

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

SECTION 1. OVERVIEW

Henrico County's Chickahominy River Benthic TMDL Action Plan for the Chickahominy River addresses the wasteload allocation (WLA) for sediment that is associated with the approved TMDL for the County (see Section 3 of the Plan). The Plan has been developed in accordance with the requirements of the County's MS4 Permit and the applicable recommendations contained in the *TMDL Action Planning for Local Total Maximum Daily Loads as Required in the Small MS4 General Permit (VAR04) Effective July 1, 2013 and MS4 Individual Permits (Guidance)*, distributed by the Virginia Department of Environmental Quality dated November 21, 2016 .

As stated in the Guidance,

This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does not mandate any particular method nor does it prohibit any particular method for the analysis of data, establishment of a wasteload allocation, or establishment of a permit limit. If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.

The Guidance also states

Beyond illicit discharges, existing programmatic practices, ordinances, and outreach currently in place under the MS4 program may be sufficient to address anthropogenic sources of bacteria. For these TMDLs, permittees are encouraged to consider practices such as public outreach and education to influence behaviors. This may include signage and supplies to encourage the collection and removal of pet waste at areas of high concentration, such as dog parks; residential outreach through fliers or pamphlets included with utility bills; and other education programs.

As such, the Plan reflects the requirements of the County's MS4 Permit and any recommendations described in the Guidance that are appropriate.

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

SECTION 2. MS4 PERMIT LANGUAGE

PART I.D. TMDL ACTION PLAN AND IMPLEMENTATION

2. TMDL Action Plans other than the Chesapeake Bay TMDL

a) TMDL Action Plan Development

The permittee shall maintain an updated MS4 Program Plan that includes TMDL Action Plans for pollutants in which wasteloads have been allocated to the MS4 in approved TMDLs. Approved TMDLs as of the effective date of this state permit are included in Attachment A of this state permit. TMDL Action Plans may be implemented in multiple phases over more than one permit cycle using the adaptive iterative approach provided adequate progress is made to reduce pollutant discharges in a manner that is consistent with the assumptions and requirements of the applicable TMDL. Progress shall be demonstrated by representative and adequate monitoring or other methods (e.g. modeling) as described in Part I.D.2.b)5) below. These TMDL Action Plans shall identify the best management practices and other interim milestone activities to be implemented during the remaining term of this state permit. The plan shall include an estimated end date for achieving the applicable wasteload allocations and, for planning purposes, a projection of BMPs and other implementation steps expected to address the WLA, outside of the permit term, as applicable.

- 1) No later than 24 months after the effective date of this state permit, the permittee shall submit to the Department TMDL Action Plans to address any new or modified requirements established under this Special Condition for pollutants identified in TMDL wasteload allocations approved prior to the effective date of this state permit.
- 2) The TMDL Action Plans shall become effective and enforceable upon written notification from the Department.
- 3) The TMDL Action Plans shall be incorporated by reference into this state permit.

b) TMDL Action Plan content

The permittee shall:

- 1) Develop and maintain a list of its legal authorities such as ordinances, permits, order, specific contract language, and inter-jurisdictional agreements applicable to reducing the pollutant identified in a WLA;
- 2) Identify and maintain an updated list of all additional management practices, control techniques and system design and engineering methods, beyond those identified in Part I.B of this state permit, that have been implemented as

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

- part of the MS4 Program Plan that are applicable to reducing the pollutant identified in the WLA;
- 3) Enhance the public education and outreach and employee training programs to also promote methods to eliminate and reduce discharges of the pollutants identified in the WLA;
 - 4) Assess all significant sources of pollutant(s) from facilities of concern owned or operated by the MS4 operator that are not covered under a separate VPDES industrial stormwater permit and identify all municipal facilities that may be a significant source of the identified pollutant. For the purpose of this assessment, a significant source of pollutant(s) from a facility of concern means a discharge where the expected pollutant loading is greater than the average pollutant loading for the land use identified in the TMDL. (For example, a significant source of pollutant from a facility of concern for a bacterial TMDL would be expected to be greater at a dog park than at other recreational facilities where dogs are prohibited);
 - 5) Develop and implement a method to assess TMDL Action Plans for their effectiveness in reducing the pollutants identified in the WLAs. The evaluation shall use any newly available information, representative and adequate water quality monitoring results, or modeling tools to estimate pollutant reductions for the pollutant(s) of concern from implementation of the MS4 Program Plan. Monitoring may include BMP, outfall, or instream monitoring, as appropriate, to estimate pollutant reductions. The permittee may conduct monitoring, utilize existing data, establish partnerships, or collaborate with other MS4 permittees or other third parties, as appropriate. This evaluation shall include assessment of the facilities identified in Part I.D.2.b)4) above. The methodology used for assessment shall be described in the TMDL Action Plan.
 - 6) Solicit public input on the draft TMDL Action Plan and consider public comments in development of the final TMDL Action Plan that is submitted to the Department for review and approval.
- c) This state permit shall be modified or alternatively revoked and reissued if any approved wasteload allocation procedure, pursuant to Section 303(d) of the Clean Water Act, imposes wasteload allocations, limits or conditions on the treatment works that are not consistent with the permit requirements.
 - d) Analytical methods for any monitoring shall be conducted according to procedures approved under 40 CFR Part 136 or alternative methods approved by the Environmental Protection Agency (EPA). Where an approved 40 CFR Part 136 method does not exist, the permittee shall use a method consistent with the TMDL.

