DRAINAGE STUDY REPORT
WILLBROOK PLANTATION

June 15th, 2022

Submitted to:

Willbrook Plantation

Table of Contents

Executive Summary

The purpose of this study is to evaluate the existing storm drainage system and tributary drainage patterns of the Willbrook Plantation located on Pawleys Island, South Carolina. As a result, the existing conditions analysis, proposed improvement recommendations were developed to alleviate the issues at each of the study areas.

A field evaluation was performed by JMT staff with residents of the community on August 4th, 2021 to confirm the observed drainage issues and establish topographic survey limits. Once topographic survey was recorded, the JMT team utilized observations and survey data to develop a hydrologic and hydraulic (H/H) model using Hydraflow Storm Sewers. Six areas of concern were analyzed for storm drain conveyance capacity and nearby surface ponding. The H/H model existing conditions output was utilized to confirm the field observations and develop proposed improvement recommendations in all the areas of concern as outlined below:

- System 1 – Heston Point Drive near the Kings River Road Entrance
    - Addition of check valve to outfall
    - Increase pipe size and adjust pipe slope
- System 2 – Oatland Lake Drive and Sandy Meadow Loop
    - Addition of check valve to outfall
    - Additional catch basin
- System 3 – Chapman Loop and Heston Point Drive
    - Replace or improve outfall condition
    - Addition of check valve to outfall
    - Additional catch basin
- System 4 – Chapman Loop and Flat Boat Landing
    - Replace or improve outfall condition
    - Additional catch basins
- System 5 – Tidewater Drive
    - Replace or improve outfall condition
    - Additional catch basin
- Area 6 – Western end of Heston Point Drive
    - Regrading of vegetated ditch

Information Sources

To start the investigation process, JMT reviewed a wide array of information sources. A survey was conducted of visible and accessible stormwater infrastructure, as well as immediate surrounding topography at six key locations within the neighborhood. This effort provided invert elevations, manhole rim and inlet grate elevations, sizes of the existing stormwater pipes, and surrounding roadway grade elevations. However, some of the storm drain information was limited due to buried junction boxes, sealed manhole covers, and submerged outfall pipes. The JMT team was able to utilize existing one-foot LiDAR contours provided by the South Carolina Department of Natural Resources (DNR) GIS database to supplement the topographic survey. The GIS was imported into AutoCAD Civil3D (CAD) to create a base map for the investigation and an aerial image was added to the model to aid in the determination of land covers.

The JMT team performed a site visit on August 4th, 2021 with residents of the community to take photos of the areas of concern and confirm drainage patterns for the development of the hydraulic model. The site visit helped to provide a more complete understanding of the existing stormwater drainage systems and more accurately model the stormwater conveyance and flooding situation in the area.

Hydrologic and Hydraulic (H/H) Model

Once the surveyed information is processed and replicated in CAD, the stormwater drainage systems are exported to Hydraflow for analysis. To calculate the stormwater runoff, drainage areas were delineated and assigned to ‘nodes’ in the model. Each node represents an inlet or manhole structure. The drainage areas were delineated using surface contours, GIS information, aerial imagery, and field observations. In accordance with standard design practices, the Rational Method was used for calculating and characterizing the stormwater runoff in the models. To determine an intensity value for the Rational Equation, a time of concentration was computed for each drainage area using the velocity method outlined in the NRCS TR-55 Manual. Rainfall intensity IDF curves were developed utilizing the rainfall intensity equation and Georgetown County coefficients provided by the South Carolina Department of Transportation (SCDOT). Rational ‘C’ coefficients used in the model were taken from the SCDOT Requirements for Hydraulic Design Studies Manual.

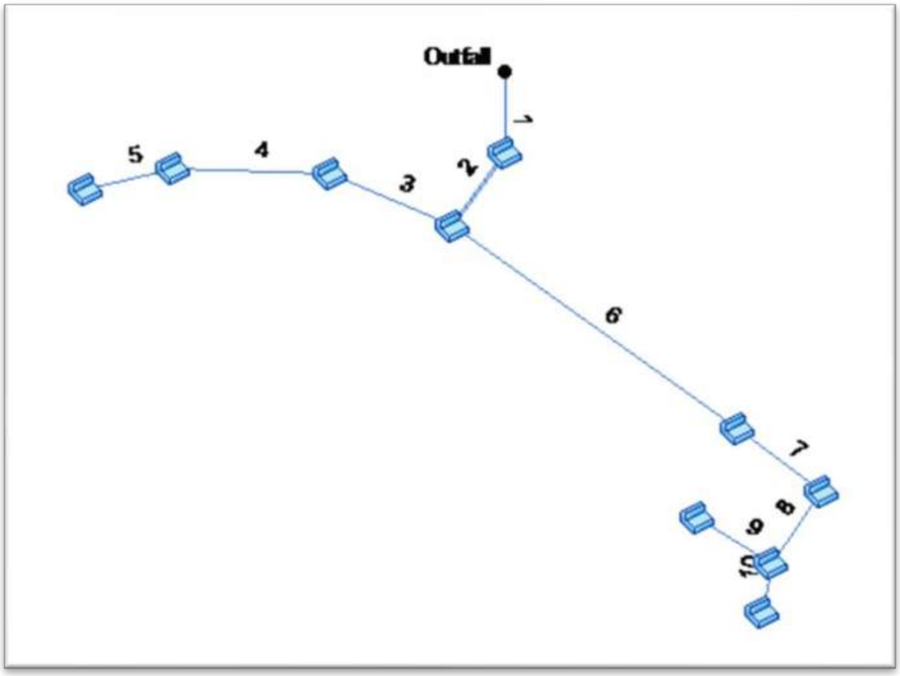


Figure 1: System 1 Hydraflow Node Layout

The Hydraflow model, utilizing the delineated drainage areas, calculates a stormwater discharge quantity in cubic feet per second, which is then routed to the node to which the drainage area is assigned. The node conveys the flow into the pipe system, where it is then routed to the systems outfall point. Modeling the stormwater drainage systems in this fashion allows Hydraflow to determine the pipe capacities in the system and develop the hydraulic grade line (HGL) at each node. When the HGL elevation is higher than the rim or grate elevation of the structure, the structure is inundated, and flooding will begin to appear around the structure.

Existing Conditions Analysis & Recommendations

Six areas of concern were noted during the field visit. For the purposes of this study, the areas of concern were grouped by their respective stormwater drainage system and are outlined below. Each recommendation is not limited and may be utilized in conjunction with one another.

SYSTEM 1

Located near the Kings River Road entrance to Willbrook Plantation, System 1 collects the stormwater runoff from the eastern intersections of Chapman Loop and Oatland Lake Drive to Heston Point Drive, as well as from yard drains on the adjacent golf course to the south. Runoff collected from the eastern and western areas of the Chapman Loop intersection is conveyed to the Chapman Loop intersection where it is combined and presumed to ultimately discharge to an existing pond to the north between Chapman Loop and Oatland Lake Drive.

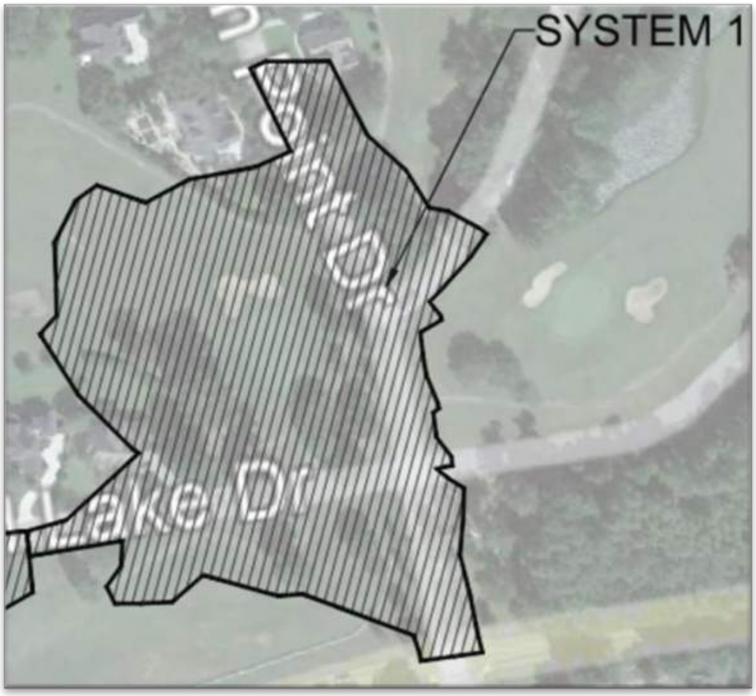


Figure 2: System 1 Location

Recommendations –

1) <u>Addition of Check Valve to the Outfalls</u>

Figure 3: In-line check valve by Tideflex Technologies

The pipe outfalls for Systems 1 were unable to be located. For modeling purposes, these outfalls were assumed to outfall directly to the nearby ponds. This assumption produced results that mimicked the flooding conditions present in the field during heavy rain events. Considering the location of Willbrook Plantation and based on observations in the field, the existing stormwater system and it's outfall locations are presumed to be tidally influenced. In coastal areas, water surface elevations at the outfalls associated with higher tides cause water to back up to the ponds and into the systems. A check valve installed near the system outfalls allows water to exit through the pipe but prevents reverse flow of the system on higher tide cycles. These types of valves are common for similar tidal systems in the Lowcountry. One example of a manufacturer of these types of valves is Red Valve (Tideflex Technologies and CheckMate Valves).

2) <u>Increase Pipe Size and Adjust Pipe Slope</u>

Several pipes throughout System 1 lack the capacity to properly convey the stormwater runoff generated by their respective upstream areas. This has a negative effect on the systems by causing upstream catch basins to pond on the surface. As evident in the existing conditions analysis, the pipes near the system outfalls are impacted the most. By upsizing the pipes near the outfalls, the system will be able to hold a larger volume of water and dewater quicker.

Another equally important influence on storm drain capacity is pipe slope. In typical applications, pipes are set to a slope between 0.5% to 10%. A crucial factor in determining what slope to construct a storm drain to is the surrounding topography. Lowcountry applications typically warrant flatter pipe slopes due to the lower elevations. Topographic survey performed throughout the Willbrook Plantation confirms the presence of flatter pipe slopes, and in some cases the pipes were measured with negative slopes (draining the opposite direction of the outfall). During the process of upsizing the existing pipes, the new replacement pipes should be set at positive slopes as much as the site conditions allow. This will ensure the system dewaters fully and will allow for future rain events to utilize the full capacity of the system.

SYSTEM 2

System 2 is located along Oatland Lake Drive to the south of System 1. This stormwater drainage system begins at the northern intersection of Sandy Meadow Loop and Oatland Lake Drive and conveys runoff to the south along Oatland Lake Drive to catch basins located in front of 280 Oatland Lake Drive. System 2 is then conveyed beneath the open space between Sandy Meadow Loop to another catch basin. The outfall location was unable to be located, however based on field observations, it is presumed to discharge stormwater runoff into the pond to the east of Sandy Meadow Loop.

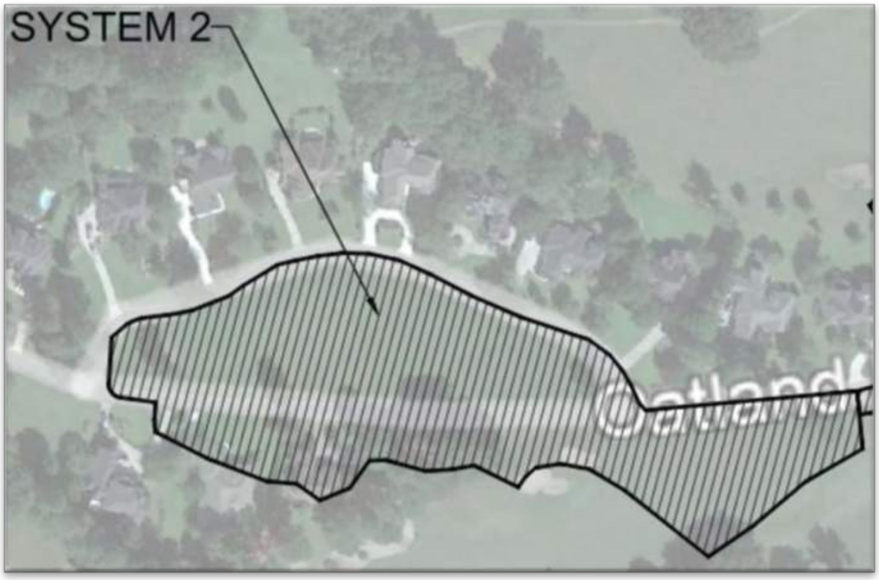


Figure 4: System 2 Location

Recommendations –

1) Addition of Check Valve to the Outfall

With the discharge pipe presumed to be at the pond to the east of Sandy Meadow Loop, the starting tailwater (water surface elevation at the outfall location) was assumed to be at the crown of the discharge pipe for modeling purposes. Unlike System 1, analysis of the existing conditions of System 2 concluded that the system is sized properly, even with this conservative tailwater approach at the outfall, however, to prevent the potential for the pond to backflow into the system's outfall, a check valve should be installed in the outfall pipe prior to the system discharging into the pond.

2) Additional Catch Basin

During the August 4th field walk, it was noted that a low spot near 280 Oatland Lake Drive tends to pond stormwater runoff after rainfall events. Localized areas like this often get worse overtime as the water infiltrates through cracks on the surface causing the pavement to settle. To combat this, an additional catch basin is proposed in the observed low spot area. A new 18" pipe will connect the new catch basin to the nearby existing catch basin, ultimately discharging to the pond to the east of Sandy Meadow Loop.

SYSTEM 3

System 3 is located near the western intersection of Chapman Loop and Heston Point Drive, Part A along Chapman Loop and Part B on Heston Point Drive. Stormwater runoff collected by both parts of System 3 is generally roadway runoff.

- System 3 Part A stormwater runoff is mainly collected by a cluster of roadway and area catch basins located in front of 648 Chapman Loop. It was noted on record drawings and surveyed information that additional runoff is conveyed to this cluster of catch basins, however, additional surface structures were unable to be located. For analysis purposes, it is assumed that System 3 Part A collects most of the runoff generated at the Chapman Loop and Heston Point Drive intersection. Stormwater runoff is conveyed to the west, where it is discharged to an existing ditch via a stilling basin type structure. Closed-circuit Television (CCTV) inspection (done by others) confirmed that portions of the system contain perforated CMP storm drain pipe. This indicates that the system was likely designed to hold stormwater runoff and allow it to infiltrate into the subgrade.
- System 3 Part B stormwater runoff is collected by two grate catch basins located in front of 250 Heston Point Drive. Captured runoff is conveyed to the south. The outfall location was unable to be located, however based on field observations, it is presumed to discharge stormwater runoff into the pond to the south of Heston Point Drive.

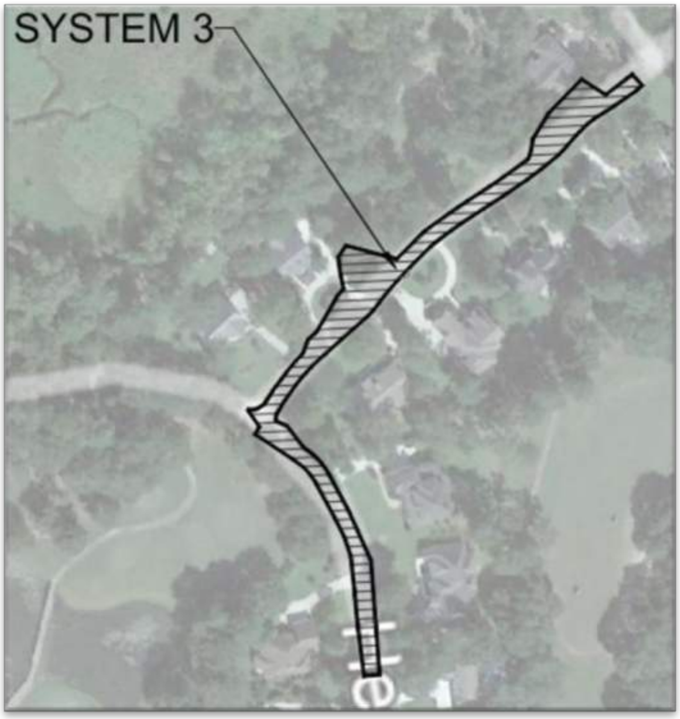


Figure 5: System 3 Location

Recommendations -

1) Replace or Improve Outfall Conditions

The existing outfall of System 3 Part A appears to be designed to allow stormwater runoff to be stored in the storm drain system for infiltration and for any overflow to be discharged out of a stilling basin type structure on the western end of the system. While this stormwater detention and infiltration approach is practical in ideal conditions, it can be negatively impacted by high groundwater, clogged pipe perforations, or tidal influences. The use of CMP in Lowcountry applications is generally avoided due to saltwater corrosion. If stormwater runoff cannot be discharged from the storm drain system, the system's capacity is severely lessened, leading to surface ponding during the next storm event. To ensure the storm drain system maintains its designed capacity, a modification of the stilling basin type structure will facilitate proper dewatering of the storm drain system in the event the originally designed intents fail and in cases when the water table is high and storm events are frequent. Any dewatering weep holes or orifices in the existing stilling should be placed above the Mean Lower Low Water (MLLW) elevation to prevent backwater into the system at low tide. The MLLW elevation according to station 8661991, Hagley, Waccamaw River, SC is 0.00'.

