CHESAPEAKE BAY TOTAL MAXIMUM DAILY LOAD (TMDL) STUDY FOR JOINT BASE MYER- HENDERSON HALL

Prepared for: **Joint Base Myer-Henderson Hall**
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UPDATED - SEPTEMBER 2018
REVISED APRIL 2019

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EXECUTIVE SUMMARY

Introduction

United States Installation Management Command (IMCOM) tasked the United States Army Corps of Engineers (USACE) to provide technical data pertaining to Chesapeake Bay pollutant load reduction requirements for Joint Base Myer-Henderson Hall (JBM-HH), Virginia. Fort McNair, located in the District of Columbia, will be addressed in a separate opportunity assessment.

The Clean Water Act (CWA) established a basic structure for regulating pollutants in United States waters to make them “fishable and swimmable”. States are responsible for implementing these requirements through Watershed Implementation Plans (WIP), and the Environmental Protection Agency (EPA) is responsible for enforcing the regulation.

There are three pollutants identified as having the greatest impact on the Chesapeake Bay: total nitrogen (TN), total phosphorus (TP), and sediment, measured as total suspended solids (TSS). States have identified impaired waters; and together with the EPA, developed a “pollution diet” to restore them. This pollution diet is known as a Total Maximum Daily Load (TMDL), or the amount of pollutant a waterbody can carry and still achieve its designated uses (drinking water, recreation, etc.). The Commonwealth of Virginia will utilize Municipal Storm Sewer System (MS4) permits to ensure developed lands achieve nutrient and sediment reduction requirements. This study will satisfy the MS4 Phase II General Permit, Chesapeake Bay TMDL Action Plan requirement (Section I C) and will contribute to the next scheduled MS4 progress report in October 2018.

Data Collection and Mapping

Land use, soils, stormwater infrastructure and drainage area data were collected and mapped in order to calculate baseline and current load rates for TN, TP, and TSS as runoff from the installation and to determine methods for reducing those pollutant loads.

Field Investigation

Existing infrastructure that is designed to treat stormwater runoff on the installation, or Best Management Practices (BMPs) were inventoried, inspected and entered into a database. The database was designed as a tracking and record keeping tool to help the installation manage their stormwater program over time. It can be used to track required pollutant reductions and to generate annual progress reports. BMP’s will be inspected in 2018 as part of MS4 permit requirements.

Establishment of Baseline Pollutant Loads

Virginia Department of Environmental Quality (DEQ) published guidance for pollutant load reduction requirements (DEQ, 2015). They used Chesapeake Bay Program (CBP) models to provide load rates for the Potomac River to be used to calculate installation-specific baseline load rates using land use data. Using 2009 land use data and the methods provided in the DEQ guidance, an estimated 3,272.40 lbs of TN, 252.05 lbs of TP and 168,742.40 lbs of TSS per year are deposited into waterways from JBM-HH.

Pollutant Load Reductions

The Phase I WIP provides a general framework for meeting Chesapeake Bay TMDL requirements. The Phase II WIP provides a more specific plan and schedule for meeting the requirements. It details that based on the 2009 baseline conditions, 9 percent of TN loads, 16 percent of TP loads, and 20 percent of TSS loads from impervious regulated acres, and 6 percent of TN loads, 7.25 percent of TP loads and 8.75 percent TSS loads from pervious regulated acres be reduced by the end of the third permit cycle in 2027. This equates to 260.72 lbs of TN, 36.31 lbs of TP and 31,535.77 lbs of TSS that need to be reduced from JBM-HH per year by 2027. Five percent of these reductions were completed by the end of the first permit cycle in 2017, and 35 percent are required to be completed by the end of the second permit cycle in 2022.

Virginia Action Plan Guidance provided a table of pollution reduction efficiencies for several types of BMPs (DEQ, 2015). Reduction efficiencies for bioswales, bioretention and permeable pavers were averaged together for each TN, TP, and TSS and applied to the baseline loads for each area of interest.

Since the 2009 baseline, some pollutant reduction has already been realized at JBM-HH. The demolition of a barracks building and the land's conversion from impervious surface to grass contributed to 15.07 lbs of TN, 1.61 lbs of TP, and 747.94 lbs of TSS per year of the required reductions. The remaining 245.65 lbs of TN, 34.70 lbs of TP, and 30,787.83 lbs of TSS per year may be reduced through proposed structural and non-structural BMPs.

