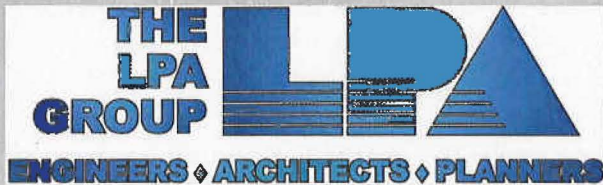


CAROPINES/DEERFIELD STORM DRAINAGE OUTFALL STUDY

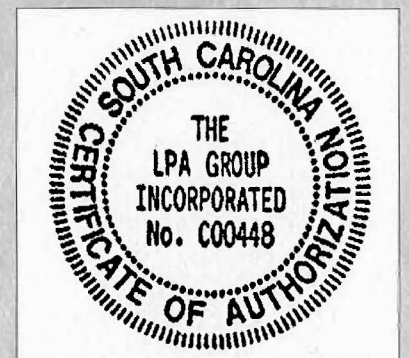
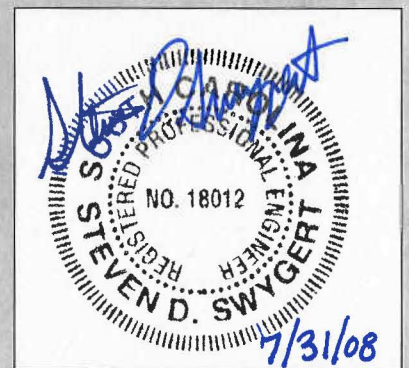
Prepared For:



Prepared By:



JULY 2008 REVISION



**REVISION OF CAROPINES AND DEERFIELD
STORM DRAINAGE OUTFALL STUDY**

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FOR
DRAINAGE CALCULATIONS**

HORRY COUNTY, SOUTH CAROLINA

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PREFACE

The Dogwood Lake Watershed is approximately 1,115 acres and encompasses South Bay Lakes, Caropines Subdivision, Deerfield Subdivision, Mallard Landing, Harbour Village, and a portion of the Town of Surfside bounded by Sixth Avenue North, U.S. Route 17 Business, Fourteenth Avenue North, and the Atlantic Ocean. The majority of the area is residential with some commercial development, especially along U.S. Route 17 Business. The land slopes range from very flat to flat throughout the watershed. The watershed consists of mostly poorly drained soils northwest of U.S. Route 17 Business and well drained soils southeast of U.S. Route 17 Business.

The LPA GROUP INCORPORATED has performed extensive hydrologic and hydraulic study on this watershed for Horry County since the 1990's. Following is a chronology of that work:

April 2000: Original outfall study performed for the Caropines and Deerfield watershed and original report submitted containing suggestions for alleviating flooding within the watershed.

October 2007: Existing model updated to include more detail in the area of Deer Track Golf Course and improvements within the watershed. Improvements made since April 2000 modeled included:

42" RCP added under Glens Bay Rd.
2 new subdivisions, Harbour Village and Mallard Landing Village, constructed with various new ponds and a weir just upstream of Spanish Oak Drive

Draft report submitted for approval.

July 2008: Existing model from October 2007 was updated to include new improvements within the watershed. New improvements since the October 2007 model included:

Channel just upstream of US 17 and adjacent to Bowling Alley replaced with double 60" RCP.
New pond added just upstream of new pipe.

A proposed model was created to reflect the development proposed in the area of the Deer Track Golf Course. This new development is known as The Old South Course, Phases 1A and 1B. Updated models and final report submitted July 2008.

The following computer programs and models were used in the analysis and design of the stormwater systems in this project:

- MicroStation V8
- XP-SWMM, v10.6
- ArcMap v9.2

1.0 PURPOSE OF STUDY

This project involves a detailed analysis of the Caropines and Deerfield drainage outfall. The scope of services includes updating the existing outfall study performed by LPA in 2000 to include all improvements made west of US Route 17 since the time of the original study, as well as a more detailed breakdown of the existing drainage patterns within the Deer Track Golf Course area.

The following Project Location Map and Watershed Maps depict in better detail, the area of the study.