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

- e) The permittee is encouraged to participate as a stakeholder in the development of any TMDL implementation plans applicable to their discharge. The permittee may incorporate applicable best management practices identified in the TMDL implementation plan in the MS4 Program Plan.
- f) Annual Reporting Requirements.
 - 1) The permittee shall submit the required TMDL Action Plans to the Department for review and acceptance with the annual report due March 31, 2017.
 - 2) Beginning with the annual report due March 31, 2018, the permittee shall report on the implementation of the TMDL Action Plans and associated evaluation including the results of any monitoring conducted as part of the evaluation.
- g) The permittee shall identify the best management practices and other steps that will be implemented during the next permit term as part of the permittee's reapplication for coverage as required under Part II.M. The permittee shall also evaluate and modify the estimated end date for achieving the applicable wasteload based on information acquired during the permit cycle.

SECTION 3. APPLICABLE SEDIMENT WASTELOAD ALLOCATION AND REDUCTION REQUIREMENTS

Wasteload Allocation (tons/year)	Watershed(s)	TMDL Report	EPA Approval Date	SWCB Approval Date
202.68	Chickahominy River and Tributaries	Benthic TMDL Development Chickahominy River, VA	11/7/2013	3/28/2014

From **Attachment A: Applicable TMDL Wasteload Allocations** in the County's MS4 Permit

Based on the best available data, the land coverage within the watershed subject to the TMDL is as follows:

Source	Existing Acres in the Current MS4 Service Area ¹ subject to the TMDL	Percentage of Regulated Areas within the Overall Watershed
Henrico Regulated Urban Impervious ²	1,562.14	92%

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

Henrico Regulated Urban Pervious ³	1,785.49	
VDOT Regulated Urban Impervious ⁴	168.46	8%

- ¹ See Attachment 1
- ² See Attachment 2
- ³ See Attachment 2
- ⁴ See Attachment 2

Since the published wasteload allocation is an aggregate between the County's MS4 and VDOT's MS4, a similar percentage breakdown is used to determine the County's allocation – 372,931.20 lbs/year (92% of 202.68 tons/year).

Sediment reductions needed to comply with the TMDL were calculated using the loading rates specified in the MS4 Permit for regulated impervious and pervious lands and comparing these loads to the County's allocation.

Source	Existing Acres in the Current MS4 Service Area subject to the TMDL	Loading Rate (lbs/acre/year)	Total Load Generated by the Regulated Areas in the MS4 Service Area (lbs/year)
Henrico Regulated Urban Impervious	1,562.14	676.94	1,057,475
Henrico Regulated Urban Pervious	1,785.49	101.08	180,477
Total			1,237,952

Therefore, the County must achieve an overall sediment reduction of 865,021 lbs/year (1,237,952 – 372,931). This will be accomplished over the course of the next five permit cycles (by 2040).

SECTION 4 SEDIMENT TMDL PLANNING

Henrico County's sediment TMDL Action Plan addresses the following:

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

SECTION 4.1 LEGAL AUTHORITY

Develop and maintain a list of its legal authorities such as ordinances, permits, order, specific contract language, and inter-jurisdictional agreements applicable to reducing the pollutant identified in a WLA.

Henrico has reviewed its current MS4 Program Plan and has determined that the legal authorities as stated in the current MS4 Program Plan are sufficient for compliance with this special condition. Please refer to Part I.A.3 of the MS4 Program Plan for a listing of the legal authorities.

SECTION 4.2 MANAGEMENT PRACTICES, CONTROL TECHNIQUES, AND METHODS

Identify and maintain an updated list of all additional management practices, control techniques and system design and engineering methods, beyond those identified in Part I.B of this state permit, that have been implemented as part of the MS4 Program Plan that are applicable to reducing the pollutant identified in the WLA

Erosion and Sediment Control (ESC) Program

In 2009, the Virginia Department of Conservation and Recreation determined the County's ESC program was consistent with the Virginia ESC Law (§ 62.1-44.15:51 et seq. of the State Code) and Regulations (9VAC25-840). This program continues to be administered and implemented in accordance with the requirements of the state law and regulations.

