediments deposited further out into the stream.

AREA L2
Some very minor bank erosion from old structure. No major issues.

LAKE HOWELL ROAD

AREA M1
Minor debris in stream w/minor bank erosion. Heavy vegetation on banks going into stream

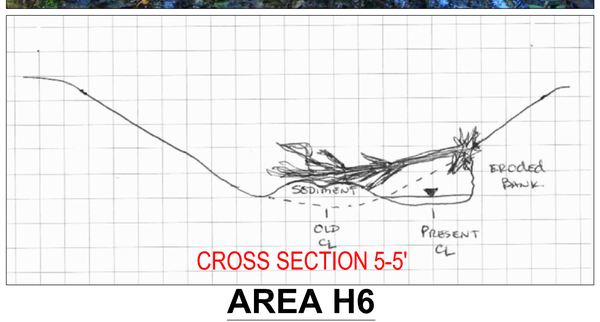
AREA H1
Sharp bend in creek w/severe bank erosion. Fallen tree here as well as minor debris in stream flow.

AREA L1
Creek unobstructed. Minor erosion along both banks which are gentle sloping. Inflow from lateral culverts below bridge

FLOW

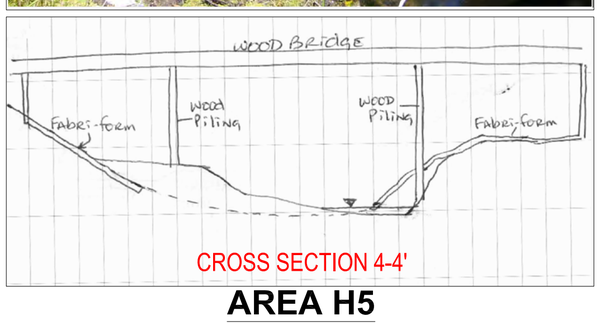
6 20 31 20 31 28 20 34 34 28 20

5 5' 4 4 3 3 2 2' 1 1'



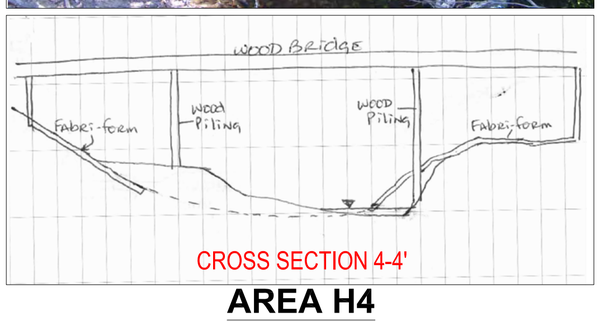
CROSS SECTION 5-5'

AREA H6



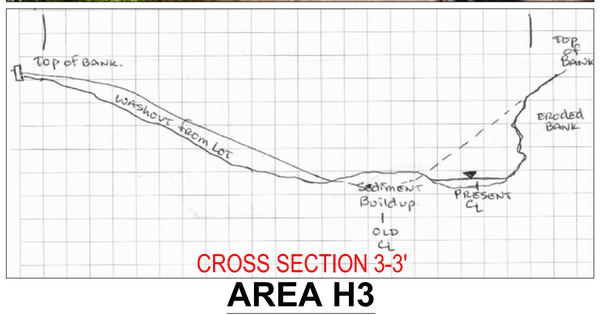
CROSS SECTION 4-4'

AREA H5



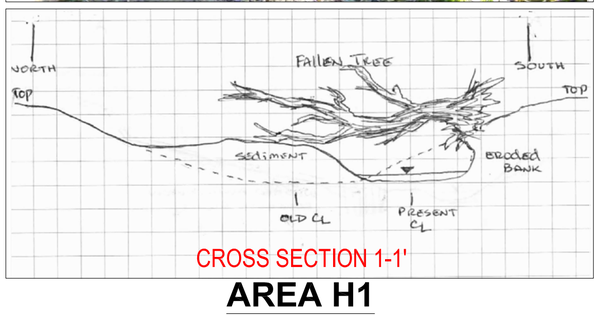
CROSS SECTION 4-4'

AREA H4



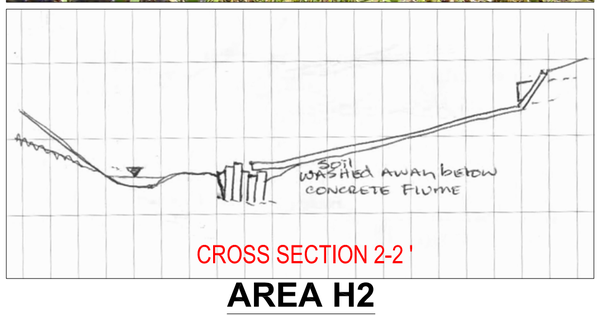
CROSS SECTION 3-3'

AREA H3



CROSS SECTION 1-1'

AREA H1



CROSS SECTION 2-2 '

AREA H2

NOTES:

Low Distress Areas - Little to no bank erosion & no stream blockage or fallen trees in stream. No immediate action required

Moderate Distress Areas - Erosion and some localized stream blockage observed.Would require action in near future to help maintain proper alignment and flow

High Distress Areas - Loose Subsoils and significant bank erosion and obstruction to flow by fallen trees and other debris

LEGEND:

Stream Flow

Stream Alignment (Approximate)

Bridge Structure

Storm Water Structure Entering Stream/Creek

23 NRCS Soil Units

SOIL LEGEND:

20. Myakka and EauGallie fine sands
28. Pompano fine sand, occasionally flooded
31. Tavares-Millhopper fine sands, 0 to 5 percent slopes
34. Urban land

Distress Area	*Recommended Method of Stabilization*
H1	Gabion Wall and Reno Mattress to Protect and Stabilize Stream Banks
H2	Sheetpiles with Rubble Rip Rap at its Base to Prevent Scour and Under-mining of the Outfall Structure
H3	Gabion Wall and Reno Mattress to Prevent Erosion and Stabilize Stream Banks
H4	Rubble Rip Rap in Channel to Prevent Under-Scour of Stream Bed together with RenoMattress along Base of Stream Banksto Train the Flow
H5	Sheetpiles with Rubble Rip Rap at its Base to Prevent Scour and Under-mining of the Slopes
H6	Gabion Wall and Reno Mattress to Prevent Erosion and Stabilize Stream Banks

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website: http://www.devoeng.com

Checked & Approved by: DS | Drawn By: AZ | Date: 04-23-09

Figure Name:
FIELD OBSERVATIONS (APRIL 2009)

Project Name:
Howell Creek Bank Erosion Assessment
From U/S of Lake Howell Rd. to D/S of S.R. 436

Scale: Noted | Proj. # 09-610.26 | Figure 1

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Date: February 2, 2010	Devo's Project No: 09-610.26

To:
Inwood Consulting Engineers
3000 Dovera Drive, Suite 200
Oviedo, FL 32765
407.971.8850; 407.971.8955 fax; mellard@inwoodinc.com

attention: **Mark W. Ellard, P.E.**
Associate Principal/Water Resources Project Manager

Re:
Supplementary Memo #1 on Preliminary Inspection and Conceptual Retrofit Measures for ...

Howell Creek - Repair & Armoring of Streambank Erosion
From Upstream of Lake Howell Road to Downstream of State Road 436

Seminole County, Florida

Dear Mr. Ellard:

This is not a stand alone document but is a Supplementary Memorandum which address comments made by Seminole County regarding the causes of failure and the necessity for retrofit works for the section of Howell Creek from just upstream of Lake Howell Road to downstream of State Road 436.

We trust that the contents of this memo meet the needs of Inwood and Seminole County on planning of future detailed inspections and remedial works. Please call us if there are any questions.

Sincerely
Devo Seereeram
Devo Seereeram, Ph.D., P.E.
Principal Engineer

Summary of Observations and Probably Causes

Table 1 presents a summary of the key observations made and the most probable cause of distress in each of the Four (4) moderately distressed areas and Six (6) severely distressed areas. These locations are labeled (**M1 to M4**) and (**H1 to H6**), respectively in Figure 1.

Note however, that neither a geotechnical investigation nor a topographical survey was included in this phase of the investigation and the possible causes of distress indicated were based solely on visual observations and our experience with soils in the area. A more detailed investigation would be required to accurately identify the causes of distress in each area.

Recommended Retrofit Measures

Table 1 also presents the location specific recommendations for retrofitting the six (6) locations where severe distress and four (4) locations where moderate distress were observed. Areas showing severe distress generally require urgent attention in the short term, while areas showing moderate distress can be retrofitted on a phased basis in the short to medium term. It is very important however that a proper monitoring and maintenance program be implemented with particular emphasis on conditions prior to, and immediately following storm events to prevent flooding and adverse impacts to adjacent infrastructure. These conditions are most often initiated by fallen tress which partially obstruct the flow, followed by rapid realignment of the flow in the channel, scouring and erosion of unprotect banks and ultimate collapse.

The areas which show minor signs of distress labeled (**L1 to L7**) in Figure 1 are not critical and these areas can be monitored and reassessed periodically.

Note that these preliminary recommendations are strictly of a conceptual nature and precursory to a design-level investigation. Apart from the stabilization methods recommended in the table above, clearing of fallen trees and removal of other forms of debris will also be required.

Table 1. Summary of Observed Distress, Probable Causes and Recommended Retrofit Measures			
Location	**Observations/Distress Noted**	**Probable Causes of Distress**	**Recommended Retrofit Measures**
M1	Minor debris in stream with minor bank erosion. Heavy vegetation on banks going into stream.	Granular subsoils and steep bank, eroded by stream flow, leading to some bank collapse and some loss of tree root support.	Condition not considered severe at this time but clearing, shaping and stabilization of banks should be done in the short to medium term.
M2	Minor debris in stream. Bank on outer curve eroded. Trees leaning as roots suffer from loss of soil support. Ditch appears to be meandering eastwards.	Granular subsoils and steep bank, eroded by stream flow, leading to some bank collapse and some loss of tree root support.	Condition not considered severe at this time but clearing, shaping and stabilization of banks should be done in the short to medium term.
M3	Large pool below bridge, Fabriform undermined and is collapsing. Water seems deeper; suspected scouring along stream bed.	Granular subsoils and inadequate scour protection, leading to erosion and some collapse of Fabriform.	Condition not considered severe at this time but clearing, re-grouting of Fabriform, shaping and stabilization of banks should be done in the short to medium term.
M4	Stream meandering, erosion along banks, tree roots exposed.	Granular subsoils and steep bank, eroded by stream flow, leading to some bank collapse and some loss of tree root support.	Condition not considered severe at this time but clearing, shaping and stabilization of banks should be done in the short to medium term.
H1	Severe bank erosion and collapse at sharp bend. Fallen tree as well as minor debris in stream.	Granular subsoils and steep bank, eroded by stream flow, leading to bank collapse and loss of tree root support.	Remove debris. Install Gabion Walls and Reno Mattresses to protect and stabilize stream banks.
H2	Severe erosion and undermining at base of outfall structure. Sediments deposited further out into the stream.	Granular subsoils, bank eroded by stream flow, inadequate scour protection.	Remove sediments. Install sheetpiles with rubble rip rap at base to prevent scour and undermining of the outfall structure.

Table 1. Summary of Observed Distress, Probable Causes and Recommended Retrofit Measures			
Location	**Observations/Distress Noted**	**Probable Causes of Distress**	**Recommended Retrofit Measures**
H3	Washout from parking lot on west side. Severe erosion along east bank. Stream blocked by fallen trees.	Granular subsoils and steep bank, eroded by stream flow, leading to bank collapse and loss of tree root support. Also, discharge from car park aggravates erosion.	Clear vegetation. Install Gabion Walls and Reno Mattresses to protect and stabilize stream banks.
H4	Stream narrow and winding in this area, bank very steep and are being eroded, flow velocities high. Heavy vegetation present.	Granular subsoils and steep bank, eroded by stream flow, leading to bank collapse.	Clear vegetation. Install rubble rip rap in channel to prevent under-scour of stream bed together with Reno Mattresses along base of stream banks to train the channel flow.
H5	Severe erosion on east bank. Fabriform undermined at bridge piles. Thick vegetation to north impeding flow.	Granular subsoils, inadequate scour protection, steep bank, eroded by stream flow, leading to bank and Fabriform collapse.	Clear vegetation. Install sheetpiles with rubble rip rap at its base to prevent scour and undermining of slopes.
H6	Severe bank erosion, stream alignment shifting, large fallen tree.	Granular subsoils and steep bank, eroded by stream flow, leading to bank collapse and loss of tree root support.	Clear vegetation. Install Gabion Walls and Reno mattresses to protect and stabilize stream banks.

Figures

NORTH

GRAPHIC SCALE
1 INCH = 100 FEET
50 0 25 50 100 200

FLOW

FENCE

AREA L7
End of study area.
Stream is aligned closer to north bank (no issues)

AREA L6
Stream narrows down here (no issues)

S.R.436

AREA L5
Stream meanders under bridge by influence from storm culvert inflow (no issues)

AREA L4
Obstruction to flow by debris and tree limbs. Narrow stream here with heavy vegetation

AREA H6
Large fallen tree and bank erosion is severe shifting stream ℄ from the original ℄. Flow splits at high flow rates.

Sta. 17+00
Sta. 16+00
Sta. 15+00
Sta. 14+00
Sta. 13+00
Sta. 12+00
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Sta. 4+00
Sta. 3+00
Sta. 2+00
Sta. 1+00
Sta. 00+00

AREA M4
Stream meanders, undermining tree roots and erosion along banks ℄ of stream is aligned closer to south bank

AREA M3
Large pool below bridge. Fabri-form has been undermind and fallen away. Water depth may be deepened by stream flow??

NORTH PLAZA BRIDGE

AREA H5
Severe erosion on east bank has under -mined fabri-form at bridge pilings. ℄ is working to east . Thick vegetation to north impeding flow

SOUTH PLAZA BRIDGE

AREA H4
Heavy vegetation along this winding part of stream. Flow path very narrow with high flow velocity

AREA H3
Severe blockage by fallen trees. Bank erosion on opposite side of wash out from parking lot depositing sand in bed of creek

AREA L3
Stream is in good condition. No blockage. Storm water flume is in rough condition. Limited access.

LAKE HOWELL LANE

AREA M2
Minor debris in creek. Flow curves and has eroded outer bank. Trees tilted from under-mining of roots. ℄ is moving east

AREA H2
Severe erosion and under mining at base of outfall structure. Sediments deposited further out into the stream.

AREA L2
Some very minor bank erosion from old structure. No major issues.

LAKE HOWELL ROAD

AREA M1
Minor debris in stream w/minor bank erosion. Heavy vegetation on banks going into stream

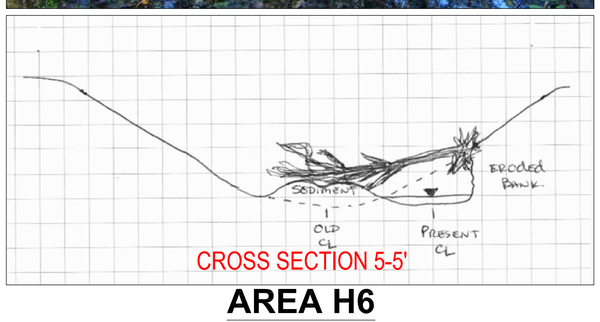
AREA H1
Sharp bend in creek w/severe bank erosion. Fallen tree here as well as minor debris in stream flow.

AREA L1
Creek unobstructed. Minor erosion along both banks which are gentle sloping. Inflow from lateral culverts below bridge

FLOW

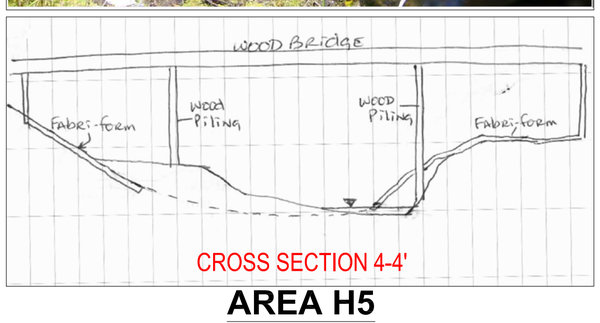
6 20 31 20 31 28 20 34 34 28 20

5 5' 4 4 3 3 2 2' 1 1'



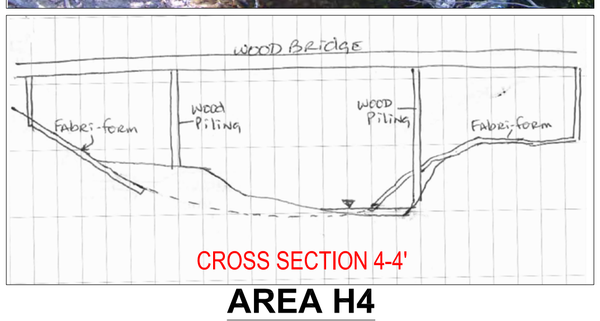
CROSS SECTION 5-5'

AREA H6



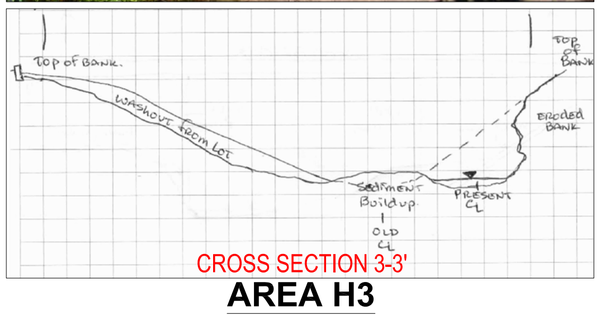
CROSS SECTION 4-4'

AREA H5



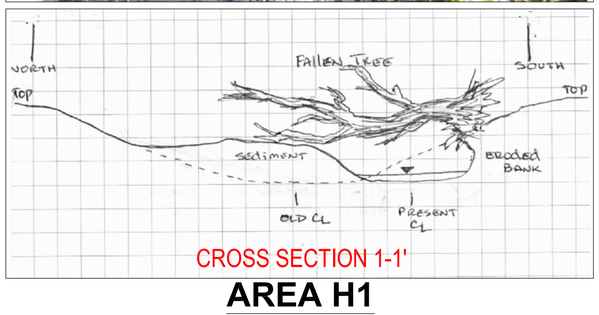
CROSS SECTION 4-4'

AREA H4



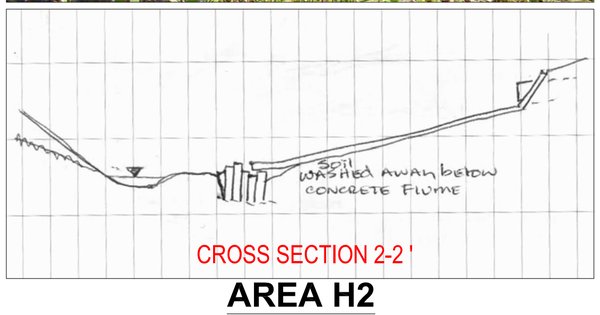
CROSS SECTION 3-3'

AREA H3



CROSS SECTION 1-1'

AREA H1



CROSS SECTION 2-2 '

AREA H2

NOTES:

Low Distress Areas - Little to no bank erosion & no stream blockage or fallen trees in stream. No immediate action required

Moderate Distress Areas - Erosion and some localized stream blockage observed.Would require action in near future to help maintain proper alignment and flow

High Distress Areas - Loose Subsoils and significant bank erosion and obstruction to flow by fallen trees and other debris

LEGEND:

Stream Flow

Stream Alignment (Approximate)

Bridge Structure

Storm Water Structure Entering Stream/Creek

23 NRCS Soil Units

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H4	Rubble Rip Rap in Channel to Prevent Under-Scour of Stream Bed together with RenoMattress along Base of Stream Banksto Train the Flow
H5	Sheetpiles with Rubble Rip Rap at its Base to Prevent Scour and Under-mining of the Slopes
H6	Gabion Wall and Reno Mattress to Prevent Erosion and Stabilize Stream Banks

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website: http://www.devoeng.com

Checked & Approved by: DS | Drawn By: AZ | Date: 04-23-09

Figure Name:
FIELD OBSERVATIONS (APRIL 2009)

Project Name:
Howell Creek Bank Erosion Assessment
From U/S of Lake Howell Rd. to D/S of S.R. 436

Scale: Noted | Proj. # 09-610.26 | Figure 1

Appendix E
Refined Model Data

CDM

Memorandum

To: *Mark Ellard, P.E.*

From: *Danielle M. Honour, P.E., D.WRE*

Date: *August 17, 2009*

Subject: *Howell Creek (Lake Howell Road to SR436) – ICPR Modeling Results*

For this effort, CDM was responsible for providing modeling support to Inwood Consulting Engineers (Inwood) in order to develop a more comprehensive understanding of the drainage patterns within the study area (**Figure 1**) and to provide modeling support for future design that will address identified level of service deficiencies in Howell Creek. The study area consists of that portion of Howell Creek from Lake Howell Road to SR436. This memorandum summarizes the methodology and the results of the modeling effort performed by CDM.

ICPR Model Update and Results

CDM developed a hydrologic model representation of the project area using the Interconnected Channel and Pond Routing (ICPR) Model, Version 3.1 software. The basis of the model was from the *Howell Creek Basin Watershed Management Plan* (CDM, 2008). The following paragraphs describe the modifications made to the model based on newly obtained data.

Hydrologic Model

In order to better define the hydrology within the study area, Inwood provided additional detailed information including stormwater inventory data taken from construction drawings as well as refined drainage patterns. CDM then used these drainage patterns and integrated them into the existing hydrologic units for the study area. The resulting hydrologic units for the study area are shown in **Figure 2**. CDM then re-calculated the curve numbers (CNs) and times of concentration for the hydrologic units of interest as well as the surrounding hydrologic units whose boundaries were impacted by these modifications. CNs and time of concentration values were calculated using the Soil Conservation Service (SCS) curve number methodology as outlined in Technical Release No. 55.

CDM developed the curve numbers using ArcView® Version 9.3 to automate the CN calculation process. Using ArcView®, the existing land use and the SCS Hydrologic Soils

LEGEND

- Streets
- County Boundary
- Major Roads

Municipal Boundaries

- Altamonte Springs
- Casselberry
- Oviedo
- Winter Springs

N
W E
S

0 250 500
Feet

Seminole County
Howell Creek Basin CIP

Aerial Imagery Source: Seminole County, 2008

CDM

Figure 1
Study Area

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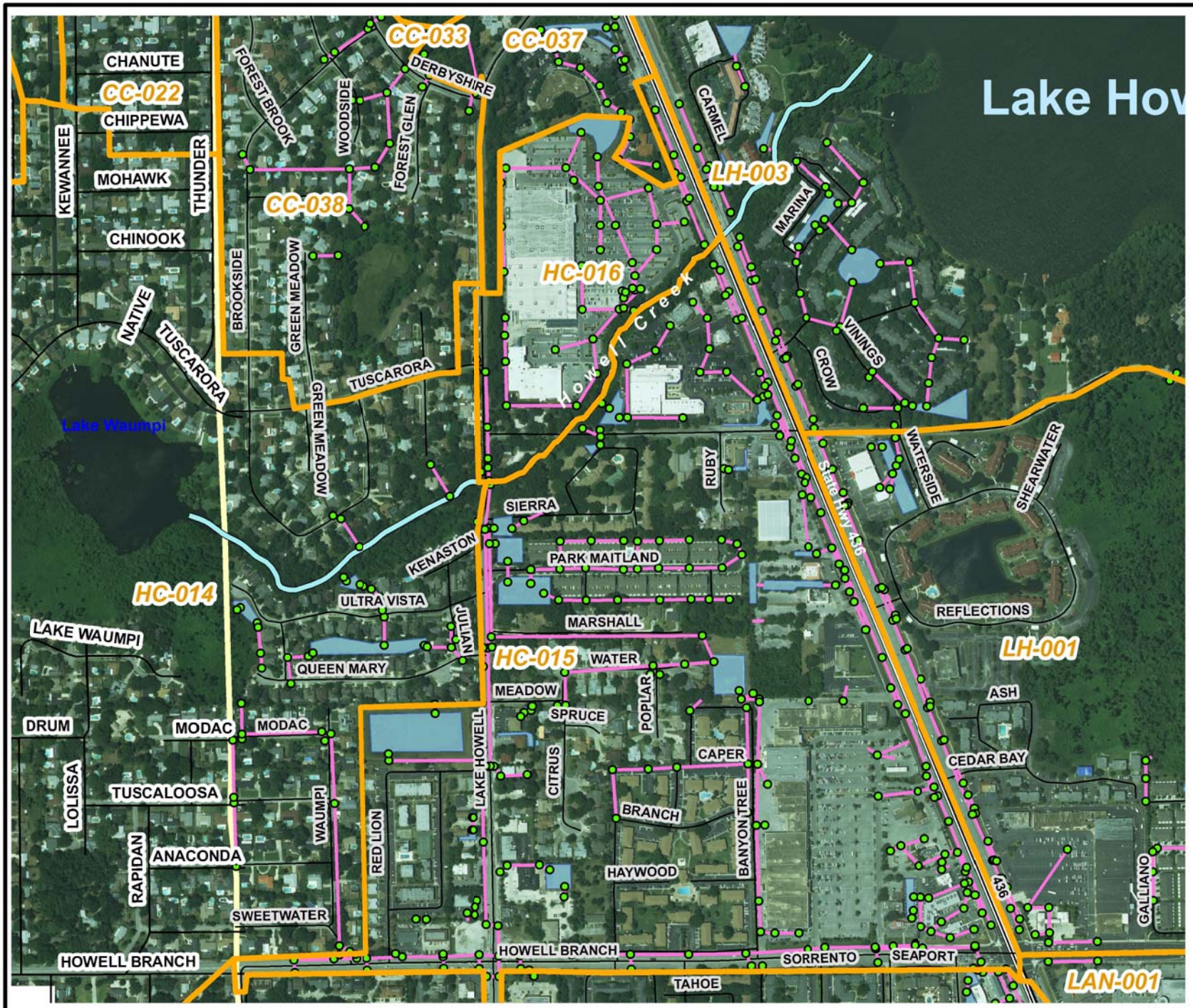


Seminole County
Howell Creek Basin CIP

Aerial Imagery Source: Seminole County, 2008

CDM

Figure 2
Hydrologic Units

Group coverages were superimposed over the hydrologic unit delineation coverage. Data from the resulting coverage were then exported to Microsoft® Access where a series of queries were developed in order to calculate the CN as well as the DCIA. The queries calculate the CN value using predefined look-up tables and the percentages (by area) of the hydrologic coverages for each hydrologic unit. It should be noted that the water body and wetland areas were not included in the calculation of the CN but were input to the model as DCIA. The resulting curve numbers and time of concentration values are provided in **Table 1**.

Table 1
Hydrologic Unit Summary

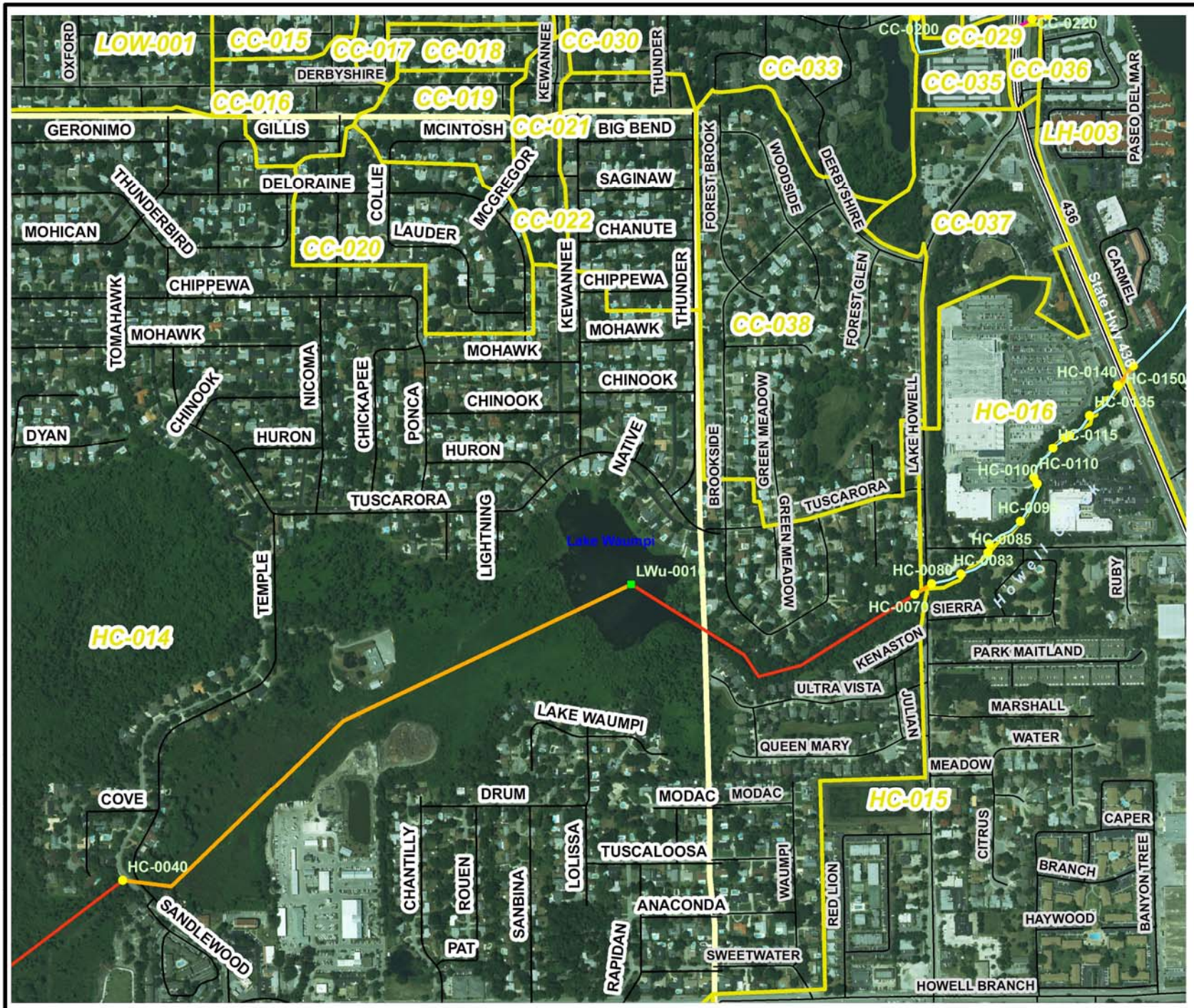
Hydrologic Unit	Area (acres)	Curve Number	Time of Concentration (minutes)
HC-014	806	75	66
HC-015	212	89	24
HC-016	31	87	16

For this effort, the SCS Type II (Florida Modified) rainfall distribution was used. Both the SJRWMD and Seminole County require the use of the SCS Type II (Florida Modified) rainfall distribution. The rainfall volumes applied to this 24-hour distribution for the design storm events that were simulated with the regional stormwater model include:

- Mean Annual - 5.3 inches of rainfall
- 10-Year - 6.8 inches of rainfall
- 25-Year - 8.4 inches of rainfall
- 100-Year - 11.4 inches of rainfall

Hydraulic Model

Inwood provided additional survey data that were obtained by Southeastern Surveying and Mapping Corp. (SSMC). Based on the survey data, CDM incorporated a number of additional open channel reaches into the existing nodal schematic from Lake Howell Road to SR 436. CDM also used existing 1-foot topographic contour data to define an extended floodplain for each of the cross sections. The updated nodal model schematic for the entire study area (including the boundary conditions) is shown in **Figure 3**. The nodal model schematic for the area of interest within Seminole County is shown in **Figure 4**.



LEGEND

Model Schematic

Type

- Linking Node
- Storage Node
- Control Structure
- Bridge
- Pipe
- Overland Flow
- Open channel
- Hydrologic Units
- Streets
- County Boundary
- Major Roads

N
W E
S

0 412.5 825

Feet

Seminole County
Howell Creek Basin CIP

Aerial Imagery Source: Seminole County, 2008

CDM

Figure 3
Model Schematic

honourdm
8/2/09
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LEGEND

Model Schematic

Type

- Linking Node
- Storage Node
- Control Structure
- Bridge
- Pipe
- Overland Flow
- Open channel
- Hydrologic Units
- Streets
- County Boundary
- Major Roads

N W E S

0 105 210

Feet

Seminole County
Howell Creek Basin CIP

Aerial Imagery Source: Seminole County, 2008

CDM

Figure 4
Model Schematic - Area of Interest

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CDM represented the segment of Howell Creek in the ICPR model from the bridge at Temple Trail (HC-0040B) to Lake Howell (LH-0090). CDM used the time series outflow values from the Lake Maitland control structure as the upstream boundary condition and the time series stage values for Lake Howell as the downstream boundary condition. CDM also used the proposed weir configuration previously provided by Inwood (January 2009) for the Howell Creek control structure (HC-0062W) replacement. The replacement of this structure is currently under construction.

CDM then simulated the mean annual, 10-, 25- and 100-year/24-hour design storm events under existing land use conditions using ICPR Version 3.1. The results of these simulations are provided in **Table 2**. Level of service (LOS) assignments shown in Table 2 are consistent with those adopted by Seminole County as well as those used in the *Howell Creek Basin Watershed Management Plan* (CDM, 2008). Based on the LOS comparisons, open channels HC-0080X and HC-0083X are predicted to overtop their banks during the 25-year/24-hour design storm event by 0.2 and 1.0 feet, respectively. This could potentially cause property and/or structure flooding to the parcel immediately to the north as shown on **Figure 5**. Also shown on Figure 5 are the nearest survey elevations to the parcel in question taken for the channel cross-section. According to previous work done by CDM in the basin (i.e., *Howell Creek Basin Watershed Management Plan*), flooding was predicted at the Lake Howell Lane bridge (HC-0085B) and not at HC-0080X and HC-0083X, which are immediately upstream of the bridge. The bridge was previously predicted to flood by 0.1 feet during the 100-year/24-hour design storm event but now it meets the LOS using the updated model. Many of the open channel critical elevations were previously defined using 1-foot topographic data. CDM updated several of these critical elevations throughout the stretch of the creek analyzed using surveyed top of bank elevations provided by the updated survey. In order to confirm the degree of flooding to the aforementioned property, it is recommended to obtain a finished floor elevation as well as some additional spot elevations on the property itself.

The predicted peak velocity (averaged across the channel) for the majority of the open channel segments exceeded 3 feet per second with the highest velocities (5 to 6 fps) predicted at conduits HC-0135X and HC-0150X during the 100-year/24-hour design storm event. It should be noted that the reported velocities represent the average velocity across the channel and that velocities in some portions of the channel would exceed the reported peak velocity. Velocities exceeding 3 fps in unlined channels can be erosive. Therefore the model results indicate potential for channel erosion.

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Table 2
Howell Creek Modeling Support - Lake Howell Road to SR436
Existing Conditions Results

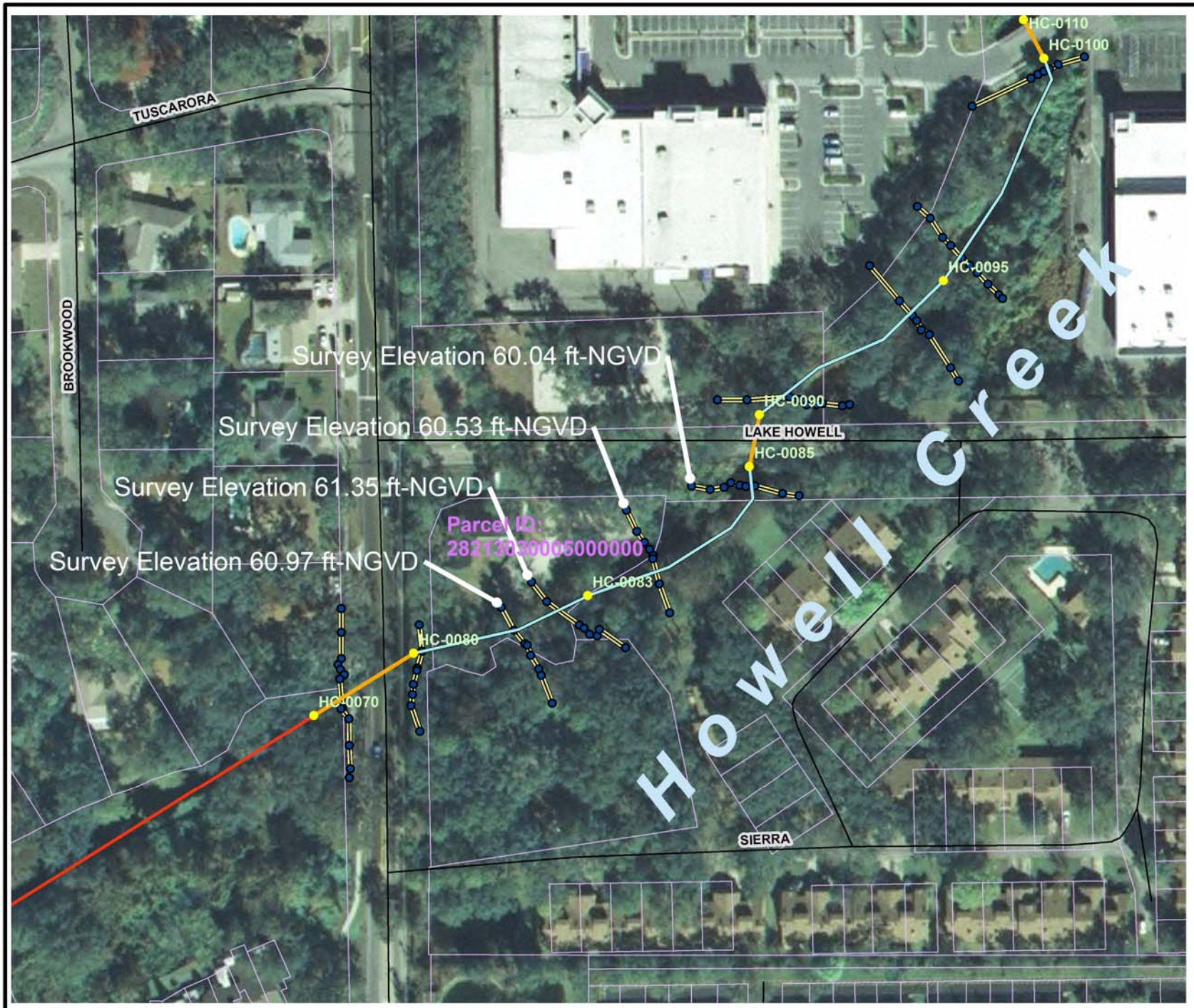
Culverts and Bridges

		Critical Elevation	Assigned LOS			Mean Annual			10-Year/24-Hour Storm			25-Year/24-Hour Storm			100-Year/24-Hour Storm			Depth of Flooding
Model ID	Description	U/S Node		U/S Node	D/S Node	Stage (ft)	Flow (cfs)	Peak Velocity (fps)	Stage (ft)	Flow (cfs)	Peak Velocity (fps)	Stage (ft)	Flow (cfs)	Peak Velocity (fps)	Stage (ft)	Flow (cfs)	Peak Velocity (fps)	during Assigned LOS
HC-0040B	Temple Trail	67.9	100	HC-0040	HC-0050	61.6	198	4.1	62.2	305	4.6	62.8	423	5.1	63.8	661	5.9	no flooding
HC-0062W	Howell Creek Dam	65.0	25	LWu-0010	HC-0070	61.5	419	3.9	62.0	669	4.1	62.5	971	4.3	63.2	1506	4.7	no flooding
HC-0070B	Lake Howell Road	65.5	100	HC-0070	HC-0080	59.1	419	3.5	60.3	669	4.4	61.3	970	5.1	62.7	1505	5.7	no flooding
HC-0085B	Lake Howell Lane	63.7	100	HC-0085	HC-0090	58.8	506	2.7	59.9	751	2.5	61.0	1058	2.5	62.4	1507	2.6	no flooding
HC-0100B	Walmart Shopping Center	67.2	100	HC-0100	HC-0110	58.5	438	3.3	59.5	681	3.8	60.5	971	4.2	61.9	1536	4.8	no flooding
HC-0120B	Walmart Shopping Center	66.8	100	HC-0120	HC-0130	58.1	443	5.6	59.1	688	6.4	60.0	981	5.8	61.4	1522	5.7	no flooding
HC-0140B	SR436	67.6	100	HC-0140	HC-0150	56.7	442	7.5	57.3	688	7.5	57.8	980	7.3	58.7	1522	7.2	no flooding

Open Channels

		Critical Elevation	Assigned LOS			Mean Annual			10-Year/24-Hour Storm			25-Year/24-Hour Storm			100-Year/24-Hour Storm			Depth of Flooding
Model ID	Description	TOB D/S		U/S Node	D/S Node	Stage (ft)	Flow (cfs)	Peak Velocity (fps)	Stage (ft)	Flow (cfs)	Peak Velocity (fps)	Stage (ft)	Flow (cfs)	Peak Velocity (fps)	Stage (ft)	Flow (cfs)	Peak Velocity (fps)	during Assigned LOS
HC-0080X	d/s Lake Howell Road	61.0	25	HC-0080	HC-0083	59.1	438	3.3	60.1	683	3.8	61.2	973	4.0	62.6	1507	4.0	0.2
HC-0083X	u/s Lake Howell Lane	60.0	25	HC-0083	HC-0085	58.9	438	3.3	60.0	681	3.5	61.0	971	3.5	62.5	1545	3.5	1.0
HC-0090X	d/s Lake Howell Lane	66.0	25	HC-0090	HC-0095	58.8	438	2.3	59.9	681	2.6	60.9	971	2.7	62.4	1531	3.0	no flooding
HC-0095X	Walmart Shopping Center	65.0	25	HC-0095	HC-0100	58.7	438	2.4	59.8	682	2.9	60.8	973	3.2	62.2	1507	3.6	no flooding
HC-0110X	Walmart Shopping Center	68.0	25	HC-0110	HC-0115	58.4	438	3.2	59.4	681	3.7	60.3	971	4.1	61.7	1507	4.6	no flooding
HC-0115X	Walmart Shopping Center	67.9	25	HC-0115	HC-0120	58.3	443	2.5	59.2	688	3.1	60.2	981	3.4	61.6	1543	3.8	no flooding
HC-0130X	Walmart Shopping Center	68.1	25	HC-0130	HC-0135	57.5	443	2.5	58.3	688	3.1	59.1	981	3.7	60.3	1522	4.5	no flooding
HC-0135X	u/s of SR436	60.3	25	HC-0135	HC-0140	57.1	443	2.9	57.8	688	3.8	58.3	981	4.7	59.1	1522	6.0	no flooding
HC-0150X	d/s of SR436	58.4	25	HC-0150	LH-0090	55.3	442	4.0	55.8	687	4.6	56.5	979	5.1	58.0	1518	5.8	no flooding

*Reported velocities represent the average velocity across the channel and that velocities in some portions of the channel would exceed the reported peak velocity.



