March 2023

DRAINAGE STUDY

WILLBROOK PLANTATION – CHAPMAN LOOP

PAWLEYS ISLAND, SC

Project # 21-00881-002

Submitted to:
Willbrook Plantation

Drainage Study

The purpose of this study is to evaluate the existing storm drainage system and tributary drainage patterns near 279 Chapman Loop in Willbrook Plantation located on Pawleys Island, South Carolina.

A field evaluation was performed by JMT staff on January 16th, 2023 to observe drainage patterns in dry conditions and record topographic information. Once the topographic information was compiled, the JMT team utilized the collected data, along with existing LiDAR contours to analyze the existing storm drainage system's capacity and determine its tributary drainage area.

Figure 1: Chapman Loop Drainage Basin Study Area

Drainage Area Analysis

To delineate the drainage area of the Chapman Loop system, JMT utilized one-foot LiDAR contours provided by the South Carolina Department of Natural Resources (DNR) database, topographic survey, and the observed drainage patterns noted during the January 16th field evaluation. The total drainage area of the storm drainage system was determined to be 19.3 acres. For this study, the overall drainage area was broken into three subareas as outlined below:

- **Manhole A**
  - While Manhole A does not collect surface runoff, it is used as a part of this analysis to "inject", for modeling purposes, the upstream golf course runoff into the downstream Chapman Loop drainage system. The drainage area to Manhole A is 10.1 acres.
- **Inlet 1**
  - Inlet 1 collects the majority of runoff from eastern properties between 123 Chapman Loop and 313 Chapman Loop. The drainage area to Inlet 1 is 6.9 acres.
- **Inlet 2**
  - Inlet 2 collects runoff from the western properties opposite of those in the Inlet 1 drainage area. The drainage area to Inlet 2 is 2.3 acres.

Attachment A outlines the drainage areas as noted above, as well as the drainage system components and elevations recording during the field evaluation.

Storm Drainage System Assessment

By utilizing a survey level, JMT staff established an assumed benchmark at Inlet 1 to determine the downstream storm drainage system grate and pipe invert elevations. As noted in **Attachment A,** a positive pipe slope (draining downstream) was recorded between Inlet 1, Inlet 2, and Inlet 3. It was discovered that the pipe invert elevations of Inlet 4 are the highest elevation in the system, which indicates a negative pipe slope between Inlet 3 and Inlet 4. This negative pipe slope was able to be visually confirmed as Inlet 3 had approximately 20" of standing water in the structure partially filling the downstream pipe (Photo 12 in Photo Log Below) and causing standing water in upstream pipes and inlets on Chapman Loop. In Lowcountry applications, flat or negative pipe slopes are increasingly common due to limited grade changes, however, can have negative effects on the performance of the upstream system components.

Downstream of Inlet 4, the storm drain system continues from 24" plastic pipe to dual 12" PVC pipes leading to Inlet 5, ultimately discharging into a golf course pond. The drainage areas to Inlets 4 and 5 are relatively small and do not influence the functionality of the system.

Findings and Recommendations

As a result of this study, the three findings listed below were discovered to be impacting the hydraulic performance of the storm drainage system on Chapman Loop.

Negative Pipe Slope

As noted in Storm Drainage System Assessment, the 24" pipe between Inlets 3 and 4 was found to have a negative pipe slope (the pipes invert out is higher than its invert in). Conditions like this inhibit the free draining capacity of the system and will cause stormwater runoff to remain in the system after the runoff event has concluded. In this case, the negative slope is causing a 1.5' elevation difference between the structures which is more significant that what we would normally see when negative pipe slopes are encountered. During larger storm events, this can cause stormwater runoff to back up in the system and lead to inlet surcharging (water coming out of the inlet opening) in the upstream Inlets 1&2. Preliminary hydraulic 1-D modeling indicates that this negative pipe slope is leading to surcharging upstream of this pipe, however, extents of the flooding were unable to be confirmed due to the limitations of a traditional 1-D model and topographic information.

Recommendations – Reconstruct the storm drainage system from Inlet 2 to the outfall into the golf course pond to provide positive pipe slopes. This will restore the free-flowing capacity of the system to its designed intent.

Root Intrusion

While it was not evident from the surface, portions of the upstream system near Manhole A and the outfall of the storm drainage system are near mature trees. It was noted in closed-circuit television (CCTV) video inspection that nearby pipe systems had multiple root intrusion incidences that will impede the flow of stormwater runoff and limit the storage capacity of the system. In addition, root intrusion will cause additional clogging of the system when pinestraw and other debris washes down the system.

Recommendations – A complete CCTV inspection is suggested from the outfall into the golf course pond to Manhole A to determine if roots have compromised the function and capacity of the system. Roots should be cut and removed, and any damaged pipe segments should be repaired to restore the pipes integrity.

Pipe Diameter

As the storm drainage system continues through Inlet 4, the pipe diameter decreases from a single 24” pipe to dual 12” pipes. Although it might be understood that two 12” pipes are equivalent to one 24” pipe, this is not necessarily the case. This decrease in pipe sizes causes additional hydraulic losses due to friction in the system at Inlet 4, leading to a decrease in the systems overall efficiency.

Recommendations – The dual 12” pipes from Inlet 4 to the Outfall should be replaced with 24” pipe to match the pipe diameter of the upstream system at a minimum.