In 2016 and 2017, five new BMP construction contracts were awarded; upon completion, these satisfy Permit Cycle 1 requirements. BMPs such as grass swales, bio-swales, bio-retention ponds, and impervious area removal were implemented to treat total of 1.96 impervious acres with 4.46 lbs TP, 32.12 lbs TN, and 1902.46 lbs TSS per year removed. Specific information can be found in Table 6.4.

Additional areas in JBM-HH where BMPs can be implemented to achieve these reductions are identified in Section 7 of this report. A schedule for BMP implementation to satisfy each permit cycle requirement is included in Section 8.

Costs

The total cost to implement BMPs to satisfy the first phase of the permit for JBM-HH was $2,995,239, excluding the cost of the building demolition. This includes BMPs constructed or in the process of being constructed in FY 17 and 18. The cost to construct the proposed BMPs listed in Section 7 has yet to be determined.

Installation Point of Contact

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Project Disc containing: GIS Data, Updated BMP Database and Digital Report

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LIST OF ACRONYMS

Area of Interest .... AOI
Best Management Practices .... BMP
Chesapeake Bay Foundation .... CBF
Chesapeake Bay Program .... CBP
Chesapeake Bay Program Watershed Model .... CBPWM
Clean Water Act .... CWA
Department of Environmental Quality .... DEQ
Digital Elevation Modeling .... DEM
Edge of stream .... EOS
Environmental Site Design .... ESD
Executive Order .... EO
Geographic Information System .... GIS
Global Positioning System .... GPS
Hydrologic Soil Group .... HSG
Installation Management Command .... IMCOM
Joint Base Myer-Henderson Hall .... JBM-HH
Level 2 .... L2
Light Detection and Ranging .... LiDAR
Low Impact Development .... LID
Municipal Storm Water Sewer System MS4
National Pollutant Discharge Elimination System .... NPDES
Natural Resource Conservation Service .... NRCS
North American Vertical Datum of 1988 .... NAVD88
Pollutants of concern .... POC
Total Maximum Daily Load .... TMDL
Total nitrogen .... TN
Total phosphorus .... TP
Total suspended solids .... TSS
United States .... US
United States Army Corps of Engineers .... USACE
United States Environmental Protection Agency .... EPA
Universal Transverse Mercator .... UTM
Virginia .... VA
Virginia Pollution Discharge Elimination System .... VPDES
Watershed Implementation Plans .... WIP
Web Soil Survey .... WSS

1 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

The Clean Water Act (CWA) established a basic structure for regulating pollutants in United States (US) waters (EPA, 1972). Despite efforts to comply with these requirements, the Chesapeake Bay continues to fall short of State water quality standards and CWA goals (CBF, 2014). The Environmental Protection Agency (EPA) established the requirements for state Watershed Implementation Plans (WIP) as part of a larger Chesapeake Bay Total Maximum Daily Load (TMDL) accountability framework.

Section 303 of the CWA requires States to: establish water quality standards based on achieving their designated uses for that water body (drinking, recreation, etc…), develop lists of impaired waters that fail to meet those standards, and estimate the amount of a pollutant that the waterbody can receive and still meet those standards. The amount of a pollutant a waterbody can carry and still satisfy its water quality standards is now known as a Total Maximum Daily Load (TMDL).

CWA Section 402 regulates any point sources discharging pollution into U.S. waters through the National Pollutant Discharge Elimination System (NPDES) program. Municipalities with stormwater conveyance systems are required to obtain a Municipal Storm Water Sewer System (MS4) Phase II General Permit for coverage under the NPDES program. States have chosen to use these permits to enforce the TMDL requirements.

The Chesapeake Bay Protection and Restoration Executive Order (EO) 13508 (FLCC, 2009) describes the Chesapeake Bay as a "national treasure" and intends to bring more accountability to Bay cleanup efforts. In response to the EO, EPA published guidance for Federal facilities describing how to comply with the Federal regulations implemented by the States.

In December 2010, EPA published a TMDL for all impaired segments of the Chesapeake Bay watershed in order to help the States establish load allocations. They determined that total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS) are the pollutants of concern (POC) causing the most environmental damage to the Chesapeake Bay. They then required those states within the Chesapeake Bay watershed to submit Watershed Implementation Plans (WIPs) detailing how they will achieve TMDL requirements for nitrogen, phosphorus and sediment. The Virginia Phase II WIP presented pollutant load reductions, referred to as Level 2 (L2) scoping run reductions requiring that 9 percent of TN loads, 16 percent of TP loads, and 20 percent of TSS loads from impervious regulated acres, and 6 percent of TN loads, 7.25 percent of TP loads, and 8.75 percent TSS loads from pervious regulated acres be reduced by the end of the third MS4 permit cycle.

