



XIV.

Agenda Item

County of Hanover

Board Meeting: November 12, 2014

Subject: Public Hearing – Department of Public Works – Ordinance 14-10, Amending Chesapeake Bay Preservation Ordinance and Stormwater Management Ordinance, and Ordinance 14-11, Amending the Hanover County Drainage Design Handbook

Summary of Agenda Item: On July 1, 2014, the Virginia Department of Environmental Quality (DEQ) informed the County Administrator that the County had been granted provisional approval of the state-required stormwater management program, conditioned upon certain amendments.

In response to DEQ comments on the adopted County ordinances and stormwater management program, the Department of Public Works and County Attorney's Office have drafted amendments to the Chesapeake Bay Preservation Ordinance, Stormwater Management Ordinance, and Drainage Design Handbook contained in Ordinances 14-10 and 14-11. These amendments are necessary to obtain state approval of Hanover County's stormwater management program. In addition, staff has proposed amendments to reduce the complexity of stormwater requirements for single family home development. A summary of the proposed changes is attached.

These ordinances were authorized for public hearing on October 8, 2014.

County Administrators Recommended Board Motion: Motion to adopt – Ordinance 14-10, Amending Chesapeake Bay Preservation Ordinance and Stormwater Management Ordinance, and Ordinance 14-11, Amending the Hanover County Drainage Design Handbook to become effective on adoption.

Summary of changes: ORDINANCE 14-10

1. Amended section 10-38 of Article II of Chapter 10 of the Hanover County Code (Chesapeake Bay Preservation Ordinance) to conform to changes in state regulation relating to qualification of persons performing inspections of on-site sewage systems.
2. Amended sections 10-78, 10-79, 10-80, 10-82, and 10-87 of Article V of Chapter 10 of the Hanover County Code (Stormwater Management Ordinance) to change provisions relating to the permitting of single-family homes. A provision authorizing an *"Agreement in lieu of a stormwater management plan"* is added as an option to simplify permitting of single family homes. In addition, single family residences separately built and disturbing less than one acre of land are now exempt from the stormwater VSMP and water quality requirements when they are not part of a common plan of development.

ORDINANCE NO. 14-11 - HANOVER COUNTY DRAINAGE DESIGN HANDBOOK

1. Section V. STORM SEWER is amended to clarify conditions for analyzing flows, due to changes in stormwater regulations.
2. Section VI. OPEN MANMADE and NATURAL CHANNELS is amended to lower the permissible slope for grass lined channels (subsection B.) and to establish minimum channel slopes for concrete lined channels (subsection C.). These changes make the exceptions in subsection H unnecessary, therefore subsection H is deleted.
3. Section IX. STORMWATER MANAGEMENT, subsection B. is modified to require compliance with the minimum state requirements set forth in 9VAC25-870-66. In addition, to ensure a higher level of protection for downstream channels from erosion, a provision requiring the analysis of channels using permissible velocity is maintained as a more stringent requirement.

**PUBLIC HEARING NOTICE
HANOVER COUNTY BOARD OF SUPERVISORS**

The Hanover County Board of Supervisors will hold a public hearing on **Wednesday, November 12, 2014, at 7:00 p.m.** in the Board meeting room at the Hanover County Administration Building, 7516 County Complex Road, at Hanover Courthouse, Hanover, Virginia, on the following ordinances being proposed for adoption:

ORDINANCE 14-10

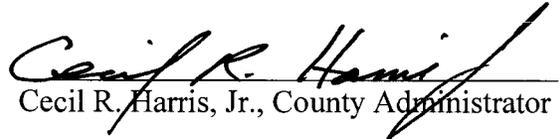
AN ORDINANCE AMENDING ARTICLES II AND V OF CHAPTER 10 OF THE HANOVER COUNTY CODE PURSUANT TO TITLE 62.1, CHAPTER 3.1, ARTICLES 2.3 (§ 62.1-44.15:24 ET SEQ.) AND 2.5 (§ 62.1-44.15:67 ET SEQ.) OF THE CODE OF VIRGINIA TO CONFORM TO CHANGES IN STATE LAW AND NEW REGULATORY REQUIREMENTS

ORDINANCE NO. 14-11

AN ORDINANCE AMENDING THE HANOVER COUNTY DRAINAGE DESIGN HANDBOOK DATED FEBRUARY 12, 2014 AND ADOPTING THE REVISED DRAINAGE DESIGN HANDBOOK INCLUDING CHANGES NECESSARY TO OBTAIN STATE APPROVAL OF HANOVER COUNTY'S STORMWATER MANAGEMENT PROGRAM. THE HANDBOOK INCLUDES SPECIFICATIONS FOR CONSTRUCTION MATERIALS, MAINTENANCE AGREEMENT REQUIREMENTS AND DETAILS FOR DESIGN OF CURB AND GUTTER, STORM SEWER, OPEN CHANNELS, LOT GRADING, IMPOUNDMENTS AND EMBANKMENTS.

Complete copies of the proposed ordinances and related information are available at the office of the County Administrator any regular working day between 8:30 a.m. and 5:00 p.m.

All persons wishing to comment on the proposal may appear at the stated time and place.


Cecil R. Harris, Jr., County Administrator

Publish: October 23, 2014 and October 30, 2014.

ORDINANCE 14-10

AN ORDINANCE AMENDING ARTICLES II AND V OF CHAPTER 10 OF THE HANOVER COUNTY CODE PURSUANT TO TITLE 62.1, CHAPTER 3.1, ARTICLES 2.3 (§ 62.1-44.15:24 ET SEQ.) AND 2.5 (§62.1-44.15:67 ET SEQ.) OF THE CODE OF VIRGINIA TO CONFORM TO CHANGES IN STATE LAW AND NEW REGULATORY REQUIREMENTS

WHEREAS on February 12, 2014, the Hanover County Board of Supervisors adopted Ordinance 13-12 to incorporate specific components of the Stormwater Management Act (Virginia Code § 62.1-44.15:24 et seq.) and Stormwater Regulations, including a stormwater management ordinance to become effective July 1, 2014; and

WHEREAS on February 12, 2014, the Hanover County Board of Supervisors adopted Ordinance 13-10 to incorporate specific components of the Chesapeake Bay Preservation Act (Virginia Code § 62.1-44.15:67 et seq.); and

WHEREAS the Department of Public Works has received comments from the Virginia Department of Environmental Quality that minor revisions are required in order to conform to statutory and regulatory requirements;

NOW, THEREFORE, BE IT ORDAINED by the Board of Supervisors of Hanover County:

1. That Section 10-38 of Article II of Chapter 10 of the Hanover County Code shall be amended to read as follows:

Sec. 10-38. - General performance criteria for Chesapeake Bay Preservation Areas.

Any use, development or redevelopment of land within the Chesapeake Bay Preservation Area (CBPA) shall meet the following performance criteria:

- (1) No more land shall be disturbed than is necessary to provide for the proposed use or development.
 - a. The limits of land disturbance, development or redevelopment, including clearing or grading, shall be strictly defined by the construction footprint shown on the building permit, site plan, subdivision plat or water quality impact assessment. These limits and all CBPAs shall be clearly shown on all plans and physically marked on the development site prior to any clearing or grading on the site.
 - b. Ingress and egress to any site within the CBPA during construction shall be limited to one (1) access point, unless otherwise approved by the director.

(2) Indigenous vegetation shall be preserved to the maximum extent practicable consistent with the use or development proposed.

a. Existing trees over six (6) inches in diameter measured outside the bark at a point four and one-half (4.5) feet above the ground shall be preserved outside the construction footprint. Diseased trees or trees weakened by age, storm, fire or other injury may be removed.

b. Clearing shall be allowed only to provide necessary access, construction of improvements, positive site drainage, water quality best management practices, and the installation of utilities, as approved by the director.

c. Prior to clearing or grading, suitable protective barriers, such as safety fencing, shall be erected five (5) feet outside of the dripline of any tree or stand of trees to be preserved. These protective barriers shall remain so erected throughout all phases of construction. The storage of equipment, materials, debris, or fill shall not be allowed within the area protected by the barrier.