LEGEND

Model Schematic

Type

- Linking Node
- Storage Node
- Control Structure
- Bridge
- Pipe
- Overland Flow
- Open channel
- Survey points
- Survey x-secs
- Streets
- County Boundary
- Major Roads

N
W E
S

0 70 140
Feet

Seminole County
Howell Creek Basin CIP

Aerial Imagery Source: Seminole County, 2008

CDM

Figure 5
Predicted Flooding Location

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ATTACHMENT 1

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================================================================================
==== Basins ====================================================================
================================================================================

        Name: HC-013                  Node: HC-0040               Status: Onsite
       Group: Howell Creek            Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh323                  Peaking Factor: 323.0
         Rainfall File:                 Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000             Time of Conc(min): 55.70
            Area(ac): 101.000               Time Shift(hrs): 0.00
        Curve Number: 74.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 1.60



--------------------------------------------------------------------------------------------------
        Name: HC-014                  Node: LWu-0010              Status: Onsite
       Group: Howell Creek            Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh323                  Peaking Factor: 323.0
         Rainfall File:                 Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000             Time of Conc(min): 66.30
            Area(ac): 806.000               Time Shift(hrs): 0.00
        Curve Number: 75.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 27.70



--------------------------------------------------------------------------------------------------
        Name: HC-015                  Node: HC-0080               Status: Onsite
       Group: Howell Creek            Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh323                  Peaking Factor: 323.0
         Rainfall File:                 Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000             Time of Conc(min): 24.20
            Area(ac): 212.000               Time Shift(hrs): 0.00
        Curve Number: 89.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 3.90



--------------------------------------------------------------------------------------------------
        Name: HC-016                  Node: HC-0115               Status: Onsite
       Group: Howell Creek            Type: SCS Unit Hydrograph CN

       Unit Hydrograph: Uh323                  Peaking Factor: 323.0
         Rainfall File:                 Storm Duration(hrs): 0.00
   Rainfall Amount(in): 0.000             Time of Conc(min): 16.30
            Area(ac): 31.400                Time Shift(hrs): 0.00
        Curve Number: 87.00             Max Allowable Q(cfs): 999999.000
             DCIA(%): 9.30

Updated for Seminole County Lake Howell Lane CIP (July 2009)

================================================================================
==== Nodes =====================================================================
================================================================================

      Name: HC-0040             Base Flow(cfs): 0.000         Init Stage(ft): 58.900
     Group: Howell Creek                                      Warn Stage(ft): 73.000
      Type: Stage/Area



      Stage(ft)        Area(ac)
--------------- ---------------
         59.000          0.1000
         63.000         12.0000
         65.000         14.0000
         66.000         28.2000
         67.000         43.7000
         68.000         63.1000

--------------------------------------------------------------------------------------------------
      Name: HC-0070             Base Flow(cfs): 0.000         Init Stage(ft): 54.240
     Group: Howell Creek                                      Warn Stage(ft): 66.000
      Type: Stage/Area

changed IS from 58.61

      Stage(ft)        Area(ac)
--------------- ---------------
         54.240          0.1000
         69.000          0.1000

--------------------------------------------------------------------------------------------------
      Name: HC-0080             Base Flow(cfs): 0.000         Init Stage(ft): 54.240
```

Group: Howell Creek Warn Stage(ft): 64.000
Type: Stage/Area

Stage(ft)	Area(ac)
54.280	0.1000
56.000	6.0000

Name: HC-0083 Base Flow(cfs): 0.000 Init Stage(ft): 54.240
Group: Howell Creek Warn Stage(ft): 64.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0085 Base Flow(cfs): 0.000 Init Stage(ft): 54.240
Group: Howell Creek Warn Stage(ft): 66.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0090 Base Flow(cfs): 0.000 Init Stage(ft): 54.240
Group: Howell Creek Warn Stage(ft): 63.647
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0095 Base Flow(cfs): 0.000 Init Stage(ft): 54.240
Group: Howell Creek Warn Stage(ft): 66.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0100 Base Flow(cfs): 0.000 Init Stage(ft): 54.240
Group: Howell Creek Warn Stage(ft): 66.280
Type: Stage/Area

Stage(ft)	Area(ac)
55.300	0.1000
75.000	0.1000

Name: HC-0110 Base Flow(cfs): 0.000 Init Stage(ft): 54.240
Group: Howell Creek Warn Stage(ft): 67.188
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0115 Base Flow(cfs): 0.000 Init Stage(ft): 54.240
Group: Howell Creek Warn Stage(ft): 67.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0120 Base Flow(cfs): 0.000 Init Stage(ft): 54.240
Group: Howell Creek Warn Stage(ft): 66.610
Type: Stage/Area

Stage(ft)	Area(ac)
54.400	0.1000
74.000	0.1000

Name: HC-0130 Base Flow(cfs): 0.000 Init Stage(ft): 53.380
Group: Howell Creek Warn Stage(ft): 66.810
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0135 Base Flow(cfs): 0.000 Init Stage(ft): 53.080
Group: Howell Creek Warn Stage(ft): 67.000
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0140 Base Flow(cfs): 0.000 Init Stage(ft): 53.080
Group: Howell Creek Warn Stage(ft): 65.470
Type: Stage/Area

Stage(ft)	Area(ac)

Name: HC-0150 Base Flow(cfs): 0.000 Init Stage(ft): 53.080
Group: Howell Creek Warn Stage(ft): 63.800
Type: Stage/Area

Stage(ft)	Area(ac)

Name: LH-0090 Base Flow(cfs): 0.000 Init Stage(ft): 53.080
Group: Lake Howell Warn Stage(ft): 58.410
Type: Time/Stage

Lake Howell
Seminole County Water Atlas - Corrected to NGVD29

Time(hrs)	Stage(ft)
0.00	53.080
999.00	53.080

Name: LWu-0010 Base Flow(cfs): 0.000 Init Stage(ft): 58.450
Group: Lake Waumpi Warn Stage(ft): 65.000
Type: Stage/Area

Lake Waumpi
Seminole County Water Atlas -Corrected to NGVD29
(long term average stage is 59.4)
modified initial stage - set to control elevation of dam d/s based on updated survey (SSMC, 2009)

Stage(ft)	Area(ac)
55.000	10.0000
58.000	12.0000
59.000	13.1000
60.000	32.4000
62.000	51.9800
63.000	61.4000
64.000	69.5400

==========
==== Cross Sections ==========
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Name: HC0040RXS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N

-100.000	75.000	0.030000
0.000	73.000	0.030000
51.000	73.000	0.030000
109.000	73.000	0.030000
149.000	73.000	0.030000
200.000	74.000	0.030000
249.000	74.000	0.030000
300.000	75.000	0.030000

Name: HC0040XS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
500.000	77.000	0.070000
1120.000	69.000	0.070000
1140.000	70.000	0.070000
1160.000	71.000	0.070000
1190.000	72.000	0.070000
1200.000	70.000	0.040000
1210.000	61.600	0.040000
1215.000	59.200	0.040000
1222.000	58.900	0.040000
1228.000	59.300	0.040000
1233.000	62.400	0.040000
1243.000	68.000	0.040000
1250.000	72.000	0.040000
1270.000	72.000	0.070000
1330.000	72.000	0.070000
1350.000	73.000	0.070000
1380.000	73.000	0.070000
1455.000	74.000	0.070000
1550.000	74.000	0.070000
1600.000	75.000	0.070000
1650.000	76.000	0.070000
1670.000	77.000	0.070000
1720.000	78.000	0.070000
1790.000	78.000	0.070000
1870.000	77.000	0.070000
1940.000	76.800	0.070000
1990.000	76.000	0.070000
2220.000	75.000	0.070000
2230.000	74.000	0.070000
2270.000	74.000	0.070000
2280.000	74.000	0.070000

Name: HC0041XS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
1120.000	71.000	0.070000
1140.000	71.000	0.070000
1160.000	71.000	0.070000
1190.000	71.000	0.070000
1200.000	68.000	0.040000
1210.000	61.200	0.040000
1215.000	58.600	0.040000
1222.000	58.200	0.040000
1228.000	58.600	0.040000
1233.000	61.300	0.040000
1243.000	63.000	0.040000
1250.000	65.000	0.040000
1270.000	70.000	0.040000
1330.000	70.000	0.070000
1350.000	70.000	0.070000
1380.000	70.000	0.070000
1455.000	73.000	0.070000
1550.000	74.000	0.070000
1600.000	75.000	0.070000
1650.000	76.000	0.070000
1670.000	76.000	0.070000
1720.000	76.000	0.070000
1790.000	76.000	0.070000
1870.000	76.000	0.070000
1940.000	76.000	0.070000
1990.000	75.800	0.070000
2220.000	75.000	0.070000
2230.000	75.000	0.070000
2270.000	74.000	0.070000
2280.000	74.000	0.070000

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---------------------------------------------------------------------
             Name: HC0062WXS                   Group: Howell Creek
      Encroachment: No

proposed cross-section from survey (Inwood, 2009)
```

Station(ft)	Elevation(ft)	Manning's N
-135.000	66.050	0.060000
-120.000	65.050	0.040000
-110.000	64.050	0.040000
-100.000	63.050	0.040000
-85.000	62.050	0.040000
-30.000	61.050	0.040000
-5.000	60.050	0.040000
0.000	59.550	0.040000
0.990	59.550	0.013000
1.000	59.050	0.013000
5.500	58.750	0.013000
6.300	58.450	0.013000
10.700	58.450	0.013000
11.500	58.750	0.013000
16.000	59.050	0.013000
16.010	59.550	0.013000
17.000	59.550	0.013000
20.000	60.050	0.040000
35.000	61.050	0.040000
45.000	62.050	0.040000
55.000	63.050	0.040000
60.000	64.050	0.040000
80.000	65.050	0.040000
90.000	66.050	0.060000

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---------------------------------------------------------------------
             Name: HC0070BXS                   Group: Howell Creek
      Encroachment: No
```

Station(ft)	Elevation(ft)	Manning's N
-400.000	70.000	0.070000
-130.000	68.000	0.070000
150.000	66.000	0.070000
220.000	64.800	0.070000
266.000	65.400	0.070000
277.000	57.300	0.030000
288.000	55.600	0.030000
297.000	57.300	0.030000
311.000	65.400	0.030000
390.000	66.000	0.070000
511.000	68.000	0.070000
611.000	70.000	0.070000

```
---------------------------------------------------------------------
             Name: HC0070RXS                   Group: Howell Creek
      Encroachment: No
```

Station(ft)	Elevation(ft)	Manning's N
-100.000	66.000	0.016000
0.000	65.830	0.016000
50.000	65.660	0.016000
100.000	65.770	0.016000
157.000	65.530	0.016000
207.000	65.820	0.016000
255.000	66.060	0.016000
305.000	66.490	0.016000

```
---------------------------------------------------------------------
             Name: HC0071BXS                   Group: Howell Creek
      Encroachment: No
```

Station(ft)	Elevation(ft)	Manning's N
225.000	65.000	0.070000
255.000	64.600	0.070000
276.000	57.300	0.030000
280.000	56.400	0.030000
287.000	56.000	0.030000
295.000	55.900	0.030000
304.000	60.600	0.030000
350.000	63.700	0.070000

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Name: HC0071BXS1 Group: Howell Creek
Encroachment: No

modified x-sec invert to match channel invert

Station(ft)	Elevation(ft)	Manning's N
225.000	65.000	0.070000
255.000	64.600	0.070000
276.000	57.300	0.030000
280.000	52.460	0.030000
287.000	52.060	0.030000
295.000	55.900	0.030000
304.000	60.600	0.030000
350.000	63.700	0.070000

Name: HC0071BXS2 Group: Howell Creek
Encroachment: No

modified x-sec invert to match channel invert

Station(ft)	Elevation(ft)	Manning's N
225.000	65.000	0.070000
255.000	64.600	0.070000
276.000	57.300	0.030000
280.000	53.300	0.030000
287.000	52.900	0.030000
295.000	55.900	0.030000
304.000	60.600	0.030000
350.000	63.700	0.070000

Name: HC0080XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_02

Station(ft)	Elevation(ft)	Manning's N
-7.000	66.000	0.070000
0.000	61.890	0.070000
26.640	60.260	0.030000
44.069	58.710	0.030000
46.400	54.960	0.030000
60.784	54.280	0.030000
70.760	54.840	0.030000
82.044	60.640	0.030000
109.047	61.160	0.070000
193.000	67.000	0.070000

Name: HC0081XS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
141.000	63.000	0.070000
201.000	60.600	0.070000
249.000	59.100	0.070000
253.000	57.200	0.030000
254.500	56.400	0.030000
259.000	54.900	0.030000
269.000	53.100	0.030000
279.000	52.800	0.030000
284.000	53.000	0.030000
287.000	52.700	0.030000
291.000	53.900	0.030000
296.000	55.500	0.030000
300.000	57.200	0.030000
300.500	58.800	0.030000
303.000	59.600	0.030000
326.000	60.600	0.070000
358.000	62.600	0.070000
374.000	67.300	0.070000

Name: HC0083XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_04

Station(ft)	Elevation(ft)	Manning's N
-48.000	63.000	0.070000
0.000	61.350	0.070000

24.686	59.380	0.030000
65.029	56.950	0.030000
70.859	54.980	0.030000
78.758	54.420	0.030000
86.577	54.130	0.030000
93.193	59.080	0.030000
125.080	60.550	0.070000
141.000	64.000	0.070000

Name: HC0083XS1 Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_04; modified x-sec invert to match channel invert

Station(ft)	Elevation(ft)	Manning's N
-48.000	63.000	0.070000
0.000	61.350	0.070000
24.686	59.380	0.030000
65.029	56.950	0.030000
70.859	53.560	0.030000
78.758	53.060	0.030000
86.577	52.760	0.030000
93.193	59.080	0.030000
125.080	60.550	0.070000
141.000	64.000	0.070000

Name: HC0084XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_05

Station(ft)	Elevation(ft)	Manning's N
-54.000	65.000	0.070000
0.000	60.530	0.070000
23.528	59.870	0.030000
36.773	54.350	0.030000
45.250	52.480	0.030000
52.427	54.260	0.030000
55.593	56.920	0.030000
81.717	58.990	0.030000
112.358	60.790	0.030000
181.800	63.000	0.070000

Name: HC0085BXS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
200.000	66.000	0.070000
250.000	65.000	0.070000
263.000	63.800	0.070000
264.000	57.300	0.030000
268.000	55.200	0.030000
272.000	55.300	0.030000
277.000	51.700	0.030000
291.000	51.200	0.030000
297.000	54.000	0.030000
312.000	59.500	0.030000
340.000	63.000	0.030000
360.000	64.000	0.070000
445.000	66.000	0.070000

Name: HC0085RXS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
-100.000	66.000	0.016000
0.000	64.940	0.016000
53.000	64.540	0.016000
108.000	64.470	0.016000
158.000	64.200	0.016000
202.000	64.030	0.016000
258.000	63.680	0.016000
309.000	63.760	0.016000
361.000	63.730	0.016000
414.000	63.760	0.016000
500.000	66.000	0.016000

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             Name: HC0085XS                    Group: Howell Creek
      Encroachment: No

SSMC x-sec HCHL_06

    Station(ft)   Elevation(ft)     Manning's N
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       -277.000          68.000        0.070000
          0.000          60.040        0.070000
         18.717          57.620        0.030000
         32.888          54.770        0.030000
         41.053          54.690        0.030000
         50.163          53.740        0.030000
         56.179          54.240        0.030000
         65.431          56.050        0.030000
         94.086          60.190        0.030000
        110.681          60.770        0.070000
        222.200          66.000        0.070000

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             Name: HC0086BXS                   Group: Howell Creek
      Encroachment: No


    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
         70.000          66.000        0.070000
        197.090          63.800        0.070000
        198.510          56.100        0.030000
        206.320          56.000        0.030000
        210.580          55.000        0.030000
        215.550          54.000        0.030000
        224.070          54.000        0.030000
        231.880          55.000        0.030000
        236.140          63.400        0.030000
        275.000          65.000        0.070000
        300.000          66.000        0.070000

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             Name: HC0090XS                    Group: Howell Creek
      Encroachment: No

SSMC x-sec HCHL_07

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
        -30.000          65.000        0.070000
          0.000          62.450        0.070000
         29.200          62.010        0.070000
         71.635          58.390        0.030000
         81.571          53.650        0.030000
         90.774          53.200        0.030000
        100.856          53.030        0.030000
        106.581          55.280        0.030000
        126.606          59.640        0.030000
        133.817          59.810        0.070000
        160.000          64.000        0.070000

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             Name: HC0091XS                    Group: Howell Creek
      Encroachment: No

SSMC x-sec HCHL_08

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
        -27.000          69.000        0.070000
          0.000          67.870        0.070000
         46.099          55.640        0.030000
         65.818          55.310        0.030000
         72.321          53.910        0.030000
         82.209          53.280        0.030000
         82.772          53.670        0.030000
         91.674          58.640        0.030000
        131.080          65.840        0.030000
        146.196          65.970        0.070000
        284.000          68.000        0.070000

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             Name: HC0093XS                    Group: Howell Creek
      Encroachment: No

SSMC x-sec HCHL_09

    Station(ft)   Elevation(ft)     Manning's N
--------------- --------------- ---------------
        -20.000          69.000        0.070000
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0.000	67.810	0.070000
17.268	61.520	0.070000
40.022	59.330	0.030000
51.251	54.430	0.030000
68.077	53.340	0.030000
78.840	54.190	0.030000
89.222	60.510	0.030000
104.913	62.480	0.070000
119.997	66.780	0.070000
125.138	67.270	0.070000
219.000	69.000	0.070000

Name: HC0094XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_10

Station(ft)	Elevation(ft)	Manning's N
-70.000	69.000	0.070000
0.000	67.080	0.070000
64.847	56.070	0.030000
72.799	53.560	0.030000
79.629	52.830	0.030000
85.561	52.960	0.030000
95.525	61.630	0.030000
122.773	64.960	0.030000
186.000	70.000	0.070000

Name: HC0095XS Group: Howell Creek
Encroachment: No

Southeastern Survey (B28-002B) WalMart Shopping Plaza

Station(ft)	Elevation(ft)	Manning's N
0.000	67.350	0.016000
39.000	67.960	0.016000
40.000	68.050	0.016000
41.000	68.440	0.016000
53.000	68.660	0.016000
64.000	68.620	0.016000
65.000	68.260	0.016000
66.000	68.210	0.016000
104.000	67.740	0.016000
137.000	67.290	0.016000
140.000	67.280	0.016000
141.000	67.650	0.016000
151.000	67.070	0.070000
195.000	64.540	0.070000
218.000	55.590	0.035000
267.000	54.980	0.035000
290.000	61.260	0.035000
314.000	65.210	0.035000
314.000	69.380	0.070000
318.000	69.520	0.070000
322.000	69.530	0.016000
322.000	69.040	0.016000
335.000	68.940	0.016000
416.000	69.400	0.016000
494.000	68.650	0.016000

Name: HC0100RXS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
-500.000	70.000	0.016000
0.000	67.767	0.016000
40.000	67.260	0.016000
74.000	67.188	0.016000
90.000	67.775	0.016000
100.000	67.723	0.016000
170.000	67.820	0.016000
221.000	68.710	0.016000
274.000	69.433	0.016000
349.000	69.928	0.016000
418.000	70.239	0.016000

Name: HC0100XS Group: Howell Creek
Encroachment: No

Southeastern Survey (B28-002B) WalMart Shopping Plaza

Station(ft)	Elevation(ft)	Manning's N
0.000	67.710	0.016000
90.000	67.110	0.016000
132.000	66.910	0.016000
134.000	67.000	0.016000
134.000	67.380	0.016000
135.000	67.260	0.016000
176.000	67.780	0.016000
201.000	62.350	0.035000
212.000	55.410	0.035000
277.000	55.690	0.035000
320.000	70.340	0.035000
324.000	70.720	0.016000
324.000	70.250	0.016000
420.000	69.650	0.016000
504.000	68.540	0.016000
519.000	69.300	0.016000

Name: HC0105XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_11

Station(ft)	Elevation(ft)	Manning's N
-58.000	68.000	0.070000
0.000	67.430	0.070000
16.105	63.900	0.070000
31.689	60.210	0.030000
38.573	56.700	0.030000
46.011	53.550	0.030000
48.191	52.760	0.030000
53.087	53.260	0.030000
56.950	53.560	0.030000
70.678	56.570	0.030000
103.059	63.100	0.030000
131.626	70.550	0.070000

Name: HC0108XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_12

Station(ft)	Elevation(ft)	Manning's N
-29.000	68.000	0.070000
0.000	67.980	0.070000
8.419	66.450	0.070000
23.237	60.620	0.070000
48.277	59.540	0.030000
55.353	55.700	0.030000
58.332	53.540	0.030000
65.488	53.200	0.030000
67.562	51.050	0.030000
73.207	52.870	0.030000
74.127	53.510	0.030000
80.021	56.110	0.030000
88.838	56.230	0.030000
101.911	61.120	0.030000
109.881	66.640	0.070000
117.447	70.270	0.070000

Name: HC0110XS Group: Howell Creek
Encroachment: No

Southeastern Survey (B28-003B) WalMart Shopping Plaza, X-Sec(38)

Station(ft)	Elevation(ft)	Manning's N
0.000	67.720	0.016000
1.000	67.820	0.016000
2.000	68.200	0.016000
10.000	68.000	0.016000
17.000	68.050	0.016000
18.000	67.640	0.016000
19.000	67.590	0.016000
47.000	67.430	0.016000
98.000	67.340	0.016000
99.000	67.450	0.016000
99.000	67.820	0.016000
106.000	68.220	0.016000
110.000	68.200	0.016000
111.000	67.770	0.016000
112.000	67.690	0.016000

122.000	67.710	0.016000
134.000	67.710	0.016000
135.000	67.760	0.016000
135.000	68.130	0.016000
139.000	67.820	0.016000
143.000	66.260	0.035000
144.000	61.130	0.035000
172.000	59.680	0.035000
188.000	54.490	0.035000
202.000	53.990	0.035000
206.000	56.820	0.035000
219.000	56.790	0.035000
233.000	63.140	0.035000
255.000	70.470	0.035000
257.000	70.560	0.016000
257.000	70.110	0.016000
289.000	69.870	0.016000
354.000	69.550	0.016000
373.000	69.200	0.016000
389.000	69.440	0.016000
389.000	69.920	0.016000
400.000	70.030	0.016000
411.000	69.840	0.016000
411.000	69.380	0.016000
459.000	69.480	0.016000

Name: HC0115XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_13

Station(ft)	Elevation(ft)	Manning's N
-67.000	69.000	0.070000
0.000	67.910	0.070000
7.195	63.750	0.070000
34.595	60.840	0.030000
45.264	56.850	0.030000
52.339	53.880	0.030000
54.712	53.180	0.030000
56.006	53.050	0.030000
59.167	52.990	0.030000
60.315	53.180	0.030000
63.630	53.500	0.030000
67.727	55.430	0.030000
90.046	55.670	0.030000
99.926	60.680	0.030000
115.574	70.340	0.070000

Name: HC0115XS1 Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_13; modified x-sec invert to match channel invert

Station(ft)	Elevation(ft)	Manning's N
-67.000	69.000	0.070000
0.000	67.910	0.070000
7.195	63.750	0.070000
34.595	60.840	0.030000
45.264	56.850	0.030000
52.339	55.130	0.030000
54.712	54.430	0.030000
56.006	54.300	0.030000
59.167	54.240	0.030000
60.315	54.430	0.030000
63.630	54.730	0.030000
67.727	55.430	0.030000
90.046	55.670	0.030000
99.926	60.680	0.030000
115.574	70.340	0.070000

Name: HC0120RXS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
-500.000	70.000	0.016000
0.000	67.390	0.016000
47.000	67.070	0.016000
58.000	66.960	0.016000
92.000	66.810	0.016000
94.000	66.920	0.016000
102.000	67.450	0.016000

108.000	66.960	0.016000
134.000	67.960	0.016000
144.000	67.110	0.016000
157.000	67.240	0.016000
232.000	68.430	0.016000
288.000	69.750	0.016000
401.000	68.670	0.016000
461.000	69.520	0.016000
475.000	70.400	0.016000

Name: HC0120XS Group: Howell Creek
Encroachment: No

Southeastern Survey (B28-003B) WalMart Shopping Plaza, X-Sec(38)

Station(ft)	Elevation(ft)	Manning's N
0.000	68.230	0.016000
41.000	67.820	0.016000
82.000	67.970	0.016000
83.000	68.060	0.016000
84.000	68.450	0.016000
90.000	68.360	0.016000
98.000	68.180	0.016000
98.000	67.780	0.016000
98.000	67.780	0.016000
100.000	67.730	0.016000
125.000	67.330	0.016000
157.000	67.470	0.016000
158.000	67.530	0.016000
158.000	67.970	0.016000
169.000	68.340	0.016000
178.000	68.210	0.016000
178.000	67.780	0.016000
180.000	67.710	0.016000
203.000	67.190	0.016000
223.000	67.630	0.016000
223.000	68.130	0.016000
226.000	68.010	0.016000
228.000	67.990	0.016000
233.000	68.070	0.016000
234.000	68.440	0.016000
234.000	63.080	0.035000
265.000	60.190	0.035000
274.000	54.890	0.035000
313.000	51.870	0.035000
316.000	57.870	0.035000
349.000	69.440	0.035000
362.000	70.760	0.035000
362.000	70.270	0.016000
427.000	69.150	0.016000
461.000	69.710	0.016000
461.000	70.200	0.016000
470.000	70.450	0.016000
480.000	69.520	0.016000
480.000	69.050	0.016000
515.000	68.430	0.016000
545.000	68.750	0.016000

Name: HC0130XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_14

Station(ft)	Elevation(ft)	Manning's N
-9.000	68.000	0.070000
0.000	67.020	0.070000
16.646	62.370	0.070000
30.970	57.980	0.030000
37.249	53.470	0.030000
44.154	52.990	0.030000
51.797	52.870	0.030000
59.905	52.780	0.030000
69.178	53.040	0.030000
77.551	53.050	0.030000
82.631	56.670	0.030000
98.794	61.150	0.030000
122.660	66.240	0.030000
140.453	70.050	0.070000
170.812	70.230	0.070000

Name: HC0135XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_15

Station(ft)	Elevation(ft)	Manning's N
-110.000	68.200	0.070000
0.000	68.050	0.070000
8.337	63.320	0.070000
38.072	60.120	0.030000
64.593	56.120	0.030000
75.035	53.020	0.030000
79.786	52.730	0.030000
87.766	52.800	0.030000
94.021	58.810	0.030000
97.043	59.160	0.030000
109.815	64.480	0.030000
129.547	70.300	0.070000
142.152	71.250	0.070000

Name: HC0137XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_16

Station(ft)	Elevation(ft)	Manning's N
-70.000	69.000	0.070000
0.000	68.730	0.070000
8.721	62.830	0.070000
31.470	59.450	0.030000
36.145	59.170	0.030000
43.584	53.150	0.030000
45.005	52.920	0.030000
63.978	52.530	0.030000
69.228	52.720	0.030000
73.184	53.620	0.030000
75.375	54.750	0.030000
102.404	61.560	0.030000
156.697	64.360	0.070000
173.644	68.360	0.070000

Name: HC0140BXS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
190.000	67.500	0.050000
207.000	53.800	0.050000
232.000	51.800	0.035000
238.000	48.900	0.035000
296.000	49.400	0.035000
303.000	50.900	0.035000
332.000	51.000	0.035000
357.000	52.900	0.035000
375.000	68.100	0.050000

Name: HC0140RXS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
0.000	67.930	0.016000
35.000	67.560	0.016000
51.000	67.580	0.016000
94.000	67.640	0.016000
144.000	67.670	0.016000
196.000	67.750	0.016000
235.000	67.920	0.016000

Name: HC0140XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_17

Station(ft)	Elevation(ft)	Manning's N
-66.000	67.000	0.070000
0.000	61.260	0.070000
28.894	58.300	0.070000
51.257	56.380	0.030000
63.106	55.300	0.030000
69.116	52.980	0.030000
72.480	52.480	0.030000

75.258	52.500	0.030000
78.743	52.710	0.030000
79.803	53.110	0.030000
84.152	55.260	0.030000
110.838	56.060	0.030000
136.349	57.290	0.030000
156.589	60.260	0.070000
200.000	66.000	0.070000

Name: HC0150BXS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
175.000	67.500	0.050000
200.000	54.100	0.050000
207.000	52.900	0.035000
222.000	49.600	0.035000
247.000	51.200	0.035000
272.000	50.400	0.035000
280.000	49.000	0.035000
288.000	48.300	0.035000
294.000	48.500	0.035000
303.000	51.100	0.035000
347.000	51.900	0.035000
360.000	67.700	0.050000

Name: HC0150XS Group: Howell Creek
Encroachment: No

SSMC x-sec HCHL_17

Station(ft)	Elevation(ft)	Manning's N
-90.000	60.000	0.070000
0.000	58.460	0.070000
34.429	56.520	0.070000
64.114	54.310	0.030000
90.397	53.980	0.030000
94.543	52.030	0.030000
96.384	51.770	0.030000
98.274	51.290	0.030000
102.515	51.480	0.030000
104.766	52.010	0.030000
111.967	54.360	0.030000
141.793	55.440	0.030000
178.134	60.590	0.030000
237.000	61.000	0.070000

Name: HC0151XS Group: Howell Creek
Encroachment: No

Station(ft)	Elevation(ft)	Manning's N
0.000	63.000	0.070000
23.000	62.000	0.070000
55.000	60.000	0.070000
160.000	58.000	0.070000
200.000	56.000	0.070000
211.000	53.100	0.035000
238.000	49.100	0.035000
253.000	50.700	0.035000
262.000	47.500	0.035000
269.000	48.100	0.035000
278.000	47.600	0.035000
287.000	48.800	0.035000
303.000	50.200	0.035000
357.000	56.500	0.035000
392.000	64.300	0.070000
437.000	66.000	0.070000

==========

==== Operating Tables ==========

==========

Name: Group: BASE
Type: Bottom Clip
Function: Time vs. Depth of Clip

Time(hrs)	Clip Depth(in)

```
-------------- --------------

================================================================================
==== Pipes =====================================================================
================================================================================

        Name:                     From Node:                   Length(ft): 0.00
       Group: BASE                  To Node:                        Count: 1
                                                          Friction Equation: Automatic
              UPSTREAM       DOWNSTREAM                Solution Algorithm: Most Restrictive
    Geometry: Circular       Circular                             Flow: Both
    Span(in): 0.00           0.00                     Entrance Loss Coef: 0.00
    Rise(in): 0.00           0.00                         Exit Loss Coef: 1.00
  Invert(ft): 0.000          0.000                        Bend Loss Coef: 0.00
 Manning's N: 0.000000       0.000000                   Outlet Ctrl Spec: Use dc or tw
Top Clip(in): 0.000          0.000                       Inlet Ctrl Spec: Use dc
Bot Clip(in): 0.000          0.000                    Stabilizer Option: None


Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall


================================================================================
==== Channels ==================================================================
================================================================================

         Name: HC-0040B            From Node: HC-0040           Length(ft): 40.00
        Group: Howell Creek          To Node: LWu-0010               Count: 1

               UPSTREAM       DOWNSTREAM                Friction Equation: Automatic
     Geometry: Trapezoidal    Trapezoidal              Solution Algorithm: Automatic
   Invert(ft): 58.900         58.900                               Flow: Both
TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.300
  Manning's N: 0.040000       0.040000                     Expansion Coef: 0.500
 Top Clip(ft): 0.000          0.000                    Entrance Loss Coef: 0.000
 Bot Clip(ft): 0.000          0.000                        Exit Loss Coef: 0.000
    Main XSec:                                         Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft):                                          Inlet Ctrl Spec: Use dn
    Aux XSec1:                                       Stabilizer Option: None
 AuxElev2(ft):
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft): 13.000         13.000
 LtSdSlp(h/v): 2.10           2.10
 RtSdSlp(h/v): 2.10           2.10

SJ94-3 (neworng.dat Bridge #1) - Temple Trail
removed top clip
Top Clip Ref Elev: 76.2, 76.2
Top Clip 3.2, 3.2

-------------------------------------------------------------------------------------------------
         Name: HC-0070B            From Node: HC-0070           Length(ft): 34.00
        Group: Howell Creek          To Node: HC-0080               Count: 1

               UPSTREAM       DOWNSTREAM                Friction Equation: Average Conveyance
     Geometry: Irregular      Irregular                Solution Algorithm: Automatic
   Invert(ft): 52.060         52.900                               Flow: Both
TClpInitZ(ft): 65.700         65.700                     Contraction Coef: 0.300
  Manning's N:                                            Expansion Coef: 0.500
 Top Clip(ft):                                         Entrance Loss Coef: 0.000
 Bot Clip(ft):                                             Exit Loss Coef: 0.000
    Main XSec: HC0071BXS1     HC0071BXS2                 Outlet Ctrl Spec: Use dc or tw
 AuxElev1(ft): 0.000          0.000                       Inlet Ctrl Spec: Use dn
    Aux XSec1:                                       Stabilizer Option: None
 AuxElev2(ft): 0.000          0.000
    Aux XSec2:
Top Width(ft):
    Depth(ft):
Bot Width(ft):
 LtSdSlp(h/v):
 RtSdSlp(h/v):

SJ94-3 (sem.dat Bridge #19) - Lake Howell Rd
inverts taken from Howell Creek Lake Howell Lane to SR 436 CIP, Southeastern Surveying - 2009
SSMC x-sec HCHL_01, HCHL_02

-------------------------------------------------------------------------------------------------
         Name: HC-0080X            From Node: HC-0080           Length(ft): 188.00
        Group: Howell Creek          To Node: HC-0083               Count: 1

               UPSTREAM       DOWNSTREAM                Friction Equation: Automatic
```

```
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 54.280         52.760                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                 Contraction Coef: 0.300
   Manning's N:                                            Expansion Coef: 0.500
  Top Clip(ft):                                        Entrance Loss Coef: 0.000
  Bot Clip(ft):                                            Exit Loss Coef: 0.000
     Main XSec: HC0080XS       HC0083XS1                Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                     Inlet Ctrl Spec: Use dn
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_02, HCHL_04

-------------------------------------------------------------------------------------------------
          Name: HC-0083X            From Node: HC-0083           Length(ft): 227.00
         Group: Howell Creek          To Node: HC-0085                Count: 1

                UPSTREAM       DOWNSTREAM                Friction Equation: Automatic
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 52.760         53.820                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                 Contraction Coef: 0.100
   Manning's N:                                            Expansion Coef: 0.300
  Top Clip(ft):                                        Entrance Loss Coef: 0.000
  Bot Clip(ft):                                            Exit Loss Coef: 0.000
     Main XSec: HC0084XS       HC0085XS                 Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                     Inlet Ctrl Spec: Use dn
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_05, HCHL_06

-------------------------------------------------------------------------------------------------
          Name: HC-0085B            From Node: HC-0085           Length(ft): 35.00
         Group: Howell Creek          To Node: HC-0090                Count: 1

                UPSTREAM       DOWNSTREAM                Friction Equation: Automatic
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 53.820         53.030                                 Flow: Both
 TClpInitZ(ft): 64.400         63.300                   Contraction Coef: 0.300
   Manning's N:                                            Expansion Coef: 0.500
  Top Clip(ft):                                        Entrance Loss Coef: 0.000
  Bot Clip(ft):                                            Exit Loss Coef: 0.000
     Main XSec: HC0085XS       HC0090XS                 Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                     Inlet Ctrl Spec: Use dn
     Aux XSec1:                                         Stabilizer Option: Level Pool Option
  AuxElev2(ft): 0.000          0.000                   Stabilizer Tol(ft): 0.010
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

SJ94-3 (sem.dat Bridge #18) - Lake Howell Lane

-------------------------------------------------------------------------------------------------
          Name: HC-0090X            From Node: HC-0090           Length(ft): 221.00
         Group: Howell Creek          To Node: HC-0095                Count: 1

                UPSTREAM       DOWNSTREAM                Friction Equation: Automatic
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 53.030         53.100                                 Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                 Contraction Coef: 0.100
   Manning's N:                                            Expansion Coef: 0.300
  Top Clip(ft):                                        Entrance Loss Coef: 0.000
  Bot Clip(ft):                                            Exit Loss Coef: 0.000
     Main XSec: HC0090XS       HC0091XS                 Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                     Inlet Ctrl Spec: Use dn
     Aux XSec1:                                         Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
```

```
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_07, HCHL_08

-------------------------------------------------------------------------------------------------
          Name: HC-0095X            From Node: HC-0095           Length(ft): 255.00
         Group: Howell Creek          To Node: HC-0100                Count: 1

                UPSTREAM       DOWNSTREAM                Friction Equation: Automatic
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 53.100         52.810                               Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
   Manning's N:                                            Expansion Coef: 0.300
  Top Clip(ft):                                          Entrance Loss Coef: 0.000
  Bot Clip(ft):                                              Exit Loss Coef: 0.000
     Main XSec: HC0093XS       HC0094XS                  Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                      Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_09, HCHL_10

-------------------------------------------------------------------------------------------------
          Name: HC-0100B            From Node: HC-0100           Length(ft): 125.00
         Group: Howell Creek          To Node: HC-0110                Count: 1

                UPSTREAM       DOWNSTREAM                Friction Equation: Average Conveyance
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 52.810         52.760                               Flow: Both
 TClpInitZ(ft): 69.560         69.560                     Contraction Coef: 0.300
   Manning's N:                                            Expansion Coef: 0.500
  Top Clip(ft):                                          Entrance Loss Coef: 0.000
  Bot Clip(ft):                                              Exit Loss Coef: 0.000
     Main XSec: HC0094XS       HC0105XS                  Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                      Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_10, HCHL_11

-------------------------------------------------------------------------------------------------
          Name: HC-0110X            From Node: HC-0110           Length(ft): 214.00
         Group: Howell Creek          To Node: HC-0115                Count: 1

                UPSTREAM       DOWNSTREAM                Friction Equation: Average Conveyance
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 52.760         50.510                               Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
   Manning's N:                                            Expansion Coef: 0.300
  Top Clip(ft):                                          Entrance Loss Coef: 0.000
  Bot Clip(ft):                                              Exit Loss Coef: 0.000
     Main XSec: HC0105XS       HC0108XS                  Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                      Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_11, HCHL_12

-------------------------------------------------------------------------------------------------
          Name: HC-0115X            From Node: HC-0115           Length(ft): 100.00
         Group: Howell Creek          To Node: HC-0120                Count: 1
```

```
               UPSTREAM       DOWNSTREAM                 Friction Equation: Average Conveyance
     Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 50.510        54.240                               Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                   Contraction Coef: 0.100
   Manning's N:                                           Expansion Coef: 0.300
  Top Clip(ft):                                        Entrance Loss Coef: 0.000
  Bot Clip(ft):                                            Exit Loss Coef: 0.000
     Main XSec: HC0108XS       HC0115XS1                 Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                      Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_13

-------------------------------------------------------------------------------------------------
          Name: HC-0120B            From Node: HC-0120           Length(ft): 32.00
         Group: Howell Creek          To Node: HC-0130                Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Average Conveyance
     Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 54.240        53.380                               Flow: Both
 TClpInitZ(ft): 68.410        69.410                     Contraction Coef: 0.300
   Manning's N:                                           Expansion Coef: 0.500
  Top Clip(ft):                                        Entrance Loss Coef: 0.000
  Bot Clip(ft):                                            Exit Loss Coef: 0.000
     Main XSec: HC0115XS1      HC0130XS                  Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                      Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_13, HCHL_14

-------------------------------------------------------------------------------------------------
          Name: HC-0130X            From Node: HC-0130           Length(ft): 169.00
         Group: Howell Creek          To Node: HC-0135                Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Average Conveyance
     Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 53.380        52.600                               Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                   Contraction Coef: 0.100
   Manning's N:                                           Expansion Coef: 0.300
  Top Clip(ft):                                        Entrance Loss Coef: 0.000
  Bot Clip(ft):                                            Exit Loss Coef: 0.000
     Main XSec: HC0130XS       HC0135XS                  Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                      Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_14, HCHL_15

-------------------------------------------------------------------------------------------------
          Name: HC-0135X            From Node: HC-0135           Length(ft): 243.00
         Group: Howell Creek          To Node: HC-0140                Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Average Conveyance
     Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 52.600        52.480                               Flow: Both
 TClpInitZ(ft): 9999.000      9999.000                   Contraction Coef: 0.100
   Manning's N:                                           Expansion Coef: 0.300
  Top Clip(ft):                                        Entrance Loss Coef: 0.000
  Bot Clip(ft):                                            Exit Loss Coef: 0.000
     Main XSec: HC0137XS       HC0140XS                  Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                      Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: None
```

```
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

Howell Creek Lake Howell Lane to SR 436 CIP
Southeastern Surveying - 2009
SSMC x-sec HCHL_16, HCHL_17

-------------------------------------------------------------------------------------------------------
          Name: HC-0140B            From Node: HC-0140           Length(ft): 82.00
         Group: Howell Creek          To Node: HC-0150                Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Average Conveyance
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 52.480         51.290                               Flow: Both
 TClpInitZ(ft): 71.000         71.000                     Contraction Coef: 0.100
   Manning's N:                                               Expansion Coef: 0.300
  Top Clip(ft):                                           Entrance Loss Coef: 0.000
  Bot Clip(ft):                                              Exit Loss Coef: 0.000
     Main XSec: HC0140XS       HC0150XS                   Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                       Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: None
  AuxElev2(ft): 0.000          0.000
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

SJ94-3 (sem.dat Bridge #17 & #16) - SR436

-------------------------------------------------------------------------------------------------------
          Name: HC-0150X            From Node: HC-0150           Length(ft): 715.00
         Group: Howell Creek          To Node: LH-0090                Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
      Geometry: Irregular      Irregular                 Solution Algorithm: Automatic
    Invert(ft): 51.290         47.500                               Flow: Both
 TClpInitZ(ft): 9999.000       9999.000                   Contraction Coef: 0.100
   Manning's N:                                               Expansion Coef: 0.300
  Top Clip(ft):                                           Entrance Loss Coef: 0.000
  Bot Clip(ft):                                              Exit Loss Coef: 0.000
     Main XSec: HC0150XS       HC0151XS                   Outlet Ctrl Spec: Use dc or tw
  AuxElev1(ft): 0.000          0.000                       Inlet Ctrl Spec: Use dn
     Aux XSec1:                                          Stabilizer Option: Level Pool Option
  AuxElev2(ft): 0.000          0.000                     Stabilizer Tol(ft): 0.010
     Aux XSec2:
 Top Width(ft):
     Depth(ft):
 Bot Width(ft):
  LtSdSlp(h/v):
  RtSdSlp(h/v):

SJ94-3 (sem.dat xsec 47935)

===============================================================================================
==== Drop Structures ==========================================================================
===============================================================================================

          Name:                     From Node:                   Length(ft): 0.00
         Group: BASE                  To Node:                        Count: 1

               UPSTREAM       DOWNSTREAM                 Friction Equation: Automatic
      Geometry: Circular       Circular                  Solution Algorithm: Most Restrictive
      Span(in): 0.00           0.00                                 Flow: Both
      Rise(in): 0.00           0.00                      Entrance Loss Coef: 0.000
    Invert(ft): 0.000          0.000                        Exit Loss Coef: 1.000
  Manning's N: 0.000000        0.000000                   Outlet Ctrl Spec: Use dc or tw
 Top Clip(in): 0.000           0.000                       Inlet Ctrl Spec: Use dc
 Bot Clip(in): 0.000           0.000                         Solution Incs: 10

Upstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall

Downstream FHWA Inlet Edge Description:
Circular Concrete: Square edge w/ headwall



===============================================================================================
==== Weirs ====================================================================================
===============================================================================================
```

```
         Name: HC-0062W           From Node: LWu-0010
        Group: Howell Creek         To Node: HC-0070
         Flow: Both                   Count: 1
         Type: Vertical: Fread     Geometry: Irregular

                        XSec: HC0062WXS
                  Invert(ft): 58.450
       Control Elevation(ft): 58.450
      Struct Opening Dim(ft): 9999.00
                                          TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 3.000
      Orifice Discharge Coef: 0.600

Howell Creek Dam with proposed cross-section (Inwood, 2009)



-------------------------------------------------------------------------------------------------
         Name: HC0040BRd          From Node: HC-0040
        Group: Howell Creek         To Node: LWu-0010
         Flow: Both                   Count: 1
         Type: Vertical: Fread     Geometry: Irregular

                        XSec: HC0040RXS
                  Invert(ft): 73.000
       Control Elevation(ft): 73.000
      Struct Opening Dim(ft): 9999.00
                                          TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 2.800
      Orifice Discharge Coef: 0.600

Temple Dr road overflow

-------------------------------------------------------------------------------------------------
         Name: HC0070BRd          From Node: HC-0070
        Group: Howell Creek         To Node: HC-0080
         Flow: Both                   Count: 1
         Type: Vertical: Paved     Geometry: Irregular

                        XSec: HC0070RXS
                  Invert(ft): 65.530
       Control Elevation(ft): 65.530
      Struct Opening Dim(ft): 9999.00
                                          TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 2.800
      Orifice Discharge Coef: 0.600

Lake Howell Road road overflow (Howell Creek Lake Howell Lane to SR 436 CIP, Southeastern Surveying - 2009)

-------------------------------------------------------------------------------------------------
         Name: HC0085BRd          From Node: HC-0085
        Group: Howell Creek         To Node: HC-0090
         Flow: Both                   Count: 1
         Type: Vertical: Fread     Geometry: Irregular

                        XSec: HC0085RXS
                  Invert(ft): 63.680
       Control Elevation(ft): 63.680
      Struct Opening Dim(ft): 9999.00
                                          TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 2.800
      Orifice Discharge Coef: 0.600

Lake Howell Lane road overflow (Howell Creek Lake Howell Lane to SR 436 CIP, Southeastern Surveying - 2009)

-------------------------------------------------------------------------------------------------
         Name: HC0100BRd          From Node: HC-0100
        Group: Howell Creek         To Node: HC-0110
         Flow: Both                   Count: 1
         Type: Vertical: Fread     Geometry: Irregular