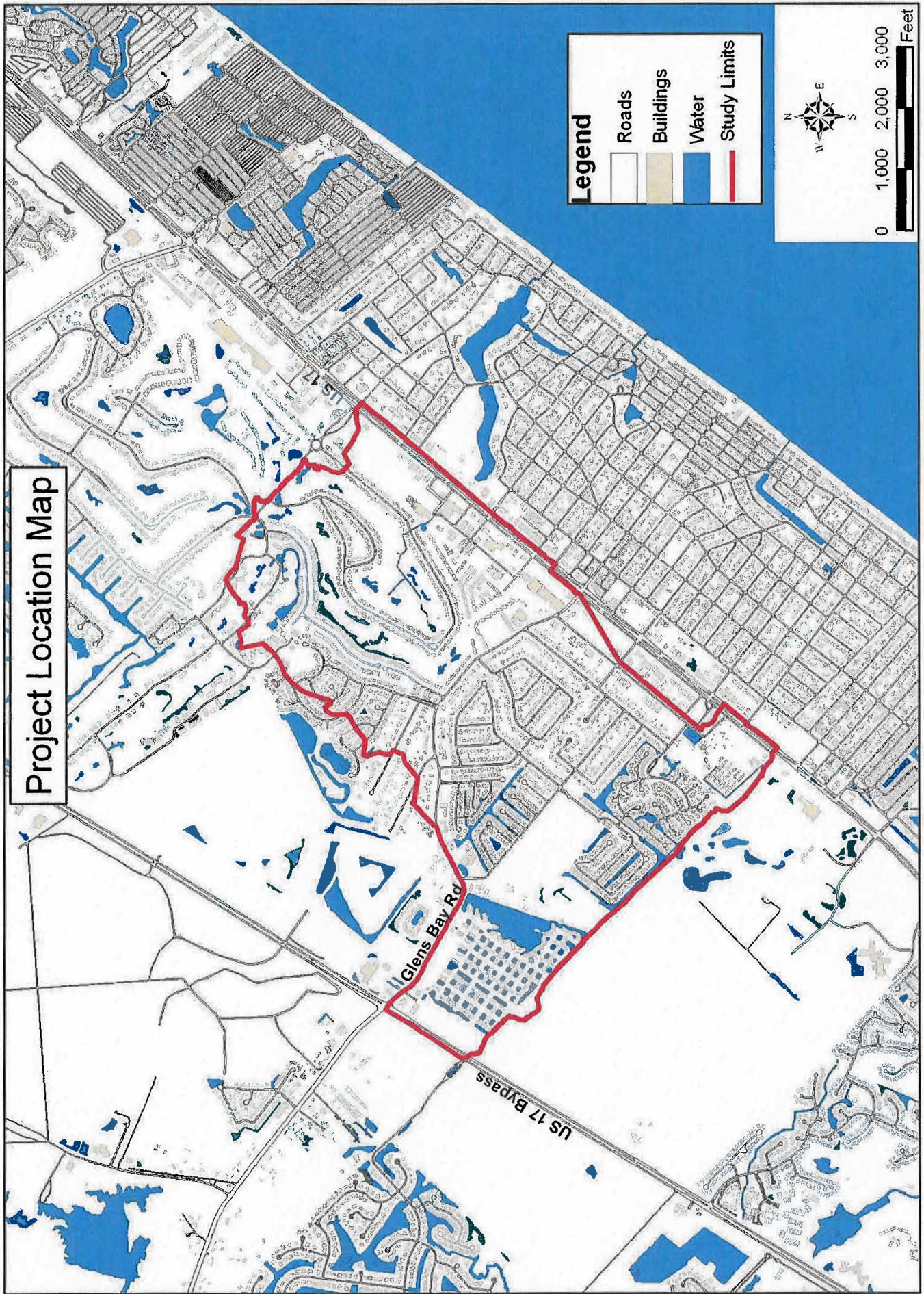
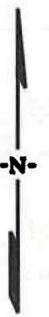
