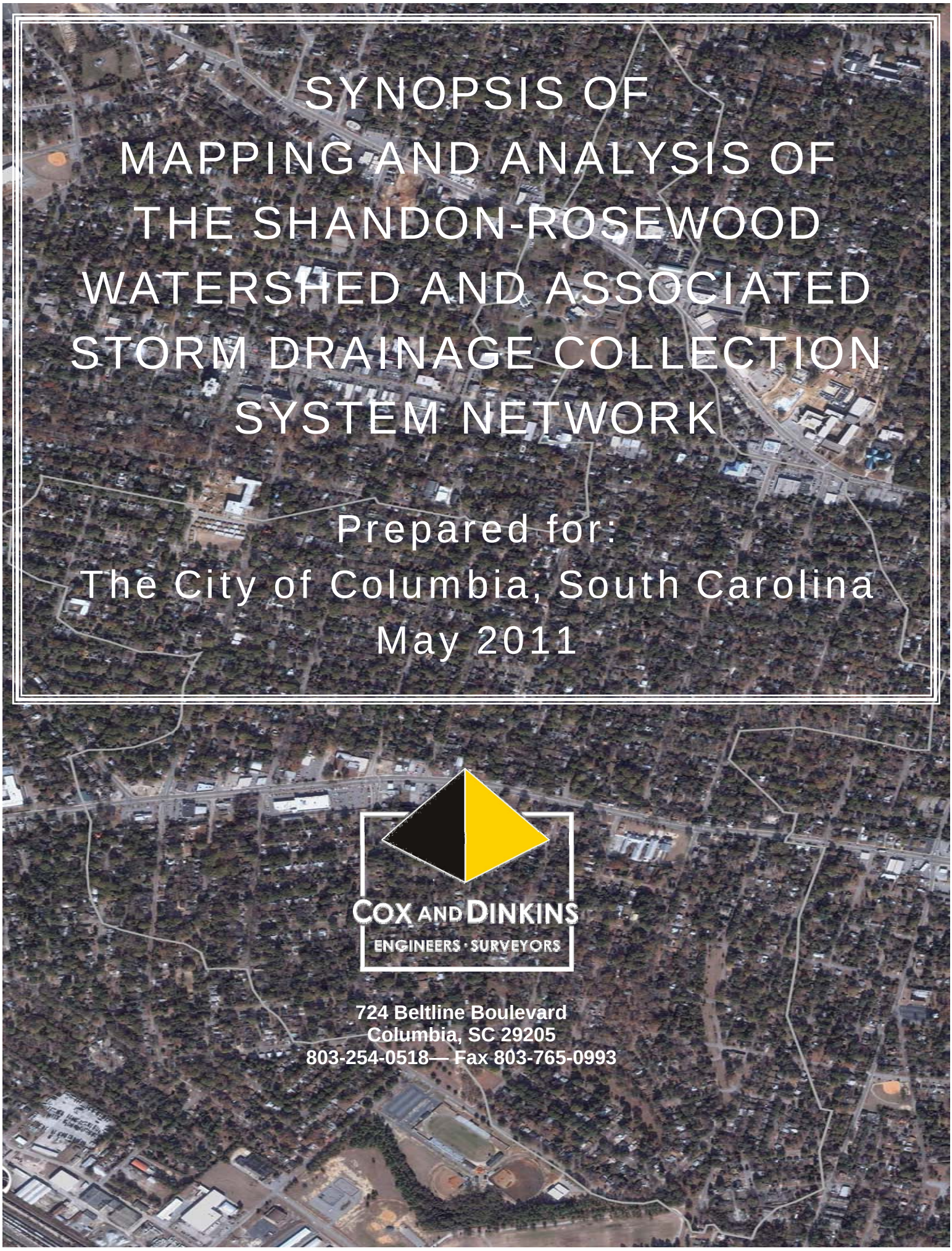

SYNOPSIS OF MAPPING AND ANALYSIS OF THE SHANDON-ROSEWOOD WATERSHED AND ASSOCIATED STORM DRAINAGE COLLECTION SYSTEM NETWORK