Stormwater Management (SWM) Program

In 2014, the Virginia Department of Environmental Quality determined the County's SWM program was consistent with the SWM Act (§ 62.1-44.15:24 et seq. of the State Code) and the Virginia Stormwater Management Regulations (9VAC25-870 et seq.). This program continues to be administered and implemented in accordance with the requirements of the state law and regulations.

Illicit Discharge Detection and Elimination (IDDE) Program

The County continues to implement an IDDE program in accordance with the requirements of its MS4 Permit to locate and eliminate illicit discharges and

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

improper disposal into the MS4. This program is described in Part I.B.2.e of the MS4 Program Plan and implementation details are provided in the Part I.B.2.e Annual Report Supplements.

SWM Facility and Municipal Separate Storm Sewer System (MS4) Infrastructure Inspection and Maintenance Programs

The County continues to inspect 1) SWM facilities (both public and private) that discharge to the MS4 and 2) MS4 infrastructure (inlets, junctions, manholes, end treatments, and channels, pipes, etc.) in accordance with the requirements of its MS4 Permit. When necessary, maintenance of these facilities and infrastructure is addressed. These programs are detailed in Part I.B.2.h of the MS4 Program Plan and implementation details are provided in the Part I.B.2.h Annual Report Supplements.

The following management practices with quantifiable sediment reductions have also been implemented in the watershed:

Mean / Method	Type	Applicable Reductions (lbs)	Anticipated / Completion Date
		TSS	
BMPs Installed between January 1, 2006 and June 30, 2009 ⁵	Stormwater Compliance BMPs	6,436.30	Complete
Energy Dissipators installed prior to June 30, 2014 that weren't previously claimed ⁶	Additional Outfall Treatment	21,694.38	Complete
TOTAL		28,130.68	

⁵ See Attachment 3

⁶ See Attachment 4

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

SECTION 4.3 PUBLIC EDUCATION, PUBLIC OUTREACH, AND EMPLOYEE TRAINING

Enhance the public education and outreach and employee training programs to also promote methods to eliminate and reduce discharges of the pollutants identified in the WLA.

Henrico County conducts various public education and outreach and employee training programs that promote a reduction of sediments discharges throughout the County. These efforts include programs such as:

ESC Preconstruction Meeting DVDs

The County distributes an informational DVD to Responsible Land Disturbers (RLD) and contractors at preconstruction meetings. The DVD explains proper installation and maintenance of Erosion and Sediment Control practices during construction of regulated land disturbing activities.

Public Outreach addressing drainage and erosion concerns / back yard stream erosion

Henrico County responds to citizen complaints related to drainage and erosion concerns, and backyard stream erosion. During site visits, citizens are provided with information on vegetative and structural controls. Any issues within the county drainage easement are addressed by County staff.

Staff training for IDDE

To address training requirements of Part I.B.2.k of the MS4 Permit, the County provides training sessions twice a year for appropriate County personnel for:

- 1) the recognition and reporting of illicit discharges, and
- 2) good housekeeping on and around municipal facilities.

Municipal Site Inspection Team

A Stormwater Inspection Team was established in 2013 to educate County staff regarding good municipal site housekeeping. The team is comprised of representatives from Recreation and Parks, General Services, Public Utilities, Fire, Public Works and Public Schools. The Stormwater Inspection Team meets monthly and inspects one municipal facility each month. The inspections will also serve as a

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

learning experience so team members become familiar with what is expected on all municipal facilities. Team members then conduct the needed inspections of the required facilities for which their Department or Division is responsible.

Pamphlets for Proper Disposal of Yard Waste

Residential Leaf Collection Services pamphlets are distributed annually to all Henrico Utility customers. The pamphlets include a leaf collection schedule, alternative methods for proper disposal of yard debris, and cautions to prevent yard debris from obstructing roads and stormwater drainage.

Individual letters are also sent to citizens in the event that yard debris is found to be dumped in the County's ROW and/or storm sewer system. The letters inform citizens that the dumping of yard debris in the storm sewer is a violation of County Code and state that it is unlawful to "cause or allow illicit discharges to the County's storm sewer system" or "discharge materials other than stormwater to the storm sewer system by spills, dumpings or disposal." Citizens are informed of the impacts caused by dumping yard debris and given information on proper disposal.

SECTION 4.4 ASSESS SIGNIFICANT SOURCES OF POLLUTANTS

Assess all significant sources of pollutant(s) from facilities of concern owned or operated by the MS4 operator that are not covered under a separate VPDES industrial stormwater permit and identify all municipal facilities that may be a significant source of the identified pollutant. For the purpose of this assessment, a significant source of pollutant(s) from a facility of concern means a discharge where the expected pollutant loading is greater than the average pollutant loading for the land use identified in the TMDL. (For example, a significant source of pollutant from a facility of concern for a bacterial TMDL would be expected to be greater at a dog park than at other recreational facilities where dogs are prohibited)

All Henrico County properties were assessed in the MS4 Municipal Management Area (MMA) System described in Part I.B.2.i of the MS4 Program Plan. These assessments did not reveal any significant sources of sediment from facilities of concern owned or operated by the County of Henrico that are not covered under a separate VPDES permit.