(3) Land development shall minimize impervious cover consistent with the use or development proposed.

(4) Notwithstanding any other provisions of this article or exceptions or exemptions, any land disturbing activity within a CBPA exceeding two thousand five hundred (2,500) square feet, including construction of all single-family houses, septic tanks and drainfields, shall comply with the erosion and sediment control requirements of state law and with this chapter. Any such proposed development shall be the subject of a land disturbance permit, certification, building permit, site plan, subdivision plat or water quality impact assessment found by the director to be consistent with this article.

(5) On-site sewage treatment systems in a CBPA not requiring a Virginia Pollutant Discharge Elimination System permit shall comply with the following:

a. Systems shall be pumped out at least once every five (5) years, unless the owner submits documentation every five (5) years, certified by ~~a sewage handler permitted by the state department of health an operator or on-site soil evaluator licensed or certified under Chapter 23 (Section 54.1-2300 et seq.) of Title 54.1 of the Code of Virginia as being qualified to operate, maintain or design on-site sewage systems~~, that the septic system has been inspected, is functioning properly, and the tank does not need to have the effluent pumped out of it. As an alternative to the mandatory pump-out or documentation, a plastic filter approved by the health department may be installed and maintained in the outflow pipe from the septic tank to filter solid material from the effluent.

b. A reserve sewage disposal site with a capacity at least equal to that of the primary sewage disposal site shall be provided on each lot or parcel proposed for new construction. This reserve sewage disposal site requirement shall not apply to any lot or parcel recorded prior to October 1, 1989, if the lot or parcel is not sufficient in capacity to accommodate a reserve sewage disposal site, as determined by the local health department.

c. Building or construction of any impervious surface shall be prohibited on the area of all sewage disposal sites until the development is served by public sewer or an on-site sewage treatment system which operates under a permit issued by the state water control board.

2. That Sections 10-78, 10-79, 10-80, 10-82, and 10-87 of Article V of Chapter 10 of the Hanover County Code shall be amended to read as follows:

ARTICLE V. STORMWATER MANAGEMENT

Sec. 10-78. Definitions.

In addition to the definitions set forth in the Virginia Stormwater Management Program Regulations, Section 25-870-10 of Title 9 of the Virginia Administrative Code, as amended, which are expressly adopted and incorporated herein by reference, the following words and terms used in this article have the following meanings unless otherwise specified herein. Where definitions differ, those incorporated herein shall have precedence.

"Agreement in lieu of a stormwater management plan" means a contract between the VSMP authority and the owner or permittee that specifies methods that shall be implemented to comply with the requirements of a VSMP for the construction of a single-family residence; such contract may be executed by the VSMP authority in lieu of a stormwater management plan.

Applicant means any person submitting an application for a permit or requesting issuance of a permit under this article.

Best management practice or *BMP* means schedules of activities, prohibitions of practices, including both structural and nonstructural practices, maintenance procedures, and other management practices to prevent or reduce the pollution of surface waters and groundwater systems from the impacts of land-disturbing activities.

Chesapeake Bay Preservation Act land-disturbing activity means a land-disturbing activity including clearing, grading, or excavation that results in a land disturbance equal or greater than 2,500 square feet and less than one acre in all areas of Hanover County designated as subject to the regulations adopted pursuant to the Chesapeake Bay Preservation Act, § 62.1-44.15:67 et seq. of the Code of Virginia.

Common plan of development or sale means a contiguous area where separate and distinct construction activities may be taking place at different times on different schedules.

Control measure means any best management practice or stormwater facility, or other method used to minimize the discharge of pollutants to state waters.

Clean Water Act or *CWA* means the federal Clean Water Act (33 U.S.C. § 1251 et seq.), formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500, as amended by Public Law 95-217, Public Law 95-576, Public Law 96-483, and Public Law 97-117, or any subsequent revisions thereto.

Department means the Department of Environmental Quality.

Development means land disturbance and the resulting landform associated with the construction of residential, commercial, industrial, institutional, recreation, transportation or utility facilities or structures or the clearing of land for non-agricultural or non-silvicultural purposes.

Director means the Director of the Department of Public Works, who is responsible for administering the VSMP on behalf of the county, or any authorized agent of the director.

General permit means the permit titled GENERAL PERMIT FOR DISCHARGES OF STORMWATER FROM CONSTRUCTION ACTIVITIES found in Chapter 880 of Title 9 of the Virginia Administrative Code (§ 25-880-1 et seq.) of the regulations, as amended, authorizing a category of discharges under the CWA and the Act within a geographical area of the Commonwealth of Virginia.

Land disturbance or land-disturbing activity means a man-made change to the land surface that potentially changes its runoff characteristics including clearing, grading, or excavation except that the term shall not include those exemptions specified in section 10-79(ed) of this article.

Layout means a conceptual drawing sufficient to provide for the specified stormwater management facilities required at the time of approval.

Minor modification means an amendment to an existing general permit before its expiration not requiring extensive review and evaluation including, but not limited to, changes in EPA promulgated test protocols, increasing monitoring frequency requirements, changes in sampling locations, and changes to compliance dates within the overall compliance schedules. A minor general permit modification or amendment does not substantially alter general permit conditions, substantially increase or decrease the amount of surface water impacts, increase the size of the operation, or reduce the capacity of the facility to protect human health or the environment.

Owner or operator means the owner or operator of any facility or activity subject to regulation under this article.

Permit or land disturbance permit means a permit to conduct a land-disturbing activity issued by the director for the initiation of a land-disturbing activity, in accordance with this article, and which may only be issued after evidence of general permit coverage has been provided by the department.

Permittee means the person to whom the land disturbance permit is issued.

Person means any individual, corporation, partnership, association, state, municipality, commission, or political subdivision of a state, governmental body, including federal, state, or local entity as applicable, any interstate body or any other legal entity.

Regulations means the Virginia Stormwater Management Program (VSMP) Regulations, section 25-870-10 et seq. of title 9 of the Virginia Administrative Code, as amended.

Site means the land or water area where any facility or land-disturbing activity is physically located or conducted, including adjacent land used or preserved in connection with the facility or land-disturbing activity. Areas channelward of mean low water in tidal Virginia shall not be considered part of a site.

State means the Commonwealth of Virginia.

State board means the Virginia State Water Control Board.

State Water Control Law means Chapter 3.1 (§62.1-44.2 et seq.) of Title 62.1 of the Code of Virginia.

State waters means all water, on the surface and under the ground, wholly or partially within or bordering the commonwealth or within its jurisdiction, including wetlands.

Stormwater means precipitation that is discharged across the land surface or through conveyances to one or more waterways and that may include stormwater runoff, snow melt runoff, and surface runoff and drainage.

Stormwater management plan means a document containing material describing methods for complying with the requirements of section 10-82 of this article.

Stormwater pollution prevention plan or *SWPPP* means a document that is prepared in accordance with good engineering practices and that identifies potential sources of pollutants that may reasonably be expected to affect the quality of stormwater discharges from the construction site, and otherwise meets the requirements of this article. In addition the document shall identify and require the implementation of control measures, and shall include or incorporate by reference an approved erosion and sediment control plan, an approved stormwater management plan, and a pollution prevention plan.

Subdivision means the same as defined in section 25-4 of the county's subdivision ordinance.

Total maximum daily load or *TMDL* means the sum of the individual wasteload allocations for point sources, load allocations for nonpoint sources, natural background loading and a margin of safety. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure. The TMDL process provides for point versus nonpoint source trade-offs.

Virginia Stormwater Management Act or *Act* means Article 2.3 (§ 62.1-44.15:24 et seq.) of Chapter 3.1 of Title 62.1 of the Code of Virginia.