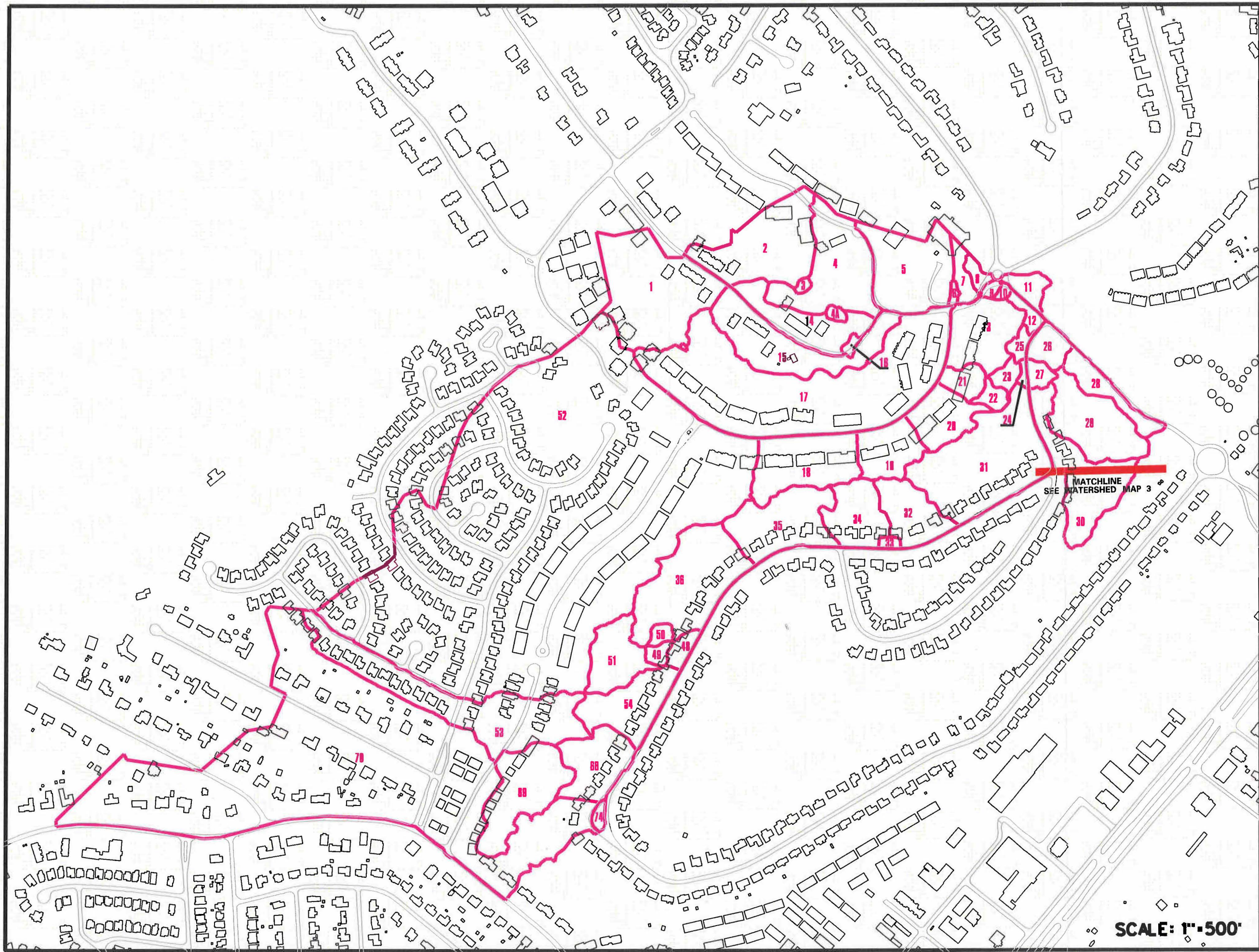


