SEMINOLE COUNTY, FL

Forest Brook Drainage Improvements Project

Phase I Design

Final Report

March 2013

CDM Smith

Seminole County

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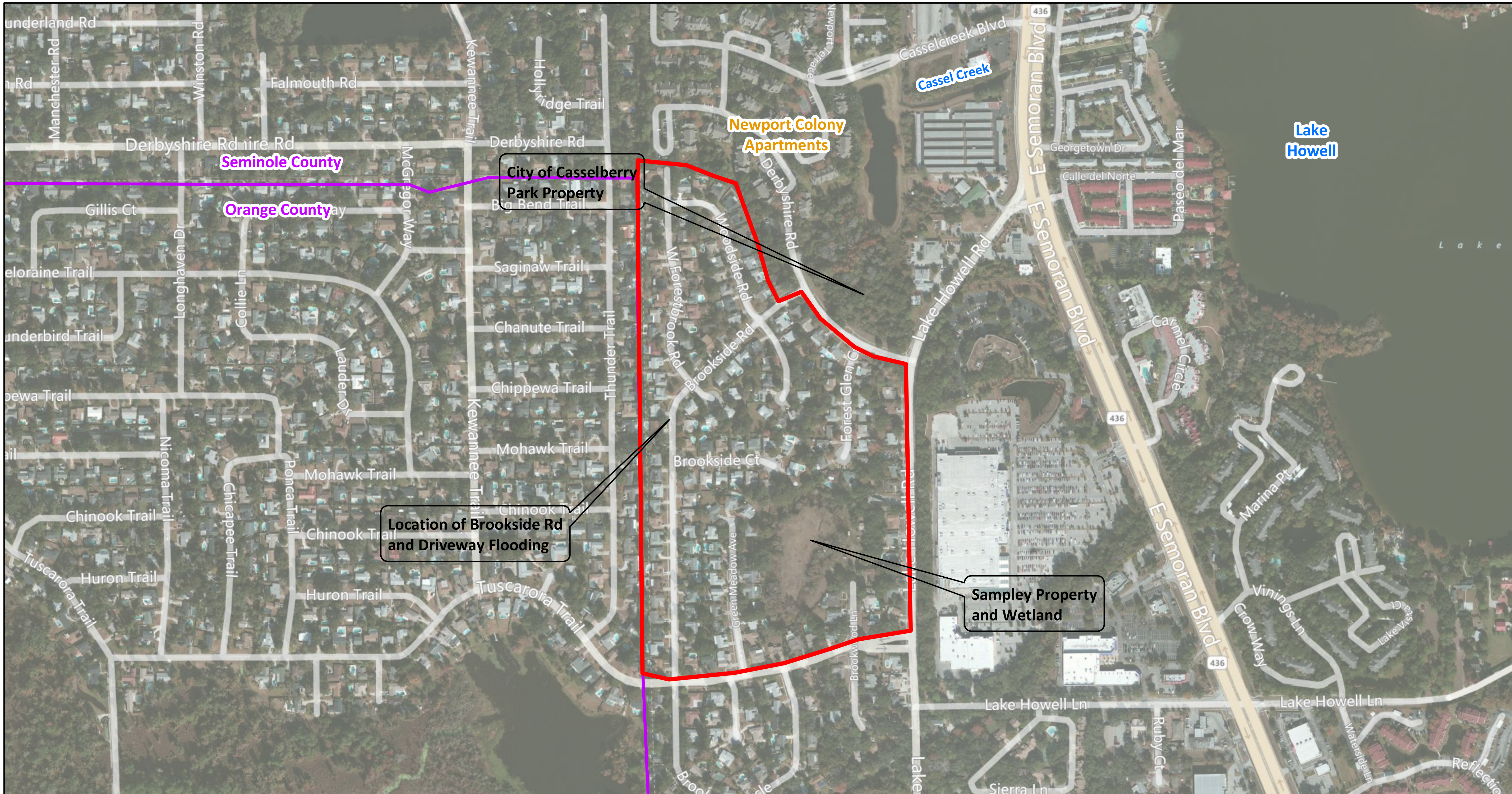
Section 1

Background and Scope

In December 2011, Seminole County (County) retained CDM Smith to evaluate the drainage infrastructure of the Forest Brook Subdivision and develop a preliminary (Phase 1) design to alleviate known flooding issues and provide water quality benefits. As shown in **Figure 1**, the Forest Brook Subdivision is a 60-acre residential neighborhood located in unincorporated Seminole County, generally bordered by Lake Howell Road to the east, Tuscarora Trail to the south, the Orange County line to the west, and Derbyshire Road to the north. The study area lies in the Howell Creek Watershed, which ultimately discharges to the impaired Lake Jesup.

The County has received several reports of road and driveway flooding on Brookside Road on the western side of the subdivision, where a 48-inch reinforced concrete pipe (RCP) culvert conveys runoff through the Forest Brook drainage system from areas of Orange County and the City of Maitland to the west. The primary objective of this Phase I design project was to develop a feasible preliminary engineering design to eliminate or significantly reduce the flooding at this location for the 10-year/24-hour design storm, with cost, construction, and permitting considerations taken into account. Preliminary design considered conveyance and storage improvements, roadway improvements, and rehabilitation of the existing drainage infrastructure. The project Scope of Services included the following items:

- Task 1 – Data Collection and Review (Section 2)
  - Review of existing reports, studies, and design plans.
  - Collection of pertinent GIS data
  - Survey coordination
  - An ecological and environmental assessment of the privately-owned wetlands on the "Sampley Property" in the southern portion of the basin (as shown in Figure 1)
- Task 2 – Existing Conditions Evaluation
  - Perform hydrologic and hydraulic modeling of the existing Forest Brook stormwater management system using the Interconnected Channel and Pond Routing (ICPR) model, Version 3 (Section 3)
  - Analyze the existing pollutant loading from the Forest Brook stormwater management system (Section 6)
- Task 3 – Stakeholder and Environmental Permitting Coordination (Appendix B)
  - Coordination with the City of Casselberry regarding a potential water quality pond in a future City park north of Derbyshire Road
  - A preliminary meeting with Saint Johns River Water Management District (SJRWMD) to clarify permitting requirements for proposed design



Legend

- Forest Brook Subdivision
- County Line

Forest Brook Drainage Improvements
Figure 1 - Project Location and Features

1 inch = 500 feet

0 125 250 500 *Feet*

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- Task 4 – Conceptual Site Plan Development
  - Develop a conceptual design that provides flood control for problem areas within Forest Brook as well as water quality benefits and credits for the County and other stakeholders (Section 4)
  - Develop a conceptual cost estimate for the preliminary design (Appendix A)
  - Evaluate the preliminary design in ICPR to quantify the flood control benefits and ensure compliance with anticipated permitting requirements (Section 4)
  - Calculate the reduction in pollutant loading associated with the proposed water quality BMPs (Section 6)
- Task 5 – Conceptual Design Letter Report

In addition to the scoped tasks, CDM Smith also investigated methods for the rehabilitation of the existing drainage culverts, and a summary of feasible alternatives is provided in Section 5.

Section 2

Data Collection

2.1 Previous Studies and Historical Plans

The analysis and design of the Forest Brook Phase I drainage improvements are built upon information provided in the *Preliminary Design Report for Cassel Creek Stormwater Management*, prepared by BCI Engineers and Scientists (now AMEC) in June 2005. This report evaluated various water quantity and water quality issues in the Cassel Creek Basin. An ICPR model (version 3) of the Cassel Creek Basin was developed under the scope of this study. CDM Smith used the 2005 Cassel Creek Basin model as the base for the quantitative analysis of the existing and proposed drainage systems for Forest Brook. Additionally, the water quality data collected and analyses performed in this study were incorporated in the water quality analysis presented in Section 6.

The *Howell Creek Basin Watershed Management Plan* (WMP) prepared by CDM (now CDM Smith) in April 2011 was also reviewed, and its recommendations were considered in the proposed design. This study incorporated elements of the 2005 BCI Cassel Creek study into a larger regional planning effort. Water quality data and analyses performed under the scope of the WMP were taken into consideration, as well as the regional ICPR model of the Howell Creek Watershed.

The Florida Department of Environmental Protection (FDEP) approved Total Maximum Daily Load (TMDL) Pollutant Load Model developed by Atkins (formerly PBS&J) was used to evaluate potential TMDL benefits as presented in Section 6.

The following plans were also referenced to evaluate existing conditions including drainage patterns:

- Forest Brook Subdivision As-Builts, dated 1967
- Proposed Forest Brook Park Plans, prepared by SK Construction for the City of Casselberry in 2004

2.2 Project Survey and Topography

A supplemental topographical survey was obtained between January and March 2012 by Southeastern Surveying and Mapping Corporation (SSMC). The supplemental survey was merged with previous surveys to provide a detailed topographical analysis and structure inventory of the Forest Brook Subdivision, including drainage pipes, inlets, and manholes, roadway profiles, and topography of the Sampley Wetland. The survey also captured the details of pipes and inlets for the upstream portion of the stormwater management system in Orange County; this was performed in order to accurately delineate the full contributing area to the Forest Brook stormwater management system. A signed and sealed hard copy and a digital copy of the project survey were previously submitted to the County under separate cover.

The topographical survey was augmented where necessary with the best available data. Additional topographical data sources included one-foot contours produced by the SJRWMD in 2001 and the historical plans noted in Section 2.1. These data are presented in **Figure 2**.

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Legend

Forest Brook Subdivision

County Line

Forest Brook Drainage Improvements
Figure 2 - Topography

1 inch = 500 feet

0 125 250 500 *Feet*

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2.3 Wetlands and Ecological Evaluation

The project area contains two wetlands: one in the privately-owned Sampley Property in the southern portion of the project area, and one in the City of Casselberry property on the north side of Derbyshire Road. The Sampley Wetland encompasses an area of 4.2 acres in the middle of a larger depressional area (**Figure 3**). The depressional area is located within a Federal Emergency Management Agency (FEMA)-designated 100-year floodplain and currently provides surface water storage within the basin and water quality benefits for adjacent upland areas and downstream receiving waters. The floodplain is designated by FEMA as Zone A, indicating that no base flood elevation (BFE) has been determined. The depressional area is directly connected to the Forest Brook stormwater management system via a 30-inch corrugated metal pipe (CMP) culvert and typically provides storage for runoff during the early phases of storms. Following the storm event, the stored runoff discharges from the wetland back into the stormwater management system through the 30-inch CMP.

In the center of the Sampley Wetland, soils consist of thick mucky peats to a depth of more than 4 feet below land surface in some locations, based on limited soils investigation performed by a CDM Smith wetland scientist. These soils meet the mucky mineral hydric soil indicator (NRCS, 2010). Along the wetland edge, soils meet the sandy mucky mineral and dark surface hydric soil indicators according to the Natural Resources Conservation Service (NRCS, 2010). The Sampley Wetland is classified as having primarily emergent vegetation with some forested and scrub-shrub areas. Common species within the wetland include primrose willow (*Ludwigia peruviana*), rushes (*Juncus* spp.), broomsedge (*Andropogon virginicus*), and pennywort (*Hydrocotlye* spp.). Canopy species include red maple (*Acer rubrum*), Chinese tallow tree (*Triadica sebifera*), and camphor tree (*Cinnamomum camphora*). Several exotics are prevalent within the wetland including elephant ear (*Xanthosoma sagittifolium*), wild taro (*Colocasia esculenta*), and Chinese tallow tree. Historically, this area has been mowed and maintained as a horse grazing and riding area. Due to the ditching and land management practices, the wetland has been drastically altered. The ditching has led to lower water table elevations within the wetland and some oxidation of the soils. This altered habitat provides little value for wildlife. Forested and scrub-shrub areas may provide some habitat for small birds, raccoons, opossums, and other opportunistic species. Wildlife species observed during the site visit include the northern cardinal, mocking bird, and red tailed hawk.

The National Wetland Inventory (NWI) database classified the entire depressional area as a palustrine emergent persistent semipermanently flooded excavated wetland (PEM1Fx). Based on field observations, this description is generally accurate. While the majority of the wetland would be considered emergent, there are areas along the edge of the wetland that have a forested canopy and vegetative mid-story. Therefore, a smaller portion of the wetland would be classified as palustrine forested (PFO) and palustrine scrub-shrub (PSS). The extents of the Sampley Wetland, as delineated by CDM Smith and surveyed by SSMC, are illustrated in Figure 3.

The second wetland in the project area is located on City of Casselberry property between Derbyshire Road and Newport Colony Apartments. This wetland was previously delineated by the City of Casselberry in 2002 in support of planning for a proposed park on the property. The wetland receives surface runoff from adjacent uplands and is connected to the Newport Colony Apartments stormwater pond by means of a control structure and RCP culvert. The delineated wetland limits are shown in **Figure 4**.