Photo Log

Photo 1 - Inlet 1

Photo 2 - Inlet 1 Looking West (Upstream)

Photo 3 - Inlet 1 Interior

Photo 4 - Inlet 2

Photo 5 - Inlet 2 Looking East (Downstream)

Photo 6 - Roadway Section (Inlet 1 in Background)

Photo Log

Photo 7 - Inlet 2 Interior

Photo 8 - Southern High Point Near 123 Chapman Loop

Photo 9 - Northern High Point Near 320 Chapman Loop

Photo 10 - Inlet 3 Looking Southeast (Downstream)

Photo 11 - Inlet 3 Looking West (Upstream)

Photo 12 - Inlet 3 Interior

Photo Log

Photo 13 - Inlet 5 from Inlet 4 Looking Southeast

Photo 14 - System Outlet to Pond

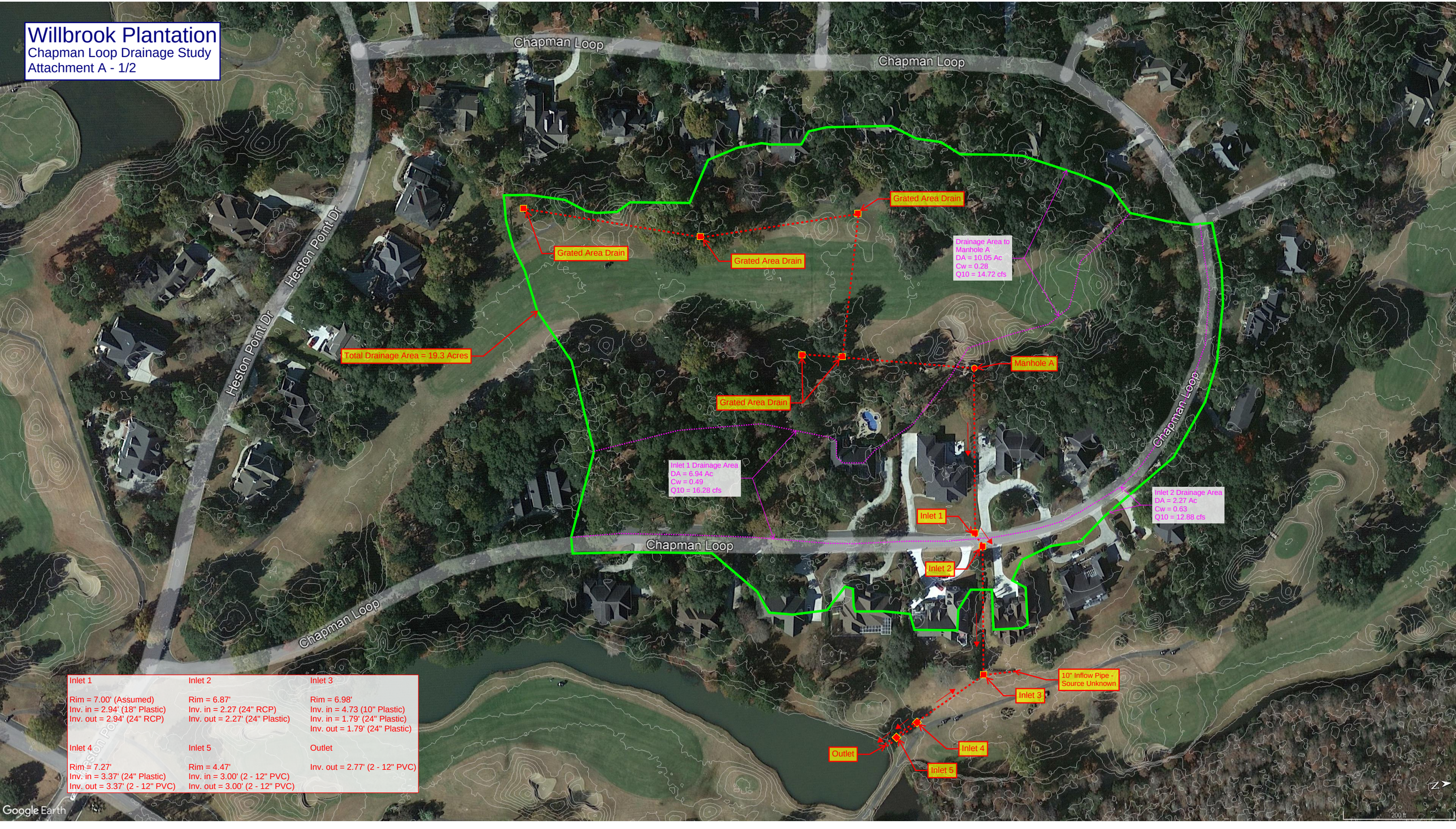
Photo 15 - Manhole A

Photo 16 - Manhole A Looking East (Downstream)

Willbrook Plantation

Chapman Loop Drainage Study

Attachment A - 1/2



Inlet 1	Inlet 2	Inlet 3
Rim = 7.00' (Assumed) Inv. in = 2.94' (18" Plastic) Inv. out = 2.94' (24" RCP)	Rim = 6.87' Inv. in = 2.27 (24" RCP) Inv. out = 2.27' (24" Plastic)	Rim = 6.98' Inv. in = 4.73 (10" Plastic) Inv. in = 1.79' (24" Plastic) Inv. out = 1.79' (24" Plastic)
Inlet 4	**Inlet 5**	**Outlet**
Rim = 7.27' Inv. in = 3.37' (24" Plastic) Inv. out = 3.37' (2 - 12" PVC)	Rim = 4.47' Inv. in = 3.00' (2 - 12" PVC) Inv. out = 3.00' (2 - 12" PVC)	Inv. out = 2.77' (2 - 12" PVC)


Chapman Loop
From Manhole A
Inlet 1
Inlet 2
Recommend full CCTV inspection and pipe cleaning
10" Inflow Pipe - Source Unknown
Recommend reconstruction of system to provide positive drainage
Inlet 3
Recommend replacement of dual 12" pipes to one 24" pipe
Outlet
Inlet 4
Inlet 5
Willbrook Plantation
Chapman Loop Drainage Study
Attachment A - 2/2