Virginia stormwater BMP clearinghouse website means a website that contains detailed design standards and specifications for control measures that may be used in Virginia to comply with the requirements of the Virginia Stormwater Management Act and associated regulations.

Virginia stormwater management program or *VSMP* means a program approved by the state board after September 13, 2011, that has been established by a locality to manage the quality and quantity of runoff resulting from land-disturbing activities and shall include such items as local ordinances, rules, permit requirements, annual standards and specifications, policies and guidelines, technical materials, and requirements for plan review, inspection, enforcement, where authorized in this article, and evaluation consistent with the requirements of this article and associated regulations.

Virginia stormwater management program authority or *VSMP authority* means an authority approved by the State Board after September 13, 2011, to operate a Virginia Stormwater Management Program.

Sec. 10-79. Stormwater permit requirement; exemptions.

- (a) Except as provided herein, no person may engage in any land-disturbing activity until a land disturbance permit has been issued by the director in accordance with the provisions of this article and article I.

- (b) A Chesapeake Bay Preservation Act land-disturbing activity shall be subject to an erosion and sediment control plan consistent with the requirements of the erosion and sediment control ordinance, Hanover County Code section 10-1 et seq., a stormwater management plan pursuant to section 10-82 or an executed agreement in lieu of a stormwater management plan, the technical criteria and administrative requirements for land-disturbing activities pursuant to section 10-85, and the requirements for long-term maintenance of control measures pursuant to section 10-86.
- (c) No person may engage in any land-disturbing activity until a complete and accurate general permit registration has been submitted to the director in accordance with section 25-880-1 et seq. of chapter 9 of the Virginia Administrative Code, if such registration is required pursuant to section 25-880-50 of title 9 of the Virginia Administrative Code.
- (1) *New construction activities.* Any operator proposing a new stormwater discharge associated with the construction of a single-family residence separately built, disturbing less than one (1) acre and part of a larger common plan of development or sale is authorized to discharge under the general permit and is not required to submit a registration statement, ~~provided that the stormwater management plan for the larger common plan of development or sale provides permanent control measures (i.e. stormwater management facilities) encompassing the single family residence.~~
- (2) *Existing construction activities.* Any operator with an existing stormwater discharge associated with the construction of a single-family residence separately built, disturbing less than one (1) acre and part of a larger common plan of development or sale, and who intends to continue coverage under the general permit, is authorized to discharge under the general permit and is not required to submit a registration statement provided that:
- a. The stormwater management plan for the larger common plan of development or sale provides permanent control measures (i.e. stormwater management facilities) encompassing the single-family residence; and
- b. The operator updates their stormwater pollution prevention plan to comply with the requirements of the general permit no later than sixty (60) days after the date of coverage under the general permit.
- (d) Notwithstanding any other provisions of this article, the following activities are exempt, unless otherwise required by federal law:
- (1) Permitted surface or deep mining operations and projects, or oil and gas operations and projects conducted under the provisions of title 45.1 of the Code of Virginia;
- (2) Clearing of lands specifically for agricultural purposes and the management, tilling, planting, or harvesting of agricultural, horticultural, or forest crops, livestock feedlot operations, or as additionally set forth by the state board in regulations, including engineering operations as follows: construction of terraces, terrace outlets, check dams, desilting basins, dikes, ponds, ditches, strip cropping, lister furrowing, contour cultivating, contour furrowing, land drainage, and land irrigation; however, this exception shall not apply to harvesting of forest crops unless the area on which harvesting occurs is reforested artificially or naturally in accordance with the provisions of chapter 11 (§ 10.1-1100 et seq.) of title 10.1 of the Code of Virginia or is converted to bona fide agricultural

or improved pasture use as described in subsection B of § 10.1-1163 of article 9 of chapter 11 of title 10.1 of the Code of Virginia;

- (3) Single-family residences separately built and disturbing less than one (1) acre of land ~~outside of an area designated as subject to the Chesapeake Bay Preservation Area Designation and Management Regulations~~ and not part of a larger common plan of development or sale, including additions or modifications to existing single-family detached residential structures;
- ~~(4) Single family residences separately built and disturbing less than two thousand five hundred (2,500) square feet of land in an area designated as subject to the Chesapeake Bay Preservation Area Designation and Management Regulations and not part of a larger common plan of development or sale, including additions or modifications to existing single family detached residential structures;~~
- ~~(5) (6)~~—Land disturbing activities that disturb less than two thousand five hundred (2,500) square feet inside of an area designated as subject to the Chesapeake Bay Preservation Area Designation and Management Regulations except for activities that are part of a larger common plan of development or sale that is one (1) acre or greater of disturbance;
- ~~(6) (7)~~—Discharges to a sanitary sewer or a combined sewer system;
- ~~(7) (8)~~—Activities under a state or federal reclamation program to return an abandoned property to an agricultural or open land use;
- ~~(8) (9)~~—Routine maintenance that is performed to maintain the original line and grade, hydraulic capacity, or original construction of the project. The paving of an existing road with a compacted or impervious surface and reestablishment of existing associated ditches and shoulders shall be deemed routine maintenance if performed in accordance with this subsection; and
- ~~(9) (10)~~—Conducting land-disturbing activities in response to a public emergency where the related work requires immediate authorization to avoid imminent endangerment to human health or the environment. In such situations, the director shall be advised of the disturbance within seven (7) days of commencing the land-disturbing activity and compliance with the administrative requirements of subsection (a) is required within thirty (30) days of commencing the land-disturbing activity.

Sec. 10-80. Stormwater management program established; submission and approval of plans; prohibitions.

- (a) Pursuant to § 62.1-44.15:27 of the Code of Virginia, Hanover County hereby establishes a Virginia stormwater management program for land-disturbing activities and adopts the applicable regulations that specify standards and specifications for VSMPs promulgated by the state board for the purposes set out in section 10-77 of this article. The county hereby designates the director of the department of public works as the person who is responsible for administering the county's Virginia stormwater management program.
- (b) No land disturbance permit shall be issued by the director, until the following items have been submitted to and approved by the director as prescribed herein:

- (1) A permit application that includes a general permit registration statement, unless such registration statement is not required pursuant to section 25-880-50 of title 9 of the Virginia Administrative Code;
 - (2) An erosion and sediment control plan approved in accordance with the Hanover County Erosion and Sediment Control Ordinance (Hanover County Code, section 10-1 et seq.); and
 - (3) A stormwater management plan that meets the requirements of section 10-82 of this article or an executed agreement in lieu of a stormwater management plan, except that the construction record drawing required by section 10-82(d) shall be required prior to closure of the land disturbance permit.
- (c) No land disturbance permit shall be issued until evidence of state fee payment in accordance with the regulations and general permit coverage is obtained, if general permit coverage is required.
 - (d) No land disturbance permit shall be issued until the fees required to be paid to the director are received, and a reasonable performance bond required pursuant to section 10-92 of this article has been submitted.
 - (e) No land disturbance permit shall be issued unless and until the permit application and attendant materials and supporting documentation demonstrate that all land clearing, construction, disturbance, land development and drainage will be done according to the approved permit.
 - (f) No grading, building or other local permit shall be issued for a property with land disturbing activity subject to the requirements of this article unless a land disturbance permit has been issued by the director.

Sec. 10-82. Stormwater management plan; contents of plan.