Legend

- Flagged Wetland Line
- FEMA 100-Year Floodplain
- County Line

Forest Brook Drainage Improvements
Figure 3 - Sampley Property Wetland and Floodplain Limits

1 inch = 200 feet

0 50 100 200 Feet

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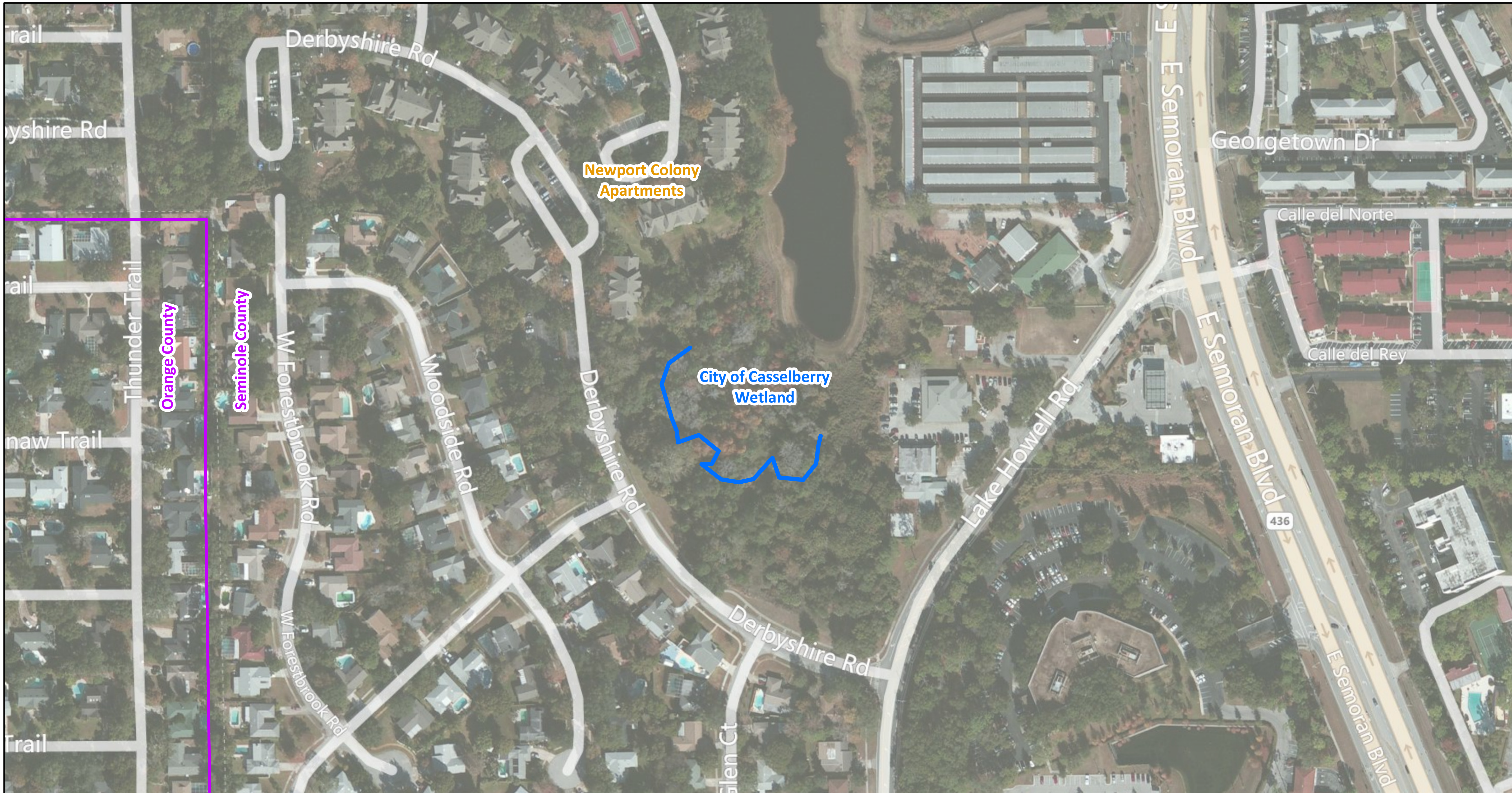

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Legend

- Flagged Wetland Line
- County Line

Forest Brook Drainage Improvements
Figure 4 - City of Casselberry Wetland

1 inch = 200 feet

0 50 100 200 *Feet*

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2.4 Surficial Soils and Site Hydrogeology

Surficial soils data were obtained from the Soil Survey Geographic Database (SSURGO) maintained by the NRCS. The limits of the hydrologic soil groups (HSG's) throughout the project area are illustrated on **Figure 5**. HSG's are typically designated as A, B, C, or D and also may have dual group classifications (e.g., B/D). An A-group soil is well drained and has low runoff potential while a D-group soil is poorly drained with high runoff potential. Groups B and C have soil characteristics between those of A and D soils.

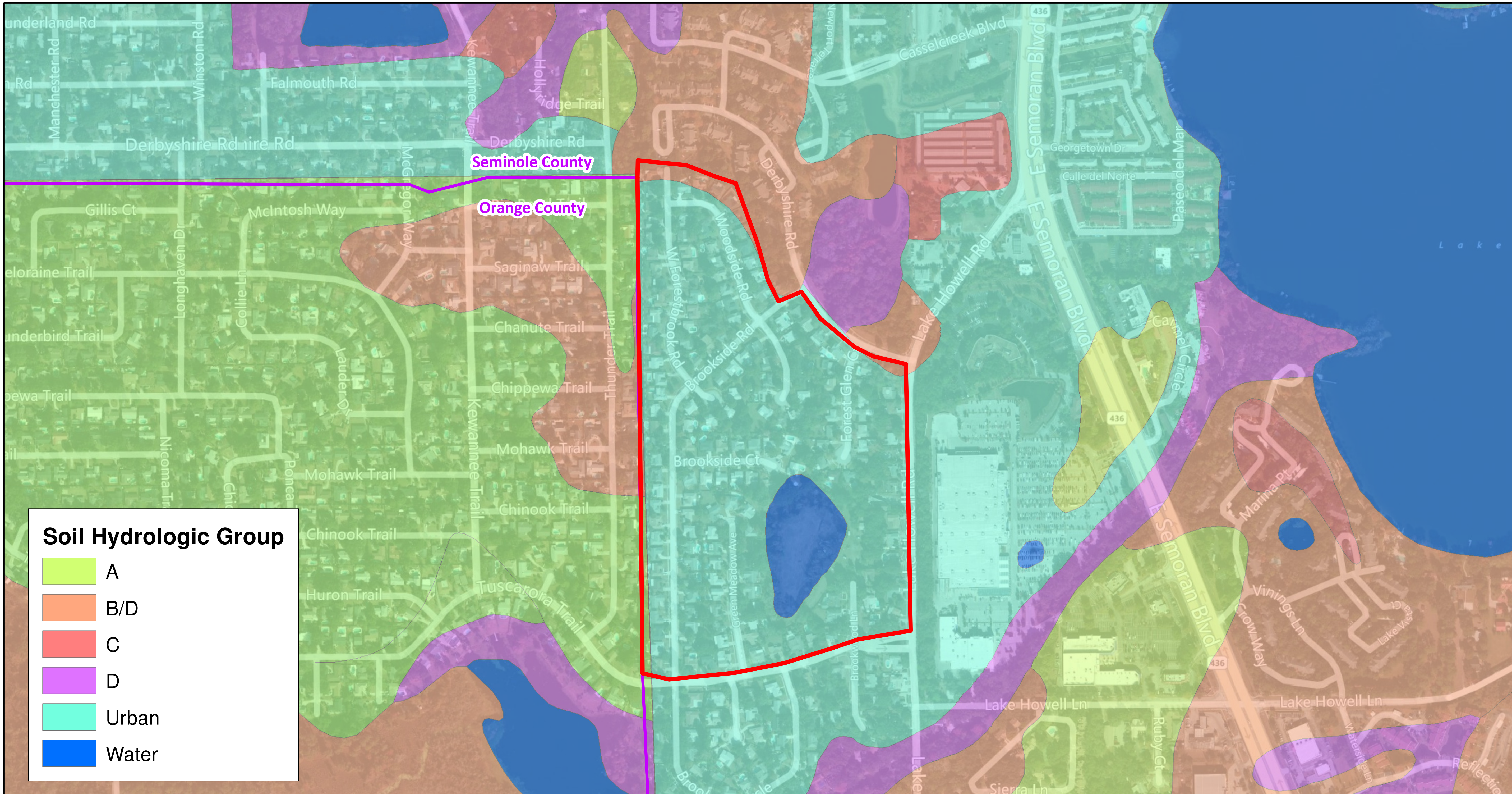
The entirety of the Forest Brook subdivision lies within the urban land complex classification, reflecting a condition wherein the drainage and storage characteristics of the native soils have been significantly altered, obscured, or filled by development. Review of older Soil Survey reports of this area indicates upland soils ranging from moderately- to well-drained, but no HSG designations. Earlier hydrologic studies considered these soils as well drained (BCI, 2005) to poorly drained (CDM Smith, 2011). For the purposes of the hydrologic model (Section 3.1), these urban complex soils were treated as class "C" soils, conservatively simulating a partially-drained condition.

The Orange County portion of the study area is dominated by class "A" Tavares series soils, with some dual-class "B/D" Smyrna series soils present as well. Dual-class soils were also treated as class "C" soils for hydrologic modeling purposes.

For water quality modeling purposes, evaluation of the runoff coefficient from the contributing drainage area was needed in an effort to estimate average annual runoff and the residence time for the proposed pond (see Sections 4 and 6). Guidance from the St. Johns River Water Management District's Applicant's Handbook was used to perform these calculations in conjunction with the land use and soils. An effective runoff coefficient of 0.4 was determined from Table 24-1 of the Applicant's Handbook based on primarily residential land use, soils having high runoff potential, and generally flat topography. This runoff coefficient is somewhat conservative though representative of the overall basin.

2.5 Land Use

Land use coverage was developed from the 2009 SJRWMD Land Use/Land Cover database. Generalized land uses in the project area are illustrated on **Figure 6**. Medium density residential is the dominant land use of the project area and the total contributing area to the Forest Brook stormwater management system. The study area consists primarily of single-family homes with lots ranging from ¼ to ½ acre. A small portion of the contributing area consists of forest and commercial land uses on the east side of Lake Howell Road.



Legend

- Forest Brook Subdivision
- County Line

Forest Brook Drainage Improvements
Figure 5 - Soils

1 inch = 500 feet

0 125 250 500 Feet

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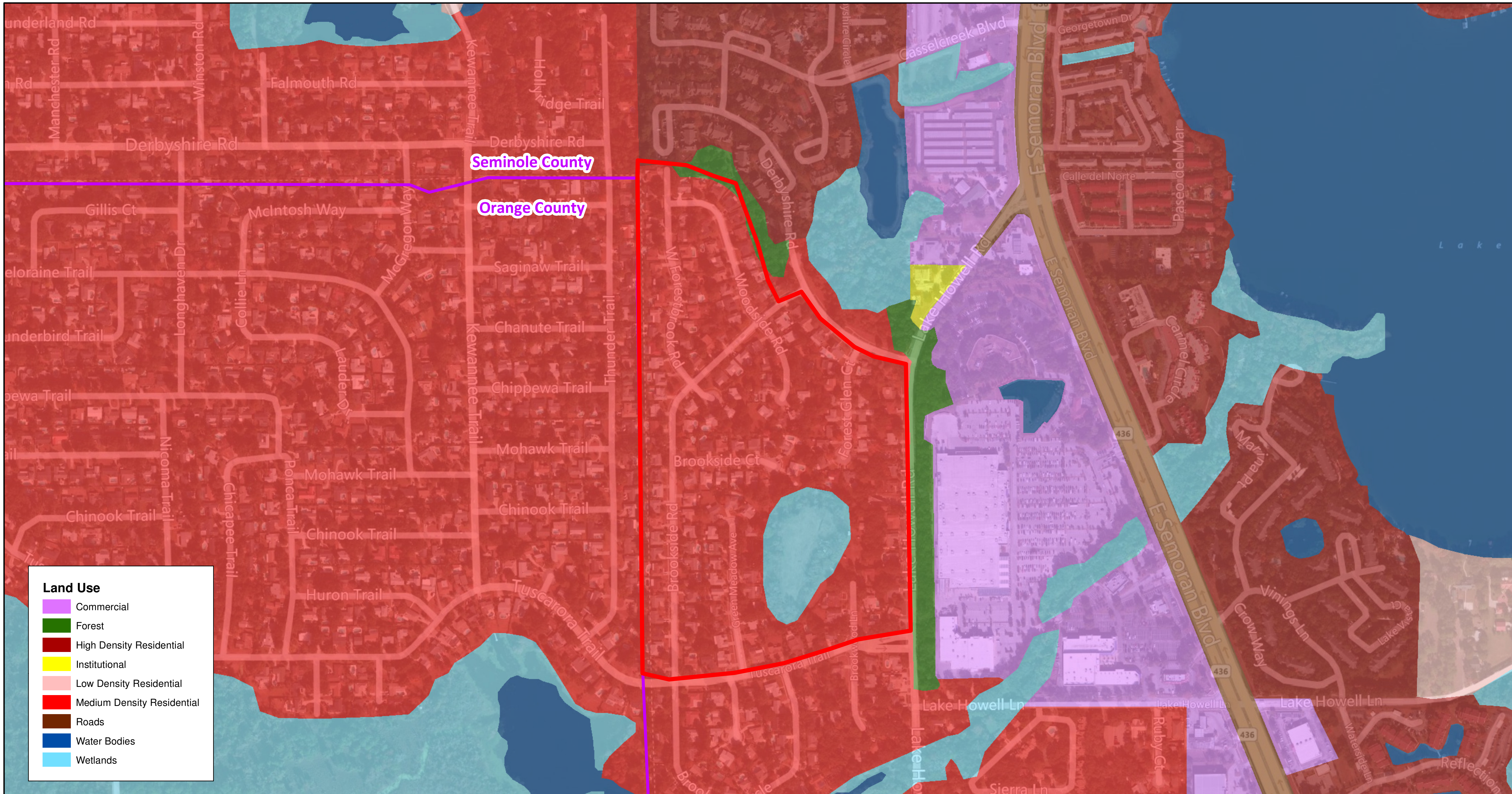

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Forest Brook Subdivision

County Line

Forest Brook Drainage Improvements

Figure 6 - Land Use

1 inch = 500 feet

0 125 250 500 *Feet*

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Section 3

Existing Condition Analysis

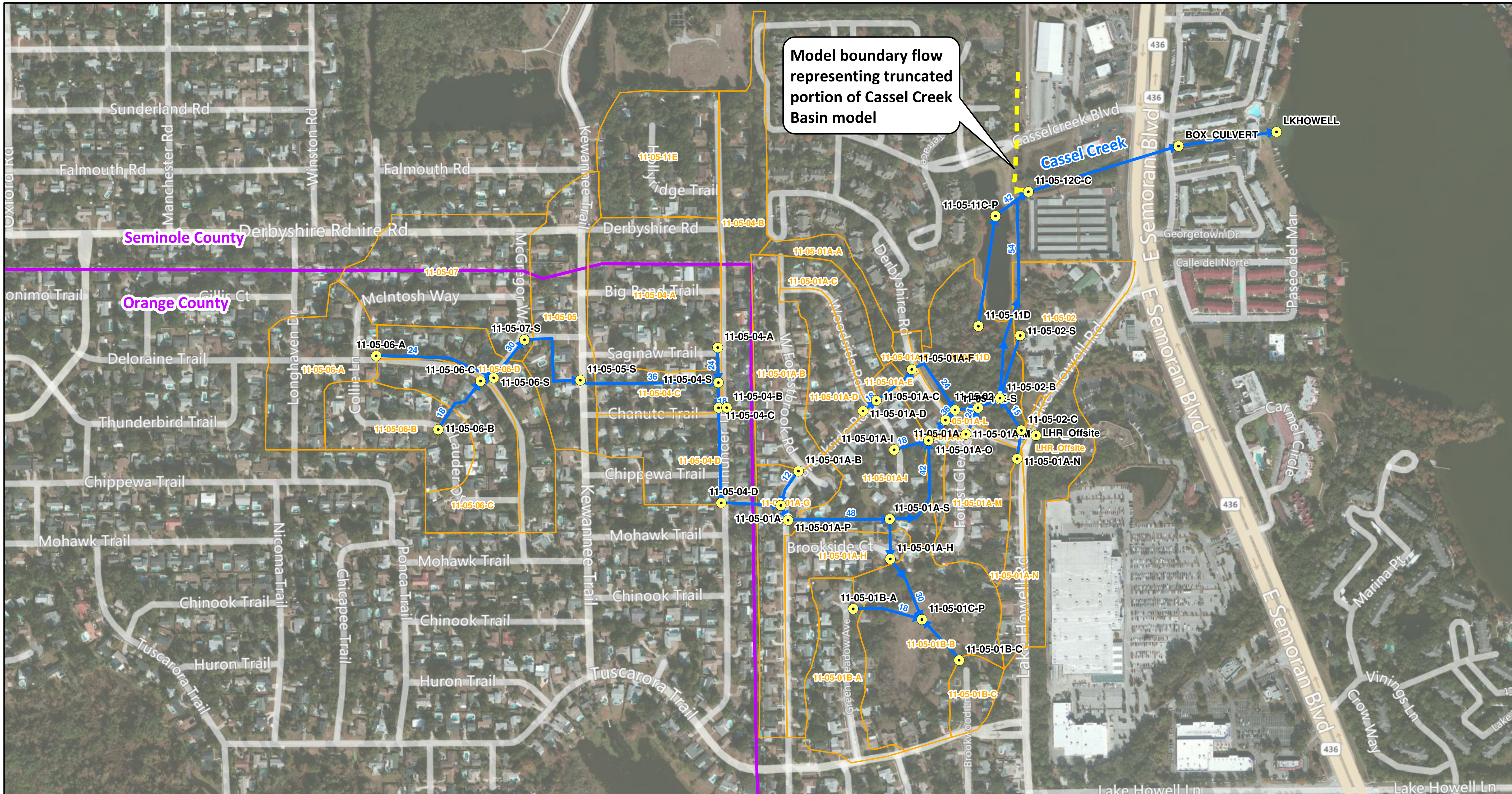
As indicated in **Figure 7**, significant stormwater runoff is generated from upstream areas west of the project and conveyed through the project area to Cassel Creek. Cassel Creek then flows east to Lake Howell which ultimately flows to Lake Jesup via Howell Creek. Lake Howell is located within the effective 100-year floodplain designated by FEMA. A quantitative evaluation of the existing Forest Brook stormwater management system was performed through the development of an ICPR hydrologic and hydraulic (H/H) model. As stated in Section 2.1, CDM Smith used the ICPR models of the Cassel Creek Basin (BCI, 2005), and Howell Creek Basin (CDM, 2011) as the base for the Forest Brook H/H model. The ICPR model uses a node-link convention where nodes represent storage areas or junctions. Links connect the nodes and represent pipes, channels, weirs, overland flow, or various rating curves (e.g., pumps). Using the survey, topographic, land use, and soils data described in the previous section, an existing conditions model was developed with sufficient detail and resolution to simulate the hydraulic response of the modeled stormwater system, quantify and verify flooding issues within the project area, and provide a base model upon which proposed design components could be evaluated.

