



# Technical Procedure Document

**Subject:** City Watershed Modeling Data

---

## Introduction

---

Hydrologic and hydraulic (H&H) models are commonly used for engineering analysis and to evaluate the benefits of proposed storm drainage infrastructure improvements. Hydrology represents the quantity and rate of water (runoff) generated from a specific area or watershed. Hydraulics deals with the physical properties of water, such as calculating the depth or velocity of flow in closed and open conveyance systems. A combined H&H model allows for the evaluation of effects of various infrastructure improvement scenarios and the benefits that would be achieved. The City has spent considerable time and resources in developing multiple H&H models for different watersheds across the City, including areas outside of the City limits. Where applicable, utilization of these H&H models is in the best interest of developers/designers to obtain the most-up to date, comprehensive, and accurate information for the watershed in which a proposed project is located. Furthermore, the use of the City's H&H modeling will streamline and facilitate both the design and review processes.

The purpose of this Technical Procedure Document is to provide an overview on what steps to follow when development is proposed within a watershed modeled by the City and how to use the watershed models. The memo details the type of modeling data available, how to request the data from the City, and what information must be submitted to the City to get the desired approval.

---

## General Steps

---

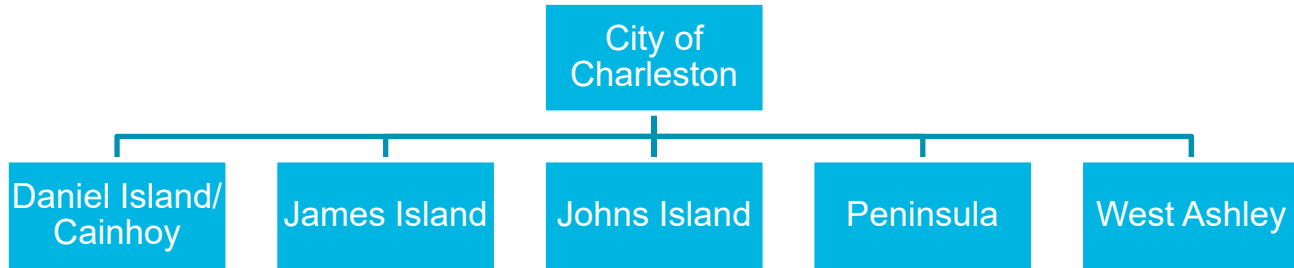
General steps required to develop a site in any watershed within the City of Charleston includes:

1. Watershed and Special Protection Area (SPA) Determination
  2. Determine Data Availability and Request
  3. Describe Watershed Modeling Methods and Requirements
  4. Submit Stormwater Technical Report
- 

## Watersheds and Special Protection Areas

---

The first step in the process is to identify the watershed where the development is planned. The City of Charleston is divided into five main geographic areas as shown below:



The City has delineated watersheds in each of the five main geographic areas. This information is available to the public and can be found the City's GIS data portal under the "Stormwater" heading. The GIS data portal can be accessed at:

<https://data-charleston-sc.opendata.arcgis.com/>

Within each geographic area, specific watersheds are identified as SPAs. If the new development or redevelopment project is located within a SPA, more stringent requirements are established in the **Stormwater Design Standards Manual (SWDSM) Section 3.6** and need to be referenced.

Within each geographic area, specific watersheds are identified as SPAs. SPAs for each watershed are determined based on a two-step process, generally outlined as follows.

1. Evaluation of existing datasets pertaining to each watershed. There are several types of datasets available for each watershed. The evaluation includes:
  - a. Potential Flooding Locations
  - b. Water Quality Concerns

Some of the existing datasets evaluated include the following:

- a. City of Charleston 1984 Master Drainage and Floodplain Management Plan
  - b. Stormwater Management Report/Studies that show the recommended improvements
  - c. Historical flooding/standing water complaints from City's database
  - d. Impaired 303(d) listed sites and locations of the monitoring stations along with Total Maximum Daily Load (TMDL) technical documents
2. Identifying SPAs based on Desktop Analysis. This is performed for several other basins within the watershed that do not have any available information. Results from the desktop analysis are used based on the following to determine SPA applicability:
    - a. Percentage of the total area of the basin that floods is calculated based on the maximum stage in that basin and the DEM. If the calculated percentage of flooding is over a certain threshold, typically 50%, then the basin is identified as potential SPA.