Prepared for:
The City of Columbia, South Carolina
May 2011

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MAY 23, 2011

PREFACE

As delineated, the Shandon-Rosewood watershed encompasses 750± acres. The upstream limit of the 750± acre Shandon-Rosewood watershed is in the vicinity of Gladden Road and Hagood Road, just south of Trenholm Road. The downstream limit of the 750± acre Shandon-Rosewood watershed is in the vicinity of the Live Oak Street and South Ott Road intersection. The eastern limits of the Shandon-Rosewood watershed are along Monroe Street near the intersection of Prospect Street and along Live Oak Street near the intersection of South Kilbourne Road. The western limit of the Shandon-Rosewood watershed is near the intersection of Duncan Street and Princess Street.

In the vicinity of the upstream watershed limit the ground elevation is approximately 354 (NAVD88). In the vicinity of the downstream watershed limit the ground elevation is approximately 190 (NAVD88). There, the piped drainage discharges into open channels.

SURVEYING AND MAPPING

Cox and Dinkins, Inc. has completed a survey of visible and accessible storm drainage structures (nodes) and pipes (links) within the 750± acre Shandon-Rosewood watershed. That survey began with establishing horizontal and vertical control points throughout the 750± acre Shandon-Rosewood watershed using survey grade GPS technology combined with conventional surveying techniques. Working on the South Carolina State Plane Coordinate System (SCSPCS; Horizontal NAD 83/2007; Vertical NAVD 88), Cox and Dinkins, Inc. proceeded to field locate and to determine the type of structure, approximate size and distinguishing features of all visible and accessible storm drainage structures (nodes). The survey also determined rim or top of structure (node) elevations along with pipe inverts and diameters or applicable geometry of visible and accessible pipes (links). Field survey data was then processed and compiled into a detailed project map. The project map includes approximate lengths of pipes (links), their diameters or applicable geometries, notes regarding apparent condition and apparent flow direction, and their location relative to approximate street centerlines.

DRAINAGE MODELING APPROACH

The storm drainage collection system as surveyed and mapped within the 750± acre Shandon-Rosewood watershed is in excess of 1,000 nodes (drainage structures) and in excess of 1,000 links (conduits). Due to physical characteristics of the drainage collection system, the 750± acre Shandon-Rosewood watershed has been divided into two primary sub-watersheds, namely the **east branch watershed** and the **west branch watershed**. The **east branch watershed** and the **west branch watershed** initially discharge into two independent open channels and those open channels converge into one open channel near the downstream limits of the study area. That configuration allows the described subdivision of the Shandon-Rosewood watershed into the **east branch watershed** and the **west branch watershed**. The described subdivision of the Shandon-Rosewood watershed into the **east branch watershed** and the **west branch watershed** also fits modeling constraints of the drainage software since it allows the creation of two independent watersheds, each with nodes (structures) and links (conduits) numbering less than 1,000. The **east branch watershed** contains 400± acres and the storm drainage collection system within the **east branch watershed** contains 700+ nodes (drainage structures) and 700+ links (conduits). The **west branch watershed** contains 350± acres and the storm drainage collection system within the **west branch watershed** contains 500+ nodes (drainage structures) and 500+ links (conduits).

DRAINAGE SOFTWARE AND MODEL PARAMETERS

XPSWMM 2009 (service Pack 3) was selected to conduct the study of the Shandon-Rosewood storm drainage network. The **XPSWMM** software purchased for use on this project has the capability of analyzing systems containing up to 1,000 nodes, each node representing either a drainage structure such as a catch basin or a point of significance along a conveyance such as a ditch. As described previously, the Shandon-Rosewood watershed has more than 1,000 such nodes and the 750± acre Shandon-Rosewood watershed has been divided into the **east branch watershed** and the **west branch watershed**.