SECTION 4.5 MEANS AND METHODS TO ASSESS TMDL ACTION PLAN

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

Develop and implement a method to assess TMDL Action Plans for their effectiveness in reducing the pollutants identified in the WLAs. The evaluation shall use any newly available information, representative and adequate water quality monitoring results, or modeling tools to estimate pollutant reductions for the pollutant(s) of concern from implementation of the MS4 Program Plan. Monitoring may include BMP, outfall, or in-stream monitoring, as appropriate, to estimate pollutant reductions. The permittee may conduct monitoring, utilize existing data, establish partnerships, or collaborate with other MS4 permittees or other third parties, as appropriate. This evaluation shall include assessment of the facilities identified in Part I.D.2.b)4) above. The methodology used for assessment shall be described in the TMDL Action Plan.

An evaluation of the activities conducted during the permit year will be included in the annual report and will consider the implementation details of the programs. Appropriate results of the In Stream Monitoring program required by Part I.C.2 of the MS4 Permit will be considered in developing the evaluations. In addition, the status of proposed watershed projects that are expected to result in quantifiable sediment reductions will be provided. Evaluations of County owned/operated facilities are conducted in accordance with MMMA System described in Part I.B.2.i of the MS4 Program Plan.

SECTION 4.6 SOLICIT PUBLIC COMMENTS

Solicit public input on the draft TMDL Action Plan and consider public comments in development of the final TMDL Action Plan that is submitted to the Department for review and approval.

A draft of this Chickahominy River Benthic TMDL Action Plan was posted on the County's website for two weeks and an opportunity for public comment was provided.

No comments were received.

SECTION 4.7 ANNUAL REPORTING REQUIREMENTS

Annual Reporting Requirements

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

- 1) **The permittee shall submit the required TMDL Action Plans to the Department for review and acceptance with the annual report due March 31, 2017.**

Noted.

- 2) **Beginning with the annual report due on March 31, 2018, the permittee shall report on the implementation of the TMDL Action Plans and associated evaluation including the results of any monitoring conducted as part of the evaluation.**

In addition to the individual program evaluations mentioned in Section 4.5, implementation details will be included in the MS4 Annual Reports beginning with the annual report due March 31, 2018. The details will be provided in the following format:

BMPs, Programs, and/or Projects Implemented during the MS4 Permit Year	Implementation Details (information such as number, location, status, estimated sediment reduction, etc.)

SECTION 4.8 PLANS FOR THE NEXT PERMIT CYCLE

The permittee shall identify the best management practices and other steps that will be implemented during the next permit term as part of the permittee's reapplication for coverage as required under Part II.M. The permittee shall also evaluate and modify the estimated end date for achieving the applicable wasteload based on information acquired during the permit cycle.

Noted.

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

**ATTACHMENT 1
MS4 SERVICE AREA**

SECTION 1. OVERVIEW

The MS4 Service Area is the land area that drains into and through the County's MS4 infrastructure. There are both privately-owned and publicly-owned lands within the County's MS4 Service Area. The publicly-owned land consists of local, state and federal properties and rights-of-way.

SECTION 2. DELINEATION

The limits of the County's MS4 Service Area were determined by delineating the drainages areas to each outfall the County owns and/or operates. These drainage areas were then aggregated into the MS4 Service Area. As required by the County's MS4 Permit, the current delineation of the MS4 Service Area was delivered to DEQ in September of 2016.

For purposes of calculating the pollutant load reductions required during the first MS4 Permit cycle for the Chesapeake Bay TMDL, the MS4 Service Area as of June 30, 2009 is required (see Table 2 of the MS4 Permit). In order to develop the MS4 Service Area as it existed in June of 2009, certain individual drainage areas were excluded from the current MS4 Service Area. These excluded areas included drainage areas associated with MS4 infrastructure that was approved for construction after June 30, 2009 and infrastructure that had been installed but not accepted by the County prior to June 30, 2009.

There are approximately 156,800 acres located within the boundaries of Henrico County.

As of December 2016, approximately 50,314 acres of the County were located within the MS4 Service Area.

As of June 2009, approximately 49,284 acres of the County were located within the MS4 Service Area. Of these 49,284 acres, approximately 3,348 acres are within the watershed subject to the Chickahominy River Benthic TMDL. There are also

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

approximately 168 acres of impervious cover within the VDOT ROW in the watershed.