- (a) The stormwater management plan, required by section 25-870-55 of title 9 of the Virginia Administrative Code and section 10-80 of this article, must apply the stormwater management technical criteria set forth in section 10-85 of this article to the entire land-disturbing activity and consider all sources of surface runoff and all sources of subsurface and groundwater flows converted to ~~sub~~surface runoff. Individual lots in new residential, commercial, or industrial developments shall not be considered separate land disturbing activities. A complete stormwater management plan shall include the following elements:
 - (1) Information on the type and location of stormwater discharges; information on the features to which stormwater is being discharged including surface waters and the predevelopment and postdevelopment drainage areas;
 - (2) Contact information including the name, address, and telephone number of the owner/operator and the parcel number of the property or properties affected;
 - (3) A narrative that includes a description of current site conditions and final site conditions;
 - (4) A general description of the proposed stormwater management facilities and the mechanism through which the facilities will be operated and maintained after construction is complete;

- (5) Information on the proposed stormwater management facilities, including:
 - a. The type of facilities;
 - b. Location, including geographic coordinates;
 - c. Acres treated; and
 - d. The surface waters into which the facility will discharge.
 - (6) Hydrologic and hydraulic computations, including runoff characteristics;
 - (7) Documentation and calculations verifying compliance with the water quality and quantity requirements of section 10-85 of this article; and
 - (8) A map or maps of the site that depicts the topography of the site and includes:
 - a. All contributing drainage areas;
 - b. Existing streams, ponds, culverts, ditches, wetlands, other water bodies, and floodplains;
 - c. Soil types, forest cover, and other vegetative areas;
 - d. Current land use including existing structures, roads, and locations of known utilities and easements;
 - e. Sufficient information on adjoining parcels to assess the impacts of stormwater from the site on these parcels;
 - f. The limits of clearing and grading, and the proposed drainage patterns on the site;
 - g. Proposed buildings, roads, parking areas, utilities, and stormwater management facilities; and
 - h. Proposed land use with tabulation of the percentage of surface area to be adapted to various uses, including but not limited to planned locations of utilities, roads, and easements.
- (b) If an operator intends to meet the water quality and/or quantity requirements set forth in section 10-85 of this article through the use of off-site compliance options, where applicable, then a letter of availability from the off-site provider must be included. Approved off-site options must achieve the necessary nutrient reductions prior to the commencement of the applicant's land-disturbing activity except as otherwise allowed by § 62.1-44.15:35 of the Code of Virginia.
- (c) Elements of the stormwater management plans that include activities regulated under chapter 4 (§ 54.1-400 et seq.) of title 54.1 of the Code of Virginia shall be appropriately sealed and signed by a professional registered in the Commonwealth of Virginia pursuant to article 1 (§ 54.1-400 et seq.) of chapter 4 of title 54.1 of the Code of Virginia.
- (d) A construction record drawing for permanent stormwater management facilities shall be submitted to the director. The construction record drawing shall be appropriately sealed and signed by a professional registered in the commonwealth, certifying that the stormwater management facilities have been constructed in accordance with the approved plan.

Sec. 10-87. Monitoring and inspections.

- (a) The director shall inspect the land-disturbing activity during construction for:
 - (1) Compliance with the approved erosion and sediment control plan;
 - (2) Compliance with the approved stormwater management plan [or agreement in lieu of a stormwater management plan](#);
 - (3) Compliance with conditions of the general permit, if general permit required;
 - (4) Development, updating, and implementation of a pollution prevention plan; and
 - (5) Development and implementation of any additional control measures necessary to address a TMDL.
- (b) The director may, at reasonable times and under reasonable circumstances, enter any establishment or upon any property, public or private, for the purpose of obtaining information or conducting surveys or investigations necessary in the enforcement of the provisions of this article.
- (c) In accordance with a performance bond with surety, cash escrow, letter of credit, any combination thereof, or such other legal arrangement or instrument, the director may also enter any establishment or upon any property, public or private, for the purpose of initiating or maintaining appropriate actions which are required by the permit conditions associated with a land-disturbing activity when a permittee, after proper notice, has failed to take acceptable action within the time specified.
- (d) Pursuant to § 62.1-44.15:40 of the Code of Virginia, the director may require every land disturbance permit applicant or permittee, or any such person subject to land disturbance permit requirements under this article, to furnish when requested such application materials, plans, specifications, and other pertinent information as may be necessary to determine the effect of his discharge on the quality of state waters, or such other information as may be necessary to accomplish the purposes of this article.
- (e) Post-construction inspections of stormwater management facilities required by the provisions of this article shall be conducted by the director pursuant to the county's adopted and state board approved inspection program, and shall occur, at minimum, at least once every five (5) years except as may otherwise be provided for in section 10-86.

3. That this Ordinance shall be effective upon adoption.

On motion of , seconded by , the members of the Board of Supervisors voted to approve Ordinance No. 14-10, as follows:

Public Hearing: , 2014
Adopted: , 2014

Vote:

Sean M. Davis
Wayne T. Hazzard
Angela Kelly-Wiecek
W. Canova Peterson
Aubrey M. Stanley
G. E. "Ed" Via, III
Elton J. Wade, Sr.

This is to certify that the above is a true copy of Ordinance 14-10 adopted by the Hanover County Board of Supervisors on , 2014.

Dated: , 2014

Cecil R. Harris, Jr., County Administrator
Clerk, Hanover County Board of Supervisors

ORDINANCE NO. 14-11

AN ORDINANCE AMENDING THE HANOVER COUNTY DRAINAGE DESIGN HANDBOOK DATED FEBRUARY 12, 2014 AND ADOPTING THE REVISED DRAINAGE DESIGN HANDBOOK INCLUDING CHANGES NECESSARY TO OBTAIN STATE APPROVAL OF HANOVER COUNTY'S STORMWATER MANAGEMENT PROGRAM. THE HANDBOOK INCLUDES SPECIFICATIONS FOR CONSTRUCTION MATERIALS, MAINTENANCE AGREEMENT REQUIREMENTS AND DETAILS FOR DESIGN OF CURB AND GUTTER, STORM SEWER, OPEN CHANNELS, LOT GRADING, IMPOUNDMENTS AND EMBANKMENTS.

WHEREAS the Board of Supervisors finds that it is proper to amend the Hanover County Drainage Design Handbook first adopted in 1988 and last amended in February 2014, and to adopt the revised Drainage Design Handbook to better provide for administration of matters related to stormwater management, floodplain, grading and drainage control facilities; and

WHEREAS the Board finds that in order to obtain state approval of Hanover County's Stormwater Management Program, and to properly provide for improvements associated with development in the County and protect the public health, safety and welfare, it is necessary to adopt requirements and standards detailed in the Drainage Design Handbook.

NOW, THEREFORE, BE IT ORDAINED by the Board of Supervisors of Hanover County that the Drainage Design Handbook first adopted October 25, 1988 and last revised in February 2014 shall be amended and the revised Handbook shall be adopted as follows:

1. *The Hanover County DRAINAGE DESIGN HANDBOOK attached to this Ordinance shall be adopted. Copies of the Handbook shall be maintained in the offices of the Public Works and Planning departments for reference.*
2. That this ordinance shall be effective on the date of adoption.

On motion of _____, seconded by _____, the members of the

Board of Supervisors voted to approve Ordinance No. 14-11, as follows:

Vote:

Sean M. Davis
Wayne T. Hazzard
Angela Kelly-Wiecek
W. Canova Peterson
Aubrey M. Stanley

G. E. "Ed" Via, III
Elton J. Wade, Sr.

This is to certify that the above is a true copy of Ordinance 14-11 adopted by the Hanover County Board of Supervisors on _____, 2014.

Public Hearing: November 12, 2014

Adopted: _____

Date: _____

Cecil R. Harris, Jr., County Administrator
Clerk, Hanover County Board of Supervisors

COUNTY OF HANOVER, VA.

DRAINAGE DESIGN HANDBOOK



DEPARTMENT OF PUBLIC WORKS

P.O. BOX 470

HANOVER, VIRGINIA 23069-0470

PHONE: (804) 365-6000

Approved by the Hanover County Board of Supervisors
February 12, 2014

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I. PURPOSE

The purpose of the Hanover County Drainage Design Handbook (“this Handbook”) is to prescribe certain design standards and specifications; construction, acceptance, and maintenance criteria; and associated technical criteria specific to Hanover County which are required for compliance with the *Hanover County Code*, Chapter 10, *Environmental Management*, Article I, *Erosion and Sediment Control*, Article II, *Chesapeake Bay Preservation*, and Article V, *Stormwater Management*, and with Chapter 12, *Floodplain and Drainage Control*, Article I and Article II.

