F.6 Hydrologic Model and Calculation Methods

F.6.1 Hydrologic Model

1. Verify that all DCIA within the project's limits of earth disturbance is routed to an SMP. [Section 1.2.1; Section 3.4.1]
2. Verify that the modeled drainage areas are accurate and consistent with the plans' drainage areas. [Section 3.4.1]
3. Verify that all SMP bypass areas within the project's limit of earth disturbance are accounted for in the hydrologic calculations' stormwater model. [Section 3.4.1]
4. Verify that the links are correct. A point of analysis (POA) must be determined for comparison of the predevelopment and post-development conditions. A POA may serve one or several drainage areas and/or SMPs. Multiple POAs must be identified for project sites with multiple points of discharge. Points of analysis should only be linked when they drain to the same sewershed or waterway. [Section 3.4.1]
5. Verify that the routing of devices within the stormwater model is provided and consistent with the plan's proposed design. [Section 3.4.1]
6. Verify that the stormwater outlet controls configuration is correct and consistent with the plans. [Section 3.4.1]
7. Verify that runoff from pervious and impervious areas is calculated separately. Weighted curve number values between pervious and impervious areas are not acceptable. [Section 3.4.3]
8. Verify that the precipitation depths used for all design storm events are in accordance with the design rainfall data listed below, pursuant to *PennDOT Drainage Manual*, Chapter 7, Appendix A, Field Manual For Pennsylvania Design Rainfall Intensity Charts From NOAA Atlas 14 Version 3 Data (2010 or latest). [Section 3.4.3]

Design Precipitation Depth (inches)							
Duration	1-year	2-year	5-year	10-year	25-year	50-year	100-year
24 hours	2.83	3.40	4.22	4.95	6.10	7.16	8.43

9. Verify that the Manning's n values used within the stormwater model are correct and consistent with the plans' proposed pipe material. A Manning's n value of 0.013 must be used for RCP, VCP, and CIP, and a value of 0.011 must be used for PVC and HDPE. [Section 3.4.3]
10. Verify that the stormwater model uses the minimum time step allowable by the implemented hydrologic software (which is 0.01 hours in HydroCAD and 1 minute in Hydraflow or a maximum of 0.01 hours. [Section 3.4.3]
11. Verify that the SMP storage provided is correct and consistent with the plans. A porosity of 0.20 for soil media, 0.30 for sand, and 0.40 for stone must be used. [Chapter 4]

F.6.2 Runoff Estimation

1. Verify that the appropriate NRCS Curve Number Method curve number values are used in the runoff estimation calculations. Refer to Table 3.4-2 of the Manual. [Section 3.4.1; Section 3.4.3]
2. When performing Water Quality slow release rate calculations for a project in a combined sewer area for which infiltration is not feasible, verify that a curve number of 98 is used with a precipitation depth of 1.7 inches when routing the Water Quality storm event. [Section 3.4.1]
3. When performing Flood Control calculations, verify that all non-forested pervious areas are considered meadow in good condition for predevelopment runoff calculations. Non-forested pervious area consists of the following cover types: meadow, grass/lawn, brush, gravel, dirt, porous pavements, and any combination of these cover types. [Section 3.4.1]
4. When performing Flood Control calculations for a Redevelopment project, verify that, in addition to any other pervious area, 20% of the existing impervious cover, when present, is considered meadow (good condition) for the predevelopment runoff calculations. [Section 3.4.1]
5. Verify that the stormwater model for Water Quality compliance analysis uses the PWD Design Storm rainfall distribution. Refer to Table 3.4-4 of the Manual. [Section 3.4.3]
6. Verify that the stormwater models for Channel Protection, Flood Control, and PHS Release Rate compliance analyses use the NRCS Type II 24-hour rainfall distribution. Refer to Table 3.4-5 of the Manual. [Section 3.4.3]

F.6.3 Flow Routing

1. Verify that time of concentration calculations are provided for all predevelopment areas. [Section 3.4.1]
2. Verify that the time of concentration paths are shown on the drainage area maps and are labeled with slopes, cover types, and lengths for each type of flow (sheet, shallow concentrated, etc.). [Section 3.4.1; Appendix E, Table E-7]
3. Verify that the time of concentration paths are shown from the hydraulically most distant point of the drainage area to a point of interest within the drainage area, and that the paths are perpendicular to each area's contours. [Section 3.4.3]
4. Verify that the minimum post-development time of concentration used for any path is six minutes. [Section 3.4.1; Section 3.4.3]
5. Verify that the correct two-year design precipitation depth (P-2) is used in the sheet flow component of the time of concentration calculations. [Section 3.4.3]
6. Verify that the correct Manning's n values (roughness coefficients) are used in the sheet flow component of the time of concentration calculations. Refer to Table 3.4-6 of the Manual. [Section 3.4.3]
7. Verify that a maximum sheet flow length of 100 feet is used if the flow is not concentrated. [Section 3.4.3]

F.6.4 Stormwater Conveyance Pipe Capacity

1. Verify that pipe capacity calculations are provided for all stormwater conveyance pipes that are not connected to the roof drainage system. [Section 3.4.2]
2. Verify that all storm sewer pipes are sized to have adequate capacity to safely convey the ten-year, 24-hour storm event without surcharging the crown of the pipe. [Section 3.4.2]
3. Verify the runoff coefficients used in the pipe capacity calculations. A runoff coefficient value of 0.35 must be used for pervious areas, and 0.95 must be used for impervious areas. [Section 3.4.2]
4. Verify the precipitation intensity used in the pipe capacity calculations. The precipitation intensity for a five-minute inlet concentration time in the ten-year storm event must be 6.96 inches per hour. [Section 3.4.2]
5. Verify that the Manning's n values used with Manning's Equation for calculating full channel pipe flow are correct and consistent with the plans. A Manning's n value of 0.013 must be used for RCP, VCP, and CIP, and a value of 0.011 must be used for PVC and HDPE. [Section 3.4.2]
6. Verify that all roof drainage systems are sized pursuant to the Philadelphia Plumbing Code. [Section 3.4.2]
    a. Verify that the minimum size of a storm drain or any of its branches that drain a roof or area drain is three inches in diameter.
    b. Verify that the main roof drain has a slope that is greater than 1/16 inch per foot.