4. COMPUTER MODELING

Section 2 of the Master Drainage Plan Methodology report (submitted separately) describes data sources and computer model requirements in detail. Each watershed presents its own unique challenges in preparing the Master Drainage Plan, and the St. Julian Creek watershed is no exception. Any modifications or additions to the approach described in the Methodology report are described below.

4.1 Data Sources & Processing

The City of Portsmouth provided Master Drainage sheets for only the easternmost portion of the St. Julian Creek watershed within their City limits. These data sheets were scanned and georeferenced in GIS, and they contain the following information:

- Streets
- Parcels
- Building footprints
- Storm water items

The City of Portsmouth also provided two-foot contours in GIS. These contours matched fairly well, though not identically, to the City of Chesapeake's contours where they overlapped along the CSX Railway.

4.2 Model Development & Selection of Parameters

4.2.1 Rainfall Hyetographs

Table 4-1 lists the rainfall depths and return periods used in Chesapeake based on an analysis of rainfall historical records. For the purposes of this study, the 2-, 5-, 10-, 25-, 50-, and 100-year rainfall events were modeled. Due to temporal discretization and the sharp peak of the design hyetographs, the rainfall volumes used in the models may differ very slightly from these values.

Table 4-1. 24-Hour Rainfall Depths

Return Period (years)	24-Hour Rainfall Depth (inches)
2	3.4
5	5.0
10	5.9
25	6.9
50	8.0
100	9.0

4.2.2 Subarea Delineation

The subcatchments, also referred to as 'subareas,' were delineated entirely using ArcView GIS software. The new subarea delineation deviated somewhat from the old, as new grading and development drainage was considered, and contour data was available for the City of Portsmouth. The difference between the old and new delineations is shown in Figure 4-1—the green shading represents the old delineation, and the new subxatchments are outlined in yellow.

The data described in Section 4.1 was used to piece together the available watershed information and resulted in an existing (2004) conditions model that has 128 subcatchments, as shown in Figure 4-2. The delineation is unchanged for the future conditions model. (This figure can be zoomed and printed to very large formats using Adobe Acrobat Reader software.) This is a very fine level of detail for this type of