II. STANDARDS

Except as stipulated in this Handbook all development, designs, construction materials, conveyance systems, structures and appurtenant facilities and structures requiring design approval constructed in Hanover County shall conform with all applicable federal, state and local laws, regulations, orders, guidelines, with manufacturers’ recommendations and with the latest editions of the following:

- *Drainage Manual, Road and Bridge Standards, and the Road and Bridge Specifications* and associated *Instructional & Informational Memorandum* prepared by the Virginia Department of Transportation (VDOT)
- *Virginia Erosion and Sediment Control Handbook*, Third Edition, 1992 (VESCH) Chapters 3, 4, 5, and 6 of the Virginia Department of Conservation and Recreation (DCR)
- Virginia Stormwater Management Program (VSMP) Regulations
- Virginia Stormwater Management Handbook, 2nd Edition 2013, prepared by Virginia Department of Environmental Quality (DEQ)
- Virginia Stormwater BMP Clearinghouse, www. <http://vwrrc.vt.edu/swc/>
- *Field Office Technical Guide* (FOTG) the United States Department of Agriculture (USDA)

In the event of a conflict, the more stringent or restrictive requirement shall prevail. In no event shall this Handbook be interpreted to waive or alter any of the requirements of federal, state or local laws, regulations, orders or guidance except to impose equivalent or more stringent requirements.

III. FORMS; INFORMATION REQUIRED; INTERPRETATION AND ADMINISTRATION

- A. All computations shall be provided in standard VDOT/DCR/DEQ format and included in a legible font on the plans.
- B. All deeds and agreements required by this Handbook shall be submitted in a form approved by the County Attorney and with content approved by the Director. All submittals shall be in a form prescribed by the Director and shall include information and

calculations deemed necessary by the Director. The Director shall administer and interpret the provisions of this Handbook.

IV. CONSTRUCTION MATERIALS

- A. Bituminous concrete shall not be allowed as a temporary or permanent channel lining.
- B. Pipe and culvert materials and associated structures shall be of concrete and/or reinforced concrete construction (poured in place or precast) except as noted below:
 - 1. Bituminous coated or aluminized corrugated metal pipe is approved for use for culverts at single family residential driveway entrances, and for temporary installations.
 - 2. High density polyethylene pipe is approved only for use as culverts for single family residential driveway entrances, for temporary installations, or for piping of an individual residential lot and serving only one single-family residential lot.
 - 3. Solid walled plastic pipe is approved for use for temporary installations, and for privately maintained storm drainage systems for non-residential developments outside of public rights-of-way and public easements.

V. STORM SEWER

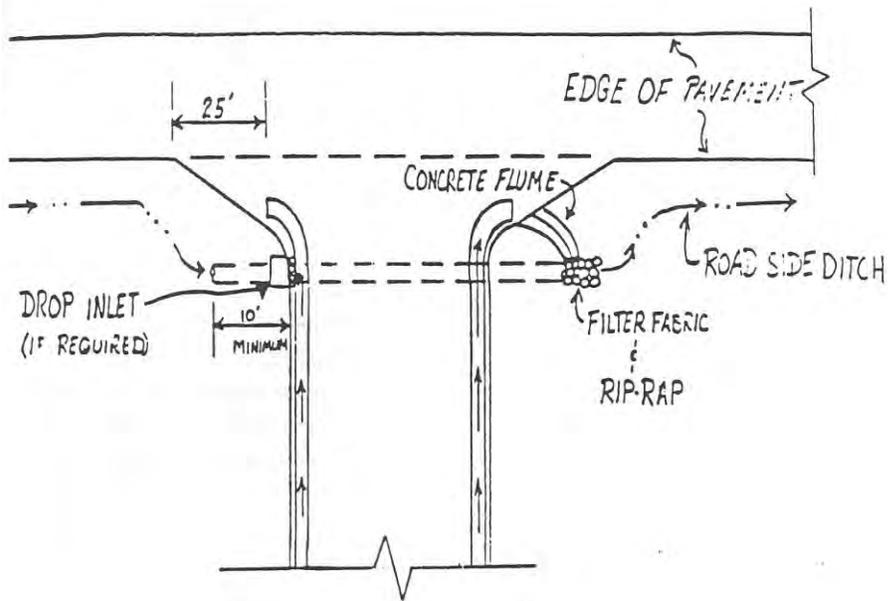
- A. Design of storm sewer systems shall provide for adequate cover for connection of future storm sewer systems from upstream areas. The storm system design shall accommodate the greater of: (i) the flows from the existing upstream conditions, or (ii) the flow from upstream areas at ultimate development conditions in accordance with the latest version of the County's Land Use Plan ~~and shall also use ultimate developed time of concentration for contributing drainage areas.~~
- B. No "necking down" of storm sewer pipe is allowed unless multiple pipes, with an equivalent size at least equal to the upstream pipe, are to be installed. In some instances it may be appropriate to allow storm sewer pipes of new upstream development to tie to existing smaller diameter downstream systems if sufficient capacity in the existing system exists. Inlet shaping is required in connecting structures for a transition in such instances.

- C. All sewers shall be a minimum size of 15 inches in diameter. This minimum size requirement does not apply to a private storm sewer system serving an individual single family lot or to private storm sewer systems which convey drainage from rooftop and unpaved areas, with no off-site drainage entering the system.
- D. Storm sewer systems shall be designed to meet the minimum design capacity requirement based on Manning's Equation using non-pressurized flow.
- E. Hydraulic grade line (HGL) computations are required for all storm sewer systems. Storm sewer profiles shall include the HGL plotted on the construction plan profile sheets. When computing the HGL, flow under pressurized conditions can be considered in order to show the design storm is contained within the system.

VI. OPEN MANMADE and NATURAL CHANNELS

- A. Permissible Velocity
 - 1. Open manmade channels shall be designed and constructed to preclude erosion during the 2-year storm and to contain the 10-year storm. Open natural channels shall be evaluated and determined to be safe from erosion during the 2-year storm. Flooding shall be evaluated in accordance with floodplain management requirements in section X of this Handbook.
 - 2. Design calculations for new manmade open channels shall use Manning's "n" values listed in Appendix A, "**Values of Roughness Coefficient "n" (Uniform Flow).**"
 - 3. Analysis of existing open or natural channels shall use the Manning's "n" values listed in Appendix A, "**Values of Roughness Coefficient "n" (Uniform Flow).**"
 - 4. The 2 year storm velocity for new or existing manmade or natural channels shall not exceed the permissible velocity for the soil type and treatment based on the chart found in Appendix B, titled "**Maximum Permissible Water Velocities as a Function of Soil Type.**" Newly established grassed lined channels must be lined with a minimum Soil Stabilization Treatment "1" or VDOT EC-2 when velocities exceed 2.5 ft/s.
- B. Minimum longitudinal slope for new manmade channels with grass linings = ~~4~~0.5%.