United States Army Corps of Engineers (USACE) has been tasked by the Installation Management Command (IMCOM) to provide technical data pertaining to the Chesapeake Bay TMDL for Joint Base Myer-Henderson Hall (JBM-HH). The technical data collected and/or developed during this investigation includes: existing land use; soils; Best Management Practices (BMPs) and stormwater infrastructure locations and conditions; contributing drainage area to each stormwater

BMP; and baseline pollutant load computations. Table 1-1 provides additional description of the data collected.

TABLE 1-1 DATA COLLECTED

Data	Applicability
Facility Boundary	The facility boundary was the first piece of information to be collected. The facility boundary is needed to begin collecting land use, soils, BMPs, and stormwater infrastructure data.
Land Use	A land use category determines the type(s) of practices conducted on that land area. Different practices yield different types and concentrations of pollutants. For example, agricultural land is typically high in nitrogen, due to certain types of fertilizer use.
Soils	Soil characteristics impact the infiltration. For example, urban areas are typically comprised of very compacted soils, which result in higher stormwater and pollutant runoff rates.
BMPs and Drainage to BMPs	Drainage areas to BMPs were identified, so new BMPs were not proposed to treat overlapping areas.
Stormwater Infrastructure	Stormwater infrastructure data shows how the stormwater is managed within the facility. It was used to delineate BMP drainage areas.

The data collected and developed were used to conduct an opportunity assessment to determine if stormwater BMP retrofits will be favorable to reduce pollutant loads to the Chesapeake Bay. The database on the attached project disk will provide a mechanism for managing data and assisting the localities and states with implementing WIPs. Current, accurate Geographic Information System (GIS) data used to conduct this assessment will also assist JBM-HH with future stormwater BMP maintenance and compliance requirements.

This study will satisfy the MS4, Chesapeake Bay TMDL Action Plan requirement (Section I C) and will be part of the next scheduled MS4 progress report in October 2018.

