

# Maryland State Highway Administration

## Hydraulic-Hydrologic Review Guidelines

This document summarizes the standard policies and procedures regarding the hydrologic analysis and hydraulic design requirements of access and utility permit applications for work within and adjacent to state roadways and facilities. While numerous references are made regarding minimum requirements, they are never substitutes for sound, professional engineering judgment. The criteria and standards cannot provide for all situations and are not intended to unreasonably limit any innovative or creative effort that may result in a more effective achievement of the intent of the requirements. Any proposed departure from such standards is judged on the likelihood that it will produce a compensatory or comparable result, adequate in every way, for the citizens of Maryland and users of the state's roadway network. All analysis and design must be performed by a Professional Engineer licensed in the State of Maryland.

### **1 Review Process**

All projects proposed by private developers, local municipalities, counties, state, or federal agencies adjacent to and/or within the right-of-way are reviewed to ensure there are no adverse impacts to the state and to verify that improvements within the right-of-way conform to all requirements and the intent of the requirements. The SHA Office of Highway Development's (OHD's) Highway Hydraulics Division (HHD) only reviews submissions it receives from SHA District Offices. Submittals received directly from applicants or from other parties on behalf of the applicants will not be reviewed.

In general, hydraulics reviews ensure that:

- All inlets, pipes, ditches, swales, channels, and stormwater management (SWM) facilities constructed within the right-of-way and/or easements meet SHA criteria.
- The design of proposed drainage facilities and infrastructure connecting directly and/or indirectly to SHA drainage facilities and/or systems either upstream or downstream are adequate, do not adversely affect state assets, and do not compromise the safety of state assets.
- Proposed developments served by on-site drainage systems that do not connect directly to the SHA drainage and conveyance systems do not directly or indirectly result in an adverse impact upon SHA assets and do not compromise the function or safety of state assets.
- Cross-sectional elements of proposed improvements do not create safety or erosion hazards.
- Grading plans and activities within the right-of-way do not cause increases in flow towards the state assets.
- Temporary erosion and sediment control (ESC) work within the right-of-way is appropriate, adequate, and will not cause a release of sediment or sediment-laden runoff to enter the SHA drainage system and/or other SHA assets.

**1.1 Conditional Approval.** Projects may be eligible for conditional hydraulic approval, allowing the applicant to submit their access permit package if the District Office determines that all other project comments have been satisfied and the project is ready for permit issuance. Conditional approval may be granted when there are only a few minor plan presentation comments remaining to be addressed, e.g. adding BMP numbers or correcting callouts. HHD has the sole discretion to grant conditional hydraulic approval and will not grant it when design-related comments are outstanding.

**1.2 Final Approval.** Final hydraulic approval will not be issued until a complete submittal of documents specified herein is received, reviewed, and deemed acceptable by HHD. Because SHA is not an approving agency for SWM and ESC for non-SHA projects, the applicant is responsible for obtaining approval from the local approving agency i.e. the town, city, county, and/or soil conservation district (SCD). The applicant is also responsible for obtaining any other necessary permits and approvals for SWM and ESC, including but not limited to Non-Tidal Wetland and Waterway Permits, Tidal Wetlands Licenses, Army Corps of Engineers Permits, and Critical Area Commission approval.

## **2 Reference Documents**

All analyses and design are required to be in accordance with the latest versions of the documents listed below for the hydrologic and hydraulic analysis and design of drainage systems and infrastructure, SWM facilities, and ESC plans within or affecting, directly or indirectly, SHA right-of-way, easements, infrastructure, and assets.

- [SHA Highway Drainage Manual, Supplements, and Design Guidelines](#) – These documents provide the standard analytical methodologies and design criteria for the design of drainage systems, culverts, and SWM facilities.
- [SHA Book of Standards for Highway and Incidental Structures](#) – Provides standard details for asset and infrastructure items to be used.
- [SHA Standard Specifications for Construction and Materials](#) and the accompanying [Supplemental](#) – Provides standard specifications for construction and materials to be used.
- [MDE Maryland Stormwater Design Manual, Volumes I and II](#) – Provides guidance and criteria for the analysis and design of SWM facilities and techniques. Some design aspects may be superseded by the SHA Highway Drainage Manual, Supplements, Design Guidelines, and the SHA Sediment and Stormwater Guidelines and Procedures.
- [SHA Sediment and Stormwater Guidelines and Procedures](#) – Provides supplemental requirements for SWM and ESC.
- [SHA Sediment and Stormwater Administrative Procedures](#) – Provides supplemental information related to the review, approval, and compliance process with SWM and ESC.