2) Addition of Check Valve to the Outfall

In addition to improving the outfall condition at the stilling basin type structure, a check valve should be considered in the pipe upstream of the stilling basin to prevent backwater into the system during tidal cycles.

The outfall location of System 3 Part B is presumed to discharge to the pond to the south of Heston Point Drive. This outfall should be confirmed, and if confirmed to discharge to the pond, a check valve should be considered to prevent backwater into the system.

3) <u>Additional Catch Basin</u>

During the August 4th field walk, it was noted that a low spot near 629 Chapman Loop tends to hold stormwater runoff after rainfall events. To prevent ponding and worsening roadway conditions, an additional catch basin is proposed near the observed low spot. The catch basin will be offset from the normal gutter line to establish a "sag" condition and avoid existing sanitary sewer lines. It will be connected to the adjacent catch basin on Chapman Loop and ultimately discharge to the stilling basin type structure to the west.

SYSTEM 4

System 4 is located near the intersection of Chapman Loop and Flat Boat Landing. Stormwater runoff is collected by two grate catch basins, one along Chapman Loop and the other in front of 15 Flat Boat Landing. A portion of stormwater runoff from Chapman Loop is conveyed to the north and discharged to an existing ditch via a stilling basin type structure. The remaining Chapman Loop runoff sheet flows to the catch basin in front of 15 Flat Boat Landing, where it is discharge at the rear of the property.

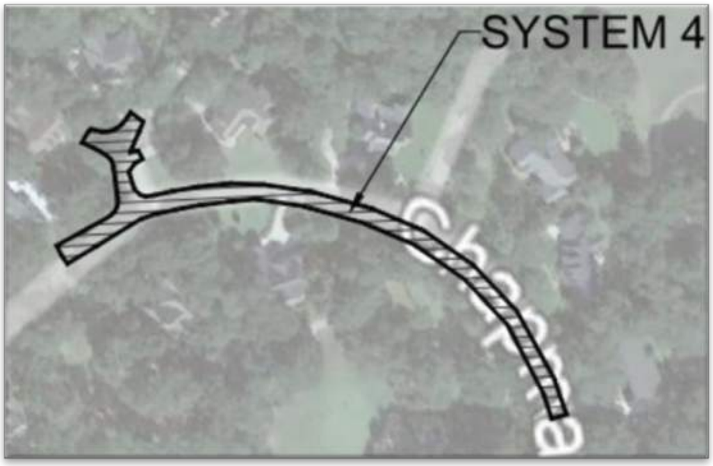


Figure 6: System 4 Location

Recommendations –

1) <u>Replace or Improve Outfall Conditions</u>

In a similar manor to System 3 Part A, the existing outfall of System 4 appears to be designed to allow stormwater runoff to be stored in the storm drain system and any overflow to be discharged out of a stilling basin type structure on the northern end of the system. This structure is the lowest point in the system, and stormwater runoff ponds in both inflow portions of the system. To ensure the storm drain system maintains its designed capacity, a modification of the stilling basin type structure will facilitate proper dewatering of the storm drain system in the event the originally designed intents fail. Any dewatering weep holes or orifices in the existing stilling should be placed above the MLLW elevation (0.00’) to prevent backwater into the system at low tide.

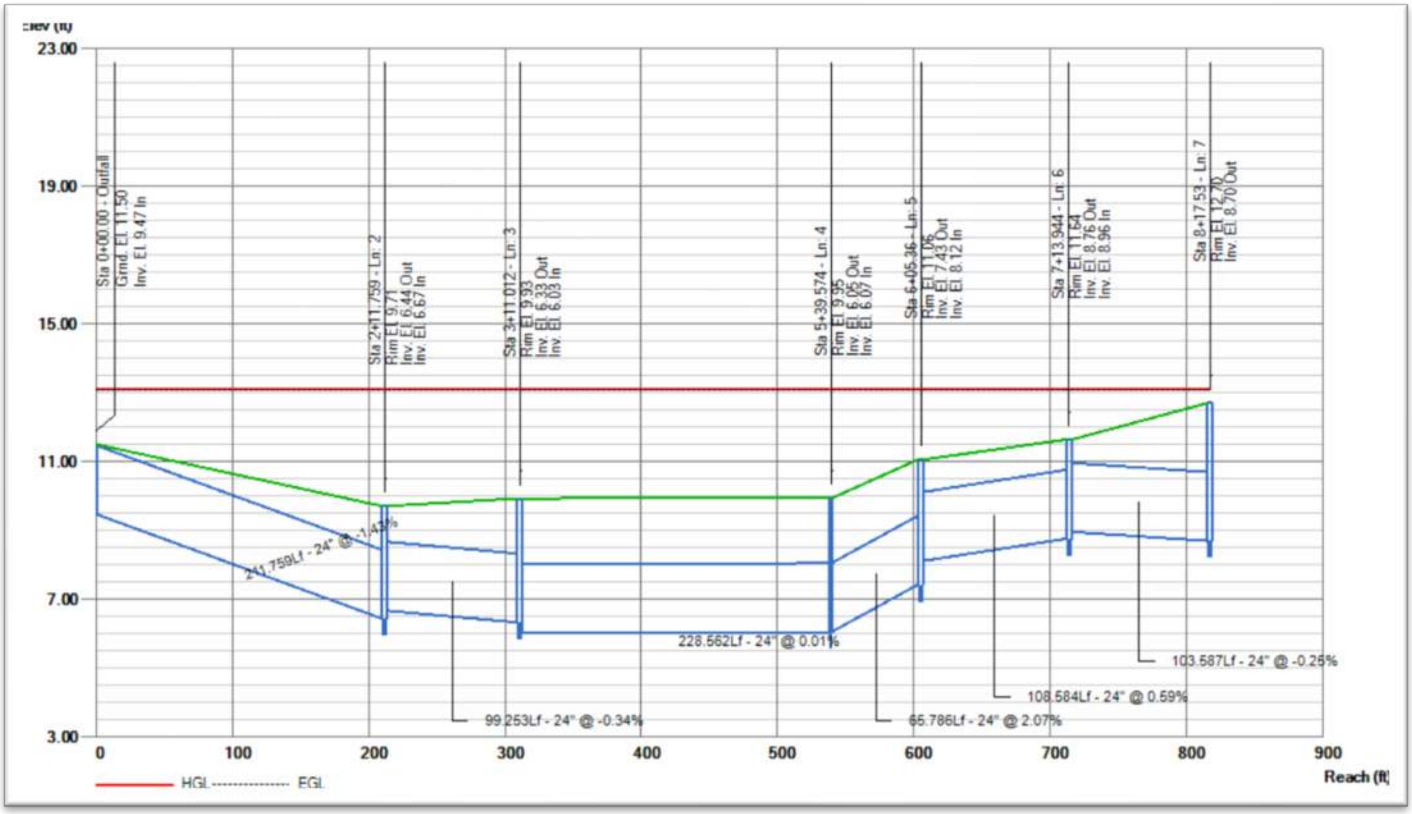


Figure 7: System 4 Pipe Profile for 10-Year Storm

2) Additional Catch Basin

In its current configuration, the existing drainage system on Chapman Loop only contains one catch basin. When modeled in Storm Sewers, this catch basin becomes overwhelmed and any bypassed stormwater runoff sheet flows to the smaller catch basin in front of 15 Flat Boat Landing. It was noted during the August 4th field walk the small catch basin in front of 15 Flat Boat Landing often becomes clogged by leaves and other debris during large storm events rendering it useless. Two additional catch basins are proposed along Chapman Loop to intercept the stormwater runoff flooding the small catch basin in front of 15 Flat Boat Landing. The catch basins are connected to adjacent storm drain system and ultimately discharging to the stilling basin type structure to the north.

A second storm drain option was considered along Flat Boat Landing. The addition of a catch basin along the southern edge of Flat Boat Landing will capture stormwater runoff that bypassed the catch basin on Chapman Loop and discharge to the existing system to the north. The existing catch basin in front of 15 Flat Boat Landing can be replaced and connected to the storm drain beneath Flat Boat Landing. This option would require the addition of a “conflict” manhole at the new storm drain and existing sanitary sewer line crossing to allow the new storm drain to discharge to the existing stormwater drainage system. A third storm drain option would be the establishment of a new outfall behind 15 Flat Boat Landing and replacing the privately owned existing system with a properly sized storm drain system. This option would require additional permitting to establish the new outfall.

All three options have been outlined in the construction plans.

SYSTEM 5

Located on the northern end of the Willbrook Plantation, System 5 collects the stormwater runoff from Tidewater Drive between the Tidewater Circle and the Black Duck Road intersections and along a portion of Tidewater Circle. This system utilizes curb style catch basins and conveys stormwater runoff to the east along Tidewater Drive. The outfall location was unable to be located, however based on surveyed information, it is presumed to discharge stormwater runoff into the pond to the south of Tidewater Drive.

Figure 8: System 5 Location

Recommendations –

1) <u>Replace or Improve Outfall Conditions</u>

According to the topographic survey, the direction of the System 5 outlet pipe indicated that the system likely discharges stormwater runoff into the pond to the south of Tidewater Drive. Because the outfall was unable to be visually located, it is presumed to discharge below the normal water surface elevation of the pond. During the modeling process, this system was analyzed assuming the outlet pipe is completely submerged. With this condition, the system is still able to function as intended, however, any increase in stormwater runoff to this outlet could potentially worsen the system causing flooding in low lying areas at the catch basins. Discharging this storm drain system above the normal water surface elevation of the pond will allow this system to dewater properly.

2) Additional Catch Basin

Analysis of the topographic survey revealed a low spot at the northern corner of the Tidewater Circle and Oatland Lake Drive intersection that has the potential to cause ponding in this area after storm events. At this time, no complaints from residents have noted this condition. If ponding does occur and cause problems to the immediate area, the addition of a catch basin at the low spot will properly dewater the area. The new catch basin can outfall into the pond to the east or discharge to the existing system along Tidewater Drive.

AREA 6

Area 6 is located on the western end of Heston Point Drive. Area 6 does not contain a stormwater drainage system and is dominated by surface flow to a shallow ditch located in an existing vegetated area between 489 and 509 Heston Point Drive.

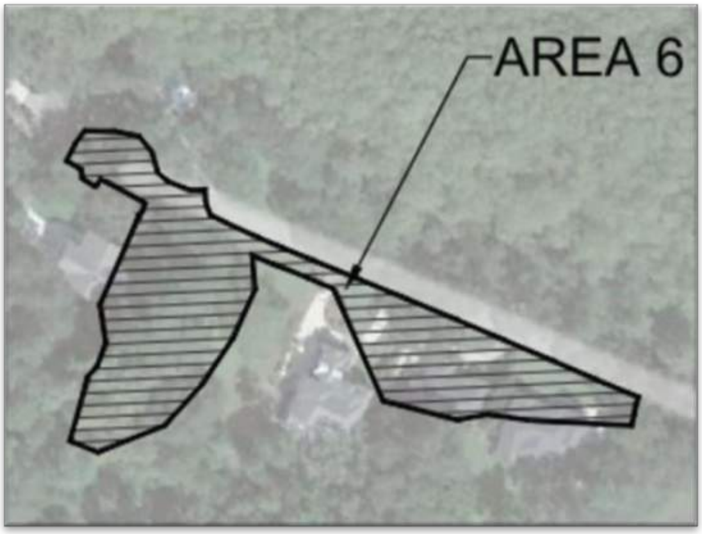


Figure 9: Area 6 Location

Recommendations –

1) Regrading of Vegetated Ditch

During the August 4th field walk, it was noted by residents and JMT staff that ponding occurs along the southern edge of Heston Point Drive causing a localized depression on the roadway edge. This area does not contain a curb or a storm drain system like other areas throughout the neighborhood, so stormwater runoff is allowed to sheet flow off the roadway surface to the surrounding areas. To provide positive drainage from the localized depression, a shallow sloping vegetated ditch is proposed to connect to the regraded Vshaped ditch in the wooded strip to the west of the depression. The regraded ditch will ultimately discharge in its existing location to the south of the area.

Cost Estimate

Table 1 below represents unit costs associated with the recommendations outlined for each system in this report. It should be noted that each unit cost is based on recent bids during the year 2022 and are subject to change.

Item	QTY	Unit	Unit Cost
Asphalt Pavement Demo	1	SY	$ 10.00
Asphalt Pavement Section	1	SY	$ 25.00
Asphalt Base	1	SY	$ 30.00
12” RCP (Including backfill and compaction)	1	LF	$ 80.00
15” RCP(Including backfill and compaction)	1	LF	$ 90.00
18” RCP(Including backfill and compaction)	1	LF	$ 100.00
24” RCP(Including backfill and compaction)	1	LF	$ 115.00
36” RCP(Including backfill and compaction)	1	LF	$ 125.00
Standard Inlet Box / drainage structure	1	EA	$ 4,200.00
Pipe Check Valve	1	EA	$25,000.00

Table 1: Unit Costs

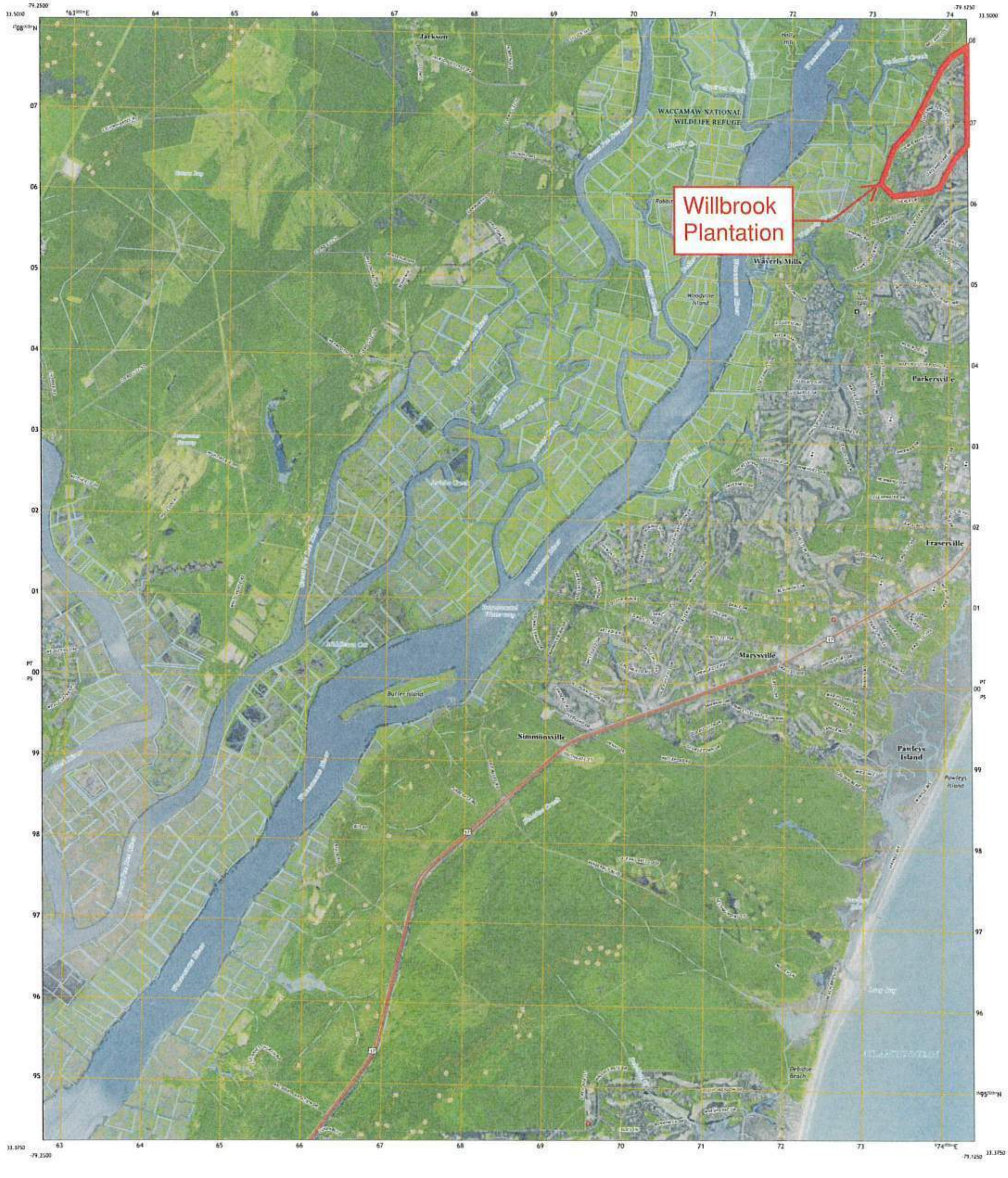
APPENDIX A

Site Maps

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

WAVERLY MILLS QUADRANGLE
SOUTH CAROLINA - GEORGETOWN COUNTY
7.5-MINUTE SERIES



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 17S
This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery .... NAIP, September 2017 - December 2017
Roads .... U.S. Census Bureau, 2017
Names .... GNIS, 1980 - 2020
Hydrography .... National Hydrography Dataset, 1999 - 2018
Contours .... National Elevation Dataset, 2019
Boundaries .... Multiple sources; see metadata file 2018 - 2019
Wetlands .... FWS National Wetlands Inventory 1994 - 2011