Independent **XPSWMM** models have been developed for the **east branch watershed** and the **west branch watershed.** Runoff has been routed through the two separate models using the SCS Hydrology Routing Method. The rainfall events selected for routing were the 2-year, 24-hour rainfall event (3.6” accumulated rainfall) and the 10-year, 24-hour rainfall event (5.3” accumulated rainfall). City of Columbia regulations typically require the 25-year, 24-hour rainfall event be used for watersheds in excess of forty (40) acres. However, the City of Columbia instructed that the 10-year, 24-hour rainfall event be used for modeling associated with the analysis of the 750± acre Shandon-Rosewood watershed. Tailwater conditions (10-year flood) used in the model have been taken from the Federal Emergency Management Agency (FEMA) Flood Insurance Study (FIS) last revised September 29, 2010.

Subdivision of the entire 750± acre Shandon-Rosewood watershed into individual sub-catchments for each storm drainage structure (node) has not been performed. The topographic basis for watershed delineation to that degree of detail does not exist and is beyond the scope of this project. But the **east branch watershed** and the **west branch watershed** have both been further subdivided into smaller sub-watersheds with areas ranging in size from less than one (1) acre to areas on the order of twenty-five (25) acres. For the purposes of this study these watershed subdivisions have been based on significance within the overall watershed. Particular attention has been given to significant

storm drainage junctions and to areas identified by the City of Columbia as having a history of underperformance and/or public complaint.

SIGNIFICANT STORM DRAINAGE JUNCTIONS

*Some of the significant storm drainage junctions and areas identified by the City of Columbia as having a history of underperformance and/or public complaint are as follows:

- Wheat Street at Amherst Avenue
- Monroe Street at Ravenel Street
- Monroe Street between Ravenel Street and Wheat Street
- Heyward Street between Ravenel Street and Wheat Street
- Shandon Street north of Wilmot Avenue
- Monroe Street at Maple Street

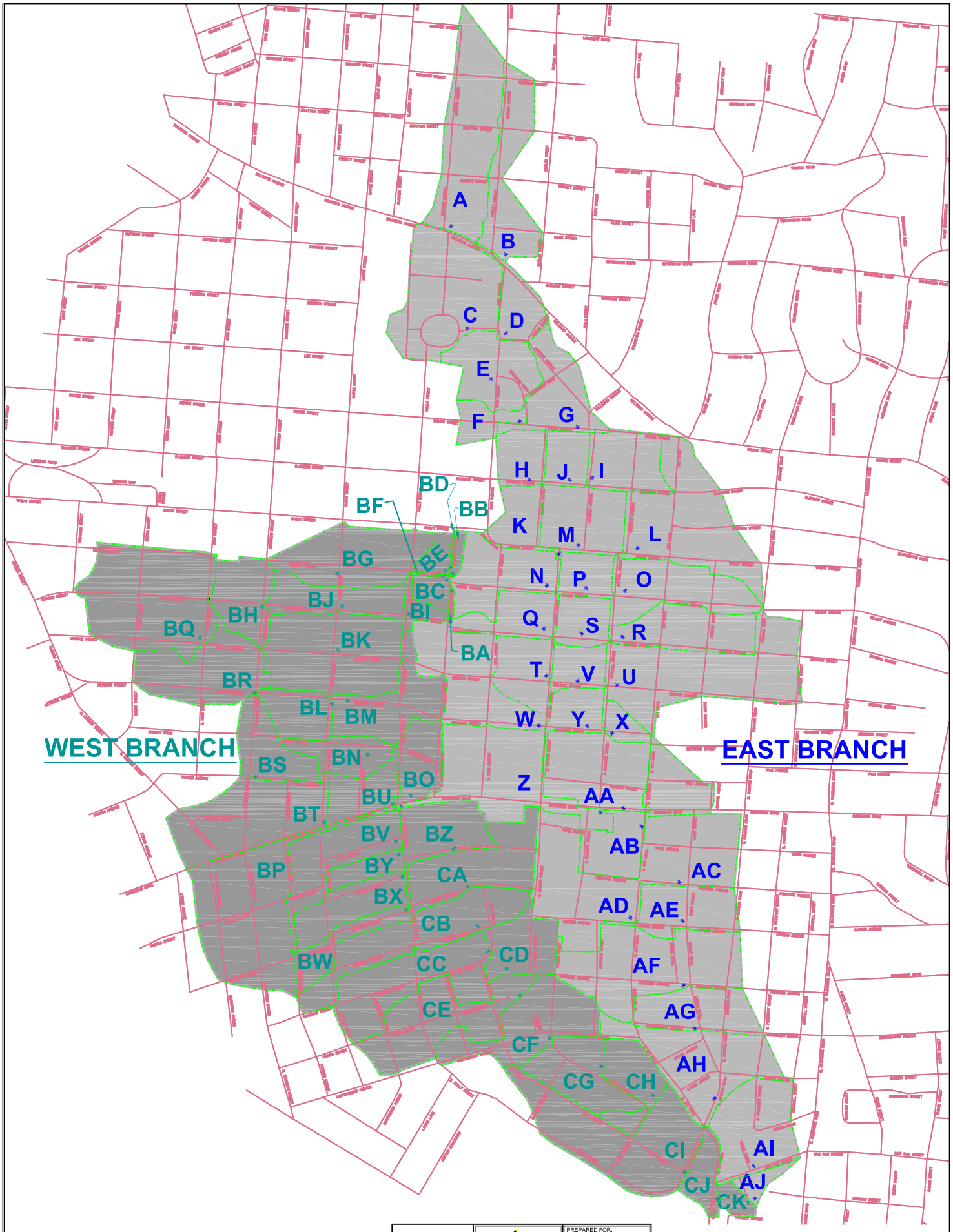
*See graphic following this preface for further identification.