                        XSec: HC0100RXS
                  Invert(ft): 67.188
       Control Elevation(ft): 67.188
      Struct Opening Dim(ft): 9999.00
                                          TABLE
             Bottom Clip(ft): 0.000
                Top Clip(ft): 0.000
          Weir Discharge Coef: 2.800
      Orifice Discharge Coef: 0.600
```

WalMart parking lot overflow

```
---------------------------------------------------------------------------------------------------
         Name: HC0120BRd           From Node: HC-0120
        Group: Howell Creek          To Node: HC-0130
         Flow: Both                    Count: 1
         Type: Vertical: Fread      Geometry: Irregular

                      XSec: HC0120RXS
                Invert(ft): 66.810
      Control Elevation(ft): 66.810
     Struct Opening Dim(ft): 9999.00
                                       TABLE
           Bottom Clip(ft): 0.000
              Top Clip(ft): 0.000
        Weir Discharge Coef: 2.800
     Orifice Discharge Coef: 0.600
```

WalMart parking lot overflow

```
---------------------------------------------------------------------------------------------------
         Name: HC0140BRd           From Node: HC-0140
        Group: Howell Creek          To Node: HC-0150
         Flow: Both                    Count: 1
         Type: Vertical: Fread      Geometry: Irregular

                      XSec: HC0140RXS
                Invert(ft): 67.560
      Control Elevation(ft): 67.560
     Struct Opening Dim(ft): 9999.00
                                       TABLE
           Bottom Clip(ft): 0.000
              Top Clip(ft): 0.000
        Weir Discharge Coef: 2.800
     Orifice Discharge Coef: 0.600
```

SR436 road overflow (Howell Creek Lake Howell Lane to SR 436 CIP, Southeastern Surveying - 2009)

```
===============================================================================================
==== Bridges ==================================================================================
===============================================================================================

         Name:                     From Node:                        Flow: Both
        Group: BASE                  To Node:                   Run WSPRO: No

      XSEC TYPE            NAME         INV(ft)        STAT(ft)       SKEW(deg)           EXPAN         CONTRAC
           Exit                          0.000            0.00           0.000           0.500           0.000
    Full Valley                          0.000            0.00           0.000           0.500           0.000
       Approach                          0.000            0.00           0.000           0.500           0.000
        Roadway                          0.000            0.00           0.000

            Road Surface Material: Paved
    Road Embankment Top Width(ft): 0.00
     Road Unsubmerged Weir Q Coef: 0.000


RATING CURVE CONTROL
         TW(ft)       QMin(cfs)       QMax(cfs)       QInc(cfs)
--------------- --------------- --------------- ---------------
          0.000           0.000           0.000           0.000


===============================================================================================
==== Rating Curves ============================================================================
===============================================================================================

         Name:                     From Node:                       Count: 1
        Group: BASE                  To Node:                        Flow: Both

              TABLE           ELEV ON(ft)     ELEV OFF(ft)
           #1:                0.000           0.000
           #2:                0.000           0.000
           #3:                0.000           0.000
           #4:                0.000           0.000



===============================================================================================
==== Filters ==================================================================================
===============================================================================================

         Name:                     From Node:                        Flow: Both
        Group: BASE                  To Node:                       Count: 1

                    Sloped: No
             Filter Elev(ft): 0.000                    Pipe Inv Elev(ft): 0.000
            Filter Width(ft): 0.000                    Pipe Diameter(in): 0.000
           Filter Length(ft): 0.000                   X Grav Thkness(in): 0.000
```

Filter Permeability(ft/day): 0.000 Y Grav Thkness(in): 0.000

==========
==== Hydrology Simulations ==========
==========

Name: HC00_PRO
Filename: E:\Projects\82058\71109_LHR_SR436\Model\Proposed\HC00_PRO.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: Flmod
Rainfall Amount(in): 11.40

Time(hrs)	Print Inc(min)
40.000	5.00

Name: HC10_PRO
Filename: E:\Projects\82058\71109_LHR_SR436\Model\Proposed\HC10_PRO.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: Flmod
Rainfall Amount(in): 6.80

Time(hrs)	Print Inc(min)
40.000	5.00

Name: HC25_PRO
Filename: E:\Projects\82058\71109_LHR_SR436\Model\Proposed\HC25_PRO.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: Flmod
Rainfall Amount(in): 8.40

Time(hrs)	Print Inc(min)
40.000	5.00

Name: HCMN_PRO
Filename: E:\Projects\82058\71109_LHR_SR436\Model\Proposed\HCMNEX_PRO.R32

Override Defaults: Yes
Storm Duration(hrs): 24.00
Rainfall File: Flmod
Rainfall Amount(in): 5.30

Time(hrs)	Print Inc(min)
40.000	5.00

==========
==== Routing Simulations ==========
==========

Name: HC00_PRO Hydrology Sim: HC00_PRO
Filename: E:\Projects\82058\71109_LHR_SR436\Model\Proposed\HC00_PRO.I32

Execute: Yes Restart: No Patch: No
Alternative: No

Max Delta Z(ft): 1.00 Delta Z Factor: 0.00500
Time Step Optimizer: 0.000
Start Time(hrs): 0.000 End Time(hrs): 60.00
Min Calc Time(sec): 0.1000 Max Calc Time(sec): 60.0000
Boundary Stages: LkHowell_100 Boundary Flows: HC0040_100

Howell Creek Dam Replacement - Proposed Conditions, 100-year/24-hour storm event

Time(hrs)	Print Inc(min)
24.000	2.000
60.000	5.000

Group	Run
BASE	Yes
Howell Creek	Yes
Lake Howell	Yes
Lake Waumpi	Yes

```
-------------------------------------------------------------------------------------------------
         Name: HC10_PRO            Hydrology Sim: HC10_PRO
     Filename: E:\Projects\82058\71109_LHR_SR436\Model\Proposed\HC10_PRO.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 0.000
        Start Time(hrs): 0.000                    End Time(hrs): 60.00
     Min Calc Time(sec): 0.1000              Max Calc Time(sec): 60.0000
        Boundary Stages: LkHowell_10             Boundary Flows: HC0040_10

Howell Creek Dam Replacement - Proposed Conditions, 10-year/24-hour storm event

Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          2.000
60.000          5.000

Group           Run
--------------- -----
BASE            Yes
Howell Creek    Yes
Lake Howell     Yes
Lake Waumpi     Yes


-------------------------------------------------------------------------------------------------
         Name: HC25_PRO            Hydrology Sim: HC25_PRO
     Filename: E:\Projects\82058\71109_LHR_SR436\Model\Proposed\HC25_PRO.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 0.000
        Start Time(hrs): 0.000                    End Time(hrs): 60.00
     Min Calc Time(sec): 0.1000              Max Calc Time(sec): 60.0000
        Boundary Stages: LkHowell_25             Boundary Flows: HC0040_25

Howell Creek Dam Replacement - Proposed Conditions, 25-year/24-hour storm event

Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          2.000
60.000          5.000

Group           Run
--------------- -----
BASE            Yes
Howell Creek    Yes
Lake Howell     Yes
Lake Waumpi     Yes


-------------------------------------------------------------------------------------------------
         Name: HCMN_PRO            Hydrology Sim: HCMN_PRO
     Filename: E:\Projects\82058\71109_LHR_SR436\Model\Proposed\HCMN_PRO.I32

      Execute: Yes         Restart: No            Patch: No
  Alternative: No

        Max Delta Z(ft): 1.00                    Delta Z Factor: 0.00500
    Time Step Optimizer: 0.000
        Start Time(hrs): 0.000                    End Time(hrs): 60.00
     Min Calc Time(sec): 0.1000              Max Calc Time(sec): 60.0000
        Boundary Stages: LkHowell_MA             Boundary Flows: HC0040_MA

Howell Creek Dam Replacement - Proposed Conditions, Mean-Annual/24-hour storm event

Time(hrs)       Print Inc(min)
--------------- ---------------
24.000          2.000
60.000          5.000

Group           Run
--------------- -----
BASE            Yes
Howell Creek    Yes
Lake Howell     Yes
Lake Waumpi     Yes