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 20 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.18

QUADRANGLE LOCATION

1 Carvers Bay
2 Plantersville
3 Brookgreen
4 Georgetown North
5 Magnolia Beach
6 Georgetown South
7 North Island

ADJOINING QUADRANGLES

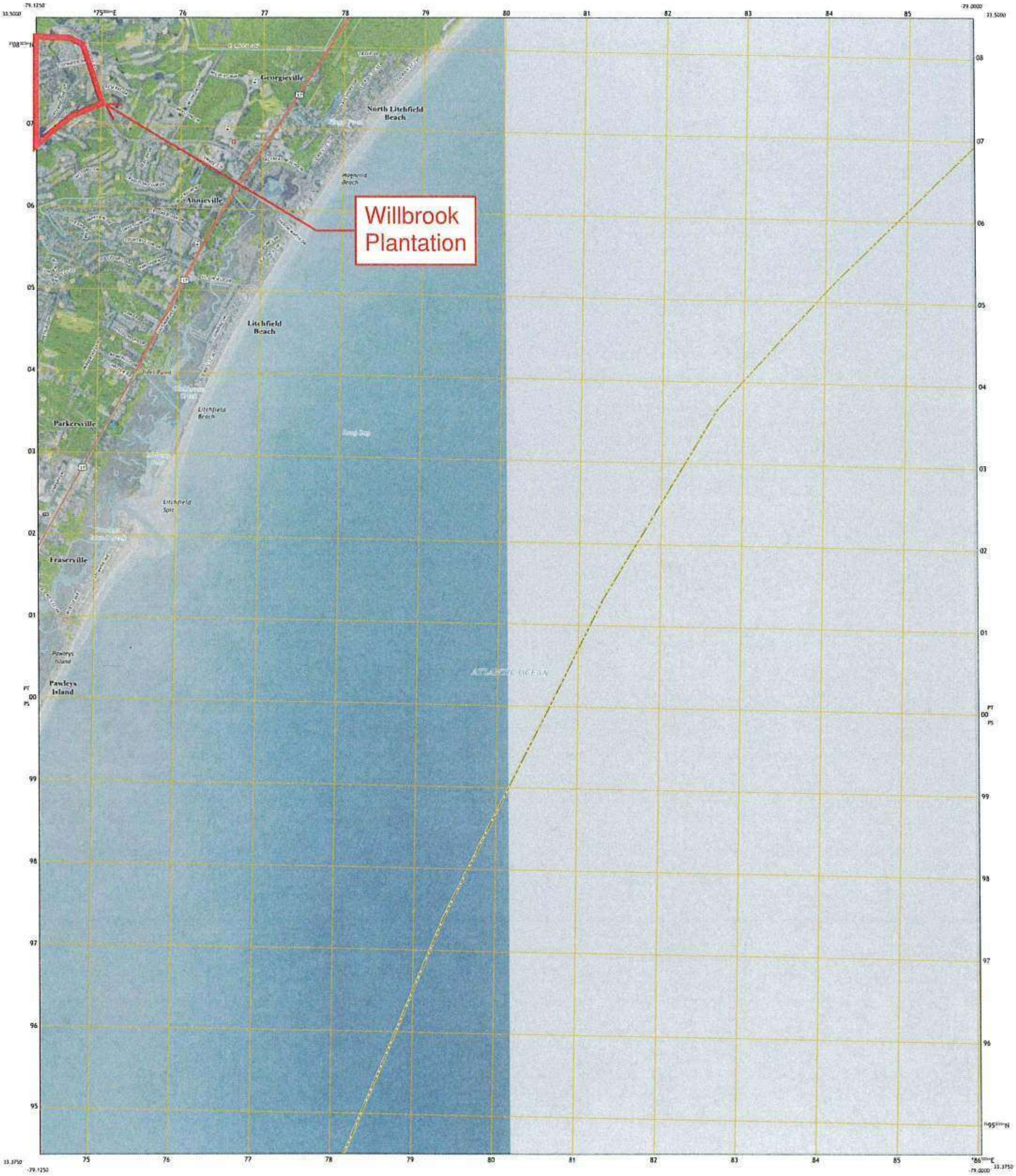
ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

WAVERLY MILLS, SC
2020

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

MAGNOLIA BEACH QUADRANGLE
SOUTH CAROLINA - GEORGETOWN COUNTY
7.5-MINUTE SERIES



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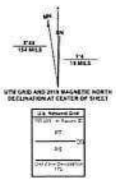

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

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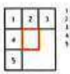
QUADRANGLE LOCATION



1 Plantersville
2 Brookgreen
3 Surfside Beach
4 Waverly Mills
5 North Island

ADJOINING QUADRANGLES

ROAD CLASSIFICATION

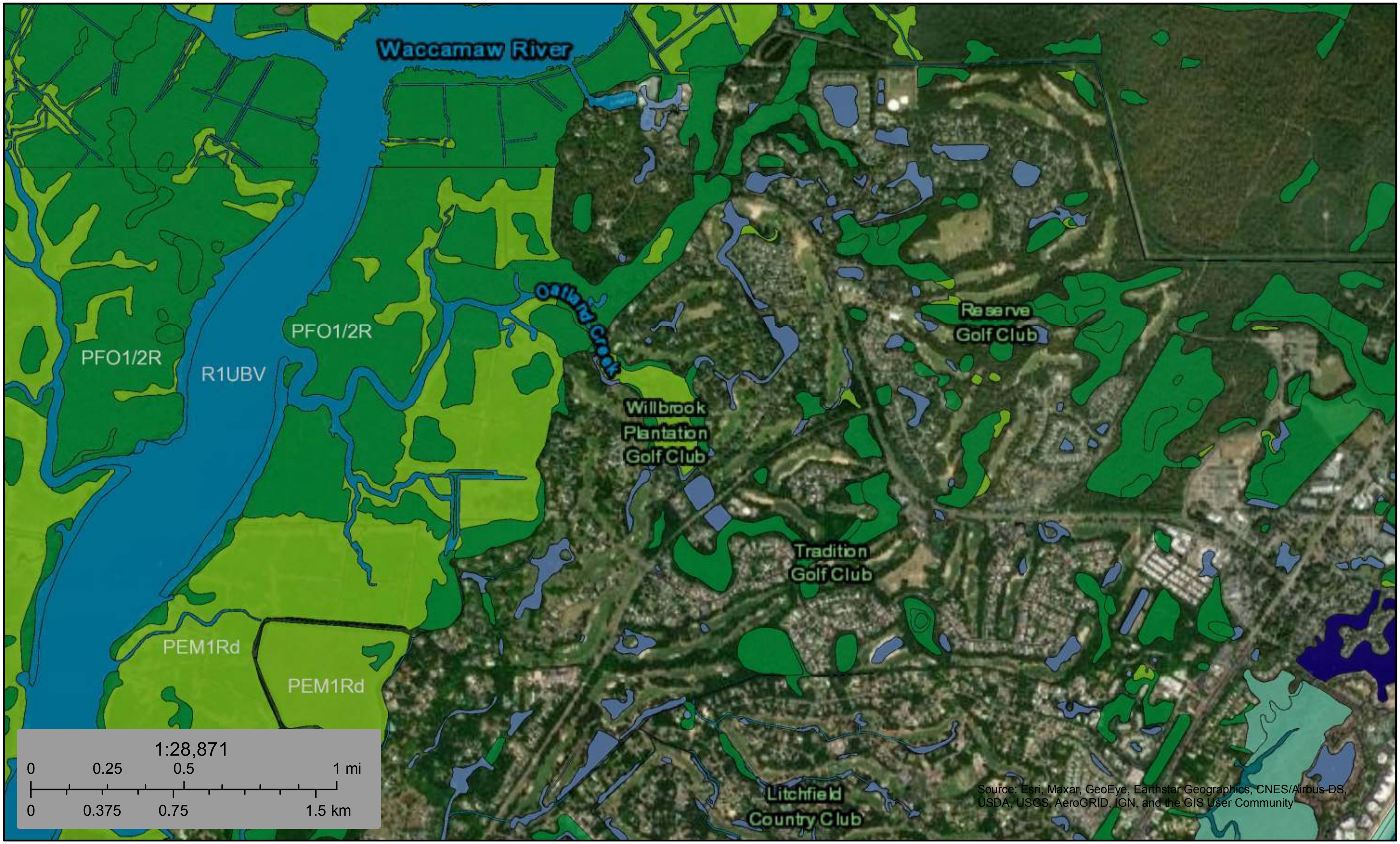
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

MAGNOLIA BEACH, SC
2020

U.S. Fish and Wildlife Service

National Wetlands Inventory

Willbrook Plantation



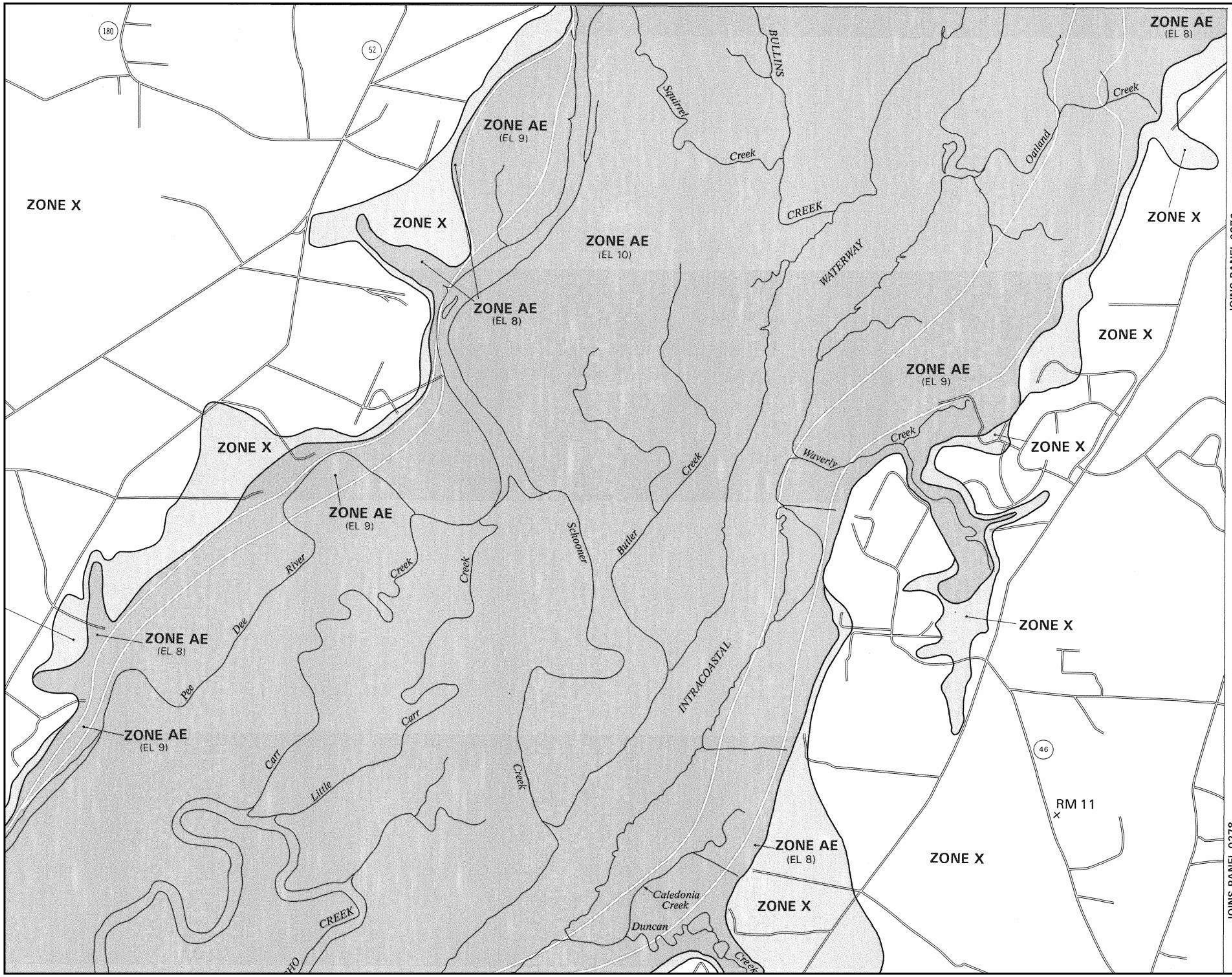
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

February 8, 2022

Wetlands

- 🟦 Estuarine and Marine Deepwater
- 🟩 Estuarine and Marine Wetland
- 🟩 Freshwater Emergent Wetland
- 🟩 Freshwater Forested/Shrub Wetland
- 🟦 Freshwater Pond
- 🟪 Lake
- 🟫 Other
- 🟦 Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.



To determine if flood insurance is available i
insurance agent or call the National Flood Insu

APPROXIMATE SC
2000
0

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

GEORGETOWN
COUNTY,
SOUTH CAROLINA
(UNINCORPORATED AREAS)

PANEL 275 OF 490
(SEE MAP INDEX FOR PANELS NOT PRINTED)

PANEL LOCATION

COMMUNITY-PANEL NUMBER
450085 0275 E

MAP REVISED:
AUGUST 2, 1996

Federal Emergency Management Agency

This is an official FIRMette showing a portion of the above-referenced flood map created from the MSC FIRMette Web tool. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For additional information about how to make sure the map is current, please see the Flood Hazard Mapping Updates Overview Fact Sheet available on the FEMA Flood Map Service Center home page at https://msc.fema.gov.