SUMMARY OF MODELS

Initially, the stormwater collection systems in the **east branch watershed** and the **west branch watershed** were modeled to determine their baseline performance during the 2-year, 24-hour rainfall event (3.6" accumulated rainfall) and the 10-year, 24-hour rainfall event (5.3" accumulated rainfall). Those **initial models** indicated underperformance in both stormwater collection systems, with underperformance occurring primarily north of Rosewood Drive. Subsequent modeling was then performed to simulate upgrades to the stormwater collection systems north of Rosewood Drive while monitoring performance impacts on the stormwater collection systems south of Rosewood Drive.

CONCEPTUAL RECOMMENDATIONS FOR IMPROVEMENTS

Conceptual recommendations for improvements to the stormwater collection systems north of Rosewood Drive have been developed based on a number of model variations. Those conceptual recommendations for improvements range from installation of parallel collection systems to in place remedies for certain portions of the existing drainage collection system trunk line(s). In some cases improvements south of Rosewood Drive may also be required. To the degree possible, budget cost projections also accompany these conceptual recommendations for improvements.



PROJECT:

SHANDON-ROSEWOOD WATERSHED

LOCATED IN THE CITY OF COLUMBIA
RICHLAND COUNTY, SOUTH CAROLINA

EAST & WEST WATERSHEDS

ISSUE DATES / REVISIONS

NO.	DATE	DESCRIPTION
1		

SOUTH CAROLINA — COX AND DINKINS, INC. No. C00294 — CERTIFICATE OF AUTHORIZATION

CERTIFICATE OF AUTHORIZATION SEAL

MAY 2011

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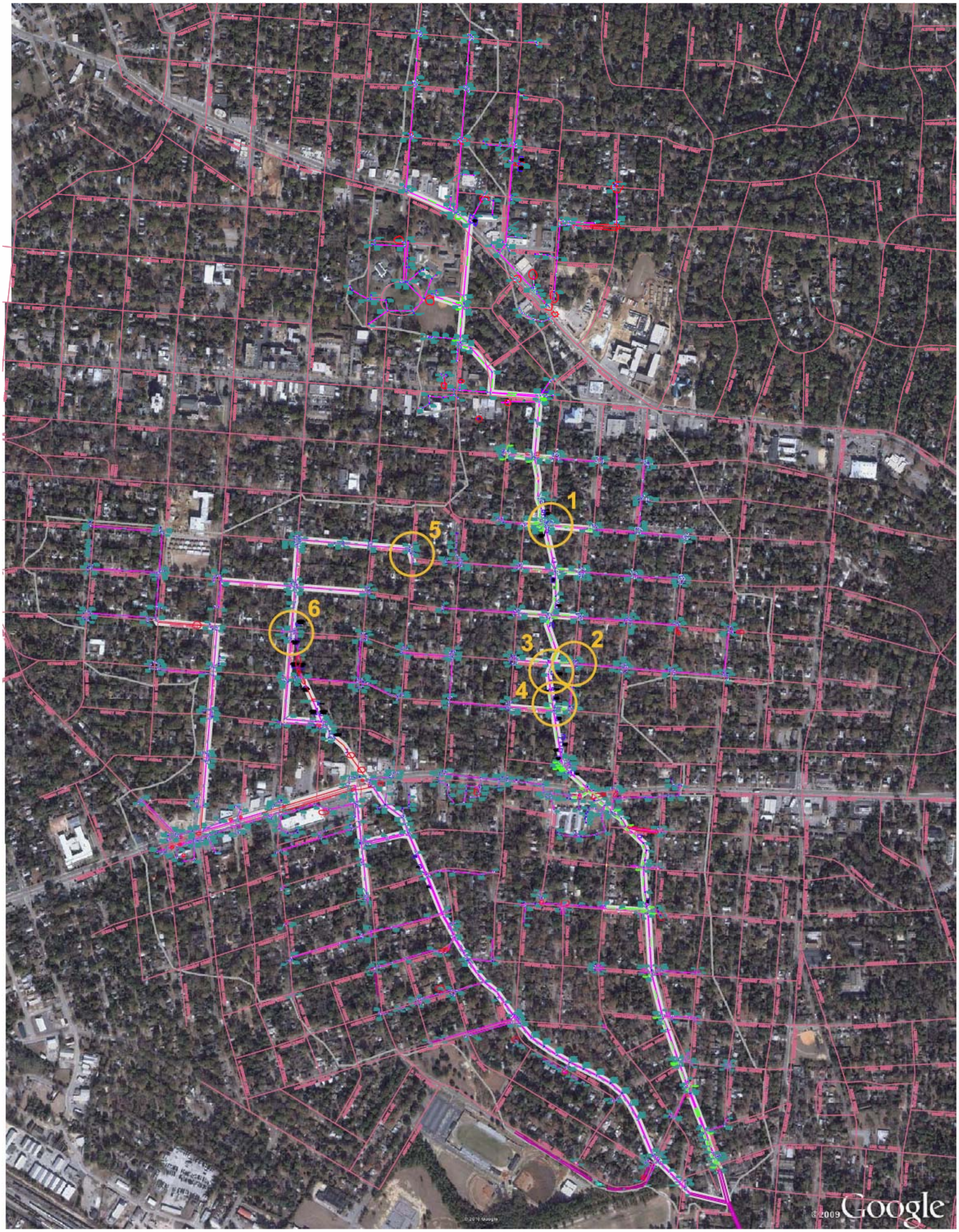
GRAPHIC SCALE IN FEET
SCALE 1" = 600'



LEGEND

1. Wheat Street at Amherst Avenue
2. Monroe Street at Ravenel Street
3. Monroe Street between Ravenel Street and Wheat Street
4. Heyward Street between Ravenel Street and Wheat Street
5. Shandon Street north of Wilmot Avenue
6. Monroe Street at Maple Street

GRAPHIC SCALE IN FEET
SCALE: 1" = 300'

MAGNETIC

PROJECT:

SHANDON-ROSEWOOD WATERSHED

LOCATED IN THE CITY OF COLUMBIA
RICHLAND COUNTY, SOUTH CAROLINA

ANALYZED NETWORK LINES

ISSUE DATES / REVISIONS		
No.	DATE	DESCRIPTION
△	-	.