===============================================================================
==== Boundary Conditions ======================================================
===============================================================================
```

Name: LkHowell_MA Node: LH-0090 Type: Stage

Time(hrs)	Stage(ft)
0.000	53.080
0.030	53.078
0.070	53.077
0.100	53.075
0.130	53.074
0.170	53.072
0.200	53.070
0.230	53.069
0.270	53.067
0.300	53.065
0.330	53.064
0.370	53.062
0.400	53.061
0.430	53.059
0.470	53.057
0.500	53.056
0.530	53.054
0.570	53.053
0.600	53.051
0.630	53.049
0.670	53.048
0.700	53.046
0.730	53.045
0.770	53.043
0.800	53.041
0.830	53.040
0.870	53.038
0.900	53.037
0.930	53.035
0.970	53.033
1.000	53.032
1.030	53.030
1.070	53.029
1.100	53.027
1.130	53.026
1.170	53.024
1.200	53.022
1.230	53.021
1.270	53.019
1.300	53.018
1.330	53.016
1.370	53.015
1.400	53.013
1.430	53.011
1.470	53.010
1.500	53.008
1.530	53.007
1.570	53.005
1.600	53.004
1.630	53.002
1.670	53.001
1.700	52.999
1.730	52.998
1.770	52.996
1.800	52.994
1.830	52.993
1.870	52.991
1.900	52.990
1.930	52.988
1.970	52.987
2.000	52.985
2.030	52.984
2.070	52.982
2.100	52.981
2.130	52.979
2.170	52.978
2.200	52.976
2.230	52.975
2.270	52.973
2.300	52.972
2.330	52.971
2.370	52.969
2.400	52.968
2.430	52.966
2.470	52.965
2.500	52.963
2.530	52.962
2.570	52.961
2.600	52.959
2.630	52.958
2.670	52.956
2.700	52.955
2.730	52.954
2.770	52.952

2.800	52.951
2.830	52.949
2.870	52.948
2.900	52.947
2.930	52.945
2.970	52.944
3.000	52.943
3.030	52.941
3.070	52.940
3.100	52.939
3.130	52.938
3.170	52.936
3.200	52.935
3.230	52.934
3.270	52.932
3.300	52.931
3.330	52.930
3.370	52.928
3.400	52.927
3.430	52.926
3.470	52.925
3.500	52.923
3.530	52.922
3.570	52.921
3.600	52.920
3.630	52.918
3.670	52.917
3.700	52.916
3.730	52.915
3.770	52.913
3.800	52.912
3.830	52.911
3.870	52.910
3.900	52.908
3.930	52.907
3.970	52.906
4.000	52.905
4.030	52.904
4.070	52.902
4.100	52.901
4.130	52.900
4.170	52.899
4.200	52.898
4.230	52.897
4.270	52.895
4.300	52.894
4.330	52.893
4.370	52.892
4.400	52.891
4.430	52.889
4.470	52.888
4.500	52.887
4.530	52.886
4.570	52.885
4.600	52.884
4.630	52.883
4.670	52.881
4.700	52.880
4.730	52.879
4.770	52.878
4.800	52.877
4.830	52.876
4.870	52.875
4.900	52.874
4.930	52.872
4.970	52.871
5.000	52.870
5.030	52.869
5.070	52.868
5.100	52.867
5.130	52.866
5.170	52.865
5.200	52.864
5.230	52.863
5.270	52.862
5.300	52.861
5.330	52.860
5.370	52.859
5.400	52.857
5.430	52.856
5.470	52.855
5.500	52.854
5.530	52.853
5.570	52.852
5.600	52.851
5.630	52.850
5.670	52.849
5.700	52.848
5.730	52.847

5.770	52.846
5.800	52.845
5.830	52.844
5.870	52.843
5.900	52.842
5.930	52.841
5.970	52.841
6.000	52.840
6.030	52.839
6.070	52.838
6.100	52.837
6.130	52.836
6.170	52.835
6.200	52.834
6.230	52.833
6.270	52.832
6.300	52.831
6.330	52.830
6.370	52.829
6.400	52.828
6.430	52.827
6.470	52.827
6.500	52.826
6.530	52.825
6.570	52.824
6.600	52.823
6.630	52.822
6.670	52.821
6.700	52.820
6.730	52.820
6.770	52.819
6.800	52.818
6.830	52.817
6.870	52.816
6.900	52.815
6.930	52.815
6.970	52.814
7.000	52.813
7.030	52.812
7.070	52.811
7.100	52.811
7.130	52.810
7.170	52.809
7.200	52.808
7.230	52.807
7.270	52.807
7.300	52.806
7.330	52.805
7.370	52.804
7.400	52.804
7.430	52.803
7.470	52.802
7.500	52.801
7.530	52.801
7.570	52.800
7.600	52.799
7.630	52.799
7.670	52.798
7.700	52.797
7.730	52.797
7.770	52.796
7.800	52.795
7.830	52.795
7.870	52.794
7.900	52.793
7.930	52.793
7.970	52.792
8.000	52.791
8.030	52.791
8.070	52.790
8.100	52.790
8.130	52.789
8.170	52.788
8.200	52.788
8.230	52.787
8.270	52.787
8.300	52.786
8.330	52.786
8.370	52.785
8.400	52.785
8.430	52.784
8.470	52.783
8.500	52.783
8.530	52.782
8.570	52.782
8.600	52.782
8.630	52.781
8.670	52.781
8.700	52.780

8.730	52.780
8.770	52.779
8.800	52.779
8.830	52.778
8.870	52.778
8.900	52.778
8.930	52.777
8.970	52.777
9.000	52.777
9.030	52.776
9.070	52.776
9.100	52.776
9.130	52.775
9.170	52.775
9.200	52.775
9.230	52.775
9.270	52.774
9.300	52.774
9.330	52.774
9.370	52.774
9.400	52.773
9.430	52.773
9.470	52.773
9.500	52.773
9.530	52.773
9.570	52.772
9.600	52.772
9.630	52.772
9.670	52.772
9.700	52.772
9.730	52.772
9.770	52.772
9.800	52.772
9.830	52.772
9.870	52.772
9.900	52.772
9.930	52.772
9.970	52.772
10.000	52.772
10.030	52.772
10.070	52.772
10.100	52.772
10.130	52.772
10.170	52.772
10.200	52.772
10.230	52.773
10.270	52.773
10.300	52.773
10.330	52.773
10.370	52.773
10.400	52.774
10.430	52.774
10.470	52.774
10.500	52.775
10.530	52.775
10.570	52.775
10.600	52.776
10.630	52.776
10.670	52.777
10.700	52.777
10.730	52.778
10.770	52.778
10.800	52.779
10.830	52.779
10.870	52.780
10.900	52.781
10.930	52.782
10.970	52.782
11.000	52.783
11.030	52.784
11.070	52.785
11.100	52.786
11.130	52.787
11.170	52.788
11.200	52.789
11.230	52.790
11.270	52.791
11.300	52.792
11.330	52.793
11.370	52.794
11.400	52.795
11.430	52.797
11.470	52.798
11.500	52.800
11.530	52.801
11.570	52.803
11.600	52.805
11.630	52.807
11.670	52.810

11.700	52.812
11.730	52.815
11.770	52.819
11.800	52.822
11.830	52.826
11.870	52.831
11.900	52.836
11.930	52.842
11.970	52.849
12.000	52.856
12.030	52.864
12.070	52.873
12.100	52.882
12.130	52.892
12.170	52.902
12.200	52.913
12.230	52.924
12.270	52.936
12.300	52.948
12.330	52.960
12.370	52.972
12.400	52.985
12.430	52.998
12.470	53.011
12.500	53.025
12.530	53.039
12.570	53.052
12.600	53.066
12.630	53.080
12.670	53.094
12.700	53.109
12.730	53.123
12.770	53.137
12.800	53.151
12.830	53.165
12.870	53.179
12.900	53.193
12.930	53.207
12.970	53.221
13.000	53.235
13.030	53.248
13.070	53.262
13.100	53.275
13.130	53.289
13.170	53.302
13.200	53.315
13.230	53.327
13.270	53.340
13.300	53.352
13.330	53.365
13.370	53.377
13.400	53.389
13.430	53.401
13.470	53.413
13.500	53.425
13.530	53.436
13.570	53.448
13.600	53.459
13.630	53.470
13.670	53.481
13.700	53.492
13.730	53.503
13.770	53.514
13.800	53.524
13.830	53.535
13.870	53.545
13.900	53.555
13.930	53.566
13.970	53.576
14.000	53.586
14.030	53.596
14.070	53.605
14.100	53.615
14.130	53.625
14.170	53.634
14.200	53.644
14.230	53.653
14.270	53.662
14.300	53.672
14.330	53.681
14.370	53.690
14.400	53.699
14.430	53.707
14.470	53.716
14.500	53.725
14.530	53.734
14.570	53.742
14.600	53.751
14.630	53.759

14.670	53.767
14.700	53.775
14.730	53.783
14.770	53.791
14.800	53.799
14.830	53.807
14.870	53.815
14.900	53.823
14.930	53.830
14.970	53.838
15.000	53.845
15.030	53.853
15.070	53.860
15.100	53.867
15.130	53.874
15.170	53.881
15.200	53.888
15.230	53.895
15.270	53.902
15.300	53.909
15.330	53.915
15.370	53.922
15.400	53.929
15.430	53.935
15.470	53.942
15.500	53.948
15.530	53.954
15.570	53.960
15.600	53.966
15.630	53.973
15.670	53.979
15.700	53.985
15.730	53.990
15.770	53.996
15.800	54.002
15.830	54.008
15.870	54.013
15.900	54.019
15.930	54.025
15.970	54.030
16.000	54.035
16.030	54.041
16.070	54.046
16.100	54.051
16.130	54.057
16.170	54.062
16.200	54.067
16.230	54.072
16.270	54.077
16.300	54.082
16.330	54.086
16.370	54.091
16.400	54.096
16.430	54.101
16.470	54.105
16.500	54.110
16.530	54.115
16.570	54.119
16.600	54.123
16.630	54.128
16.670	54.132
16.700	54.137
16.730	54.141
16.770	54.145
16.800	54.149
16.830	54.153
16.870	54.157
16.900	54.161
16.930	54.165
16.970	54.169
17.000	54.173
17.030	54.177
17.070	54.181
17.100	54.185
17.130	54.188
17.170	54.192
17.200	54.196
17.230	54.199
17.270	54.203
17.300	54.206
17.330	54.210
17.370	54.213
17.400	54.217
17.430	54.220
17.470	54.223
17.500	54.226
17.530	54.230
17.570	54.233
17.600	54.236

17.630	54.239
17.670	54.242
17.700	54.245
17.730	54.248
17.770	54.250
17.800	54.253
17.830	54.256
17.870	54.259
17.900	54.262
17.930	54.264
17.970	54.267
18.000	54.270
18.030	54.272
18.070	54.275
18.100	54.277
18.130	54.280
18.170	54.282
18.200	54.285
18.230	54.287
18.270	54.289
18.300	54.292
18.330	54.294
18.370	54.296
18.400	54.298
18.430	54.301
18.470	54.303
18.500	54.305
18.530	54.307
18.570	54.309
18.600	54.312
18.630	54.314
18.670	54.316
18.700	54.318
18.730	54.320
18.770	54.322
18.800	54.324
18.830	54.326
18.870	54.328
18.900	54.330
18.930	54.332
18.970	54.334
19.000	54.336
19.030	54.338
19.070	54.339
19.100	54.341
19.130	54.343
19.170	54.345
19.200	54.347
19.230	54.348
19.270	54.350
19.300	54.352
19.330	54.354
19.370	54.355
19.400	54.357
19.430	54.359
19.470	54.360
19.500	54.362
19.530	54.364
19.570	54.365
19.600	54.367
19.630	54.368
19.670	54.370
19.700	54.372
19.730	54.373
19.770	54.375
19.800	54.376
19.830	54.378
19.870	54.379
19.900	54.381
19.930	54.382
19.970	54.383
20.000	54.385
20.030	54.386
20.070	54.388
20.100	54.389
20.130	54.390
20.170	54.392
20.200	54.393
20.230	54.394
20.270	54.396
20.300	54.397
20.330	54.398
20.370	54.399
20.400	54.401
20.430	54.402
20.470	54.403
20.500	54.404
20.530	54.406
20.570	54.407

20.600	54.408
20.630	54.409
20.670	54.410
20.700	54.411
20.730	54.412
20.770	54.413
20.800	54.414
20.830	54.416
20.870	54.417
20.900	54.418
20.930	54.419
20.970	54.420
21.000	54.421
21.030	54.422
21.070	54.423
21.100	54.424
21.130	54.425
21.170	54.426
21.200	54.426
21.230	54.427
21.270	54.428
21.300	54.429
21.330	54.430
21.370	54.431
21.400	54.432
21.430	54.433
21.470	54.434
21.500	54.435
21.530	54.435
21.570	54.436
21.600	54.437
21.630	54.438
21.670	54.439
21.700	54.439
21.730	54.440
21.770	54.441
21.800	54.442
21.830	54.443
21.870	54.443
21.900	54.444
21.930	54.445
21.970	54.446
22.000	54.446
22.030	54.447
22.070	54.448
22.100	54.449
22.130	54.449
22.170	54.450
22.200	54.451
22.230	54.451
22.270	54.452
22.300	54.453
22.330	54.454
22.370	54.454
22.400	54.455
22.430	54.456
22.470	54.456
22.500	54.457
22.530	54.458
22.570	54.458
22.600	54.459
22.630	54.460
22.670	54.460
22.700	54.461
22.730	54.461
22.770	54.462
22.800	54.463
22.830	54.463
22.870	54.464
22.900	54.464
22.930	54.465
22.970	54.466
23.000	54.466
23.030	54.467
23.070	54.467
23.100	54.468
23.130	54.468
23.170	54.469
23.200	54.469
23.230	54.470
23.270	54.471
23.300	54.471
23.330	54.472
23.370	54.472
23.400	54.473
23.430	54.473
23.470	54.474
23.500	54.474
23.530	54.475

23.570	54.475
23.600	54.475
23.630	54.476
23.670	54.476
23.700	54.477
23.730	54.477
23.770	54.478
23.800	54.478
23.830	54.479
23.870	54.479
23.900	54.479
23.930	54.480
23.970	54.480
24.000	54.481
24.250	54.483
24.500	54.484
24.750	54.484
25.000	54.484
25.250	54.482
25.500	54.479
25.750	54.476
26.000	54.472
26.250	54.468
26.500	54.463
26.750	54.458
27.000	54.453
27.250	54.447
27.500	54.441
27.750	54.435
28.000	54.428
28.250	54.422
28.500	54.415
28.750	54.408
29.000	54.401
29.250	54.394
29.500	54.387
29.750	54.379
30.000	54.372
30.250	54.364
30.500	54.357
30.750	54.350
31.000	54.342
31.250	54.334
31.500	54.327
31.750	54.319
32.000	54.312
32.250	54.304
32.500	54.296
32.750	54.289
33.000	54.281
33.250	54.273
33.500	54.266
33.750	54.258
34.000	54.251
34.250	54.243
34.500	54.235
34.750	54.228
35.000	54.220
35.250	54.212
35.500	54.205
35.750	54.197
36.000	54.189
36.250	54.181
36.500	54.174
36.750	54.166
37.000	54.158
37.250	54.151
37.500	54.143
37.750	54.135
38.000	54.128
38.250	54.120
38.500	54.112
38.750	54.105
39.000	54.097
39.250	54.089
39.500	54.082
39.750	54.074
40.000	54.067
40.250	54.059
40.500	54.051
40.750	54.044
41.000	54.036
41.250	54.029
41.500	54.021
41.750	54.014
42.000	54.006
42.250	53.998
42.500	53.991
42.750	53.983

43.000	53.976
43.250	53.968
43.500	53.961
43.750	53.954
44.000	53.946
44.250	53.939
44.500	53.931
44.750	53.924
45.000	53.917
45.250	53.909
45.500	53.902
45.750	53.895
46.000	53.887
46.250	53.880
46.500	53.873
46.750	53.866
47.000	53.859
47.250	53.851
47.500	53.844
47.750	53.837
48.000	53.830
48.250	53.823
48.500	53.816
48.750	53.809
49.000	53.802
49.250	53.795
49.500	53.788
49.750	53.781
50.000	53.774
50.250	53.768
50.500	53.761
50.750	53.754
51.000	53.747
51.250	53.740
51.500	53.734
51.750	53.727
52.000	53.720
52.250	53.713
52.500	53.707
52.750	53.700
53.000	53.693
53.250	53.687
53.500	53.680
53.750	53.673
54.000	53.667
54.250	53.660
54.500	53.654
54.750	53.647
55.000	53.641
55.250	53.634
55.500	53.628
55.750	53.621
56.000	53.615
56.250	53.609
56.500	53.602
56.750	53.596
57.000	53.590
57.250	53.583
57.500	53.577
57.750	53.571
58.000	53.565
58.250	53.559
58.500	53.552
58.750	53.546
59.000	53.540
59.250	53.534
59.500	53.528
59.750	53.522
60.000	53.516
60.250	53.510
60.500	53.504
60.750	53.498
61.000	53.492
61.250	53.486
61.500	53.481
61.750	53.475
62.000	53.469
62.250	53.463
62.500	53.457
62.750	53.452
63.000	53.446
63.250	53.440
63.500	53.435
63.750	53.429
64.000	53.423
64.250	53.418
64.500	53.412
64.750	53.407
65.000	53.401

65.250	53.396
65.500	53.390
65.750	53.385
66.000	53.380
66.250	53.374
66.500	53.369
66.750	53.363
67.000	53.358
67.250	53.353
67.500	53.347
67.750	53.342
68.000	53.337
68.250	53.332
68.500	53.326
68.750	53.321
69.000	53.316
69.250	53.311
69.500	53.306
69.750	53.301
70.000	53.296
70.250	53.290
70.500	53.285
70.750	53.280
71.000	53.275
71.250	53.270
71.500	53.265
71.750	53.260
72.000	53.255
72.250	53.250
72.500	53.246
72.750	53.241
73.000	53.236
73.250	53.231
73.500	53.226
73.750	53.221
74.000	53.216
74.250	53.212
74.500	53.207
74.750	53.202
75.000	53.197
75.250	53.193
75.500	53.188
75.750	53.183
76.000	53.178
76.250	53.174
76.500	53.169
76.750	53.165
77.000	53.160
77.250	53.155
77.500	53.151
77.750	53.146
78.000	53.142
78.250	53.137
78.500	53.133
78.750	53.128
79.000	53.124
79.250	53.119
79.500	53.115
79.750	53.110
80.000	53.106
80.250	53.101
80.500	53.097
80.750	53.093
81.000	53.088
81.250	53.084
81.500	53.079
81.750	53.075
82.000	53.071
82.250	53.066
82.500	53.062
82.750	53.058
83.000	53.054
83.250	53.049
83.500	53.045
83.750	53.041
84.000	53.037
84.250	53.033
84.500	53.028
84.750	53.024
85.000	53.020
85.250	53.016
85.500	53.012
85.750	53.008
86.000	53.004
86.250	52.999
86.500	52.995
86.750	52.991
87.000	52.987
87.250	52.983

87.500	52.979
87.750	52.975
88.000	52.971
88.250	52.967
88.500	52.963
88.750	52.959
89.000	52.955
89.250	52.951
89.500	52.947
89.750	52.943
90.000	52.939
90.250	52.936
90.500	52.932
90.750	52.928
91.000	52.924
91.250	52.920
91.500	52.916
91.750	52.912
92.000	52.908
92.250	52.905
92.500	52.901
92.750	52.897
93.000	52.893
93.250	52.890
93.500	52.886
93.750	52.882
94.000	52.878
94.250	52.875
94.500	52.871
94.750	52.867
95.000	52.863
95.250	52.860
95.500	52.856
95.750	52.852
96.000	52.849
96.250	52.845
96.500	52.841
96.750	52.838
97.000	52.834
97.250	52.830
97.500	52.827
97.750	52.823
98.000	52.820
98.250	52.816
98.500	52.813
98.750	52.809
99.000	52.805
99.250	52.802
99.500	52.798
99.750	52.795
100.000	52.791

Name: HC0040_MA Node: HC-0040 Type: Flow

Time(hrs)	Flow(cfs)
0.000	0.666
0.030	0.672
0.070	0.678
0.100	0.684
0.130	0.690
0.170	0.696
0.200	0.702
0.230	0.709
0.270	0.715
0.300	0.721
0.330	0.727
0.370	0.733
0.400	0.740
0.430	0.746
0.470	0.752
0.500	0.758
0.530	0.764
0.570	0.770
0.600	0.777
0.630	0.783
0.670	0.789
0.700	0.795
0.730	0.801
0.770	0.807
0.800	0.813
0.830	0.819
0.870	0.825
0.900	0.831
0.930	0.837
0.970	0.843
1.000	0.849
1.030	0.855

1.070	0.861
1.100	0.867
1.130	0.872
1.170	0.878
1.200	0.884
1.230	0.890
1.270	0.896
1.300	0.901
1.330	0.907
1.370	0.913
1.400	0.918
1.430	0.924
1.470	0.930
1.500	0.935
1.530	0.941
1.570	0.947
1.600	0.952
1.630	0.958
1.670	0.963
1.700	0.969
1.730	0.974
1.770	0.980
1.800	0.986
1.830	0.991
1.870	0.997
1.900	1.003
1.930	1.009
1.970	1.015
2.000	1.021
2.030	1.028
2.070	1.034
2.100	1.041
2.130	1.048
2.170	1.055
2.200	1.062
2.230	1.069
2.270	1.077
2.300	1.085
2.330	1.093
2.370	1.101
2.400	1.109
2.430	1.117
2.470	1.126
2.500	1.135
2.530	1.144
2.570	1.153
2.600	1.162
2.630	1.172
2.670	1.182
2.700	1.191
2.730	1.201
2.770	1.211
2.800	1.222
2.830	1.232
2.870	1.242
2.900	1.253
2.930	1.264
2.970	1.275
3.000	1.285
3.030	1.297
3.070	1.308
3.100	1.319
3.130	1.330
3.170	1.342
3.200	1.353
3.230	1.365
3.270	1.377
3.300	1.389
3.330	1.401
3.370	1.413
3.400	1.425
3.430	1.437
3.470	1.450
3.500	1.462
3.530	1.475
3.570	1.487
3.600	1.500
3.630	1.513
3.670	1.525
3.700	1.539
3.730	1.552
3.770	1.565
3.800	1.578
3.830	1.591
3.870	1.605
3.900	1.618
3.930	1.632
3.970	1.645
4.000	1.659

4.030	1.673
4.070	1.686
4.100	1.700
4.130	1.714
4.170	1.728
4.200	1.742
4.230	1.757
4.270	1.771
4.300	1.785
4.330	1.799
4.370	1.814
4.400	1.829
4.430	1.843
4.470	1.858
4.500	1.872
4.530	1.887
4.570	1.902
4.600	1.917
4.630	1.932
4.670	1.947
4.700	1.962
4.730	1.977
4.770	1.992
4.800	2.007
4.830	2.023
4.870	2.038
4.900	2.054
4.930	2.069
4.970	2.085
5.000	2.100
5.030	2.116
5.070	2.132
5.100	2.148
5.130	2.164
5.170	2.180
5.200	2.196
5.230	2.212
5.270	2.228
5.300	2.244
5.330	2.261
5.370	2.277
5.400	2.293
5.430	2.310
5.470	2.326
5.500	2.343
5.530	2.359
5.570	2.376
5.600	2.393
5.630	2.410
5.670	2.426
5.700	2.443
5.730	2.460
5.770	2.477
5.800	2.494
5.830	2.512
5.870	2.529
5.900	2.546
5.930	2.563
5.970	2.581
6.000	2.598
6.030	2.615
6.070	2.633
6.100	2.650
6.130	2.668
6.170	2.685
6.200	2.703
6.230	2.721
6.270	2.739
6.300	2.756
6.330	2.774
6.370	2.792
6.400	2.810
6.430	2.829
6.470	2.847
6.500	2.865
6.530	2.883
6.570	2.902
6.600	2.920
6.630	2.939
6.670	2.957
6.700	2.976
6.730	2.995
6.770	3.014
6.800	3.033
6.830	3.052
6.870	3.072
6.900	3.091
6.930	3.110
6.970	3.130

7.000	3.149
7.030	3.169
7.070	3.189
7.100	3.208
7.130	3.228
7.170	3.248
7.200	3.268
7.230	3.288
7.270	3.308
7.300	3.329
7.330	3.349
7.370	3.369
7.400	3.390
7.430	3.411
7.470	3.431
7.500	3.452
7.530	3.473
7.570	3.494
7.600	3.516
7.630	3.537
7.670	3.559
7.700	3.581
7.730	3.604
7.770	3.626
7.800	3.648
7.830	3.671
7.870	3.694
7.900	3.717
7.930	3.741
7.970	3.764
8.000	3.788
8.030	3.812
8.070	3.835
8.100	3.859
8.130	3.884
8.170	3.908
8.200	3.933
8.230	3.958
8.270	3.982
8.300	4.008
8.330	4.033
8.370	4.059
8.400	4.084
8.430	4.110
8.470	4.136
8.500	4.162
8.530	4.189
8.570	4.216
8.600	4.242
8.630	4.269
8.670	4.297
8.700	4.324
8.730	4.352
8.770	4.380
8.800	4.408
8.830	4.437
8.870	4.466
8.900	4.495
8.930	4.524
8.970	4.554
9.000	4.584
9.030	4.614
9.070	4.644
9.100	4.675
9.130	4.706
9.170	4.738
9.200	4.770
9.230	4.802
9.270	4.834
9.300	4.867
9.330	4.901
9.370	4.934
9.400	4.968
9.430	5.002
9.470	5.037
9.500	5.073
9.530	5.108
9.570	5.144
9.600	5.181
9.630	5.218
9.670	5.255
9.700	5.293
9.730	5.331
9.770	5.370
9.800	5.410
9.830	5.449
9.870	5.490
9.900	5.531
9.930	5.573

9.970	5.614
10.000	5.658
10.030	5.701
10.070	5.744
10.100	5.789
10.130	5.834
10.170	5.881
10.200	5.927
10.230	5.975
10.270	6.024
10.300	6.072
10.330	6.123
10.370	6.174
10.400	6.226
10.430	6.278
10.470	6.333
10.500	6.387
10.530	6.444
10.570	6.501
10.600	6.559
10.630	6.620
10.670	6.680
10.700	6.743
10.730	6.807
10.770	6.873
10.800	6.940
10.830	7.010
10.870	7.079
10.900	7.150
10.930	7.224
10.970	7.298
11.000	7.374
11.030	7.451
11.070	7.531
11.100	7.612
11.130	7.694
11.170	7.779
11.200	7.864
11.230	7.951
11.270	8.042
11.300	8.133
11.330	8.226
11.370	8.322
11.400	8.423
11.430	8.525
11.470	8.631
11.500	8.740
11.530	8.853
11.570	8.969
11.600	9.091
11.630	9.219
11.670	9.353
11.700	9.494
11.730	9.645
11.770	9.806
11.800	9.980
11.830	10.164
11.870	10.366
11.900	10.585
11.930	10.824
11.970	11.085
12.000	11.369
12.030	11.677
12.070	12.012
12.100	12.377
12.130	12.772
12.170	13.199
12.200	13.658
12.230	14.151
12.270	14.679
12.300	15.242
12.330	15.840
12.370	16.474
12.400	17.145
12.430	17.845
12.470	18.581
12.500	19.349
12.530	20.147
12.570	20.975
12.600	21.829
12.630	22.718
12.670	23.617
12.700	24.537
12.730	25.479
12.770	26.433
12.800	27.405
12.830	28.383
12.870	29.371
12.900	30.242

12.930	30.819
12.970	31.442
13.000	32.103
13.030	32.802
13.070	33.537
13.100	34.295
13.130	35.078
13.170	35.883
13.200	36.706
13.230	37.539
13.270	38.391
13.300	39.254
13.330	40.128
13.370	41.010
13.400	41.892
13.430	42.780
13.470	43.675
13.500	44.568
13.530	45.469
13.570	46.359
13.600	47.257
13.630	48.152
13.670	49.041
13.700	49.928
13.730	50.809
13.770	51.689
13.800	52.557
13.830	53.426
13.870	54.289
13.900	55.147
13.930	56.000
13.970	56.846
14.000	57.686
14.030	58.524
14.070	59.350
14.100	60.176
14.130	60.991
14.170	61.799
14.200	62.601
14.230	63.394
14.270	64.189
14.300	64.971
14.330	65.747
14.370	66.516
14.400	67.278
14.430	68.035
14.470	68.789
14.500	69.534
14.530	70.272
14.570	71.005
14.600	71.731
14.630	72.451
14.670	73.165
14.700	73.874
14.730	74.577
14.770	75.274
14.800	75.965
14.830	76.651
14.870	77.332
14.900	78.007
14.930	78.678
14.970	79.343
15.000	80.002
15.030	80.657
15.070	81.307
15.100	81.952
15.130	82.592
15.170	83.227
15.200	83.858
15.230	84.484
15.270	85.105
15.300	85.721
15.330	86.332
15.370	86.942
15.400	87.543
15.430	88.139
15.470	88.735
15.500	89.326
15.530	89.911
15.570	90.492
15.600	91.064
15.630	91.639
15.670	92.208
15.700	92.772
15.730	93.332
15.770	93.888
15.800	94.440
15.830	94.988
15.870	95.532

15.900	96.073
15.930	96.609
15.970	97.142
16.000	97.671
16.030	98.196
16.070	98.718
16.100	99.236
16.130	99.751
16.170	100.262
16.200	100.769
16.230	101.273
16.270	101.774
16.300	102.270
16.330	102.764
16.370	103.254
16.400	103.741
16.430	104.224
16.470	104.704
16.500	105.181
16.530	105.654
16.570	106.124
16.600	106.591
16.630	107.055
16.670	107.516
16.700	107.973
16.730	108.427
16.770	108.879
16.800	109.327
16.830	109.771
16.870	110.213
16.900	110.652
16.930	111.087
16.970	111.519
17.000	111.948
17.030	112.374
17.070	112.796
17.100	113.216
17.130	113.632
17.170	114.045
17.200	114.455
17.230	114.862
17.270	115.266
17.300	115.667
17.330	116.065
17.370	116.460
17.400	116.852
17.430	117.242
17.470	117.629
17.500	118.014
17.530	118.397
17.570	118.778
17.600	119.156
17.630	119.533
17.670	119.907
17.700	120.280
17.730	120.650
17.770	121.020
17.800	121.387
17.830	121.753
17.870	122.117
17.900	122.479
17.930	122.840
17.970	123.199
18.000	123.557
18.030	123.913
18.070	124.267
18.100	124.620
18.130	124.971
18.170	125.321
18.200	125.669
18.230	126.016
18.270	126.361
18.300	126.704
18.330	127.046
18.370	127.387
18.400	127.726
18.430	128.063
18.470	128.399
18.500	128.734
18.530	129.067
18.570	129.399
18.600	129.729
18.630	130.059
18.670	130.387
18.700	130.714
18.730	131.039
18.770	131.363
18.800	131.686
18.830	132.008

18.870	132.329
18.900	132.648
18.930	132.966
18.970	133.282
19.000	133.598
19.030	133.912
19.070	134.224
19.100	134.535
19.130	134.845
19.170	135.153
19.200	135.460
19.230	135.766
19.270	136.069
19.300	136.372
19.330	136.673
19.370	136.972
19.400	137.270
19.430	137.566
19.470	137.861
19.500	138.154
19.530	138.445
19.570	138.736
19.600	139.024
19.630	139.310
19.670	139.595
19.700	139.877
19.730	140.158
19.770	140.438
19.800	140.716
19.830	140.993
19.870	141.268
19.900	141.543
19.930	141.816
19.970	142.089
20.000	142.360
20.030	142.631
20.070	142.900
20.100	143.168
20.130	143.435
20.170	143.700
20.200	143.965
20.230	144.228
20.270	144.491
20.300	144.752
20.330	145.013
20.370	145.272
20.400	145.531
20.430	145.788
20.470	146.044
20.500	146.299
20.530	146.554
20.570	146.807
20.600	147.059
20.630	147.311
20.670	147.562
20.700	147.812
20.730	148.061
20.770	148.309
20.800	148.556
20.830	148.802
20.870	149.048
20.900	149.293
20.930	149.537
20.970	149.780
21.000	150.023
21.030	150.265
21.070	150.506
21.100	150.746
21.130	150.986
21.170	151.225
21.200	151.464
21.230	151.702
21.270	151.939
21.300	152.176
21.330	152.412
21.370	152.648
21.400	152.883
21.430	153.118
21.470	153.352
21.500	153.586
21.530	153.819
21.570	154.052
21.600	154.285
21.630	154.517
21.670	154.748
21.700	154.980
21.730	155.211
21.770	155.441
21.800	155.671

21.830	155.901
21.870	156.131
21.900	156.360
21.930	156.589
21.970	156.817
22.000	157.046
22.030	157.274
22.070	157.502
22.100	157.729
22.130	157.956
22.170	158.183
22.200	158.410
22.230	158.637
22.270	158.863
22.300	159.089
22.330	159.315
22.370	159.541
22.400	159.767
22.430	159.992
22.470	160.217
22.500	160.442
22.530	160.667
22.570	160.892
22.600	161.116
22.630	161.341
22.670	161.565
22.700	161.789
22.730	162.013
22.770	162.236
22.800	162.460
22.830	162.683
22.870	162.906
22.900	163.129
22.930	163.351
22.970	163.573
23.000	163.795
23.030	164.017
23.070	164.238
23.100	164.459
23.130	164.680
23.170	164.900
23.200	165.120
23.230	165.340
23.270	165.559
23.300	165.778
23.330	165.996
23.370	166.214
23.400	166.431
23.430	166.648
23.470	166.865
23.500	167.081
23.530	167.296
23.570	167.512
23.600	167.726
23.630	167.941
23.670	168.155
23.700	168.368
23.730	168.582
23.770	168.794
23.800	169.007
23.830	169.218
23.870	169.430
23.900	169.641
23.930	169.852
23.970	170.062
24.000	170.272
24.250	171.824
24.500	173.305
24.750	174.666
25.000	175.887
25.250	176.991
25.500	177.993
25.750	178.912
26.000	179.760
26.250	180.547
26.500	181.283
26.750	181.974
27.000	182.625
27.250	183.243
27.500	183.831
27.750	184.394
28.000	184.936
28.250	185.461
28.500	185.981
28.750	186.497
29.000	187.002
29.250	187.491
29.500	187.966
29.750	188.428

30.000	188.877
30.250	189.317
30.500	189.767
30.750	190.209
31.000	190.636
31.250	191.047
31.500	191.444
31.750	191.828
32.000	192.199
32.250	192.558
32.500	192.904
32.750	193.237
33.000	193.559
33.250	193.868
33.500	194.166
33.750	194.451
34.000	194.725
34.250	194.987
34.500	195.237
34.750	195.475
35.000	195.701
35.250	195.916
35.500	196.119
35.750	196.311
36.000	196.493
36.250	196.663
36.500	196.822
36.750	196.970
37.000	197.106
37.250	197.231
37.500	197.344
37.750	197.446
38.000	197.537
38.250	197.609
38.500	197.624
38.750	197.668
39.000	197.712
39.250	197.749
39.500	197.776
39.750	197.794
40.000	197.802
40.250	197.800
40.500	197.790
40.750	197.771
41.000	197.744
41.250	197.707
41.500	197.663
41.750	197.611
42.000	197.607
42.250	197.554
42.500	197.481
42.750	197.398
43.000	197.307
43.250	197.209
43.500	197.105
43.750	196.994
44.000	196.877
44.250	196.754
44.500	196.625
44.750	196.491
45.000	196.352
45.250	196.206
45.500	196.056
45.750	195.900
46.000	195.739
46.250	195.573
46.500	195.402
46.750	195.225
47.000	195.044
47.250	194.859
47.500	194.668
47.750	194.473
48.000	194.273
48.250	194.070
48.500	193.862
48.750	193.652
49.000	193.438
49.250	193.221
49.500	193.002
49.750	192.779
50.000	192.554
50.250	192.326
50.500	192.095
50.750	191.861
51.000	191.624
51.250	191.385
51.500	191.143
51.750	190.898
52.000	190.650

52.250	190.400
52.500	190.148
52.750	189.892
53.000	189.635
53.250	189.375
53.500	189.112
53.750	188.847
54.000	188.580
54.250	188.310
54.500	188.038
54.750	187.764
55.000	187.488
55.250	187.209
55.500	186.928
55.750	186.645
56.000	186.360
56.250	186.073
56.500	185.784
56.750	185.494
57.000	185.201
57.250	184.906
57.500	184.610
57.750	184.311
58.000	184.011
58.250	183.709
58.500	183.406
58.750	183.101
59.000	182.794
59.250	182.485
59.500	182.175
59.750	181.864
60.000	181.551
60.250	181.236
60.500	180.921
60.750	180.603
61.000	180.284
61.250	179.964
61.500	179.643
61.750	179.320
62.000	178.997
62.250	178.672
62.500	178.345
62.750	178.018
63.000	177.689
63.250	177.360
63.500	177.029
63.750	176.697
64.000	176.365
64.250	176.031
64.500	175.696
64.750	175.361
65.000	175.024
65.250	174.692
65.500	174.356
65.750	174.018
66.000	173.678
66.250	173.337
66.500	172.995
66.750	172.653
67.000	172.310
67.250	171.966
67.500	171.622
67.750	171.277
68.000	170.932
68.250	170.587
68.500	170.240
68.750	169.894
69.000	169.547
69.250	169.199
69.500	168.851
69.750	168.503
70.000	168.154
70.250	167.805
70.500	167.456
70.750	167.106
71.000	166.755
71.250	166.404
71.500	166.053
71.750	165.702
72.000	165.351
72.250	165.000
72.500	164.648
72.750	164.297
73.000	163.945
73.250	163.594
73.500	163.242
73.750	162.890
74.000	162.538
74.250	162.186

74.500	161.834
74.750	161.482
75.000	161.130
75.250	160.778
75.500	160.426
75.750	160.074
76.000	159.722
76.250	159.370
76.500	159.018
76.750	158.667
77.000	158.316
77.250	157.964
77.500	157.613
77.750	157.263
78.000	156.912
78.250	156.561
78.500	156.211
78.750	155.861
79.000	155.511
79.250	155.162
79.500	154.813
79.750	154.464
80.000	154.115
80.250	153.767
80.500	153.419
80.750	153.071
81.000	152.724
81.250	152.377
81.500	152.030
81.750	151.684
82.000	151.338
82.250	150.992
82.500	150.647
82.750	150.302
83.000	149.958
83.250	149.614
83.500	149.271
83.750	148.928
84.000	148.585
84.250	148.243
84.500	147.901
84.750	147.560
85.000	147.219
85.250	146.879
85.500	146.539
85.750	146.200
86.000	145.862
86.250	145.523
86.500	145.186
86.750	144.849
87.000	144.512
87.250	144.176
87.500	143.841
87.750	143.506
88.000	143.171
88.250	142.838
88.500	142.504
88.750	142.172
89.000	141.840
89.250	141.508
89.500	141.178
89.750	140.848
90.000	140.518
90.250	140.189
90.500	139.861
90.750	139.533
91.000	139.207
91.250	138.880
91.500	138.555
91.750	138.230
92.000	137.906
92.250	137.582
92.500	137.260
92.750	136.937
93.000	136.616
93.250	136.294
93.500	135.974
93.750	135.654
94.000	135.334
94.250	135.015
94.500	134.697
94.750	134.379
95.000	134.063
95.250	133.746
95.500	133.431
95.750	133.116
96.000	132.802
96.250	132.488
96.500	132.175

96.750	131.863
97.000	131.551
97.250	131.241
97.500	130.930
97.750	130.621
98.000	130.312
98.250	130.004
98.500	129.697
98.750	129.390
99.000	129.084
99.250	128.779
99.500	128.474
99.750	128.170
100.000	127.867

Name: HC0040_100 Node: HC-0040 Type: Flow

Time(hrs)	Flow(cfs)
0.000	0.666
0.030	0.672
0.070	0.678
0.100	0.684
0.130	0.690
0.170	0.696
0.200	0.702
0.230	0.709
0.270	0.715
0.300	0.721
0.330	0.727
0.370	0.733
0.400	0.740
0.430	0.746
0.470	0.752
0.500	0.758
0.530	0.764
0.570	0.770
0.600	0.777
0.630	0.783
0.670	0.789
0.700	0.795
0.730	0.801
0.770	0.807
0.800	0.813
0.830	0.819
0.870	0.826
0.900	0.832
0.930	0.838
0.970	0.844
1.000	0.851
1.030	0.858
1.070	0.864
1.100	0.872
1.130	0.879
1.170	0.886
1.200	0.894
1.230	0.902
1.270	0.911
1.300	0.919
1.330	0.928
1.370	0.938
1.400	0.948
1.430	0.958
1.470	0.968
1.500	0.980
1.530	0.991
1.570	1.003
1.600	1.015
1.630	1.028
1.670	1.041
1.700	1.054
1.730	1.068
1.770	1.082
1.800	1.097
1.830	1.112
1.870	1.128
1.900	1.143
1.930	1.159
1.970	1.176
2.000	1.192
2.030	1.210
2.070	1.227
2.100	1.245
2.130	1.263
2.170	1.281
2.200	1.299
2.230	1.318
2.270	1.338

2.300	1.357
2.330	1.377
2.370	1.397
2.400	1.417
2.430	1.438
2.470	1.458
2.500	1.480
2.530	1.501
2.570	1.523
2.600	1.545
2.630	1.567
2.670	1.589
2.700	1.611
2.730	1.634
2.770	1.658
2.800	1.681
2.830	1.705
2.870	1.729
2.900	1.753
2.930	1.777
2.970	1.802
3.000	1.827
3.030	1.852
3.070	1.877
3.100	1.903
3.130	1.929
3.170	1.955
3.200	1.981
3.230	2.008
3.270	2.034
3.300	2.061
3.330	2.089
3.370	2.116
3.400	2.144
3.430	2.171
3.470	2.199
3.500	2.228
3.530	2.256
3.570	2.285
3.600	2.314
3.630	2.343
3.670	2.373
3.700	2.402
3.730	2.432
3.770	2.462
3.800	2.493
3.830	2.523
3.870	2.554
3.900	2.585
3.930	2.616
3.970	2.648
4.000	2.680
4.030	2.711
4.070	2.744
4.100	2.776
4.130	2.808
4.170	2.841
4.200	2.874
4.230	2.906
4.270	2.939
4.300	2.973
4.330	3.006
4.370	3.040
4.400	3.074
4.430	3.108
4.470	3.142
4.500	3.177
4.530	3.212
4.570	3.247
4.600	3.282
4.630	3.318
4.670	3.353
4.700	3.389
4.730	3.426
4.770	3.462
4.800	3.499
4.830	3.536
4.870	3.573
4.900	3.611
4.930	3.649
4.970	3.687
5.000	3.725
5.030	3.763
5.070	3.802
5.100	3.841
5.130	3.880
5.170	3.919
5.200	3.959
5.230	3.999

5.270	4.039
5.300	4.079
5.330	4.120
5.370	4.161
5.400	4.202
5.430	4.243
5.470	4.284
5.500	4.326
5.530	4.369
5.570	4.411
5.600	4.454
5.630	4.498
5.670	4.541
5.700	4.585
5.730	4.630
5.770	4.675
5.800	4.720
5.830	4.765
5.870	4.811
5.900	4.857
5.930	4.904
5.970	4.951
6.000	4.999
6.030	5.046
6.070	5.095
6.100	5.143
6.130	5.192
6.170	5.242
6.200	5.292
6.230	5.342
6.270	5.393
6.300	5.445
6.330	5.496
6.370	5.549
6.400	5.602
6.430	5.655
6.470	5.709
6.500	5.764
6.530	5.819
6.570	5.875
6.600	5.932
6.630	5.989
6.670	6.047
6.700	6.106
6.730	6.165
6.770	6.226
6.800	6.286
6.830	6.348
6.870	6.410
6.900	6.473
6.930	6.537
6.970	6.601
7.000	6.667
7.030	6.732
7.070	6.799
7.100	6.867
7.130	6.935
7.170	7.004
7.200	7.074
7.230	7.144
7.270	7.216
7.300	7.288
7.330	7.361
7.370	7.435
7.400	7.510
7.430	7.586
7.470	7.663
7.500	7.741
7.530	7.820
7.570	7.899
7.600	7.980
7.630	8.062
7.670	8.145
7.700	8.229
7.730	8.314
7.770	8.401
7.800	8.488
7.830	8.576
7.870	8.666
7.900	8.757
7.930	8.848
7.970	8.941
8.000	9.035
8.030	9.131
8.070	9.227
8.100	9.324
8.130	9.423
8.170	9.523
8.200	9.624

8.230	9.727
8.270	9.830
8.300	9.935
8.330	10.042
8.370	10.150
8.400	10.260
8.430	10.371
8.470	10.484
8.500	10.599
8.530	10.715
8.570	10.834
8.600	10.954
8.630	11.076
8.670	11.199
8.700	11.325
8.730	11.452
8.770	11.580
8.800	11.711
8.830	11.843
8.870	11.977
8.900	12.113
8.930	12.251
8.970	12.390
9.000	12.532
9.030	12.675
9.070	12.821
9.100	12.968
9.130	13.118
9.170	13.269
9.200	13.423
9.230	13.579
9.270	13.737
9.300	13.897
9.330	14.060
9.370	14.224
9.400	14.391
9.430	14.560
9.470	14.731
9.500	14.905
9.530	15.081
9.570	15.260
9.600	15.441
9.630	15.625
9.670	15.814
9.700	16.005
9.730	16.198
9.770	16.395
9.800	16.593
9.830	16.794
9.870	16.998
9.900	17.205
9.930	17.414
9.970	17.625
10.000	17.840
10.030	18.059
10.070	18.280
10.100	18.505
10.130	18.733
10.170	18.965
10.200	19.201
10.230	19.441
10.270	19.684
10.300	19.931
10.330	20.182
10.370	20.437
10.400	20.697
10.430	20.960
10.470	21.229
10.500	21.501
10.530	21.779
10.570	22.061
10.600	22.348
10.630	22.640
10.670	22.937
10.700	23.240
10.730	23.548
10.770	23.862
10.800	24.182
10.830	24.508
10.870	24.839
10.900	25.177
10.930	25.521
10.970	25.872
11.000	26.229
11.030	26.594
11.070	26.965
11.100	27.343
11.130	27.729
11.170	28.122

11.200	28.523
11.230	28.932
11.270	29.348
11.300	29.772
11.330	30.152
11.370	30.406
11.400	30.692
11.430	31.008
11.470	31.350
11.500	31.715
11.530	32.103
11.570	32.511
11.600	32.940
11.630	33.389
11.670	33.860
11.700	34.353
11.730	34.870
11.770	35.414
11.800	35.987
11.830	36.592
11.870	37.232
11.900	37.911
11.930	38.633
11.970	39.404
12.000	40.227
12.030	41.106
12.070	42.046
12.100	43.053
12.130	44.132
12.170	45.286
12.200	46.520
12.230	47.838
12.270	49.244
12.300	50.743
12.330	52.338
12.370	54.031
12.400	55.826
12.430	57.725
12.470	59.730
12.500	61.841
12.530	64.061
12.570	66.388
12.600	68.823
12.630	71.365
12.670	74.012
12.700	76.763
12.730	79.617
12.770	82.570
12.800	85.620
12.830	88.763
12.870	91.996
12.900	95.315
12.930	98.715
12.970	102.193
13.000	105.742
13.030	109.359
13.070	113.038
13.100	116.774
13.130	120.562
13.170	124.396
13.200	128.271
13.230	132.181
13.270	136.121
13.300	140.086
13.330	144.070
13.370	148.069
13.400	152.077
13.430	156.090
13.470	160.102
13.500	164.107
13.530	168.096
13.570	172.067
13.600	176.014
13.630	179.936
13.670	183.828
13.700	187.688
13.730	191.516
13.770	195.309
13.800	199.065
13.830	202.785
13.870	206.466
13.900	210.109
13.930	213.713
13.970	217.277
14.000	220.802
14.030	224.287
14.070	227.732
14.100	231.138
14.130	234.504

14.170	237.832
14.200	241.121
14.230	244.370
14.270	247.582
14.300	250.755
14.330	253.890
14.370	256.988
14.400	260.049
14.430	263.074
14.470	266.064
14.500	269.028
14.530	271.993
14.570	274.955
14.600	277.912
14.630	280.861
14.670	283.798
14.700	286.723
14.730	289.633
14.770	292.526
14.800	295.401
14.830	298.258
14.870	301.096
14.900	303.914
14.930	306.710
14.970	309.483
15.000	312.232
15.030	314.958
15.070	317.658
15.100	320.332
15.130	322.979
15.170	325.599
15.200	328.192
15.230	330.757
15.270	333.294
15.300	335.804
15.330	338.287
15.370	340.742
15.400	343.171
15.430	345.573
15.470	347.948
15.500	350.298
15.530	352.622
15.570	354.920
15.600	357.194
15.630	359.444
15.670	361.670
15.700	363.872
15.730	366.051
15.770	368.208
15.800	370.343
15.830	372.456
15.870	374.548
15.900	376.620
15.930	378.671
15.970	380.532
16.000	382.402
16.030	384.286
16.070	386.177
16.100	388.069
16.130	389.958
16.170	391.841
16.200	393.715
16.230	395.579
16.270	397.430
16.300	399.269
16.330	401.094
16.370	402.904
16.400	404.699
16.430	406.479
16.470	408.243
16.500	409.992
16.530	411.726
16.570	413.444
16.600	415.146
16.630	416.833
16.670	418.504
16.700	420.160
16.730	421.801
16.770	423.426
16.800	425.036
16.830	426.630
16.870	428.209
16.900	429.773
16.930	431.322
16.970	432.881
17.000	434.399
17.030	435.901
17.070	437.388
17.100	438.861

17.130	440.318
17.170	441.761
17.200	443.189
17.230	444.603
17.270	446.004
17.300	447.392
17.330	448.768
17.370	450.132
17.400	451.485
17.430	452.827
17.470	454.161
17.500	455.486
17.530	456.802
17.570	458.110
17.600	459.410
17.630	460.686
17.670	461.934
17.700	463.161
17.730	464.372
17.770	465.572
17.800	466.761
17.830	467.942
17.870	469.115
17.900	470.281
17.930	471.440
17.970	472.592
18.000	473.738
18.030	474.877
18.070	476.010
18.100	477.137
18.130	478.257
18.170	479.371
18.200	480.479
18.230	481.581
18.270	482.677
18.300	483.768
18.330	484.852
18.370	485.932
18.400	487.006
18.430	488.075
18.470	489.139
18.500	490.198
18.530	491.253
18.570	492.303
18.600	493.349
18.630	494.391
18.670	495.428
18.700	496.461
18.730	497.491
18.770	498.516
18.800	499.537
18.830	500.554
18.870	501.566
18.900	502.575
18.930	503.579
18.970	504.579
19.000	505.575
19.030	506.566
19.070	507.553
19.100	508.534
19.130	509.512
19.170	510.484
19.200	511.452
19.230	512.416
19.270	513.374
19.300	514.329
19.330	515.279
19.370	516.225
19.400	517.166
19.430	518.104
19.470	519.038
19.500	519.968
19.530	520.895
19.570	521.818
19.600	522.737
19.630	523.654
19.670	524.567
19.700	525.477
19.730	526.385
19.770	527.289
19.800	528.190
19.830	529.089
19.870	529.984
19.900	530.877
19.930	531.767
19.970	532.653
20.000	533.537
20.030	534.417
20.070	535.295

20.100	536.169
20.130	537.040
20.170	537.907
20.200	538.771
20.230	539.632
20.270	540.489
20.300	541.343
20.330	542.193
20.370	543.040
20.400	543.883
20.430	544.722
20.470	545.558
20.500	546.391
20.530	547.219
20.570	548.044
20.600	548.865
20.630	549.682
20.670	550.495
20.700	551.304
20.730	552.110
20.770	552.912
20.800	553.711
20.830	554.505
20.870	555.297
20.900	556.084
20.930	556.868
20.970	557.649
21.000	558.427
21.030	559.201
21.070	559.972
21.100	560.740
21.130	561.504
21.170	562.266
21.200	563.025
21.230	563.781
21.270	564.534
21.300	565.284
21.330	566.032
21.370	566.777
21.400	567.520
21.430	568.259
21.470	568.996
21.500	569.731
21.530	570.463
21.570	571.192
21.600	571.920
21.630	572.644
21.670	573.367
21.700	574.087
21.730	574.804
21.770	575.520
21.800	576.233
21.830	576.944
21.870	577.653
21.900	578.360
21.930	579.064
21.970	579.767
22.000	580.468
22.030	581.166
22.070	581.863
22.100	582.557
22.130	583.236
22.170	583.897
22.200	584.578
22.230	585.264
22.270	585.950
22.300	586.635
22.330	587.317
22.370	587.997
22.400	588.676
22.430	589.352
22.470	590.027
22.500	590.700
22.530	591.371
22.570	592.041
22.600	592.708
22.630	593.374
22.670	594.039
22.700	594.701
22.730	595.362
22.770	596.021
22.800	596.678
22.830	597.333
22.870	597.987
22.900	598.638
22.930	599.287
22.970	599.934
23.000	600.579
23.030	601.222

23.070	601.862
23.100	602.500
23.130	603.136
23.170	603.769
23.200	604.400
23.230	605.029
23.270	605.654
23.300	606.278
23.330	606.899
23.370	607.517
23.400	608.134
23.430	608.747
23.470	609.359
23.500	609.968
23.530	610.575
23.570	611.179
23.600	611.782
23.630	612.382
23.670	612.979
23.700	613.575
23.730	614.168
23.770	614.758
23.800	615.347
23.830	615.933
23.870	616.517
23.900	617.098
23.930	617.676
23.970	618.252
24.000	618.824
24.250	622.996
24.500	626.823
24.750	629.554
25.000	632.802
25.250	635.686
25.500	638.237
25.750	640.516
26.000	642.564
26.250	644.412
26.500	646.083
26.750	647.601
27.000	648.981
27.250	650.239