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

GEORGETOWN
COUNTY,
SOUTH CAROLINA
(UNINCORPORATED AREAS)

PANEL 276 OF 490

PANEL LOCATION

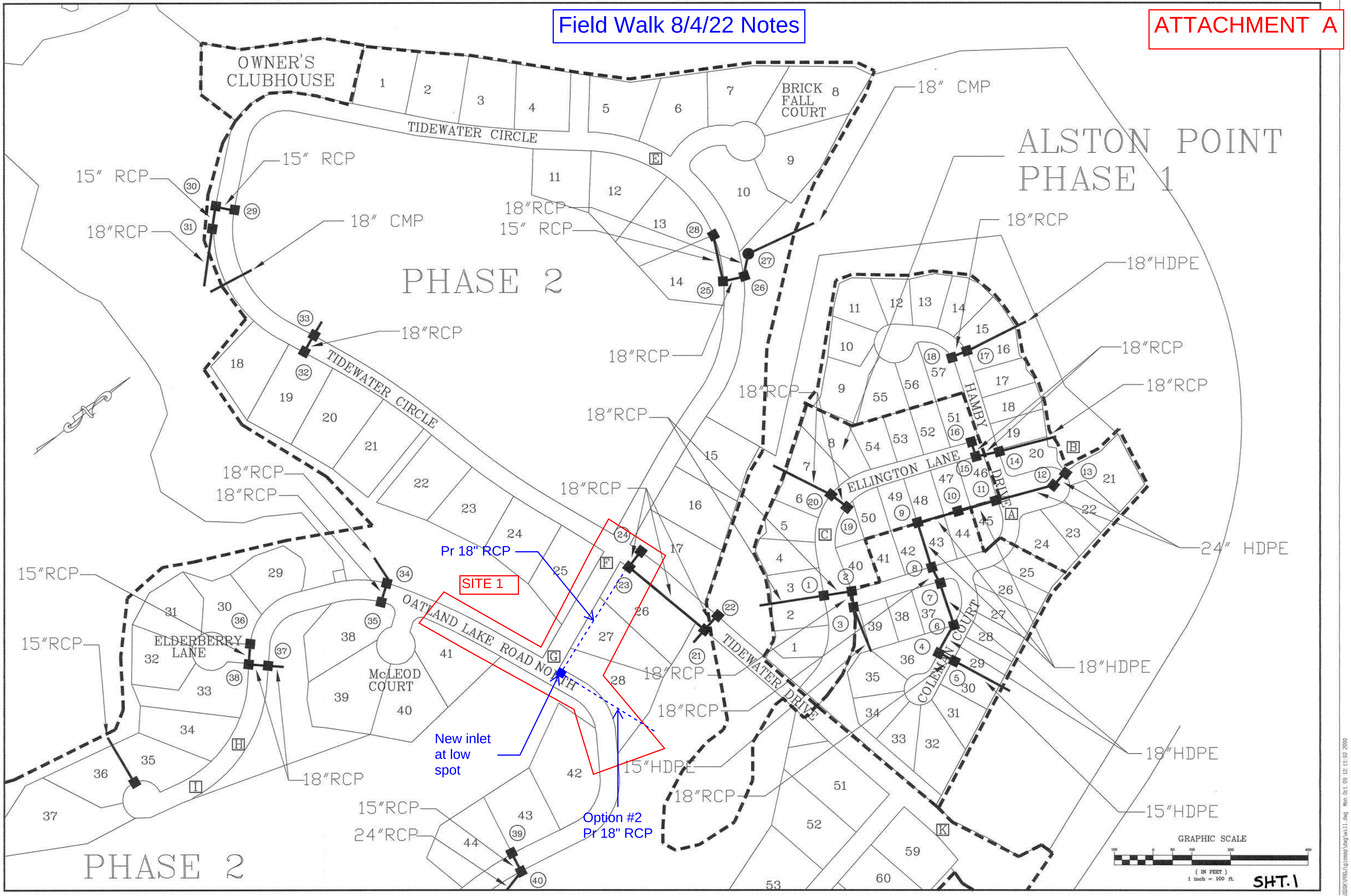
COMMUNITY-PANEL NUMBER
450085 0276 D

MAP REVISED:
MARCH 16, 1989

Federal Emergency Management Agency

Field Walk 8/4/22 Notes

ATTACHMENT A



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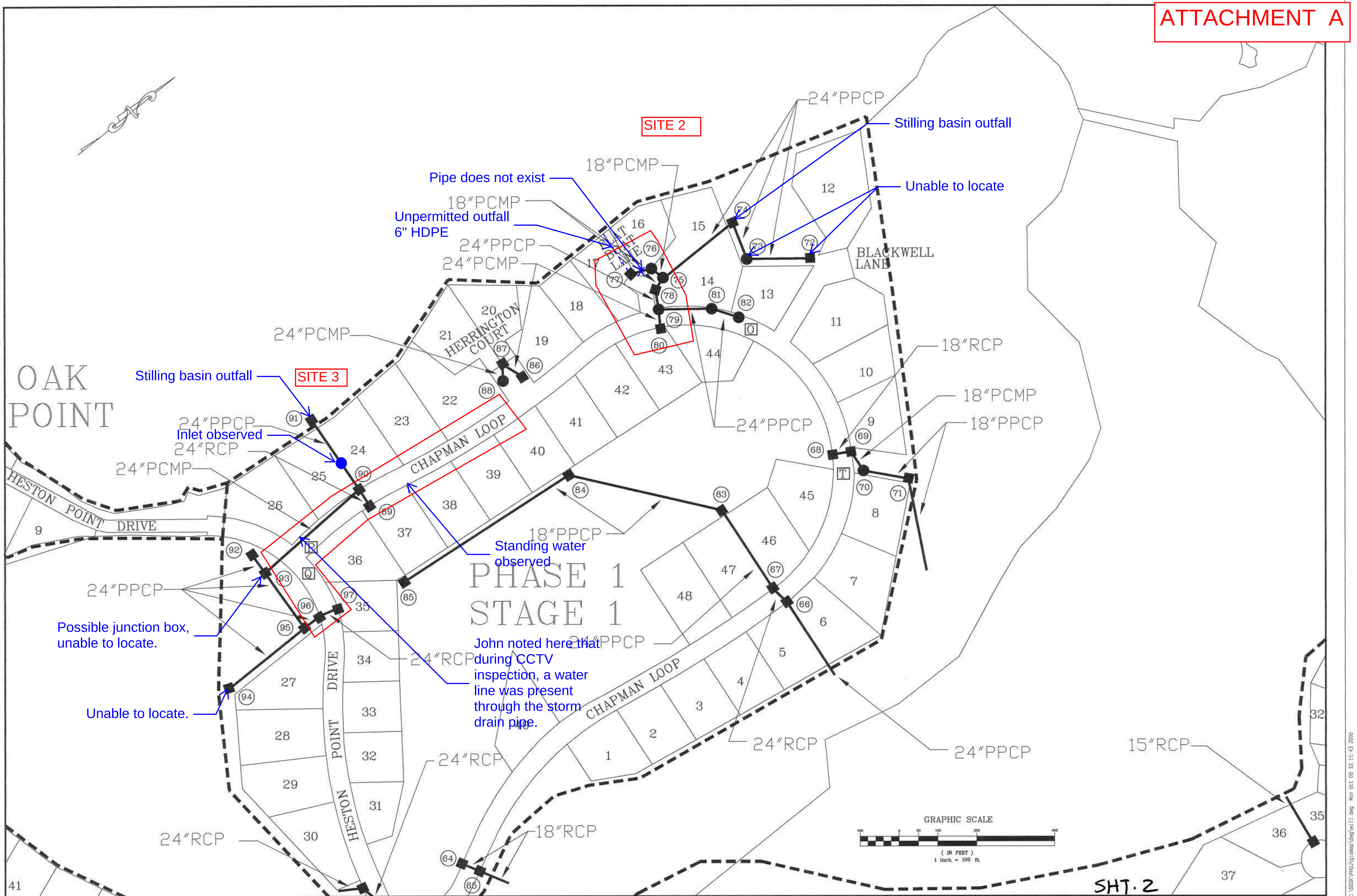

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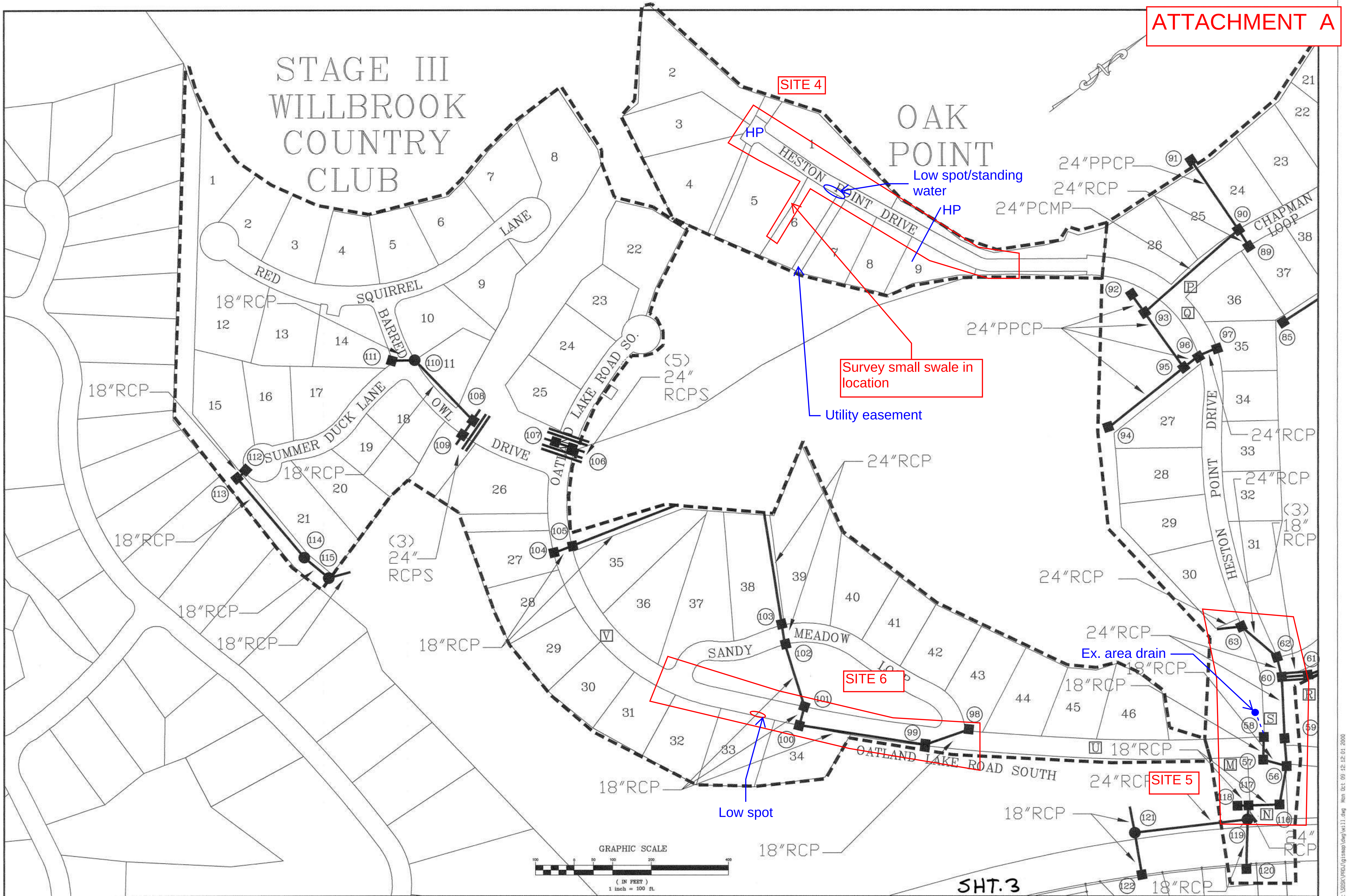


SITE 4

HP

Low spot/standing water

HP

Survey small swale in location

Utility easement

SITE 6

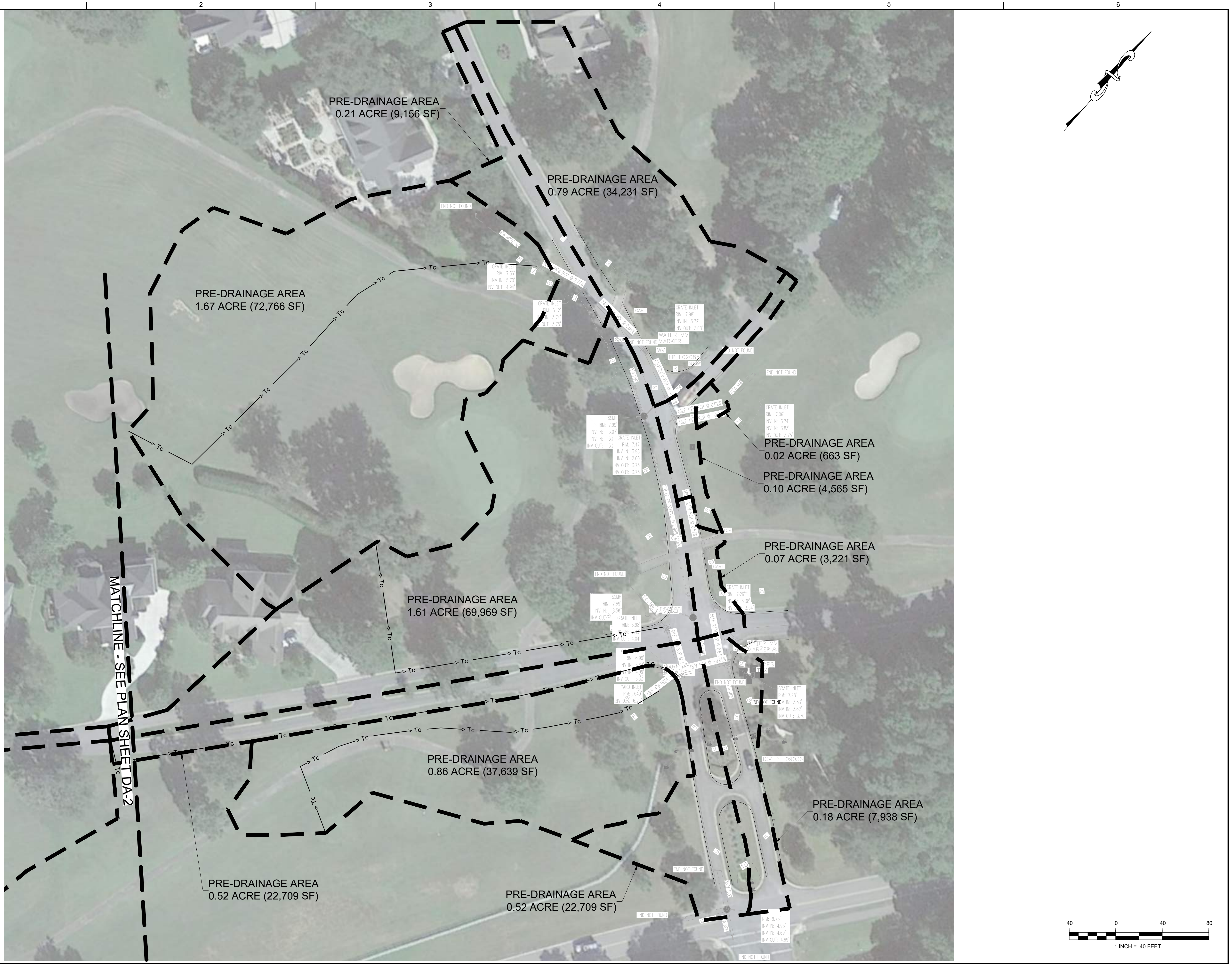
Low spot

Ex. area drain

SITE 5

APPENDIX B

Drainage Area Maps



235 MAGRATH DARBY BLVD., SUITE 275 |
MT. PLEASANT, SC 29464
P: (843) 556-2624 | www.jmt.com

SEAL:

PREPARED FOR:

WILLBROOK
PLANTATION HOA
426 TIDEWATER CIRCLE
PAWLEYS ISLAND, SC 29585

REVISIONS

NO.	DATE	DESCRIPTION

PROJECT:

WILLBROOK
PLANTATION
DRAINAGE
IMPROVEMENTS

PROJECT LOCATION:

PAWLEYS ISLAND
SOUTH CAROLINA 29585, ----

PROJECT NUMBER:

21-00881-001

DATE:	SCALE:
06/15/2022	1" = 40'

PLAN SET:

DRAINAGE AREA PLAN

DRAWING TITLE:

DRAINAGE PLAN
SYSTEM 1

DRAWING NUMBER:

DA-1

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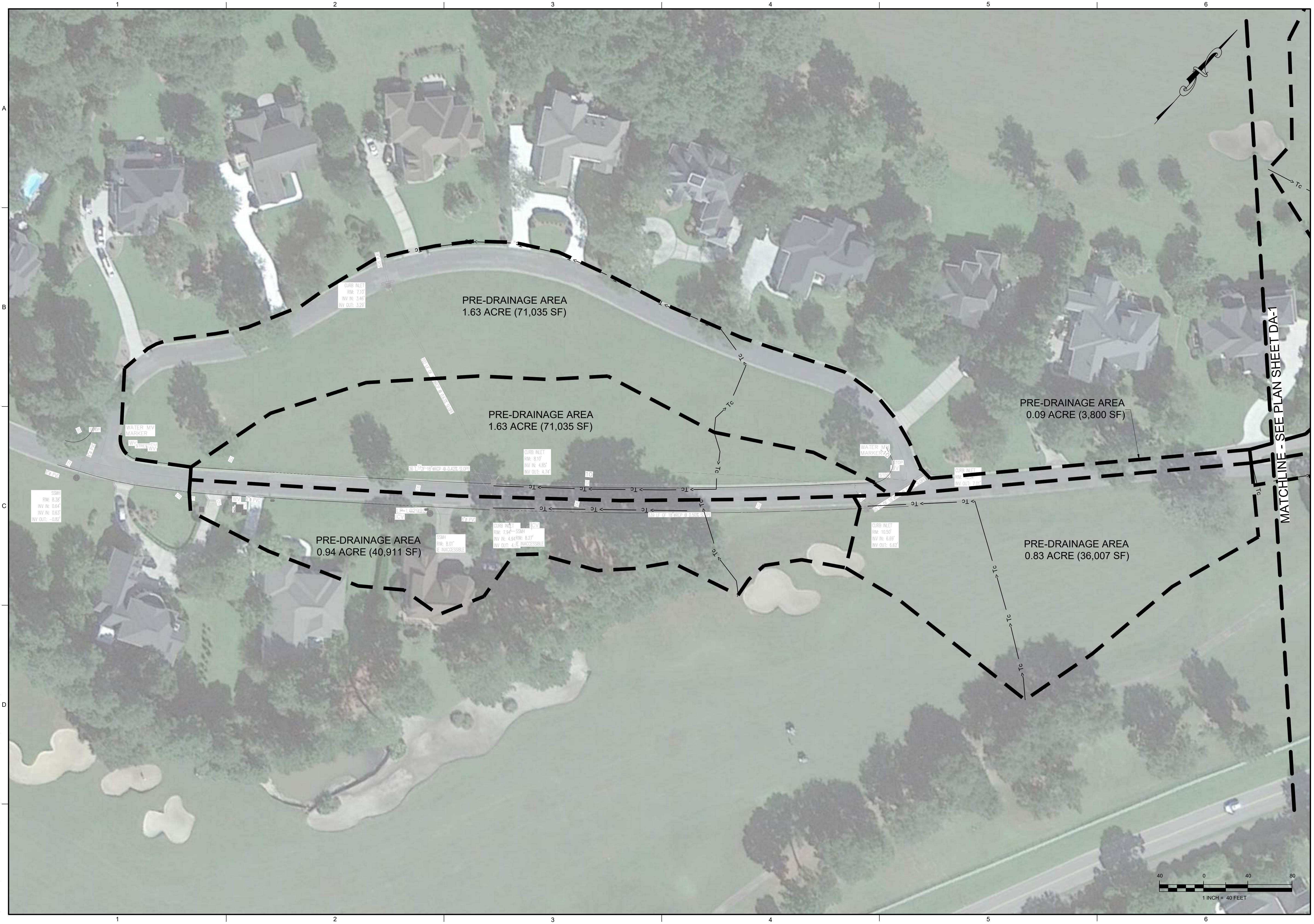

1
2
3
4
5
6
A
B
C
D

235 MAGRATH DARBY BLVD., SUITE 275 |
MT. PLEASANT, SC 29464
P: (843) 556-2624 | www.jmt.com

SEAL:

PREPARED FOR:

WILLBROOK PLANTATION HOA
426 TIDEWATER CIRCLE
PAWLEYS ISLAND, SC 29585

REVISIONS

NO.	DATE	DESCRIPTION

PROJECT:

WILLBROOK
PLANTATION
DRAINAGE
IMPROVEMENTS

PROJECT LOCATION:

PAWLEYS ISLAND
SOUTH CAROLINA 29585, ----

PROJECT NUMBER:

21-00881-001

DATE: 06/15/2022

SCALE: 1" = 40'

PLAN SET:

DRAINAGE AREA PLAN

DRAWING TITLE:

DRAINAGE PLAN
SYSTEM 2

DRAWING NUMBER:

DA-2

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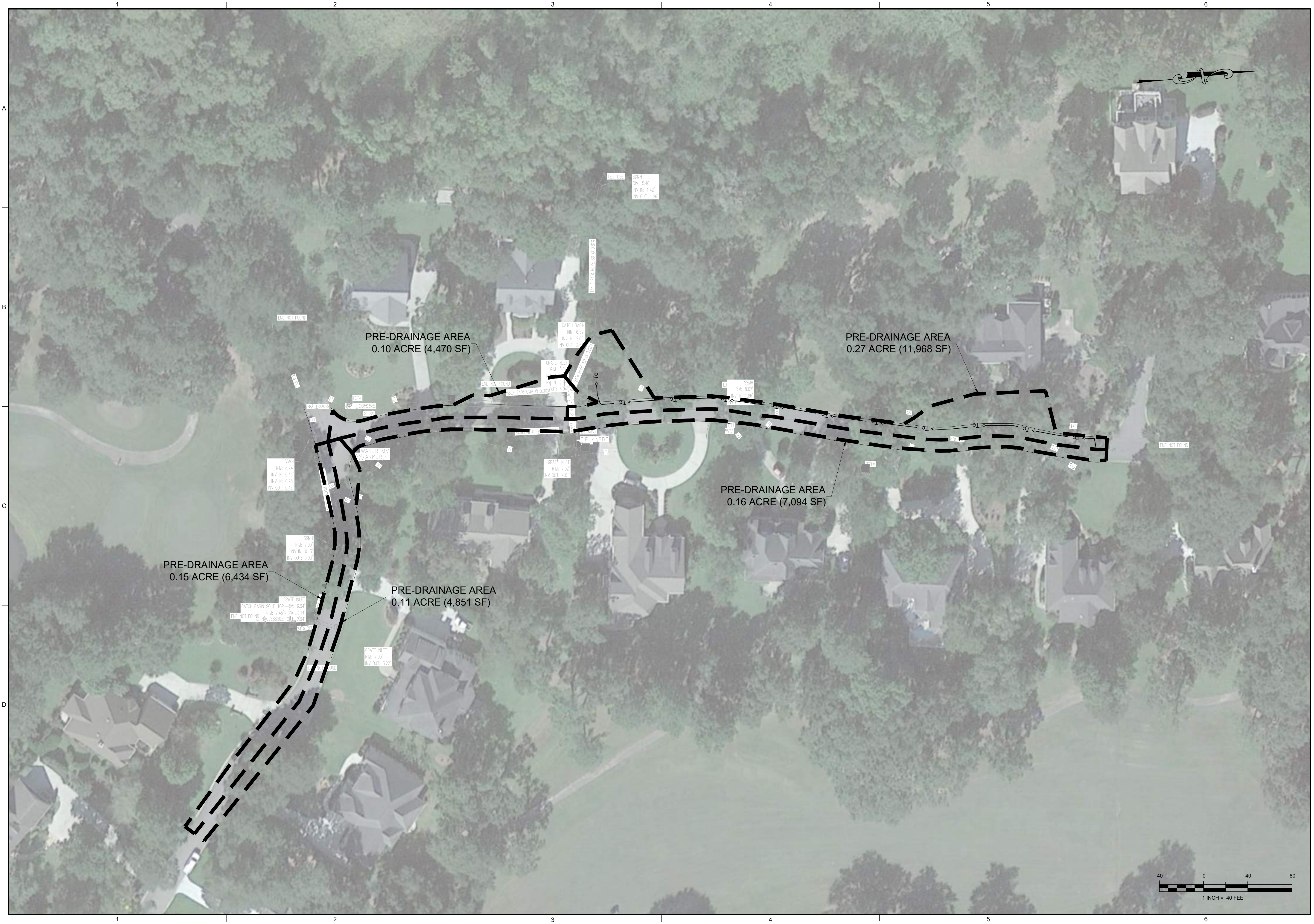

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SEAL:

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WILLBROOK
PLANTATION HOA
426 TIDEWATER CIRCLE
PAWLEYS ISLAND, SC 29585

REVISIONS

NO.	DATE	DESCRIPTION

PROJECT:

WILLBROOK
PLANTATION
DRAINAGE
IMPROVEMENTS

PROJECT LOCATION:

PAWLEYS ISLAND
SOUTH CAROLINA 29585, ----

PROJECT NUMBER:

21-00881-001

DATE:	SCALE:
06/15/2022	1" = 40'

PLAN SET:

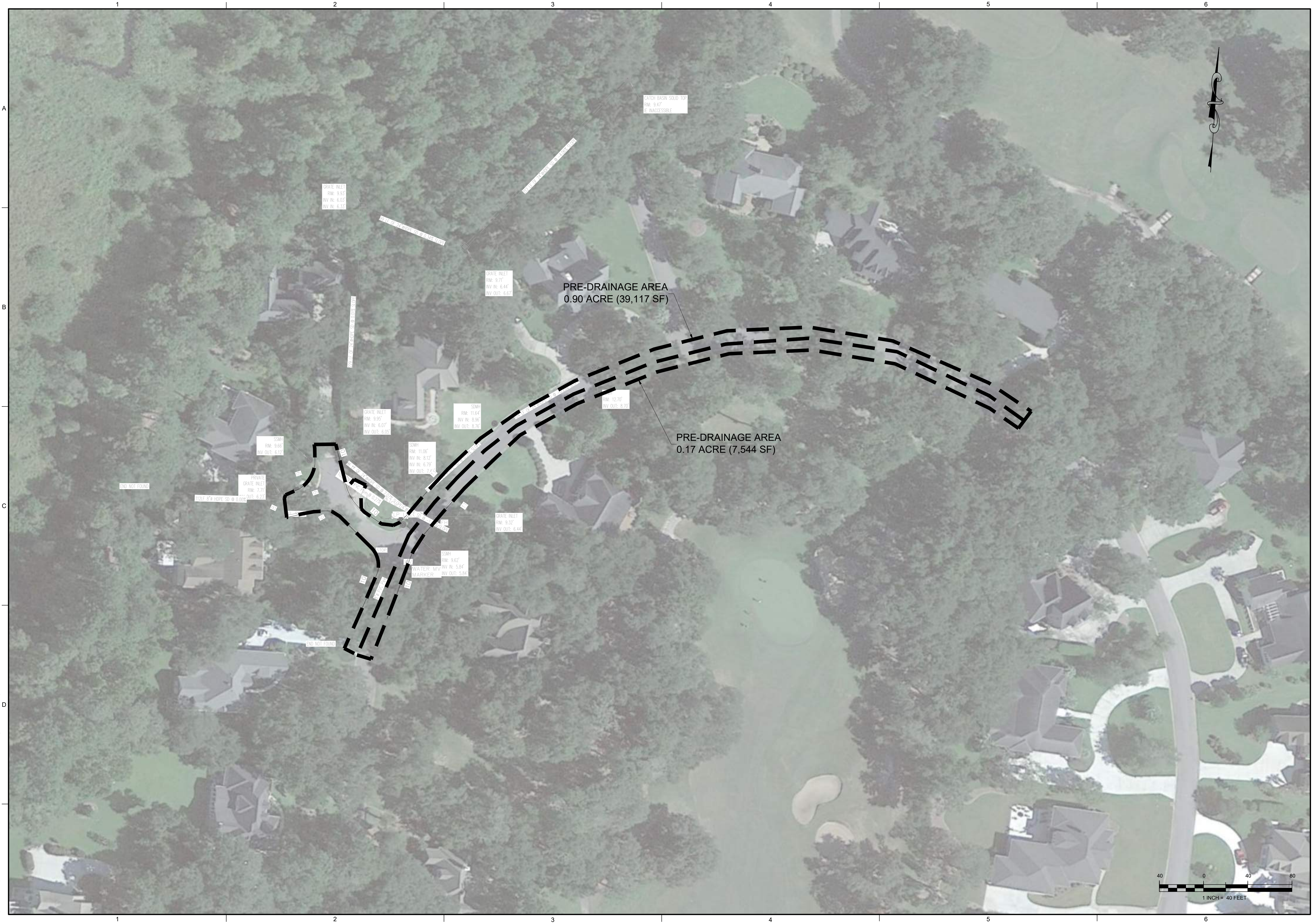
DRAINAGE AREA PLAN

DRAWING TITLE:

DRAINAGE PLAN
SYSTEM 3

DRAWING NUMBER:

DA-3



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SEAL:

PREPARED FOR:

WILLBROOK
PLANTATION HOA
426 TIDEWATER CIRCLE
PAWLEYS ISLAND, SC 29585

REVISIONS

NO.	DATE	DESCRIPTION

PROJECT:

WILLBROOK
PLANTATION
DRAINAGE
IMPROVEMENTS

PROJECT LOCATION:

PAWLEYS ISLAND
SOUTH CAROLINA 29585, ----

PROJECT NUMBER:

21-00881-001

DATE:	SCALE:
06/15/2022	1" = 40'

PLAN SET:

DRAINAGE AREA PLAN

DRAWING TITLE:

DRAINAGE PLAN
SYSTEM 4

DRAWING NUMBER:

DA-4

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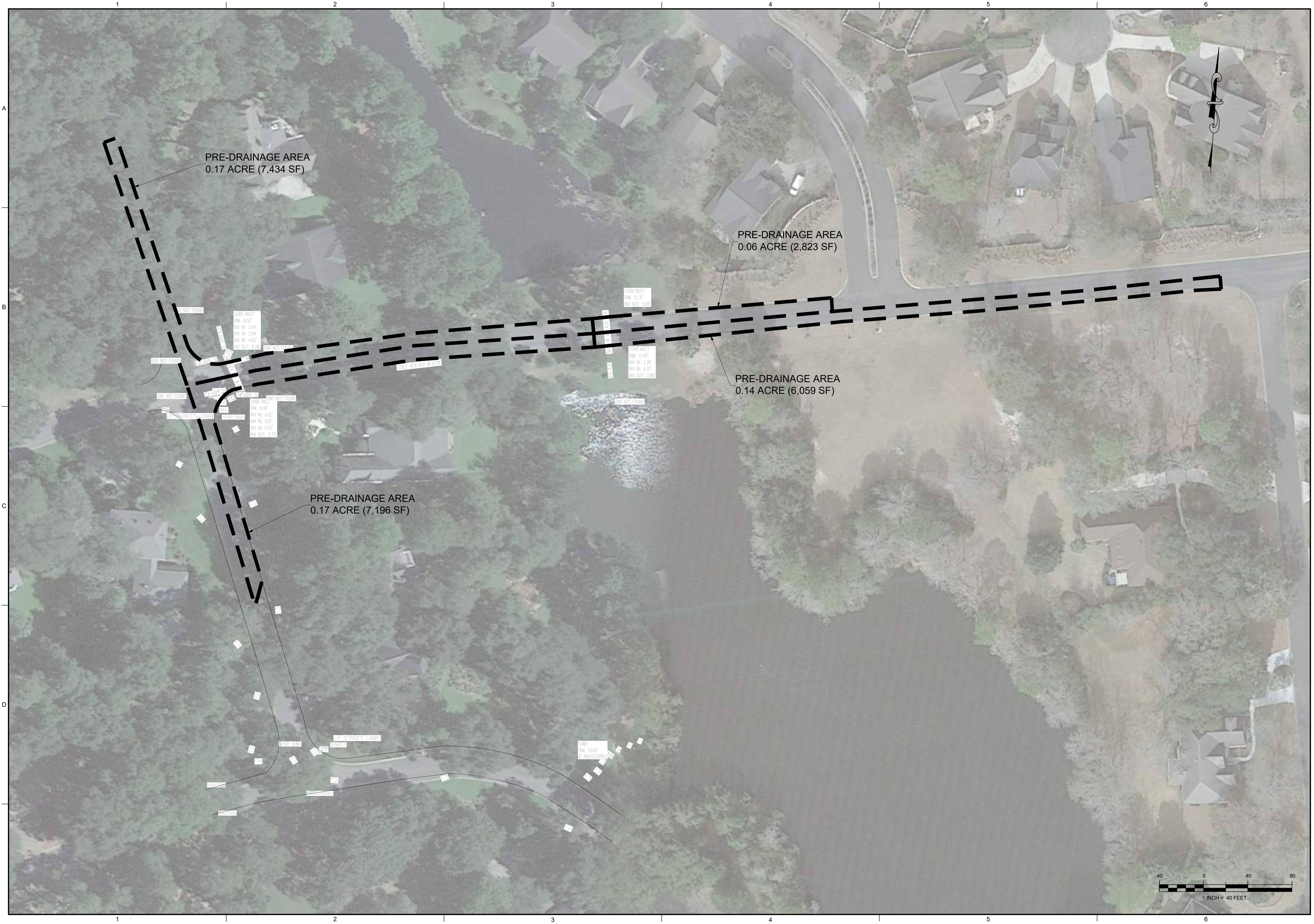

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426 TIDEWATER CIRCLE
PAWLEYS ISLAND, SC 29585

REVISIONS

NO.	DATE	DESCRIPTION

PROJECT:

WILLBROOK
PLANTATION
DRAINAGE
IMPROVEMENTS

PROJECT LOCATION:

PAWLEYS ISLAND
SOUTH CAROLINA 29585, ----

PROJECT NUMBER:

21-00881-001

DATE:	SCALE:
06/15/2022	1" = 40'

PLAN SET:

DRAINAGE AREA PLAN

DRAWING TITLE:

DRAINAGE PLAN
SYSTEM 5

DRAWING NUMBER:

DA-5

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SEAL:

PREPARED FOR:

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PLANTATION HOA
426 TIDEWATER CIRCLE
PAWLEYS ISLAND, SC 29585

REVISIONS

NO.	DATE	DESCRIPTION

PROJECT:

WILLBROOK
PLANTATION
DRAINAGE
IMPROVEMENTS

PROJECT LOCATION:

PAWLEYS ISLAND
SOUTH CAROLINA 29585, ----

PROJECT NUMBER:

21-00881-001

DATE: 06/15/2022

SCALE: 1" = 40'

PLAN SET:

DRAINAGE AREA PLAN

DRAWING TITLE:

DRAINAGE PLAN
AREA 6

DRAWING NUMBER:

DA-6

APPENDIX C

Engineering Report

APPENDIX C-1

Collection & Conveyance

C_f is defined by:

Recurrence Interval (Years)	C_f
2 -10	1.0
25	1.1
50	1.2
100	1.25

Runoff factors can be seen in Table 4.