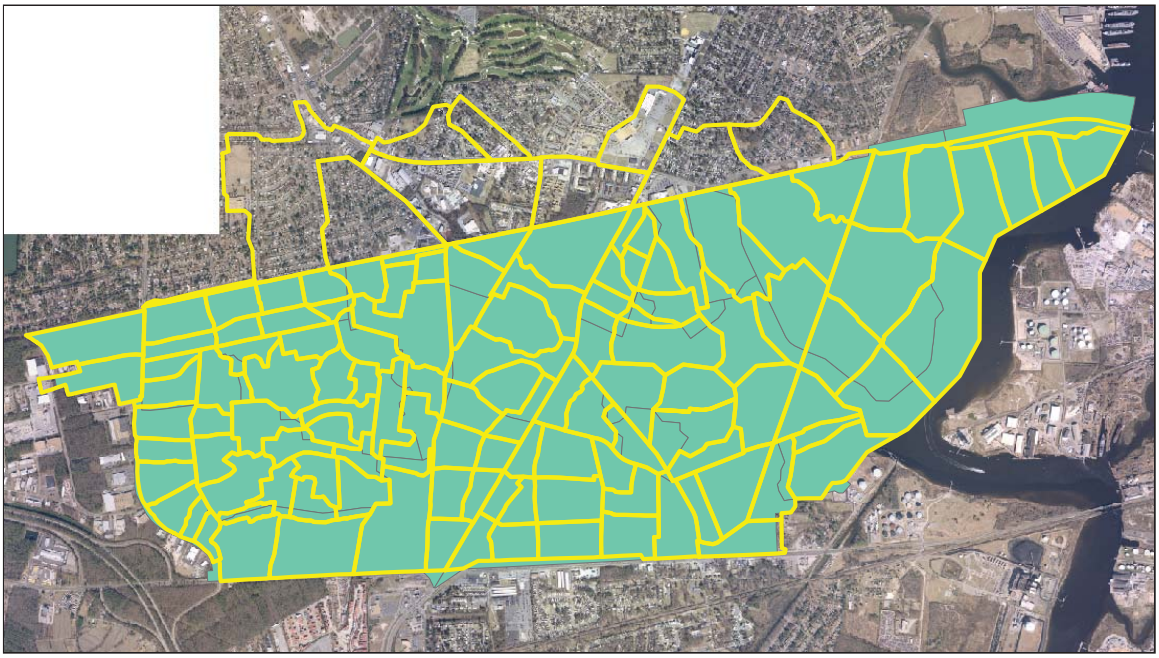

Figure 4-1. 1986 Delineation (Green) and 2004 Delineation (Yellow Outline)

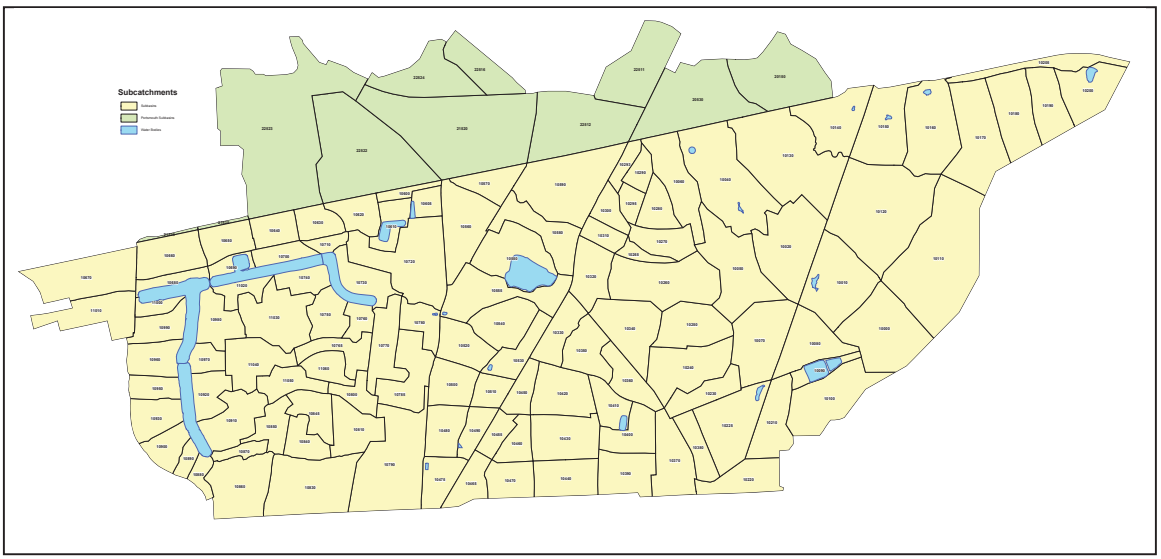

Figure 4-2. Subcatchment Delineation

modeling. Heavy weight was given to site plan drawings and aerial imagery in performing the digitizing, as these data sources represented the most up-to-date information on the watersheds.

This process was time consuming, due to the size of the data files involved, and the need to constantly re-order the themes in the GIS to see critical information in different combinations of overlays. An extraordinary amount of computer processing time was consumed regenerating the screen images during zooming to perform the required snap digitizing that defines the subcatchments.

4.2.3 Subcatchment Imperviousness, Roughness & Depression Storage

To determine the imperviousness of each subcatchment, a GIS frequency analysis was performed to categorize and measure the land use in each subcatchment. The land use coverage employed was obtained directly from the 1999 Regional Stormwater Loading Study prepared by CH2M-Hill consultants for the Hampton Roads Planning District Commission (HRPDC). By overlaying this land use data on the newly delineated subcatchments, the actual area of each land use category within each subcatchment was directly measured in the GIS. The percentage imperviousness of each subcatchment was then calculated entirely within GIS in a two-step process using Chesapeake-specific values of imperviousness for each land use category provided by HRPDC, as shown in Appendix A. The GIS land use coverage was provided by the City of Chesapeake, as shown in Figure 4-3.