27.500	651.387
27.750	652.436
28.000	653.396
28.250	654.277
28.500	655.084
28.750	655.824
29.000	656.503
29.250	657.124
29.500	657.695
29.750	658.220
30.000	658.699
30.250	659.133
30.500	659.526
30.750	659.877
31.000	660.187
31.250	660.459
31.500	660.693
31.750	660.889
32.000	661.050
32.250	661.177
32.500	661.278
32.750	661.384
33.000	661.458
33.250	661.499
33.500	661.507
33.750	661.481
34.000	661.425
34.250	661.337
34.500	661.219
34.750	661.070
35.000	660.889
35.250	660.678
35.500	660.436
35.750	660.165
36.000	659.864
36.250	659.534
36.500	659.176
36.750	658.791
37.000	658.378
37.250	657.939
37.500	657.475
37.750	656.985
38.000	656.471
38.250	655.934
38.500	655.374
38.750	654.792
39.000	654.188

39.250	653.562
39.500	652.916
39.750	652.248
40.000	651.560
40.250	650.853
40.500	650.126
40.750	649.381
41.000	648.618
41.250	647.838
41.500	647.041
41.750	646.229
42.000	645.402
42.250	644.561
42.500	643.707
42.750	642.840
43.000	641.961
43.250	641.071
43.500	640.170
43.750	639.259
44.000	638.338
44.250	637.409
44.500	636.470
44.750	635.524
45.000	634.570
45.250	633.609
45.500	632.641
45.750	631.666
46.000	630.684
46.250	629.695
46.500	628.699
46.750	627.698
47.000	626.874
47.250	626.506
47.500	625.601
47.750	624.650
48.000	623.696
48.250	622.739
48.500	621.779
48.750	620.816
49.000	619.852
49.250	618.886
49.500	617.918
49.750	616.948
50.000	615.977
50.250	615.004
50.500	614.029
50.750	613.053
51.000	612.074
51.250	611.094
51.500	610.111
51.750	609.127
52.000	608.140
52.250	607.152
52.500	606.161
52.750	605.169
53.000	604.176
53.250	603.181
53.500	602.185
53.750	601.188
54.000	600.190
54.250	599.192
54.500	598.194
54.750	597.196
55.000	596.198
55.250	595.200
55.500	594.203
55.750	593.207
56.000	592.213
56.250	591.219
56.500	590.228
56.750	589.238
57.000	588.251
57.250	587.266
57.500	586.283
57.750	585.303
58.000	584.326
58.250	583.352
58.500	582.383
58.750	581.461
59.000	580.494
59.250	579.531
59.500	578.571
59.750	577.615
60.000	576.662
60.250	575.712
60.500	574.766
60.750	573.823
61.000	572.883
61.250	571.947

61.500	571.014
61.750	570.084
62.000	569.157
62.250	568.234
62.500	567.314
62.750	566.397
63.000	565.484
63.250	564.574
63.500	563.666
63.750	562.762
64.000	561.861
64.250	560.963
64.500	560.067
64.750	559.174
65.000	558.283
65.250	557.395
65.500	556.508
65.750	555.622
66.000	554.737
66.250	553.851
66.500	552.965
66.750	552.079
67.000	551.191
67.250	550.303
67.500	549.412
67.750	548.519
68.000	547.624
68.250	546.725
68.500	545.823
68.750	544.917
69.000	544.007
69.250	543.094
69.500	542.177
69.750	541.255
70.000	540.329
70.250	539.399
70.500	538.464
70.750	537.524
71.000	536.581
71.250	535.632
71.500	534.679
71.750	533.721
72.000	532.757
72.250	531.788
72.500	530.814
72.750	529.836
73.000	528.852
73.250	527.864
73.500	526.871
73.750	525.872
74.000	524.869
74.250	523.861
74.500	522.847
74.750	521.829
75.000	520.806
75.250	519.778
75.500	518.745
75.750	517.706
76.000	516.662
76.250	515.613
76.500	514.560
76.750	513.502
77.000	512.439
77.250	511.372
77.500	510.301
77.750	509.225
78.000	508.144
78.250	507.060
78.500	505.971
78.750	504.877
79.000	503.779
79.250	502.677
79.500	501.572
79.750	500.462
80.000	499.350
80.250	498.234
80.500	497.114
80.750	495.991
81.000	494.865
81.250	493.736
81.500	492.603
81.750	491.466
82.000	490.327
82.250	489.185
82.500	488.041
82.750	486.894
83.000	485.744
83.250	484.592
83.500	483.438

83.750	482.281
84.000	481.122
84.250	479.960
84.500	478.797
84.750	477.633
85.000	476.466
85.250	475.298
85.500	474.129
85.750	472.960
86.000	471.790
86.250	470.620
86.500	469.449
86.750	468.279
87.000	467.108
87.250	465.937
87.500	464.767
87.750	463.596
88.000	462.409
88.250	461.181
88.500	459.958
88.750	458.735
89.000	457.514
89.250	456.294
89.500	455.075
89.750	453.858
90.000	452.642
90.250	451.427
90.500	450.214
90.750	449.001
91.000	447.790
91.250	446.579
91.500	445.369
91.750	444.159
92.000	442.949
92.250	441.740
92.500	440.532
92.750	439.323
93.000	438.116
93.250	436.908
93.500	435.701
93.750	434.494
94.000	433.287
94.250	432.080
94.500	430.872
94.750	429.664
95.000	428.456
95.250	427.246
95.500	426.035
95.750	424.824
96.000	423.612
96.250	422.399
96.500	421.185
96.750	419.971
97.000	418.757
97.250	417.542
97.500	416.327
97.750	415.112
98.000	413.897
98.250	412.682
98.500	411.466
98.750	410.251
99.000	409.036
99.250	407.822
99.500	406.607
99.750	405.393
100.000	404.182

Name: LkHowell_100 Node: LH-0090 Type: Stage

Time(hrs)	Stage(ft)
0.000	53.080
0.030	53.078
0.070	53.077
0.100	53.075
0.130	53.074
0.170	53.072
0.200	53.070
0.230	53.069
0.270	53.067
0.300	53.065
0.330	53.064
0.370	53.062
0.400	53.061
0.430	53.059
0.470	53.057
0.500	53.056
0.530	53.054

0.570	53.053
0.600	53.051
0.630	53.049
0.670	53.048
0.700	53.046
0.730	53.045
0.770	53.043
0.800	53.041
0.830	53.040
0.870	53.038
0.900	53.037
0.930	53.035
0.970	53.034
1.000	53.032
1.030	53.030
1.070	53.029
1.100	53.027
1.130	53.026
1.170	53.024
1.200	53.023
1.230	53.021
1.270	53.020
1.300	53.018
1.330	53.017
1.370	53.015
1.400	53.014
1.430	53.012
1.470	53.011
1.500	53.009
1.530	53.008
1.570	53.007
1.600	53.005
1.630	53.004
1.670	53.002
1.700	53.001
1.730	53.000
1.770	52.998
1.800	52.997
1.830	52.996
1.870	52.994
1.900	52.993
1.930	52.992
1.970	52.991
2.000	52.989
2.030	52.988
2.070	52.987
2.100	52.986
2.130	52.984
2.170	52.983
2.200	52.982
2.230	52.981
2.270	52.980
2.300	52.979
2.330	52.977
2.370	52.976
2.400	52.975
2.430	52.974
2.470	52.973
2.500	52.972
2.530	52.971
2.570	52.969
2.600	52.968
2.630	52.967
2.670	52.966
2.700	52.965
2.730	52.964
2.770	52.963
2.800	52.962
2.830	52.961
2.870	52.960
2.900	52.959
2.930	52.958
2.970	52.957
3.000	52.956
3.030	52.955
3.070	52.954
3.100	52.953
3.130	52.952
3.170	52.951
3.200	52.950
3.230	52.949
3.270	52.948
3.300	52.947
3.330	52.946
3.370	52.946
3.400	52.945
3.430	52.944
3.470	52.943
3.500	52.942

3.530	52.941
3.570	52.940
3.600	52.940
3.630	52.939
3.670	52.938
3.700	52.937
3.730	52.936
3.770	52.936
3.800	52.935
3.830	52.934
3.870	52.933
3.900	52.933
3.930	52.932
3.970	52.931
4.000	52.930
4.030	52.930
4.070	52.929
4.100	52.928
4.130	52.928
4.170	52.927
4.200	52.926
4.230	52.926
4.270	52.925
4.300	52.924
4.330	52.924
4.370	52.923
4.400	52.923
4.430	52.922
4.470	52.922
4.500	52.921
4.530	52.920
4.570	52.920
4.600	52.919
4.630	52.919
4.670	52.918
4.700	52.918
4.730	52.917
4.770	52.917
4.800	52.917
4.830	52.916
4.870	52.916
4.900	52.915
4.930	52.915
4.970	52.914
5.000	52.914
5.030	52.914
5.070	52.913
5.100	52.913
5.130	52.913
5.170	52.912
5.200	52.912
5.230	52.912
5.270	52.912
5.300	52.911
5.330	52.911
5.370	52.911
5.400	52.911
5.430	52.910
5.470	52.910
5.500	52.910
5.530	52.910
5.570	52.910
5.600	52.909
5.630	52.909
5.670	52.909
5.700	52.909
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5.800	52.909
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5.870	52.909
5.900	52.908
5.930	52.908
5.970	52.908
6.000	52.908
6.030	52.908
6.070	52.908
6.100	52.908
6.130	52.908
6.170	52.908
6.200	52.908
6.230	52.909
6.270	52.909
6.300	52.909
6.330	52.909
6.370	52.909
6.400	52.909
6.430	52.909
6.470	52.909

6.500	52.910
6.530	52.910
6.570	52.910
6.600	52.910
6.630	52.911
6.670	52.911
6.700	52.911
6.730	52.912
6.770	52.912
6.800	52.912
6.830	52.913
6.870	52.913
6.900	52.914
6.930	52.914
6.970	52.914
7.000	52.915
7.030	52.915
7.070	52.916
7.100	52.916
7.130	52.917
7.170	52.917
7.200	52.918
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7.400	52.922
7.430	52.922
7.470	52.923
7.500	52.924
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7.570	52.925
7.600	52.926
7.630	52.927
7.670	52.928
7.700	52.929
7.730	52.930
7.770	52.930
7.800	52.931
7.830	52.932
7.870	52.933
7.900	52.934
7.930	52.935
7.970	52.936
8.000	52.937
8.030	52.938
8.070	52.939
8.100	52.941
8.130	52.942
8.170	52.943
8.200	52.944
8.230	52.945
8.270	52.946
8.300	52.948
8.330	52.949
8.370	52.950
8.400	52.952
8.430	52.953
8.470	52.954
8.500	52.956
8.530	52.957
8.570	52.959
8.600	52.960
8.630	52.962
8.670	52.963
8.700	52.965
8.730	52.967
8.770	52.968
8.800	52.970
8.830	52.972
8.870	52.973
8.900	52.975
8.930	52.977
8.970	52.979
9.000	52.981
9.030	52.983
9.070	52.985
9.100	52.987
9.130	52.989
9.170	52.991
9.200	52.993
9.230	52.995
9.270	52.998
9.300	53.000
9.330	53.002
9.370	53.004
9.400	53.007
9.430	53.009

9.470	53.012
9.500	53.014
9.530	53.017
9.570	53.019
9.600	53.022
9.630	53.024
9.670	53.027
9.700	53.030
9.730	53.032
9.770	53.035
9.800	53.038
9.830	53.041
9.870	53.044
9.900	53.047
9.930	53.050
9.970	53.053
10.000	53.056
10.030	53.060
10.070	53.063
10.100	53.066
10.130	53.070
10.170	53.073
10.200	53.077
10.230	53.080
10.270	53.084
10.300	53.088
10.330	53.092
10.370	53.095
10.400	53.099
10.430	53.103
10.470	53.107
10.500	53.112
10.530	53.116
10.570	53.120
10.600	53.125
10.630	53.129
10.670	53.134
10.700	53.138
10.730	53.143
10.770	53.148
10.800	53.153
10.830	53.158
10.870	53.163
10.900	53.168
10.930	53.174
10.970	53.179
11.000	53.185
11.030	53.190
11.070	53.196
11.100	53.202
11.130	53.207
11.170	53.213
11.200	53.220
11.230	53.226
11.270	53.232
11.300	53.238
11.330	53.245
11.370	53.252
11.400	53.258
11.430	53.266
11.470	53.273
11.500	53.280
11.530	53.288
11.570	53.296
11.600	53.305
11.630	53.314
11.670	53.323
11.700	53.333
11.730	53.344
11.770	53.356
11.800	53.369
11.830	53.383
11.870	53.397
11.900	53.413
11.930	53.431
11.970	53.449
12.000	53.470
12.030	53.492
12.070	53.515
12.100	53.540
12.130	53.566
12.170	53.594
12.200	53.623
12.230	53.653
12.270	53.683
12.300	53.714
12.330	53.745
12.370	53.778
12.400	53.810

12.430	53.844
12.470	53.878
12.500	53.913
12.530	53.948
12.570	53.984
12.600	54.020
12.630	54.057
12.670	54.094
12.700	54.131
12.730	54.168
12.770	54.205
12.800	54.243
12.830	54.280
12.870	54.317
12.900	54.354
12.930	54.390
12.970	54.427
13.000	54.463
13.030	54.499
13.070	54.534
13.100	54.569
13.130	54.604
13.170	54.639
13.200	54.673
13.230	54.707
13.270	54.740
13.300	54.773
13.330	54.806
13.370	54.839
13.400	54.871
13.430	54.902
13.470	54.934
13.500	54.965
13.530	54.996
13.570	55.026
13.600	55.056
13.630	55.086
13.670	55.115
13.700	55.144
13.730	55.173
13.770	55.202
13.800	55.230
13.830	55.258
13.870	55.285
13.900	55.313
13.930	55.340
13.970	55.366
14.000	55.393
14.030	55.419
14.070	55.445
14.100	55.471
14.130	55.497
14.170	55.522
14.200	55.548
14.230	55.573
14.270	55.598
14.300	55.623
14.330	55.647
14.370	55.672
14.400	55.696
14.430	55.720
14.470	55.745
14.500	55.768
14.530	55.792
14.570	55.816
14.600	55.839
14.630	55.863
14.670	55.886
14.700	55.909
14.730	55.931
14.770	55.954
14.800	55.976
14.830	55.998
14.870	56.021
14.900	56.043
14.930	56.064
14.970	56.086
15.000	56.107
15.030	56.128
15.070	56.149
15.100	56.170
15.130	56.191
15.170	56.211
15.200	56.232
15.230	56.252
15.270	56.272
15.300	56.291
15.330	56.311
15.370	56.330

15.400	56.349
15.430	56.369
15.470	56.387
15.500	56.406
15.530	56.424
15.570	56.443
15.600	56.461
15.630	56.479
15.670	56.497
15.700	56.514
15.730	56.532
15.770	56.549
15.800	56.566
15.830	56.583
15.870	56.600
15.900	56.616
15.930	56.633
15.970	56.649
16.000	56.665
16.030	56.681
16.070	56.697
16.100	56.712
16.130	56.728
16.170	56.743
16.200	56.758
16.230	56.773
16.270	56.788
16.300	56.802
16.330	56.817
16.370	56.831
16.400	56.845
16.430	56.859
16.470	56.873
16.500	56.886
16.530	56.900
16.570	56.913
16.600	56.926
16.630	56.939
16.670	56.952
16.700	56.965
16.730	56.977
16.770	56.990
16.800	57.002
16.830	57.014
16.870	57.026
16.900	57.038
16.930	57.049
16.970	57.061
17.000	57.073
17.030	57.084
17.070	57.095
17.100	57.106
17.130	57.116
17.170	57.127
17.200	57.137
17.230	57.148
17.270	57.158
17.300	57.168
17.330	57.178
17.370	57.188
17.400	57.197
17.430	57.207
17.470	57.216
17.500	57.225
17.530	57.234
17.570	57.243
17.600	57.252
17.630	57.260
17.670	57.269
17.700	57.277
17.730	57.285
17.770	57.293
17.800	57.301
17.830	57.309
17.870	57.317
17.900	57.325
17.930	57.332
17.970	57.340
18.000	57.347
18.030	57.354
18.070	57.362
18.100	57.369
18.130	57.376
18.170	57.382
18.200	57.389
18.230	57.396
18.270	57.403
18.300	57.409
18.330	57.416

18.370	57.422
18.400	57.428
18.430	57.435
18.470	57.441
18.500	57.447
18.530	57.453
18.570	57.459
18.600	57.465
18.630	57.471
18.670	57.477
18.700	57.483
18.730	57.488
18.770	57.494
18.800	57.500
18.830	57.505
18.870	57.511
18.900	57.516
18.930	57.522
18.970	57.527
19.000	57.532
19.030	57.537
19.070	57.543
19.100	57.548
19.130	57.553
19.170	57.558
19.200	57.563
19.230	57.568
19.270	57.573
19.300	57.578
19.330	57.582
19.370	57.587
19.400	57.592
19.430	57.597
19.470	57.601
19.500	57.606
19.530	57.610
19.570	57.615
19.600	57.619
19.630	57.624
19.670	57.628
19.700	57.632
19.730	57.637
19.770	57.641
19.800	57.645
19.830	57.649
19.870	57.654
19.900	57.658
19.930	57.662
19.970	57.666
20.000	57.670
20.030	57.674
20.070	57.678
20.100	57.682
20.130	57.686
20.170	57.689
20.200	57.693
20.230	57.697
20.270	57.701
20.300	57.704
20.330	57.708
20.370	57.712
20.400	57.715
20.430	57.719
20.470	57.722
20.500	57.726
20.530	57.729
20.570	57.732
20.600	57.736
20.630	57.739
20.670	57.742
20.700	57.746
20.730	57.749
20.770	57.752
20.800	57.755
20.830	57.758
20.870	57.761
20.900	57.765
20.930	57.768
20.970	57.771
21.000	57.773
21.030	57.776
21.070	57.779
21.100	57.782
21.130	57.785
21.170	57.788
21.200	57.791
21.230	57.793
21.270	57.796
21.300	57.799

21.330	57.802
21.370	57.804
21.400	57.807
21.430	57.810
21.470	57.812
21.500	57.815
21.530	57.817
21.570	57.820
21.600	57.822
21.630	57.825
21.670	57.827
21.700	57.830
21.730	57.832
21.770	57.834
21.800	57.837
21.830	57.839
21.870	57.841
21.900	57.844
21.930	57.846
21.970	57.848
22.000	57.850
22.030	57.853
22.070	57.855
22.100	57.857
22.130	57.859
22.170	57.861
22.200	57.863
22.230	57.866
22.270	57.868
22.300	57.870
22.330	57.872
22.370	57.874
22.400	57.876
22.430	57.878
22.470	57.880
22.500	57.882
22.530	57.883
22.570	57.885
22.600	57.887
22.630	57.889
22.670	57.891
22.700	57.893
22.730	57.894
22.770	57.896
22.800	57.898
22.830	57.900
22.870	57.901
22.900	57.903
22.930	57.905
22.970	57.906
23.000	57.908
23.030	57.910
23.070	57.911
23.100	57.913
23.130	57.914
23.170	57.916
23.200	57.918
23.230	57.919
23.270	57.921
23.300	57.922
23.330	57.924
23.370	57.925
23.400	57.927
23.430	57.928
23.470	57.929
23.500	57.931
23.530	57.932
23.570	57.933
23.600	57.935
23.630	57.936
23.670	57.937
23.700	57.939
23.730	57.940
23.770	57.941
23.800	57.943
23.830	57.944
23.870	57.945
23.900	57.946
23.930	57.947
23.970	57.949
24.000	57.950
24.250	57.958
24.500	57.963
24.750	57.967
25.000	57.969
25.250	57.969
25.500	57.967
25.750	57.964
26.000	57.959

26.250	57.953
26.500	57.947
26.750	57.940
27.000	57.932
27.250	57.923
27.500	57.914
27.750	57.904
28.000	57.894
28.250	57.883
28.500	57.872
28.750	57.861
29.000	57.850
29.250	57.838
29.500	57.826
29.750	57.814
30.000	57.801
30.250	57.789
30.500	57.776
30.750	57.764
31.000	57.751
31.250	57.738
31.500	57.726
31.750	57.713
32.000	57.700
32.250	57.687
32.500	57.674
32.750	57.661
33.000	57.648
33.250	57.635
33.500	57.622
33.750	57.609
34.000	57.596
34.250	57.584
34.500	57.571
34.750	57.558
35.000	57.545
35.250	57.532
35.500	57.519
35.750	57.506
36.000	57.493
36.250	57.480
36.500	57.467
36.750	57.455
37.000	57.442
37.250	57.429
37.500	57.416
37.750	57.403
38.000	57.391
38.250	57.378
38.500	57.365
38.750	57.352
39.000	57.340
39.250	57.327
39.500	57.314
39.750	57.302
40.000	57.289
40.250	57.276
40.500	57.264
40.750	57.251
41.000	57.239
41.250	57.226
41.500	57.214
41.750	57.201
42.000	57.189
42.250	57.176
42.500	57.164
42.750	57.152
43.000	57.139
43.250	57.127
43.500	57.114
43.750	57.102
44.000	57.090
44.250	57.077
44.500	57.065
44.750	57.052
45.000	57.040
45.250	57.028
45.500	57.015
45.750	57.003
46.000	56.991
46.250	56.978
46.500	56.966
46.750	56.954
47.000	56.942
47.250	56.929
47.500	56.917
47.750	56.905
48.000	56.893
48.250	56.881

48.500	56.869
48.750	56.857
49.000	56.845
49.250	56.833
49.500	56.821
49.750	56.809
50.000	56.797
50.250	56.785
50.500	56.773
50.750	56.761
51.000	56.749
51.250	56.738
51.500	56.726
51.750	56.714
52.000	56.702
52.250	56.691
52.500	56.679
52.750	56.667
53.000	56.656
53.250	56.644
53.500	56.633
53.750	56.621
54.000	56.610
54.250	56.598
54.500	56.587
54.750	56.575
55.000	56.564
55.250	56.553
55.500	56.542
55.750	56.530
56.000	56.519
56.250	56.508
56.500	56.497
56.750	56.486
57.000	56.475
57.250	56.464
57.500	56.453
57.750	56.442
58.000	56.431
58.250	56.420
58.500	56.409
58.750	56.398
59.000	56.387
59.250	56.377
59.500	56.366
59.750	56.355
60.000	56.344
60.250	56.334
60.500	56.323
60.750	56.313
61.000	56.302
61.250	56.292
61.500	56.281
61.750	56.271
62.000	56.260
62.250	56.250
62.500	56.240
62.750	56.230
63.000	56.219
63.250	56.209
63.500	56.199
63.750	56.189
64.000	56.179
64.250	56.169
64.500	56.159
64.750	56.149
65.000	56.139
65.250	56.129
65.500	56.119
65.750	56.109
66.000	56.099
66.250	56.090
66.500	56.080
66.750	56.070
67.000	56.061
67.250	56.051
67.500	56.041
67.750	56.032
68.000	56.022
68.250	56.013
68.500	56.003
68.750	55.994
69.000	55.985
69.250	55.975
69.500	55.966
69.750	55.957
70.000	55.947
70.250	55.938
70.500	55.929

70.750	55.920
71.000	55.911
71.250	55.901
71.500	55.892
71.750	55.883
72.000	55.874
72.250	55.865
72.500	55.856
72.750	55.847
73.000	55.838
73.250	55.829
73.500	55.820
73.750	55.811
74.000	55.802
74.250	55.793
74.500	55.785
74.750	55.776
75.000	55.767
75.250	55.758
75.500	55.749
75.750	55.741
76.000	55.732
76.250	55.723
76.500	55.715
76.750	55.706
77.000	55.698
77.250	55.689
77.500	55.681
77.750	55.672
78.000	55.664
78.250	55.655
78.500	55.647
78.750	55.638
79.000	55.630
79.250	55.622
79.500	55.613
79.750	55.605
80.000	55.597
80.250	55.588
80.500	55.580
80.750	55.572
81.000	55.564
81.250	55.556
81.500	55.548
81.750	55.540
82.000	55.531
82.250	55.523
82.500	55.515
82.750	55.507
83.000	55.499
83.250	55.491
83.500	55.483
83.750	55.475
84.000	55.468
84.250	55.460
84.500	55.452
84.750	55.444
85.000	55.436
85.250	55.428
85.500	55.420
85.750	55.413
86.000	55.405
86.250	55.397
86.500	55.389
86.750	55.382
87.000	55.374
87.250	55.366
87.500	55.359
87.750	55.351
88.000	55.343
88.250	55.336
88.500	55.328
88.750	55.320
89.000	55.313
89.250	55.305
89.500	55.298
89.750	55.290
90.000	55.282
90.250	55.275
90.500	55.267
90.750	55.260
91.000	55.252
91.250	55.245
91.500	55.237
91.750	55.230
92.000	55.222
92.250	55.215
92.500	55.207
92.750	55.200

93.000	55.192
93.250	55.185
93.500	55.178
93.750	55.170
94.000	55.163
94.250	55.155
94.500	55.148
94.750	55.141
95.000	55.133
95.250	55.126
95.500	55.119
95.750	55.111
96.000	55.104
96.250	55.097
96.500	55.089
96.750	55.082
97.000	55.075
97.250	55.067
97.500	55.060
97.750	55.053
98.000	55.045
98.250	55.038
98.500	55.031
98.750	55.024
99.000	55.016
99.250	55.009
99.500	55.002
99.750	54.995
100.000	54.988

Name: HC0040_10 Node: HC-0040 Type: Flow

Time(hrs)	Flow(cfs)
0.000	0.666
0.030	0.672
0.070	0.678
0.100	0.684
0.130	0.690
0.170	0.696
0.200	0.702
0.230	0.709
0.270	0.715
0.300	0.721
0.330	0.727
0.370	0.733
0.400	0.740
0.430	0.746
0.470	0.752
0.500	0.758
0.530	0.764
0.570	0.770
0.600	0.777
0.630	0.783
0.670	0.789
0.700	0.795
0.730	0.801
0.770	0.807
0.800	0.813
0.830	0.819
0.870	0.825
0.900	0.831
0.930	0.837
0.970	0.843
1.000	0.849
1.030	0.855
1.070	0.861
1.100	0.867
1.130	0.872
1.170	0.878
1.200	0.884
1.230	0.890
1.270	0.896
1.300	0.902
1.330	0.907
1.370	0.913
1.400	0.919
1.430	0.925
1.470	0.931
1.500	0.937
1.530	0.943
1.570	0.949
1.600	0.956
1.630	0.962
1.670	0.969
1.700	0.976
1.730	0.983
1.770	0.990

1.800	0.998
1.830	1.005
1.870	1.013
1.900	1.021
1.930	1.030
1.970	1.038
2.000	1.047
2.030	1.056
2.070	1.066
2.100	1.075
2.130	1.085
2.170	1.095
2.200	1.105
2.230	1.116
2.270	1.126
2.300	1.137
2.330	1.148
2.370	1.160
2.400	1.171
2.430	1.183
2.470	1.194
2.500	1.207
2.530	1.219
2.570	1.231
2.600	1.244
2.630	1.256
2.670	1.269
2.700	1.282
2.730	1.296
2.770	1.309
2.800	1.322
2.830	1.336
2.870	1.350
2.900	1.364
2.930	1.378
2.970	1.392
3.000	1.406
3.030	1.421
3.070	1.435
3.100	1.450
3.130	1.465
3.170	1.480
3.200	1.495
3.230	1.510
3.270	1.526
3.300	1.541
3.330	1.556
3.370	1.572
3.400	1.588
3.430	1.604
3.470	1.620
3.500	1.636
3.530	1.652
3.570	1.669
3.600	1.685
3.630	1.702
3.670	1.719
3.700	1.735
3.730	1.752
3.770	1.769
3.800	1.786
3.830	1.804
3.870	1.821
3.900	1.839
3.930	1.856
3.970	1.874
4.000	1.892
4.030	1.910
4.070	1.928
4.100	1.946
4.130	1.964
4.170	1.982
4.200	2.001
4.230	2.019
4.270	2.038
4.300	2.056
4.330	2.075
4.370	2.094
4.400	2.113
4.430	2.132
4.470	2.151
4.500	2.171
4.530	2.190
4.570	2.209
4.600	2.228
4.630	2.248
4.670	2.268
4.700	2.288
4.730	2.307

4.770	2.327
4.800	2.348
4.830	2.368
4.870	2.388
4.900	2.408
4.930	2.429
4.970	2.450
5.000	2.470
5.030	2.491
5.070	2.512
5.100	2.533
5.130	2.554
5.170	2.575
5.200	2.597
5.230	2.618
5.270	2.639
5.300	2.661
5.330	2.683
5.370	2.704
5.400	2.726
5.430	2.748
5.470	2.770
5.500	2.792
5.530	2.814
5.570	2.836
5.600	2.859
5.630	2.881
5.670	2.904
5.700	2.926
5.730	2.949
5.770	2.972
5.800	2.995
5.830	3.018
5.870	3.041
5.900	3.064
5.930	3.087
5.970	3.110
6.000	3.134
6.030	3.157
6.070	3.181
6.100	3.204
6.130	3.228
6.170	3.252
6.200	3.276
6.230	3.300
6.270	3.324
6.300	3.347
6.330	3.372
6.370	3.396
6.400	3.421
6.430	3.445
6.470	3.470
6.500	3.495
6.530	3.519
6.570	3.544
6.600	3.569
6.630	3.595
6.670	3.620
6.700	3.646
6.730	3.672
6.770	3.697
6.800	3.723
6.830	3.749
6.870	3.776
6.900	3.802
6.930	3.829
6.970	3.856
7.000	3.883
7.030	3.911
7.070	3.938
7.100	3.966
7.130	3.994
7.170	4.022
7.200	4.050
7.230	4.079
7.270	4.108
7.300	4.137
7.330	4.166
7.370	4.195
7.400	4.224
7.430	4.254
7.470	4.284
7.500	4.315
7.530	4.345
7.570	4.376
7.600	4.407
7.630	4.438
7.670	4.470
7.700	4.501

7.730	4.533
7.770	4.566
7.800	4.598
7.830	4.631
7.870	4.664
7.900	4.697
7.930	4.731
7.970	4.765
8.000	4.798
8.030	4.832
8.070	4.867
8.100	4.902
8.130	4.937
8.170	4.972
8.200	5.008
8.230	5.044
8.270	5.080
8.300	5.117
8.330	5.154
8.370	5.191
8.400	5.229
8.430	5.267
8.470	5.305
8.500	5.345
8.530	5.384
8.570	5.423
8.600	5.464
8.630	5.504
8.670	5.546
8.700	5.587
8.730	5.630
8.770	5.673
8.800	5.717
8.830	5.760
8.870	5.805
8.900	5.850
8.930	5.896
8.970	5.943
9.000	5.989
9.030	6.038
9.070	6.086
9.100	6.135
9.130	6.185
9.170	6.235
9.200	6.287
9.230	6.339
9.270	6.392
9.300	6.445
9.330	6.500
9.370	6.554
9.400	6.610
9.430	6.667
9.470	6.724
9.500	6.783
9.530	6.841
9.570	6.902
9.600	6.962
9.630	7.024
9.670	7.086
9.700	7.149
9.730	7.214
9.770	7.279
9.800	7.346
9.830	7.413
9.870	7.482
9.900	7.551
9.930	7.623
9.970	7.694
10.000	7.767
10.030	7.842
10.070	7.918
10.100	7.996
10.130	8.074
10.170	8.155
10.200	8.236
10.230	8.319
10.270	8.403
10.300	8.489
10.330	8.575
10.370	8.665
10.400	8.754
10.430	8.846
10.470	8.939
10.500	9.033
10.530	9.131
10.570	9.229
10.600	9.330
10.630	9.432
10.670	9.537

10.700	9.643
10.730	9.752
10.770	9.862
10.800	9.975
10.830	10.091
10.870	10.211
10.900	10.331
10.930	10.457
10.970	10.584
11.000	10.713
11.030	10.845
11.070	10.981
11.100	11.119
11.130	11.258
11.170	11.403
11.200	11.548
11.230	11.698
11.270	11.850
11.300	12.005
11.330	12.163
11.370	12.325
11.400	12.491
11.430	12.661
11.470	12.835
11.500	13.014
11.530	13.199
11.570	13.391
11.600	13.590
11.630	13.794
11.670	14.011
11.700	14.240
11.730	14.482
11.770	14.740
11.800	15.012
11.830	15.307
11.870	15.624
11.900	15.965
11.930	16.336
11.970	16.739
12.000	17.175
12.030	17.648
12.070	18.160
12.100	18.715
12.130	19.315
12.170	19.961
12.200	20.655
12.230	21.399
12.270	22.194
12.300	23.041
12.330	23.940
12.370	24.893
12.400	25.897
12.430	26.952
12.470	28.062
12.500	29.223
12.530	30.273
12.570	30.981
12.600	31.763
12.630	32.611
12.670	33.527
12.700	34.487
12.730	35.518
12.770	36.596
12.800	37.716
12.830	38.878
12.870	40.087
12.900	41.339
12.930	42.622
12.970	43.938
13.000	45.284
13.030	46.657
13.070	48.054
13.100	49.474
13.130	50.913
13.170	52.369
13.200	53.839
13.230	55.322
13.270	56.816
13.300	58.317
13.330	59.824
13.370	61.336
13.400	62.849
13.430	64.364
13.470	65.877
13.500	67.378
13.530	68.885
13.570	70.388
13.600	71.889
13.630	73.386

13.670	74.853
13.700	76.339
13.730	77.798
13.770	79.252
13.800	80.701
13.830	82.125
13.870	83.550
13.900	84.949
13.930	86.348
13.970	87.734
14.000	89.100
14.030	90.468
14.070	91.822
14.100	93.159
14.130	94.476
14.170	95.788
14.200	97.085
14.230	98.373
14.270	99.651
14.300	100.909
14.330	102.175
14.370	103.401
14.400	104.628
14.430	105.849
14.470	107.045
14.500	108.238
14.530	109.421
14.570	110.591
14.600	111.758
14.630	112.911
14.670	114.042
14.700	115.173
14.730	116.289
14.770	117.402
14.800	118.496
14.830	119.588
14.870	120.667
14.900	121.738
14.930	122.799
14.970	123.851
15.000	124.895
15.030	125.929
15.070	126.956
15.100	127.973
15.130	128.983
15.170	129.984
15.200	130.977
15.230	131.962
15.270	132.938
15.300	133.907
15.330	134.869
15.370	135.822
15.400	136.768
15.430	137.707
15.470	138.638
15.500	139.562
15.530	140.479
15.570	141.388
15.600	142.291
15.630	143.187
15.670	144.075
15.700	144.957
15.730	145.833
15.770	146.702
15.800	147.564
15.830	148.420
15.870	149.270
15.900	150.113
15.930	150.950
15.970	151.781
16.000	152.607
16.030	153.426
16.070	154.239
16.100	155.047
16.130	155.848
16.170	156.644
16.200	157.435
16.230	158.219
16.270	158.999
16.300	159.772
16.330	160.540
16.370	161.303
16.400	162.060
16.430	162.812
16.470	163.558
16.500	164.300
16.530	165.036
16.570	165.767
16.600	166.493

16.630	167.214
16.670	167.930
16.700	168.641
16.730	169.347
16.770	170.049
16.800	170.745
16.830	171.436
16.870	172.123
16.900	172.804
16.930	173.480
16.970	174.151
17.000	174.815
17.030	175.475
17.070	176.130
17.100	176.779
17.130	177.424
17.170	178.064
17.200	178.699
17.230	179.329
17.270	179.955
17.300	180.576
17.330	181.193
17.370	181.805
17.400	182.414
17.430	183.018
17.470	183.618
17.500	184.215
17.530	184.809
17.570	185.399
17.600	185.986
17.630	186.570
17.670	187.152
17.700	187.730
17.730	188.306
17.770	188.879
17.800	189.450
17.830	190.018
17.870	190.584
17.900	191.147
17.930	191.709
17.970	192.267
18.000	192.824
18.030	193.378
18.070	193.930
18.100	194.480
18.130	195.020
18.170	195.554
18.200	196.085
18.230	196.614
18.270	197.141
18.300	197.668
18.330	198.194
18.370	198.719
18.400	199.242
18.430	199.765
18.470	200.286
18.500	200.805
18.530	201.325
18.570	201.842
18.600	202.358
18.630	202.872
18.670	203.385
18.700	203.896
18.730	204.406
18.770	204.915
18.800	205.422
18.830	205.927
18.870	206.431
18.900	206.934
18.930	207.435
18.970	207.934
19.000	208.432
19.030	208.928
19.070	209.423
19.100	209.915
19.130	210.406
19.170	210.893
19.200	211.381
19.230	211.867
19.270	212.351
19.300	212.833
19.330	213.314
19.370	213.791
19.400	214.270
19.430	214.747
19.470	215.218
19.500	215.692
19.530	216.160
19.570	216.631

19.600	217.096
19.630	217.563
19.670	218.026
19.700	218.491
19.730	218.950
19.770	219.412
19.800	219.872
19.830	220.328
19.870	220.786
19.900	221.239
19.930	221.694
19.970	222.145
20.000	222.598
20.030	223.046
20.070	223.496
20.100	223.944
20.130	224.388
20.170	224.833
20.200	225.275
20.230	225.718
20.270	226.156
20.300	226.597
20.330	227.035
20.370	227.469
20.400	227.903
20.430	228.337
20.470	228.767
20.500	229.196
20.530	229.623
20.570	230.048
20.600	230.475
20.630	230.898
20.670	231.318
20.700	231.738
20.730	232.154
20.770	232.570
20.800	232.983
20.830	233.396
20.870	233.808
20.900	234.217
20.930	234.624
20.970	235.030
21.000	235.434
21.030	235.836
21.070	236.237
21.100	236.636
21.130	237.033
21.170	237.430
21.200	237.824
21.230	238.217
21.270	238.609
21.300	238.999
21.330	239.388
21.370	239.775
21.400	240.161
21.430	240.546
21.470	240.929
21.500	241.311
21.530	241.691
21.570	242.071
21.600	242.449
21.630	242.826
21.670	243.202
21.700	243.576
21.730	243.950
21.770	244.322
21.800	244.693
21.830	245.063
21.870	245.432
21.900	245.800
21.930	246.167
21.970	246.532
22.000	246.897
22.030	247.260
22.070	247.623
22.100	247.984
22.130	248.345
22.170	248.704
22.200	249.063
22.230	249.421
22.270	249.777
22.300	250.133
22.330	250.488
22.370	250.842
22.400	251.195
22.430	251.547
22.470	251.899
22.500	252.249
22.530	252.599

22.570	252.948
22.600	253.296
22.630	253.643
22.670	253.990
22.700	254.336
22.730	254.681
22.770	255.025
22.800	255.368
22.830	255.711
22.870	256.053
22.900	256.394
22.930	256.734
22.970	257.073
23.000	257.411
23.030	257.749
23.070	258.085
23.100	258.421
23.130	258.756
23.170	259.089
23.200	259.422
23.230	259.754
23.270	260.084
23.300	260.414
23.330	260.742
23.370	261.070
23.400	261.397
23.430	261.722
23.470	262.047
23.500	262.371
23.530	262.694
23.570	263.015
23.600	263.336
23.630	263.656
23.670	263.975
23.700	264.294
23.730	264.611
23.770	264.927
23.800	265.243
23.830	265.557
23.870	265.871
23.900	266.184
23.930	266.495
23.970	266.806
24.000	267.116
24.250	269.449
24.500	271.700
24.750	273.771
25.000	275.623
25.250	277.246
25.500	278.694
25.750	280.011
26.000	281.222
26.250	282.343
26.500	283.388
26.750	284.370
27.000	285.297
27.250	286.179
27.500	287.046
27.750	287.887
28.000	288.691
28.250	289.464
28.500	290.210
28.750	290.932
29.000	291.632
29.250	292.313
29.500	292.977
29.750	293.624
30.000	294.253
30.250	294.865
30.500	295.459
30.750	296.034
31.000	296.590
31.250	297.127
31.500	297.645
31.750	298.144
32.000	298.624
32.250	299.086
32.500	299.528
32.750	299.952
33.000	300.355
33.250	300.738
33.500	301.101
33.750	301.445
34.000	301.769
34.250	302.073
34.500	302.359
34.750	302.626
35.000	302.875
35.250	303.106

35.500	303.319
35.750	303.515
36.000	303.694
36.250	303.855
36.500	303.999
36.750	304.126
37.000	304.237
37.250	304.332
37.500	304.411
37.750	304.475
38.000	304.524
38.250	304.557
38.500	304.575
38.750	304.578
39.000	304.566
39.250	304.539
39.500	304.497
39.750	304.441
40.000	304.372
40.250	304.288
40.500	304.190
40.750	304.079
41.000	303.955
41.250	303.817
41.500	303.666
41.750	303.501
42.000	303.323
42.250	303.132
42.500	302.927
42.750	302.710
43.000	302.480
43.250	302.236
43.500	301.980
43.750	301.711
44.000	301.430
44.250	301.137
44.500	300.833
44.750	300.518
45.000	300.192
45.250	299.855
45.500	299.508
45.750	299.151
46.000	298.785
46.250	298.409
46.500	298.023
46.750	297.629
47.000	297.227
47.250	296.817
47.500	296.400
47.750	295.975
48.000	295.542
48.250	295.104
48.500	294.658
48.750	294.207
49.000	293.749
49.250	293.285
49.500	292.816
49.750	292.342
50.000	291.863
50.250	291.379
50.500	290.892
50.750	290.401
51.000	289.906
51.250	289.409
51.500	288.909
51.750	288.405
52.000	287.899
52.250	287.389
52.500	286.877
52.750	286.363
53.000	285.846
53.250	285.326
53.500	284.804
53.750	284.279
54.000	283.751
54.250	283.221
54.500	282.689
54.750	282.155
55.000	281.619
55.250	281.080
55.500	280.540
55.750	279.998
56.000	279.454
56.250	278.907
56.500	278.359
56.750	277.809
57.000	277.256
57.250	276.701
57.500	276.144

57.750	275.586
58.000	275.025
58.250	274.462
58.500	273.897
58.750	273.331
59.000	272.763
59.250	272.194
59.500	271.624
59.750	271.054
60.000	270.484
60.250	269.914
60.500	269.344
60.750	268.774
61.000	268.203
61.250	267.633
61.500	267.062
61.750	266.497
62.000	265.943
62.250	265.392
62.500	264.840
62.750	264.288
63.000	263.736
63.250	263.184
63.500	262.631
63.750	262.078
64.000	261.524
64.250	260.970
64.500	260.416
64.750	259.861
65.000	259.306
65.250	258.750
65.500	258.194
65.750	257.638
66.000	257.082
66.250	256.525
66.500	255.968
66.750	255.411
67.000	254.854
67.250	254.296
67.500	253.738
67.750	253.181
68.000	252.623
68.250	252.065
68.500	251.507
68.750	250.949
69.000	250.391
69.250	249.832
69.500	249.274
69.750	248.716
70.000	248.158
70.250	247.600
70.500	247.043
70.750	246.485
71.000	245.927
71.250	245.370
71.500	244.813
71.750	244.255
72.000	243.698
72.250	243.141
72.500	242.584
72.750	242.027
73.000	241.471
73.250	240.915
73.500	240.359
73.750	239.804
74.000	239.249
74.250	238.695
74.500	238.140
74.750	237.587
75.000	237.033
75.250	236.480
75.500	235.928
75.750	235.375
76.000	234.824
76.250	234.273
76.500	233.722
76.750	233.172
77.000	232.622
77.250	232.073
77.500	231.525
77.750	230.977
78.000	230.430
78.250	229.883
78.500	229.337
78.750	228.792
79.000	228.248
79.250	227.704
79.500	227.161
79.750	226.618

80.000	226.077
80.250	225.536
80.500	224.996
80.750	224.456
81.000	223.917
81.250	223.379
81.500	222.842
81.750	222.306
82.000	221.770
82.250	221.235
82.500	220.701
82.750	220.168
83.000	219.635
83.250	219.104
83.500	218.573
83.750	218.043
84.000	217.514
84.250	216.986
84.500	216.458
84.750	215.932
85.000	215.406
85.250	214.882
85.500	214.358
85.750	213.835
86.000	213.313
86.250	212.792
86.500	212.272
86.750	211.753
87.000	211.235
87.250	210.718
87.500	210.202
87.750	209.687
88.000	209.173
88.250	208.659
88.500	208.147
88.750	207.636
89.000	207.126
89.250	206.617
89.500	206.108
89.750	205.601
90.000	205.095
90.250	204.590
90.500	204.086
90.750	203.583
91.000	203.081
91.250	202.581
91.500	202.081
91.750	201.582
92.000	201.085
92.250	200.588
92.500	200.093
92.750	199.599
93.000	199.105
93.250	198.613
93.500	198.122
93.750	197.670
94.000	197.209
94.250	196.726
94.500	196.240
94.750	195.753
95.000	195.268
95.250	194.783
95.500	194.300
95.750	193.818
96.000	193.337
96.250	192.857
96.500	192.378
96.750	191.901
97.000	191.425
97.250	190.950
97.500	190.476
97.750	190.003
98.000	189.531
98.250	189.060
98.500	188.591
98.750	188.122
99.000	187.654
99.250	187.188
99.500	186.723
99.750	186.259
100.000	185.797

Name: LkHowell_10 Node: LH-0090 Type: Stage

Time(hrs)	Stage(ft)
0.000	53.080
0.030	53.078

0.070	53.077
0.100	53.075
0.130	53.074
0.170	53.072
0.200	53.070
0.230	53.069
0.270	53.067
0.300	53.065
0.330	53.064
0.370	53.062
0.400	53.061
0.430	53.059
0.470	53.057
0.500	53.056
0.530	53.054
0.570	53.053
0.600	53.051
0.630	53.049
0.670	53.048
0.700	53.046
0.730	53.045
0.770	53.043
0.800	53.041
0.830	53.040
0.870	53.038
0.900	53.037
0.930	53.035
0.970	53.033
1.000	53.032
1.030	53.030
1.070	53.029
1.100	53.027
1.130	53.026
1.170	53.024
1.200	53.022
1.230	53.021
1.270	53.019
1.300	53.018
1.330	53.016
1.370	53.015
1.400	53.013
1.430	53.012
1.470	53.010
1.500	53.008
1.530	53.007
1.570	53.005
1.600	53.004
1.630	53.002
1.670	53.001
1.700	52.999
1.730	52.998
1.770	52.996
1.800	52.995
1.830	52.993
1.870	52.992
1.900	52.990
1.930	52.989
1.970	52.987
2.000	52.986
2.030	52.984
2.070	52.983
2.100	52.982
2.130	52.980
2.170	52.979
2.200	52.977
2.230	52.976
2.270	52.975
2.300	52.973
2.330	52.972
2.370	52.970
2.400	52.969
2.430	52.968
2.470	52.966
2.500	52.965
2.530	52.964
2.570	52.962
2.600	52.961
2.630	52.960
2.670	52.958
2.700	52.957
2.730	52.956
2.770	52.955
2.800	52.953
2.830	52.952
2.870	52.951
2.900	52.950
2.930	52.948
2.970	52.947
3.000	52.946

3.030	52.944
3.070	52.943
3.100	52.942
3.130	52.941
3.170	52.940
3.200	52.938
3.230	52.937
3.270	52.936
3.300	52.935
3.330	52.933
3.370	52.932
3.400	52.931
3.430	52.930
3.470	52.929
3.500	52.928
3.530	52.926
3.570	52.925
3.600	52.924
3.630	52.923
3.670	52.922
3.700	52.921
3.730	52.919
3.770	52.918
3.800	52.917
3.830	52.916
3.870	52.915
3.900	52.914
3.930	52.913
3.970	52.911
4.000	52.910
4.030	52.909
4.070	52.908
4.100	52.907
4.130	52.906
4.170	52.905
4.200	52.904
4.230	52.903
4.270	52.902
4.300	52.901
4.330	52.899
4.370	52.898
4.400	52.897
4.430	52.896
4.470	52.895
4.500	52.894
4.530	52.893
4.570	52.892
4.600	52.891
4.630	52.890
4.670	52.889
4.700	52.888
4.730	52.887
4.770	52.886
4.800	52.885
4.830	52.884
4.870	52.883
4.900	52.882
4.930	52.881
4.970	52.880
5.000	52.879
5.030	52.878
5.070	52.878
5.100	52.877
5.130	52.876
5.170	52.875
5.200	52.874
5.230	52.873
5.270	52.872
5.300	52.871
5.330	52.870
5.370	52.869
5.400	52.869
5.430	52.868
5.470	52.867
5.500	52.866
5.530	52.865
5.570	52.864
5.600	52.863
5.630	52.863
5.670	52.862
5.700	52.861
5.730	52.860
5.770	52.859
5.800	52.858
5.830	52.858
5.870	52.857
5.900	52.856
5.930	52.855
5.970	52.854

6.000	52.854
6.030	52.853
6.070	52.852
6.100	52.851
6.130	52.851
6.170	52.850
6.200	52.849
6.230	52.848
6.270	52.848
6.300	52.847
6.330	52.846
6.370	52.845
6.400	52.845
6.430	52.844
6.470	52.843
6.500	52.843
6.530	52.842
6.570	52.841
6.600	52.841
6.630	52.840
6.670	52.839
6.700	52.839
6.730	52.838
6.770	52.838
6.800	52.837
6.830	52.836
6.870	52.836
6.900	52.835
6.930	52.835
6.970	52.834
7.000	52.834
7.030	52.833
7.070	52.832
7.100	52.832
7.130	52.831
7.170	52.831
7.200	52.830
7.230	52.830
7.270	52.829
7.300	52.829
7.330	52.828
7.370	52.828
7.400	52.827
7.430	52.827
7.470	52.827
7.500	52.826
7.530	52.826
7.570	52.825
7.600	52.825
7.630	52.825
7.670	52.824
7.700	52.824
7.730	52.824
7.770	52.823
7.800	52.823
7.830	52.823
7.870	52.822
7.900	52.822
7.930	52.822
7.970	52.821
8.000	52.821
8.030	52.821
8.070	52.820
8.100	52.820
8.130	52.820
8.170	52.820
8.200	52.820
8.230	52.819
8.270	52.819
8.300	52.819
8.330	52.819
8.370	52.819
8.400	52.818
8.430	52.818
8.470	52.818
8.500	52.818
8.530	52.818
8.570	52.818
8.600	52.818
8.630	52.818
8.670	52.818
8.700	52.818
8.730	52.818
8.770	52.818
8.800	52.818
8.830	52.818
8.870	52.818
8.900	52.818
8.930	52.818

8.970	52.818
9.000	52.818
9.030	52.818
9.070	52.818
9.100	52.818
9.130	52.818
9.170	52.819
9.200	52.819
9.230	52.819
9.270	52.819
9.300	52.820
9.330	52.820
9.370	52.820
9.400	52.820
9.430	52.821
9.470	52.821
9.500	52.821
9.530	52.822
9.570	52.822
9.600	52.823
9.630	52.823
9.670	52.823
9.700	52.824
9.730	52.824
9.770	52.825
9.800	52.825
9.830	52.826
9.870	52.827
9.900	52.827
9.930	52.828
9.970	52.828
10.000	52.829
10.030	52.830
10.070	52.830
10.100	52.831
10.130	52.832
10.170	52.833
10.200	52.834
10.230	52.834
10.270	52.835
10.300	52.836
10.330	52.837
10.370	52.838
10.400	52.839
10.430	52.840
10.470	52.841
10.500	52.842
10.530	52.843
10.570	52.845
10.600	52.846
10.630	52.847
10.670	52.848
10.700	52.850
10.730	52.851
10.770	52.853
10.800	52.854
10.830	52.856
10.870	52.857
10.900	52.859
10.930	52.861
10.970	52.862
11.000	52.864
11.030	52.866
11.070	52.868
11.100	52.870
11.130	52.872
11.170	52.874
11.200	52.876
11.230	52.878
11.270	52.880
11.300	52.883
11.330	52.885
11.370	52.887
11.400	52.890
11.430	52.892
11.470	52.895
11.500	52.898
11.530	52.901
11.570	52.904
11.600	52.908
11.630	52.911
11.670	52.915
11.700	52.920
11.730	52.925
11.770	52.930
11.800	52.936
11.830	52.943
11.870	52.951
11.900	52.959

11.930	52.968
11.970	52.978
12.000	52.988
12.030	53.000
12.070	53.012
12.100	53.025
12.130	53.039
12.170	53.053
12.200	53.068
12.230	53.084
12.270	53.099
12.300	53.116
12.330	53.133
12.370	53.150
12.400	53.167
12.430	53.185
12.470	53.203
12.500	53.222
12.530	53.240
12.570	53.259
12.600	53.278
12.630	53.297
12.670	53.316
12.700	53.335
12.730	53.354
12.770	53.374
12.800	53.393
12.830	53.412
12.870	53.431
12.900	53.450
12.930	53.469
12.970	53.488
13.000	53.506
13.030	53.525
13.070	53.543
13.100	53.562
13.130	53.580
13.170	53.598
13.200	53.616
13.230	53.633
13.270	53.650
13.300	53.668
13.330	53.685
13.370	53.701
13.400	53.718
13.430	53.735
13.470	53.751
13.500	53.767
13.530	53.783
13.570	53.799
13.600	53.814
13.630	53.830
13.670	53.845
13.700	53.860
13.730	53.875
13.770	53.890
13.800	53.905
13.830	53.919
13.870	53.934
13.900	53.948
13.930	53.963
13.970	53.977
14.000	53.991
14.030	54.005
14.070	54.019
14.100	54.032
14.130	54.046
14.170	54.060
14.200	54.073
14.230	54.086
14.270	54.100
14.300	54.113
14.330	54.126
14.370	54.139
14.400	54.152