Figure 1-1



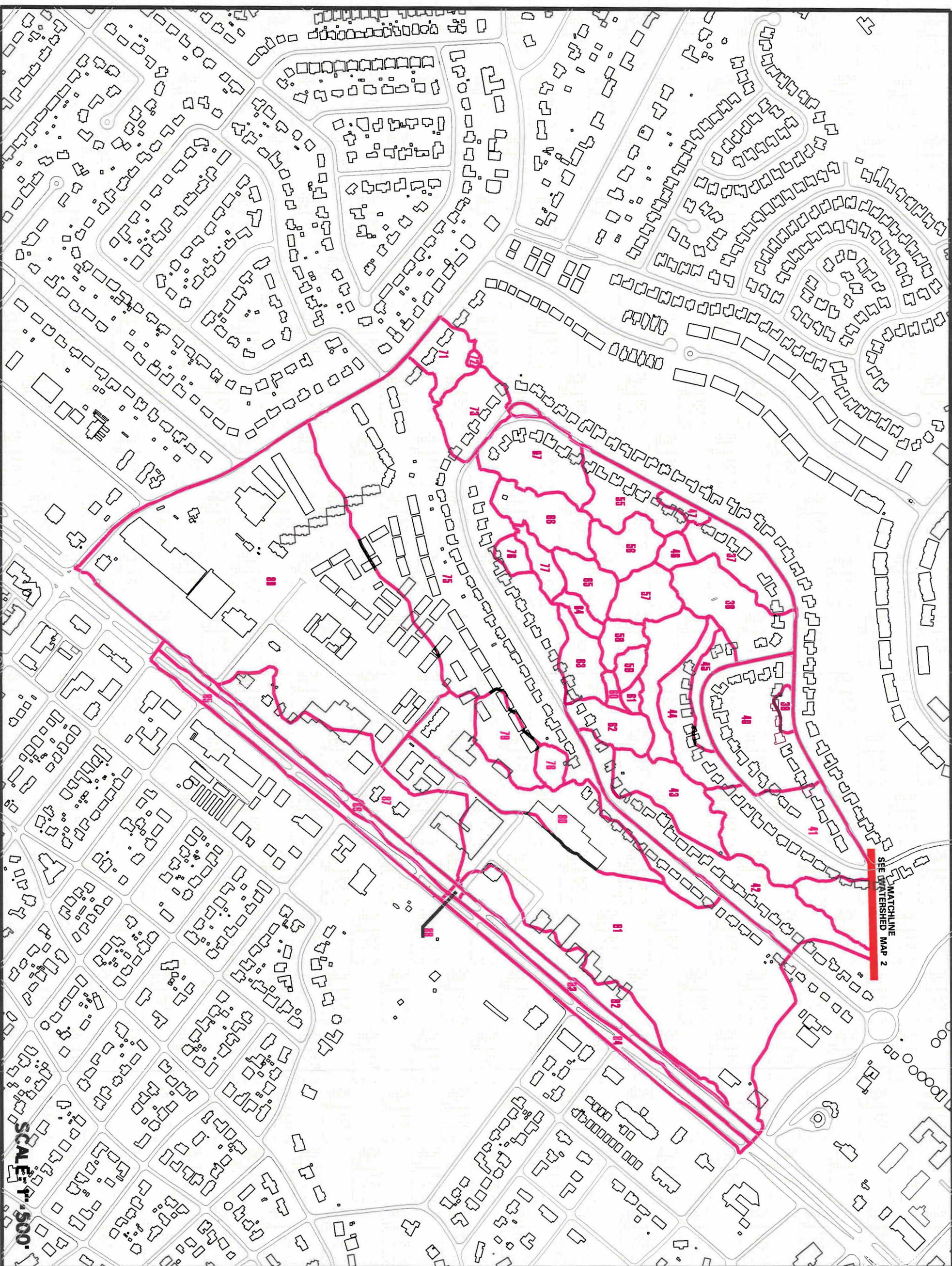
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PHILADELPHIA, PA • RALEIGH, NC • TALLAHASSEE, FL
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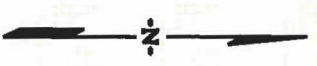
Project Name:
**REVISION OF CAROPINES
AND DEERFIELD STORM
DRAINAGE OUTFALL STUDY**

Drawing Name:
WATERSHED MAP 2

SCALE: 1"=500'



SCALE: 1" = 500'



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Project Name:
**REVISION OF CAROPINES
 AND DEERFIELD STORM
 DRAINAGE OUTFALL STUDY**
 Drawing Name:
WATERSHED MAP 3

Table 1 shows the drainage areas for the 8 major watersheds within the project area.

Watershed	Area (Ac.)
WS 1	117.92
WS 2	61.28
WS 3	49.90
WS 4	48.30
WS 5	28.62
WS 6	60.64
WS 7	154.11
WS 8	412.47

Table 1.

Table 2 shows the drainage areas for the subdivided watersheds within Watershed 8 (Deer Tracks Golf Course).