ATTACHMENT 2

REGULATED URBAN IMPERVIOUS AND PERVIOUS AREAS

SECTION 1. OVERVIEW

Calculating the pollutant reduction requirements associated with the Chickahominy River Benthic TMDL requires the *regulated impervious* acreage and the *regulated pervious* acreage within the MS4 Service Area as of June 30, 2009. In the absence of a data set depicting land cover as of June 30, 2009, several land use data sets were used to estimate the required acreages.

SECTION 2. APPLICABLE LAND COVER DATA SETS

2008 Henrico Land Cover Data Set

The 2008 land cover data set was created from the 2008 planimetric data. The following is from the 2008 planimetric metadata. "Planimetric features" are collected and updated from the digital orthophotography. They were collected in MicroStation and exported out as DGN or DWG (CAD) files. These were then converted to ESRI shapefiles and finally to ESRI coverages for editing and final attribution. The finished coverages were then used to load the ESRI geodatabase feature classes."

The land cover data consists of four feature classes;

- a. *Water* was generated from the waterbodies feature class a representation of any water feature equal to or greater than three feet wide. Meaning any stream three feet or wider is contained in the feature class.
- b. *Trees* was generated from the trees feature class which is any tree covered area equal to or greater than fifty square feet. The tree cover in the landcover data took only tree covered areas equal to or greater than ninety square meters. For the tree covered areas less than ninety square meters the data was assigned the neighboring coverage designation. If the small tree covered area was surrounded by other or impervious it took on that designation.
- c. *Impervious* was derived from the buildings, driveways, parking, and roads feature classes. The roads and parking lots that had any landscape islands or divided roads median strips were added to the other land cover feature class.

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

- d. *Other* was the remainder of the above process. Any area that was not covered by water, trees, buildings, driveways, parking, and roads became other.

2011 Henrico Land Cover Data Set

The 2011 land cover data set was created from the 2011 planimetric data. The following is from the 2011 planimetric metadata.

Buildings, Driveways, Parking, Roads

Planimetric features are collected and updated from the digital orthophotography. They are collected in MicroStation and exported out as DGN or DWG (CAD) files. These are then converted to ESRI shapefiles and finally to ESRI coverages for editing and final attribution. The finished coverages are then used to load the ESRI geodatabase feature classes.

Waterbodies (Compiled from Lidar)

Using MARS software Hydrologic features (streams, rivers and lakes) are compiled in a 3d environment. These features are used in both the breaklines feature class (3d) and the waterbodies feature class (2d). ESRI shape files are created and these are imported into the geodatabase feature class.

Trees (Compiled from Lidar)

Using MARS software tree polygons larger than 50 square feet were created from the lidar dataset. ESRI shape files were created by tiles which were then merged together and dissolved to create the final geodatabase feature class.

The land cover data consists of four feature classes;

- a. *Water* was generated from the waterbodies feature class which is a representation of any water feature equal to or greater than three feet wide. Meaning any stream three feet or wider is contained in the feature class.
- b. *Trees* was generated from the trees feature class which is any tree covered area equal to or greater than fifty square feet. The tree cover in the landcover data took only tree covered areas equal to or greater than ninety square meters. For the tree covered areas less than ninety square meters the data was assigned the neighboring coverage designation. If the small tree covered area was surrounded by other or impervious it took on that designation.

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

- c. *Impervious* was derived from the buildings, driveways, parking, and roads feature classes. The roads and parking lots that had any landscape islands or divided roads median strips were added to the other land cover feature class.
- d. *Other* is the remainder of the above process. Any area that was not covered by water, trees, buildings, driveways, parking, and roads became other.

2014 Virginia Statewide Land Cover Data Set

The Virginia Statewide 2014 land cover data set was created, in part, from the 2011-2014 VBMP 4-band orthophotography. Resolution is provided at 1 meter and produced in both raster and vector formats using Textron Systems Feature Analyst Software for ESRI. The following is from the 2014 Technical Plan of Operations document Version 7 dated May 6, 2016.

The four classes used to develop area measurements are below.

Water: This classification includes all areas of open water; typically 25 percent or greater pixel cover of water, and all areas characterized by perennial cover of ice/snow as defined by the EPA. Includes drainage network and basins such as rivers, streams, lakes, canals, waterways, reservoirs, ponds, bays, estuaries, and ocean as defined by the NHD. Only features greater than 1 acre in size will remain in this classification.

Impervious: This classification includes areas characterized by a high percentage of constructed materials such as asphalt and concrete, buildings and parking lots, and infrastructure such as roads and rail-roads as defined by the EPA.

Turf Grass: This classification includes vegetation (primarily grasses) planted in developed settings for erosion control or aesthetic purposes, as well as natural herbaceous vegetation and undeveloped land, including upland grasses and forbs, as defined by the EPA. Examples include but are not limited to recreational areas, lawns, and vacant lands. Any grasses or managed turf that fall into this description will be included if the land is less than 1 acre in size, or visually determined to be recreational from the imagery.