14.430	54.165
14.470	54.177
14.500	54.190
14.530	54.202
14.570	54.215
14.600	54.227
14.630	54.239
14.670	54.251
14.700	54.263
14.730	54.275
14.770	54.286
14.800	54.298
14.830	54.309
14.870	54.321

14.900	54.332
14.930	54.343
14.970	54.354
15.000	54.365
15.030	54.376
15.070	54.386
15.100	54.397
15.130	54.407
15.170	54.418
15.200	54.428
15.230	54.438
15.270	54.448
15.300	54.458
15.330	54.468
15.370	54.477
15.400	54.487
15.430	54.497
15.470	54.506
15.500	54.515
15.530	54.524
15.570	54.534
15.600	54.543
15.630	54.551
15.670	54.560
15.700	54.569
15.730	54.578
15.770	54.586
15.800	54.595
15.830	54.603
15.870	54.611
15.900	54.619
15.930	54.628
15.970	54.635
16.000	54.643
16.030	54.651
16.070	54.659
16.100	54.667
16.130	54.674
16.170	54.681
16.200	54.689
16.230	54.696
16.270	54.703
16.300	54.710
16.330	54.717
16.370	54.724
16.400	54.731
16.430	54.738
16.470	54.745
16.500	54.752
16.530	54.758
16.570	54.765
16.600	54.771
16.630	54.778
16.670	54.784
16.700	54.790
16.730	54.796
16.770	54.803
16.800	54.809
16.830	54.815
16.870	54.820
16.900	54.826
16.930	54.832
16.970	54.838
17.000	54.844
17.030	54.849
17.070	54.855
17.100	54.860
17.130	54.866
17.170	54.871
17.200	54.876
17.230	54.882
17.270	54.887
17.300	54.892
17.330	54.897
17.370	54.902
17.400	54.907
17.430	54.912
17.470	54.917
17.500	54.922
17.530	54.927
17.570	54.932
17.600	54.936
17.630	54.941
17.670	54.946
17.700	54.950
17.730	54.955
17.770	54.959
17.800	54.964
17.830	54.968

17.870	54.972
17.900	54.977
17.930	54.981
17.970	54.985
18.000	54.989
18.030	54.993
18.070	54.997
18.100	55.001
18.130	55.005
18.170	55.009
18.200	55.013
18.230	55.017
18.270	55.020
18.300	55.024
18.330	55.028
18.370	55.031
18.400	55.035
18.430	55.039
18.470	55.042
18.500	55.046
18.530	55.049
18.570	55.053
18.600	55.056
18.630	55.059
18.670	55.063
18.700	55.066
18.730	55.069
18.770	55.073
18.800	55.076
18.830	55.079
18.870	55.082
18.900	55.085
18.930	55.088
18.970	55.091
19.000	55.094
19.030	55.097
19.070	55.100
19.100	55.103
19.130	55.106
19.170	55.109
19.200	55.111
19.230	55.114
19.270	55.117
19.300	55.120
19.330	55.122
19.370	55.125
19.400	55.128
19.430	55.130
19.470	55.133
19.500	55.135
19.530	55.138
19.570	55.141
19.600	55.143
19.630	55.146
19.670	55.148
19.700	55.151
19.730	55.153
19.770	55.155
19.800	55.158
19.830	55.160
19.870	55.163
19.900	55.165
19.930	55.167
19.970	55.170
20.000	55.172
20.030	55.174
20.070	55.176
20.100	55.179
20.130	55.181
20.170	55.183
20.200	55.185
20.230	55.188
20.270	55.190
20.300	55.192
20.330	55.194
20.370	55.196
20.400	55.198
20.430	55.200
20.470	55.202
20.500	55.204
20.530	55.206
20.570	55.208
20.600	55.210
20.630	55.212
20.670	55.214
20.700	55.216
20.730	55.218
20.770	55.220
20.800	55.222

20.830	55.224
20.870	55.226
20.900	55.227
20.930	55.229
20.970	55.231
21.000	55.233
21.030	55.235
21.070	55.236
21.100	55.238
21.130	55.240
21.170	55.242
21.200	55.243
21.230	55.245
21.270	55.247
21.300	55.248
21.330	55.250
21.370	55.252
21.400	55.253
21.430	55.255
21.470	55.256
21.500	55.258
21.530	55.260
21.570	55.261
21.600	55.263
21.630	55.264
21.670	55.266
21.700	55.267
21.730	55.269
21.770	55.270
21.800	55.272
21.830	55.273
21.870	55.275
21.900	55.276
21.930	55.278
21.970	55.279
22.000	55.280
22.030	55.282
22.070	55.283
22.100	55.285
22.130	55.286
22.170	55.287
22.200	55.289
22.230	55.290
22.270	55.291
22.300	55.293
22.330	55.294
22.370	55.295
22.400	55.297
22.430	55.298
22.470	55.299
22.500	55.300
22.530	55.302
22.570	55.303
22.600	55.304
22.630	55.306
22.670	55.307
22.700	55.308
22.730	55.309
22.770	55.310
22.800	55.312
22.830	55.313
22.870	55.314
22.900	55.315
22.930	55.316
22.970	55.317
23.000	55.318
23.030	55.320
23.070	55.321
23.100	55.322
23.130	55.323
23.170	55.324
23.200	55.325
23.230	55.326
23.270	55.327
23.300	55.328
23.330	55.329
23.370	55.330
23.400	55.331
23.430	55.332
23.470	55.333
23.500	55.334
23.530	55.335
23.570	55.336
23.600	55.337
23.630	55.338
23.670	55.339
23.700	55.340
23.730	55.341
23.770	55.342

23.800	55.343
23.830	55.343
23.870	55.344
23.900	55.345
23.930	55.346
23.970	55.347
24.000	55.348
24.250	55.353
24.500	55.358
24.750	55.361
25.000	55.362
25.250	55.363
25.500	55.362
25.750	55.360
26.000	55.358
26.250	55.354
26.500	55.351
26.750	55.346
27.000	55.341
27.250	55.335
27.500	55.329
27.750	55.323
28.000	55.316
28.250	55.309
28.500	55.301
28.750	55.294
29.000	55.286
29.250	55.277
29.500	55.269
29.750	55.261
30.000	55.252
30.250	55.243
30.500	55.234
30.750	55.225
31.000	55.216
31.250	55.207
31.500	55.198
31.750	55.189
32.000	55.179
32.250	55.170
32.500	55.161
32.750	55.152
33.000	55.143
33.250	55.133
33.500	55.124
33.750	55.115
34.000	55.106
34.250	55.097
34.500	55.088
34.750	55.079
35.000	55.070
35.250	55.061
35.500	55.052
35.750	55.043
36.000	55.034
36.250	55.025
36.500	55.017
36.750	55.008
37.000	54.999
37.250	54.990
37.500	54.981
37.750	54.973
38.000	54.964
38.250	54.955
38.500	54.947
38.750	54.938
39.000	54.929
39.250	54.921
39.500	54.912
39.750	54.904
40.000	54.895
40.250	54.887
40.500	54.878
40.750	54.870
41.000	54.861
41.250	54.853
41.500	54.844
41.750	54.836
42.000	54.828
42.250	54.819
42.500	54.811
42.750	54.802
43.000	54.794
43.250	54.786
43.500	54.778
43.750	54.769
44.000	54.761
44.250	54.753
44.500	54.745

44.750	54.736
45.000	54.728
45.250	54.720
45.500	54.712
45.750	54.704
46.000	54.695
46.250	54.687
46.500	54.679
46.750	54.671
47.000	54.663
47.250	54.655
47.500	54.647
47.750	54.639
48.000	54.631
48.250	54.623
48.500	54.615
48.750	54.607
49.000	54.599
49.250	54.591
49.500	54.583
49.750	54.575
50.000	54.568
50.250	54.560
50.500	54.552
50.750	54.544
51.000	54.536
51.250	54.529
51.500	54.521
51.750	54.513
52.000	54.505
52.250	54.498
52.500	54.490
52.750	54.482
53.000	54.475
53.250	54.467
53.500	54.460
53.750	54.452
54.000	54.445
54.250	54.437
54.500	54.430
54.750	54.422
55.000	54.415
55.250	54.407
55.500	54.400
55.750	54.393
56.000	54.385
56.250	54.378
56.500	54.371
56.750	54.363
57.000	54.356
57.250	54.349
57.500	54.342
57.750	54.334
58.000	54.327
58.250	54.320
58.500	54.313
58.750	54.306
59.000	54.299
59.250	54.291
59.500	54.284
59.750	54.277
60.000	54.270
60.250	54.263
60.500	54.256
60.750	54.249
61.000	54.242
61.250	54.235
61.500	54.228
61.750	54.221
62.000	54.213
62.250	54.206
62.500	54.199
62.750	54.192
63.000	54.185
63.250	54.178
63.500	54.171
63.750	54.164
64.000	54.157
64.250	54.150
64.500	54.143
64.750	54.136
65.000	54.129
65.250	54.122
65.500	54.115
65.750	54.108
66.000	54.101
66.250	54.094
66.500	54.088
66.750	54.081

67.000	54.074
67.250	54.067
67.500	54.060
67.750	54.054
68.000	54.047
68.250	54.040
68.500	54.034
68.750	54.027
69.000	54.020
69.250	54.014
69.500	54.007
69.750	54.001
70.000	53.994
70.250	53.987
70.500	53.981
70.750	53.975
71.000	53.968
71.250	53.962
71.500	53.955
71.750	53.949
72.000	53.942
72.250	53.936
72.500	53.930
72.750	53.923
73.000	53.917
73.250	53.911
73.500	53.904
73.750	53.898
74.000	53.892
74.250	53.886
74.500	53.879
74.750	53.873
75.000	53.867
75.250	53.861
75.500	53.855
75.750	53.849
76.000	53.843
76.250	53.837
76.500	53.831
76.750	53.825
77.000	53.819
77.250	53.813
77.500	53.807
77.750	53.801
78.000	53.795
78.250	53.789
78.500	53.783
78.750	53.777
79.000	53.772
79.250	53.766
79.500	53.760
79.750	53.754
80.000	53.748
80.250	53.743
80.500	53.737
80.750	53.731
81.000	53.726
81.250	53.720
81.500	53.714
81.750	53.709
82.000	53.703
82.250	53.698
82.500	53.692
82.750	53.686
83.000	53.681
83.250	53.675
83.500	53.670
83.750	53.664
84.000	53.659
84.250	53.654
84.500	53.648
84.750	53.643
85.000	53.637
85.250	53.632
85.500	53.627
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86.000	53.616
86.250	53.611
86.500	53.605
86.750	53.600
87.000	53.595
87.250	53.589
87.500	53.584
87.750	53.579
88.000	53.574
88.250	53.569
88.500	53.563
88.750	53.558
89.000	53.553

89.250	53.548
89.500	53.543
89.750	53.538
90.000	53.533
90.250	53.527
90.500	53.522
90.750	53.517
91.000	53.512
91.250	53.507
91.500	53.502
91.750	53.497
92.000	53.492
92.250	53.487
92.500	53.482
92.750	53.477
93.000	53.472
93.250	53.467
93.500	53.462
93.750	53.458
94.000	53.453
94.250	53.448
94.500	53.443
94.750	53.438
95.000	53.433
95.250	53.428
95.500	53.424
95.750	53.419
96.000	53.414
96.250	53.409
96.500	53.404
96.750	53.400
97.000	53.395
97.250	53.390
97.500	53.385
97.750	53.381
98.000	53.376
98.250	53.371
98.500	53.367
98.750	53.362
99.000	53.357
99.250	53.353
99.500	53.348
99.750	53.343
100.000	53.339

Name: HC0040_25 Node: HC-0040 Type: Flow

Time(hrs)	Flow(cfs)
0.000	0.666
0.030	0.672
0.070	0.678
0.100	0.684
0.130	0.690
0.170	0.696
0.200	0.702
0.230	0.709
0.270	0.715
0.300	0.721
0.330	0.727
0.370	0.733
0.400	0.740
0.430	0.746
0.470	0.752
0.500	0.758
0.530	0.764
0.570	0.770
0.600	0.777
0.630	0.783
0.670	0.789
0.700	0.795
0.730	0.801
0.770	0.807
0.800	0.813
0.830	0.819
0.870	0.825
0.900	0.831
0.930	0.837
0.970	0.843
1.000	0.849
1.030	0.855
1.070	0.861
1.100	0.867
1.130	0.873
1.170	0.879
1.200	0.885
1.230	0.891
1.270	0.898

1.300	0.904
1.330	0.911
1.370	0.917
1.400	0.924
1.430	0.931
1.470	0.938
1.500	0.946
1.530	0.953
1.570	0.961
1.600	0.970
1.630	0.978
1.670	0.987
1.700	0.996
1.730	1.005
1.770	1.015
1.800	1.025
1.830	1.035
1.870	1.046
1.900	1.057
1.930	1.068
1.970	1.079
2.000	1.091
2.030	1.103
2.070	1.115
2.100	1.128
2.130	1.140
2.170	1.153
2.200	1.167
2.230	1.180
2.270	1.194
2.300	1.208
2.330	1.222
2.370	1.236
2.400	1.251
2.430	1.266
2.470	1.281
2.500	1.296
2.530	1.311
2.570	1.327
2.600	1.343
2.630	1.359
2.670	1.375
2.700	1.391
2.730	1.408
2.770	1.424
2.800	1.441
2.830	1.458
2.870	1.476
2.900	1.493
2.930	1.511
2.970	1.528
3.000	1.546
3.030	1.564
3.070	1.583
3.100	1.601
3.130	1.619
3.170	1.638
3.200	1.657
3.230	1.676
3.270	1.695
3.300	1.714
3.330	1.734
3.370	1.753
3.400	1.773
3.430	1.793
3.470	1.813
3.500	1.834
3.530	1.854
3.570	1.874
3.600	1.895
3.630	1.916
3.670	1.937
3.700	1.958
3.730	1.979
3.770	2.001
3.800	2.022
3.830	2.044
3.870	2.066
3.900	2.088
3.930	2.110
3.970	2.132
4.000	2.155
4.030	2.177
4.070	2.200
4.100	2.223
4.130	2.245
4.170	2.269
4.200	2.292
4.230	2.315

4.270	2.339
4.300	2.362
4.330	2.386
4.370	2.410
4.400	2.433
4.430	2.457
4.470	2.482
4.500	2.506
4.530	2.530
4.570	2.555
4.600	2.579
4.630	2.604
4.670	2.629
4.700	2.654
4.730	2.680
4.770	2.705
4.800	2.730
4.830	2.756
4.870	2.782
4.900	2.808
4.930	2.834
4.970	2.861
5.000	2.887
5.030	2.914
5.070	2.940
5.100	2.967
5.130	2.994
5.170	3.021
5.200	3.048
5.230	3.076
5.270	3.103
5.300	3.131
5.330	3.159
5.370	3.187
5.400	3.215
5.430	3.243
5.470	3.271
5.500	3.299
5.530	3.328
5.570	3.357
5.600	3.385
5.630	3.414
5.670	3.443
5.700	3.472
5.730	3.502
5.770	3.531
5.800	3.561
5.830	3.590
5.870	3.620
5.900	3.650
5.930	3.680
5.970	3.710
6.000	3.741
6.030	3.771
6.070	3.802
6.100	3.832
6.130	3.863
6.170	3.894
6.200	3.925
6.230	3.956
6.270	3.988
6.300	4.019
6.330	4.051
6.370	4.083
6.400	4.116
6.430	4.148
6.470	4.181
6.500	4.214
6.530	4.247
6.570	4.281
6.600	4.315
6.630	4.349
6.670	4.383
6.700	4.418
6.730	4.453
6.770	4.488
6.800	4.524
6.830	4.560
6.870	4.596
6.900	4.632
6.930	4.669
6.970	4.705
7.000	4.743
7.030	4.780
7.070	4.818
7.100	4.856
7.130	4.895
7.170	4.934
7.200	4.973

7.230	5.012
7.270	5.052
7.300	5.092
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7.370	5.174
7.400	5.215
7.430	5.257
7.470	5.298
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7.530	5.384
7.570	5.427
7.600	5.471
7.630	5.515
7.670	5.561
7.700	5.606
7.730	5.652
7.770	5.698
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7.830	5.792
7.870	5.840
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7.930	5.938
7.970	5.988
8.000	6.038
8.030	6.089
8.070	6.140
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8.170	6.296
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8.570	6.983
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8.630	7.106
8.670	7.170
8.700	7.234
8.730	7.300
8.770	7.366
8.800	7.434
8.830	7.502
8.870	7.571
8.900	7.641
8.930	7.712
8.970	7.785
9.000	7.857
9.030	7.933
9.070	8.008
9.100	8.085
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9.170	8.242
9.200	8.322
9.230	8.403
9.270	8.487
9.300	8.571
9.330	8.658
9.370	8.744
9.400	8.833
9.430	8.922
9.470	9.014
9.500	9.106
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9.570	9.296
9.600	9.393
9.630	9.492
9.670	9.593
9.700	9.695
9.730	9.799
9.770	9.904
9.800	10.011
9.830	10.119
9.870	10.228
9.900	10.339
9.930	10.452
9.970	10.567
10.000	10.684
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10.070	10.919
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10.330	11.953
10.370	12.094
10.400	12.236
10.430	12.380
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10.530	12.827
10.570	12.983
10.600	13.138
10.630	13.299
10.670	13.462
10.700	13.629
10.730	13.797
10.770	13.970
10.800	14.144
10.830	14.324
10.870	14.505
10.900	14.691
10.930	14.880
10.970	15.072
11.000	15.270
11.030	15.470
11.070	15.675
11.100	15.883
11.130	16.096
11.170	16.314
11.200	16.536
11.230	16.762
11.270	16.990
11.300	17.226
11.330	17.464
11.370	17.711
11.400	17.962
11.430	18.215
11.470	18.478
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11.570	19.312
11.600	19.609
11.630	19.917
11.670	20.240
11.700	20.579
11.730	20.936
11.770	21.314
11.800	21.713
11.830	22.141
11.870	22.599
11.900	23.091
11.930	23.622
11.970	24.197
12.000	24.817
12.030	25.486
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12.100	26.989
12.130	27.830
12.170	28.734
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12.370	33.520
12.400	34.482
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12.470	36.635
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12.570	40.398
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12.630	43.245
12.670	44.773
12.700	46.358
12.730	48.007
12.770	49.716
12.800	51.482
12.830	53.301
12.870	55.172
12.900	57.092
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12.970	61.067
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13.030	65.199
13.070	67.317
13.100	69.465
13.130	71.640

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        13.170          73.839
        13.200          76.058
        13.230          78.294
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        13.300          82.806
        13.330          85.077
        13.370          87.353
        13.400          89.632
        13.430          91.911
        13.470          94.189
        13.500          96.462
        13.530          98.739
        13.570         100.999
        13.600         103.248
        13.630         105.487
        13.670         107.707
        13.700         109.924
        13.730         112.120
        13.770         114.291
        13.800         116.454
        13.830         118.608
        13.870         120.730
        13.900         122.842
        13.930         124.931
        13.970         127.000
        14.000         129.049
        14.030         131.078
        14.070         133.087
        14.100         135.076
        14.130         137.044
        14.170         138.993
        14.200         140.921
        14.230         142.830
        14.270         144.718
        14.300         146.586
        14.330         148.434
        14.370         150.263
        14.400         152.072
        14.430         153.862
        14.470         155.633
        14.500         157.385
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        14.570         160.835
        14.600         162.548
        14.630         164.214
        14.670         165.871
        14.700         167.519
        14.730         169.157
        14.770         170.766
        14.800         172.376
        14.830         173.944
        14.870         175.508
        14.900         177.048
        14.930         178.587
        14.970         180.102
        15.000         181.612
        15.030         183.097
        15.070         184.576
        15.100         186.033
        15.130         187.484
        15.170         188.921
        15.200         190.328
        15.230         191.725
        15.270         193.099
        15.300         194.471
        15.330         195.842
        15.370         197.170
        15.400         198.507
        15.430         199.836
        15.470         201.153
        15.500         202.455
        15.530         203.736
        15.570         205.018
        15.600         206.296
        15.630         207.555
        15.670         208.807
        15.700         210.055
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        15.770         212.503
        15.800         213.714
        15.830         214.917
        15.870         216.107
        15.900         217.299
        15.930         218.469
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16.330	231.877
16.370	232.941
16.400	233.996
16.430	235.043
16.470	236.083
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16.530	238.138
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16.630	241.165
16.670	242.159
16.700	243.146
16.730	244.125
16.770	245.097
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16.830	247.019
16.870	247.969
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16.970	250.776
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17.070	253.517
17.100	254.416
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17.370	261.357
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17.470	263.854
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17.570	266.304
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17.670	268.730
17.700	269.541
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17.770	271.164
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17.970	276.009
18.000	276.809
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18.070	278.403
18.100	279.196
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18.170	280.773
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18.270	283.116
18.300	283.891
18.330	284.663
18.370	285.432
18.400	286.198
18.430	286.961
18.470	287.721
18.500	288.479
18.530	289.234
18.570	289.986
18.600	290.735
18.630	291.482
18.670	292.226
18.700	292.968
18.730	293.708
18.770	294.446
18.800	295.182
18.830	295.916
18.870	296.647
18.900	297.376
18.930	298.103
18.970	298.828
19.000	299.550
19.030	300.269
19.070	300.987

19.100	301.701
19.130	302.413
19.170	303.123
19.200	303.829
19.230	304.533
19.270	305.234
19.300	305.933
19.330	306.629
19.370	307.322
19.400	308.013
19.430	308.701
19.470	309.387
19.500	310.070
19.530	310.751
19.570	311.430
19.600	312.106
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19.700	314.123
19.730	314.791
19.770	315.457
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19.830	316.784
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20.400	327.753
20.430	328.380
20.470	329.004
20.500	329.625
20.530	330.245
20.570	330.862
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20.630	332.088
20.670	332.698
20.700	333.305
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20.770	334.511
20.800	335.111
20.830	335.708
20.870	336.303
20.900	336.895
20.930	337.485
20.970	338.073
21.000	338.658
21.030	339.241
21.070	339.822
21.100	340.400
21.130	340.977
21.170	341.551
21.200	342.123
21.230	342.693
21.270	343.261
21.300	343.827
21.330	344.391
21.370	344.953
21.400	345.513
21.430	346.072
21.470	346.628
21.500	347.183
21.530	347.736
21.570	348.288
21.600	348.837
21.630	349.385
21.670	349.932
21.700	350.477
21.730	351.020
21.770	351.561
21.800	352.102
21.830	352.640
21.870	353.177
21.900	353.713
21.930	354.247
21.970	354.780
22.000	355.311
22.030	355.841

22.070	356.370
22.100	356.897
22.130	357.423
22.170	357.947
22.200	358.471
22.230	358.993
22.270	359.513
22.300	360.033
22.330	360.551
22.370	361.068
22.400	361.584
22.430	362.098
22.470	362.612
22.500	363.124
22.530	363.635
22.570	364.145
22.600	364.654
22.630	365.162
22.670	365.668
22.700	366.174
22.730	366.678
22.770	367.181
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23.070	371.648
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23.200	373.595
23.230	374.077
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23.430	376.937
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23.630	379.737
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23.900	383.380
23.930	383.827
23.970	384.273
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24.500	390.470
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25.000	395.642
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27.500	410.128
27.750	411.023
28.000	411.860
28.250	412.647
28.500	413.387
28.750	414.087
29.000	414.749
29.250	415.377
29.500	415.975
29.750	416.545
30.000	417.088
30.250	417.602
30.500	418.091
30.750	418.554
31.000	418.991
31.250	419.405
31.500	419.794

31.750	420.159
32.000	420.502
32.250	420.821
32.500	421.119
32.750	421.394
33.000	421.647
33.250	421.879
33.500	422.090
33.750	422.281
34.000	422.451
34.250	422.601
34.500	422.731
34.750	422.842
35.000	422.933
35.250	423.006
35.500	423.060
35.750	423.096
36.000	423.113
36.250	423.113
36.500	423.095
36.750	423.061
37.000	423.011
37.250	422.944
37.500	422.863
37.750	422.766
38.000	422.656
38.250	422.531
38.500	422.393
38.750	422.242
39.000	422.078
39.250	421.902
39.500	421.715
39.750	421.515
40.000	421.304
40.250	421.082
40.500	420.849
40.750	420.605
41.000	420.352
41.250	420.088
41.500	419.813
41.750	419.527
42.000	419.229
42.250	418.920
42.500	418.599
42.750	418.266
43.000	417.922
43.250	417.566
43.500	417.199
43.750	416.819
44.000	416.427
44.250	416.023
44.500	415.607
44.750	415.181
45.000	414.743
45.250	414.292
45.500	413.828
45.750	413.350
46.000	412.859
46.250	412.354
46.500	411.835
46.750	411.303
47.000	410.758
47.250	410.199
47.500	409.628
47.750	409.044
48.000	408.448
48.250	407.839
48.500	407.219
48.750	406.586
49.000	405.942
49.250	405.288
49.500	404.624
49.750	403.949
50.000	403.266
50.250	402.574
50.500	401.873
50.750	401.165
51.000	400.448
51.250	399.724
51.500	398.993
51.750	398.255
52.000	397.510
52.250	396.759
52.500	396.001
52.750	395.237
53.000	394.468
53.250	393.693
53.500	392.913
53.750	392.128

54.000	391.338
54.250	390.544
54.500	389.745
54.750	388.942
55.000	388.136
55.250	387.326
55.500	386.831
55.750	386.160
56.000	385.348
56.250	384.522
56.500	383.692
56.750	382.859
57.000	382.023
57.250	381.185
57.500	380.345
57.750	379.502
58.000	378.657
58.250	377.809
58.500	376.959
58.750	376.107
59.000	375.253
59.250	374.397
59.500	373.540
59.750	372.681
60.000	371.820
60.250	370.958
60.500	370.095
60.750	369.231
61.000	368.365
61.250	367.497
61.500	366.629
61.750	365.760
62.000	364.891
62.250	364.020
62.500	363.149
62.750	362.279
63.000	361.408
63.250	360.539
63.500	359.670
63.750	358.802
64.000	357.935
64.250	357.068
64.500	356.202
64.750	355.336
65.000	354.471
65.250	353.607
65.500	352.744
65.750	351.880
66.000	351.017
66.250	350.155
66.500	349.293
66.750	348.432
67.000	347.572
67.250	346.712
67.500	345.853
67.750	344.995
68.000	344.137
68.250	343.280
68.500	342.423
68.750	341.567
69.000	340.711
69.250	339.855
69.500	339.000
69.750	338.144
70.000	337.289
70.250	336.435
70.500	335.580
70.750	334.726
71.000	333.872
71.250	333.020
71.500	332.169
71.750	331.320
72.000	330.473
72.250	329.628
72.500	328.785
72.750	327.944
73.000	327.105
73.250	326.267
73.500	325.431
73.750	324.597
74.000	323.764
74.250	322.934
74.500	322.105
74.750	321.278
75.000	320.452
75.250	319.629
75.500	318.806
75.750	317.986
76.000	317.167

76.250	316.350
76.500	315.534
76.750	314.720
77.000	313.908
77.250	313.097
77.500	312.288
77.750	311.481
78.000	310.675
78.250	309.871
78.500	309.068
78.750	308.267
79.000	307.468
79.250	306.670
79.500	305.874
79.750	305.079
80.000	304.287
80.250	303.496
80.500	302.706
80.750	301.918
81.000	301.132
81.250	300.347
81.500	299.564
81.750	298.783
82.000	298.004
82.250	297.226
82.500	296.450
82.750	295.675
83.000	294.902
83.250	294.131
83.500	293.362
83.750	292.594
84.000	291.828
84.250	291.064
84.500	290.303
84.750	289.544
85.000	288.786
85.250	288.030
85.500	287.276
85.750	286.524
86.000	285.773
86.250	285.024
86.500	284.277
86.750	283.531
87.000	282.788
87.250	282.046
87.500	281.305
87.750	280.567
88.000	279.830
88.250	279.095
88.500	278.362
88.750	277.631
89.000	276.901
89.250	276.173
89.500	275.447
89.750	274.723
90.000	274.000
90.250	273.280
90.500	272.561
90.750	271.844
91.000	271.129
91.250	270.416
91.500	269.705
91.750	268.996
92.000	268.288
92.250	267.582
92.500	266.878
92.750	266.190
93.000	265.513
93.250	264.839
93.500	264.167
93.750	263.497
94.000	262.828
94.250	262.161
94.500	261.495
94.750	260.831
95.000	260.168
95.250	259.507
95.500	258.848
95.750	258.190
96.000	257.533
96.250	256.878
96.500	256.225
96.750	255.573
97.000	254.923
97.250	254.274
97.500	253.627
97.750	252.981
98.000	252.338
98.250	251.695

98.500	251.055
98.750	250.416
99.000	249.778
99.250	249.143
99.500	248.509
99.750	247.877
100.000	247.246

Name: LkHowell_25 Node: LH-0090 Type: Stage

Time(hrs)	Stage(ft)
0.000	53.080
0.030	53.078
0.070	53.077
0.100	53.075
0.130	53.074
0.170	53.072
0.200	53.070
0.230	53.069
0.270	53.067
0.300	53.065
0.330	53.064
0.370	53.062
0.400	53.061
0.430	53.059
0.470	53.057
0.500	53.056
0.530	53.054
0.570	53.053
0.600	53.051
0.630	53.049
0.670	53.048
0.700	53.046
0.730	53.045
0.770	53.043
0.800	53.041
0.830	53.040
0.870	53.038
0.900	53.037
0.930	53.035
0.970	53.033
1.000	53.032
1.030	53.030
1.070	53.029
1.100	53.027
1.130	53.026
1.170	53.024
1.200	53.022
1.230	53.021
1.270	53.019
1.300	53.018
1.330	53.016
1.370	53.015
1.400	53.013
1.430	53.012
1.470	53.010
1.500	53.009
1.530	53.007
1.570	53.006
1.600	53.004
1.630	53.003
1.670	53.001
1.700	53.000
1.730	52.998
1.770	52.997
1.800	52.995
1.830	52.994
1.870	52.993
1.900	52.991
1.930	52.990
1.970	52.988
2.000	52.987
2.030	52.986
2.070	52.984
2.100	52.983
2.130	52.982
2.170	52.980
2.200	52.979
2.230	52.978
2.270	52.976
2.300	52.975
2.330	52.974
2.370	52.972
2.400	52.971
2.430	52.970
2.470	52.969
2.500	52.967

2.530	52.966
2.570	52.965
2.600	52.964
2.630	52.962
2.670	52.961
2.700	52.960
2.730	52.959
2.770	52.957
2.800	52.956
2.830	52.955
2.870	52.954
2.900	52.953
2.930	52.951
2.970	52.950
3.000	52.949
3.030	52.948
3.070	52.947
3.100	52.946
3.130	52.944
3.170	52.943
3.200	52.942
3.230	52.941
3.270	52.940
3.300	52.939
3.330	52.938
3.370	52.937
3.400	52.936
3.430	52.934
3.470	52.933
3.500	52.932
3.530	52.931
3.570	52.930
3.600	52.929
3.630	52.928
3.670	52.927
3.700	52.926
3.730	52.925
3.770	52.924
3.800	52.923
3.830	52.922
3.870	52.921
3.900	52.920
3.930	52.919
3.970	52.918
4.000	52.917
4.030	52.916
4.070	52.915
4.100	52.914
4.130	52.913
4.170	52.912
4.200	52.911
4.230	52.910
4.270	52.909
4.300	52.908
4.330	52.907
4.370	52.906
4.400	52.905
4.430	52.905
4.470	52.904
4.500	52.903
4.530	52.902
4.570	52.901
4.600	52.900
4.630	52.899
4.670	52.898
4.700	52.898
4.730	52.897
4.770	52.896
4.800	52.895
4.830	52.894
4.870	52.894
4.900	52.893
4.930	52.892
4.970	52.891
5.000	52.890
5.030	52.890
5.070	52.889
5.100	52.888
5.130	52.887
5.170	52.887
5.200	52.886
5.230	52.885
5.270	52.884
5.300	52.884
5.330	52.883
5.370	52.882
5.400	52.882
5.430	52.881
5.470	52.880

5.500	52.880
5.530	52.879
5.570	52.878
5.600	52.878
5.630	52.877
5.670	52.876
5.700	52.876
5.730	52.875
5.770	52.875
5.800	52.874
5.830	52.873
5.870	52.873
5.900	52.872
5.930	52.872
5.970	52.871
6.000	52.871
6.030	52.870
6.070	52.870
6.100	52.869
6.130	52.869
6.170	52.868
6.200	52.868
6.230	52.867
6.270	52.867
6.300	52.866
6.330	52.866
6.370	52.865
6.400	52.865
6.430	52.865
6.470	52.864
6.500	52.864
6.530	52.863
6.570	52.863
6.600	52.863
6.630	52.862
6.670	52.862
6.700	52.862
6.730	52.861
6.770	52.861
6.800	52.861
6.830	52.860
6.870	52.860
6.900	52.860
6.930	52.860
6.970	52.859
7.000	52.859
7.030	52.859
7.070	52.859
7.100	52.858
7.130	52.858
7.170	52.858
7.200	52.858
7.230	52.858
7.270	52.857
7.300	52.857
7.330	52.857
7.370	52.857
7.400	52.857
7.430	52.857
7.470	52.857
7.500	52.857
7.530	52.857
7.570	52.857
7.600	52.857
7.630	52.857
7.670	52.857
7.700	52.857
7.730	52.857
7.770	52.857
7.800	52.857
7.830	52.857
7.870	52.857
7.900	52.857
7.930	52.857
7.970	52.857
8.000	52.857
8.030	52.857
8.070	52.858
8.100	52.858
8.130	52.858
8.170	52.858
8.200	52.858
8.230	52.859
8.270	52.859
8.300	52.859
8.330	52.859
8.370	52.860
8.400	52.860
8.430	52.860

8.470	52.861
8.500	52.861
8.530	52.861
8.570	52.862
8.600	52.862
8.630	52.863
8.670	52.863
8.700	52.863
8.730	52.864
8.770	52.864
8.800	52.865
8.830	52.865
8.870	52.866
8.900	52.867
8.930	52.867
8.970	52.868
9.000	52.869
9.030	52.869
9.070	52.870
9.100	52.871
9.130	52.871
9.170	52.872
9.200	52.873
9.230	52.874
9.270	52.875
9.300	52.875
9.330	52.876
9.370	52.877
9.400	52.878
9.430	52.879
9.470	52.880
9.500	52.881
9.530	52.882
9.570	52.883
9.600	52.884
9.630	52.885
9.670	52.887
9.700	52.888
9.730	52.889
9.770	52.890
9.800	52.891
9.830	52.893
9.870	52.894
9.900	52.895
9.930	52.897
9.970	52.898
10.000	52.900
10.030	52.901
10.070	52.903
10.100	52.904
10.130	52.906
10.170	52.907
10.200	52.909
10.230	52.911
10.270	52.913
10.300	52.914
10.330	52.916
10.370	52.918
10.400	52.920
10.430	52.922
10.470	52.924
10.500	52.926
10.530	52.928
10.570	52.930
10.600	52.933
10.630	52.935
10.670	52.937
10.700	52.940
10.730	52.942
10.770	52.945
10.800	52.947
10.830	52.950
10.870	52.953
10.900	52.955
10.930	52.958
10.970	52.961
11.000	52.964
11.030	52.967
11.070	52.970
11.100	52.973
11.130	52.977
11.170	52.980
11.200	52.984
11.230	52.987
11.270	52.991
11.300	52.994
11.330	52.998
11.370	53.002
11.400	53.006

11.430	53.010
11.470	53.015
11.500	53.019
11.530	53.024
11.570	53.029
11.600	53.034
11.630	53.040
11.670	53.046
11.700	53.053
11.730	53.060
11.770	53.068
11.800	53.076
11.830	53.086
11.870	53.096
11.900	53.107
11.930	53.119
11.970	53.131
12.000	53.145
12.030	53.160
12.070	53.176
12.100	53.194
12.130	53.211
12.170	53.230
12.200	53.250
12.230	53.270
12.270	53.291
12.300	53.312
12.330	53.334
12.370	53.356
12.400	53.378
12.430	53.402
12.470	53.425
12.500	53.449
12.530	53.473
12.570	53.497
12.600	53.521
12.630	53.546
12.670	53.570
12.700	53.595
12.730	53.620
12.770	53.645
12.800	53.669
12.830	53.694
12.870	53.719
12.900	53.743
12.930	53.768
12.970	53.792
13.000	53.817
13.030	53.841
13.070	53.866
13.100	53.890
13.130	53.914
13.170	53.938
13.200	53.962
13.230	53.986
13.270	54.009
13.300	54.033
13.330	54.056
13.370	54.079
13.400	54.103
13.430	54.125
13.470	54.148
13.500	54.170
13.530	54.192
13.570	54.214
13.600	54.236
13.630	54.258
13.670	54.279
13.700	54.300
13.730	54.321
13.770	54.341
13.800	54.362
13.830	54.382
13.870	54.402
13.900	54.422
13.930	54.442
13.970	54.461
14.000	54.480
14.030	54.500
14.070	54.519
14.100	54.537
14.130	54.556
14.170	54.574
14.200	54.593
14.230	54.611
14.270	54.629
14.300	54.647
14.330	54.664
14.370	54.682

14.400	54.699
14.430	54.716
14.470	54.733
14.500	54.750
14.530	54.767
14.570	54.784
14.600	54.800
14.630	54.816
14.670	54.832
14.700	54.848
14.730	54.864
14.770	54.880
14.800	54.895
14.830	54.910
14.870	54.925
14.900	54.940
14.930	54.955
14.970	54.970
15.000	54.984
15.030	54.998
15.070	55.012
15.100	55.026
15.130	55.040
15.170	55.054
15.200	55.067
15.230	55.080
15.270	55.093
15.300	55.106
15.330	55.119
15.370	55.131
15.400	55.144
15.430	55.156
15.470	55.168
15.500	55.180
15.530	55.192
15.570	55.204
15.600	55.215
15.630	55.227
15.670	55.238
15.700	55.249
15.730	55.260
15.770	55.271
15.800	55.282
15.830	55.293
15.870	55.303
15.900	55.314
15.930	55.324
15.970	55.334
16.000	55.344
16.030	55.354
16.070	55.364
16.100	55.374
16.130	55.383
16.170	55.393
16.200	55.402
16.230	55.411
16.270	55.421
16.300	55.430
16.330	55.439
16.370	55.447
16.400	55.456
16.430	55.465
16.470	55.473
16.500	55.482
16.530	55.490
16.570	55.498
16.600	55.506
16.630	55.515
16.670	55.523
16.700	55.530
16.730	55.538
16.770	55.546
16.800	55.554
16.830	55.561
16.870	55.568
16.900	55.576
16.930	55.583
16.970	55.590
17.000	55.597
17.030	55.604
17.070	55.611
17.100	55.618
17.130	55.625
17.170	55.632
17.200	55.638
17.230	55.645
17.270	55.652
17.300	55.658
17.330	55.664

17.370	55.671
17.400	55.677
17.430	55.683
17.470	55.689
17.500	55.695
17.530	55.701
17.570	55.707
17.600	55.713
17.630	55.719
17.670	55.725
17.700	55.731
17.730	55.737
17.770	55.742
17.800	55.748
17.830	55.753
17.870	55.759
17.900	55.764
17.930	55.770
17.970	55.775
18.000	55.780
18.030	55.785
18.070	55.790
18.100	55.795
18.130	55.800
18.170	55.805
18.200	55.810
18.230	55.815
18.270	55.820
18.300	55.825
18.330	55.830
18.370	55.834
18.400	55.839
18.430	55.843
18.470	55.848
18.500	55.853
18.530	55.857
18.570	55.862
18.600	55.866
18.630	55.870
18.670	55.875
18.700	55.879
18.730	55.883
18.770	55.887
18.800	55.892
18.830	55.896
18.870	55.900
18.900	55.904
18.930	55.908
18.970	55.912
19.000	55.916
19.030	55.920
19.070	55.924
19.100	55.928
19.130	55.932
19.170	55.936
19.200	55.939
19.230	55.943
19.270	55.947
19.300	55.951
19.330	55.954
19.370	55.958
19.400	55.961
19.430	55.965
19.470	55.969
19.500	55.972
19.530	55.976
19.570	55.979
19.600	55.983
19.630	55.986
19.670	55.989
19.700	55.993
19.730	55.996
19.770	55.999
19.800	56.003
19.830	56.006
19.870	56.009
19.900	56.012
19.930	56.015
19.970	56.019
20.000	56.022
20.030	56.025
20.070	56.028
20.100	56.031
20.130	56.034
20.170	56.037
20.200	56.040
20.230	56.043
20.270	56.046
20.300	56.049

20.330	56.051
20.370	56.054
20.400	56.057
20.430	56.060
20.470	56.062
20.500	56.065
20.530	56.068
20.570	56.070
20.600	56.073
20.630	56.075
20.670	56.078
20.700	56.080
20.730	56.083
20.770	56.085
20.800	56.088
20.830	56.090
20.870	56.093
20.900	56.095
20.930	56.097
20.970	56.100
21.000	56.102
21.030	56.104
21.070	56.107
21.100	56.109
21.130	56.111
21.170	56.113
21.200	56.116
21.230	56.118
21.270	56.120
21.300	56.122
21.330	56.124
21.370	56.126
21.400	56.128
21.430	56.131
21.470	56.133
21.500	56.135
21.530	56.137
21.570	56.139
21.600	56.141
21.630	56.143
21.670	56.145
21.700	56.147
21.730	56.149
21.770	56.150
21.800	56.152
21.830	56.154
21.870	56.156
21.900	56.158
21.930	56.160
21.970	56.162
22.000	56.164
22.030	56.165
22.070	56.167
22.100	56.169
22.130	56.171
22.170	56.173
22.200	56.174
22.230	56.176
22.270	56.178
22.300	56.179
22.330	56.181
22.370	56.183
22.400	56.185
22.430	56.186
22.470	56.188
22.500	56.190
22.530	56.191
22.570	56.193
22.600	56.194
22.630	56.196
22.670	56.198
22.700	56.199
22.730	56.201
22.770	56.202
22.800	56.204
22.830	56.205
22.870	56.207
22.900	56.208
22.930	56.210
22.970	56.211
23.000	56.213
23.030	56.214
23.070	56.216
23.100	56.217
23.130	56.218
23.170	56.220
23.200	56.221
23.230	56.222
23.270	56.224

23.300	56.225
23.330	56.227
23.370	56.228
23.400	56.229
23.430	56.230
23.470	56.232
23.500	56.233
23.530	56.234
23.570	56.235
23.600	56.237
23.630	56.238
23.670	56.239
23.700	56.240
23.730	56.241
23.770	56.243
23.800	56.244
23.830	56.245
23.870	56.246
23.900	56.247
23.930	56.248
23.970	56.249
24.000	56.250
24.250	56.258
24.500	56.264
24.750	56.268
25.000	56.270
25.250	56.271
25.500	56.270
25.750	56.269
26.000	56.266
26.250	56.263
26.500	56.258
26.750	56.253
27.000	56.248
27.250	56.241
27.500	56.235
27.750	56.227
28.000	56.220
28.250	56.212
28.500	56.203
28.750	56.195
29.000	56.186
29.250	56.177
29.500	56.168
29.750	56.158
30.000	56.149
30.250	56.139
30.500	56.129
30.750	56.119
31.000	56.109
31.250	56.098
31.500	56.088
31.750	56.078
32.000	56.067
32.250	56.057
32.500	56.047
32.750	56.036
33.000	56.026
33.250	56.015
33.500	56.005
33.750	55.994
34.000	55.984
34.250	55.973
34.500	55.963
34.750	55.953
35.000	55.942
35.250	55.932
35.500	55.922
35.750	55.911
36.000	55.901
36.250	55.891
36.500	55.881
36.750	55.871
37.000	55.860
37.250	55.850
37.500	55.840
37.750	55.830
38.000	55.820
38.250	55.810
38.500	55.801
38.750	55.791
39.000	55.781
39.250	55.771
39.500	55.761
39.750	55.751
40.000	55.742
40.250	55.732
40.500	55.722
40.750	55.713

41.000	55.703
41.250	55.694
41.500	55.684
41.750	55.675
42.000	55.665
42.250	55.656
42.500	55.646
42.750	55.637
43.000	55.627
43.250	55.618
43.500	55.609
43.750	55.599
44.000	55.590
44.250	55.581
44.500	55.571
44.750	55.562
45.000	55.553
45.250	55.543
45.500	55.534
45.750	55.525
46.000	55.516
46.250	55.507
46.500	55.497
46.750	55.488
47.000	55.479
47.250	55.470
47.500	55.461
47.750	55.452
48.000	55.443
48.250	55.433
48.500	55.424
48.750	55.415
49.000	55.406
49.250	55.397
49.500	55.388
49.750	55.379
50.000	55.370
50.250	55.361
50.500	55.353
50.750	55.344
51.000	55.335
51.250	55.326
51.500	55.317
51.750	55.308
52.000	55.299
52.250	55.290
52.500	55.282
52.750	55.273
53.000	55.264
53.250	55.255
53.500	55.247
53.750	55.238
54.000	55.229
54.250	55.220
54.500	55.212
54.750	55.203
55.000	55.194
55.250	55.186
55.500	55.177
55.750	55.169
56.000	55.160
56.250	55.151
56.500	55.143
56.750	55.134
57.000	55.126
57.250	55.117
57.500	55.109
57.750	55.100
58.000	55.092
58.250	55.084
58.500	55.075
58.750	55.067
59.000	55.058
59.250	55.050
59.500	55.042
59.750	55.033
60.000	55.025
60.250	55.017
60.500	55.009
60.750	55.000
61.000	54.992
61.250	54.984
61.500	54.976
61.750	54.967
62.000	54.959
62.250	54.951
62.500	54.943
62.750	54.935
63.000	54.927

63.250	54.919
63.500	54.911
63.750	54.903
64.000	54.895
64.250	54.887
64.500	54.879
64.750	54.871
65.000	54.863
65.250	54.855
65.500	54.847
65.750	54.839
66.000	54.831
66.250	54.823
66.500	54.816
66.750	54.808
67.000	54.800
67.250	54.792
67.500	54.784
67.750	54.776
68.000	54.768
68.250	54.761
68.500	54.753
68.750	54.745
69.000	54.737
69.250	54.729
69.500	54.722
69.750	54.714
70.000	54.706
70.250	54.698
70.500	54.691
70.750	54.683
71.000	54.675
71.250	54.668
71.500	54.660
71.750	54.652
72.000	54.645
72.250	54.637
72.500	54.629
72.750	54.622
73.000	54.614
73.250	54.607
73.500	54.599
73.750	54.591
74.000	54.584
74.250	54.576
74.500	54.569
74.750	54.562
75.000	54.554
75.250	54.547
75.500	54.539
75.750	54.532
76.000	54.524
76.250	54.517
76.500	54.510
76.750	54.502
77.000	54.495
77.250	54.488
77.500	54.480
77.750	54.473
78.000	54.466
78.250	54.459
78.500	54.451
78.750	54.444
79.000	54.437
79.250	54.430
79.500	54.423
79.750	54.416
80.000	54.409
80.250	54.402
80.500	54.394
80.750	54.387
81.000	54.380
81.250	54.373
81.500	54.366
81.750	54.359
82.000	54.352
82.250	54.346
82.500	54.339
82.750	54.332
83.000	54.325
83.250	54.318
83.500	54.311
83.750	54.304
84.000	54.298
84.250	54.291
84.500	54.284
84.750	54.277
85.000	54.271
85.250	54.264

85.500	54.257
85.750	54.250
86.000	54.244
86.250	54.237
86.500	54.231
86.750	54.224
87.000	54.217
87.250	54.211
87.500	54.204
87.750	54.198
88.000	54.191
88.250	54.184
88.500	54.178
88.750	54.171
89.000	54.165
89.250	54.158
89.500	54.152
89.750	54.145
90.000	54.139
90.250	54.132
90.500	54.126
90.750	54.119
91.000	54.113
91.250	54.106
91.500	54.100
91.750	54.094
92.000	54.087
92.250	54.081
92.500	54.075
92.750	54.068
93.000	54.062
93.250	54.056
93.500	54.049
93.750	54.043
94.000	54.037
94.250	54.030
94.500	54.024
94.750	54.018
95.000	54.012
95.250	54.006
95.500	53.999
95.750	53.993
96.000	53.987
96.250	53.981
96.500	53.975
96.750	53.969
97.000	53.963
97.250	53.957
97.500	53.951
97.750	53.944
98.000	53.938
98.250	53.932
98.500	53.926
98.750	53.921
99.000	53.915
99.250	53.909
99.500	53.903
99.750	53.897
100.000	53.891

ATTACHMENT 2