3.1 Hydrologic Parameters

The hydrologic model component of ICPR uses the "curve number method" of runoff estimation detailed in *Technical Release 55 – Urban Hydrology for Small Watersheds* (USDA, 1986). Soils, land use, survey, and topographic data are used to calculate the appropriate hydrologic model parameters, including subbasin area, composite curve number, and time of concentration.

The structure inventory performed in the project survey and available topographic data were used to subdivide the total 177-acre study area subbasins, ranging in size from 0.4 to 12.6 acres. Of this area, runoff from approximately 160 acres is conveyed through the project area while the remainder is part of the Newport Colony Apartments and is served by a separate stormwater pond and stormwater system. The subbasins were delineated to allow distribution of the runoff from the contributing areas to designated loading points including major surveyed inlets. The subbasins are illustrated in the existing conditions model schematics in Figure 7 and **Figure 8**.

For each subbasin, a composite curve number (CN) and percent directly connected impervious area (DCIA) was calculated based on soils and land use coverages. The composite curve number is an area-weighted average of the curve numbers assigned to each land use and soil combination present in each subbasin. The curve number takes into account the non-directly connected imperviousness and soil storage of a land use/soil combination and is directly related to the total volume of runoff generated by a subbasin. The curve numbers and percent DCIA assigned to the various land uses and soils in the study area are presented in **Table 1**.



Legend

- Forest Brook Model Nodes
- Cassel Creek Boundary Flow
- Existing Links
- Forest Brook Model Basins
- County Line

Forest Brook Drainage Improvements
Figure 7 - Existing Condition Model Schematic

1 inch = 500 feet

0 125 250 500 Feet

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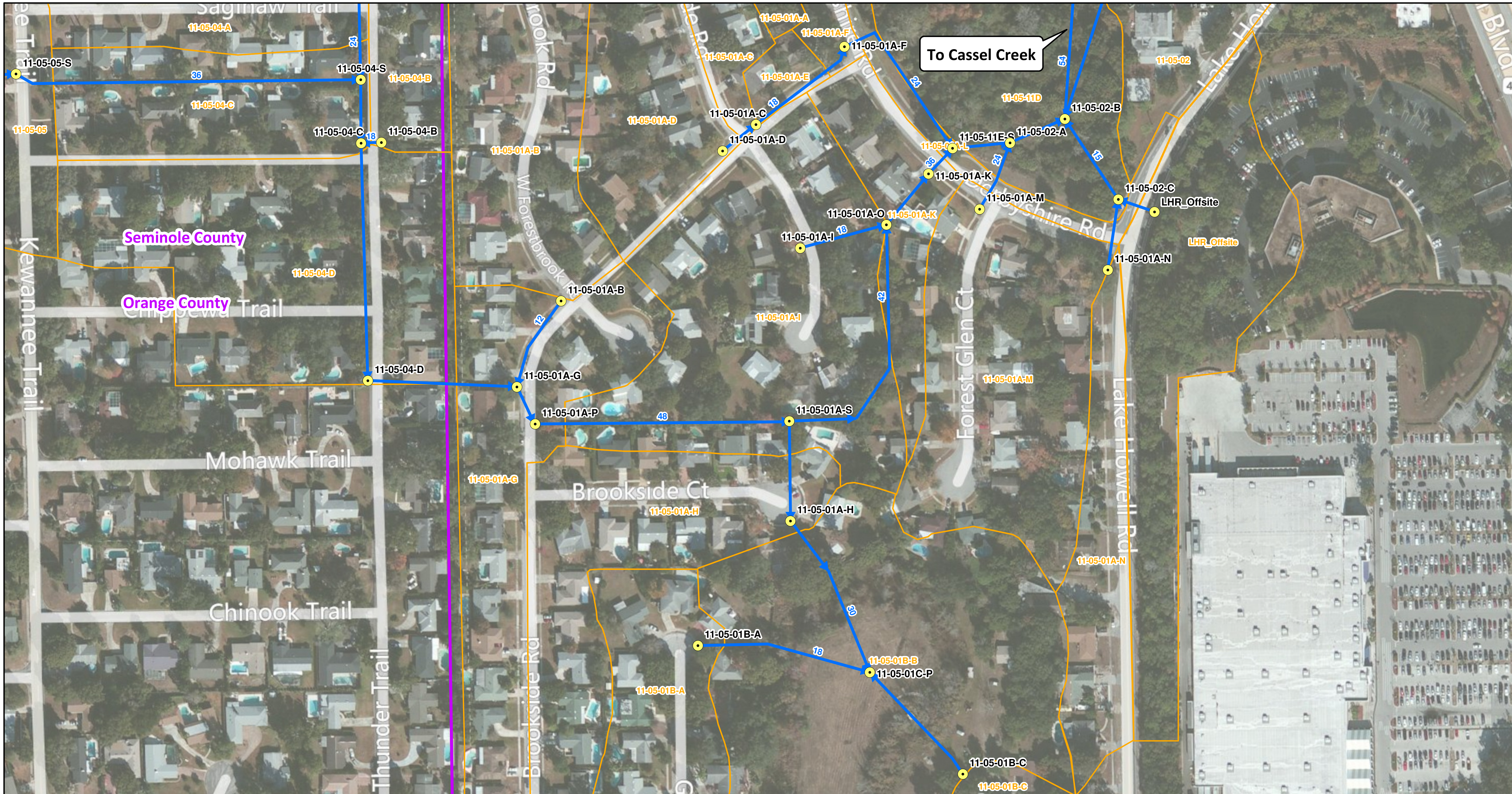

Legend

- Forest Brook Model Nodes
- Cassel Creek Boundary Flow
- Existing Links
- Forest Brook Model Basins
- County Line

Forest Brook Drainage Improvements

Figure 8 - Existing Condition Model Schematic (Detail)

1 inch = 200 feet

0 50 100 200 Feet

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Table 1 Curve Numbers and % DCIA for Land Uses and Soils in Project Area

Land Use	DCIA (%)	CN (Class A Soils)	CN (Class C Soils)*
Medium Density Residential	15	61	83
Forest	0.5	36	73
Commercial	85	89	94

*Includes Urban and Dual-Class Soils

Topographic data were used to calculate a time of concentration for each subbasin. The time of concentration is defined as the time necessary for surface runoff to travel from the most hydrologically-distant point of the subbasin to the inlet or point of collection within the subbasin. The time of concentration affects the timing and amplitude of the peak of the runoff hydrograph.

The hydrologic model was run with five synthetic design storms. The 10-year/24-hour design storm was used as the benchmark for assessing the level-of-service of the existing system and a target level-of-service for any proposed design. The 3-year/1-hour design storm was run as a secondary level-of-service event to gauge the response of the stormwater management system to a brief, high-intensity event. The mean annual/24-hour, 25-year/24-hour, and 100-year/24-hour design storms were also run in order to evaluate the existing and proposed systems per the current analysis requirements for environmental resource permitting through SJRWMD, which will be required in subsequent phases of design. The 24-hour design storms used the SCS Type II Florida Modified rainfall distribution, and the 3-year/1-hour event used the Florida Department of Transportation (FDOT) 1-hour distribution. The rainfall volumes for the five design storms are listed in **Table 2**.

Table 2 Rainfall Volumes for Selected Design Storms

Design Storm	Rainfall Volume (inches)
3-Year/1-Hour	2.7
Mean Annual/24-Hour	4.4
10 Year/24-Hour	7.0
25-Year/24-Hour	8.5
100-Year/24-Hour	11.5

Sources: Howell Creek Basin WMP (CDM, 2011), FDOT 2012 Drainage Manual

3.2 Hydraulic Parameters

A detailed hydraulic model was developed using ICPR based on the structure inventory and project survey. Survey information including pipe lengths, inverts, and material were used to develop appropriate model parameters. Pipes were modeled with a Manning's roughness coefficient (N) of 0.024 for corrugated metal pipe (CMP) and 0.012 for reinforced concrete pipe (RCP) and for lined CMP. Stage-storage relationships for wetlands, ponds, and surface depressions were developed from survey and SJRWMD topography and 1-foot contours. The nodes and links of the hydraulic model are shown in Figures 7 and 8.

The Forest Brook hydraulic model is based on the 2005 BCI Cassel Creek Basin model and extends from the upstream end of the Forest Brook stormwater management system in Orange County to a boundary condition at Lake Howell. The majority of the Cassel Creek Basin model lies outside of the project area; therefore, the offsite portion of the Cassel Creek model was truncated at Cassel Creek (Node 11-05-12C-C). This node is also the outfall for the Forest Brook stormwater management system. Model flows from Cassel Creek upstream of the truncation point were included as a time-flow boundary condition (boundary flow) into the truncation node; the boundary flow time-series for each of the design storms is shown in **Table 3**. Links representing Cassel Creek and the culvert crossing under Semoran Boulevard were modified from the original BCI study to reflect improvements constructed and survey data collected since the original study was conducted. The receiving water for the project model is Lake Howell which is modeled using various static stage boundary conditions relative to the design storm simulation.

3.3 Existing Conditions Model Results

Model results verify the flood-prone nature of the problem area at Brookside Road; six inches of flooding above the road centerline are predicted at the node (11-05-01A-G) representing the problem area for the mean annual/24-hour design storm, and 16 inches of flooding are predicted for the 10-year/24-hour design storm. Model results indicate that the peak pipe flow and overland flow entering the problem area from upstream areas to the west cannot be adequately conveyed by the existing system, resulting in surcharging of the inlets in the problem area and pooling and flooding in an existing sag in Brookside Road at this location. Node peak stages are listed in **Table 4**.

Table 4 also indicates several other areas of the modeled system that do not meet the 10-year level of service (LOS). 10-year peak stages exceed the critical elevations for areas near Derbyshire Road between Brookside Road and Forest Glen Court as well as offsite areas west of the project (Figure 8).

Table 3 Time-Flow Boundary Condition for Cassel Creek at Existing 42-inch Discharge (Node 11-05-12C-C)