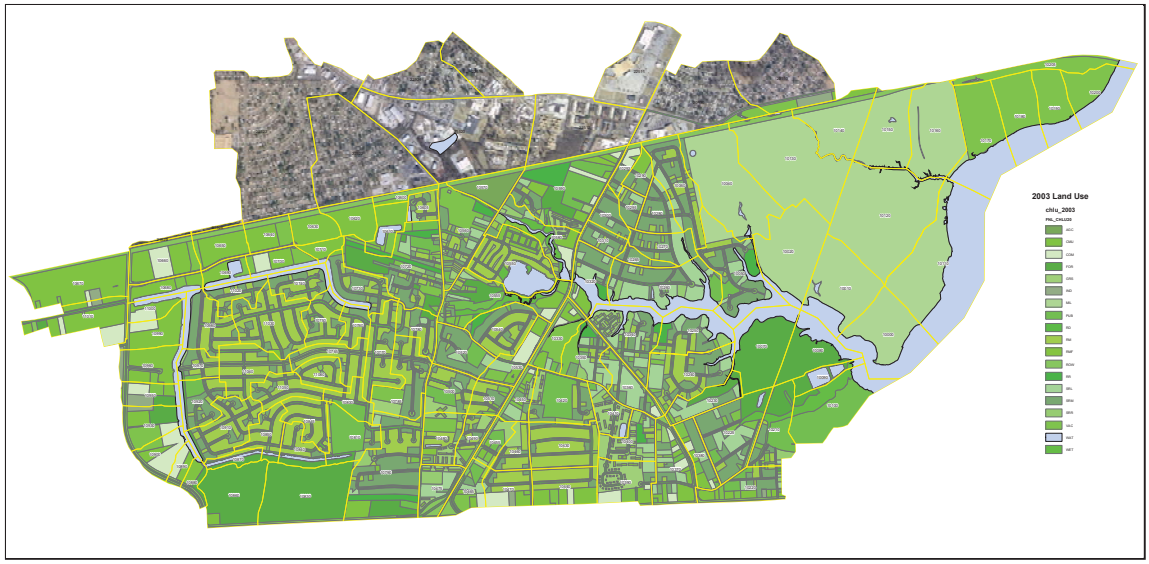

Figure 4-3. Existing (2003) Conditions Land Use

The Manning overland roughness coefficients for impervious and pervious land cover were taken from tables that are widely available in engineering literature, as were the depression storage depths. These provisional values are widely published for applications where there is no calibration data that can be used. For the future conditions models, future imperviousness was based on estimates of future development, as described in Section 5.3 of this document. Tables depicting the imperviousness and soils parameters for each subcatchment are also presented in Appendix A.

4.2.4 Subcatchment Basins

URS digitized storm water management basins and ponds into new polygon coverages from the aerial imagery and site data in the GIS. The St. Julian Creek watershed generally has not been subjected to a proliferation of storm water management basins, however the Virginia Storm Water Management Act now stipulates that detention BMPs must be used if the downstream channel from a proposed development is inadequate.

Outfall structures for major facilities were surveyed, and the facilities were represented using an EXTRAN storage junction. The bottom area and top area of all identifiable ponds was digitized and measured in the GIS, and modeled carefully with SWMM. All other detention facilities were accounted for by land use only (i.e., water as 100% impervious), either because they discharged directly to the tidal estuary or because their area was small compared to the overall subbasin. This approach should adequately account for the storage effects within each subcatchment, without making the model overly complex.

4.2.5 Green-Ampt Soils Parameters

At the time the hydrology data for this project was prepared, the NRCS soil texture update was not yet ready digitally, so infiltration parameters were estimated as described in the Methodology report. Figure 4-4 shows a georeferenced hand drawing of soils textures to the GIS SSURGO soils data. The used values for the SWMM RUNOFF infiltration parameters, SUCT, HYDCON and SMDMAX, were tabulated in a spreadsheet as presented in Table A-3 in Appendix A.