```
            Basin Name: HC-013
            Group Name: Howell Creek
            Simulation: HC00_PRO
             Node Name: HC-0040
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
    Spec Time Inc (min): 7.43
    Comp Time Inc (min): 7.43
         Rainfall File: Flmod
   Rainfall Amount (in): 11.400
   Storm Duration (hrs): 24.00
                 Status: Onsite
     Time of Conc (min): 55.70
       Time Shift (hrs): 0.00
              Area (ac): 101.000
   Vol of Unit Hyd (in): 1.001
          Curve Number: 74.000
              DCIA (%): 1.600

         Time Max (hrs): 12.50
        Flow Max (cfs): 283.322
     Runoff Volume (in): 8.096
    Runoff Volume (ft3): 2968231.997


--------------------------------------------------------------------------------

            Basin Name: HC-014
            Group Name: Howell Creek
            Simulation: HC00_PRO
             Node Name: LWu-0010
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
    Spec Time Inc (min): 8.84
    Comp Time Inc (min): 8.84
         Rainfall File: Flmod
   Rainfall Amount (in): 11.400
   Storm Duration (hrs): 24.00
                 Status: Onsite
     Time of Conc (min): 66.30
       Time Shift (hrs): 0.00
              Area (ac): 806.000
   Vol of Unit Hyd (in): 1.000
          Curve Number: 75.000
              DCIA (%): 27.700

         Time Max (hrs): 12.67
        Flow Max (cfs): 2174.337
     Runoff Volume (in): 9.041
    Runoff Volume (ft3): 26451377.610


--------------------------------------------------------------------------------

            Basin Name: HC-015
            Group Name: Howell Creek
            Simulation: HC00_PRO
             Node Name: HC-0080
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
    Spec Time Inc (min): 3.23
    Comp Time Inc (min): 3.23
         Rainfall File: Flmod
   Rainfall Amount (in): 11.400
   Storm Duration (hrs): 24.00
                 Status: Onsite
     Time of Conc (min): 24.20
       Time Shift (hrs): 0.00
              Area (ac): 212.000
   Vol of Unit Hyd (in): 1.000
          Curve Number: 89.000
              DCIA (%): 3.900

         Time Max (hrs): 12.15
        Flow Max (cfs): 1098.800
     Runoff Volume (in): 10.092
    Runoff Volume (ft3): 7766308.107


--------------------------------------------------------------------------------

            Basin Name: HC-016
```

```
            Group Name: Howell Creek
            Simulation: HC00_PRO
             Node Name: HC-0115
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 2.17
   Comp Time Inc (min): 2.17
         Rainfall File: Flmod
  Rainfall Amount (in): 11.400
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 16.30
      Time Shift (hrs): 0.00
            Area (ac): 31.400
  Vol of Unit Hyd (in): 1.000
          Curve Number: 87.000
              DCIA (%): 9.300

       Time Max (hrs): 12.10
       Flow Max (cfs): 190.130
    Runoff Volume (in): 9.927
   Runoff Volume (ft3): 1131500.783


--------------------------------------------------------------------------------

            Basin Name: HC-013
            Group Name: Howell Creek
            Simulation: HC10_PRO
             Node Name: HC-0040
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 7.43
   Comp Time Inc (min): 7.43
         Rainfall File: Flmod
  Rainfall Amount (in): 6.800
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 55.70
      Time Shift (hrs): 0.00
            Area (ac): 101.000
  Vol of Unit Hyd (in): 1.001
          Curve Number: 74.000
              DCIA (%): 1.600

       Time Max (hrs): 12.50
       Flow Max (cfs): 136.253
    Runoff Volume (in): 3.909
   Runoff Volume (ft3): 1433033.952


--------------------------------------------------------------------------------

            Basin Name: HC-014
            Group Name: Howell Creek
            Simulation: HC10_PRO
             Node Name: LWu-0010
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 8.84
   Comp Time Inc (min): 8.84
         Rainfall File: Flmod
  Rainfall Amount (in): 6.800
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 66.30
      Time Shift (hrs): 0.00
            Area (ac): 806.000
  Vol of Unit Hyd (in): 1.000
          Curve Number: 75.000
              DCIA (%): 27.700

       Time Max (hrs): 12.67
       Flow Max (cfs): 1133.538
    Runoff Volume (in): 4.723
   Runoff Volume (ft3): 13817653.479


--------------------------------------------------------------------------------

            Basin Name: HC-015
            Group Name: Howell Creek
```

```
            Simulation: HC10_PRO
             Node Name: HC-0080
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 3.23
   Comp Time Inc (min): 3.23
         Rainfall File: Flmod
  Rainfall Amount (in): 6.800
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 24.20
      Time Shift (hrs): 0.00
             Area (ac): 212.000
  Vol of Unit Hyd (in): 1.000
          Curve Number: 89.000
              DCIA (%): 3.900

       Time Max (hrs): 12.15
       Flow Max (cfs): 621.902
    Runoff Volume (in): 5.561
   Runoff Volume (ft3): 4279243.125


--------------------------------------------------------------------------------

            Basin Name: HC-016
            Group Name: Howell Creek
            Simulation: HC10_PRO
             Node Name: HC-0115
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 2.17
   Comp Time Inc (min): 2.17
         Rainfall File: Flmod
  Rainfall Amount (in): 6.800
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 16.30
      Time Shift (hrs): 0.00
             Area (ac): 31.400
  Vol of Unit Hyd (in): 1.000
          Curve Number: 87.000
              DCIA (%): 9.300

       Time Max (hrs): 12.10
       Flow Max (cfs): 106.677
    Runoff Volume (in): 5.419
   Runoff Volume (ft3): 617619.589


--------------------------------------------------------------------------------

            Basin Name: HC-013
            Group Name: Howell Creek
            Simulation: HC25_PRO
             Node Name: HC-0040
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 7.43
   Comp Time Inc (min): 7.43
         Rainfall File: Flmod
  Rainfall Amount (in): 8.400
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 55.70
      Time Shift (hrs): 0.00
             Area (ac): 101.000
  Vol of Unit Hyd (in): 1.001
          Curve Number: 74.000
              DCIA (%): 1.600

       Time Max (hrs): 12.50
       Flow Max (cfs): 186.661
    Runoff Volume (in): 5.327
   Runoff Volume (ft3): 1953044.322


--------------------------------------------------------------------------------

            Basin Name: HC-014
            Group Name: Howell Creek
            Simulation: HC25_PRO
```

```
             Node Name: LWu-0010
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 8.84
   Comp Time Inc (min): 8.84
         Rainfall File: Flmod
  Rainfall Amount (in): 8.400
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 66.30
      Time Shift (hrs): 0.00
             Area (ac): 806.000
  Vol of Unit Hyd (in): 1.000
          Curve Number: 75.000
              DCIA (%): 27.700

       Time Max (hrs): 12.67
       Flow Max (cfs): 1492.279
    Runoff Volume (in): 6.198
   Runoff Volume (ft3): 18135374.971


--------------------------------------------------------------------------------

            Basin Name: HC-015
            Group Name: Howell Creek
            Simulation: HC25_PRO
             Node Name: HC-0080
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 3.23
   Comp Time Inc (min): 3.23
         Rainfall File: Flmod
  Rainfall Amount (in): 8.400
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 24.20
      Time Shift (hrs): 0.00
             Area (ac): 212.000
  Vol of Unit Hyd (in): 1.000
          Curve Number: 89.000
              DCIA (%): 3.900

       Time Max (hrs): 12.15
       Flow Max (cfs): 788.740
    Runoff Volume (in): 7.129
   Runoff Volume (ft3): 5486146.458


--------------------------------------------------------------------------------

            Basin Name: HC-016
            Group Name: Howell Creek
            Simulation: HC25_PRO
             Node Name: HC-0115
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
   Spec Time Inc (min): 2.17
   Comp Time Inc (min): 2.17
         Rainfall File: Flmod
  Rainfall Amount (in): 8.400
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 16.30
      Time Shift (hrs): 0.00
             Area (ac): 31.400
  Vol of Unit Hyd (in): 1.000
          Curve Number: 87.000
              DCIA (%): 9.300

       Time Max (hrs): 12.10
       Flow Max (cfs): 135.861
    Runoff Volume (in): 6.977
   Runoff Volume (ft3): 795213.608


--------------------------------------------------------------------------------

            Basin Name: HC-013
            Group Name: Howell Creek
            Simulation: HCMN_PRO
             Node Name: HC-0040
```

```
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
    Spec Time Inc (min): 7.43
    Comp Time Inc (min): 7.43
          Rainfall File: Flmod
   Rainfall Amount (in): 5.300
   Storm Duration (hrs): 24.00
                 Status: Onsite
     Time of Conc (min): 55.70
       Time Shift (hrs): 0.00
              Area (ac): 101.000
   Vol of Unit Hyd (in): 1.001
           Curve Number: 74.000
               DCIA (%): 1.600

         Time Max (hrs): 12.50
         Flow Max (cfs): 90.741
     Runoff Volume (in): 2.644
    Runoff Volume (ft3): 969234.639


--------------------------------------------------------------------------------

            Basin Name: HC-014
            Group Name: Howell Creek
            Simulation: HCMN_PRO
             Node Name: LWu-0010
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
    Spec Time Inc (min): 8.84
    Comp Time Inc (min): 8.84
          Rainfall File: Flmod
   Rainfall Amount (in): 5.300
   Storm Duration (hrs): 24.00
                 Status: Onsite
     Time of Conc (min): 66.30
       Time Shift (hrs): 0.00
              Area (ac): 806.000
   Vol of Unit Hyd (in): 1.000
           Curve Number: 75.000
               DCIA (%): 27.700

         Time Max (hrs): 12.67
         Flow Max (cfs): 805.280
     Runoff Volume (in): 3.384
    Runoff Volume (ft3): 9900819.246


--------------------------------------------------------------------------------

            Basin Name: HC-015
            Group Name: Howell Creek
            Simulation: HCMN_PRO
             Node Name: HC-0080
            Basin Type: SCS Unit Hydrograph

        Unit Hydrograph: Uh323
          Peaking Fator: 323.0
    Spec Time Inc (min): 3.23
    Comp Time Inc (min): 3.23
          Rainfall File: Flmod
   Rainfall Amount (in): 5.300
   Storm Duration (hrs): 24.00
                 Status: Onsite
     Time of Conc (min): 24.20
       Time Shift (hrs): 0.00
              Area (ac): 212.000
   Vol of Unit Hyd (in): 1.000
           Curve Number: 89.000
               DCIA (%): 3.900

         Time Max (hrs): 12.15
         Flow Max (cfs): 464.404
     Runoff Volume (in): 4.105
    Runoff Volume (ft3): 3159200.333


--------------------------------------------------------------------------------

            Basin Name: HC-016
            Group Name: Howell Creek
            Simulation: HCMN_PRO
             Node Name: HC-0115
            Basin Type: SCS Unit Hydrograph
```

```
       Unit Hydrograph: Uh323
         Peaking Fator: 323.0
   Spec Time Inc (min): 2.17
   Comp Time Inc (min): 2.17
         Rainfall File: Flmod
  Rainfall Amount (in): 5.300
  Storm Duration (hrs): 24.00
                Status: Onsite
    Time of Conc (min): 16.30
      Time Shift (hrs): 0.00
             Area (ac): 31.400
  Vol of Unit Hyd (in): 1.000
          Curve Number: 87.000
              DCIA (%): 9.300