Time (hours)	Mean Annual Flow (cfs)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)	Time (hours)	Mean Annual Flow (cfs)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)	Time (hours)	Mean Annual Flow (cfs)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)	Time (hours)	Mean Annual Flow (cfs)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)
0	0.00	0.00	0.00	0.00	16.5	101.33	188.80	239.38	347.35	26.25	29.61	49.39	58.03	68.42	36	8.25	10.79	12.03	14.03
7	4.15	14.68	19.94	30.78	16.75	98.49	181.09	227.85	326.46	26.5	28.39	44.23	55.84	65.93	36.25	8.04	10.51	11.71	13.64
7.25	4.39	15.89	21.07	32.58	17	95.56	173.37	217.42	307.59	26.75	27.24	41.63	53.41	63.19	36.5	7.85	10.23	11.41	13.28
7.5	4.66	16.98	22.32	35.06	17.25	92.74	166.15	207.67	291.11	27	26.16	39.50	50.79	61.17	36.75	7.66	9.97	11.10	12.92
7.75	4.96	18.40	24.21	37.02	17.5	90.08	159.54	202.38	277.11	27.25	25.12	37.63	45.83	59.52	37	7.47	9.71	10.82	12.58
8	5.71	19.41	25.58	39.10	17.75	87.52	153.29	191.19	269.58	27.5	24.15	35.89	42.68	57.66	37.25	7.29	9.46	10.54	12.26
8.25	8.51	20.38	26.86	41.49	18	84.78	147.19	181.99	254.59	27.75	23.39	34.28	40.34	55.63	37.5	7.12	9.23	10.27	11.95
8.5	10.08	22.00	28.71	44.34	18.25	82.09	141.47	173.66	240.43	28	22.48	32.77	38.34	53.30	37.75	6.95	9.00	10.02	11.64
8.75	11.34	23.62	30.70	47.78	18.5	79.79	136.59	166.70	229.94	28.25	21.61	31.35	36.55	50.71	38	6.79	8.78	9.78	11.35
9	12.55	25.40	33.29	51.56	18.75	77.75	132.15	160.58	220.68	28.5	20.80	30.00	34.91	48.63	38.25	6.63	8.57	9.55	11.07
9.25	13.70	27.24	35.75	55.32	19	75.59	127.33	153.99	217.27	28.75	20.02	28.73	33.37	43.77	38.5	6.47	8.37	9.31	10.81
9.5	14.78	29.01	38.21	59.23	19.25	73.79	122.58	147.68	206.79	29	19.29	27.56	31.92	40.85	38.75	6.32	8.17	9.09	10.55
9.75	16.12	31.03	40.87	63.55	19.5	72.25	118.53	142.66	195.55	29.25	18.58	26.45	30.56	38.75	39	6.18	7.98	8.87	10.29
10	17.40	33.51	44.13	68.76	19.75	70.69	114.91	138.58	188.10	29.5	17.90	25.40	29.26	36.90	39.25	6.04	7.80	8.66	10.05
10.25	18.78	36.48	48.28	74.73	20	68.93	110.98	133.97	182.55	29.75	17.26	24.41	28.07	35.20	39.5	5.90	7.62	8.46	9.82
10.5	20.99	40.21	53.41	82.86	20.25	67.35	107.54	129.51	173.84	30	16.79	23.67	26.94	33.60	39.75	5.77	7.45	8.27	9.59
10.75	23.07	44.53	59.31	89.31	20.5	66.07	103.90	125.00	166.87	30.25	16.05	22.73	25.87	32.11	40	5.64	7.28	8.07	9.37
11	25.97	50.17	66.63	97.91	20.75	64.73	100.35	120.63	160.65	30.5	15.51	21.87	24.87	30.71					
11.25	28.95	56.01	73.88	106.17	21	63.33	97.11	116.69	154.95	30.75	15.00	21.05	24.17	29.38					
11.5	33.50	64.56	86.18	121.20	21.25	61.89	93.34	113.08	150.02	31	14.53	20.27	23.18	28.16					
11.75	54.61	115.24	141.91	189.00	21.5	60.48	91.09	109.74	144.93	31.25	14.08	19.53	22.31	27.02					
12	112.18	180.66	215.60	318.17	21.75	58.92	91.51	106.65	141.47	31.5	13.65	18.82	21.48	25.95					
12.25	162.69	226.21	307.54	409.41	22	57.40	87.44	103.77	137.63	31.75	13.24	18.16	20.69	24.93					
12.5	162.64	271.27	347.09	495.64	22.25	55.89	84.70	101.19	134.06	32	12.85	17.52	19.94	23.97					
12.75	142.14	290.77	368.81	561.28	22.5	54.42	82.48	98.58	130.72	32.25	12.47	16.91	19.23	23.28					
13	123.69	302.39	390.49	576.57	22.75	52.42	80.50	96.19	127.55	32.5	12.10	16.26	18.55	22.33					
13.25	126.30	295.32	412.66	578.09	23	50.19	78.43	93.52	123.58	32.75	11.75	15.75	17.91	21.47					
13.5	126.07	295.10	408.36	583.18	23.25	48.71	76.42	90.96	120.31	33	11.42	15.26	17.30	20.73					
13.75	125.60	295.10	408.89	584.15	23.5	47.34	74.86	88.53	117.14	33.25	11.10	14.79	16.72	20.02					
14	124.68	294.75	435.59	575.49	23.75	46.13	73.45	86.30	114.04	33.5	10.78	14.35	16.16	19.34					
14.25	125.16	289.63	386.37	549.93	24	44.89	71.73	83.88	110.57	33.75	10.48	13.92	15.73	18.68					
14.5	122.40	268.19	372.78	532.38	24.25	43.55	69.73	81.30	106.83	34	10.19	13.52	15.08	18.04					
14.75	120.28	255.35	353.72	513.49	24.5	41.64	66.95	76.63	100.91	34.25	9.92	13.13	14.67	17.44					
15	117.67	244.22	328.47	493.69	24.75	39.59	64.25	72.85	94.69	34.5	9.65	12.75	14.25	16.87					
15.25	115.02	234.60	308.61	472.13	25	37.55	61.69	71.61	89.03	34.75	9.39	12.40	13.84	16.33					
15.5	112.80	225.18	294.01	448.83	25.25	35.66	59.14	67.42	83.93	35	9.14	12.05	13.45	15.80					
15.75	110.20	216.11	286.91	426.54	25.5	33.84	56.76	63.92	79.33	35.25	8.91	11.72	13.07	15.31					
16	107.07	210.36	266.63	404.49	25.75	32.33	54.38	61.79	75.14	35.5	8.68	11.40	12.71	14.85					
16.25	104.31	198.70	251.76	374.09	26	30.92	51.89	60.01	71.44	35.75	8.46	11.09	12.36	14.43					

Table 4 Node Stages for Existing Condition Model (ft NAVD)

Node ID	Critical Elevation	3 Yr/1 Hr	Mean Annual/24 Hr	10 Yr/24 Hr	25 Yr/24 Hr	100 Year/24 Hr
11 05 01A B	64.61	64.45	64.40	65.18	65.39	65.68
11 05 01A C	63.24	63.12	62.97	63.89	64.28	64.93
11 05 01A D	63.49	63.74	63.61	64.20	64.44	65.00
11 05 01A F	62.60	61.23	61.32	62.78	63.34	63.76
11 05 01A G	63.88	64.29	64.29	65.18	65.39	65.69
11 05 01A H	61.38	60.57	60.89	63.10	63.43	64.27
11 05 01A I	62.07	61.69	62.26	63.13	63.35	63.77
11 05 01A K	60.81	60.07	61.21	62.74	63.33	63.74
11 05 01A M	60.70	59.06	60.26	62.36	62.76	63.34
11 05 01A N	64.69	62.14	62.07	62.83	63.76	65.19
11 05 01A O	64.39	61.02	61.88	63.14	63.57	63.90
11 05 01A P	63.16	64.17	64.23	65.16	65.36	65.65
11 05 01A S	64.22	62.55	62.96	64.07	64.21	64.33
11 05 01B A	63.90	63.78	63.05	64.58	65.05	66.01
11 05 01B C	64.34	64.39	64.34	64.48	64.54	64.65
11 05 01C P	63.90	58.81	59.24	61.44	62.61	64.28
11 05 02 A	62.56	58.69	60.17	62.36	62.76	63.34
11 05 02 B	62.11	58.42	59.90	61.97	62.33	63.33
11 05 02 C	63.85	60.63	61.10	62.60	63.07	63.82
11 05 02 S	62.00	60.42	61.04	61.61	61.95	62.48
11 05 04 A	74.80	75.29	75.22	75.52	75.63	75.82
11 05 04 B	72.86	73.32	73.15	73.62	73.70	73.81
11 05 04 C	72.86	73.03	72.46	73.83	74.09	74.50
11 05 04 D	70.90	68.58	68.58	71.49	71.76	72.12
11 05 04 S	73.45	74.14	73.50	74.62	74.75	74.97
11 05 05 S	79.51	77.41	75.94	80.45	80.70	81.08
11 05 06 A	89.32	86.42	86.34	87.14	89.08	89.71
11 05 06 B	87.50	85.97	85.87	88.11	88.19	88.31
11 05 06 C	85.51	84.27	83.79	86.17	86.30	86.47
11 05 06 S	85.07	83.86	83.59	85.30	85.46	85.69
11 05 07 S	82.98	82.71	82.49	83.38	83.56	83.82
11 05 11C P	65.00	59.05	59.41	60.57	61.46	63.30
11 05 11D	62.50	59.09	59.48	60.49	62.05	63.33
11 05 11E S	63.20	58.88	60.39	62.74	63.33	63.73
11 05 12C C	63.90	56.81	58.72	60.45	61.38	62.78
BOX_CULVERT	59.90	52.92	53.05	54.18	54.70	55.61
BOX_CULVERT_UP	63.90	56.79	58.68	60.42	61.34	62.74
LHR_Offsite	64.00	60.96	61.38	62.79	63.26	64.01
LKHOWELL	55.50	52.90	52.90	54.10	54.60	55.50

Section 4

Preliminary Design and Analysis

4.1 Design Components and Layout

Through consultations with the County and other relevant stakeholders, as well as a comprehensive alternatives analysis and modeling effort, CDM Smith has developed a preliminary design that eliminates the flooding at Brookside Road for the 10-year/24-hour design storm. The preliminary design also provides water quality benefits to the County and has been configured to meet relevant expected permitting requirements. A layout of the proposed design components is presented in **Figure 9**.

To address flooding issues at the Brookside Road cross-drain, conveyance improvements have been proposed paired with re-grading (raising) of Brookside Road to eliminate the flood-prone sag. As previously described, the existing primary stormwater management system lies in narrow easements between the backyards of houses, making replacement of the existing pipe system infeasible. As such, CDM Smith has proposed a new, parallel system of 48-inch RCP culverts and inlets along Brookside Road running northeast. This system will replace existing segments of 18-inch secondary culverts. The proposed system will cross under Derbyshire Road and connect to an upsized 48-inch by 76-inch elliptical RCP culvert, which connects to the outfall system to Cassel Creek. In order to accommodate the additional flows, CDM Smith proposes adding a parallel 54-inch RCP outfall to the existing 1,290 lineal foot (LF) 54-inch RCP outfall system from Derbyshire Road to Cassel Creek (Figure 9). As indicated in Figure 9 (and Figure 12 in Section 5), approximately 1,400 linear feet of pipe (and the associated manhole junctions) are also proposed to be rehabilitated to increase the remaining life span for this portion of the existing drainage system. This work is discussed further in Section 5. Since most of the rehabilitated pipe is already currently lined, proposed rehabilitated pipes were modeled with the same Manning's roughness coefficients (N) as used under the existing lined conditions, with one exception. A 190-foot section of 30-inch CMP (unlined) that runs north from the eastern end of Brookside Court (Figure 9) was modeled with a Manning's roughness of 0.012 (under rehabilitated lined condition). No additional lining or adjustments were assumed for proposed conditions.

The sag in Brookside Road will be eliminated by raising and re-grading Brookside Road, resulting in an elevated road centerline of up to 8 inches. This will prevent the extended pooling currently observed in the problem area and allow additional head within the conveyance system without surcharge. However, preliminary model results indicated that raising the road, combined with the conveyance improvements on Brookside Road, would cause a decrease in the volume of runoff reaching the Sampley Wetland, which receives both piped flow from the existing stormwater management system, as well as overland flow from the problem area via the gutters on Brookside Court.

The improvements were designed to have minimal to no impact on the Sampley Wetland. In order to maintain the existing hydroperiod of the Sampley Wetland and storage within this floodplain, the existing 48-inch cross-drain under Brookside Road will be upsized to 54-inch, and a new 48-inch RCP culvert along Brookside Court will connect the upsized cross-drain directly to the Sampley Wetland (Figure 9). While not proposed herein, any significant impacts to the Sampley wetland would require

Legend

- Proposed Pipes
- Existing Pipes
- Extent of Road Raising
- Proposed Pond
- County Line

Forest Brook Drainage Improvements
Figure 9 - Preliminary Design Components and Layout

1 inch = 300 feet

0 75 150 300 Feet

CDM Smith

PerneznyBJ G:\6116\Forest Brook\GIS\MXD\Figures\Figure9_PrelimDesignLayout_030513.mxd 3/18/2013 demonstration of avoidance, minimization, and mitigation. Mitigation for significant impacts to the Sampley Wetland would require additional analysis using the Uniform Mitigation Assessment Methodology (UMAM) and coordination with applicable permitting agencies (SJRWMD and Army Corps of Engineers). The cost of mitigation using an approved mitigation bank would depend upon many factors including the perceived quality of the wetland, the required wetland credits, and the mitigation bank ratio. Based on preliminary analysis, costs to purchase mitigation credits for impacts to the entire wetland (if permitted) could range from $300,000 to more than $400,000.

No new impervious areas are proposed and existing flow patterns and land uses are maintained. Therefore no increase in pollutant loading associated with the improved conveyance is anticipated. However, water quality benefits are anticipated via a 1-acre water quality pond proposed on the City of Casselberry property on the north side of Derbyshire Road. The City of Casselberry will work with the County to incorporate the pond and associated structures into the City's plans to develop a park on the property. The pond is conceptually designed to receive off-line inflow from the improved conveyance system (Figure 9) with return flow to the outfall system via a control structure. The pond will provide water quality credits to the County and the City of Casselberry (quantified in Section 6), and also a measure of additional attenuation storage for the proposed conveyance improvements.

The conceptual capital cost estimate for the preliminary design, including contingencies is approximately $1,967,000 for the conveyance upgrades, pipe rehabilitation, and road regrading, and an additional $183,000 for the water quality pond. Cost breakdowns are provided in Tables A-1 through A-3 in Appendix A.

4.2 Proposed Conditions Model Results

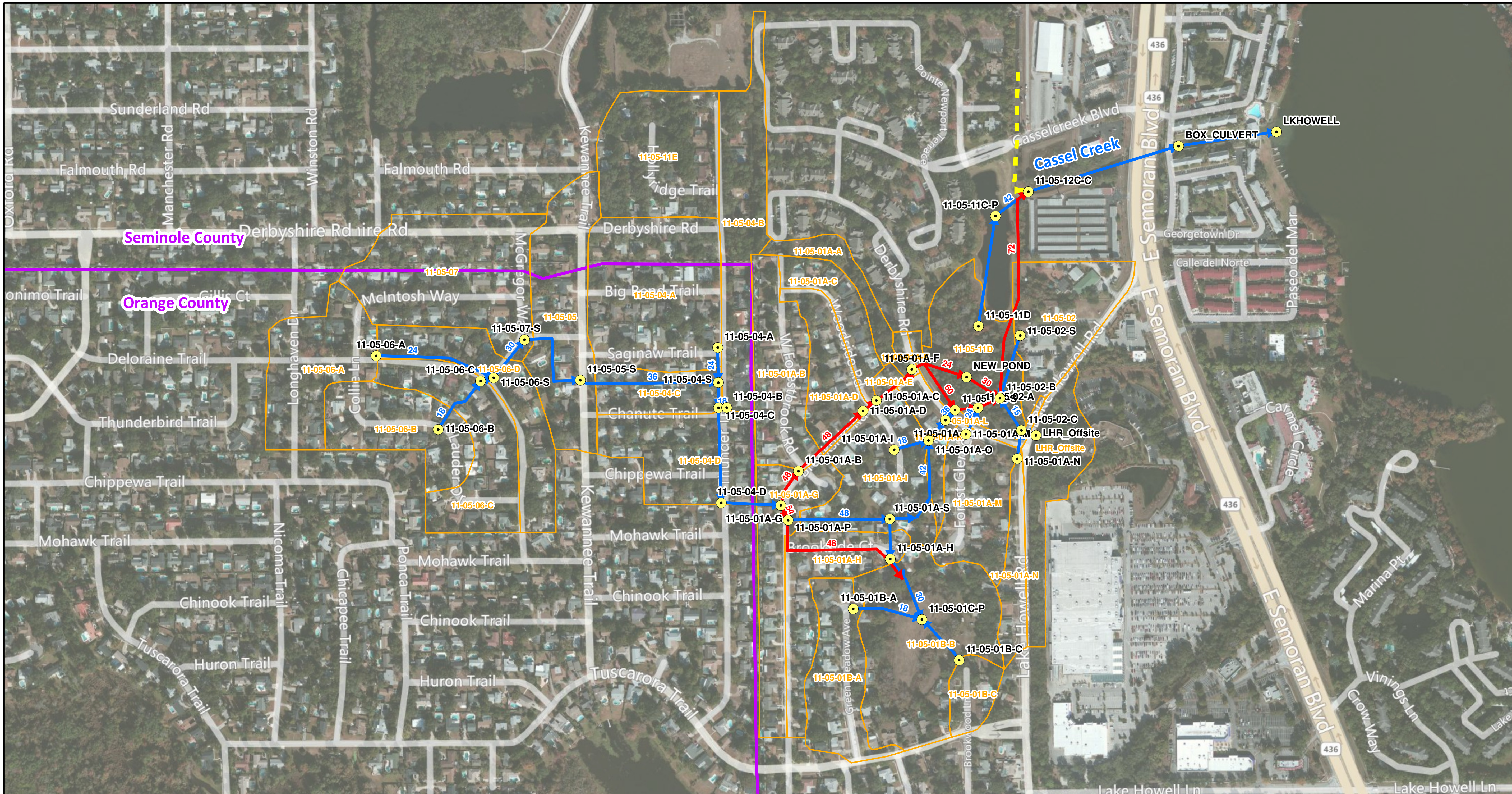
The County requirement for the peak hydraulic grade line (HGL) for secondary drainage systems on local roads is 0.5 feet below the gutter line for the 10-year design storm. Model results indicate that the proposed improvements significantly reduce flooding at the problem area along Brookside Road (node 11-05-01A-G) by more than 1 foot for the 10-year/24-hour design storm to within 1 to 2 inches above the gutter line and also provide six inches of freeboard below the proposed (raised) road centerline. This improved level of service (LOS) is considered appropriate since this project is a retro-fit involving localized improvements within a developed basin and the resulting flood stages are passable in a vehicle. To fully achieve the standard County LOS, additional road raising and pipe capacity would be required which would increase costs and constructability challenges. Alternatively, a less costly reduced LOS (below that proposed) could also be provided, if needed. Since the extents of the proposed improvements were focused on the 10-year LOS, even more dramatic flood reductions at the problem area are indicated for lesser storm events (e.g., 3-year, 1-hour and the mean annual 24-hour).