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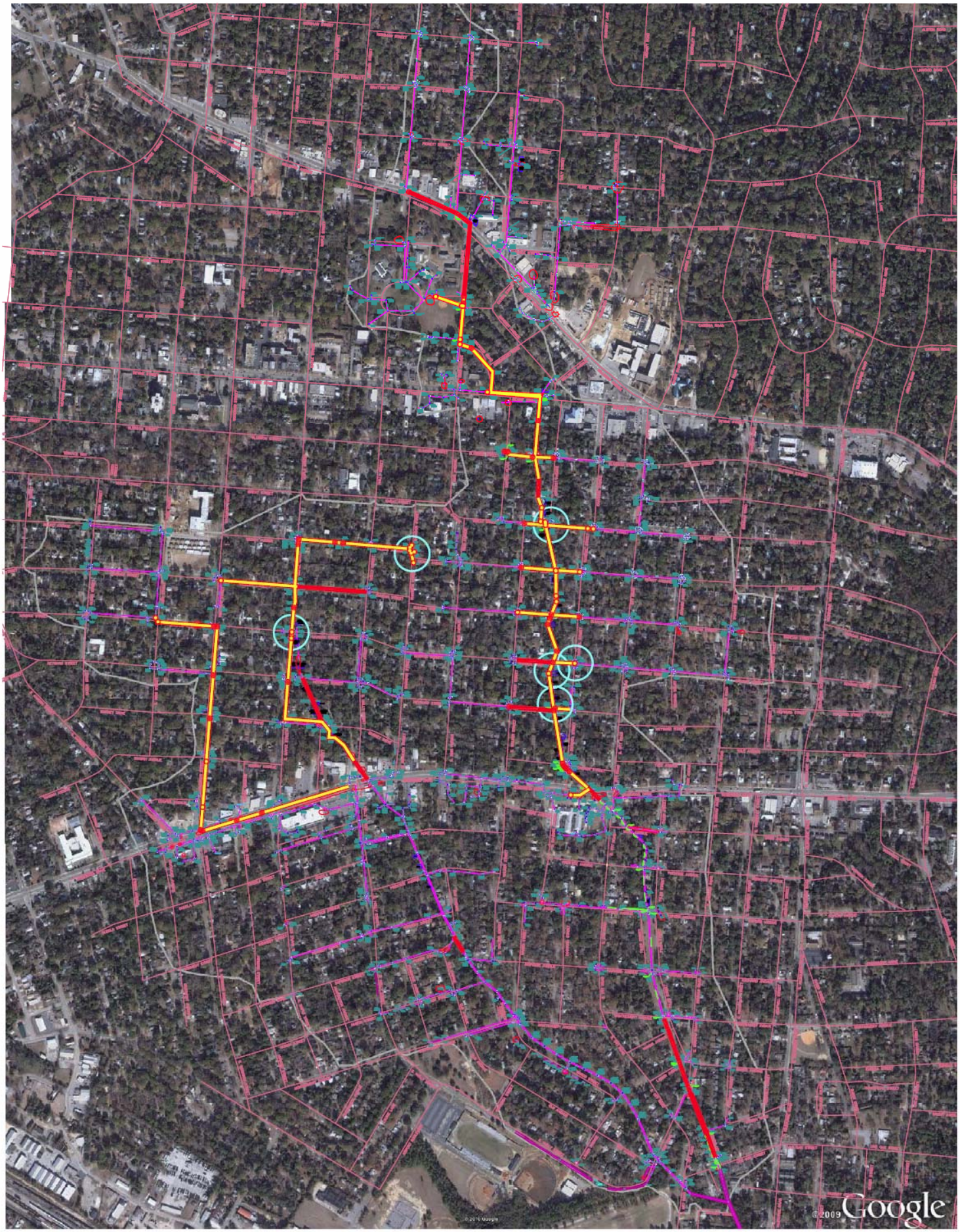

PROJECT:

SHANDON-ROSEWOOD WATERSHED

LOCATED IN THE CITY OF COLUMBIA
RICHLAND COUNTY, SOUTH CAROLINA

PROBLEM AREAS

ISSUE DATES / REVISIONS

BY	DATE	DESCRIPTION
1	.	.