Table 4: Runoff Factors for Rational Method

RUNOFF FACTORS FOR RATIONAL METHOD			
	Flat	**Rolling**	**Hilly**
	0% - 2%	**2% - 10%**	**Over 10%**
Pavements & Roofs	0.90	0.90	0.90
Earth shoulders	0.50	0.50	0.50
Drives & Walks	0.75	0.80	0.85
Gravel Pavements	0.50	0.55	0.60
City Business Areas	0.80	0.85	0.85
Unpaved Road, Sandy Soils	0.34	0.45	0.59
Unpaved Road, Silty Soils	0.35	0.47	0.61
Unpaved Road, Clay Soils	0.40	0.53	0.69
Apartment Dwelling Areas	0.50	0.60	0.70
Suburban, Normal Residential	0.45	0.50	0.55
Dense Residential Sections	0.60	0.65	0.70
Lawns, Sandy Soils	0.10	0.15	0.20
Lawns, Heavy Soils	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.60	0.60	0.60
Side Slopes, Turf	0.30	0.30	0.30
Median Areas, Turf	0.25	0.30	0.30
Cultivated Land, Clay & Loam	0.50	0.55	0.60
Cultivated Land, Sand & Gravel	0.25	0.30	0.35
Industrial Areas, Light	0.50	0.70	0.80
Industrial Areas, Heavy	0.60	0.80	0.90
Parks & Cemeteries	0.10	0.15	0.25
Playgrounds	0.20	0.25	0.30
Woodland & Forest	0.10	0.15	0.20
Meadows & Pasture Land	0.25	0.30	0.35
Unimproved Areas	0.10	0.20	0.30
Rail Yards	0.25	0.30	NA
Expressways & Freeways *	0.60*	0.70*	0.75*

* The designer can also calculate weighted ‘C’ values for expressways and freeways using the values in the table for pavement, side slopes and planted medians.

Revised 3/16/09

Rainfall Intensity Values
Utilized by South Carolina Department of Transportation

Rainfall intensity values utilized by the South Carolina Department of Transportation are computed by the following formula:

$$i = \frac{a}{(b+Tc)^{c}}$$

where: i = rainfall intensity in inches per hour,
Tc = time of concentration in minutes,
and a , b, and c are coefficients.

The coefficients for the 2-, 5-, 10-, 25-, 50-, and 100-year rainfall events are given in the table below for each county in South Carolina. The intensity values for time of concentration of 5, 10, 15, 30, and 60 minutes are also listed in the table for the same frequencies. To use these values compute the time of concentration for the drainage area using the velocity method in the NRCS TR-55 manual. Pick the appropriate county in the tables below to determine the appropriate coefficients. Then apply the equation to obtain the intensity value.

ABBEVILLE

Frequency (years)	Rational Coefficients			Rainfall Intensity ("/hr) for Time of Concentration (T_c)				
	a	b	c	$T_c = 5$	$T_c = 10$	$T_c = 15$	$T_c = 30$	$T_c = 60$
2	59.9700	11.6400	0.8430	5.60	4.49	3.77	2.59	1.64
5	52.0100	10.0900	0.7640	6.54	5.26	4.43	3.10	2.02
10	44.2700	8.3710	0.6978	7.25	5.81	4.91	3.47	2.32
25	37.3900	6.5840	0.6234	8.12	6.49	5.51	3.96	2.73
50	33.5200	5.3490	0.5738	8.77	6.99	5.95	4.33	3.05
100	30.9800	4.3120	0.5327	9.41	7.48	6.38	4.70	3.36

AIKEN

Frequency (years)	Rational Coefficients			Rainfall Intensity ("/hr) for Time of Concentration (T_c)				
	a	b	c	$T_c = 5$	$T_c = 10$	$T_c = 15$	$T_c = 30$	$T_c = 60$
2	70.1300	11.7200	0.8490	6.42	5.14	4.31	2.95	1.86
5	56.3200	9.8490	0.7558	7.33	5.89	4.97	3.48	2.27
10	50.6000	8.4690	0.6994	8.21	6.58	5.57	3.94	2.63
25	43.1600	6.6790	0.6275	9.23	7.38	6.26	4.50	3.09
50	37.4200	5.0350	0.5680	10.10	8.03	6.82	4.96	3.49
100	34.8600	4.0560	0.5277	10.90	8.64	7.36	5.42	3.88

EDGEFIELD

Frequency (years)	Rational Coefficients			Rainfall Intensity (“/hr) for Time of Concentration (T_c)				
	a	b	c	T_c = 5	T_c = 10	T_c = 15	T_c = 30	T_c = 60
2	62.9900	11.2500	0.8340	6.16	4.92	4.13	2.83	1.79
5	56.8600	10.0700	0.7650	7.14	5.73	4.84	3.38	2.20
10	47.5700	8.2840	0.6936	7.91	6.34	5.36	3.80	2.54
25	41.7700	6.7270	0.6284	8.89	7.11	6.04	4.34	2.98
50	37.2700	5.4580	0.5769	9.62	7.68	6.53	4.76	3.34
100	34.8800	4.6290	0.5386	10.30	8.22	7.02	5.17	3.69

FAIRFIELD

Frequency (years)	Rational Coefficients			Rainfall Intensity (“/hr) for Time of Concentration (T_c)				
	a	b	c	T_c = 5	T_c = 10	T_c = 15	T_c = 30	T_c = 60
2	64.4900	11.5800	0.8430	6.04	4.84	4.06	2.78	1.76
5	54.6000	10.0100	0.7599	6.97	5.60	4.73	3.31	2.16
10	47.6400	8.4770	0.6982	7.75	6.22	5.26	3.73	2.49
25	39.8600	6.5420	0.6232	8.68	6.94	5.88	4.23	2.91
50	36.4400	5.4770	0.5782	9.37	7.48	6.36	4.63	3.25
100	31.9400	3.9540	0.5252	10.10	8.00	6.81	5.02	3.60

FLORENCE

Frequency (years)	Rational Coefficients			Rainfall Intensity (“/hr) for Time of Concentration (T_c)				
	a	b	c	T_c = 5	T_c = 10	T_c = 15	T_c = 30	T_c = 60
2	66.7000	11.5700	0.8440	6.24	4.99	4.19	2.87	1.81
5	56.1300	9.9080	0.7601	7.20	5.78	4.87	3.41	2.22
10	48.7400	8.2340	0.6930	8.14	6.52	5.51	3.90	2.61
25	42.7900	6.6630	0.6271	9.17	7.33	6.22	4.47	3.07
50	39.7100	5.7030	0.5818	10.00	8.00	6.81	4.96	3.48
100	36.3300	4.5790	0.5369	10.80	8.62	7.36	5.42	3.88

GEORGETOWN

Frequency (years)	Rational Coefficients			Rainfall Intensity (“/hr) for Time of Concentration (T_c)				
	a	b	c	T_c = 5	T_c = 10	T_c = 15	T_c = 30	T_c = 60
2	72.2600	11.40	0.8380	6.93	5.55	4.65	3.19	2.02
5	61.8000	9.9120	0.7585	7.96	6.39	5.39	3.77	2.47
10	55.8900	8.5230	0.7003	9.02	7.24	6.12	4.33	2.90
25	46.1100	6.3850	0.6202	10.20	8.14	6.90	4.96	3.42
50	42.0400	5.1540	0.5707	11.20	8.91	7.57	5.51	3.88
100	39.0600	4.1520	0.5293	12.10	9.61	8.19	6.03	4.32

NOAA Atlas 14, Volume 2, Version 3
Location name: Pawleys Island, South Carolina, USA*
Latitude: 33.4851°, Longitude: -79.1277°
Elevation: 4.65 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.508 (0.473-0.549)	0.596 (0.555-0.645)	0.685 (0.635-0.740)	0.775 (0.717-0.836)	0.873 (0.804-0.942)	0.957 (0.877-1.03)	1.04 (0.944-1.12)	1.11 (1.01-1.20)	1.21 (1.09-1.31)	1.30 (1.16-1.41)
10-min	0.812 (0.756-0.878)	0.954 (0.888-1.03)	1.10 (1.02-1.19)	1.24 (1.15-1.34)	1.39 (1.28-1.50)	1.52 (1.40-1.64)	1.65 (1.50-1.78)	1.77 (1.60-1.91)	1.92 (1.72-2.07)	2.05 (1.82-2.22)
15-min	1.01 (0.945-1.10)	1.20 (1.12-1.30)	1.39 (1.29-1.50)	1.57 (1.45-1.69)	1.76 (1.62-1.90)	1.93 (1.77-2.08)	2.08 (1.90-2.24)	2.23 (2.02-2.40)	2.41 (2.16-2.61)	2.57 (2.29-2.79)
30-min	1.39 (1.30-1.50)	1.66 (1.54-1.79)	1.97 (1.83-2.13)	2.27 (2.10-2.45)	2.61 (2.40-2.82)	2.91 (2.67-3.13)	3.19 (2.91-3.44)	3.47 (3.14-3.74)	3.84 (3.44-4.15)	4.17 (3.70-4.52)
60-min	1.73 (1.62-1.88)	2.08 (1.93-2.25)	2.53 (2.35-2.73)	2.96 (2.74-3.19)	3.48 (3.20-3.75)	3.94 (3.61-4.25)	4.39 (4.00-4.73)	4.87 (4.41-5.25)	5.51 (4.94-5.96)	6.08 (5.41-6.59)
2-hr	2.11 (1.96-2.28)	2.55 (2.36-2.75)	3.16 (2.92-3.42)	3.76 (3.46-4.05)	4.50 (4.12-4.85)	5.14 (4.69-5.54)	5.79 (5.25-6.24)	6.47 (5.82-6.97)	7.38 (6.58-7.98)	8.19 (7.23-8.87)
3-hr	2.27 (2.09-2.47)	2.73 (2.52-2.98)	3.41 (3.13-3.72)	4.09 (3.74-4.44)	4.95 (4.51-5.37)	5.72 (5.17-6.21)	6.51 (5.85-7.06)	7.36 (6.55-7.98)	8.55 (7.51-9.29)	9.61 (8.35-10.5)
6-hr	2.72 (2.49-2.98)	3.28 (3.00-3.60)	4.09 (3.74-4.49)	4.90 (4.47-5.37)	5.96 (5.39-6.52)	6.91 (6.21-7.56)	7.89 (7.03-8.63)	8.96 (7.91-9.79)	10.4 (9.10-11.4)	11.8 (10.2-12.9)
12-hr	3.18 (2.91-3.52)	3.84 (3.49-4.24)	4.82 (4.38-5.33)	5.81 (5.27-6.41)	7.11 (6.39-7.83)	8.30 (7.40-9.12)	9.53 (8.42-10.4)	10.9 (9.52-11.9)	12.8 (11.0-14.0)	14.6 (12.4-16.0)
24-hr	3.92 (3.54-4.34)	4.77 (4.31-5.29)	6.16 (5.56-6.81)	7.30 (6.57-8.07)	8.94 (7.98-9.86)	10.3 (9.14-11.4)	11.8 (10.4-13.0)	13.3 (11.7-14.7)	15.6 (13.6-17.3)	17.5 (15.1-19.4)
2-day	4.54 (4.13-5.03)	5.51 (5.01-6.09)	7.05 (6.39-7.77)	8.31 (7.52-9.16)	10.1 (9.11-11.1)	11.6 (10.4-12.8)	13.2 (11.8-14.6)	15.0 (13.2-16.5)	17.5 (15.2-19.3)	19.5 (16.9-21.7)
3-day	4.75 (4.34-5.24)	5.75 (5.25-6.33)	7.31 (6.65-8.03)	8.58 (7.78-9.42)	10.4 (9.38-11.4)	11.9 (10.7-13.0)	13.5 (12.0-14.8)	15.2 (13.4-16.7)	17.6 (15.4-19.4)	19.6 (17.0-21.8)
4-day	4.97 (4.54-5.45)	5.99 (5.48-6.58)	7.58 (6.91-8.29)	8.85 (8.05-9.68)	10.7 (9.64-11.6)	12.1 (10.9-13.3)	13.7 (12.3-15.0)	15.3 (13.7-16.8)	17.7 (15.6-19.5)	19.6 (17.2-21.9)
7-day	5.78 (5.33-6.29)	6.96 (6.43-7.57)	8.69 (8.00-9.43)	10.1 (9.26-10.9)	12.0 (11.0-13.0)	13.5 (12.3-14.7)	15.2 (13.7-16.5)	16.9 (15.2-18.3)	19.3 (17.2-21.0)	21.2 (18.9-23.2)
10-day	6.50 (6.04-7.02)	7.80 (7.24-8.41)	9.57 (8.88-10.3)	11.0 (10.1-11.8)	12.8 (11.8-13.8)	14.3 (13.2-15.4)	15.9 (14.5-17.1)	17.5 (15.9-18.8)	19.6 (17.8-21.2)	21.4 (19.3-23.2)
20-day	8.81 (8.21-9.47)	10.5 (9.78-11.3)	12.7 (11.8-13.6)	14.4 (13.4-15.4)	16.7 (15.5-17.9)	18.5 (17.1-19.9)	20.4 (18.8-21.9)	22.3 (20.4-24.0)	24.9 (22.7-26.9)	27.0 (24.5-29.2)
30-day	10.8 (10.1-11.5)	12.8 (12.0-13.6)	15.2 (14.2-16.1)	17.0 (15.9-18.1)	19.4 (18.1-20.6)	21.3 (19.8-22.6)	23.2 (21.5-24.6)	25.0 (23.1-26.6)	27.5 (25.3-29.4)	29.5 (27.0-31.5)
45-day	13.7 (12.9-14.6)	16.2 (15.2-17.2)	18.9 (17.8-20.1)	21.0 (19.7-22.3)	23.7 (22.2-25.2)	25.7 (24.1-27.4)	27.8 (25.9-29.6)	29.8 (27.7-31.8)	32.5 (30.1-34.7)	34.6 (31.9-37.0)
60-day	16.4 (15.4-17.3)	19.3 (18.2-20.4)	22.3 (21.0-23.7)	24.6 (23.2-26.1)	27.6 (25.9-29.2)	29.8 (28.0-31.6)	32.0 (29.9-34.0)	34.2 (31.8-36.3)	37.0 (34.4-39.4)	39.1 (36.2-41.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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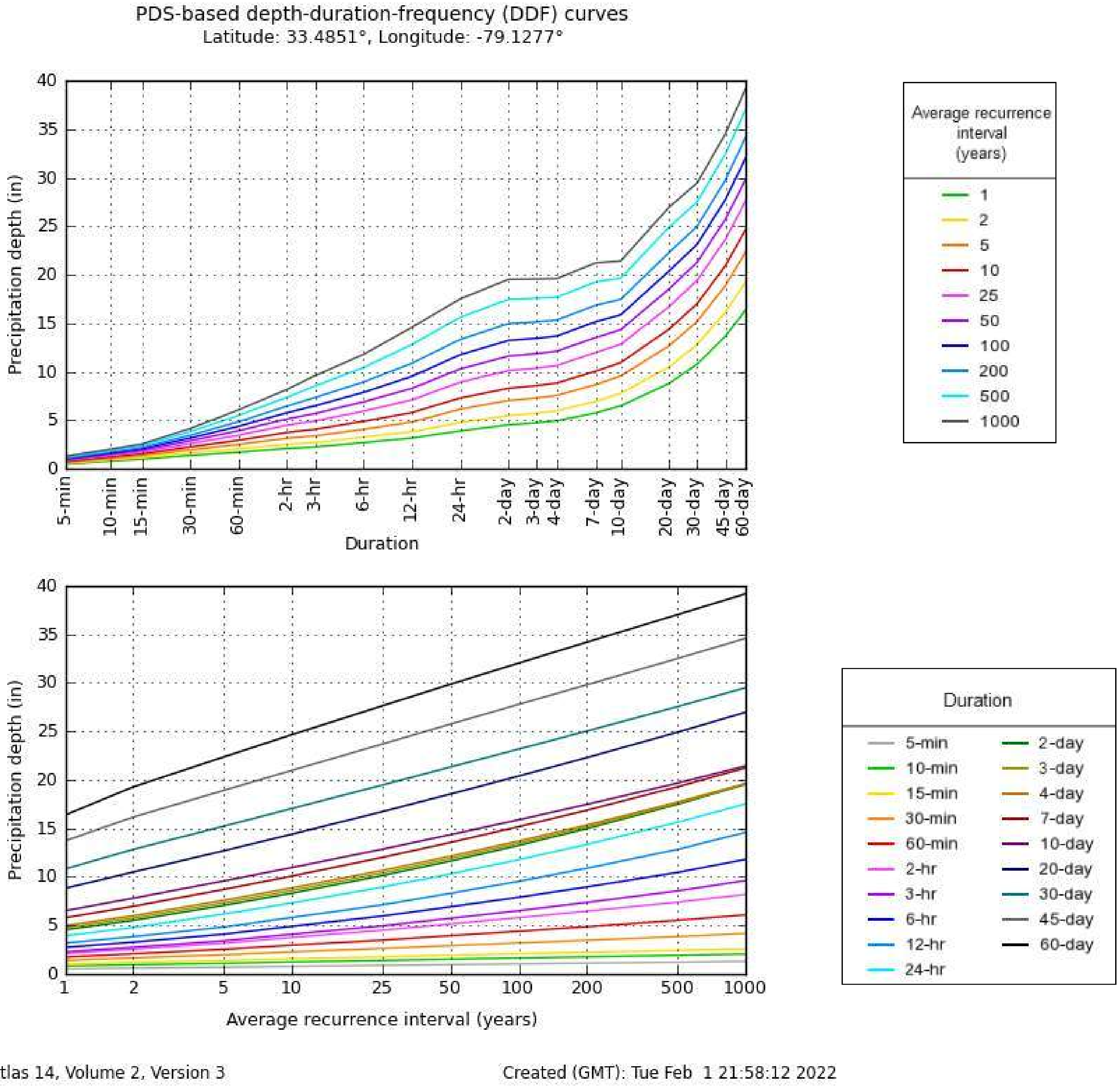
PF graphical