        Time Max (hrs): 12.10
        Flow Max (cfs): 79.172
    Runoff Volume (in): 3.977
   Runoff Volume (ft3): 453280.327
```

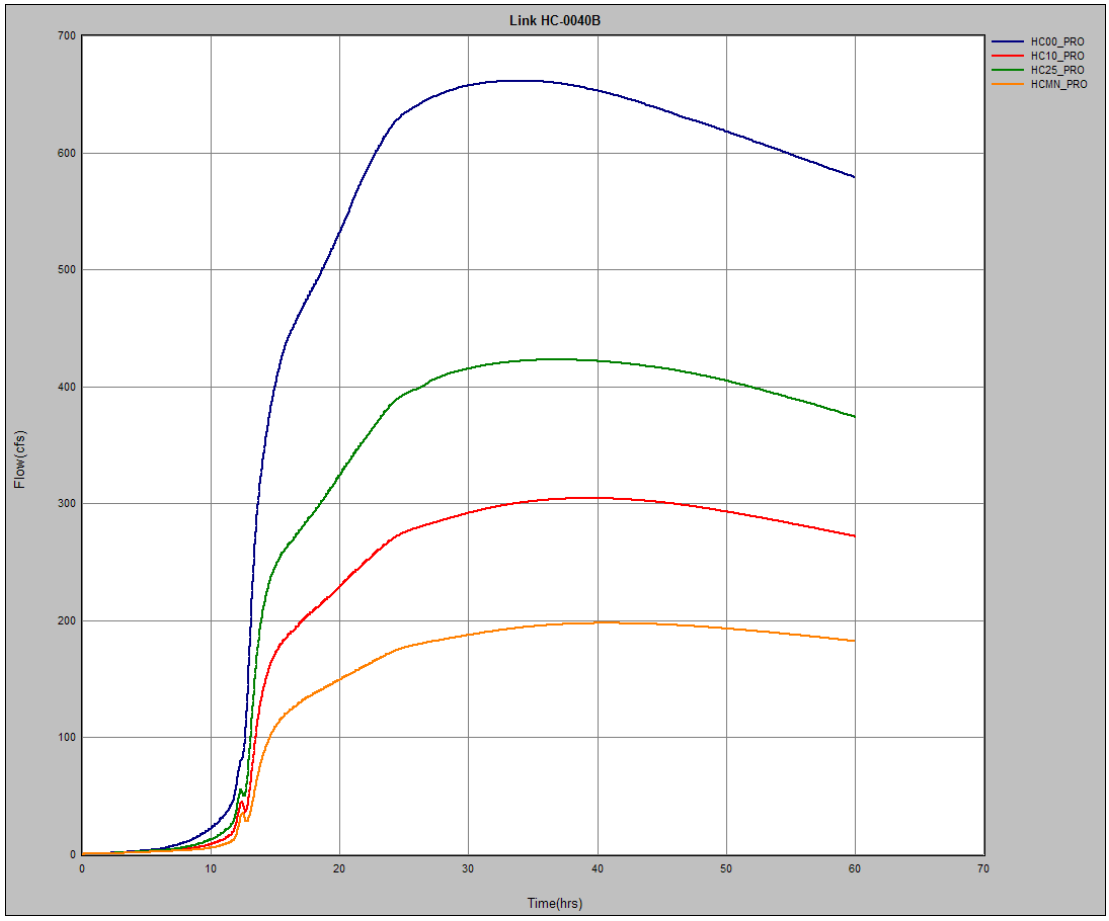
Name	Group	Simulation	Max Time Stage hrs	Max Stage ft	Warning Stage ft	Max Delta Stage ft	Max Surf Area ft2	Max Time Inflow hrs	Max Inflow cfs	Max Time Outflow hrs	
HC-0040	Howell Creek	HC00_PRO	34.00	63.767	73.000	0.0044	556782	33.50	661.507	34.00	
HC-0070	Howell Creek	HC00_PRO	14.09	62.696	66.000	0.0031	5614	13.41	1506.092	13.42	1
HC-0080	Howell Creek	HC00_PRO	14.16	62.563	64.000	0.0043	1256307	13.19	1764.833	14.09	1
HC-0083	Howell Creek	HC00_PRO	14.18	62.477	64.000	0.0032	36321	14.09	1507.491	14.18	1
HC-0085	Howell Creek	HC00_PRO	14.16	62.413	66.000	0.0049	27743	14.18	1545.395	14.13	1
HC-0090	Howell Creek	HC00_PRO	14.18	62.353	63.647	-0.0050	17377	14.13	1506.874	14.18	1
HC-0095	Howell Creek	HC00_PRO	14.18	62.218	66.000	0.0029	22396	14.18	1530.532	14.16	1
HC-0100	Howell Creek	HC00_PRO	14.17	61.850	66.280	0.0028	17852	14.16	1506.619	14.08	1
HC-0110	Howell Creek	HC00_PRO	14.18	61.712	67.188	0.0049	12408	14.08	1535.829	14.19	1
HC-0115	Howell Creek	HC00_PRO	14.17	61.600	67.000	-0.0042	12797	14.15	1522.104	14.08	1
HC-0120	Howell Creek	HC00_PRO	14.18	61.408	66.610	-0.0029	9234	14.08	1542.770	14.16	1
HC-0130	Howell Creek	HC00_PRO	14.18	60.255	66.810	0.0049	6640	14.16	1522.037	14.17	1
HC-0135	Howell Creek	HC00_PRO	14.27	59.090	67.000	0.0018	13673	14.17	1522.090	14.18	1
HC-0140	Howell Creek	HC00_PRO	14.44	58.665	65.470	-0.0049	17757	14.18	1521.920	14.17	1
HC-0150	Howell Creek	HC00_PRO	25.00	58.037	63.800	-0.0016	65059	14.17	1521.639	14.17	1
LH-0090	Lake Howell	HC00_PRO	25.00	57.969	58.410	0.0014	68062	14.17	1518.682	0.00	
LWu-0010	Lake Waumpi	HC00_PRO	13.78	63.222	65.000	0.0023	2754031	12.67	2277.202	13.41	1
HC-0040	Howell Creek	HC10_PRO	39.05	62.193	73.000	0.0044	418651	38.75	304.578	39.35	
HC-0070	Howell Creek	HC10_PRO	14.75	60.254	66.000	0.0015	4963	14.07	669.387	14.08	
HC-0080	Howell Creek	HC10_PRO	14.84	60.143	64.000	-0.0049	887042	13.65	748.163	14.73	
HC-0083	Howell Creek	HC10_PRO	14.84	60.007	64.000	0.0015	16712	14.73	682.930	14.81	
HC-0085	Howell Creek	HC10_PRO	14.88	59.928	66.000	0.0050	11325	14.81	681.115	14.73	
HC-0090	Howell Creek	HC10_PRO	14.85	59.878	63.647	-0.0050	10098	14.73	750.948	14.81	
HC-0095	Howell Creek	HC10_PRO	14.88	59.772	66.000	0.0015	14889	14.81	681.021	14.88	
HC-0100	Howell Creek	HC10_PRO	14.86	59.487	66.280	-0.0029	13832	14.88	681.917	14.85	
HC-0110	Howell Creek	HC10_PRO	14.86	59.362	67.188	-0.0049	8858	14.85	680.932	14.88	
HC-0115	Howell Creek	HC10_PRO	14.86	59.232	67.000	-0.0041	8726	14.84	688.058	14.85	
HC-0120	Howell Creek	HC10_PRO	14.87	59.081	66.610	-0.0029	8114	14.85	688.008	14.86	
HC-0130	Howell Creek	HC10_PRO	14.88	58.333	66.810	0.0049	5350	14.86	687.996	14.86	
HC-0135	Howell Creek	HC10_PRO	14.90	57.764	67.000	0.0022	11183	14.86	687.988	14.87	
HC-0140	Howell Creek	HC10_PRO	14.96	57.265	65.470	0.0050	14184	14.87	687.965	14.87	
HC-0150	Howell Creek	HC10_PRO	15.94	55.783	63.800	-0.0016	43050	14.87	687.901	14.87	
LH-0090	Lake Howell	HC10_PRO	25.25	55.363	58.410	0.0006	47637	14.87	686.974	0.00	
LWu-0010	Lake Waumpi	HC10_PRO	14.07	62.036	65.000	0.0013	2279683	12.67	1170.256	14.07	
HC-0040	Howell Creek	HC25_PRO	36.80	62.807	73.000	0.0044	498250	36.00	423.113	36.80	
HC-0070	Howell Creek	HC25_PRO	14.51	61.295	66.000	0.0022	5193	13.83	970.581	13.83	
HC-0080	Howell Creek	HC25_PRO	14.60	61.170	64.000	0.0043	1044447	13.52	1094.533	14.55	
HC-0083	Howell Creek	HC25_PRO	14.61	61.046	64.000	0.0021	24928	14.55	973.370	14.55	
HC-0085	Howell Creek	HC25_PRO	14.63	60.968	66.000	0.0050	17821	14.55	971.385	14.63	1
HC-0090	Howell Creek	HC25_PRO	14.62	60.912	63.647	0.0050	12373	14.63	1057.959	14.55	
HC-0095	Howell Creek	HC25_PRO	14.63	60.796	66.000	0.0021	17905	14.55	971.100	14.63	
HC-0100	Howell Creek	HC25_PRO	14.62	60.467	66.280	0.0030	15424	14.63	972.590	14.61	
HC-0110	Howell Creek	HC25_PRO	14.63	60.337	67.188	-0.0049	10461	14.61	970.956	14.63	
HC-0115	Howell Creek	HC25_PRO	14.62	60.181	67.000	-0.0040	11611	14.59	980.850	14.61	
HC-0120	Howell Creek	HC25_PRO	14.63	60.003	66.610	-0.0029	8626	14.61	980.748	14.61	
HC-0130	Howell Creek	HC25_PRO	14.64	59.095	66.810	0.0049	5814	14.61	980.726	14.62	
HC-0135	Howell Creek	HC25_PRO	14.68	58.299	67.000	0.0021	12123	14.62	980.709	14.62	
HC-0140	Howell Creek	HC25_PRO	14.75	57.826	65.470	-0.0050	15669	14.62	980.643	14.64	
HC-0150	Howell Creek	HC25_PRO	24.76	56.473	63.800	-0.0016	49445	14.64	980.475	14.66	
LH-0090	Lake Howell	HC25_PRO	25.25	56.271	58.410	0.0009	53208	14.66	978.787	0.00	
LWu-0010	Lake Waumpi	HC25_PRO	13.83	62.480	65.000	0.0018	2461690	12.67	1543.609	13.83	
HC-0040	Howell Creek	HCMN_PRO	14.57	61.592	73.000	0.0044	340796	40.00	197.802	40.71	
HC-0070	Howell Creek	HCMN_PRO	15.08	59.146	66.000	-0.0013	4873	14.42	419.175	14.42	
HC-0080	Howell Creek	HCMN_PRO	15.17	59.052	64.000	-0.0050	722133	12.17	528.694	15.11	
HC-0083	Howell Creek	HCMN_PRO	15.17	58.919	64.000	0.0010	11731	15.11	438.155	15.11	
HC-0085	Howell Creek	HCMN_PRO	15.20	58.836	66.000	0.0049	9093	15.11	437.645	14.94	
HC-0090	Howell Creek	HCMN_PRO	15.19	58.805	63.647	0.0050	7449	14.94	506.138	15.14	
HC-0095	Howell Creek	HCMN_PRO	15.20	58.713	66.000	0.0011	12265	15.14	437.633	15.20	
HC-0100	Howell Creek	HCMN_PRO	15.20	58.490	66.280	-0.0022	12416	15.20	437.994	15.18	
HC-0110	Howell Creek	HCMN_PRO	15.20	58.374	67.188	-0.0050	7631	15.18	437.519	15.20	
HC-0115	Howell Creek	HCMN_PRO	15.20	58.275	67.000	-0.0044	7394	15.17	442.563	15.17	
HC-0120	Howell Creek	HCMN_PRO	15.20	58.127	66.610	-0.0027	7763	15.17	442.545	15.19	
HC-0130	Howell Creek	HCMN_PRO	15.22	57.523	66.810	0.0047	4926	15.19	442.536	15.19	
HC-0135	Howell Creek	HCMN_PRO	15.24	57.143	67.000	0.0019	9916	15.19	442.530	15.20	
HC-0140	Howell Creek	HCMN_PRO	15.31	56.670	65.470	0.0050	11623	15.20	442.515	15.20	
HC-0150	Howell Creek	HCMN_PRO	15.94	55.340	63.800	-0.0016	38871	15.20	442.475	15.26	
LH-0090	Lake Howell	HCMN_PRO	24.50	54.484	58.410	0.0003	42951	15.26	441.880	0.00	
LWu-0010	Lake Waumpi	HCMN_PRO	14.42	61.541	65.000	0.0007	2069107	12.67	834.491	14.42	

Link Min/Max Report

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
HC-0040B	Howell Creek	HC00_PRO	34.00	661.424	0.448	34.00	63.767	13.78	63.222
HC-0062W	Howell Creek	HC00_PRO	13.41	1506.092	1.635	13.78	63.222	14.09	62.696
HC-0070B	Howell Creek	HC00_PRO	13.42	1504.871	-3.312	14.09	62.696	14.16	62.563
HC-0080X	Howell Creek	HC00_PRO	14.09	1507.491	-7.883	14.16	62.563	14.18	62.477
HC-0083X	Howell Creek	HC00_PRO	14.18	1545.395	-42.811	14.18	62.477	14.16	62.413
HC-0085B	Howell Creek	HC00_PRO	14.13	1506.874	240.644	14.16	62.413	14.18	62.353
HC-0090X	Howell Creek	HC00_PRO	14.18	1530.532	-29.990	14.18	62.353	14.18	62.218
HC-0095X	Howell Creek	HC00_PRO	14.16	1506.619	8.949	14.18	62.218	14.17	61.850
HC-0100B	Howell Creek	HC00_PRO	14.08	1535.829	-30.175	14.17	61.850	14.18	61.712
HC-0110X	Howell Creek	HC00_PRO	14.19	1506.579	56.243	14.18	61.712	14.17	61.600
HC-0115X	Howell Creek	HC00_PRO	14.08	1542.770	-21.566	14.17	61.600	14.18	61.408
HC-0120B	Howell Creek	HC00_PRO	14.16	1522.037	-43.364	14.18	61.408	14.18	60.255
HC-0130X	Howell Creek	HC00_PRO	14.17	1522.090	5.720	14.18	60.255	14.27	59.090
HC-0135X	Howell Creek	HC00_PRO	14.18	1521.920	0.724	14.27	59.090	14.44	58.665
HC-0140B	Howell Creek	HC00_PRO	14.17	1521.639	-155.854	14.44	58.665	25.00	58.037
HC-0150X	Howell Creek	HC00_PRO	14.17	1518.682	-1.677	25.00	58.037	25.00	57.969
HC0040BRd	Howell Creek	HC00_PRO	0.00	0.000	0.000	34.00	63.767	13.78	63.222
HC0070BRd	Howell Creek	HC00_PRO	0.00	0.000	0.000	14.09	62.696	14.16	62.563
HC0085BRd	Howell Creek	HC00_PRO	0.00	0.000	0.000	14.16	62.413	14.18	62.353
HC0100BRd	Howell Creek	HC00_PRO	0.00	0.000	0.000	14.17	61.850	14.18	61.712
HC0120BRd	Howell Creek	HC00_PRO	0.00	0.000	0.000	14.18	61.408	14.18	60.255
HC0140BRd	Howell Creek	HC00_PRO	0.00	0.000	0.000	14.44	58.665	25.00	58.037
HC-0040B	Howell Creek	HC10_PRO	39.35	304.572	0.096	39.05	62.193	14.07	62.036
HC-0062W	Howell Creek	HC10_PRO	14.07	669.387	0.464	14.07	62.036	14.75	60.254
HC-0070B	Howell Creek	HC10_PRO	14.08	668.952	-3.312	14.75	60.254	14.84	60.143
HC-0080X	Howell Creek	HC10_PRO	14.73	682.930	-1.747	14.84	60.143	14.84	60.007
HC-0083X	Howell Creek	HC10_PRO	14.81	681.115	19.753	14.84	60.007	14.88	59.928
HC-0085B	Howell Creek	HC10_PRO	14.73	750.948	146.688	14.88	59.928	14.85	59.878
HC-0090X	Howell Creek	HC10_PRO	14.81	681.021	18.510	14.85	59.878	14.88	59.772
HC-0095X	Howell Creek	HC10_PRO	14.88	681.917	8.695	14.88	59.772	14.86	59.487
HC-0100B	Howell Creek	HC10_PRO	14.85	680.932	16.537	14.86	59.487	14.86	59.362
HC-0110X	Howell Creek	HC10_PRO	14.88	680.958	20.632	14.86	59.362	14.86	59.232
HC-0115X	Howell Creek	HC10_PRO	14.85	688.008	0.197	14.86	59.232	14.87	59.081
HC-0120B	Howell Creek	HC10_PRO	14.86	687.996	-43.477	14.87	59.081	14.88	58.333
HC-0130X	Howell Creek	HC10_PRO	14.86	687.988	5.683	14.88	58.333	14.90	57.764
HC-0135X	Howell Creek	HC10_PRO	14.87	687.965	0.494	14.90	57.764	14.96	57.265
HC-0140B	Howell Creek	HC10_PRO	14.87	687.901	154.980	14.96	57.265	15.94	55.783
HC-0150X	Howell Creek	HC10_PRO	14.87	686.974	-1.677	15.94	55.783	25.25	55.363
HC0040BRd	Howell Creek	HC10_PRO	0.00	0.000	0.000	39.05	62.193	14.07	62.036
HC0070BRd	Howell Creek	HC10_PRO	0.00	0.000	0.000	14.75	60.254	14.84	60.143
HC0085BRd	Howell Creek	HC10_PRO	0.00	0.000	0.000	14.88	59.928	14.85	59.878
HC0100BRd	Howell Creek	HC10_PRO	0.00	0.000	0.000	14.86	59.487	14.86	59.362
HC0120BRd	Howell Creek	HC10_PRO	0.00	0.000	0.000	14.87	59.081	14.88	58.333
HC0140BRd	Howell Creek	HC10_PRO	0.00	0.000	0.000	14.96	57.265	15.94	55.783
HC-0040B	Howell Creek	HC25_PRO	36.80	423.051	0.270	36.80	62.807	13.83	62.480
HC-0062W	Howell Creek	HC25_PRO	13.83	970.581	0.825	13.83	62.480	14.51	61.295
HC-0070B	Howell Creek	HC25_PRO	13.83	969.901	-3.312	14.51	61.295	14.60	61.170
HC-0080X	Howell Creek	HC25_PRO	14.55	973.370	-2.115	14.60	61.170	14.61	61.046
HC-0083X	Howell Creek	HC25_PRO	14.55	971.385	-21.247	14.61	61.046	14.63	60.968
HC-0085B	Howell Creek	HC25_PRO	14.63	1057.959	222.306	14.63	60.968	14.62	60.912
HC-0090X	Howell Creek	HC25_PRO	14.55	971.100	-23.441	14.62	60.912	14.63	60.796
HC-0095X	Howell Creek	HC25_PRO	14.63	972.590	8.811	14.63	60.796	14.62	60.467
HC-0100B	Howell Creek	HC25_PRO	14.61	970.956	17.201	14.62	60.467	14.63	60.337
HC-0110X	Howell Creek	HC25_PRO	14.63	971.071	22.044	14.63	60.337	14.62	60.181
HC-0115X	Howell Creek	HC25_PRO	14.61	980.748	0.353	14.62	60.181	14.63	60.003
HC-0120B	Howell Creek	HC25_PRO	14.61	980.726	-43.328	14.63	60.003	14.64	59.095
HC-0130X	Howell Creek	HC25_PRO	14.62	980.709	5.710	14.64	59.095	14.68	58.299
HC-0135X	Howell Creek	HC25_PRO	14.62	980.643	-0.569	14.68	58.299	14.75	57.826
HC-0140B	Howell Creek	HC25_PRO	14.64	980.475	154.935	14.75	57.826	24.76	56.473
HC-0150X	Howell Creek	HC25_PRO	14.66	978.787	-1.677	24.76	56.473	25.25	56.271
HC0040BRd	Howell Creek	HC25_PRO	0.00	0.000	0.000	36.80	62.807	13.83	62.480
HC0070BRd	Howell Creek	HC25_PRO	0.00	0.000	0.000	14.51	61.295	14.60	61.170
HC0085BRd	Howell Creek	HC25_PRO	0.00	0.000	0.000	14.63	60.968	14.62	60.912
HC0100BRd	Howell Creek	HC25_PRO	0.00	0.000	0.000	14.62	60.467	14.63	60.337
HC0120BRd	Howell Creek	HC25_PRO	0.00	0.000	0.000	14.63	60.003	14.64	59.095
HC0140BRd	Howell Creek	HC25_PRO	0.00	0.000	0.000	14.75	57.826	24.76	56.473
HC-0040B	Howell Creek	HCMN_PRO	40.71	197.784	0.042	14.57	61.592	14.42	61.541
HC-0062W	Howell Creek	HCMN_PRO	14.42	419.175	0.164	14.42	61.541	15.08	59.146
HC-0070B	Howell Creek	HCMN_PRO	14.42	418.933	-3.312	15.08	59.146	15.17	59.052
HC-0080X	Howell Creek	HCMN_PRO	15.11	438.155	-0.642	15.17	59.052	15.17	58.919
HC-0083X	Howell Creek	HCMN_PRO	15.11	437.645	9.660	15.17	58.919	15.20	58.836
HC-0085B	Howell Creek	HCMN_PRO	14.94	506.138	232.650	15.20	58.836	15.19	58.805
HC-0090X	Howell Creek	HCMN_PRO	15.14	437.633	13.160	15.19	58.805	15.20	58.713
HC-0095X	Howell Creek	HCMN_PRO	15.20	437.994	8.546	15.20	58.713	15.20	58.490
HC-0100B	Howell Creek	HCMN_PRO	15.18	437.519	15.369	15.20	58.490	15.20	58.374
HC-0110X	Howell Creek	HCMN_PRO	15.20	437.522	19.959	15.20	58.374	15.20	58.275
HC-0115X	Howell Creek	HCMN_PRO	15.17	442.545	-0.157	15.20	58.275	15.20	58.127
HC-0120B	Howell Creek	HCMN_PRO	15.19	442.536	-43.672	15.20	58.127	15.22	57.523
HC-0130X	Howell Creek	HCMN_PRO	15.19	442.530	5.702	15.22	57.523	15.24	57.143
HC-0135X	Howell Creek	HCMN_PRO	15.20	442.515	0.491	15.24	57.143	15.31	56.670
HC-0140B	Howell Creek	HCMN_PRO	15.20	442.475	155.011	15.31	56.670	15.94	55.340
HC-0150X	Howell Creek	HCMN_PRO	15.26	441.880	-1.677	15.94	55.340	24.50	54.484
HC0040BRd	Howell Creek	HCMN_PRO	0.00	0.000	0.000	14.57	61.592	14.42	61.541
HC0070BRd	Howell Creek	HCMN_PRO	0.00	0.000	0.000	15.08	59.146	15.17	59.052
HC0085BRd	Howell Creek	HCMN_PRO	0.00	0.000	0.000	15.20	58.836	15.19	58.805
HC0100BRd	Howell Creek	HCMN_PRO	0.00	0.000	0.000	15.20	58.490	15.20	58.374

Link Min/Max Report

Name	Group	Simulation	Max Time Flow hrs	Max Flow cfs	Max Delta Q cfs	Max Time US Stage hrs	Max US Stage ft	Max Time DS Stage hrs	Max DS Stage ft
HC0120BRd	Howell Creek	HCMN_PRO	0.00	0.000	0.000	15.20	58.127	15.22	57.523
HC0140BRd	Howell Creek	HCMN_PRO	0.00	0.000	0.000	15.31	56.670	15.94	55.340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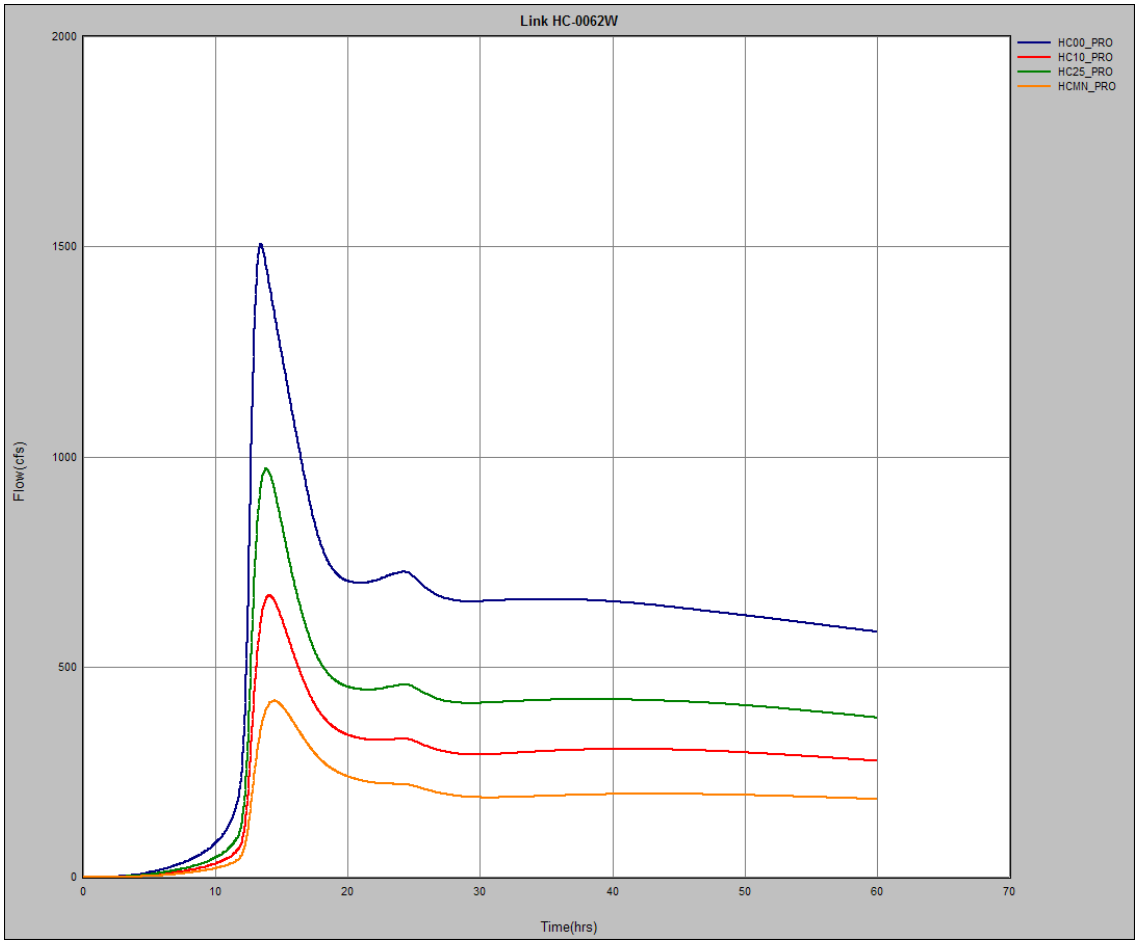
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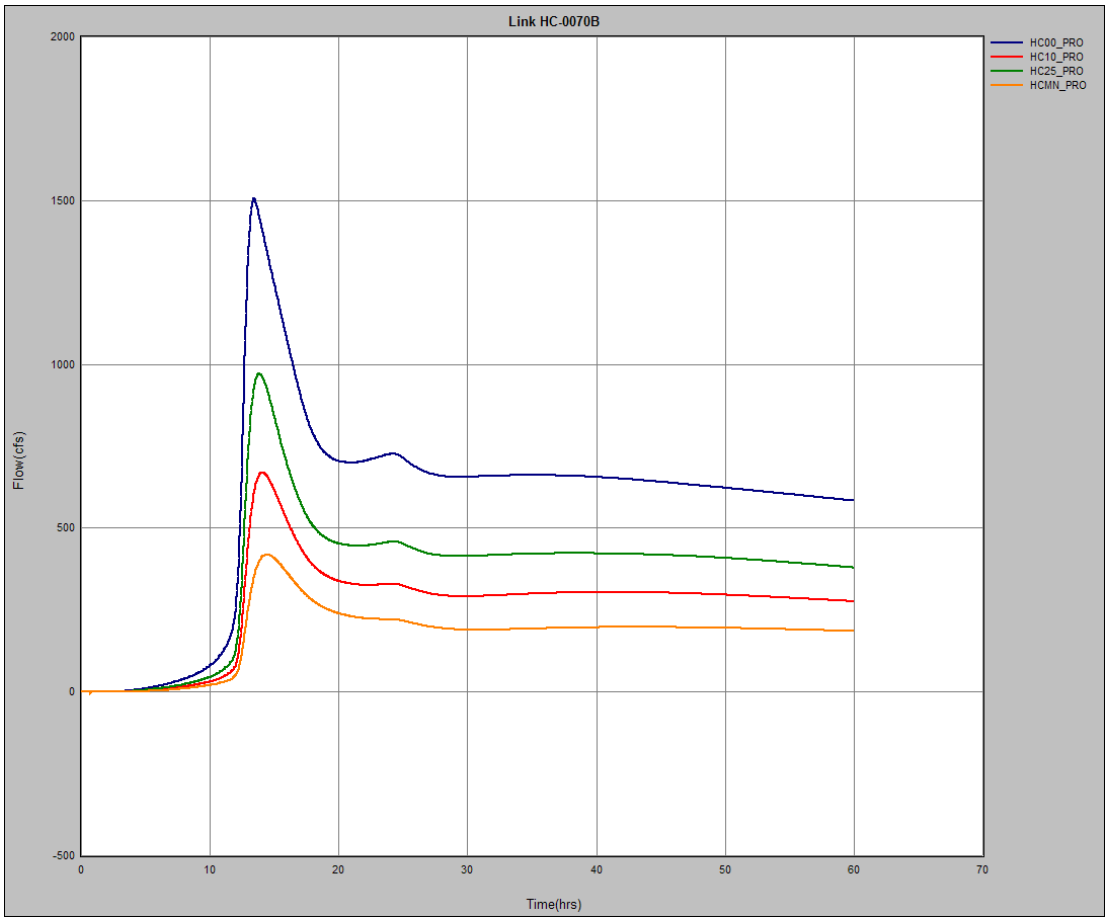
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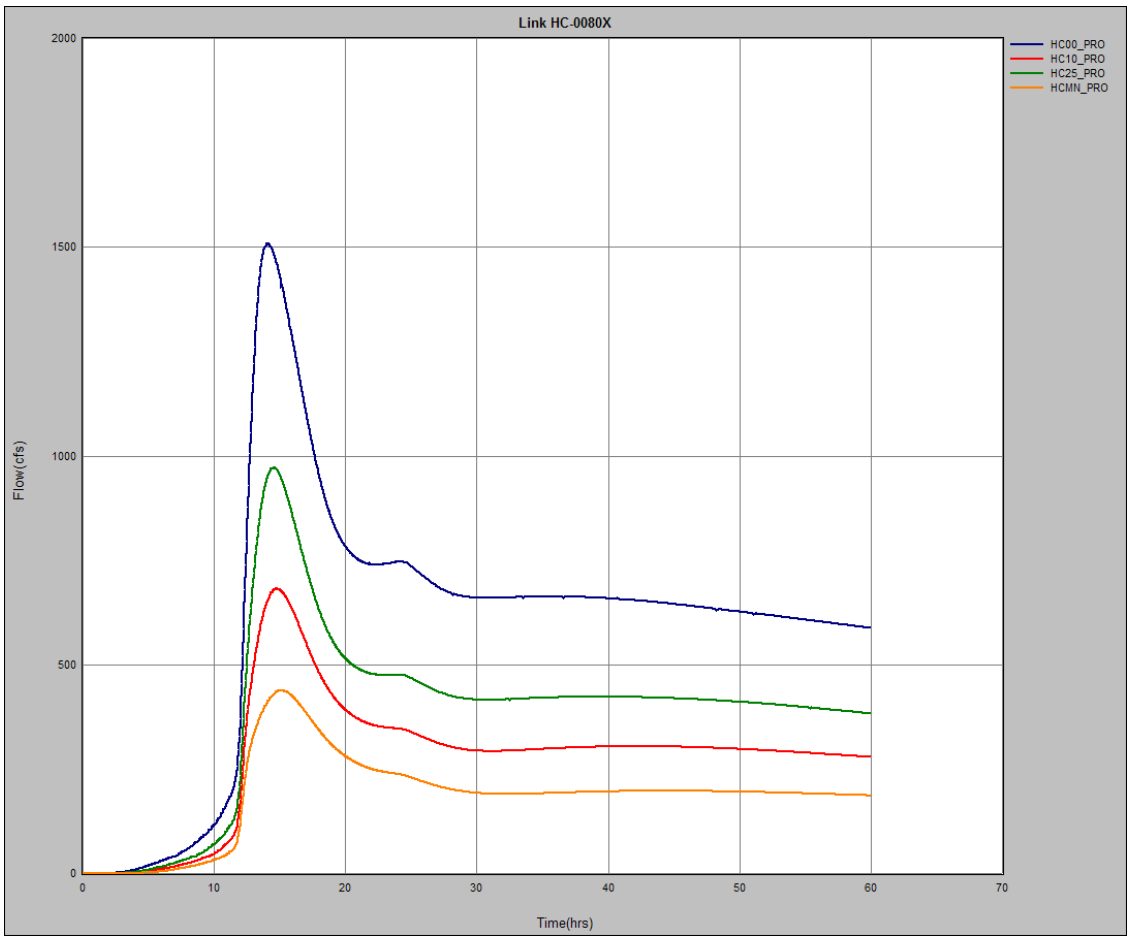
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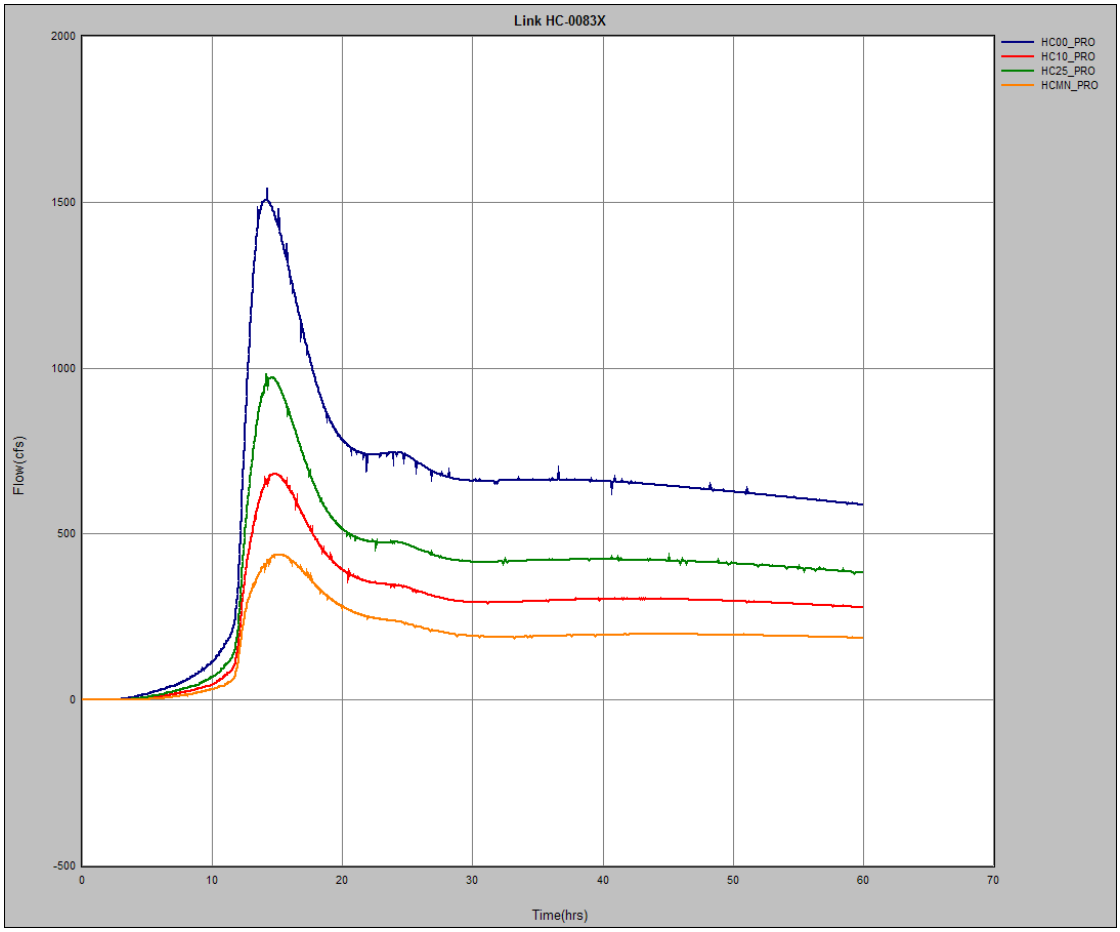
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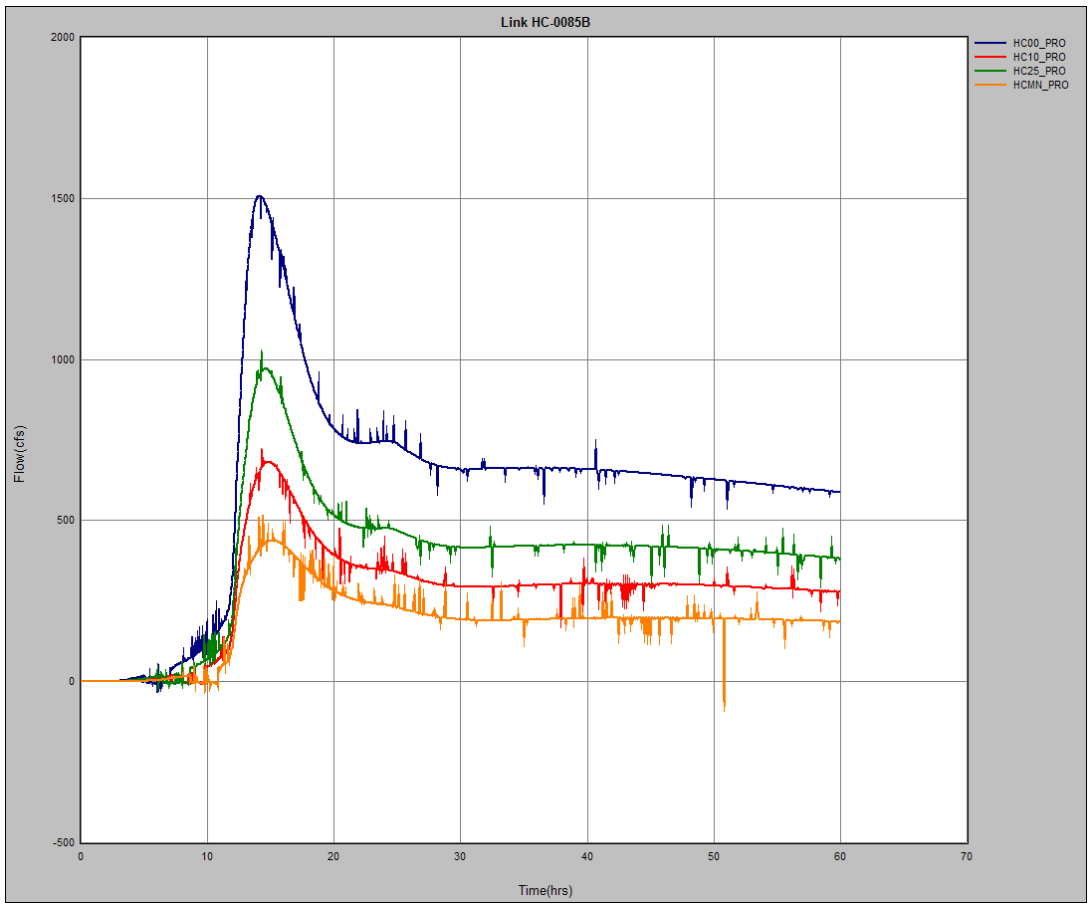
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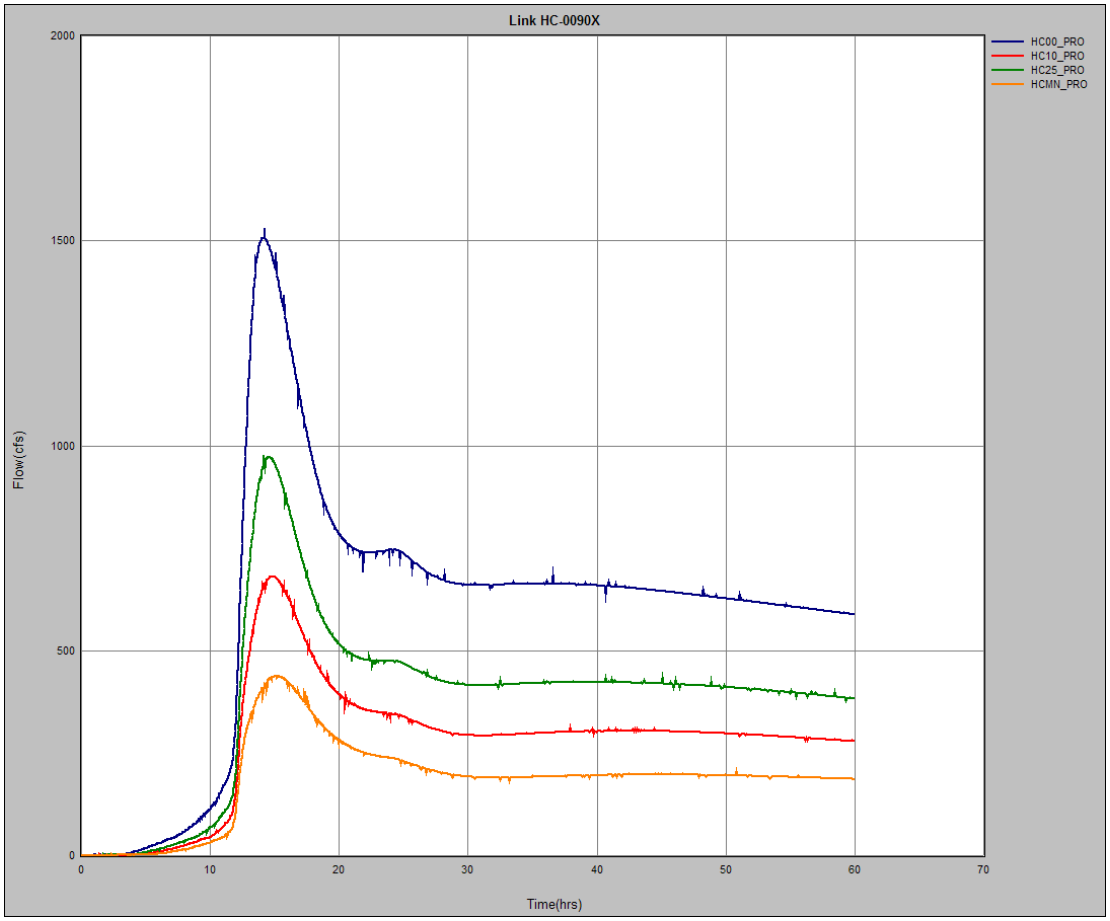
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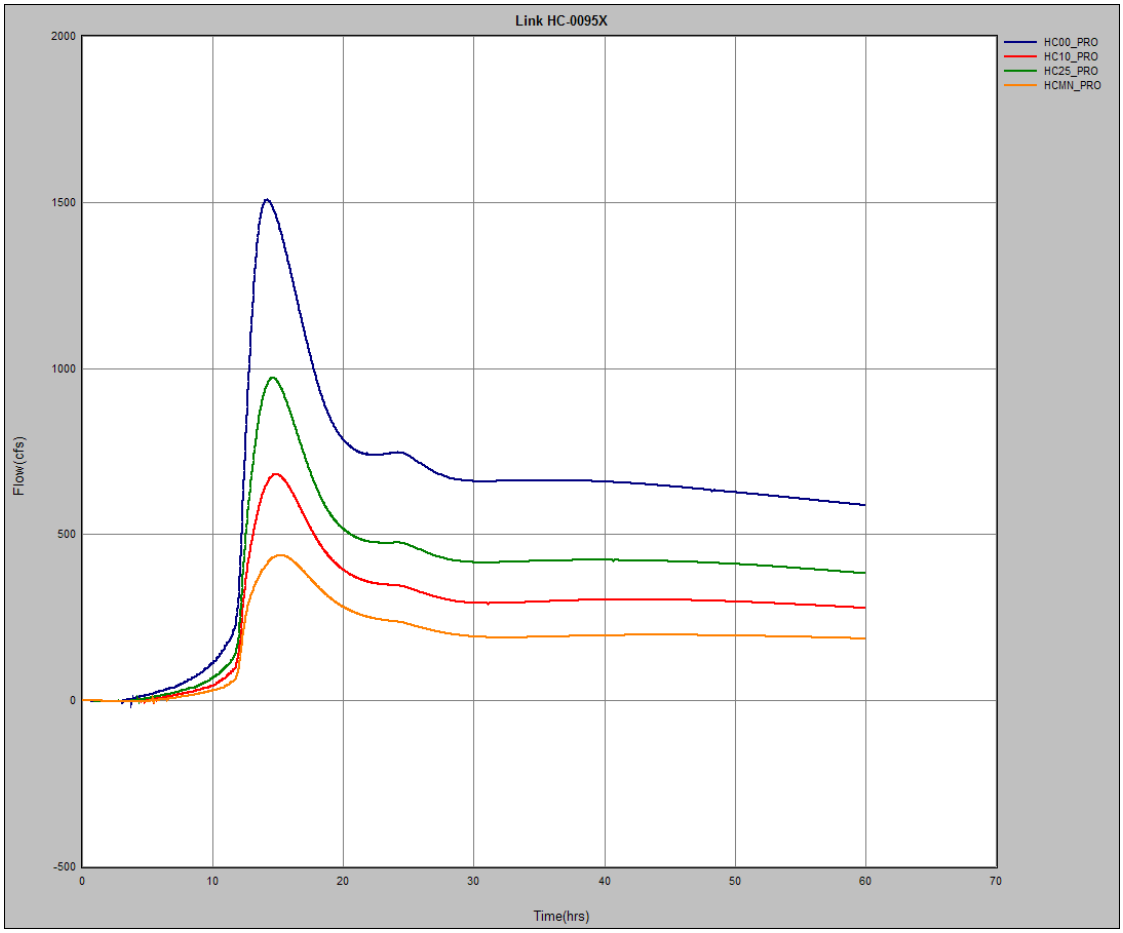
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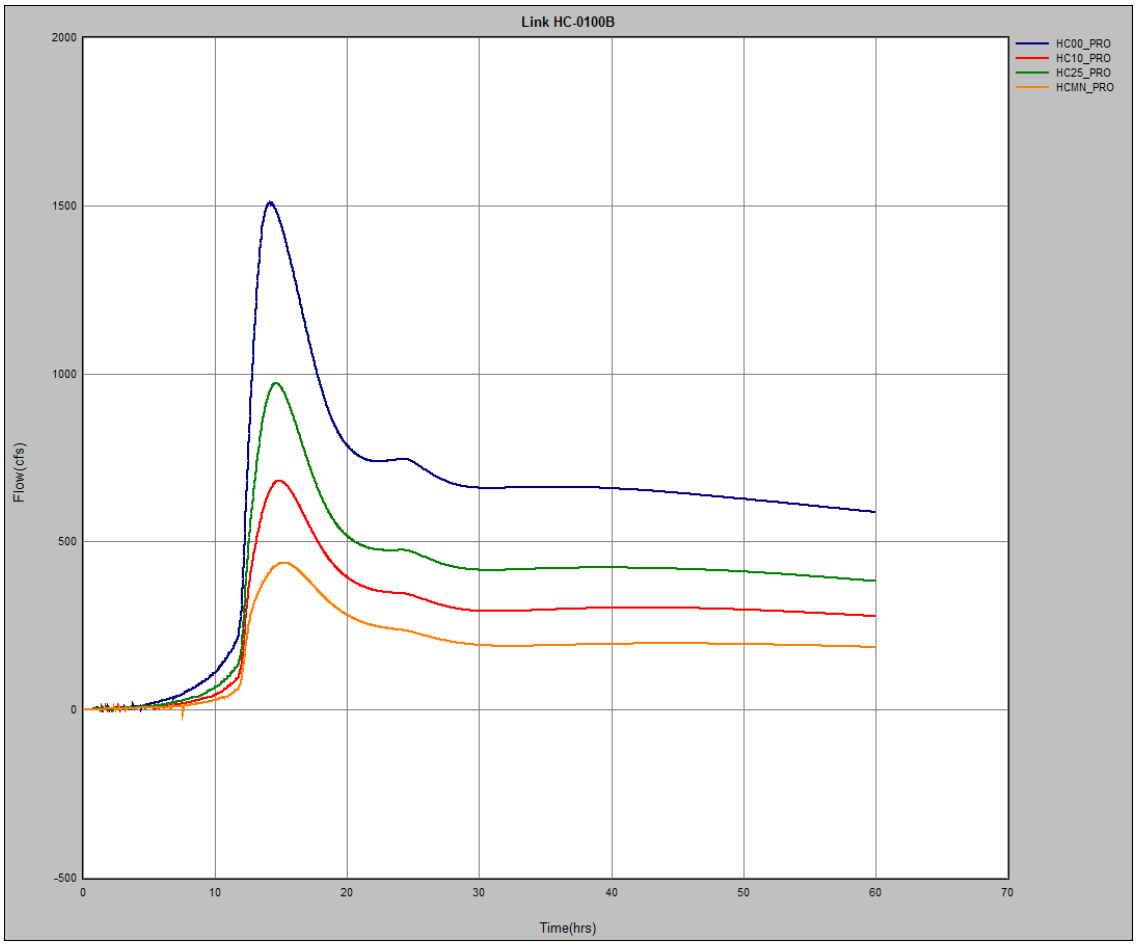
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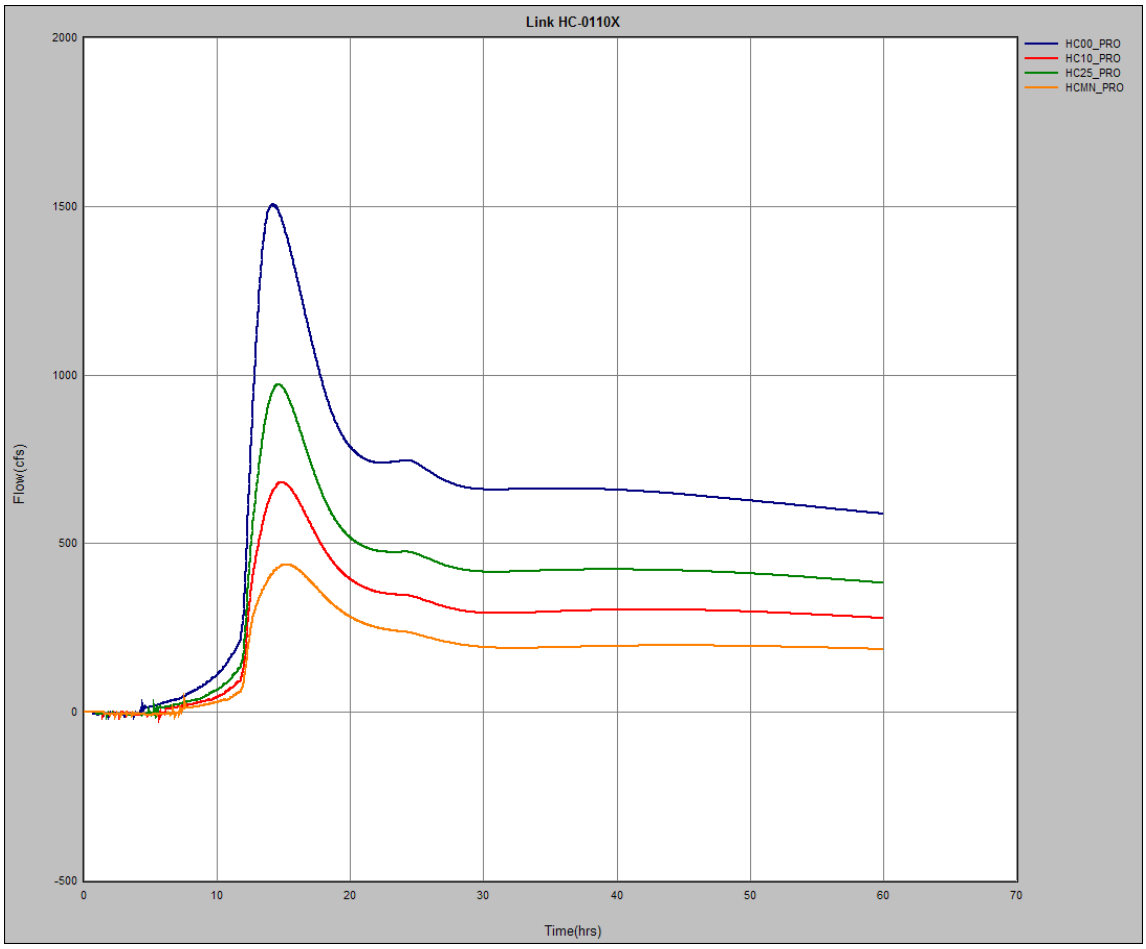
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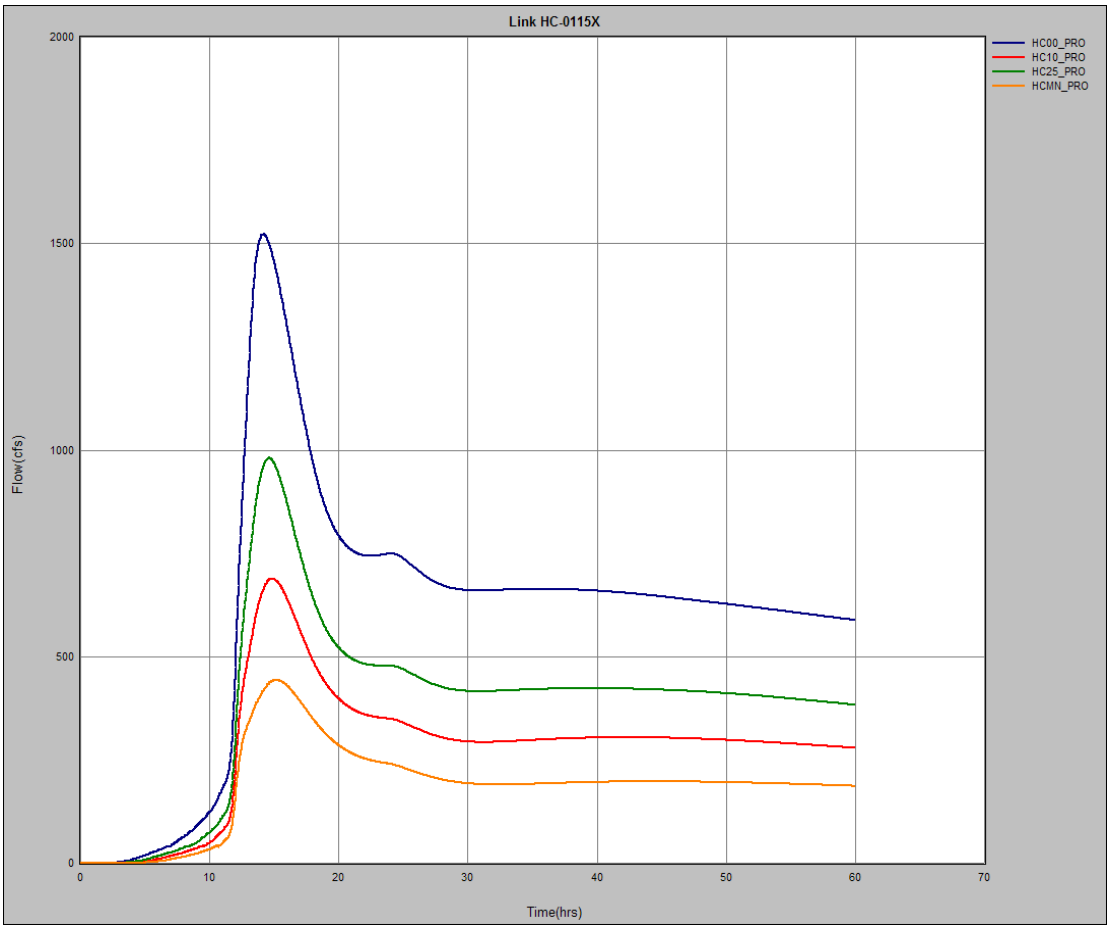
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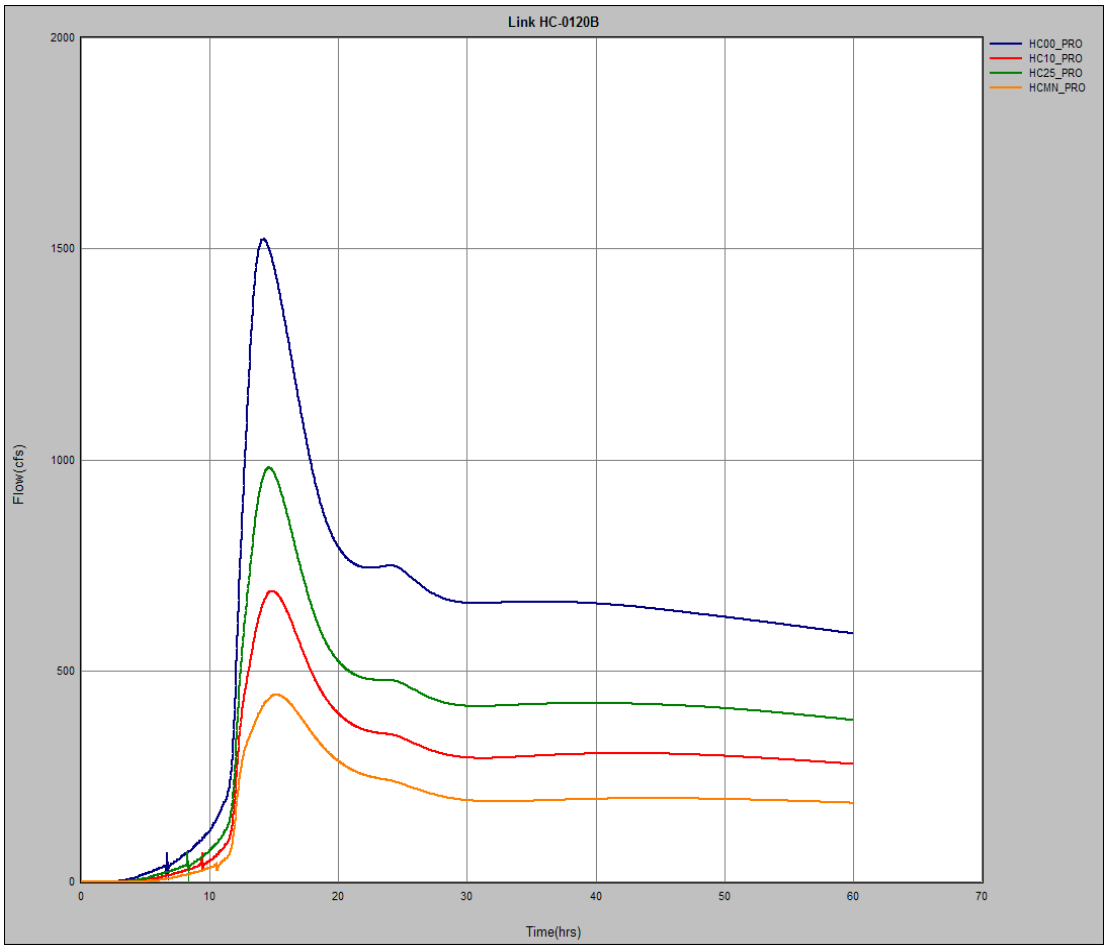
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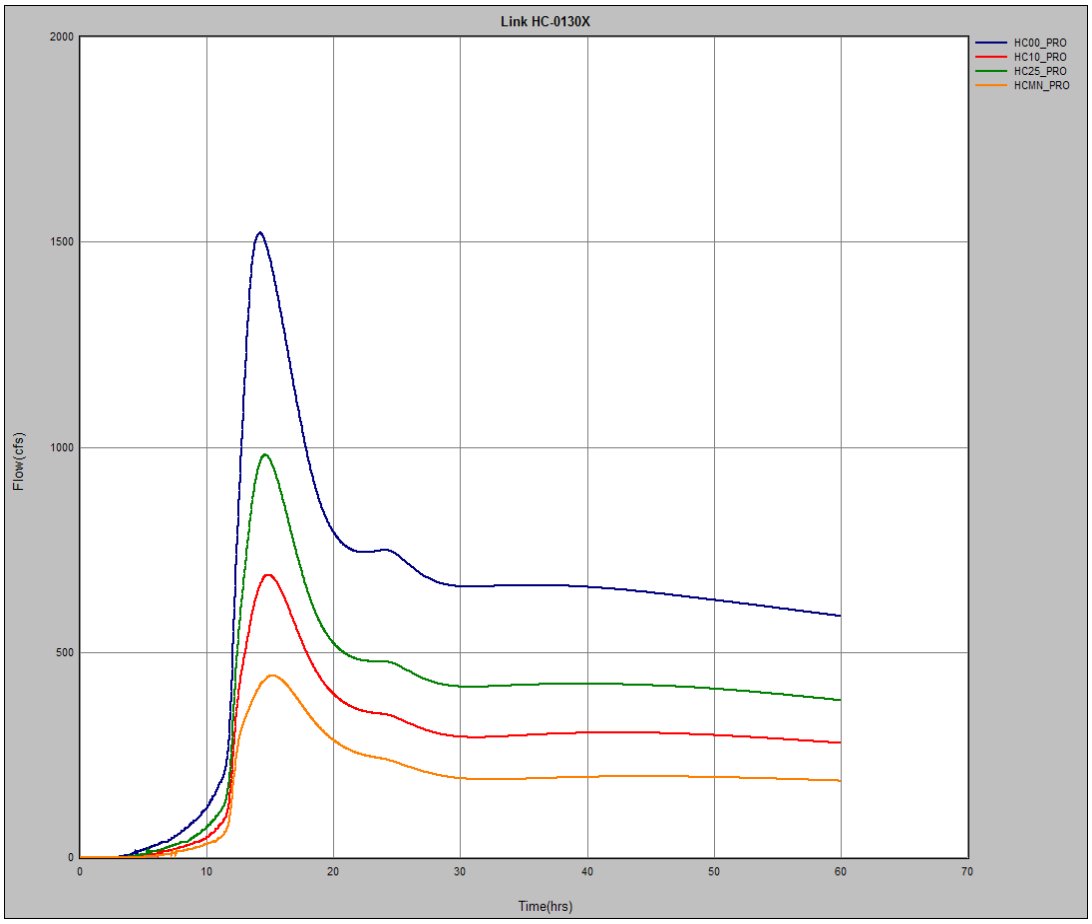
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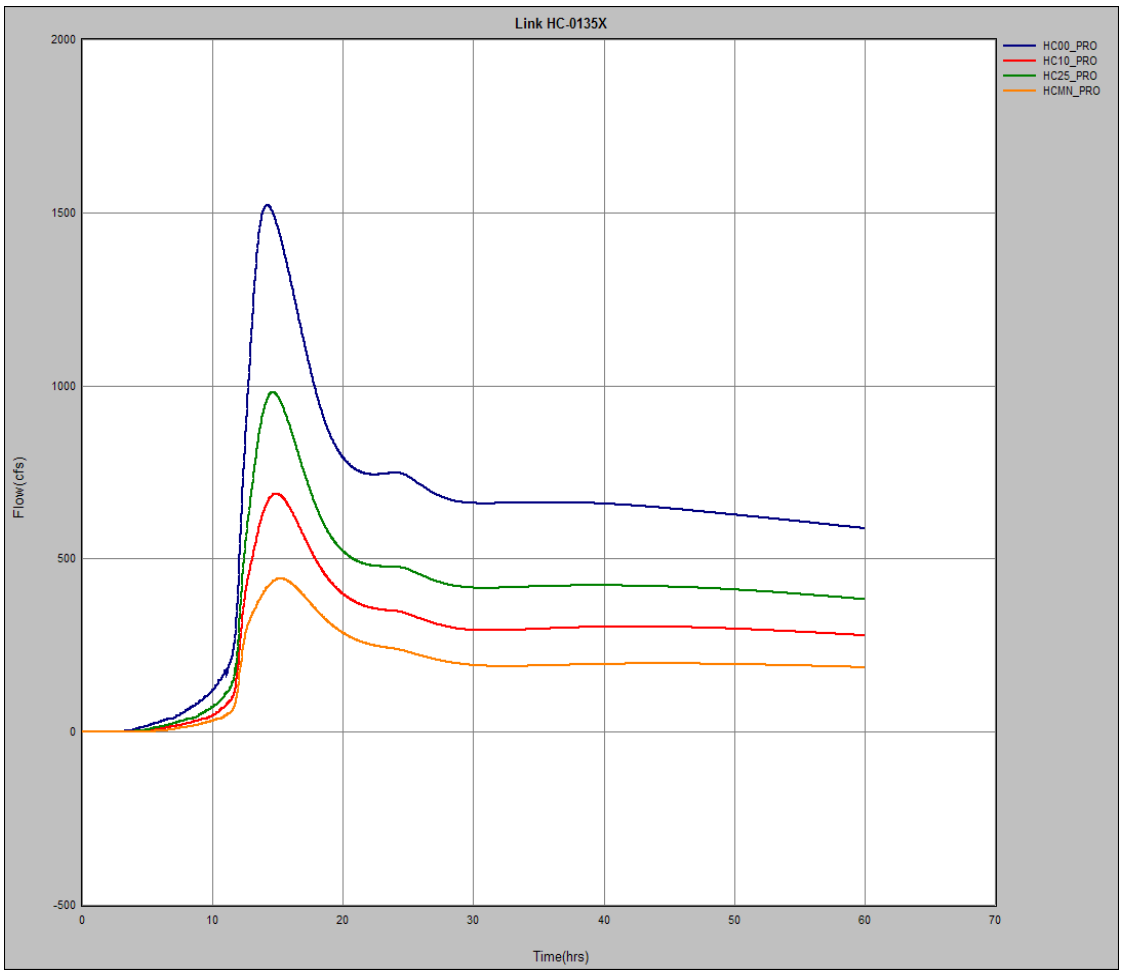
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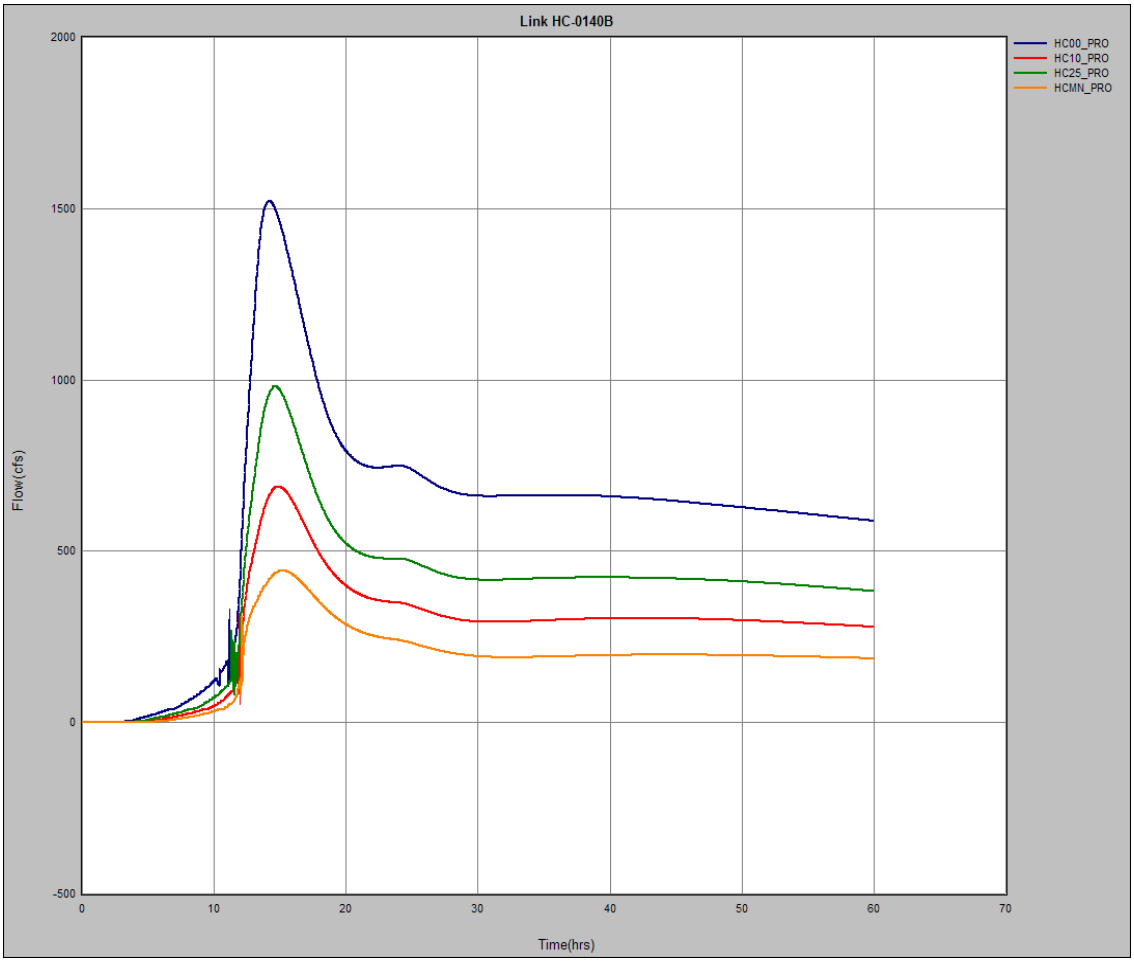
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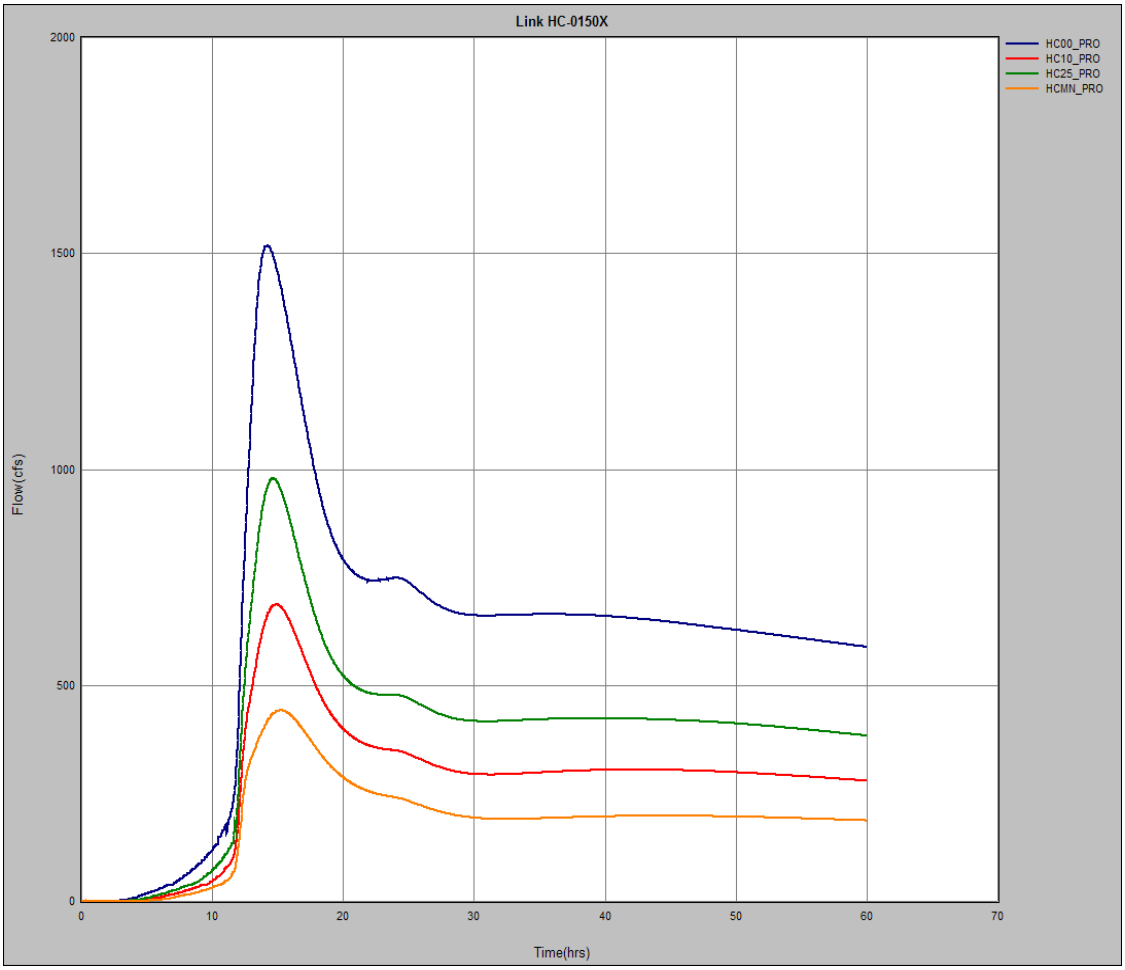
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Appendix F
SJRWMD Permit Determination Meeting Minutes

M E E T I N G M I N U T E S

DATE: January 29, 2010 (Meeting Date: January 28, 2010)

TO: Roland Raymundo, PE, CFM – Principle Engineer
Seminole County Public Works Engineering Division

FROM: Mark Ellard, P.E., Steve Sommerfeldt, P.E. – Inwood Consulting Engineers

RE: **Howell Creek Improvements Project**
Howell Creek Road to Howell Lane to SR 436
SJRWMD Permit Determination Meeting

ATTENDEES: Margie Cook, Richard Lee, Victoria Nations, Monica Sovacool, Tonya Guadalupe – St. Johns River Water Management District (SJRWMD)
Robert Walter, Roland Raymundo – Seminole County (County)
Mark Ellard, Steve Sommerfeldt – Inwood Consulting Engineers (Inwood)

- Brief project background and site characteristics:
  - Problems with erosion, trash / debris
  - Flat grades / low velocities
  - Steep side slopes
  - Creek surrounded by mostly built-out urbanized areas
- Is Creek considered as Sovereign Submerged Lands (SSL) by FDEP?
  - Most likely because the project area (Howell Creek Water Control Structure) upstream of this project was determined by FDEP to be SSL.
  - SJRWMD suggests that this be determined prior to permit application.
  - If Creek is considered SSL then project would be held to more stringent permitting thresholds.
  - Inwood / County is going to submit SSL Determination letter to FDEP.
  - If determined to be SSL then the "Ordinary High" water level will need to be determined. SJRWMD stated that FDEP (contact Richard Malloy) usually can provide this information.
  - What type of work falls under Letter of Consent vs. Easement? SJRWMD – Refer to thresholds in rule books.
- Debris Removal (throughout corridor):
  - No permit necessary to remove trash within creek as long as surrounding vegetation isn't destroyed.

  - Uprooting of living vegetation or moving soil would need to be evaluated on whether or not a permit would be necessary.
  - No permit necessary to cut out dead limbs but would need to leave larger trunks / stumps that would provide a healthy habitat. It's a fine balance that should be evaluated on a case-by-case basis.
  - Removing a large stump could require a dredge and fill permit.
  - Possibly schedule a field trip / visit with SJRWMD Staff to get clearer direction on debris removal.
- Structural Rehabilitation (throughout corridor):
  - Look at rule 40C-4.041 for thresholds associated with structural rehabilitation.
  - Are there any limitations to separate smaller projects accumulating above threshold limits? Yes, review rules.
  - Exemptions may be issued for improvements less than 20' into a wetland from the end of a pipe / structure.
- Bank Stabilization(several locations throughout the corridor):
  - Any type of structural bank stabilization or works that would require regrading would most likely require a permit and SSL authorization.
  - Bank stabilization less than 1 acre would most likely be a staff issued permit.
  - The previously permitted water control structure was an individual permit because it was a control structure that impounded a large upstream area. Bank stabilization is a conveyance related issue relative to a specific location that normally doesn't require an individual permit.
  - SJRWMD would require that calculations be submitted that demonstrate Pre vs. Post conditions (u/s and d/s stages, creek capacity, velocities, etc.) are equivalent or better with no significant impacts.
- General Permit Discussion:
  - All improvements could be bundled into one permit and then implemented individually as funding becomes available.
  - Issued permits have a 5-year shelf life. After 5-years, a permit extension would need to be filed for if the improvements were to go to construction.
  - Surface water impacts would be considered from Top of Bank to Top of Bank.

This memo reflects the author's interpretation of information presented and discussed during the meeting, and may not address every item covered. If any other parties involved in the meeting have any additional pertinent comments of information to add to this meeting record, please provide it to the full attendees list. Questions on this record can be directed towards Mark Ellard of Inwood Consulting Engineers, Inc. 407-971-8850 or mellard@inwoodinc.com.

Exhibits

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

Howell Creek Assessment

EXHIBIT 1

INFRASTRUCTURE MAP

Lake Howell Road to SR 436

Inwood consulting engineers

LEGEND

- HOWELL CREEK
- STRUCTURES
- Howell Creek Water Control Structure
- BRIDGES
- CHANNELS
- PIPES
- EXFILTRATION AREA
- PONDS
- PARCELS

CONTRIBUTING AREAS

- NORTH
- SOUTH

N

0 120 240 Feet

DATA SOURCES:
DRAINAGE INFRASTRUCTURE:
SEMINOLE COUNTY PLANS,SJRWMD PERMITS AND FIELD OBSERVATION
AERIALS: SEMINOLE COUNTY,2008
PARCELS:SEMINOLE COUNTY,2008
STREETS:SEMINOLE COUNTY,2008

NEWPORT COLONY POND
NEWPORT COLONY APARTMENTS
MARBEYA CLUB CONDO
CALLE DEL REY
7-ELEVEN JUNCTION
LAKE HOWELL SQUARE MEDICAL CENTER
DERBYSHIRE PARK
DERBYSHIRE RD
INTERLACHEN CORPORATE CENTER
CARMEL BY THE LAKE POND
CARMEL BY THE LAKE CONDOMINIUM
CARMEL DR
LAKE HOWELL
WAL-MART POND
PEOPLES FIRST COMMUNITY BANK
FOREST BROOK SEC 5
FOREST GLEN CT
BROOKSIDE CT
WAL-MART SUPERCENTER
SR 436
HARBOR POND
FOREST BROOK SEC 3
GREEN MEADOW AVE
LAKE HOWELL RD
CALICO JACKS
LAKE VISTA CT
HARBOR AT LAKE HOWELL
VININGS LN
GROW WAY
LAKE HOWELL SQUARE
FOREST BROOK
TUSCARORA TRL
BROOKWOOD LN
MCDONALD'S
LAKE HOWELL SQUARE POND
LAKE HOWELL LN
HOWELL CREEK WATER CONTROL STRUCTURE
FORMER DAM STRUCTURE
GREEN MEADOW CT
BROOKSIDE CIR
SIERRA CONDO POND
SIERRA CONDO PH 1
LAKE HOWELL FAMILY MEDICINE ASSOCIATES
TROPICAL POOLS AND SPA
SIMONIZ CARWASH
RUBY CT
LAKE HOWELL BIBLE CHAPEL
SIMONIZ POND
ROOMS TO GO
EMERALD LAKE CV
WATERSEDGE LN
FOREST BROOK SEC 2
SIERRA CONDO POND
SIERRA CONDO PH 2
SIERRA LN
OPAL TERRACE
PUBLIC STORAGE
REFLECTIONS
ULTRA VISTA CONDO
PARK MAITLAND VILLAS POND
GREENRIDGE LN
PARK MAITLAND CT
LEGENDS PLACE
KENASTON RD
SENECA MEADOWS WAY
PARK MAITLAND VILLAS
ROCKLEDGE GROVE LN
PARK MAITLAND VILLAS POND
LEGENDS COMMONS
REFLECTIONS CIR
ULTRA VISTA DR
BRITTANY GARDENS
MARSHALL RD
WACHOVIA
ST. PAUL EXECUTIVE CENTER
BRITTANY GARDENS POND
PENNY LN
QUEEN MARY PL
WATER LN
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BRANCH TREE POND
MEADOW AVE
POPLAR CT
ASH CIR
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BIRCHWOOD LANDINGS
SPRUCE CT
LAKE HOWELL ROAD POND
MODAC TRL
WAUMPUM TRL
GILRUS LN
FLEMING WAY
PUBLIX
FIX
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COAWOOD CT
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LAKE HOWELL PLAZA

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

Howell Creek Assessment

EXHIBIT 2
FIELD ASSESSEMENT MAP

Lake Howell Road to SR 436

Inwood consulting engineers

LEGEND

- STRUCTURES
- WATER CONTROL STRUCTURE
- BRIDGES
- CHANNELS
- PIPES
- EXFILTRATION AREA
- PONDS
- HOWELL CREEK
- PARCELS

N

0 60 120 Feet

DATA SOURCES:
PHOTOS: FIELD REVIEWS, APR 29, MAY 15 & AUG 20, 2009
DRAINAGE INFRASTRUCTURE:
SEMINOLE COUNTY PLANS,SJRWMD PERMITS AND FIELD OBSERVATION
PARCELS: SEMINOLE COUNTY, 2008
STREETS: SEMINOLE COUNTY, 2008
AERIALS: SEMINOLE COUNTY, 2008

INTERLACHEN CORPORATE CENTER

OUTFALL PIPE

VIEW FROM THE TOP OF THE BRIDGE

CARMEL BY THE LAKE

VIEW UPSTREAM TO THE SOUTHWEST

OUTFALL PIPE

VIEW UPSTREAM TO THE SOUTHWEST

VIEW DOWNSTREAM TO THE NORTHEAST

SR 436

VIEW UPSTREAM TO THE SOUTHWEST

OUTFALL PIPE

VIEW UPSTREAM TO THE SOUTHWEST

VIEW DOWNSTREAM TO THE NORTHEAST

OUTFALL PIPE

WAL-MART SUPERCENTER

VIEW UPSTREAM TO THE SOUTHWEST

OUTFALL PIPE

VIEW DOWNSTREAM TO THE NORTHEAST

WATER TRANSMISSION AUTHORITY

VIEW UPSTREAM TO THE SOUTHWEST

VIEW FROM THE TOP OF THE BRIDGE

FOREST BROOK

LAKE HOWELL RD

VIEW UPSTREAM TO THE SOUTHWEST

HABANEROS

VIEW DOWNSTREAM TO THE NORTHEAST

VIEW UPSTREAM TO THE SOUTHWEST

VIEW UPSTREAM TO THE SOUTHWEST

LAKE HOWELL SQUARE

HARBOR AT LAKE HOWELL

VIEW UPSTREAM TO THE SOUTHWEST

TUSCARORA TRL

VIEW FROM THE TOP OF THE BRIDGE

VIEW FROM THE TOP OF THE BRIDGE

VIEW DOWNSTREAM TO THE NORTHEAST

MCDONALDS

VIEW OF OUTFALL PIPE UNDER BRIDGE

WATER CONTROL STRUCTURE (DAM) (CURRENTLY UNDER RE-CONSTRUCTION)

LAKE HOWELL LN

VIEW DOWNSTREAM TO THE NORTHEAST

LAKE HOWELL FAMILY MEDICINE ASSOCIATES

RUBY CT

TROPICAL POOLS AND SPA

SUPERWASH CARWASH

VIEW DOWNSTREAM TO THE NORTHEAST

LAKE HOWELL BIBLE CHAPEL

SIERRA CONDO

VIEW DOWNSTREAM TO THE NORTHEAST

USGS STAFF GUAGE

OUTFALL PIPE

PUBLIC STORAGE

OPAL TERRACE

VIEW DOWNSTREAM TO THE NORTHEAST

ULTRA VISTA CONDO

VIEW FROM THE TOP OF THE BRIDGE

PARK MAITLAND VILLAS

LEGENDS PLACE

VIEW OF OUTFALL PIPE UNDER BRIDGE

FORMER DAM STRUCTURE (VIEW UPSTREAM FROM SOUTH BANK)

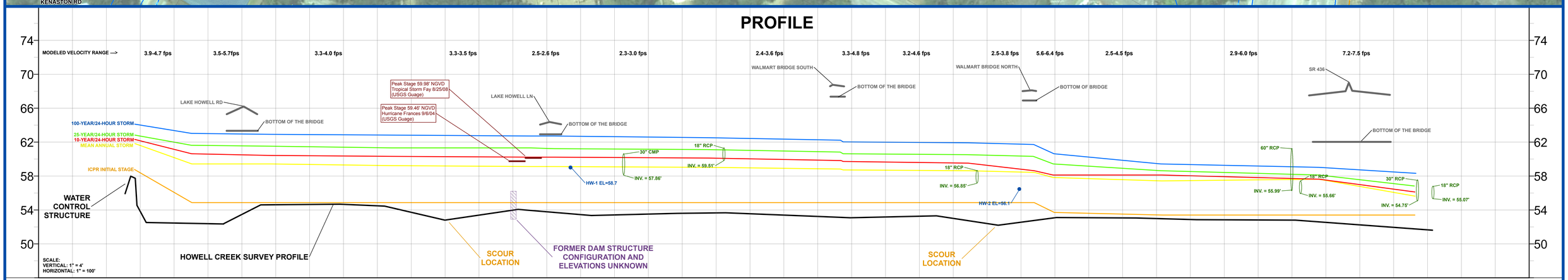
VIEW OF UNKNOWN STRUCTURE FAILURE ON SOUTH BANK

LEGENDS COMMONS

BRANCH TREE

WACHOVIA

PROFILE



CROSS SECTIONS

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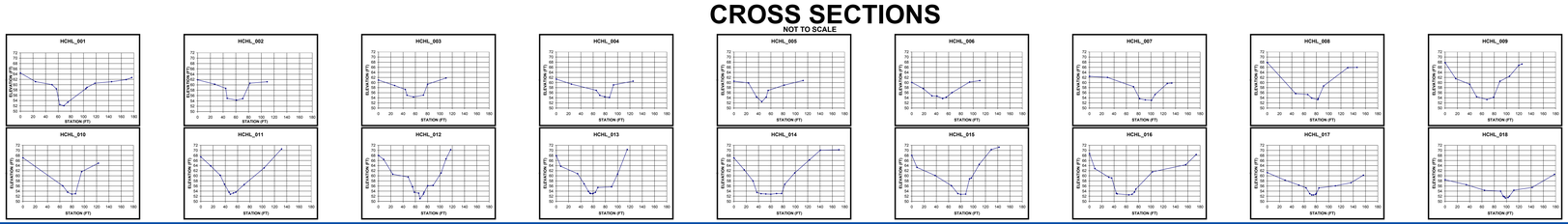

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PARCELS: SEMINOLE COUNTY,2008
AERIALS:SEMINOLE COUNTY,2008

NOTES:
Design storm stage profile and velocity results interpreted from results of CDM modeling for the project, July 2009.
Velocity results represent range of model results for all design storms for given channel reach (link).

SEMINOLE COUNTY
FLORIDA'S NATURAL CHOICE

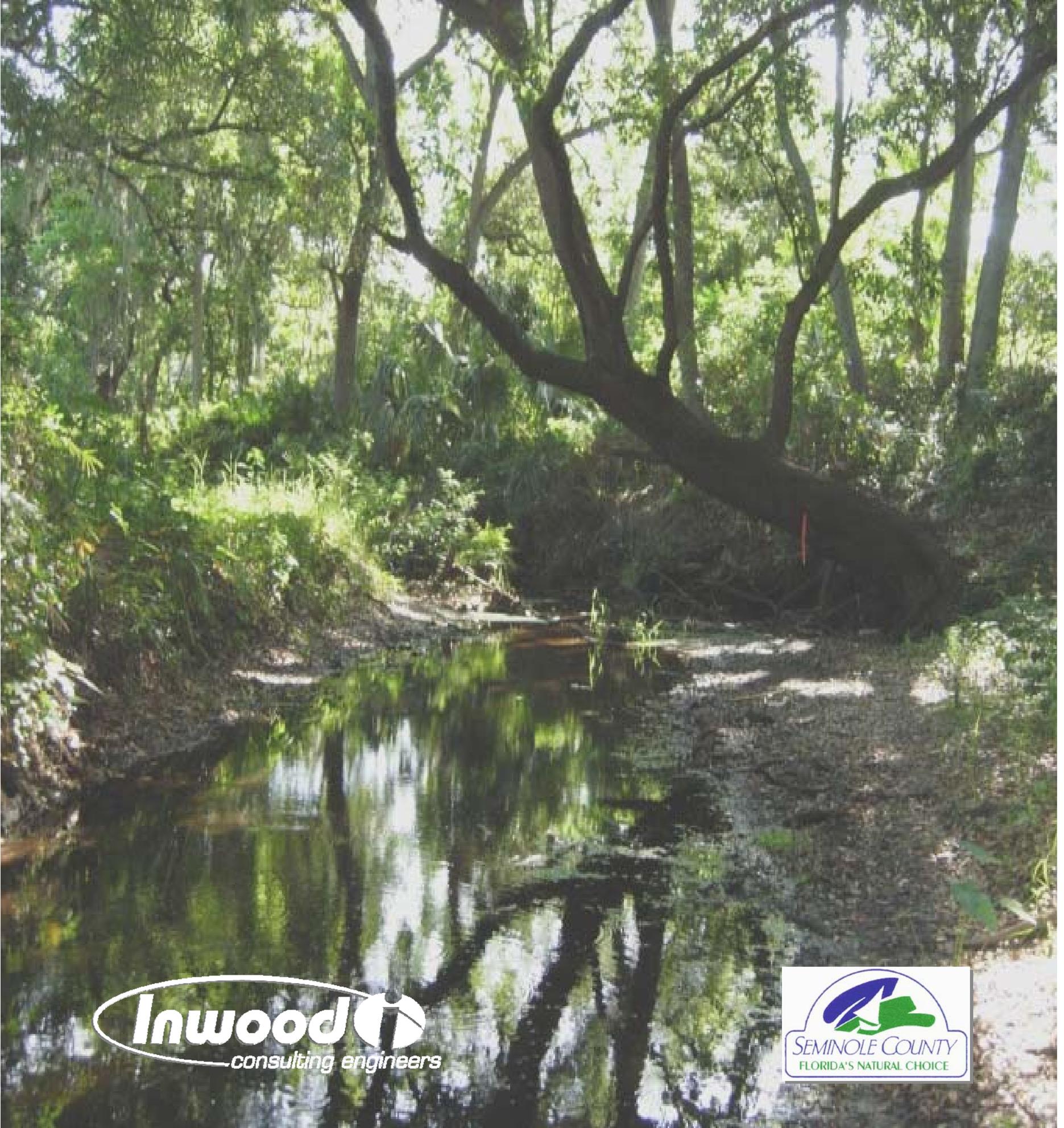
Howell Creek Assessment

Lake Howell Road to SR 436

0 50 100 Feet

Inwood consulting engineers

EXHIBIT 3
HOWELL CREEK PROFILE
LAKE HOWELL ROAD TO SR 436
PLAN / PROFILE / CROSS SECTION MAP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