Watershed	Area (Ac.)	Watershed	Area (Ac.)	Watershed	Area (Ac.)	Watershed	Area (Ac.)
1	6.70	23	0.46	46	0.63	69	3.75
2	4.84	24	0.13	47	0.48	70	33.33
3	0.12	25	0.35	48	0.51	71	2.01
4	4.54	26	0.95	49	0.31	72	0.12
4A	0.17	27	0.43	50	0.28	73	2.91
5	4.25	28	1.43	51	2.23	74	0.12
6	0.12	29	3.57	52	62.65	75	32.92
7	0.67	30	3.96	53	6.98	76	0.66
8	0.35	31	7.08	54	2.89	77	1.04
9	0.17	32	2.25	55	3.12	78	0.74
10	0.13	33	0.16	56	2.13	79	2.58
11	0.69	34	2.33	57	2.07	80	8.14
12	0.40	35	3.76	58	1.02	81	28.88
13	2.94	36	5.50	59	0.66	82	4.13
14	2.63	37	3.08	60	0.36	83	2.94
15	4.33	38	4.46	61	0.34	84	3.35
16	0.16	39	0.44	62	1.96	85	3.20
17	14.85	40	5.86	63	2.20	86	2.46
18	3.79	41	7.42	64	0.64	87	8.44
19	2.08	42	6.99	65	1.68	88	0.09
20	2.03	43	3.56	66	2.92	89	41.10
21	0.81	44	3.23	67	4.40		
22	0.44	45	1.34	68	2.63		

Table 2.

2.0 EXISTING DRAINAGE SYSTEM

Prior to initiating the revisions, a field reconnaissance was performed on July 26, 2007. The purpose of this site visit was to take a general look at the overall watershed and to make note of improvements that have taken place since the original model was completed. An additional visit was made on August 13, 2007 in order to better inventory the existing drainage and to verify the boundaries of tributary watersheds draining through the Deer Track Golf Course area of the project. During the model updating process, a site visit was made on September 18, 2007 in order to obtain a better understanding of the improvements to the new communities in the upper end of the watershed.

Photos taken at the various site visits can be found in Appendix 5.

2.1 EXISTING MODEL UPDATES

In the original model, one general node was used to represent the contributing area from Deer Track Golf Course. In order to obtain a more accurate representation of the contributing area from the golf course, a more detailed breakdown of the individual ponds and their connectivity were added to the revised Draft model that was submitted in October 2007. This data was obtained using a combination of field sight investigation, Horry County contour maps and aerial photography.

Numerous updates within the watershed have occurred since the original study was performed. An additional 42" reinforced concrete cross line pipe was added underneath Glens Bay Road in the main channel at the entrance to Caropines Subdivision.

Two new subdivisions, Harbour Village and Mallard Landing Village, have been constructed since the last study was performed. As part of this new construction, additional ponds were added as well as a weir in the location where the Harbour Village pond empties into the main outfall channel. The changes in these areas were investigated via field sight investigation, Horry County contour maps and aerial photography in order to include the most accurate information possible in the revised model.

A Draft Report was submitted in October 2007 reflecting the updates above. After the time of the Draft submittal, additional improvements were made to the watershed. The portion of the outfall channel that runs parallel to the Bowling Alley at US 17 (XS #10) was replaced with double 60" reinforced concrete pipes, and a pond was added just upstream of these pipes.

2.2. OUTFALL ANALYSIS

All of the new data was input into the revised model in order to obtain the most accurate representation of the current existing conditions possible. Additions to the model included the changes to the watershed that have been implemented since the time of the previous model, as well as the addition of more detail in areas that were more generally modeled previously. The model was run to determine what is currently taking place within the watershed.

Due to the addition of detailed modeling in the Deer Tracks Golf Course, a significant number of potential flooding areas were located within the golf course property. As the revised model included all of the detention ponds located on the golf course, a large volume of stormwater storage was added to the model. This additional storage resulted in the elimination of some flooding in the main outfall channel downstream from the Deer Tracks Golf Course.

Also included in the revised model were changes concerning new housing developments in the area South West of Glens Bay Road. The hydraulic changes caused by these new developments eliminated flooding in the main outfall channel just upstream from Glens Bay Road. However, these changes also created new flooding in the main outfall channel in the area between Spanish Oaks Drive and Indian Oak Lane.