Other: Includes all remaining land cover classifications, including Forest, Scrub/Shrub, Agriculture, Wetlands, and Barren.

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

Methodologies for Determining Land Cover classes:

Water: These are polygonal features representing open water features. Existing National Hydrology Dataset (NHD) data will be delivered as an overlay to the full dataset. This overlay will include flow polylines that will be buffered based on a general 15ft representation of perennial stream features. The Eliminate tool will be ran against the Feature Analyst hydrography output to reclassify incorrect and smaller features of this type to the closest competing feature classification of the greatest size. This will ensure that shadows from buildings will dissolve into the surrounding land features, while anomalies of green and brown land that may have been misclassified as water be corrected to forest or turf. The minimum area criteria will decide which extracted features stay in the dataset. VGIN DTM Data will also be analyzed for capability in filtering of potential water surfaces using a terrain deviation parameter (e.g., filtering features with a deviation from the terrain of <1 meter).

Impervious: Impervious and Building layers were originally created separately in order to utilize the Feature Analyst Building Toolkit to extract more precise footprints for localities that did not already maintain them. These two feature classifications will be combined grouping all impervious features together. The next step to developing the impervious features will be the input of existing vector data sources. Feature Analyst impervious surface features will be supplemented with available local, regional and state basemap data by erasing and appending these datasets to the extracted output. This will ensure that the land cover data represent impervious surfaces regardless of overhanging tree canopy. Where vector features provide a more accurate representation of impervious surfaces for any given feature, we will defer to this source. Where they are less accurate or not available we will defer to the spectral classification method for the impervious feature.

Turf Grass: Turf Grass will start as a set of training samples that define those non-forested and non-agricultural areas of flat land into large classifications including spectral variation between yellows, greens, and browns. Any attempt to distinguish between what is actually agricultural, turf, etc. within the image extraction process ends up as blended results, so although this class will also capture agricultural land, these areas will be removed later on as they are processed first. Areas that are extracted in this classification that are greater than

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

or equal to 2 acres will, and are within parcels greater than 3 acres, will be reevaluated as possible reclassification into Pasture. For those areas where parcel data is unavailable, all features meeting the size threshold will be reviewed. There will be a stage of manual cleanup for falsely identified features.

Other: After the three previous classes (water, impervious and turf grass) have been extracted, the remaining classes are grouped into the Other category. The previously referenced document outlines specific criteria for each.

SECTION 3. REGULATED IMPERVIOUS ACREAGE SERVED BY THE MS4 SERVICE AREA AS OF JUNE 30, 2009

Using the available land cover data sets described above and the 2009 MS4 Service Area described in Attachment 1, the various acreages for impervious cover were developed:

Impervious Cover

Available Land Cover Data Sets	Acreage within the MS4 Service Area as of June 30, 2009	Notes
2008 Henrico Land Cover Data Set	14,310.85	includes 233.96 acres within VDOT rights-of-way
2011 Henrico Land Cover Data Set	14,476.65	includes acreage within VDOT rights-of-way
2014 Virginia Statewide Land Cover Data Set	17,253.64	includes acreage within VDOT rights-of-way

A linear interpolation between the 2008 and 2011 data results in a value 14,421.12 acres of impervious land cover within the MS4 Service Area as of June 30, 2009. Of this area, 14,187.16 acres (14,421.12 less 233.96 acres regulated by VDOT) are regulated by the County through its MS4 Permit. Of these 14,187.16 acres, approximately 1,562 acres are within the watershed subject to the Chickahominy River Benthic TMDL.

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

SECTION 4. REGULATED PERVIOUS ACREAGE SERVED BY THE MS4 SERVICE AREA AS OF JUNE 30, 2009

Pervious Cover

Available Land Cover Data Sets	Acreage within the MS4 Service Area as of June 30, 2009	Notes
2008 Henrico Land Cover Data Set		Data is not available to determine the extent of pervious (turf) land cover
2011 Henrico Land Cover Data Set		Data is not available to determine the extent of pervious (turf) land cover
2014 Virginia Statewide Land Cover Data Set	17,529.11	

Since only the 2014 Virginia Statewide Land Cover Data Set includes a turf feature class, **17,529.11 acres** is used as an estimate of the pervious area within the MS4 Service Area as of June 30, 2009 that is regulated by the County through its MS4 Permit. This results in an overestimation of the required value. Of these 17,529.11 acres, approximately 1,785 acres are within the watershed subject to the Chickahominy River Benthic TMDL.

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

ATTACHMENT 3
BMPS INSTALLED BETWEEN
JANUARY 1, 2006 AND JUNE 30, 2009

SECTION 1. OVERVIEW

In accordance with the Chesapeake Bay TMDL Guidance document distributed by DEQ on May 18, 2015:

All permittees may receive credit for any stormwater quality BMPs installed between Jan 1, 2006 and June 30, 2009 within the MS4 service area if the permittee provides a full historical accounting, to the maximum extent practical, of BMPs in their jurisdiction.