Model results also indicate negligible changes in the peak stage in the Sampley Wetland (Node 11-05-11C-P) for the mean annual storm event, indicating that the proposed design maintains the existing hydroperiod and storage capacity of the wetland.

No upstream stage increases in the Orange County portion of the study area are predicted, and the design components have been configured such that modeled increases in downstream stages and flows in Cassel Creek are negligible. Results are presented in **Table 5**, and proposed condition model schematics are presented in **Figures 10** and **11**.

Table 5 Node Stages for Proposed Condition Model (ft NAVD)

Node ID	Critical Elevation	3 Yr/1 Hr Existing	3 Yr/1 Hr Proposed	Difference	Mean Annual 24 Hr Existing	Mean Annual 24 Hr Proposed	Difference	10 Yr/24 Hr Existing	10 Yr/24 Hr Proposed	Difference	25 Yr/24 Hr Existing	25 Yr/24 Hr Proposed	Difference	100 Year 24 Hr Existing	100 Year 24 Hr Proposed	Difference
11 05 01A B	64.61	64.45	59.99	-4.46	64.40	59.72	-4.69	65.18	63.81	-1.49	65.39	64.93	-0.47	65.68	65.45	-0.23
11 05 01A C	63.24	63.12	59.79	-3.33	62.97	59.61	-3.36	63.89	62.37	-1.66	64.28	63.46	-0.84	64.93	64.33	-0.61
11 05 01A D	63.49	63.74	59.91	-3.83	63.61	59.67	-3.94	64.20	63.01	-1.33	64.44	64.03	-0.43	65.00	64.62	-0.38
11 05 01A F	62.60	61.23	59.60	-1.63	61.32	59.50	-1.82	62.78	61.52	-1.37	63.34	62.51	-0.85	63.76	63.37	-0.39
11 05 01A G	63.88/64.50	64.29	60.00	-4.29	64.29	59.72	-4.57	65.18	64.10	-1.20	65.39	64.95	-0.45	65.69	65.47	-0.22
11 05 01A H	61.38	60.57	58.76	-1.81	60.89	59.32	-1.57	63.10	61.67	-1.70	63.43	62.42	-1.01	64.27	63.95	-0.32
11 05 01A I	62.07	61.69	60.39	-1.30	62.26	60.34	-1.92	63.13	62.57	-0.55	63.35	63.01	-0.33	63.77	63.38	-0.38
11 05 01A K	60.81	60.07	57.75	-2.32	61.21	59.02	-2.19	62.74	61.38	-1.41	63.33	62.27	-1.12	63.74	63.34	-0.39
11 05 01A M	60.70	59.06	59.06	0.00	60.26	58.87	-1.39	62.36	61.18	-1.17	62.76	62.14	-0.70	63.34	63.09	-0.23
11 05 01A N	64.69	62.14	62.14	0.00	62.07	62.07	0.00	62.83	62.63	-0.20	63.76	63.48	-0.28	65.19	65.18	-0.01
11 05 01A O	64.39	61.02	58.15	-2.87	61.88	59.18	-2.71	63.14	61.61	-1.53	63.57	62.57	-1.02	63.90	63.54	-0.34
11 05 01A P	63.16	64.17	59.53	-4.65	64.23	59.56	-4.67	65.16	62.53	-2.66	65.36	64.06	-1.24	65.65	65.09	-0.54
11 05 01A S	64.22	62.55	58.68	-3.87	62.96	59.33	-3.63	64.07	61.96	-2.03	64.21	63.13	-1.06	64.33	64.08	-0.20
11 05 01B A	63.90	63.78	63.78	0.00	63.05	63.05	0.00	64.58	64.58	0.00	65.05	65.05	0.00	66.01	66.03	0.02
11 05 01B C	64.34	64.39	64.39	0.00	64.34	64.34	0.00	64.48	64.48	0.00	64.54	64.54	0.00	64.65	64.65	0.00
11 05 01C P	63.90	58.81	58.90	0.09	59.24	59.39	0.15	61.44	61.41	-0.02	62.61	62.42	-0.21	64.28	63.96	-0.32
11 05 02 A	62.56	58.69	57.12	-1.58	60.17	58.77	-1.40	62.36	61.07	-1.27	62.76	62.13	-0.69	63.34	63.09	-0.23
11 05 02 B	62.11	58.42	57.04	-1.38	59.90	58.75	-1.15	61.97	60.99	-0.94	62.33	62.01	-0.39	63.33	63.06	-0.25
11 05 02 C	63.85	60.63	60.63	0.00	61.10	60.66	-0.43	62.60	62.20	-0.36	63.07	62.85	-0.23	63.82	63.74	-0.08
11 05 02 S	62.00	60.42	60.42	0.00	61.04	61.04	0.00	61.61	61.23	-0.33	61.95	61.77	-0.20	62.48	62.42	-0.07
11 05 04 A	74.80	75.29	75.30	0.01	75.22	75.23	0.01	75.52	75.51	0.00	75.63	75.63	0.00	75.82	75.82	0.00
11 05 04 B	72.86	73.32	73.35	0.03	73.15	73.22	0.07	73.62	73.62	0.00	73.70	73.70	0.00	73.81	73.81	0.00
11 05 04 C	72.86	73.03	73.15	0.13	72.46	72.68	0.23	73.83	73.83	0.00	74.09	74.09	0.00	74.50	74.50	0.00
11 05 04 D	70.90	68.58	69.13	0.54	68.58	68.80	0.22	71.49	71.43	-0.07	71.76	71.74	-0.02	72.12	72.11	-0.01
11 05 04 S	73.45	74.14	74.19	0.05	73.50	73.70	0.19	74.62	74.62	0.00	74.75	74.75	0.00	74.97	74.97	0.00
11 05 05 S	79.51	77.41	77.50	0.09	75.94	76.00	0.06	80.45	80.45	0.00	80.70	80.70	0.00	81.08	81.08	0.00
11 05 06 A	89.32	86.42	86.42	0.00	86.34	86.34	0.00	87.14	87.14	0.00	89.08	89.08	0.00	89.71	89.71	0.00
11 05 06 B	87.50	85.97	85.97	0.00	85.87	85.87	0.00	88.11	88.11	0.00	88.19	88.19	0.00	88.31	88.31	0.00
11 05 06 C	85.51	84.27	84.27	0.00	83.79	83.79	0.00	86.17	86.17	0.00	86.30	86.30	0.00	86.47	86.47	0.00
11 05 06 S	85.07	83.86	83.86	0.00	83.59	83.59	0.00	85.30	85.30	0.00	85.46	85.46	0.00	85.69	85.69	0.00
11 05 07 S	82.98	82.71	82.71	0.00	82.49	82.49	0.00	83.38	83.38	0.00	83.56	83.56	0.00	83.82	83.82	0.00
11 05 11C P	65.00	59.05	59.02	-0.02	59.41	59.39	-0.02	60.57	60.63	0.04	61.46	61.57	0.13	63.30	63.03	-0.25
11 05 11D	62.50	59.09	59.06	-0.04	59.48	59.44	-0.05	60.49	60.43	0.01	62.05	61.10	-0.60	63.33	63.06	-0.25
11 05 11E S	63.20	58.88	57.19	-1.69	60.39	58.78	-1.61	62.74	61.15	-1.59	63.33	62.26	-1.12	63.73	63.33	-0.39
11 05 12C C	63.90	56.81	56.60	-0.21	58.72	58.56	-0.16	60.45	60.52	0.04	61.38	61.45	0.07	62.78	62.76	-0.01
BOX_CULVERT	59.90	52.92	52.92	-0.01	53.05	53.03	-0.02	54.18	54.18	0.00	54.70	54.70	0.00	55.61	55.61	0.00
BOX_CULVERT_UP	63.90	56.79	56.58	-0.21	58.68	58.52	-0.16	60.42	60.48	0.04	61.34	61.42	0.07	62.74	62.72	-0.01
LHR_Offsite	64.00	60.96	60.96	0.00	61.38	61.04	-0.34	62.79	62.50	-0.27	63.26	63.11	-0.16	64.01	63.95	-0.06
LKHOWELL	55.50	52.90	52.90	0.00	52.90	52.90	0.00	54.10	54.10	0.00	54.60	54.60	0.00	55.50	55.50	0.00



Legend

- Forest Brook Model Nodes
- Cassel Creek Boundary Flow
- Proposed Pipes
- Existing Links
- Forest Brook Model Basins
- County Line

Forest Brook Drainage Improvements
Figure 10 - Proposed Condition Model Schematic

1 inch = 500 feet

0 125 250 500 Feet

CDM Smith

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Legend

- Forest Brook Model Nodes
- Proposed Pipes
- Existing Links
- Forest Brook Model Basins
- County Line

1 inch = 200 feet

0 50 100 200 *Feet*

Forest Brook Drainage Improvements

Figure 11 - Proposed Condition Model Schematic (Detail)

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In addition to the primary problem area (node 11-05-01A-G), several other areas along Brookside Road and Brookside Court not currently meeting the 10-year LOS, are predicted to meet the 10-year LOS under proposed conditions. Reduced flood stages are also provided for areas near Derbyshire Road between Brookside Road and Forest Glen Court though 10-year LOS is not achieved primarily due to downstream tailwater conditons. Flood stages for offsite areas west of the project are not changed.

It is our understanding the County may consider phasing this project by implementing the repair of the asphalt lined corrugated metal pipe between Brookside Road and Derbyshire Road (Section 5) first and then following up with the conveyance improvements described above as funding becomes available. This phased approach is a viable option for the cured-in-place pipe (CIPP) repair option as it typically does not significantly reduce the existing pipe diameters, however, if other pipe repair alternatives, such as slip lining, are considered then a hydraulic evaluation of the resulting system should be performed to check if the improvements will result in adverse impacts within the study area.

Section 5

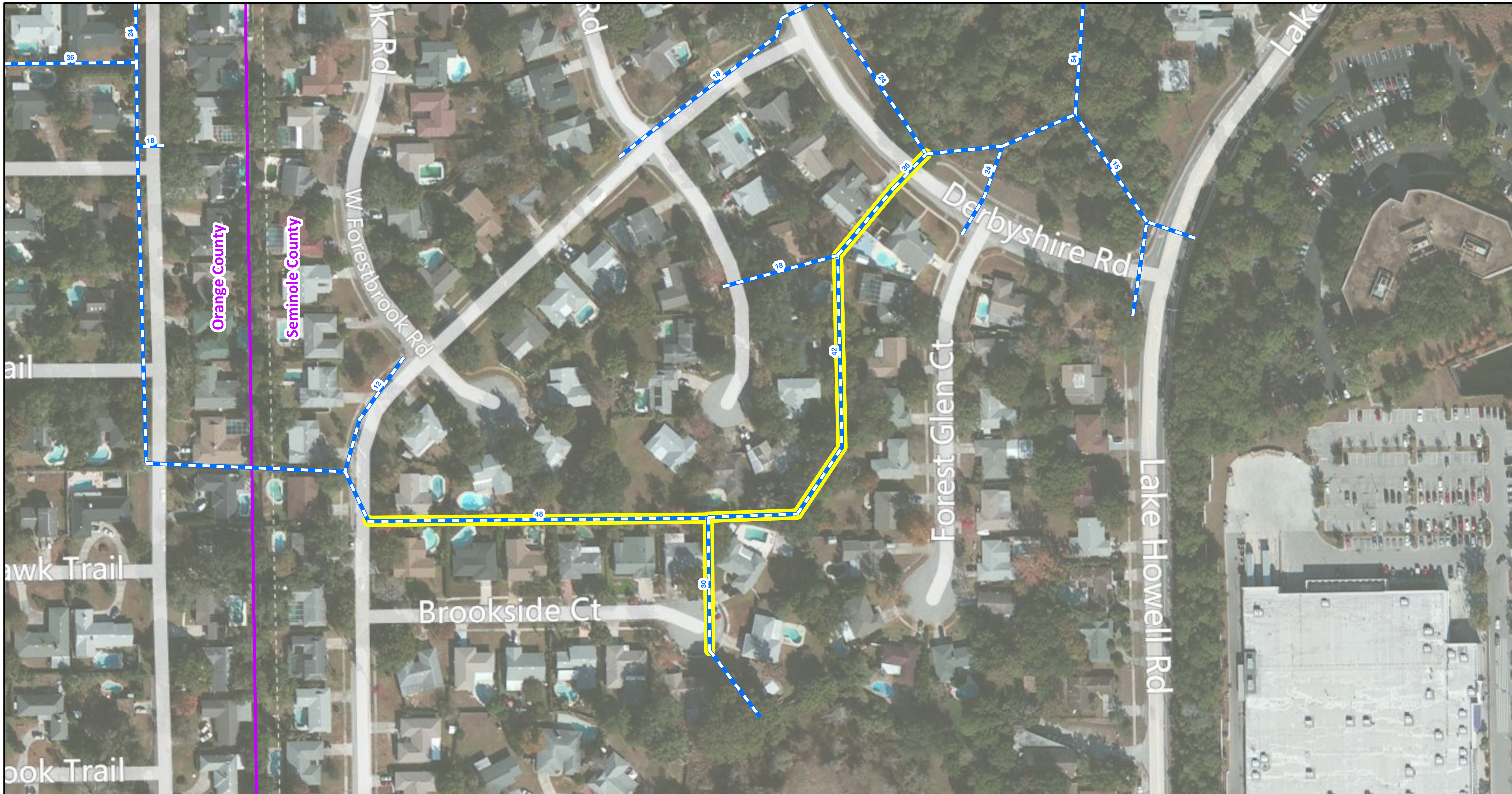
System Rehabilitation

As part of the overall proposed improvements described in Section 4, the County has expressed a desire to repair and rehabilitate the portion of the Forest Brook storm sewer conveyance system illustrated in **Figure 12**. This section of the storm sewer system consists of approximately 1,200 linear feet of asphalt-lined corrugated metal pipe (CMP) culverts ranging from 36 to 48 inches in diameter and approximately 200 feet of 30-inch CMP. Based on a pipe video investigation performed by SSMC in February 2012, the asphalt-lined pipe has degraded and there are numerous leaking joints. Refer to the pipe video reports provided by SSMC under separate cover. Based on the observations of the pipe video investigation, the pipe requires replacement, repair or abandonment. Abandonment of the pipe was not considered because the replacement trunk line to be constructed along Brookside Drive would be excessively large (greater than 48-inch diameter) and difficult to construct within the existing road corridor while maintaining traffic. To replace the pipe would result in impacts to existing fences and other backyard structures that have been constructed by the homeowners within the County's maintenance easement. Rehabilitating the existing pipe, as opposed to replacement by cut and cover techniques, would minimize the impacts to these existing structures, significantly prolong the life of the pipe, and minimize the size of the proposed trunk line to be constructed along Brookside Drive and Derbyshire Road. As a result of these considerations, the County has asked for recommendations for rehabilitation techniques that are suitable to the conditions of this project.