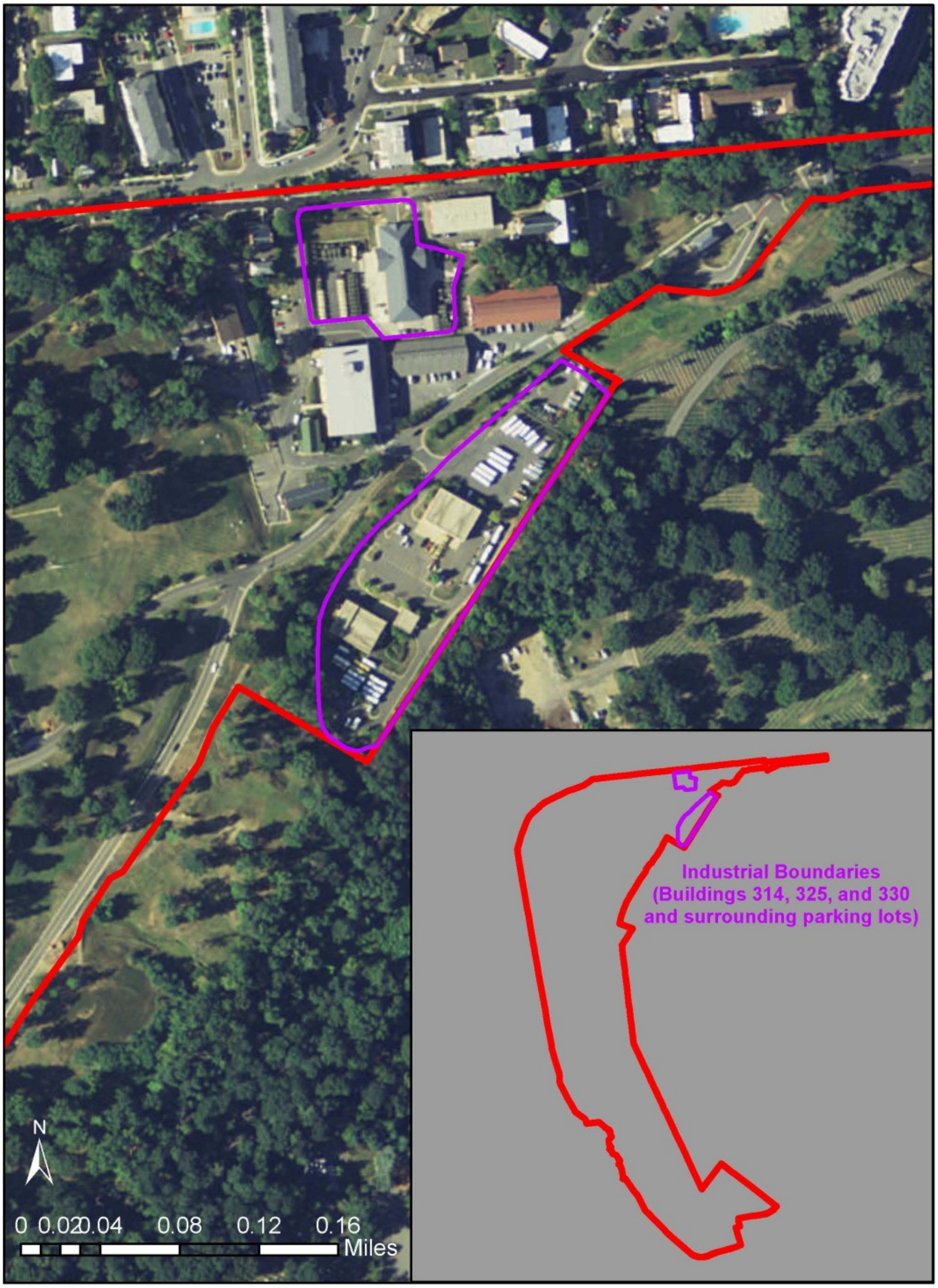
1.2 STUDY AREA

The study area for this investigation is Joint Base Myer-Henderson Hall, which occupies approximately 269 acres within Arlington County, Virginia. The Virginia MS4 General Permit for JBM-HH applies to U.S. Army Installation Fort Myer (Fort Myer) and Marine Corps Headquarters Battalion Henderson Hall (Henderson Hall), which are jointly referred to as “the installation” throughout this Plan. JBM-HH borders Arlington National Cemetery to the west, and is located in the Potomac River watershed, which is part of the Chesapeake Bay Watershed (Figure 1-1). Arlington National Cemetery, adjacent to JBM-HH, and Fort McNair, in the District of Columbia, are not included in this opportunity assessment.

Of the installation’s 268.95 acres, 263.03 acres are regulated under the MS4 permit and 5.92 acres are covered by a VPDES permit for industrial discharges (VAR05). Based on Virginia Department of Environmental Quality’s (DEQ) May 2015 VA TMDL Guidance (DEQ, 2015), any land regulated under a General VPDES permit for industrial discharges (shown in Figure 1-2) may be excluded from this opportunity assessment.

FIGURE 1-1 JBM-HH LOCATION MAP

FIGURE 1-2 JBM-HH INDUSTRIAL PERMIT AREAS



1.3 REPORT OUTLINE

The tasks required to complete this study and satisfy General MS4 Permit Section I.C.2.a requirements are described in the following sections of this report. Section 2 reviews the current and future MS4 program and legal authorities (I.C.2.a (1, 2)). Section 3 describes the development of GIS data layers that were used in the calculation of current baseline pollutant loads. Section 4 describes the stormwater BMP database created for JBM-HH. Section 5 describes calculation of baseline loads (I.C.2.a (4). Section 6 details the nutrient reduction requirements and a plan to meet those requirements (I.C.2.a (3, 5, 6, 7, 8, and 10). Section 7 shows the suggested BMPs implementation schedule. Section 8 explains the costs to complete the reduction requirements (I.C.2.a. (11). Section 9 includes conclusions from this study (I.C.2.a. (9 and 12) (Commonwealth of Virginia, 2013).

TABLE 1-2 RELATING MS4 PERMIT TO THIS REPORT

General MS4 Permit Section I.C.2.a subsection	Section in this report addressing the permit requirement
1,2	Section 2
3,5,6,7,8,10	Section 7
4	Section 5
11	Section 8
9, 12	Section 9

2 MS4 PROGRAM AND LEGAL AUTHORITIES

The provisions contained in the MS4 Permit and associated regulations will be enforced through JBM-HH policy memorandums and standardized procedures for project review and implementation. A draft Installation-wide stormwater policy was developed and approved in 2016 to address the Installation's compliance with the Virginia MS4 permit, the Virginia general industrial stormwater permit, and other stormwater regulations. The policy outlines proper protocols for minimizing stormwater pollution during activities that directly and indirectly impact stormwater.