- C. ~~New manmade channels with slopes less than 1.0% shall be concrete lined.~~ The minimum longitudinal slope for concrete lined channels = 0.5%.
- D. When used, concrete lining shall be installed to a depth of at least 110% of the 10 year storm depth.
- E. Rip-Rap Lined Channels shall meet the following criteria:
 - 1. Minimum rip-rap size of Class I to be used in all applications.
 - 2. Maximum side slope of 2:1.
 - 3. Minimum rip-rap thickness = 18 inches.
 - 4. Minimum channel depth = 18 inches.
 - 5. Rip-rap shall be placed over a layer of filter fabric.
 - 6. Rip-rap shall not be allowed for energy dissipation or channel lining on slopes over 15%.
 - 7. Rip-rap channel lining shall not be allowed within 200 hundred feet of residences. The two hundred feet distance will be measured from the front yard set-back line.
- F. Where intersecting a street that does not have curb and gutter, the design shall accommodate the conveyance of run-off from the curb and gutter section to the roadside ditch via paved ditch transitions or drop structures. See Figure C-1 for illustration.
- G. In residential developments, open channels shall be designed in a manner to permit maintenance by residents. This requires:
 - 1. Maximum side slopes for grassed channels to facilitate maintenance is 3H: 1V, rounded at the top.
 - 2. Longitudinal slope sufficient to allow stormwater to drain unless specifically designed and approved as a Best Management Practice (BMP).
- H. ~~The Director may grant an exception in non-residential developments to the criteria for open channel design allowing an earthen ditch with minimum longitudinal slope of 0.5 percent if the Director finds that such a slope will adequately contain the design storm and convey drainage.~~



ENDING CURB & GUTTER AT AN INTERSECTION

FIGURE C-1

VII. Drainage

A. General

In all developments, plans shall provide for drainage by gravity of all lands within the boundaries of the project to a natural watercourse, wetland, man-made system, or natural receiving area so as not to create a public nuisance due to increase in standing water not specifically intended for Best Management Practice, Low Impact Development (LID) or Environmental Site Design (ESD) purposes. Measures to allow for efficient dissipation of stormwater shall be provided on all plans.

B. Non-residential (Business, Commercial, Industrial)

In non-residential developments, provide a minimum 0.5% slope to provide positive drainage for all unpaved areas. All unpaved areas shall slope continuously at a minimum 0.5% to lower elevations off the lot in accordance with the general requirements for lot grading, or to drainage structures on the lot.

- C. Residential (Single Family, Multi-Family, Townhouse)
Lot grading plans shall be submitted to and approved by the County in order to obtain building permits for construction. Lot grading plans shall be in substantial conformance to the grading shown on approved construction plans. The owner is responsible for the implementation of the lot grading plan. Should an on-site inspection reveal areas of standing water or areas not in accordance with approved plans, improvements or re-grading to provide adequate drainage shall be required. A Certificate of Occupancy may not be issued if an inspection reveals that work has not been completed in accordance with the approved plan.
- D. Lot grading plans shall include the items listed under the "Required attachments" list found on the Erosion and Sediment Control and Chesapeake Bay Permit Application, Form 201, found in the Building Permit Application Package and shall comply with the following criteria:
1. Provide minimum fall of 6 inches from structure in no more than 10 feet, except as restricted by side lot lines or other major considerations, without regard to soil type. Paved areas adjacent to or within 10 feet of the structure need be constructed at an elevation that allows for gravity drainage away from the foundation. The horizontal length of such slopes may be reduced as necessary at building corners and side yards; the 6-inch fall may not be reduced.
 2. Provide a minimum 1% slope to provide drainage by gravity for all disturbed areas. All disturbed areas shall slope continuously at a minimum 1% to lower elevations off the lot, or to drainage structures on the lot.
 3. Slabs on grade shall be higher than exterior grades.

VIII. IMPOUNDMENTS AND EMBANKMENTS

- A. When a permanent dam is proposed within any development, or when an existing dam is affected by development, the County regulates the design and construction of the dam for safety purposes and to prevent wash-outs that may cause downstream siltation or flooding. An existing impoundment is considered "affected" by development when there is any increase in run-off to the impoundment. Ponds located downstream of development will not be considered "affected" if the peak post-development discharge rate to the impoundment is attenuated to pre-development 2, 10, and 100-year flows.

- B. All impoundments shall be designed and inspected by a qualified professional and shall meet the following criteria:
1. All impoundments shall be capable of passing the 10-year storm event through a hardened principal and / or auxiliary spillway. A 100-year storm event shall be conveyed through the combined principal and emergency spillways while maintaining 1-foot of freeboard at the dam embankment. Basins without embankments (completely dug ponds) and impoundments with spillway design floods in excess of the .25 Probable Maximum Flood (PMF) are not required to meet the 1 foot freeboard requirement.
 2. The embankment shall be structurally able to withstand the intended depth of the impoundment.
 3. Impoundment side slopes shall not exceed 2 horizontal to 1 vertical.
 4. In dry impoundments, the basin bottom shall be graded to drain at a minimum 1% slope, from all directions to the outlet structure for vegetated surfaces or 0.25% for facilities with concrete low flow channels.
 5. The professional shall address seepage around the barrel pipe. At a minimum, this requirement shall be addressed by the use of gasketed concrete pipe bedded and backfilled with flowable fill or alternate equivalent approved by the Director.
 6. The qualified professional shall address how the outlet structure is protected from debris and clogging.
 7. The limits of the "Maintenance Agreement" for impoundments and embankments shall be recorded to a point 10 feet past the toe of slope of the embankment and to either the elevation of the maximum design storm or 20 feet landward of the normal pool elevation, whichever is greater. In addition, maintenance agreements must conform to the general requirements of this Handbook.
 8. Following completion, a qualified professional shall prepare a certification stating the embankment and impoundment have been constructed in accordance with the approved plans.

9. All existing impoundments shall be inspected by a qualified professional to assess the structural stability of the embankment and make any recommendations for repairs, if necessary, when affected by development. A report shall be prepared and submitted by the qualified professional detailing the dam condition and including information required by the Director.

IX. STORMWATER MANAGEMENT

- A. All impoundments, embankments or other structures serving as water quality or water quantity control measures additionally shall be designed in accordance with the applicable standards set forth in this Handbook and in the regulations and documents listed in section II of this Handbook.

- B. ~~B.~~—The adequacy of receiving channels shall be analyzed in accordance with the requirements of the Hanover County Stormwater Ordinance, the Hanover County Drainage Design Handbook, ~~and~~ the Hanover County Drainage Ordinance, ~~and~~ applicable state regulations.

~~Discharges from development shall must be determined Pursuant to first meet the requirements set forth in 9VAC25-870-66, and the Discharges must then be evaluated using the permissible velocity requirements of this set forth in this Handbook to determine which is most restrictive, energy balance or permissible velocity. (B)(3)(b), maximum peak flow rate following land disturbing activity shall be calculated in accordance with a methodology other than that set forth in 9VAC25-870-66(B)(3)(a) which is demonstrated by the County to achieve equivalent results and is approved by the SWCB. This methodology is referred to as "Permissible Velocity" and is set forth in section VI of this Handbook. The provisions for 9VAC25-870-66(B)(3)(a) "energy balance formula" set forth in 9VAC25-870-66(B)(3)(a) shall not be permitted unless they are only be used if it is demonstrated to be at least as protective as the permissible velocity requirements of this Handbook. Channel cross-sections and calculations for the downstream receiving channel shall be provided on the plans. Cross sections shall be representative and conservatively selected to represent the worst case erosion condition along the channel, as required by the Director, to a point of analysis within the channel that is one hundred times greater than the contributing drainage area of the project in question or to a point where the flow from the project is one percent or less of the total flow. If permissible velocity is found to be more restrictive than energy balance, then, as a default, an applicant will be deemed to be in~~

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compliance with receiving channel adequacy requirements when the applicant has demonstrated compliance with 9VAC25-870-66, and post-developed peak release rate from the 2-year storm is attenuated to the peak release rate associated with forest in good condition for the contributing project pre-development drainage area, provided the discharge is to a receiving channel.