A summary of the three rehabilitation techniques considered are presented below:

Cured-In Place Pipe (CIPP): CIPP is a traditional pipe repair technique that remediates existing pipes by curing in-place a resin-saturated tube. The type of liner used is dependent upon the severity of the bends in the pipe. Felted fabrics are typically used for straight pipe installations while a woven fabric is used for installations that include pipe bends. The resin is typically cured using hot water or steam and can take from five to 30 hours. The process requires careful monitoring throughout. The result is a tight-fitting, jointless and corrosion-resistant replacement pipe. This method is typically cost effective as opposed to slip lining and spiral wound techniques. A disadvantage of this method is that it relies on the host pipe for structural strength; therefore, this option does not provide a comparable design life with respect to slip lining and if the host pipe has existing structural deficiencies then this is not a viable option. There are several CIPP contractors that perform work in central Florida.

Slip Liner Pipe: Slip lining is a trenchless pipe repair technique that involves slipping a new smaller pipe inside the existing pipe using blocks to offset the new pipe slightly from the existing pipe and backfilling the annular space, typically with grout. The advantage of slip lining is it provides a brand new pipe that is not dependent on the host pipe for structural strength and can typically outlast other trenchless pipe repair alternatives including CIPP and spiral wound techniques. The primary disadvantage of this technique is it reduces the diameter of the conveyance pipe by about six inches. For this project, this repair technique may be difficult to construct due to the bends in the system and limited access since a trench would be required for installation of the pipes or the proposed pipes would need to be constructed at relatively short lengths (say about 2 feet) that could be passed through the existing manholes and then slipped together inside the existing pipe.



Legend

Existing Pipes
Pipes to be Rehabilitated
County Line

Forest Brook Drainage Improvements
Figure 12 - Pipes Identified for Rehabilitation

1 inch = 150 feet

0 37.5 75 150 *Feet*

CDM Smith

PerneznyBJ G:\6116\Forest Brook\GIS\MXD\Figures\Figure12_PipeRehabExtents_030513.mxd 3/18/2013

Spiral Wound Pipe: The spiral wound pipe repair technique involves the installation of a plastic strip, commonly referred to as the profile, within the pipe to form a continuous plastic liner. The profile is installed with a machine that is guided by personnel within the pipe. Grooves are located on the profile that connect and lock the adjacent strips to form the continuous solid pipe. The advantage of this technique is that the spiral wound formed pipe can be easily adjusted to accommodate uniquely shaped pipes. The resulting plastic liner is typically backfilled with grout and, similar to the CIPP technique, this technique is dependent on the existing pipe for structural strength. The primary disadvantages of this technique are that it is not as cost effective as the CIPP technique and that it is more applicable for larger pipe diameters.

For purposes of our hydraulic modeling of the proposed drainage system, we have assumed the pipe repair technique will be cured-in place pipe (CIPP) repair. The resulting pipe will have a similar pipe diameter as the existing lined pipe with a Manning's roughness coefficient of 0.012 for smooth-lined pipe.

Based on the two quotes received by the cured-in-place contractors and the one quote from the spiral wound contractor, we recommend that cured-in-place pipe repair be implemented for this project. Based on the quotes received, CIPP can be implemented for significantly less cost than the spiral wound pipe repair method. Also, CIPP is a more prevalent repair technology that will provide predictable performance results.

As discussed in Section 4.2, pipe rehabilitation could be performed as part of the overall proposed stormwater and roadway improvements or in a phased approach as funding is available.

Section 6

Pollutant Load Analysis and Water Quality Considerations

6.1 Existing Condition

Total nitrogen (TN) and total phosphorus (TP) pollutant loads were calculated for the Forest Brook study area using the Florida Department of Environmental Protection (FDEP)-approved Total Maximum Daily Load (TMDL) Pollutant Load model for the Lake Jesup Basin. The Forest Brook Subdivision is located within the Howell Creek Subbasin which is a major tributary to Lake Jesup and therefore subject to the TMDL regulation. For consistency with current accepted TMDL protocols, the pollutant model was simulated to provide an estimate of loadings for the study area.

The model is a geographic information system (GIS) and Microsoft Access® application that uses drainage basin characteristics, along with runoff, best management practice (BMP), soils information, septic tank data and event mean concentration (EMC) lookup tables to generate average annual runoff volumes, gross pollutant loads, and net pollutant loads. A GIS shape file including attributes for land use, soil, existing BMPs, and jurisdiction was clipped to the Forest Brook basin boundary. These data were used to calculate the TP and TN existing loads using pre-defined equations in the pollutant load model. Both gross and net TN and TP loads were calculated and summarized by jurisdiction. Gross loads represent pollutant loads prior to existing BMP treatment while net loads indicate pollutant loads that account for existing BMPs. Approximately 9 percent of the Forest Brook study area is currently treated by dry detention.

Results of the existing condition pollutant load analysis are presented in **Table 6**.

Table 6 Forest Brook Basin Pollutant Loading

Jurisdiction	Area (acres)	Gross TP (lbs/year)	Gross TN (lbs/year)	Net TP (lbs/year)	Net TN (lbs/year)
Casselberry	21.4	16.0	98.2	14.4	87.4
FDOT District 5	0.1	0.1	0.4	0.1	0.3
Maitland	57.4	15.4	69.7	15.4	69.7
Unincorporated Orange County	0.2	0.0	0.2	0.0	0.2
Unincorporated Seminole County	77.5	28.4	142.4	27.8	139.4
Water/ Wetlands/ Natural Lands	3.8	1.4	24.1	1.4	24.1
Total	160.3	61.2	335.0	59.0	321.2

As can be seen from Table 6, the pollutant load model estimates relatively low loads of TN and TP. In addition to the pollutant load model, water quality sampling within the study area had previously been performed as part of the *Preliminary Design Report for Cassel Creek Stormwater Management* (BCI Engineers, 2005). As part of the preliminary design, water quality monitoring was performed to assess pollutant loads which contribute to Lake Howell. In addition to Lake Jesup, Lake Howell is also impaired for nutrients (trophic state index) but does not currently have a TMDL. Pollutant parameters were sampled for five wet season storm events, four dry season storm events, and six baseflow conditions during 2004 and 2005.

Pollutant loads from storm events were calculated in the BCI analysis by multiplying the available measured concentration data by the flow hydrograph. The flow hydrograph was established by taking stage data observed from the storm event and simulating the event using the ICPR model that was developed as part of the *Preliminary Design Report for Cassel Creek Stormwater Management*. Station 5 was located in the 54-inch RCP which serves the southern portion of the Cassel Creek Subbasin which also coincides with the outfall of the study area for the Forest Brook drainage improvements. The *Preliminary Design Report for Cassel Creek Stormwater Management* estimated pollutant loads based on the monitoring data using measured concentration values multiplied by the volume passing a given station. Based on the results in the *Preliminary Design Report for Cassel Creek Stormwater Management*, the estimated annual TP load (baseflow and storm event) is 480 lb/yr for the upstream area tributary to the sampling point at Station 5. Since this load was based on measured data, it was used for the purpose of estimating load reduction (see Section 6.2) by the proposed pond instead of the load estimates provided by the FDEP model. Loading estimates for TN, although sampled at Station 5 as part of the *Preliminary Design Report for Cassel Creek Stormwater Management*, were not included in the report. Therefore, only TP will be evaluated. Further analysis of the available data may be needed to support more rigorous estimates of pollutant loads and load reductions.

6.2 Water Quality Credits for Proposed Casselberry Park Pond

CDM Smith estimated the potential for load reduction provided by the proposed 1-acre water quality pond using the TP load estimates documented in the *Preliminary Design Report for Cassel Creek Stormwater Management* since these are based on actual collected data. The contributing area to the pond is somewhat smaller (101.9 ac) compared to the entire tributary area of the Forest Brook subbasin (160 acres) which is representative of the TP load (480 lb/yr). Since the land use and soils are homogenous throughout, CDM Smith estimated the load to the proposed pond by proportioning the load (and therefore the flow) by the contributing area. Approximately 64 percent of the load will be conveyed to the pond while the remaining 36 percent will bypass the pond all together.

Since this is a retrofit pond, CDM Smith used the FDEP approved method for calculating removal efficiencies for wet detention as documented in the *Draft Stormwater Treatment Applicant's Handbook* (FDEP 2010). The calculated removal efficiency is based on residence time and is shown in **Table 7**. Residence time was calculated using tributary area, runoff coefficient, and rainfall depth according to approved methods outlined in the St. Johns River Water Management District's *Applicant's Handbook: Regulation of Stormwater Management Systems* (2010). The pond was determined to have a residence time of approximately 8.4 days.

While measured TN load values were not available, the primary pollutant of concern for the Lake Jesup TMDL is TP. However, since Lake Howell is also impaired for nutrients and is co-limited by both TN and TP, it will be important to understand the potential of the proposed water quality pond to reduce TN as well. From the *Preliminary Design Report for Cassel Creek Stormwater Management*, it appears that both TN and TP were sampled, yet only TP loads were reported based on measured data. It is recommended that a similar loading estimate for TN be performed based on the measured data from this study or other appropriate data in order to estimate the potential for TN reduction by the proposed water quality pond. As indicated in Table 7, the proposed pond is estimated to remove more than 58% (or 178 pounds) of TP from stormwater runoff in a typical year.

Table 7 Estimated TP Load Reduction Parameters and Removal

Water Quality Pond Treatment Area (ac)	101.9
Average Annual Flow Rate (ac-ft/day)	0.47
Proposed Pond Permanent Pool Volume (ac-ft)	4
Residence Time (days)	8.4
Existing Load to Pond (lbs/yr)	306
Removal Efficiency (%)	58.3
Estimated Load Removal (lbs/yr)	178

Notes:
1. Average annual flow rate uses 51 inches of annual rainfall and a runoff coefficient of 0.4
2. Existing load to pond is estimated based on 1 year of measured data

Appendix A

Conceptual Cost Estimates

Table A-1: Preliminary Engineer's Estimate of Probable Cost
Forest Brook Drainage Improvements_ Conveyance and Roadway Regrading

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 63,400	$ 63,400
2	Traffic Control (approx. 5 percent)	LS	1	$ 63,400	$ 63,400
3	48-in RCP, Class III	LF	1,710	$ 150	$ 256,500
4	54-in RCP, Class III	LF	1,370	$ 185	$ 253,450
5	48-in x 76-in ERCP, Class III	LF	340	$ 220	$ 74,800
6	Ditch Bottom Inlet, Type J-bottom, <10'	EA	22	$ 5,000	$ 110,000
7	Milling Existing Asphalt Pavement, 2" Average Depth	SY	2,143	$ 4	$ 8,570
8	Optional Base Group 04 (Limerock)	SY	2,143	$ 12	$ 25,716
9	Asphaltic Concrete FC-12.5	TN	241	$ 115	$ 27,665
10	Brookside Road Regrading (**Table A-3**)	LS	1	$ 80,000	$ 80,000
11	Rehabilitation of Existing Corrugated Metal Pipe	LS	1	$ 300,000	$ 300,000
12	Sodding	SY	2,500	$ 2	$ 5,000
				Subtotal	**$ 1,269,000**
			Contingency:	30%	$380,700
			Legal, Engineering, and Adminstration:	20%	$253,800
			Overhead & Profit:	5%	$63,500
	Total Preliminary Engineer's Estimate of Probable Cost				**$ 1,967,000**
	(Rounded to the nearest $1,000)				

These Opinions of Conceptual Capital Cost:

1. Are in 2012 dollars.
2. Do not include potential replacement, re-alignment, or rehabilitation of non-stormwater infrastructure (e.g., water, sewer, reuse, cable, telephone, gas, fiber optic, etc.)
3. Do not include potential land acquisition (unless noted).
4. Do not include any potential hazardous material or groundwater remediation.
5. Do not include any potential wetlands mitigation.
6. Have a 30% contingency.
7. Are rounded to the next highest $1000.
8. Unit costs developed from FDOT Historical Cost Information tables and standard contractor cost information databases.

Table A-2: Preliminary Engineer's Estimate of Probable Cost
Forest Brook Drainage Improvements_ Water Quality Pond

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Mobilization (approx. 5 percent)	LS	1	$ 5,900	$ 5,900
2	Traffic Control (approx. 5 percent)	LS	1	$ 5,900	$ 5,900
3	24-in RCP, Class III	LF	40	$ 70	$ 2,800
4	30-in RCP, Class III	LF	50	$ 95	$ 4,750
5	Mitered End Section, 24"	EA	1	$ 1,000	$ 1,000
6	Excavation	CY	16,700	$ 4	$ 66,800
7	Clearing and Grubbing	AC	1.5	$ 10,000	$ 15,000
8	Ditch Bottom Inlet, Type J-bottom, <10'	EA	1	$ 5,000	$ 5,000
9	Sodding	SY	5,000	$ 2	$ 10,000
				Subtotal	**$ 118,000**

Contingency:	30%	$35,400
Legal, Engineering, and Adminstration:	20%	$23,600
Overhead & Profit:	5%	$5,900

Total Preliminary Engineer's Estimate of Probable Cost **$ 183,000**
(Rounded to the nearest $1,000)

These Opinions of Conceptual Capital Cost:

1. Are in 2012 dollars.
2. Do not include potential replacement, re-alignment, or rehabilitation of non-stormwater infrastructure (e.g., water, sewer, reuse, cable, telephone, gas, fiber optic, etc.)
3. Do not include potential land acquisition (unless noted).
4. Do not include any potential hazardous material or groundwater remediation.
5. Do not include any potential wetlands mitigation.
6. Have a 30% contingency.
7. Are rounded to the next highest $1000.
8. Unit costs developed from FDOT Historical Cost Information tables and standard contractor cost information databases.