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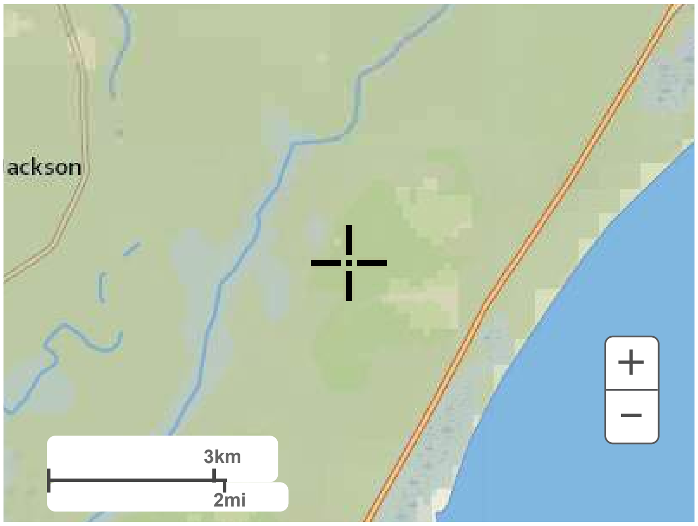
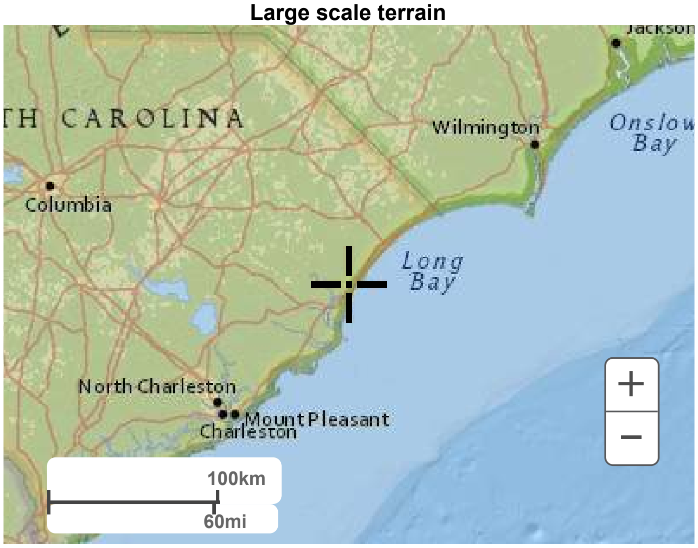
Maps & aerials

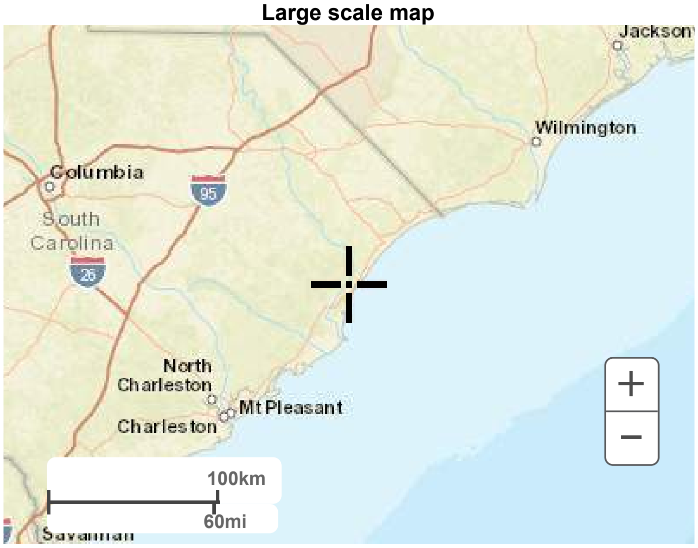
Small scale terrain



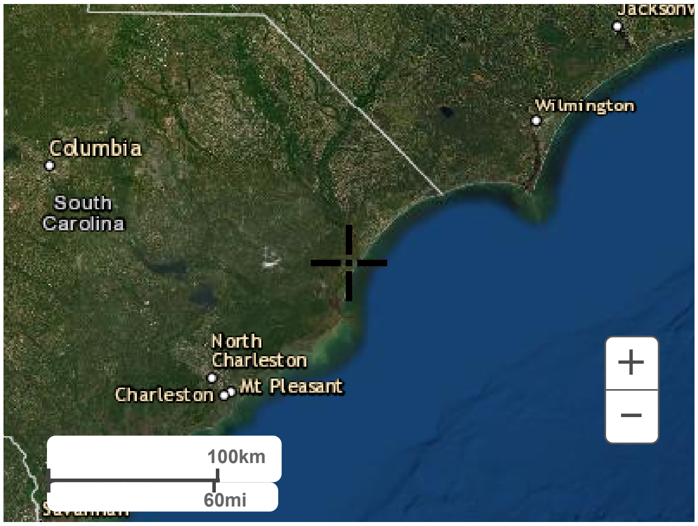
Large scale terrain



Large scale map



Large scale aerial



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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

Worksheet for CH-1 Area 6

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.035
Channel Slope	0.010 ft/ft
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Discharge	6.84 cfs

Results

Normal Depth	11.5 in
Flow Area	2.7 ft²
Wetted Perimeter	6.0 ft
Hydraulic Radius	5.4 in
Top Width	5.73 ft
Critical Depth	9.6 in
Critical Slope	0.026 ft/ft
Velocity	2.50 ft/s
Velocity Head	0.10 ft
Specific Energy	1.05 ft
Froude Number	0.639
Flow Type	Subcritical

GVF Input Data

Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	11.5 in
Critical Depth	9.6 in
Channel Slope	0.010 ft/ft
Critical Slope	0.026 ft/ft

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APPENDIX C-2

Peak Rate Calculations

Willbrook Plantation
CB-1-2
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.040	0.3	0.012
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.065	0.9	0.058
	0.105		0.070

C_w= 0.672

Willbrook Plantation
CB-1-3
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	**C**	C*AREA
Grass	0.019	0.3	0.006
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.055	0.9	0.049
	0.074		0.055

C_w= 0.743

Willbrook Plantation
CB-1-4
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.077	0.3	0.023
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.105	0.9	0.095
	0.182		0.118

C_w= 0.646

Willbrook Plantation
CB-1-5
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA	
Grass	0.209	0.3	0.063	
Woods	0.000	0.25	0.000	
Residential	0.000	0.54	0.000	C_w= 0.660
Impervious	0.313	0.9	0.281	
	0.521		0.344	

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Location CB-1-5
Circle one: [✓ Present] Developed
Circle one: [✓ T_c] T_t

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID		AB				
1. Surface description			Impervious				
2. Manning's roughness coeff., n			0.011				
3. Flow length, L (total L < 150 ft)		ft	18.50				
4. Two-yr 24-hr rainfall, P2		in	4.77				
5. Land slope, s		ft/ft	0.010				
6. $T_t = \dfrac{0.007\,(nL)^{0.8}}{P_2^{0.5}s^{0.4}}$	Compute T_t	hr	0.006	+		=	0.006

Shallow Concentrated Flow	Segment ID		BC				
7. Surface description (paved or unpaved)			Paved				
8. Flow length, L		ft	1754.10				
9. Watercourse slope, s		ft/ft	0.003				
10. Average velocity, V (from TR-55 Fig 3-1)		ft/s	1.02				
11. $T_t = \dfrac{L}{3600V}$	Compute T_t	hr	0.478	+		=	0.478

Channel Flow	Segment ID						
12. Cross sectional flow area, a		ft^2					
13. Wetted perimeter, p_w		ft					
14. Hydraulic radius, $r = \dfrac{a}{p_w}$		ft					
15. Channel slope, s		ft/ft					
16. Manning's roughness coeff., n							
17. $V = \dfrac{1.49r^{2/3}s^{1/2}}{n}$	Compute V	ft/s					
18. Flow length, L		ft					
19. $T_t = \dfrac{L}{3600V}$	Compute T_t	hr		+		=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr	0.483
	min	29.0

Willbrook Plantation
CB-1-6
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.805	0.3	0.241
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.059	0.9	0.053
	0.864		0.295

C_w= 0.341

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Location CB-1-6

Circle one: [✓ Present] Developed

Circle one: [✓ T_c] T_t

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID		AB		BC		
1. Surface description			Grass		Imp		
2. Manning's roughness coeff., n			0.240		0.240		
3. Flow length, L (total L < 150 ft)		ft	61.00		80.00		
4. Two-yr 24-hr rainfall, P2		in	4.77		4.77		
5. Land slope, s		ft/ft	0.030		0.008		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.112	+	0.241	=	0.354

Shallow Concentrated Flow	Segment ID		BC				
7. Surface description (paved or unpaved)			Unpaved				
8. Flow length, L		ft	240.67				
9. Watercourse slope, s		ft/ft	0.010				
10. Average velocity, V (from TR-55 Fig 3-1)		ft/s	1.58				
11. $T_t = \frac{L}{3600V}$	Compute T_t	hr	0.042	+		=	0.042

Channel Flow	Segment ID						
12. Cross sectional flow area, a		ft^2					
13. Wetted perimeter, p_w		ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$		ft					
15. Channel slope, s		ft/ft					
16. Manning's roughness coeff., n							
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute V	ft/s					
18. Flow length, L		ft					
19. $T_t = \frac{L}{3600V}$	Compute T_t	hr		+		=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr	0.396
	min	23.7

Willbrook Plantation
CB-1-7
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	1.260	0.3	0.378
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.347	0.9	0.312
	1.606		0.690

C_w= 0.429

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Location CB-1-7

Circle one: [✓ Present] Developed

Circle one: [✓ T_c] T_t

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

	Segment ID		AB				
1. Surface description			Grass				
2. Manning's roughness coeff., n			0.240				
3. Flow length, L (total L < 150 ft)		ft	113.20				
4. Two-yr 24-hr rainfall, P2		in	4.77				
5. Land slope, s		ft/ft	0.016				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}s^{0.4}}$	Compute T_t	hr	0.237	+		=	0.237

Shallow Concentrated Flow

	Segment ID						
7. Surface description (paved or unpaved)							
8. Flow length, L		ft					
9. Watercourse slope, s		ft/ft					
10. Average velocity, V (from TR-55 Fig 3-1)		ft/s					
11. $T_t = \frac{L}{3600V}$	Compute T_t	hr		+		=	

Channel Flow

	Segment ID		BC				
12. Cross sectional flow area, a		ft^2	0.10				
13. Wetted perimeter, p_w		ft	6.50				
14. Hydraulic radius, $r = \frac{a}{p_w}$		ft	0.02				
15. Channel slope, s		ft/ft	0.008				
16. Manning's roughness coeff., n			0.013				
17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$	Compute V	ft/s	0.65				
18. Flow length, L		ft	234.00				
19. $T_t = \frac{L}{3600V}$	Compute T_t	hr	0.101	+		=	0.101

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)

hr	0.338
min	20.3

Willbrook Plantation
CB-1-8
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.599	0.3	0.180
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.187	0.9	0.169
	0.786		0.348

C_w= 0.443

Willbrook Plantation
CB-1-9
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA	
Grass	0.130	0.3	0.039	
Woods	0.000	0.25	0.000	
Residential	0.000	0.54	0.000	C_w= 0.528
Impervious	0.080	0.9	0.072	
	0.210		0.111	

Willbrook Plantation
CB-1-10
Heston Point

Rational C Determination

LAND USE	AREA (Acres)	**C**	C*AREA
Grass	2.075	0.3	0.622
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.000	0.9	0.000
	2.075		0.622

C_w= 0.300

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Location CB-1-10
Circle one: [✓ Present] Developed
Circle one: [✓ T_c] T_t

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID		AB				
1. Surface description			Grass				
2. Manning's roughness coeff., n			0.240				
3. Flow length, L (total L < 150 ft)		ft	62.40				
4. Two-yr 24-hr rainfall, P2		in	4.77				
5. Land slope, s		ft/ft	0.075				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.079	+		=	0.079

Shallow Concentrated Flow	Segment ID		BC				
7. Surface description (paved or unpaved)			Unpaved				
8. Flow length, L		ft	362.50				
9. Watercourse slope, s		ft/ft	0.007				
10. Average velocity, V (from TR-55 Fig 3-1)		ft/s	1.32				
11. $T_t = \frac{L}{3600V}$	Compute T_t	hr	0.076	+		=	0.076

Channel Flow	Segment ID						
12. Cross sectional flow area, a		ft^2					
13. Wetted perimeter, p_w		ft					
14. Hydraulic radius, $r = \frac{a}{p_w}$		ft					
15. Channel slope, s		ft/ft					
16. Manning's roughness coeff., n							
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute V	ft/s					
18. Flow length, L		ft					
19. $T_t = \frac{L}{3600V}$	Compute T_t	hr		+		=	

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr	0.155
	min	9.3

Willbrook Plantation
CB-2-1
Oatland Lake Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	1.190	0.3	0.357
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.440	0.9	0.396
	1.631		0.753