X. FLOODPLAIN MANAGEMENT

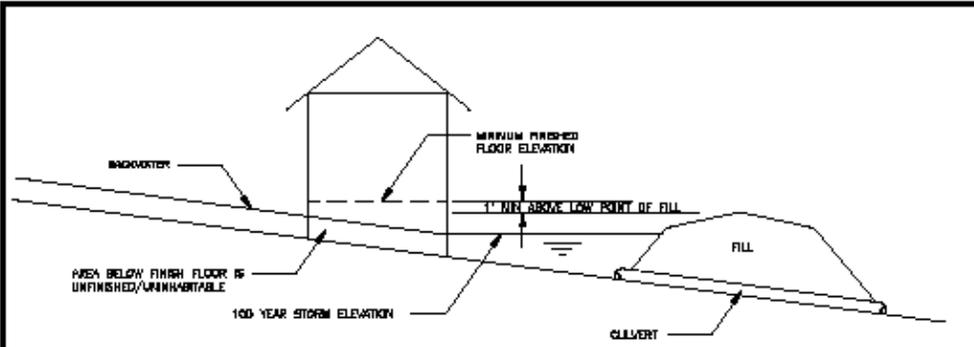
Downstream properties and drainage ways shall be protected from damage from localized flooding due to changes in runoff rate of flow and hydrologic characteristics, including but not limited to, changes in volume, velocity, frequency, duration, and peak flow rate of stormwater runoff in accordance with the Code of Federal Regulations CFR 44, applicable building codes, and the minimum design standards set out in this section.

In addition:

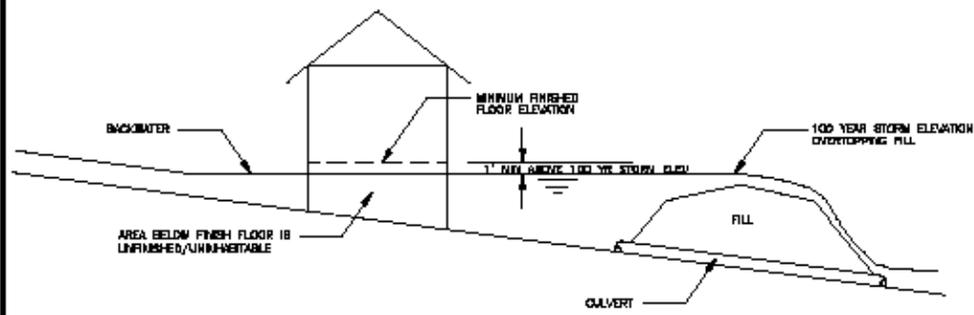
1. The 100-year storm elevation shall be calculated for all culverts and drop inlets located in road sags and other depressed areas. The 100-year elevation shall be shown on plans.
2. Structures within any floodplain or computed 100-year storm elevation area shall clearly demonstrate compliance with floodplain requirements.
3. Residential structures shall be designed and built with a minimum finished floor (habitable) elevation above the 100 year elevation or designed to be outside of these areas. In addition all subfloor insulation materials, electrical and mechanical equipment and appurtenances shall be above or outside this elevation.
4. In cases as shown in Figures G-1(a) and (b) where a permanent structure is proposed upstream of an embankment, impoundment or other fill section, the structure shall have a minimum finished floor elevation 1 foot or more above the low point of the fill.
5. In cases as shown in Figures G-1(A) and (B) where a new fill section, embankment or impoundment is proposed downstream of an existing permanent structure a minimum finished floor elevation 1 foot or more above the low point of the fill shall be maintained.
6. Any fills or grading necessary to elevate the structure shall be shown on the site or subdivision construction plans and building permit.
7. Computations and survey data shall be submitted to demonstrate that the 100-year flood level as the result of proposed improvements for the

developed watershed will not increase the flooding impact for existing structures on adjacent properties.

8. Computations and survey data shall be submitted to demonstrate that proposed improvements will not increase the 100 year flood level for the developed watershed more than 1 foot on adjacent properties.



MINIMUM FINISHED FLOOR ELEVATION
OF STRUCTURE LOCATED UPSTREAM OF FILL SECTION
WHEN 100 YEAR STORM DOES NOT OVERTOP FILL
FIGURE G-1(A)



MINIMUM FINISHED FLOOR ELEVATION
OF STRUCTURE LOCATED UPSTREAM OF FILL
SECTION WHEN 100 YEAR STORM OVERTOPS FILL
FIGURE G-1(B)

HANOVER
DPW

**MINIMUM FINISHED FLOOR ELEVATIONS
TO ADDRESS FLOODING**

DRWG. NO.
G1

XI. AGRICULTURAL IMPOUNDMENTS, CONSERVATION ASSESSMENT AND AGRICULTURAL BEST MANAGEMENT PRACTICES

Agricultural engineering practices, including designs for impoundments and conservation assessment and best management practices shall conform to the United States Department of Agriculture (USDA) Field Office Technical Guide (FOTG) or applicable Agricultural Best Management Practice Cost Share specifications. The practice of engineering as it pertains to agricultural engineering practices is in accordance with standards of practice for engineering under Code of Virginia 54.1.

XII. DRAINAGE EASEMENTS

A. General

1. Storm sewer may enter the public road right of way in order to allow for connections from yards or properties and may leave the right of way for purpose of out-falling. Generally these connections shall be at 90 degree angles to the right of way. Public drainage easements outside the road right of way shall be a minimum 20 feet in width. Wider easements may be required by the Director based on depth of the system and other factors relating to the long term maintenance of the facility.
2. Required landscaping shall generally not be located within drainage easements. If there is no other alternative, landscaping will be permitted within the easement as long as the landscaping does not interfere with the installed drainage system.
3. Dedications and conveyances shall be free of title or other encumbrances interfering with use for the intended purposes, as evidenced by title documentation required by the Director. Public easements shall extend to the limits of the development to allow for future connection. This requirement applies to property boundaries both upstream and downstream of the drainage system.
4. Public easements may be dedicated by recordation of subdivision plat, if approved by the Director.

B. Residential Development

1. Stormwater conveyance systems providing for drainage of a public road shall be contained within the public right of way or within public easements.
2. If fill sections are necessary for construction of road and drainage infrastructure, then this area shall be included within public right of way and slope easements shall not be permitted. The expansion of right of way for cut slopes will not be required unless required by the Virginia Department of Transportation for maintenance acceptance.
3. Private drainage easements shall be recorded prior to subdivision plat recordation and the recordation information noted on the subdivision plat.

C. Non-residential Development

1. A combined public drainage easement and private maintenance agreement, stipulating maintenance by the property owner, shall be required if private drainage is combined with public drainage from a publically maintained roadway, or if the site accommodates surface drainage from off-site properties. If the system accommodates surface drainage from off-site upstream properties, public easements shall be extended to the limits of the development for future connection. Off-site easements shall be recorded prior to plan approval.
2. Fill slopes may be contained within a slope easement, provided that a Maintenance Agreement is recorded in conjunction with the slope easement and shown on the subdivision construction plans or site plan, prior to plan approval.
3. Easements shall be recorded and recordation information noted on site plans prior to DPW site plan approval. Off-site easements shall be recorded prior to site plan or subdivision plan approval.

XIII. MAINTENANCE AGREEMENTS

- A. Maintenance agreements shall be required by the Director for all Best Management Practices (BMPs), Low Impact Development Practice (LID), Environmental Site Design Practice (ESD),

impoundments or embankments or other facility or feature necessitating permanency or long term maintenance when, in the judgment of the Director such agreements are necessary to comply with local, state or federal requirements. These maintenance agreements shall reference a plan or plat that clearly delineates the boundary for the facility and any necessary or anticipated maintenance and access.

- B. A suitable access route and, if necessary, easement shall be provided from a public road to the facility requiring long term maintenance. These routes and / or easements shall be shown on the site plan or construction plan and subdivision plat. The Hanover County "Maintenance Agreement" shall be executed and recorded prior to plan approval. Recordation information shall be noted on the site plan or construction plan and subdivision plat, as applicable.