- [MDE Maryland Standards and Specifications for Soil Erosion and Sediment Control](#) – Provides guidance and criteria for the design of ESC and accepted ESC techniques and devices.
- [USDA Technical Release 55 \(TR-55\) – Urban Hydrology for Small Watersheds](#) – Provides methodology for hydrologic analysis.
- [USDA Technical Release 20 \(TR-20\) – Watershed Hydrology](#) – Provides methodology for hydrologic analysis.

Where discrepancies exist, this document shall supersede all other reference documents listed above.

### **3 Exemptions from Hydraulic Review**

Under certain limited circumstances, projects may be exempt from hydraulic review. Refer to the **Hydraulic Review Waiver Request** that includes a flow chart to determine whether a specific project may qualify for exemption. Send review requests to the appropriate District Office for concurrence. The District Office will forward the request to HHD for approval. Regardless of the results of the flow chart, HHD reserves the right to review all projects when it deems a review is necessary.

### **4 Drainage Design**

All drainage systems located within SHA right-of-way and easements are designed per criteria and requirements documented in the Highway Drainage Manual, Part I, Chapters 1-4 and its supplements.

**4.1 Basic Concepts.** Requirements for basic hydrologic and hydraulic computations may be found in the Highway Drainage Manual, Part I, Chapter 2 and its supplements.

**4.2 Inlet Capacity and Spread.** Refer to the requirements as set forth in the Highway Drainage Manual, Part I, Chapter 3.B, Chapter 4.A.1 and supplements. Provide computations to demonstrate criteria is met. Additional specific requirements are as follows.

- A. The maximum allowable flow across entrances is 1.0 cfs.
- B. The maximum allowable flow onto downstream property owners from the end of curb and gutter is 0.5 cfs when SHA has the right to discharge at that location. Supply the pertinent plat that shows the right to discharge.
- C. Curb cuts are discouraged and only allowed with prior HHD approval. Standard COG/COS Openings may be used as an alternative.
- D. Prepare a pre- and post-development analysis for existing inlets when runoff from the proposed development is directed toward the highway. Additional flow from the development should not be directed toward the roadway.
- E. When proposed conditions cannot accommodate a standard SHA structure, a specially-designed structure may be proposed. The structure design must be signed and sealed by a professional engineer licensed in the State of Maryland.

**4.3 Inlet Selection.** The following is a basic guideline to inlet selection.

- a. Curb Opening Inlets
  - Preferred when heavy truck traffic is anticipated in a turning or parking lane.
  - Assume a one foot gutter pan with a 1.5 inch local depression.
- b. Grate Inlets
  - Grates include those that are safely traversable by bicycles. (This is not applicable for roadways in which bicycles are prohibited.)
  - In sumps containing an inlet, reduce the perimeter length to 75% of actual length to compensate for potential clogging.

**4.4 Closed Storm Drains.** Provide existing and proposed conditions analyses of the storm drains that are directly and indirectly affected by the proposed development. Analysis and design guidance is located within the Highway Drainage Manual, Part I, Chapter 4.

Additional specific requirements are as follows.

- a. All new or replacement drainage structures must conform to the latest version of SHA's Book of Standards for Highway and Incidental Structures, except where the use of modified or non-standard structures is expressly noted on the approved plans.
- b. Approval of the use of modified or non-standard structures is at the sole discretion of HHD and the structural design must be approved by HHD prior to final approval.
- c. Before pre-cast structures are ordered, shop drawings must be approved prior to installation of the structure.
- d. Minimize the number of storm drain trunk lines and cross pipes running beneath travel lanes.
- e. If the storm drain extends from SHA right-of-way to the development site, use a manhole structure just inside the SHA right-of-way to set the maintenance limits.
- f. All new or replacement drainage pipes shall conform to the approved materials listed in the latest version of the SHA Standard Specifications for Construction and Materials, with the following specific requirements:
  - i. Reinforced concrete pipe shall be a minimum of Class IV
  - ii. Metal pipes larger than 84 in. shall be structural plate.
  - iii. Use of Corrugated Polyethylene Pipe (CPP-S) or Polyvinyl Chloride Profile Wall Pipe (PPWP) is restricted to outside the pavement template unless prior approval from HHD is granted. Polyethylene end-sections are not allowed.
  - iv. Metal pipe larger than 60 in diameter shall have 3"x1" corrugations.
  - v. All pipes shall have gasket joints appropriate to the pipe material.

**4.5 Open Channels.** Provide an analysis for all channels adjacent to state highways and any that may be affected as a result of the proposed development. This may include channels that are located beyond the property boundaries. Size inlet and outlet channels of culverts for the design storm of the roadway functional classification.

Additional guidance may be found in the Highway Drainage Manual, Part I, Chapter 3.

- 4.6 Culverts.** Provide an analysis for all existing and proposed culverts within SHA right-of-way that may be affected as a result of the proposed development. This may include culverts that are located beyond the property boundaries. If hydrologic computations for existing culverts show no increase in peak discharge for all storms up to the design storm of the roadway, a culvert analysis is not required. The roadway's design storm is based on the functional classification as set forth in the Highway Location Reference.