COX AND DINKINS, INC.
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MAY 2011

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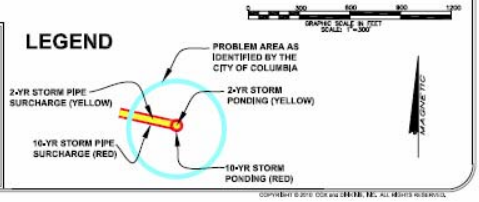
SCALE: 1"=300'

LEGEND

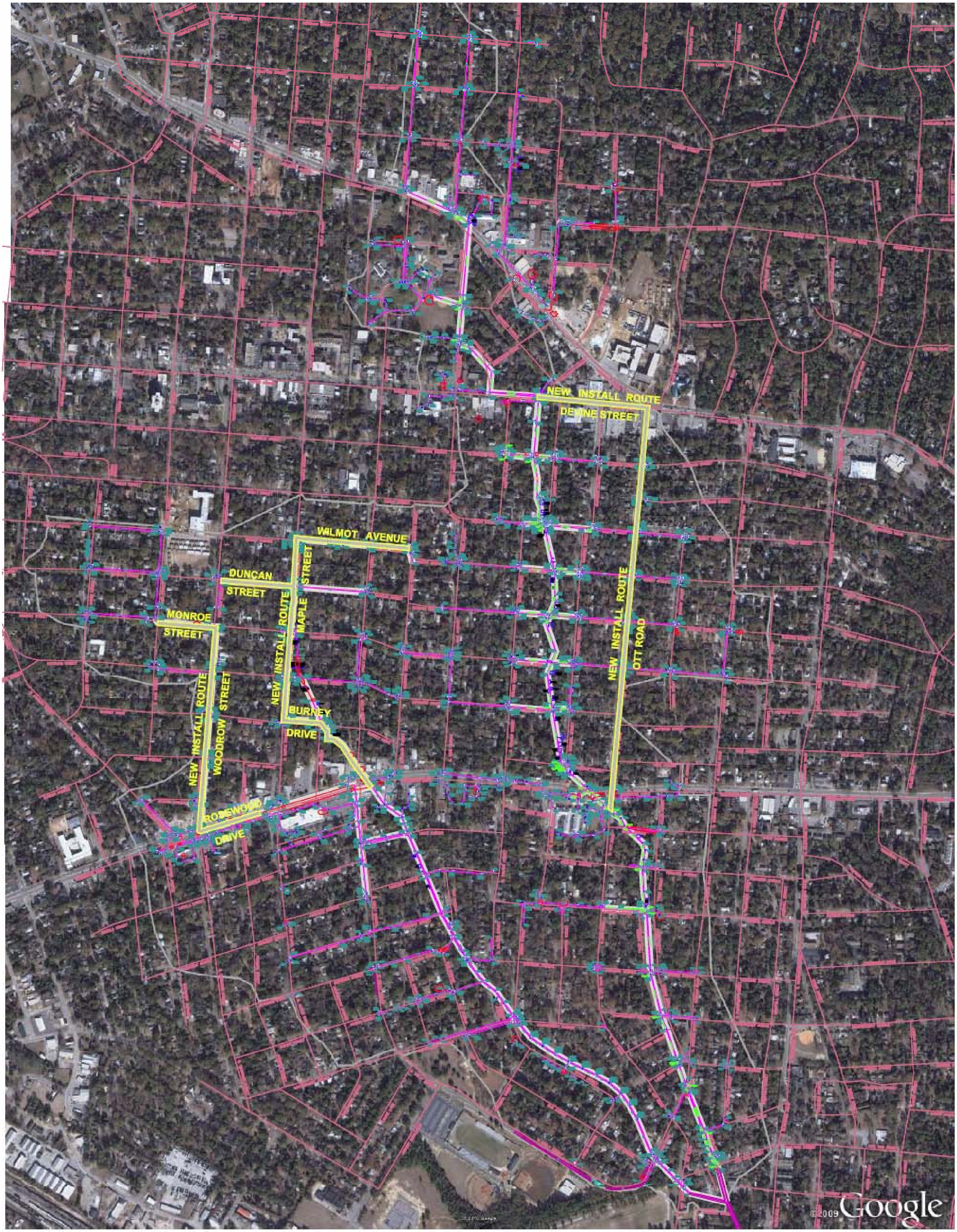


Summary

The visible and accessible portions of the storm drainage collection system within the 750± acre Shandon-Rosewood watershed have been surveyed and mapped. The inventory of drainage structures (nodes) exceeds 1,200 and the inventory of pipes (links) also exceeds 1,200. The overall 750± acre watershed has been delineated and divided into two primary sub-watersheds, namely the **east branch watershed** (400± acres) and the **west branch watershed** (350± acres). Two independent **XPSWMM** models of the storm drainage collection systems have been established, one for the **east branch watershed** and one for the **west branch watershed**. All of the survey data has been entered into the **XPSWMM** model and seventy-three sub-watersheds have been delineated and incorporated into the model. The main collection systems have been activated in the model (approximately 120 nodes and links active in both the **east branch watershed** and the **west branch watershed**) and the performance of both storm drainage collection systems has been modeled independently using both the 2-year, 24-hour rainfall event (3.6" accumulated rainfall) and the 10-year, 24-hour rainfall event (5.3" accumulated rainfall). Certain underperforming portions of each analyzed system have been identified by these models, with underperformance occurring primarily north of Rosewood Drive. Where these independent collection systems discharge into open channels, tailwater conditions for the 10-year flood, taken from the FEMA Flood Insurance Study last revised September 29, 2010, have been incorporated into the models.

Certain recommendations have been made for conceptual improvements for each system, primarily north of Rosewood Drive, and these conceptual improvements are the product of a number of modeling efforts. The concepts for improvements range from installation of parallel collection systems to in place remedies for certain portions of the existing drainage collection system, primarily north of Rosewood Drive and in both the **east branch watershed** and the **west branch watershed**. Modeling