The guidance document also states:

To receive credit for previously unreported BMPs installed on or after January 1, 2006 and prior to July 1, 2009, permittees will need to include the following in their Action Plan:

- 1. An affirmative statement that a complete list, to the maximum extent practicable, of historical BMPs was or will be submitted to the Department by September 1, 2015. Permittees may submit this data as part of the "Historical Data Clean-Up" effort that is currently ongoing.*
- 2. Appropriate calculations for the BMPs that the permittee is claiming for credit towards its required POC load reductions.*

As requested, the County's full historical accounting of BMP data was submitted to DEQ in September of 2015. This submission included all the facilities in the County, both in and outside the MS4 Service Area.

The following pollutant removal evaluation includes those BMPs that are within the MS4 Service Area that were installed between January 1, 2006 and June 30, 2009 in the watershed subject to the Chickahominy River Benthic TMDL.

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

SECTION 2. LOCATION

As stated above, the BMPs included in this evaluation are located within the MS4 Service Area in the watershed subject to the Chickahominy River Benthic TMDL.

SECTION 3. STATUS

Each of the BMPs included in this evaluation were brought online between January 1, 2006 and June 30, 2009 and continue to be maintained and operated as approved.

SECTION 4. POLLUTANT LOAD REDUCTIONS

Calculating the pollutant load reductions achieved by the BMPs brought online between January 1, 2006 and June 30, 2009, requires removal efficiencies for the various types of BMPs. The historical BMPs within the MS4 Service Area were grouped based on BMP types from Table V.C.1 – Chesapeake Bay Program BMPs, Established Efficiencies in the TMDL Guidance.

Chesapeake Bay Program BMP Type	County BMP Type
Wet Ponds and Wetlands	Retention basin
Filtering Practices	Filterra
	Stormwater360

The removal efficiencies for these Chesapeake Bay Program BMPs are:

Chesapeake Bay Program BMP Type	Removal Efficiencies
	TSS
Wet Ponds and Wetlands	60%
Filtering Practices	80%

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

Based on the BMP design data, the total drainage area and impervious and pervious areas served by these BMPs are:

Chesapeake Bay Program BMP Type	Acres Served		
	Drainage Area	Impervious Area	Pervious Area
Wet Ponds and Wetlands	17.60	10.1	7.50
Filtering Practices	5.35	3.14	2.21

The pollutant loads generated by these areas are calculated using the 2009 EOS Loading Rates for the James River Basin from Table 1 in the MS4 Permit.

2009 EOS Loading Rates (lbs/acre/year)	
Source	TSS
Urban Impervious	676.94
Urban Pervious	101.08

Pollutant Loading to BMPs	
Chesapeake Bay Program BMP Type	TSS
Wet Ponds and Wetlands	7,595.19
Filtering Practices	2,348.98

Application of the removal efficiencies identified previously from Table V.C.1 – Chesapeake Bay Program BMPs, Established Efficiencies in the TMDL Guidance yields the following load reductions for the BMPs that are within the MS4 Service Area that were installed between January 1, 2006 and June 30, 2009

Pollutant Loading Removed by BMPs	
Chesapeake Bay Program BMP Type	TSS
Wet Ponds and Wetlands	4,557.12
Filtering Practices	1,879.18

HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN

TOTAL	6,436.30
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SECTION 5. COST

The cost associated with these BMPs is unknown.

ATTACHMENT 4
ENERGY DISSIPATORS INSTALLED BETWEEN
JANUARY 1, 2006 AND JUNE 30, 2014

SECTION 1. OVERVIEW

Since 2001, the County has required the installation of Energy Dissipators at select stormwater outfalls as a requirement of the development process in addition to meeting the required pollutant removal requirement associated with the proposed impervious cover. The County's Energy Dissipator is also listed as an acceptable alternative to Virginia DEQ Stormwater Design Specification No. 2 – Sheet Flow to a Vegetated Filter Strip or Conserved Open Space and as of July 1, 2014 is an approved BMP for complying with the pollutant removal requirement dictated by Virginia's stormwater program.

In accordance with the Chesapeake Bay TMDL Guidance distributed by DEQ on May 18, 2015:

Permittees may receive credit for:

...BMPs that were installed to meet development requirements, but exceed those requirements and any applicable state standards...

An accounting of these Energy Dissipators was submitted to DEQ in September of 2015 in response to the historical BMP data request.

The following pollutant removal evaluation includes those Energy Dissipators that are within the MS4 Service Area that were installed between January 1, 2006 and June 30, 2014 in the watershed subject to the Chickahominy River Benthic TMDL and exceeded any applicable state standards in place at the time of installation.