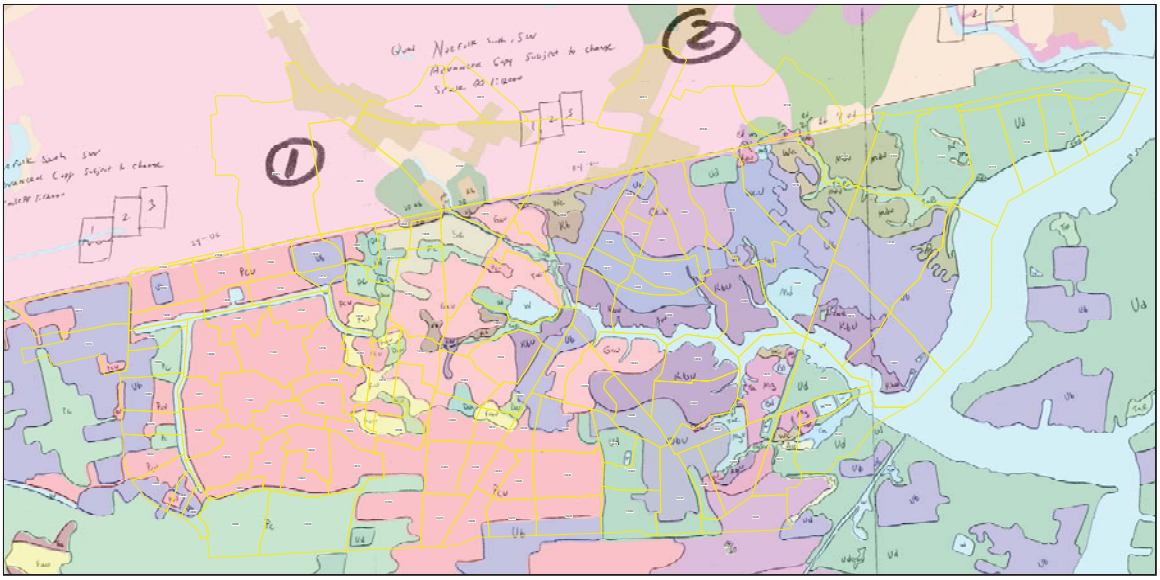

Figure 4-4. Soil Texture Mapping

4.2.6 Drainage Network Discretization (Links and Nodes)

The model links and nodes were discretized after the subarea delineation task was completed (see Section 4.2.2). The existing (2004) conditions and future conditions link-node diagrams are presented in Figures 4-5 and 4-6, respectively.