While this is not a detailed analysis of the watershed, it does provide an aid to the City in determining whether a watershed has the potential to be designated as a potential SPA. The City can use the size and capacity of the hypothetical stormwater conveyance in this analysis and compare that against the capacity of the existing stormwater conveyance system to determine the potential for flooding in a watershed. The locations for which the capacity of the stormwater conveyance system is less than the capacity of the hypothetical calculated pipe can be further analyzed prior to designating a watershed as an potential SPA.



Both steps are performed concurrently and results from each step are consolidated, prioritized, and finalized to determine the potential SPAs. Determinations of the potential SPAs are currently underway for each watershed. Once the SPAs are approved and finalized by the City, they will be uploaded to the City's GIS Portal. From that information, the design community can identify where a potential development site is located and determine whether the site falls within an SPA.

---

## Data Availability and Request

---

It is the responsibility of the developer/designer to request data for the watershed needed to perform appropriate analyses to attain City approval. Example available datasets that can be requested from the City include:

- Watershed H&H Model Files and/or Master Plan Reports/Drainage Studies
- Watershed Maps with SPA boundaries
- Record Drawings/As-builts
- GIS Datasets and Maps

Datasets pertaining to the watershed of interest must be formally requested from the City. To request the data, submit an e-mail to the City's Stormwater Development Manager ([giraloa@charleston-sc.gov](mailto:giraloa@charleston-sc.gov)) with the applicable watershed name(s). As part of this correspondence, be sure to provide a general description on the type of information being requested and include the associated property information, project name, and City project identification number as applicable. The Stormwater Development Manager will then coordinate with the appropriate model manager to provide the City's H&H modeling data associated with the subject site.

---

## Watershed Modeling Methods and Requirements (SWDSM Section 3.4.4.2)

---

The City may have completed a Stormwater Master Plan and/or H&H model of a specific watershed. The purpose of the H&H model is to assess areas with drainage issues, model existing storm drainage infrastructure, and identify potential projects to reduce flooding.

Stormwater H&H models that have been completed or are currently underway include:

- Barberry Woods (Johns Island)
- Calhoun West (Peninsula) (On-going)
- Central Park Watershed (James Island)
- Church Creek Watershed (West Ashley)
- Cooper-Jackson Watershed (Peninsula) (On-going)
- Dupont-Wappoo Watershed (West Ashley)



- Huger Street (Peninsula) (On-going)

If a Stormwater H&H model is available, the proposed development must use boundary conditions from the City maintained H&H model to as part of the site's stormwater management design. As stated in the **SWDSM Section 3.9.4**.

*If a project is in an area that has a stormwater master plan and model, the analysis shall use the boundary conditions from the master plan model provided by the City. The model shall extend up to the top of the water and down to the project. If the modeling results indicate there is an impact [listed in SWDSM Section 3.9.4], then stormwater volume and flowrate leaving the site must be reduced until such a point that there are no impacts.*

H&H models include other parameters (curve numbers, time of concentration, and stage-storage relationships) which contribute to calculating the amount of runoff generated, peak flowrates, and maximum water depths. These parameters associated with the City's watershed modeling are developed and calibrated on an overall watershed scale. The developer/designer must carefully review all parameters when updating their site-specific model within a watershed. In general, the developer/designer must evaluate the parameters individually for the site and update the model for both pre-development and post-development conditions and then compare the results watershed wide to assure there are no adverse impacts upstream or downstream of the proposed development site.

If the project does not have a H&H model, then the analysis must be performed from the top of the watershed to a point downstream of the proposed project site where the site makes up 10% of the basin (see *Technical Procedure Document #4: 1% Annual Exceedance Storm Event Analysis*). The default Peaking Factor of 484 must be used unless the developer/designer can justify using a lower peaking factor (see *Technical Procedure Document #3: Peaking Factor*).