Table A-3: Preliminary Engineer's Estimate of Probable Cost
Forest Brook Drainage Improvements_ Roadway Regrading Detail

Item No.	Item Description	Unit	Qty	Unit Cost	Capital Cost
1	Regular Excavation	CY	203	$ 4	$ 812
2	Embankment	CY	68	$ 6	$ 408
3	Stabilization (Type B - 12")	SY	1,950	$ 3	$ 5,850
4	Optional Base Group 4 - 6"	SY	1,950	$ 12	$ 23,400
5	Type SP Structural Course 1.5" (Traffic Level D - 165 lb/SY)	TN	161	$ 94	$ 15,134
6	Asphalt Concrete Friction Course, FC-3/4" (80 lb/sy) PG-76	TN	78	$ 103	$ 8,034
7	2.0' Concrete Curb and Gutter	LF	1,250	$ 13	$ 16,250
8	Valley Gutter	LF	140	$ 23	$ 3,220
9	4" Sidewalk	SY	240	$ 26	$ 6,240
				Subtotal	**$ 80,000**

Appendix B

Coordination Meeting Minutes – City of Casselberry

Memorandum

To: *Robert Walter, P.E., CFM, Seminole County*

From: *Paul Snead, P.E., CDM Smith*

Date: *September 19, 2012*

Subject: *Forest Brook Phase I Design*
Minutes of Meeting with City of Casselberry – September 13, 2012

Attendees: *Robert Walter (SC), Mark Flomerfelt (SC), Kelly Brock (CC), Luis Cruz (CC), Mark Gisclar (CC), Paul Snead (CDMS), Jim Wittig (CDMS)*

The purpose of this meeting was to coordinate the park and pond site requirements with the City of Casselberry. The following items were discussed at the meeting:

- The City would like the following improvements at the park site:
  - Asphalt trail (or flexipave if affordable) from Derbyshire Road to the existing Kewanee Trail. The trail is to be located within the existing jogging trail easement. Trail can be as narrow as 8-feet wide but 12-feet wide is preferred.
  - A mid-block crossing at Kewanee
  - Preferably a sidewalk around the entire pond but around the front side at a minimum. The sidewalk is to connect to the apartments. Need to coordinate with Newport Colony Management Company.
  - No fence around the pond.
  - Provide parking for the trail head. It was discussed that 6 general use spots and 2 handicap spots should be sufficient. Need to follow-up on the minimum parking requirements and pavement design. The City would like the County to include the parking lot layout in their design plans.
  - Include space for a pavilion (30'x30'), restrooms and playground.
  - The proposed pond is to provide water quality treatment for the City's park improvements. Need to clarify water quality requirements for trail.
  - The County is to design utility stub outs (water and wastewater) for the park improvements.
  - Include a couple of educational signs to enhance grant opportunities.

- It was discussed that the County would design, permit and construct the pond, trail, utility stub outs and trail head parking lot. The City would reimburse the County for a portion of the pond (based on TMDL credits and stormwater treatment for Park) and would entirely fund all of the park related improvements including the parking lot, utilities, trail, irrigation, landscaping and other park amenities.
- The County indicated that design is funded in the next fiscal year (2012/2013) but construction is not funded yet. The County anticipates waiting for the 1 cent sales tax referendum. The City indicated possible funding alternatives are TMDL 319 and Metroplan Type B project ($300k).
- The City indicated that if the project is greater than 30% impervious (including pond) then a conditional use permit is required from City unless a variance is approved.
- The City anticipates that areas needing stormwater treatment could be conveyed to the pond via swales.
- The City requested that the design be phased to include a Trail Phase ($300k) and a Stormwater Improvement Phase (everything else).
- The City will require that non-invasive trees with 6" DBH (diameter breast height) or greater be replaced. A tree survey will be required as part of the final design. The City mentioned that Cypress Trees could be planted around the pond as one option.
- The wetland lines will need to be re-established and resurveyed.
- The City was receptive to designing the pond for irrigation reuse. The City suggested that it could be designed to include a switch to use either potable water or stormwater as source options.
- The City was receptive to a fountain (solar bee) if the utility cost can be minimized.

Action Items

- Setup a coordination meeting with the Newport Colony Apartments management company. (County)
- Clarify water quality requirements for the trail. (CDM Smith)
- Continue to coordinate the parking requirements and pavement design with City. (CDM Smith)
- Research the City's conditional use permit requirements. (CDM Smith)

cc: Attendees

Memorandum

To: *Paul Snead*

From: *Robert Walter*

Date: *December 21, 2012*

Subject: *Forest Brook Phase I Design Comments and Responses*

1. **Figure 2. Use black letters to see street names.**

   Response: *Figure 2 will be updated to more clearly show the street names.*

2. **Page 2-3, 3rd paragraph. "Semi permanently flooded excavated wetlands". Were these wetlands excavated? Or are you referring to the ditching?**

   Response: *This designation came from the NWI database indicating that all or part of the wetland was excavated in the past. There is ditching present around this wetland. The area may have been excavated in the past. A review of historic aerial photographs would be necessary to make a full determination.*

3. **Page 2-6. We have attached a copy of an old SCS map which has soil types rather than the urban classification. Look at this and let us know if using actual soil types would make a difference.**

   Response: Water Quantity: *The soils map submitted with the report (Figure 5) indicates various hydrologic soil groups (HSG) dominated by HSG A (well to excessively drained) in Orange County and soils primarily designated as Urban in Seminole County as indicated in the latest SCS soil surveys. The Urban soil designation represent areas where the native soils have been significantly altered, obscured, or filled by development. An older soil survey for Seminole County reports actual (presumably native) soils within the study area. Review of the older SCS soil survey indicates that the upland soils in the Seminole County portion of the project area range from moderately to well drained but does not provide a HSG designation.*

For this project, the Urban soils were treated as HSG C soils which are moderately drained. Therefore, using the soils as designated in the older SCS map (instead of as Urban) would likely not make a significant difference in regards to the proposed improvements. This conclusion is further supported by flow sources that cause flooding along Brookside Road. Under existing conditions, node 11-05-01A-G receives a peak 10-year inflow of 161 cfs, of which less than 25% (36 cfs) comes from Seminole County basins.

In previous studies, BCI used a lower Curve Number (CN) for the basins in Seminole County similar to that used for the Orange County basins. This does not appear to provide a conservative approach to stormwater management needed for the Forest Brook project. The 2011 Howell Creek Basin Masterplan by CDM Smith designated the Urban soils in the Seminole County basins as HSG D (poorly drained), which is a very conservative approach consistent with master planning. For the Forest Brook project, our approach was to use a reasonable, but conservative approach to the hydrology to use as the basis for design to address the flood prone areas.

Water Quality: Evaluation of the runoff coefficient was needed in an effort to estimate the residence time for the pond based on average annual runoff. Guidance from the SJRWMD (applicant's handbook) was used to perform these calculations in conjunction with the land use and soils. In terms of picking a runoff coefficient for the project area, as it is mostly residential with soils with a higher runoff potential we assumed a flat slope for Single Family residential as shown on the attached table. We used the 0.4 runoff coefficient and while it was somewhat conservative, it was not as conservative as the maximum value of 0.5. We believe 0.4 is most representative of the characteristics of the basin in light of the old and new SCS reports.

4. **Page 3-5, 1st paragraph. Can you include the time flow boundary condition at Cassel creek?**

Response: *See Attachment 1 for the time-flow boundary condition at Cassel Creek from areas not explicitly included in our models. The load point in Cassel Creek for these time-flows is node 11-05-12C-C. The time-flow data is included for the mean annual, 10-, 25-, and 100-year storms from hour 0 to hour 40. This table will be included in the final report.*

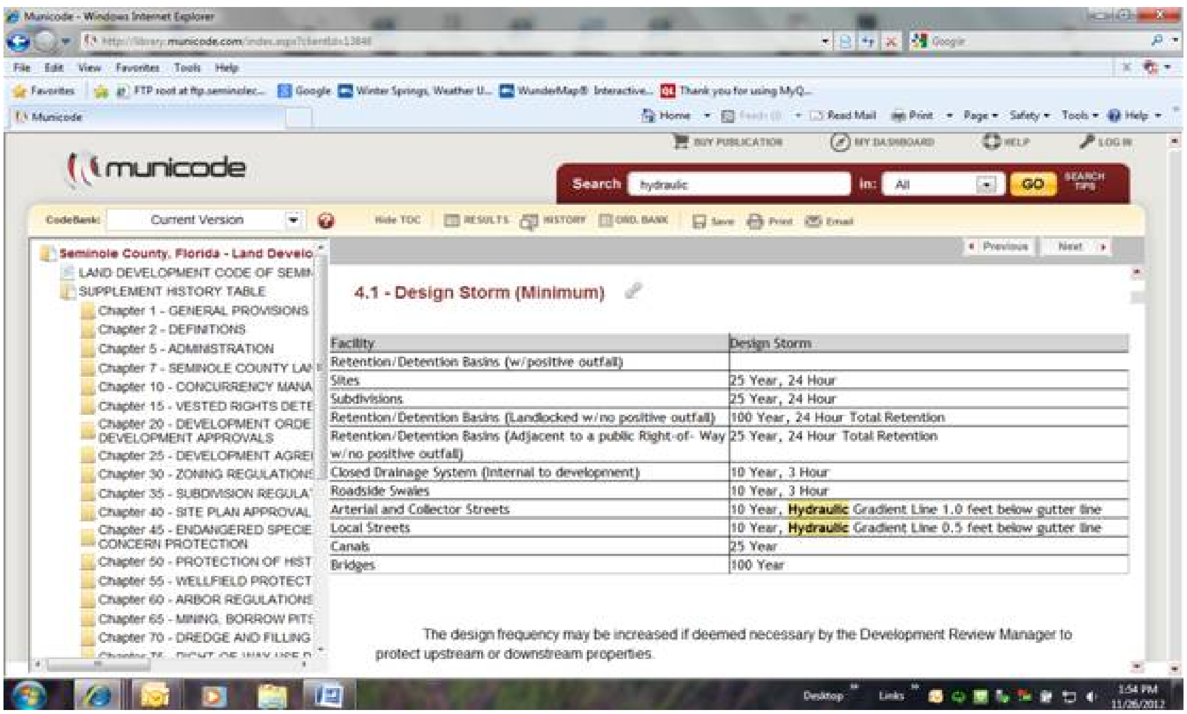
5. **Table 3. There appears to be flooding at several locations during the 10/24 storm, not just at Brookside road. What manning number is in the model for the results in table 3? Please state.**

Response: *This is correct. Several areas (nodes) primarily within the project area indicate flooding for design storms (e.g., 10-year storm). The flooding is primarily due to inadequate conveyance of upstream and local runoff to Cassel Creek. The proposed improvements improve the conveyance through the project area and also to the outfall at Cassel Creek. Pipes were modeled using a Manning's N of 0.024 for CMP and 0.012 for RCP and lined CMP.*

6. Table 4. Again please state the manning numbers used for the existing piped (and any reduction for condition as applicable). Are these results after the pipes have been lined?

Response: *Pipes were modeled using a Manning's N of 0.024 for CMP and 0.012 for RCP and lined CMP. No reduction of conveyance was applied to the existing lined pipes to account for condition. No additional lining or adjustment was made to the Manning's N for proposed conditions.*

7. Table 4. The difference in flood elevation between existing and proposed during 3/1 and mean annual at Brookside Rd (and a couple of other locations) is amazing. What is driving the design pipe size? The County's requirements for HGL for secondary drainage systems on local roads is half foot below gutter line.



4.1 - Design Storm (Minimum)

Facility	Design Storm
Retention/Detention Basins (w/positive outfall)	
Sites	25 Year, 24 Hour
Subdivisions	25 Year, 24 Hour
Retention/Detention Basins (Landlocked w/no positive outfall)	100 Year, 24 Hour Total Retention
Retention/Detention Basins (Adjacent to a public Right-of- Way w/no positive outfall)	25 Year, 24 Hour Total Retention
Closed Drainage System (Internal to development)	10 Year, 3 Hour
Roadside Swales	10 Year, 3 Hour
Arterial and Collector Streets	10 Year, Hydraulic Gradient Line 1.0 feet below gutter line
Local Streets	10 Year, Hydraulic Gradient Line 0.5 feet below gutter line
Canals	25 Year
Bridges	100 Year

The design frequency may be increased if deemed necessary by the Development Review Manager to protect upstream or downstream properties.

Response: *Our goal was to keep the peak stage for the 10-yr/24-hr storm below the gutter line on Brookside Road at Node 11-05-01A-G. In addition to the proposed pipes it was required that we raise the road about 0.7'. The model results indicate the peak stage of the 10-year / 24-hour storm will still exceed the gutter line slightly (1 to 2 inches) but considering this is a retrofit project and the resulting flooding is passable in a car we believe it should be acceptable. To achieve the Level of Service shown in the table above additional road raising and an upsized outfall would likely be required. We believe that pipes in excess of 48" would be excessively challenging to construct through the existing neighborhood; therefore, we do not recommending this alternative. We also understand there may be a desire to explore less costly alternatives that provide a lower level of service. If desired CDM Smith can work with the County to develop an approach for developing these alternatives.*

8. Page 5-3. So do you have a recommended type of fix?

Response: *Based on the two quotes received by the cured-in-place contractors and the one quote from the spiral wound contractor, we recommend that cured-in-place pipe (CIPP) repair be implemented for this project. Based on the quotes received CIPP is about the half the cost of the spiral wound pipe repair method and it is a more prevalent repair technology that will provide predictable performance results.*

9. Is there a table/list of the pipe lining costs? Also add recommended pipe lining costs to table A1.

Response: *A value for the pipe lining cost, based on the two quotes received for the cured-in-place technology, will be added to Table A1.*

10. Can you estimate a number of mitigation credits that would be assessed, if we were to go in and disturb all of Mr. Sampley wetlands? (We understand that this would be an estimate without doing the UMAM and getting it approved by SJ , but would give us a ball park). Then do you know what credits in this basin are going for?