3 DATA COLLECTION AND MAPPING

GIS was used to create, analyze and plan all geographically related information. These data were created as shapefiles, which can be used to accurately measure the spatial area needed to perform land use and load reduction calculations. Each data set is in Universal Transverse Mercator (UTM) Zone 18 North American Vertical Datum of 1988 (NAVD88) horizontal coordinate system.

3.1 LAND USE

Accurate land use data is essential for baseline and reduction load calculations. Considerable effort was made to collect and develop the most accurate data and categorize it in two different ways for multiple uses. Virginia TMDL Guidance classification was necessary for Action Plan calculations; Chesapeake Bay Program (CBP) classifications will be used for model runs.

Land use polygons were attributed with land uses relevant to Virginia Guidance calculations (i.e. regulated urban impervious and regulated urban pervious). The polygons were also attributed using the same categories of land cover as those used by the CBP and their watershed model (construction, forest, hay, hay with nutrients, high intensity impervious urban, high intensity pervious urban, low intensity impervious urban, high intensity pervious urban, unfertilized grass, and water) (see Table 3-1 Land Use).

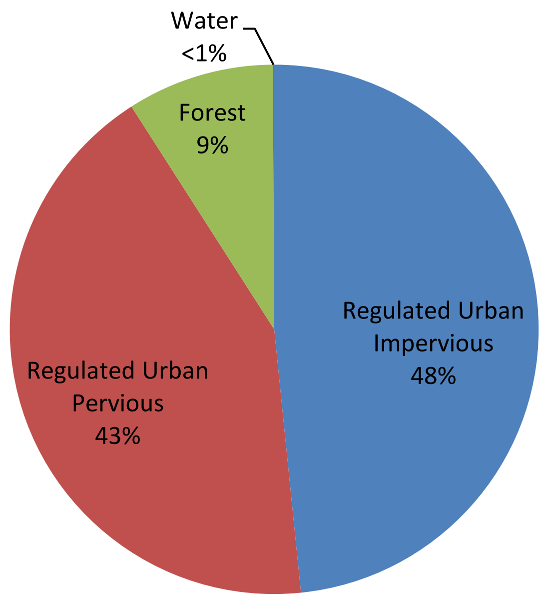
The EPA required each state to submit guidance for how to achieve the goals set forth in the WIP. Virginia Department of Environmental Quality provided draft guidance to USACE in 2013, which provided instructions to permittees for estimating pollutant source loads as of June 30, 2009 (DEQ, 2015). Before guidance was released setting 2009 as the baseline year, land use layers were developed using the most up to date information at the time (2013 aerial imagery). In response to that draft guidance, existing land use was digitized using the 2009 aerial imagery. As a result, land use layers were developed for both 2009 and 2013 conditions and will be provided in the attached project disk. The digitized imagery was used to calculate baseline load rates and the baseline load rates were then used to establish L2 reductions (see Section 5-1).

TABLE 3-1 LAND USE CLASSIFICATIONS

VA Land Use	CBP Land Use	General Description
Regulated Urban Impervious	High Intensity Impervious Urban/ Low Intensity Impervious urban	building, road, parking
Regulated Urban Pervious	High Intensity Pervious Urban/ Low Intensity Pervious urban	beach, gravel, lawn, shrubs
N/A	construction	bare earth
N/A	forest	forest, wetland
N/A	hay	row crops, not fertilized
N/A	hay with nutrients	row crops, fertilized
N/A	unfertilized grass	brush
N/A	water	water

Forty-eight percent of JBM-HH's 263.03 acres, excluding the 5.92 acres in industrial areas, is categorized as regulated urban impervious urban land cover (127.27 acres). This includes building rooftops, parking areas, sidewalks, and recreational courts. An estimated 43 percent (111.88 acres) is categorized as regulated urban pervious land cover, or beach, gravel, lawn, or shrubs. Forest comprises 9 percent of the land (23.66 acres). Another 0.22 acres of the installation's total area is comprised of water, which accounts for less than 1 percent of the installations total area (Figure 3-1).