Figures 2-1 and 2-2 show a detailed schematic of flooding areas for the 10, 25, and 100 year storm events for the existing model as of October 2007. These figures can be found in Appendix 2 along with the model output for the existing conditions. It should be noted that the water surface elevations shown in XP-SWMM Table E16 coincide with the water surface elevations just inside the upstream and downstream end of each conduit. The actual water surface elevation at each node can be found in XP-SWMM Table E15.

The existing model from October 2007 was edited to include the new pipes and pond. These additions further reduced the flooding at various points throughout the watershed. Figures 3-1 and 3-2 show a detailed schematic of flooding areas for the 10, 25, and 100 year storm events for the most current existing model. These figures can be found in Appendix 3 along with the model output for the current existing conditions.

3.0 PROPOSED CHANGES ANALYSIS

Proposed development plans and report for the Deer Track Golf course area were provided by Horry County. The proposed area to be developed is known as The Old South Course, Phases 1A and 1B. The current existing conditions model was revised to include these changes as proposed by the developer. The Proposed Conditions model is shown as a schematic of the proposed development.

The maximum computed water surface elevation from the current existing conditions model is compared to the maximum computed water surface elevation from of the proposed conditions model in Table 3. The results are compared at the following strategic locations:

- 21 – Node just upstream of Glens Bay Road
- 27 – Node located at the junction of the outfall from Caropines and Deerfield and the existing channel from the Glens Bay area.
- 34 – Just upstream (west side) of U.S. Rte. 17
- Lk Elzbth – Node at Lake Elizabeth
- Dgwood Lk – Node at Dogwood Lake

Location (Node)	Existing Condition – W.S. Elev			Proposed Condition – W.S. Elev		
	10-Year	25-Year	100-Year	10-Year	25-Year	100-Year
21	21.78	22.08	23.01	21.91	22.30	23.26
27	19.92	20.22	21.54	20.08	20.64	21.93
34	19.34	19.96	21.78	19.52	20.11	21.82
Lk Elzbth	11.15	11.51	12.19	11.27	11.62	12.25
Dgwood Lk	8.02	8.14	8.50	8.06	8.18	8.54

Table 3. Results from Proposed Conditions Model.

Table 4 shows the resultant maximum flows in the newly piped section of channel (XS #10). XS #10 is located downstream of Node 27 and upstream of U.S. Rte 17, adjacent to the Bowling Alley.

Location (Link)	Existing Condition – Flow			Proposed Condition – Flow		
	10-Year	25-Year	100-Year	10-Year	25-Year	100-Year
XS #10	150.2 cfs	169.6cfs	208.9 cfs	159.9 cfs	181.4 cfs	225.6 cfs

Table 4. Resultant flows at XS #10.

In the proposed conditions model, overall flooding within the Deer Track area is reduced from the existing condition. The proposed development does not increase flooding in any of the remaining portions of the watershed. The model output depicting the effect of the proposed changes to the watershed can be found in Appendix 4. It should be noted that