C_w= 0.462

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Location CB-2-1
Circle one: [✓ Present] Developed
Circle one: [✓ T_c] T_t

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)

Segment ID		AB		BC		
1. Surface description		Grass		Imp		
2. Manning's roughness coeff., n		0.240		0.011		
3. Flow length, L (total L < 150 ft)	ft	69.00		40.00		
4. Two-yr 24-hr rainfall, P2	in	4.77		7.44		
5. Land slope, s	ft/ft	0.071		0.017		
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t	hr	0.087	+	0.007	=	0.094

Shallow Concentrated Flow

Segment ID						
7. Surface description (paved or unpaved)						
8. Flow length, L	ft					
9. Watercourse slope, s	ft/ft					
10. Average velocity, V (from TR-55 Fig 3-1)	ft/s					
11. $T_t = \frac{L}{3600V}$ Compute T_t	hr		+		=	

Channel Flow

Segment ID		CD				
12. Cross sectional flow area, a	ft^2	0.10				
13. Wetted perimeter, p_w	ft	6.50				
14. Hydraulic radius, $r = \frac{a}{p_w}$	ft	0.02				
15. Channel slope, s	ft/ft	0.004				
16. Manning's roughness coeff., n		0.013				
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s	0.47				
18. Flow length, L	ft	322.00				
19. $T_t = \frac{L}{3600V}$ Compute T_t	hr	0.189	+		=	0.189

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr	0.283
	min	17.0

Willbrook Plantation
CB-2-2
Oatland Lake Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.927	0.3	0.278
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.165	0.9	0.148
	1.092		0.427

C_w= 0.391

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Location CB-2-2
Circle one: [✓ Present] Developed
Circle one: [✓ T_c] T_t

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet Flow	(Applicable to T_c only)	Segment ID	AB				
1. Surface description			Grass				
2. Manning's roughness coeff., n			0.240				
3. Flow length, L (total L < 150 ft)		ft	51.60				
4. Two-yr 24-hr rainfall, P2		in	4.77				
5. Land slope, s		ft/ft	0.097				
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$	Compute T_t	hr	0.061	+		=	0.061

Shallow Concentrated Flow		Segment ID					
7. Surface description (paved or unpaved)							
8. Flow length, L		ft					
9. Watercourse slope, s		ft/ft					
10. Average velocity, V (from TR-55 Fig 3-1)		ft/s					
11. $T_t = \frac{L}{3600V}$	Compute T_t	hr		+		=	

Channel Flow		Segment ID	CD				
12. Cross sectional flow area, a		ft^2	0.10				
13. Wetted perimeter, p_w		ft	6.50				
14. Hydraulic radius, $r = \frac{a}{p_w}$		ft	0.02				
15. Channel slope, s		ft/ft	0.008				
16. Manning's roughness coeff., n			0.013				
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$	Compute V	ft/s	0.62				
18. Flow length, L		ft	202.39				
19. $T_t = \frac{L}{3600V}$	Compute T_t	hr	0.091	+		=	0.091

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr	0.152
	min	9.1

Willbrook Plantation
CB-2-3
Oatland Lake Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.579	0.3	0.174
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.360	0.9	0.324
	0.939		0.498

C_w= 0.530

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Location CB-2-3
Circle one: [✓ Present] Developed
Circle one: [✓ T_c] T_t

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to T_c only)	Segment ID	AB				
1. Surface description		Grass				
2. Manning's roughness coeff., n		0.240				
3. Flow length, L (total L < 150 ft)	ft	83.88				
4. Two-yr 24-hr rainfall, P2	in	4.77				
5. Land slope, s	ft/ft	0.125				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t	hr	0.081	+		=	0.081

Shallow Concentrated Flow	Segment ID					
7. Surface description (paved or unpaved)						
8. Flow length, L	ft					
9. Watercourse slope, s	ft/ft					
10. Average velocity, V (from TR-55 Fig 3-1)	ft/s					
11. $T_t = \frac{L}{3600V}$ Compute T_t	hr		+		=	

Channel Flow	Segment ID	CD				
12. Cross sectional flow area, a	ft^2	0.10				
13. Wetted perimeter, p_w	ft	6.50				
14. Hydraulic radius, $r = \frac{a}{p_w}$	ft	0.02				
15. Channel slope, s	ft/ft	0.008				
16. Manning's roughness coeff., n		0.013				
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V	ft/s	0.63				
18. Flow length, L	ft	190.58				
19. $T_t = \frac{L}{3600V}$ Compute T_t	hr	0.084	+		=	0.084

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr	0.165
	min	9.9

Willbrook Plantation
CB-2-4
Oatland Lake Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.956	0.3	0.287
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.123	0.9	0.111
	1.079		0.398

C_w= 0.369

Worksheet 3: Time of concentration (T_c) or travel time (T_t)

Location CB-2-4

Circle one: [✓ Present] Developed

Circle one: [✓ T_c] T_t

NOTES: Space for as many as two segments per flow type can be used for each worksheet.

Include a map, schematic, or description of flow segments.

Sheet Flow	(Applicable to T_c only)	Segment ID	AB				
1. Surface description			Grass				
2. Manning's roughness coeff., n			0.240				
3. Flow length, L (total L < 150 ft)		ft	83.88				
4. Two-yr 24-hr rainfall, P2		in	4.77				
5. Land slope, s		ft/ft	0.020				
6. $T_t = \frac{0.007\ (nL)^{0.8}}{P_2^{0.5}s^{0.4}}$	Compute T_t	hr	0.169	+		=	0.169

Shallow Concentrated Flow		Segment ID	BC				
7. Surface description (paved or unpaved)			Unpaved				
8. Flow length, L		ft	34.00				
9. Watercourse slope, s		ft/ft	0.015				
10. Average velocity, V (from TR-55 Fig 3-1)		ft/s	1.96				
11. $T_t = \frac{L}{3600V}$	Compute T_t	hr	0.005	+		=	0.005

Channel Flow		Segment ID	CD				
12. Cross sectional flow area, a		ft^2	0.10				
13. Wetted perimeter, p_w		ft	6.50				
14. Hydraulic radius, $r = \frac{a}{p_w}$		ft	0.02				
15. Channel slope, s		ft/ft	0.010				
16. Manning's roughness coeff., n			0.013				
17. $V = \frac{1.49r^{2/3}s^{1/2}}{n}$	Compute V	ft/s	0.71				
18. Flow length, L		ft	97.00				
19. $T_t = \frac{L}{3600V}$	Compute T_t	hr	0.038	+		=	0.038

20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)	hr	0.212
	min	12.7

Willbrook Plantation
CB-3-1
Chapman Loop / Heston Point Dr

Rational C Determination

LAND USE	AREA (Acres)	**C**	C*AREA
Grass	0.112	0.3	0.034
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.163	0.9	0.146
	0.275		0.180

C_w= 0.655

Willbrook Plantation
CB-3-2
Chapman Loop / Heston Point Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.000	0.3	0.000
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.160	0.9	0.144
	0.160		0.144

C_w= 0.900

Willbrook Plantation
CB-3-3
Chapman Loop / Heston Point Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.030	0.3	0.009
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.073	0.9	0.066
	0.103		0.074

C_w= 0.726

Willbrook Plantation
CB-3-4
Chapman Loop / Heston Point Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.007	0.3	0.002
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.105	0.9	0.095
	0.112		0.097

C_w= 0.865

Willbrook Plantation
CB-3-5
Chapman Loop / Heston Point Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.000	0.3	0.000
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.109	0.9	0.098
	0.109		0.098

C_w= 0.900

Willbrook Plantation
CH-1
Heston Point Dr

Rational C Determination

LAND USE	AREA (Acres)	C	C*AREA
Grass	0.866	0.3	0.260
Woods	0.000	0.25	0.000
Residential	0.000	0.54	0.000
Impervious	0.553	0.9	0.498
	1.419		0.758

C_w= 0.534

Flow to channel

i_{10} = 9.02

Q_{10}= ($c*i_{10}*A$= **6.84** cfs)+ (Bypass= 0.00)

Q_{10}= **6.84**

Storm Sewer Tabulation

System 1

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	38.296	0.01	6.42	0.30	0.00	2.75	5.0	31.2	4.2	11.67	15.93	5.61	24	0.50	3.56	3.75	4.79	5.04	6.79	7.06	NP-1-1
2	1	43.158	0.10	6.41	0.67	0.07	2.75	5.0	30.9	4.3	11.70	0.00	3.31	18(2b)	-0.09	3.79	3.75	5.49	5.61	7.06	7.47	NP-1-2
3	2	63.131	0.79	3.07	0.44	0.35	1.18	5.0	10.9	7.0	8.29	0.00	2.67	24	-0.48	3.98	3.68	5.86	5.93	7.47	7.98	NP-1-3
4	3	74.180	0.21	2.28	0.53	0.11	0.84	5.0	10.2	7.2	6.00	4.55	1.91	24	0.04	3.72	3.75	6.00	6.05	7.98	6.12	NP-1-4
5	4	43.268	2.07	2.07	0.35	0.72	0.72	9.8	9.8	7.3	5.28	40.81	2.36	24	2.77	3.74	4.94	6.08	6.02	6.12	7.36	NP-1-5
6	2	166.252	0.07	3.24	0.74	0.05	1.50	5.0	29.6	4.4	6.53	18.42	2.08	24	0.57	2.60	3.54	5.86	5.98	7.47	7.26	NP-1-6
7	6	49.649	0.18	3.17	0.65	0.12	1.44	5.0	29.2	4.4	6.35	19.67	2.02	24	0.64	3.38	3.70	6.01	6.05	7.26	7.28	NP-1-7
8	7	41.742	0.52	2.99	0.66	0.34	1.33	29.0	29.0	4.4	5.86	0.00	3.32	18	-0.65	3.62	3.35	6.14	6.27	7.28	6.99	NP-1-8
9	8	41.040	1.61	1.61	0.43	0.69	0.69	20.3	20.3	5.3	3.68	11.37	2.08	18	1.00	3.63	4.04	6.53	6.57	6.99	6.98	NP-1-9
10	8	23.102	0.86	0.86	0.34	0.29	0.29	23.7	23.7	4.9	1.44	0.48	16.46	4	5.45	4.99	6.25	6.53	17.76	6.99	7.40	NP-1-10

Project File: HestonPt_System1.stm

Number of lines: 10

Run Date: 2/7/2022

NOTES:Intensity = 55.89 / (Inlet time + 8.52) ^ 0.70; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

System 2

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	49.187	1.63	4.83	0.46	0.75	2.15	17.0	17.0	5.8	12.45	7.34	7.28	18	0.49	3.05	3.29	4.38	5.14	8.10	7.10	NP-2-1
2	1	202.101	1.09	3.20	0.39	0.43	1.40	9.1	16.0	5.9	8.35	9.05	4.73	18	0.63	3.46	4.74	5.53	6.62	7.10	8.10	NP-2-2
3	2	26.264	0.94	2.11	0.53	0.50	0.98	9.9	15.9	6.0	5.84	7.36	3.31	18	0.42	4.85	4.96	6.91	6.98	8.10	7.94	NP-2-3
4	3	338.792	1.08	1.17	0.37	0.40	0.48	12.7	12.7	6.6	3.16	8.01	2.26	18	0.50	4.94	6.62	7.24	7.56	7.94	10.50	NP-2-4
5	4	64.529	0.09	0.09	0.90	0.08	0.08	5.0	5.0	9.0	0.73	8.01	1.64	18	0.50	6.69	7.01	7.66	7.33	10.50	10.34	NP-2-5

Project File: OatlandLake_System2.stm

Number of lines: 5

Run Date: 2/7/2022

NOTES:Intensity = 55.89 / (Inlet time + 8.52) ^ 0.70; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

System 3

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	23.663	0.00	0.22	0.00	0.00	0.19	0.0	6.9	8.2	1.59	17.45	3.13	24	0.51	2.70	2.82	3.14	3.26	6.70	7.45	NP-3-5
2	1	22.739	0.11	0.22	0.90	0.10	0.19	5.0	6.2	8.5	1.65	17.80	3.21	24	0.53	2.82	2.94	3.26	3.38	7.45	6.94	NP-3-6
3	2	19.428	0.11	0.11	0.86	0.09	0.09	5.0	5.0	9.0	0.85	15.72	2.67	24	0.41	3.14	3.22	3.46	3.54	6.94	7.03	NP-3-7
4	End	144.127	0.27	0.53	0.66	0.18	0.40	5.0	451.2	0.8	0.31	21.98	2.05	24	0.80	1.42	2.58	1.61	2.77	5.46	6.52	NP-3-1
5	4	47.391	0.10	0.26	0.73	0.07	0.22	5.0	450.0	0.8	0.18	21.94	1.93	24	0.80	2.66	3.04	2.79	3.18	6.52	6.94	NP-3-2
6	5	30.890	0.16	0.16	0.90	0.14	0.14	5.0	5.0	9.0	1.30	38.94	4.34	24	2.53	3.23	4.01	3.48	4.40	6.94	7.02	NP-3-3
7	5	85.934	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	17.33	0.32	24	0.50	2.84	3.27	3.18	3.31	6.94	7.83	NP-3-4

Project File: ChapmanHeston_System3.stm

Number of lines: 7

Run Date: 2/7/2022

NOTES:Intensity = 55.89 / (Inlet time + 8.52) ^ 0.70; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

System 4

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	112.310	0.27	0.27	0.90	0.24	0.24	5.0	5.0	9.0	2.19	0.92	6.32	8	0.50	5.67	6.23	6.31	9.28	6.23	7.71	NP-4-8
2	End	211.759	0.00	0.17	0.00	0.00	0.15	0.0	1126.3	0.4	0.07	0.00	0.02	24	-1.43	9.47	6.44	13.09	13.09	11.50	9.71	NP-4-7
3	2	99.253	0.00	0.17	0.00	0.00	0.15	0.0	1122.3	0.4	0.07	0.00	0.02	24	-0.34	6.67	6.33	13.09	13.09	9.71	9.93	NP-4-1
4	3	228.562	0.00	0.17	0.00	0.00	0.15	0.0	1113.4	0.4	0.07	2.29	0.02	24	0.01	6.03	6.05	13.09	13.09	9.93	9.95	NP-4-2
5	4	65.786	0.00	0.17	0.00	0.00	0.15	0.0	1110.9	0.4	0.07	35.23	0.02	24	2.07	6.07	7.43	13.09	13.09	9.95	11.06	NP-4-3
6	5	108.584	0.00	0.00	0.00	0.00	0.00	0.0	542.4	0.0	0.01	18.81	0.00	24	0.59	8.12	8.76	13.09	13.09	11.06	11.64	NP-4-4
7	6	103.587	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.01	0.00	0.00	24	-0.25	8.96	8.70	13.09	13.09	11.64	12.70	NP-4-5
8	5	25.978	0.17	0.17	0.90	0.15	0.15	5.0	5.0	9.0	1.38	16.65	0.44	24	0.46	-3.20	-3.08	13.09	13.09	11.06	0.00	NP-4-6

Project File: Chapman_System4.stm

Number of lines: 8

Run Date: 2/7/2022

NOTES:Intensity = 55.89 / (Inlet time + 8.52) ^ 0.70; Return period =Yrs. 10 ; c = cir e = ellip b = box

Storm Sewer Tabulation

System 5

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	39.801	0.13	0.53	0.90	0.12	0.48	5.0	9.2	7.5	3.56	16.72	2.01	18	2.16	2.25	3.11	6.00	6.04	5.00	12.40	NP-5-1
2	1	335.012	0.17	0.34	0.90	0.15	0.31	5.0	5.6	8.7	2.67	3.78	1.51	18	0.11	3.36	3.73	6.13	6.32	12.40	9.45	NP-5-2
3	2	29.527	0.17	0.17	0.90	0.15	0.15	5.0	5.0	9.0	1.38	10.26	0.78	18	0.81	4.02	4.26	6.37	6.37	9.45	9.50	NP-5-4
4	1	29.692	0.06	0.06	0.90	0.05	0.05	5.0	5.0	9.0	0.49	23.99	0.71	18	4.45	4.37	5.69	6.13	6.12	12.40	0.00	NP-5-3

Project File: Tidewater_System5.stm

Number of lines: 4

Run Date: 2/7/2022

NOTES:Intensity = 55.89 / (Inlet time + 8.52) ^ 0.70; Return period =Yrs. 10 ; c = cir e = ellip b = box