APPENDIX A

Values of Roughness Coefficient “n” (Uniform Flow)

Type of Channel and Description	Minimum	Normal	Maximum
LINED CHANNELS (Selected linings)			
a. Concrete			
1. Trowel finish	0.011	0.013	0.015
2. Float finish	0.013	0.015	0.016
3. Gunite, good section	0.016	0.019	0.023
b. Asphalt			
1. Smooth	0.013	0.013	-
2. Rough	0.016	0.016	-
c. Riprap (standard VDOT sizes)			
1. Class 1A	0.033	0.038	-
2. Class 1	0.035	0.040	-
3. Class 2	0.037	0.042	-
4. Class 3	0.039	0.045	-
5. Type I	0.041	0.047	-
6. Type II	0.044	0.050	-
EXCAVATED OR DREDGED			
a. Earth, straight and uniform			
1. Clean, recently completed	0.016	0.018	0.020
2. Clean, after weathering	0.018	0.022	0.025
3. Gravel, uniform section, clean	0.022	0.025	0.030
4. With short grass, few weeds	0.022	0.027	0.033
b. Earth, winding and sluggish			
1. No vegetation	0.023	0.025	0.030
2. Grass, some weeds	0.025	0.030	0.033
3. Dense weeds or aquatic plants in deep channels	0.030	0.035	0.040
4. Earth bottom and rubble sides	0.025	0.030	0.035
5. Stony bottom and weedy sides	0.025	0.035	0.045
6. Cobble bottom and clean sides	0.030	0.040	0.050
c. Dragline excavated or dredged			
1. No vegetation	0.025	0.028	0.033
2. Light brush on banks	0.035	0.050	0.060
d. Rock cuts			
1. Smooth and uniform	0.025	0.035	0.040
2. Jagged and irregular	0.035	0.040	0.050
e. Channels not maintained, weeds and brush uncut			
1. Dense weeds, high as flow depth	0.050	0.080	0.120
2. Clean bottom, brush on sides	0.040	0.050	0.080
3. Same, highest stage of flow	0.045	0.070	0.110
4. Dense brush, high stage	0.080	0.100	0.140
NATURAL STREAMS			
1. Minor streams (top width at flood stage <100 ft)			
a. Streams on Plain			
1. Clean, straight, full stage, no rifts or deep pools	0.025	0.030	0.033
2. Same as above, but more stones/weeds	0.030	0.035	0.040
3. Clean, winding, some pools/shoals	0.033	0.040	0.045
4. Same as above, but some weeds/stones	0.035	0.045	0.050
5. Same as above, lower stages, more ineffective slopes and sections	0.040	0.048	0.055
6. Same as 4, but more stones	0.045	0.050	0.060
7. Sluggish reaches, weedy, deep pools	0.050	0.070	0.080
8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush	0.075	0.100	0.150
b. Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages			
1. Bottom: gravels, cobbles and few boulders	0.030	0.040	0.050
2. Bottom: cobbles with large boulders	0.040	0.050	0.070

Values of Roughness Coefficient n (Uniform Flow) continued:

Type of Channel and Description	Minimum	Normal	Maximum
2. Floodplains			
a. Pasture, no brush			
1. Short grass	0.025	0.030	0.035
2. High grass	0.030	0.035	0.050
b. Cultivated area			
1. No crop	0.020	0.030	0.040
2. Mature row crops	0.025	0.035	0.045
3. Mature field crops	0.030	0.040	0.050
c. Brush			
1. Scattered brush, heavy weeds	0.035	0.050	0.070
2. Light brush and trees, in winter	0.035	0.050	0.060
3. Light brush and trees, in summer	0.040	0.060	0.080
4. Medium to dense brush, in winter	0.045	0.070	0.110
5. Medium to dense brush, in summer	0.070	0.100	0.160
d. Trees			
1. Dense Willows, summer, straight	0.110	0.150	0.200
2. Cleared land with tree stumps, no sprouts	0.030	0.040	0.050
3. Same as above, but with heavy growth of sprouts	0.050	0.060	0.080
4. Heavy stand of timber, a few down trees, little undergrowth, flood stage below branches	0.080	0.100	0.120
5. Same as above, but with flood stage reaching branches	0.100	0.120	0.160
3. Major Streams (top width at flood stage > 100 ft)			
The n-value is less than that for minor streams of similar description, because banks offer less effective resistance.			
a. Regular section with no boulders or brush	0.025	-	0.060
b. Irregular and rough section	0.035	-	0.100

* For bare earth linings when the soil classifications in accordance with either AASHTO or USCS designations are known, use the Manning's "n" values recommended in the preceding tables

Source: VDOT Drainage Manual*

APPENDIX B

Maximum Permissible Water Velocities as a Function of Soil Type based on the AASHTO Classification:

AASHTO Classification	AASHTO Soil Description	Fortier and Scobey Soil Description	Maximum Water Velocity (ft/s)
	BROKEN ROCK and COBBLES	Cobbles and Shingles	5.5
A-1-a	Stone fragments or GRAVEL , with or without well-graded 1 binder ²	Coarse gravel, non- colloidal	4.5
A-1-a	Stone fragments or GRAVEL , with or without well-graded 1 binder ²	Fine gravel	3.5
A-1-b	Coarse SAND , with or without well- graded 1 binder ²	Graded loam to cobbles when non- colloidal	4.0
A-2 (A-2.4, A-2.5, A-2.6, A-2.7)	Mixture of GRAVEL and SAND , with silty or clay fines ³ , or nonplastic silt fines	Graded silts to cobbles when colloidal	4.5
A-2 (A-2.4, A-2.5, A-2.6, A-2.7)	Mixture of GRAVEL and SAND , with silty or clay fines ³ , or nonplastic silt fines	Sandy loam, non- colloidal	2.0
A-3	Fine SAND , without silty clay fines; e.g. beach sand or stream-deposited fine sand	Fine Sand, non- colloidal	1.5
A-3	Fine SAND , without silty clay fines; e.g. beach sand or stream-deposited fine sand	Silt loam, non- colloidal	2.3
A-4	Non- to moderately plastic ⁴ SILT ; mixtures of silt, sand, and/or gravel, with a minimum silt content of 36%	Alluvial silts, non- colloidal	2.3
A-5	Moderately to highly plastic ⁴ SILT . Soil; mixtures of silt, sand, and/or gravel, with a minimum fines ³ content of 36%	Ordinary firm loam	2.5
A-6	Plastic ⁴ CLAY soil; mixtures of clay, sand, and/or gravel, with a minimum fines ³ content of 36%	Alluvial silts, colloidal	3.5
A-7	Moderately to highly plastic, CLAY ; mixtures of clay, sand, and/or gravel, with a minimum clay content of 36%	Stiff clay, very colloidal	4.0

**Maximum Permissible Water Velocities as a Function of
Soil Type based on the Unified Soil Classification
System (USCS):**

USCS Classification	USCS Soil Description	Fortier and Scobey Soil Description	Maximum Water Velocity (ft/s)
BROKEN ROCK and COBBLES	Cobbles and Shingles		5.5
GP, GW, SW, SP	Poorly graded gravel, well graded gravel, well graded sand, poorly graded sand	Coarse gravel, non-colloidal	4.5
		Fine gravel	3.5
SW	Well graded sand	Graded loam to cobbles when non-colloidal	4.0
GC, SC	Clayey gravel, clayey sand	Graded silts to cobbles when colloidal	4.5
SM	Silty sand	Sandy loam, non-colloidal	2.0
SP, SW	Poorly graded sand, well graded sand	Fine Sand, non-colloidal	1.5
ML	Silt	Silt loam, non-colloidal	2.3
CL	Lean clay	Alluvial silts, non-colloidal	2.3
ML, CL	Silt, lean clay	Ordinary firm loam	2.5
CL	Lean clay	Alluvial silts, colloidal	3.5
CH	Fat clay	Stiff clay, very colloidal	4.0