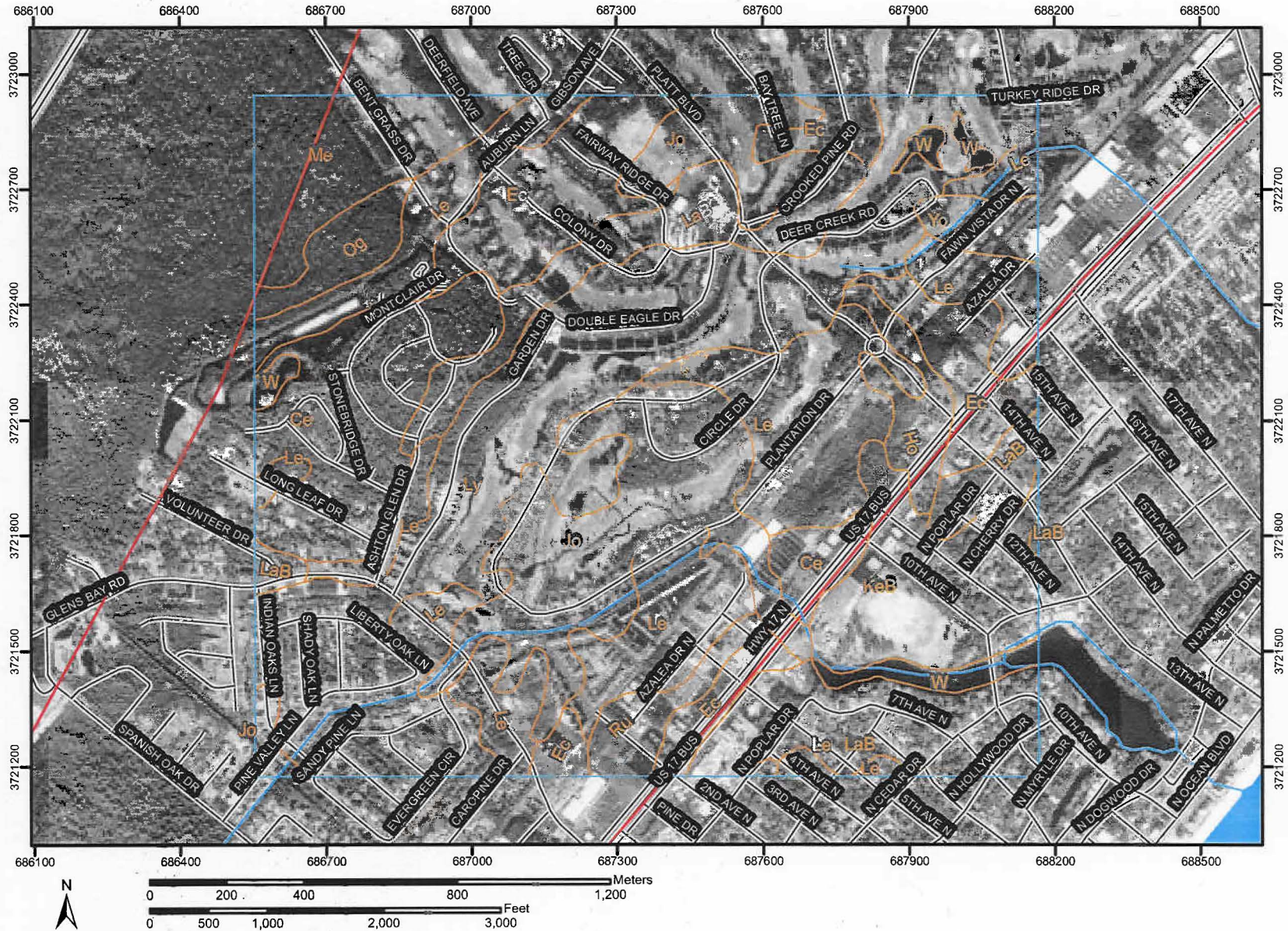
the water surface elevations shown in XP-SWMM Table E16 coincide with the water surface elevations just inside the upstream and downstream end of each conduit. The actual water surface elevation at each node can be found in XP-SWMM Table E15.

4.0 CONCLUSION

Development occurring in the watershed since 2000 has been added to the hydraulic model. This development includes Harbour Village and Mallard Landing Village. Additional changes in the watershed were also subsequently added to the model, including the new pond and the double 60 inch pipes adjacent to the Bowling Alley. The updated existing conditions model was then used as a basis to assess the impact of the proposed redevelopment of the former Deer Track Golf Course.








































In summary, the proposed hydraulic model shows a decrease in the overall flooding occurring within the proposed development. The proposed development will also have a very minor effect on the lake levels for Lake Elizabeth and Dogwood Lake. In the proposed condition, Lake Elizabeth is increased by 0.11 feet for the 25-year storm event and Dogwood Lake is increased by 0.04 feet for the 25-year storm event.