SECTION 2. LOCATION

As stated above, the Energy Dissipators included in this evaluation are located within the MS4 Service Area in the watershed subject to the Chickahominy River Benthic TMDL.

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

SECTION 3. STATUS

Each of the Energy Dissipators included in this evaluation were installed between January 1, 2006 and June 30, 2014 and continue to be maintained and operated as approved.

SECTION 4. POLLUTANT LOAD REDUCTIONS

To calculate the pollutant load reductions achieved by these Energy Dissipators, removal efficiencies are required. Removal efficiencies for TN and TP can be found in the Virginia Runoff Reduction Method (VRRM).

Pollutant	Removal Efficiency	
	A / B Soils	C / D Soils
TN	75%	50%
TP	75%	50%

Since quantification of sediment reduction is not provided for any of the BMPs listed in the VRRM, the performance curves provided by the Bay Program were used to establish a removal efficiency for TSS. Assuming a runoff depth of 0.5 inches (the approximate runoff depth that results in a 50% efficiency for TN and TP), the performance curve for TSS yields a removal efficiency for TSS of 55%.

To calculate the pollutant load entering each of the Energy Dissipators, an analysis of the drainage areas to each Energy Dissipator was conducted to determine the impervious and pervious acreage that drains to each facility. This analysis is based on the 2014 Virginia Statewide Land Cover Data Set. The location of the Energy Dissipator was also studied to determine whether the facility is on an A / B soil or a C / D soil.

The 2009 EOS Loading Rates for the James River Basin from Table 1 in the MS4 Permit were then used to determine the pollutant load entering each facility from these acreages.

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

2009 EOS Loading Rates (lbs/acre/year)	
Source	TSS
Urban Impervious	676.94
Urban Pervious	101.08

Application of the removal efficiencies identified previously to the incoming loads results in the following load reductions for the Energy Dissipators that were installed prior to July 1, 2014 within the MS4 Service Area and exceeded any applicable state standards in place at the time of installation.

TSS Removed by the Energy Dissipators
21,694.38

SECTION 5. COST

The cost associated with these Energy Dissipators is unknown.

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN**

	A	C	D	G	H	I	P	Q	R	Y	Z	AA	AB
	End Treatment ID	IMPERVIOUS_AC	TURF_AC	P_LOAD_FROM_DA	I_LOAD_FROM_DA	S_LOAD_FROM_DA	P_EFFICIENCY	I_EFFICIENCY	S_EFFICIENCY	NET_P_REDUCTION_BY_EN	NET_I_REDUCTION_BY_EN	NET_S_REDUCTION_BY_EN	
1	E1000000000282	3.316	5.160	8.4	67.2	2766.5	50.00%	50.00%	55.00%	4.21	33.60	1,521.58	
3	E1000000000283	1.919	1.756	4.3	30.3	1476.6	50.00%	50.00%	55.00%	2.13	15.15	812.11	
4	E1000000000284	4.442	6.670	11.2	88.3	3681.2	50.00%	50.00%	55.00%	5.58	44.17	2,024.65	
5	E1000000000646	8.984	12.538	22.1	172.0	7349.2	50.00%	50.00%	55.00%	11.04	86.00	4,042.08	
6	E1000000000652	0.548	0.697	1.3	10.0	441.1	50.00%	50.00%	55.00%	0.66	5.01	242.61	
7	E1000000000653	1.157	1.630	2.9	22.3	948.1	50.00%	50.00%	55.00%	1.43	11.13	521.48	
8	E1000000000655	0.461	2.243	1.9	20.0	539.1	50.00%	50.00%	55.00%	0.97	10.01	296.50	
9	E1000000000659	5.543	8.228	13.9	109.6	4583.8	50.00%	50.00%	55.00%	6.93	54.78	2,521.11	
10	E1000000000666	1.328	1.487	3.1	22.9	1049.2	50.00%	50.00%	55.00%	1.54	11.43	577.07	
11	E10000000008919	8.743	10.249	20.5	153.7	6654.6	50.00%	50.00%	55.00%	10.26	76.87	3,025.04	
12	E10000000008920	8.463	14.027	21.9	177.5	7146.7	50.00%	50.00%	55.00%	10.95	88.76	3,930.70	
13	E1000000011615	1.015	1.373	2.5	19.1	825.6	50.00%	50.00%	55.00%	1.24	9.58	454.10	
14	E1000000012204	1.547	1.603	3.5	25.7	1209.4	50.00%	50.00%	55.00%	1.76	12.87	685.15	
15	E1000000012205	0.509	1.274	1.5	13.7	473.1	50.00%	50.00%	55.00%	0.77	6.84	280.23	
16										59.45	466.17	21,694.38	
17													

**HENRICO COUNTY
CHICKAHOMINY RIVER BENTHIC TMDL ACTION PLAN
ATTACHMENT 4**