Designers may select an appropriate computer modeling program to calculate the pre-development and post-development site conditions. The City may use one specific computer modeling program for a watershed (the City recommends the designer use the same modeling program), but the designer may use a different modeling program for their project site so long as certain considerations are met (**SWDSM Section 3.4.4.2**):

- In circumstances where backwater, tailwater, and tidal conditions are not present, and for storm drainage systems with less than five (5) connections, programs using Manning's equations will be considered satisfactory.
- In circumstances where backwater, tailwater, and tidal conditions are present, or have five (5) or more connections in the stormwater drainage system, programs must incorporate Saint-Venant equations to better represent the hydrodynamic environment.

Designers may select a simplified model if a storm drainage system will not experience surcharging or backwater under design conditions. The terms "surcharge" and "backwater" are not synonymous. Surchage results when flowrates entering a pipe are in excess of pipe's free flowing (Manning's) capacity. In a surcharge situation, hydraulic head will build up behind the pipe and force higher flowrates through the pipe at higher velocities. In a backwater condition, the water surface elevation at the downstream end of the pipe prevents the flow in the pipe from discharging freely ("free-outfall condition"). While the hydraulic grade line in the pipe will be above the pipe crown for both surcharge and backwater conditions, the velocity and flowrate will be lower (potentially much lower) in the backwater condition. Backwater conditions in Charleston may result as a result of submerged or tidal conditions at the outlet, obstructions or debris in the downstream system, or restriction in the hydraulic capacities of the downstream system. Surcharged systems will result when upstream watershed peak flowrates are greater than the hydraulic conveyance capacity of the system draining the watershed.



Backwater and surcharge conditions require considerations of both momentum and continuity equations as incorporated in models that solve the Saint Venant equations using the Dynamic Wave Flow routing method. These models include ICPR, InfoWorks ICM, SWMM Extran (public domain version provided by Environmental Protection Agency; enhanced versions available through private software companies), and DHI MIKE URBAN.

In circumstances where backwater or surcharging are not present, and for storm drainage systems with less than five connections, static programs using Manning's equations will be considered satisfactory. Also satisfactory are kinematic wave programs such as the simplified SWMM Transport hydraulic calculation option, Hydra, SewerCad, etc. The selected program and its associated computational methodologies and inputs must be listed in the Stormwater Technical Report narrative, which is part of the document submission process as detailed in the following section.

---

## Stormwater Technical Report

---

**Section 4.5** and in the **Guidelines and Checklist Appendices of the 2020 SWDSM** details the required contents of the Stormwater Technical Report. In addition to the aforementioned, the report must include:

- Model information including name, version, and methodology
- Input Report with the City-provided boundary conditions (upstream and downstream)
- Pre-Development Time Series Report for the upstream and downstream boundary nodes provided by the City
- Post-Development Time Series Report for the upstream and downstream boundary nodes provided by the City

Any updates required to the Stormwater Technical Report as a result of comments received from the City shall be resubmitted per the process outlined in *Technical Procedure Document #1: Stormwater Permitting Process*.

---

## Record Drawings (SWDSM Section 6.3)

---

The Close-Out Application Package Process is in **Chapter 6 of the 2020 SWDSM** and in *Technical Procedure Document #1: Stormwater Permitting Process*. Part of this package includes a submittal of Record Drawings to the City in accordance to the Dedication Manual ([https://www.charleston-sc.gov/DocumentCenter/View/14638/2017-Dedication-Manual-Final\\_031517?bidId=](https://www.charleston-sc.gov/DocumentCenter/View/14638/2017-Dedication-Manual-Final_031517?bidId=)). The City will review Record Drawings and provide comments, and approval will be granted once all comments have been addressed to the City's satisfaction.

Final deliverables may require an updated project H&H model if the Record Drawings show design elements were not constructed in accordance with approved plans. Digital copies of the Record Drawings must be submitted with a data structure compliant with the City's GIS standards. The Record Drawing preparer should coordinate with the City's Stormwater Development Manager for the appropriate GIS data structure prior to submittal to the City.