Headwalls and endwalls are required on pipes 36" in diameter and larger; otherwise end sections are required. Include safety and clear zone requirements in the decision-making for determining the most appropriate entrance and end treatments of culverts.

- 4.7 Utility Clearances.** Provide clearances with existing and proposed utilities in accordance with the criteria established by the specific utility owner. Ensure utility designations have been completed and include them on final design plans; include test pit information. Coordinate test pits during the design phase, prior to issuance of the permit, with the District Utility Engineer (DUE) and obtain the pertinent permits from the DUE. In the event of utility conflicts during construction, any alternative designs require approval from HHD.

Unforeseen or improperly evaluated conflicts with underground utilities can have a profound effect on the schedule and cost of construction. Redesign of proposed storm drainage systems may require considerable engineering efforts and relocation of the utility may be the only acceptable alternative. Applicants are advised to utilize appropriate resources early in the design process to positively identify the precise horizontal and vertical location of all underground utilities at points of potential conflict with proposed storm drainage systems.

- 4.8 Rights to Discharge.** For all existing and proposed locations where discharge leaves the SHA right-of-way, provide a right to discharge. A recorded deed and plat into the public record are required. Direct all plat and deed related questions to SHA's Plats and Surveys Division.

## **5 Stormwater Management**

- 5.1 Approval Authority.** Regulatory approval authority of SWM and ESC for any project within Maryland is based on the applicant and location of the project, typically either a local jurisdiction or MDE. Except for projects undertaken by SHA itself, SHA is not a regulatory authority for SWM and ESC. However, as an affected land owner and asset owner responsible for maintenance, SHA has supreme authority regarding the location, type, and design for any SWM and ESC practices proposed within SHA right-of-way and easements and is due compensatory mitigation for adverse impacts within the SHA right-of-way and easements should they arise as a direct or indirect result of the proposed development.

All work within the SHA right-of-way must comply with all SHA requirements, criteria, and standards *regardless* of local standards.

**5.2 Design and Analysis Requirements.** All SWM facilities must be designed and analyzed using the NRCS TR-55 Hydrograph Method. No other methods are accepted. The SWM computations must include the appropriate pre- and post-development discharge rates. In addition, computations based on the design storm for the roadway functional class are required.

The following specific requirements apply to all SWM facilities proposed within the SHA right-of-way.

- a. SWM facilities may only manage SHA impervious areas. All other impervious areas are excluded.
- b. In general, joint-use facilities are prohibited; however, they may be approved on a case-by-case basis if a direct benefit to SHA is demonstrated.
- c. The reduced curve number method may only be used for the 1-year design storm and does not apply to any higher-volume storms. To determine the reduced discharge influenced by a Chapter 5 SWM facility, the appropriate design storm may be routed through the facility using the TR-20 methodology.
- d. SWM filtration facilities using the SHA bioretention soil mix (BSM) must be designed using the “Surface Storage Volume Tables for Bioretention, Bioswales, Rain Gardens, and Landscape Infiltration.”

**5.3 Peak Discharge Requirements.** Specific requirements are as follows.

- a. For any proposed improvements in which stormwater runoff will enter the right-of-way, the applicant must demonstrate no increases in peak discharges *entering* the right-of-way for the 1, 2, 10, 25, 50, and 100-year design storms.
- b. For any proposed improvements in which stormwater runoff will exit the right-of-way, the applicant must demonstrate no increases in peak discharges *exiting* the right-of-way for the 1, 2, 10, 25, 50, and 100-year design storms.

**5.4 Impervious Area Requirements.** For any improvements or alterations that increase the amount of impervious area within the SHA right-of-way, regardless of the need or amount of new impervious area, the applicant must provide direct treatment for water quality of the increase of impervious area. Direct treatment is provided by runoff from the SHA impervious area flowing directly into a facility. Treatment may be provided by either of the following:

- a. Constructing a SWM facility within the right-of-way that directly receives runoff from the impervious area it is managing within the right-of-way. Areas outside of the right-of-way, impervious or otherwise, may not be managed by any SWM facilities located within the right-of-way. Any SWM facilities within the right-of-way are owned and maintained by SHA like any other asset or infrastructure within the right-of-way. As such, the SWM facility must meet all SHA requirements for design, materials, and construction.
- b. Constructing a SWM facility on the proposed development site and entirely outside the

right-of-way or easement that directly receives runoff from the impervious area it is managing, including the impervious area from the right-of-way or easement. Any SWM facilities located outside of the right-of-way are owned and maintained by the property owner.

Treatment requirements related to the reconstruction of existing pavement is deferred to the regulatory agency responsible for approving the stormwater management for the project.