Response: *Without doing a full UMAM analysis and depending on UMAM scores accepted by SJRWMD, we have roughly estimated the credits necessary to impact the entire wetland would be approximately 4.1 UMAM credits. If the wetland was scored on the low range of values, 1.6 UMAM credits would be necessary. If the wetland was scored on the mid-range of values, 2.9 UMAM credits would be necessary. Colbert Cameron mitigation bank could service this project – the price is $50,000/credit. This bank is set up for ratio credits – so if SJRWMD accepts 1.5:1, then 6.2 credits would be needed (~$310,000). If the ratio is 2:1, then 8.2 credits would be needed (~$410,000). This information is provided as a rough estimate only and may change significantly from values that are determined from a more detailed analysis. We can also look into other banks that may service this area to compare prices as a next step.*

11. Is the Sampley area really a FEMA flood plain? Is there any way to remove it from the maps?

Response: *Yes, it is a designated FEMA 100-year floodplain with an undetermined elevation. If it was determined from our modeling that the extent of the floodplain was inaccurate the floodplain can be revised by coordinating a map revision with FEMA. The process would include modeling the floodplain with an approved program (ICPR, SWMM) and having it approved by FEMA.*

12. We should add an option something like this– Option 2; The County may decide to line the existing pipe to prevent further damage, and since there is no immediate structure flooding allow the road to flood for short periods until future funding is available to complete the project.

Response: *We agree that phasing the project is a viable option, however, this interim pipe repair option should consider replacing the impacted inlets and manholes with structures that are large enough to accommodate the ultimate pipe sizes.*

cc: Jim Wittig
Mark Flomerfelt

From: Snead, Paul Q.
Sent: Monday, February 04, 2013 10:59 AM
To: 'Walter, Robert'
Subject: RE: Forest brook Phase 1 Report

Thanks Bob. We'll get these incorporated and get the final reports over to you. When I have a handle on our schedule I'll let you know.

From: Walter, Robert [mailto:RWalter@seminolecountyfl.gov]
Sent: Friday, February 01, 2013 2:25 PM
To: Snead, Paul Q.
Cc: Flomerfelt, Mark; Wittig, James; Mack, Brian
Subject: RE: Forest brook Phase 1 Report

Paul, Sorry it taken me so long to get back to you. My comments are below shown in red.

Thanks and Have a Nice Day!!

Seminole County Engineering

Robert Walter, P.E., CFM
Seminole County Professional Engineer
100 East First Street
Sanford, FL 32771

rwalter@seminolecountyfl.gov

Phone: 407-665-5753
Fax: 407-665-5788

From: Snead, Paul Q. [mailto:sneadpq@cdmsmith.com]
Sent: Friday, December 21, 2012 10:14 AM
To: Walter, Robert
Cc: Flomerfelt, Mark; Wittig, James; Mack, Brian
Subject: RE: Forest brook Phase 1 Report

Bob,

Below are our draft comment responses. I'm calling them "draft" because we might need to adjust them after you've had a chance to review and we've all discussed. When we are all good with them I can submit you a formal copy on letterhead for your records.

I'm working today but then headed out to vacation for the next two weeks returning on January 7th. I'll call you when I get back to follow up. If you have any questions in the meantime you can email or call me and I'll get back with you as soon as I can.

I hope you have a good holiday!

Paul

From: Walter, Robert [mailto:RWalter@seminolecountyfl.gov]
Sent: Thursday, December 06, 2012 3:24 PM
To: Snead, Paul Q.
Cc: Flomerfelt, Mark
Subject: Forest brook Phase 1 Report

Forest Brook Phase 1 design report comments

1) Figure 2 Use black letters to see street names.

   Figure 2 will be updated to more clearly show the street names. Ok add to report

2) Page 2-3, 3rd paragraph; "semi permanently flooded **excavated** wetlands" Were these wetlands excavated? Or are you referring to the ditching?

   This designation came from the NWI database indicating that all or part of the wetland was excavated in the past. There is ditching present around this wetland. The area may have been excavated in the past. A review of historic aerial photographs would be necessary to make a full determination. Ok

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soil survey indicates that the upland soils in the Seminole County portion of the project area range from moderately to well drained but does not provide a HSG designation.

For this project, the Urban soils were treated as HSG C soils which are moderately drained. Therefore, using the soils as designated in the older SCS map (instead of as Urban) would likely not make a significant difference in regards to the proposed improvements. This conclusion is further supported by flow sources that cause flooding along Brookside Road. Under existing conditions, node 11-05-01A-G receives a peak 10-year inflow of 161 cfs, of which less than 25% (36 cfs) comes from Seminole County basins.

In previous studies, BCI used a lower Curve Number (CN) for the basins in Seminole County similar to that used for the Orange County basins. This does not appear to provide a conservative approach to stormwater management needed for the Forest Brook project. The 2011 Howell Creek Basin Masterplan by CDM Smith designated the Urban soils in the Seminole County basins as HSG D (poorly drained), which is a very conservative approach consistent with master planning. For the Forest Brook project, our approach was to use a reasonable, but conservative approach to the hydrology to use as the basis for design to address the flood prone areas.

Water Quality: Evaluation of the runoff coefficient was needed in an effort to estimate the residence time for the pond based on average annual runoff. Guidance from the SJRWMD (applicant's handbook) was used to perform these calculations in conjunction with the land use and soils. In terms of picking a runoff coefficient for the project area, as it is mostly residential with soils with a higher runoff potential we assumed a flat slope for Single Family residential as shown on the attached table. We used the 0.4 runoff coefficient and while it was somewhat conservative, it was not as conservative as the maximum value of 0.5. We believe 0.4 is most representative of the characteristics of the basin in light of the old and new SCS reports.

Ok add or summarize this discussion to the to report

4) Page 3-5, 1st paragraph; can you include the time flow boundary condition at Cassel creek?

See Attachment 1 for the time-flow boundary condition at Cassel Creek from areas not explicitly included in our models. The load point in Cassel Creek for these time-flows is node 11-05-12C-C. The time-flow data is included for the mean annual, 10-, 25-, and 100-year storms from hour 0 to hour 40. This table will be included in the final report. Ok add to report

5) Table 3; There appears to be flooding at several locations during the 10/24 storm, not just at Brookside road. What manning number is in the model for the results in table 3? Please state.

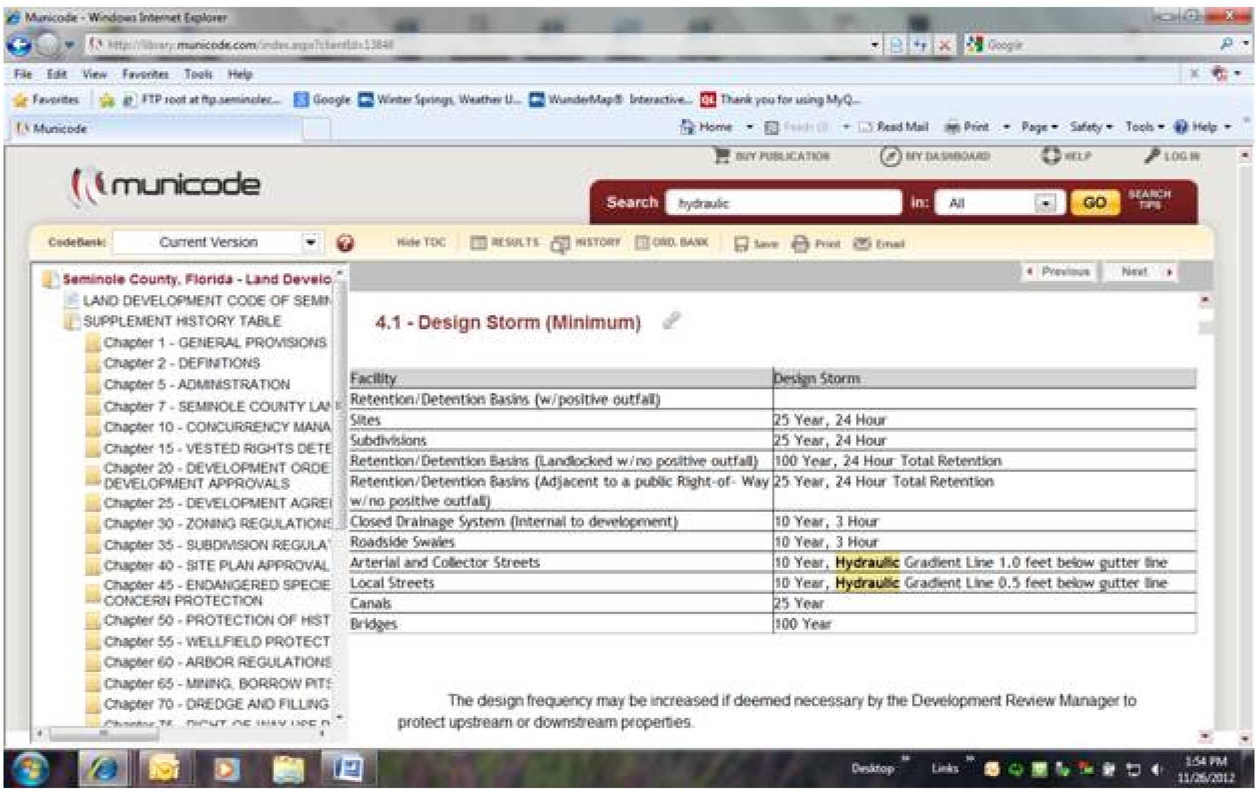
This is correct, several areas (nodes) primarily within the project area indicate flooding for design storms (e.g., 10-year storm). The flooding is primarily due to inadequate conveyance of upstream and local runoff to Cassel Creek. The proposed improvements improve the

conveyance through the project area and also to the outfall at Cassel Creek. Pipes were modeled using a Manning's N of 0.024 for CMP and 0.012 for RCP and lined CMP. Ok

6) Table 4; again please state the manning numbers used for the existing piped (and any reduction for condition as applicable). Are these results after the pipes have been lined?

Pipes were modeled using a Manning's N of 0.024 for CMP and 0.012 for RCP and lined CMP. No reduction of conveyance was applied to the existing lined pipes to account for condition. No additional lining or adjustment was made to the Manning's N for proposed conditions. Ok add to report

7) Table 4; the difference in flood elevation between existing and proposed during 3/1 and mean annual at Brookside Rd (and a couple of other locations) is amazing. What is driving the design pipe size? The County's requirements for HGL for secondary drainage systems on local roads is half foot below gutter line.



4.1 - Design Storm (Minimum)

Facility	Design Storm
Retention/Detention Basins (w/positive outfall)	
Sites	25 Year, 24 Hour
Subdivisions	25 Year, 24 Hour
Retention/Detention Basins (Landlocked w/no positive outfall)	100 Year, 24 Hour Total Retention
Retention/Detention Basins (Adjacent to a public Right-of- Way w/no positive outfall)	25 Year, 24 Hour Total Retention
Closed Drainage System (Internal to development)	10 Year, 3 Hour
Roadside Swales	10 Year, 3 Hour
Arterial and Collector Streets	10 Year, Hydraulic Gradient Line 1.0 feet below gutter line
Local Streets	10 Year, Hydraulic Gradient Line 0.5 feet below gutter line
Canals	25 Year
Bridges	100 Year

The design frequency may be increased if deemed necessary by the Development Review Manager to protect upstream or downstream properties.

Our goal was to keep the peak stage for the 10-yr/24-hr storm below the gutter line on Brookside Road at Node 11-05-01A-G. In addition to the proposed pipes it was required that we raise the road about 0.7'. The model results indicate the peak stage of the 10-year / 24-hour storm will still exceed the gutter line slightly (1 to 2 inches) but considering this is a retrofit project and the resulting flooding is passable in a car we believe it should be acceptable. To achieve the Level of Service shown in the table above additional road raising and an upsized outfall would likely be required. We believe that pipes in excess of 48" would be excessively challenging to construct through the existing neighborhood; therefore, we do

not recommending this alternative. We also understand there may be a desire to explore less costly alternatives that provide a lower level of service. If desired CDM Smith can work with the County to develop an approach for developing these alternatives. Ok add something like this to report

8) Page 5-3 So do you have a recommended type of fix?

Based on the two quotes received by the cured-in-place contractors and the one quote from the spiral wound contractor, we recommend that cured-in-place pipe (CIPP) repair be implemented for this project. Based on the quotes received CIPP is about the half the cost of the spiral wound pipe repair method and it is a more prevalent repair technology that will provide predictable performance results. Ok add to report

9) Is there a table/list of the pipe lining costs? Also add recommended pipe lining costs to table A1.

A value for the pipe lining cost, based on the two quotes received for the cured-in-place technology, will be added to Table A1. Ok add to report

10) Can you estimate a number of mitigation credits that would be assessed, if we were to go in and disturb all of Mr. Sampley wetlands? (we understand that this would be an estimate without doing the UMAM and getting it approved by SJ – But would give us an ball park) Then do you know what credits in this basin are going for?

Without doing a full UMAM analysis and depending on UMAM scores accepted by SJRWMD, we have roughly estimated the credits necessary to impact the entire wetland would be approximately 4.1 UMAM credits. If the wetland was scored on the low range of values, 1.6 UMAM credits would be necessary. If the wetland was scored on the mid range of values, 2.9 UMAM credits would be necessary. Colbert Cameron mitigation bank could service this project – the price is $50,000/credit. This bank is set up for ratio credits – so if SJRWMD accepts 1.5:1, then 6.2 credits would be needed (~$310,000), if the ratio is 2:1, then 8.2 credits would be needed (~$410,000). This information is provided as a rough estimate only and may change significantly from values that are determined from a more detailed analysis. We can also look into other banks that may service this area to compare prices as a next step. Ok add to report

11) Is the Sampley area really a FEMA flood plain? Is there any way to remove it from the maps?

Yes, it is a designated FEMA 100-year floodplain with an undetermined elevation. If it was determined from our modeling that the extent of the floodplain was inaccurate the floodplain can be revised by coordinating a map revision with FEMA. The process would include modeling the floodplain with an approved program (ICPR, SWMM) and having it approved by FEMA. Ok

12) We should add an option something like this– Option 2; The County may decide to line the existing pipe to prevent further damage, and since there is no immediate structure flooding allow the road to flood for short periods until future funding is available to complete the project.

We agree that phasing the project is a viable option, however, this interim pipe repair option should consider replacing the impacted inlets and manholes with structures that are large enough to accommodate the ultimate pipe sizes. **Ok add to report**

Thanks and Have a Nice Day!!

Seminole County Engineering

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From: Snead, Paul Q. [mailto:sneadpq@cdmsmith.com]
Sent: Thursday, December 06, 2012 2:30 PM
To: Walter, Robert
Subject: RE: Forest brook

Ok, thanks for the heads up.

From: Walter, Robert [mailto:RWalter@seminolecountyfl.gov]
Sent: Thursday, December 06, 2012 9:46 AM
To: Snead, Paul Q.
Subject: Forest brook

Paul,

Mark and I have discussed the Forest Brook Report and I am compiling a few comments. I will send them to you shortly.

Thanks and Have a Nice Day!!

Seminole County Engineering

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