Soil Map-Horry County, South Carolina
(Deertrack Golf Course)



Soil Map—Horry County, South Carolina
(Deertrack Golf Course)

MAP LEGEND

Area of Interest (AOI)		Area of Interest (AOI)		Very Stony Spot
Soils		Soil Map Units		Wet Spot
Special Point Features		Blowout		Other
	Borrow Pit	Special Line Features		Gully
	Clay Spot		Short Steep Slope	
	Closed Depression		Other	
	Gravel Pit	Political Features		
	Gravelly Spot	Municipalities		Cities
	Landfill		Urban Areas	
	Lava Flow	Water Features		Oceans
	Marsh		Streams and Canals	
	Mine or Quarry	Transportation		Rails
	Miscellaneous Water	Roads		Interstate Highways
	Perennial Water		US Routes	
	Rock Outcrop		State Highways	
	Saline Spot		Local Roads	
	Sandy Spot		Other Roads	
	Severely Eroded Spot			
	Sinkhole			
	Slide or Slip			
	Sodic Spot			
	Spoil Area			
	Stony Spot			

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 17N

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

Soil Survey Area: Horry County, South Carolina
Survey Area Data: Version 14, Jun 28, 2007

Date(s) aerial images were photographed: 1/23/1994





















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

Map Unit Legend

Horry County, South Carolina (SC051)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ce	Centenary fine sand	74.9	8.4%
Ec	Echaw sand	89.2	10.0%
Ho	Hobcaw fine sandy loam	16.0	1.8%
Jo	Johnston loam	110.6	12.4%
KeB	Kenansville fine sand, 0 to 6 percent slopes	53.2	6.0%
LaB	Lakeland sand, 0 to 6 percent slopes	103.1	11.5%
Le	Leon fine sand	163.2	18.3%
Ly	Lynn Haven sand	185.9	20.8%
Me	Meggett loam	44.8	5.0%
Og	Ogeechee loamy fine sand	14.2	1.6%
Ru	Rutlege loamy sand	14.0	1.6%
W	Water	13.6	1.5%
Yo	Yonges fine sandy loam	10.5	1.2%
Totals for Area of Interest (AOI)		893.2	100.0%

Hydrologic Soil Group—Horry County, South Carolina
(Deertrack Golf Course)

MAP LEGEND

- Area of Interest (AOI)**
 -  Area of Interest (AOI)
- Soils**
 -  Soil Map Units
- Soil Ratings**
 -  A
 -  A/D
 -  B
 -  B/D
 -  C
 -  C/D
 -  D
 -  Not rated or not available
- Political Features**
 - Municipalities**
 -  Cities
 -  Urban Areas
- Water Features**
 -  Oceans
 -  Streams and Canals
- Transportation**
 -  Rails
- Roads**
 -  Interstate Highways
 -  US Routes
 -  State Highways
-  Local Roads
-  Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>
Coordinate System: UTM Zone 17N

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

Soil Survey Area: Horry County, South Carolina
Survey Area Data: Version 14, Jun 28, 2007

Date(s) aerial images were photographed: 1/23/1994

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Horry County, South Carolina				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ce	Centenary fine sand	A	74.9	8.4%
Ec	Echaw sand	A	89.2	10.0%
Ho	Hobcaw fine sandy loam	D	16.0	1.8%
Jo	Johnston loam	D	110.6	12.4%
KeB	Kenansville fine sand, 0 to 6 percent slopes	A	53.2	6.0%
LaB	Lakeland sand, 0 to 6 percent slopes	A	103.1	11.5%
Le	Leon fine sand	B/D	163.2	18.3%
Ly	Lynn Haven sand	B/D	185.9	20.8%
Me	Meggett loam	D	44.8	5.0%
Og	Ogeechee loamy fine sand	B/D	14.2	1.6%
Ru	Rutlege loamy sand	B/D	14.0	1.6%
W	Water		13.6	1.5%
Yo	Yonges fine sandy loam	D	10.5	1.2%
Totals for Area of Interest (AOI)			893.2	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

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

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

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

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

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

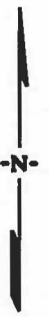
Tie-break Rule: Lower



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LEGEND

- FLOODING DURING 10, 25, AND 100 YEAR STORM EVENTS
- FLOODING DURING 25 AND 100 YEAR STORM EVENTS
- FLOODING DURING 100 YEAR STORM EVENT ONLY



Title:
EXISTING MODEL AS OF OCTOBER 2007

Scale:
SCALE: 1"=400'

Project Name:
REVISION OF CAROPINES AND DEERFIELD STORM DRAINAGE OUTFALL STUDY

Drawing Name:
FIGURE 2-1

Drawing Description:
FLOODED AREAS TO SOUTH WEST OF GLENS BAY RD.