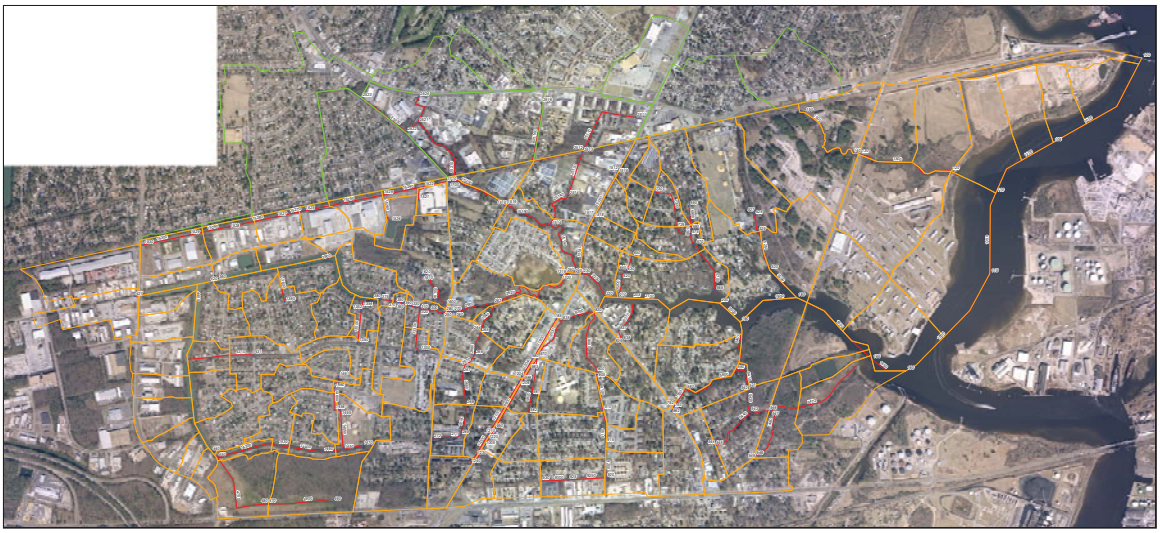

Figure 4-5. Existing (2004) Conditions Link-Node Diagram

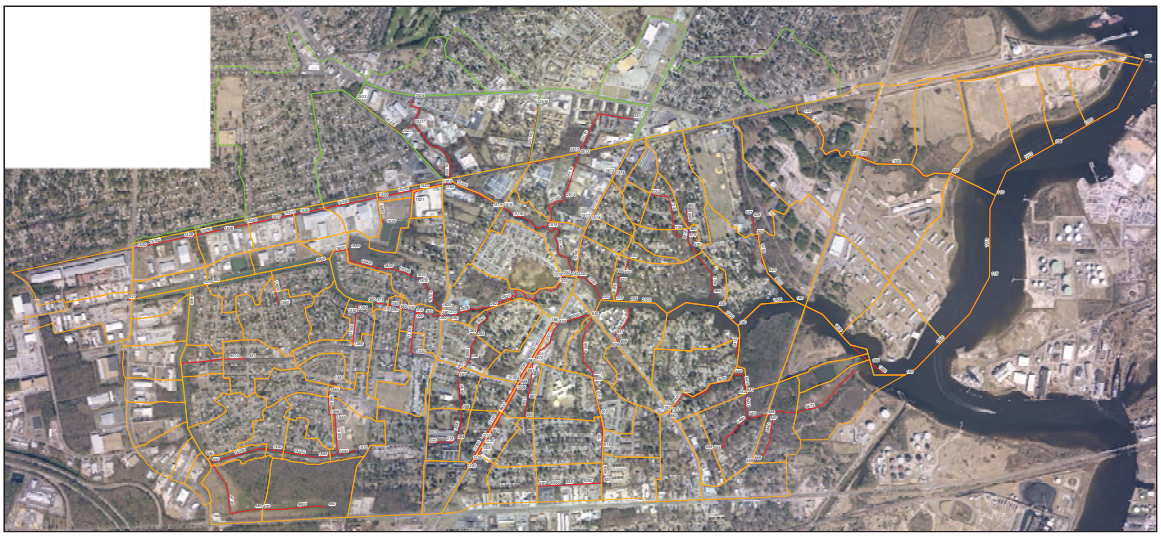

Figure 4-6. Future Conditions Link-Node Diagram

As in all stormwater models, there is some missing pipe and channel configuration data that had to be guessed. The pipe configurations and dimensions in these areas should be field-verified before constructing any improvements based on these models.

4.2.7 Open Channel Approximations

All open channels in the St. Julian Creek watershed master drainage plan models are represented as trapezoidal channels. Left and right side slopes were estimated in e GIS by examining the City's two-foot contour data. Invert elevations were obtained from the City's survey for this project. For deep channels (e.g. St. Julian Creek downtream of U.S. 17, and the South Elizabeth River), where the invert is significantly below the normal waterline, trapezoid bottom widths were set so that the channel width at zero feet NAVD would match the width apparent in the aerial photographs within a reasonable tolerance.

Because the linear pond that makes up the southern arm of Camelot Lake is fairly uniform in both width and side slope, the pond was also approximated using trapezoidal channels.

4.2.8 Important Considerations and Implications Regarding Boundary Conditions and Return Periods

According to National Flood Insurance Rate Map Panel 5100340015C, Revised 2 May 1999, the 100-year flood elevation in St. Julian Creek is 7.7 feet (NAVD88).

The FEMA flood insurance models are the definitive source of floodplain limits and elevations in all cases. The City's SWMM models are design scenarios based on 2-, 5-, 10-, 25-, 50-, and 100-year rainfall events — THEY ARE NOT TO BE CONSTRUED AS INDICATIVE OF THE EXPECTED WATER SURFACE ELEVATIONS FOR THE PURPOSE OF FLOODPLAIN MANAGEMENT AND/OR INSURANCE REQUIREMENTS.