Alternative management may not be provided by overcompensation or over-management elsewhere on the development site, and Final Hydraulic Approval will not be granted, regardless of whether or not the local approval authority accepts or approves such an alternative.

**5.5 Modifications to Existing SWM Facilities.** Any modifications to an existing SHA-owned SWM facility requires approval from either MDE or SHA's Plan Review Division (PRD). This review and approval process is independent from the HHD review and will only commence once HHD is confident that the proposed modifications are approvable.

**5.6 SWM Facility Numbers.** All SWM facilities, regardless of location and ownership, receiving runoff from impervious area located in the SHA right-of-way must receive a SWM Facility Number from HHD. Instructions for receiving the SWM facility numbers are included in HHD comments. Numbers are issued prior to Final Hydraulic Approval and only when all design-related comments have been addressed.

## **6 Erosion and Sediment Control**

Establish an ESC plan that is approved by the local approval authority. Ensure the plan prevents sediment and sediment-laden runoff from entering any SHA drainage systems, SWM facilities, and similar infrastructure and assets. Projects exempt from ESC approval as determined by the local approval authority are still required to have an appropriate ESC plan for work within the SHA right-of-way and easements.

Ensure all existing drainage systems continue to function effectively while work is in progress and upon completion of work. Should any disturbance be made to existing drainage systems, restore them to their original condition and function using appropriate methods.

## **7 Submittal Requirements**

Deliver all submissions to the appropriate District Office. HHD will not review any submissions submitted directly from the applicant or anyone acting on the behalf of the applicant.

**7.1 Traffic Impact Study (TIS) Phase Reviews.** Because of the potential for significant roadway changes that affect drainage and SWM, HHD will not review projects for which a TIS is required but not approved.

**7.2 Plan Reviews.** Prepare and present all computations neatly, well organized, and sufficiently and appropriately labeled so they may be easily reviewed. Include references to all design charts and publications used in the preparation of the computations.

At a minimum, submit the following for hydraulic review:

- a. Plans
  - i. A set of the latest approved development site plans signed and sealed by a professional engineer licensed in the State of Maryland.
  - ii. A set of the latest SHA roadway improvement plans (if separate from the development site plans) signed and sealed by a professional engineer licensed in the State of Maryland.
  - iii. Proof of county and/or local approving agency approval of the SWM and ESC plans.
- b. Drainage Computations
  - i. Pre- and post-development drainage area maps.
  - ii. Inlet spacing computations. Included existing and proposed conditions. For existing storm drain system modifications, provide documentation demonstrating condition. Structures found to be in deficient condition may need to be replaced to ensure safety.
  - iii. Storm drain design computations. Include existing and proposed conditions. For existing storm drain pipes, provide documentation demonstrating condition. Pipes found to be in deficient condition may need to be replaced to ensure safety.
  - iv. Hydraulic gradient computations. Include existing and proposed conditions.
  - v. Flow computations for open channels and ditches. Include existing and proposed conditions.
  - vi. Hydraulic analyses for culverts. Include existing and proposed conditions. For existing culverts, provide documentation demonstrating condition. Culverts found to be in deficient condition may need to be replaced to ensure safety.
- c. Stormwater Management Report
  - i. Pre- and post-development drainage area maps for all points and lines of investigation.
  - ii. Impervious area summary detailing the amount of new impervious, existing impervious, redevelopment, and removed impervious areas within the SHA right-of-way and easements.
  - iii. Peak discharge computations demonstrating no increase in peak flow into and out of the SHA right-of-way and easements.
  - iv. Design computations for all SWM facilities within or adjacent to the SHA right-of-way and easements.
  - v. Complete supporting documentation of the hydrologic analysis e.g.:  $t_c$  paths, runoff curve numbers, soil types, TR-20 Schematic Diagrams, land uses, etc.).

**7.3 Computational Software.** Only outputs from SHA-approved software will be reviewed. Approved software can be found here:  
[http://www.roads.maryland.gov/OHD2/HDM\\_guidelines\\_software.pdf](http://www.roads.maryland.gov/OHD2/HDM_guidelines_software.pdf)

**7.4 Addenda/Modifications.** In the event that the permitted drainage systems, SWM facilities, and other items that directly or indirectly affect runoff drainage patterns cannot be constructed according to the approved plans due to utility conflicts, adverse site conditions, and other factors discovered during construction activities, the applicant is responsible to provide a functionally equivalent or improved design that meets or exceeds the intent and function of the approved design and submit revised plans to SHA for approval, including an amended hydraulic review approval when necessary.

At the SHA inspector's discretion, certain changes may be approved in the field. All other changes require an amended hydraulic review approval.

**7.5 As-Built Drawings.** Submit approved SWM facility as-builts to the applicable District Office for all SWM facilities constructed within SHA right-of-way and easements. The applicable District Office will forward the submittal to HHD.