has also been performed in an effort to predict the impact of north of Rosewood Drive system improvement concepts on the in-place systems south of Rosewood Drive. Based on interpretation of these models, certain precautions have been emphasized in an effort to minimize the potential for transfer of underperformance from north of Rosewood Drive to south of Rosewood Drive, especially in the **east branch watershed.** But it is also possible that improvements may be required south of Rosewood Drive. Where the independent collection systems discharge into open channels, tailwater conditions for the 10-year flood have been incorporated into the models (taken from the FEMA Flood Insurance Study last revised September 29, 2010). But modeling of the open channel downstream of piped outfalls (Tributary G-1) has not been performed. During the surveying phase it was discovered that a portion of Tributary G-1 has been rerouted and no longer follows the route shown on current FEMA maps. Reconciliation of FEMA maps with the rerouted Tributary G-1 will be required before modeling of the channel can be performed.

For the purposes of budgeting the conceptual remedies recommended have been expanded to include detailed descriptions of anticipated work, including anticipated/projected costs, with the end result being approximated/projected costs approaching $12 million. This approximated/projected cost is better defined as an Opinion of Probable Construction Cost or OPCC. But the OPCC was developed without the benefit of final plans or construction documents and without control of the costs or the price of labor, equipment or materials, or the ultimate bidder's methods of pricing. As a result of these considerations, proposals based on final design and received through the competitive bidding process may vary significantly from the OPCC. The OPCC and its basis are open for further discussion and comparison to comparable City of Columbia project costs. Those discussions and comparisons may also result in significant modifications to the OPCC.



PROJECT:

SHANDON-ROSEWOOD WATERSHED

LOCATED IN THE CITY OF COLUMBIA
RICHLAND COUNTY, SOUTH CAROLINA

PROPOSED SOLUTIONS

ISSUE DATES / REVISIONS

No.	DATE	DESCRIPTION
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MAGNETIC

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