FIGURE 3-1 LAND USE SUMMARY FOR JBM-HH



3.2 SOILS

Soil type was used to determine preliminary BMP site locations for planning purposes. Reduction efficiency and cost effectiveness are generally maximized when BMPs are implemented in A and B soils, and B soils make up 97 percent of the installation (260.05 acres). It is more expensive and fewer nutrients are reduced when BMPs are built in C and D soils, which are not present on the installation. The remaining three percent of the installation (8.9 acres) is considered part of the Arlington National Cemetery survey group and was therefore not identified. Soils data were obtained from the Natural Resource Conservation Service (NRCS) Web Soil Survey (WSS) (USDA NCRS, 2013). The county-wide soils layer obtained from the WSS was clipped to the installation boundary to create a shapefile specific for JBM-HH. The shapefiles are attributed with soil type and Hydrologic Soil Group (HSG). Figure 3-2 and Table 3-2 summarize JBM-HH soil groups. **Error! Reference source not found.**

FIGURE 3-2 – HYDROLOGIC SOIL GROUPS

TABLE 3-2 SOIL GROUP DISTRIBUTION

HSG	Total Area (AC)	Percentage of Installation Area
B	260.05	97%
N/A	8.9	3%

3.3 STORMWATER BEST MANAGEMENT PRACTICES (BMPs)

BMPs were inventoried and inspected annually during the first permit cycle. Drainage areas were established using the final as-built drawings or design plans. For BMPs were plans were not available, drainage areas were delineated using Light Detection and Ranging (LiDAR) data, Digital Elevation Modeling (DEM), topographic contours, and 2009 aerials (TMDL Action Plan baseline year). BMPs were delineated to include all stormwater conveyed to them through existing infrastructure. Figure 3-3 shows the location of all existing BMPs. Data pertaining to each BMPs has been stored in an Access database and GIS are both included on the project disk.

3.4 STORMWATER INFRASTRUCTURE

The stormwater layers used for this investigation were provided by the installation. Separate shapefiles were created for stormwater lines and BMPs. All GIS data created for this project and analyses are included on the attached project disk.

FIGURE 3-3 EXISTING BMPS

4 FIELD INVESTIGATION

A field assessment was performed in August 2011 to confirm land use and installation boundaries, and to inventory and assess stormwater BMPs. Project members traveled to JBM-HH and coordinated with installation points of contact to locate BMP facilities and inspect structural features. Another round of inspections will be performed in 2018.

4.1 STORMWATER BMP INVENTORY AND INSPECTION

During initial BMP evaluations in 2011, data were compiled for each stormwater BMP. A field team documented the type of BMP installed (i.e. ponds, infiltration, filtration, manufactured/underground), and the geographic location, using Global Positioning System (GPS) technology. A visual assessment of the condition of the BMP was performed and documented using The Virginia Stormwater Management Handbook (DCR, 1999). Digital photographs were also taken to document the location and condition of each BMP at the time of the inventory and assessment. This section will be updated after completion of construction and inspection of the 5 BMPs currently under construction.

The end product of the stormwater BMP inventory and inspections is the BMP database, which is discussed in Section 4-2. An overall rating was assigned to each BMP; for the BMPs constructed prior to 2011, the rating was based on field evaluations. All BMPs under construction or with a contract awarded before 2017 will be inspected and rated during the 2018 inspections. A description of the ratings is provided in Table 4-1 Stormwater BMP Rating Description. These ratings will assist the installation in prioritizing maintenance and improvement activities for each facility.

TABLE 4-1 STORMWATER BMP RATING DESCRIPTION

Rating	Description
A	The BMP is functioning as designed with no problem conditions identified. No signs of impending deterioration.
B	Minor problems are observed, however BMP is functioning as designed with no problem conditions in critical parameters.
C	Minor problems are observed, however BMP is functioning as designed with no problem conditions in critical parameters, but BMP performance is being compromised.
D	Major problems are observed and BMP is not functioning as designed with problem conditions in several critical parameters. Conditions have compromised the BMP performance.

E	Major problems are observed and BMP is not functioning as designed with problem conditions in several critical parameters. Conditions have compromised the BMP performance. BMP shows signs of impending failure.

All stormwater BMPs were assigned a Permanent ID that includes an abbreviation for the type of stormwater BMP (i.e. "P" for pond or "I" infiltration), and then an identification number.

Twelve stormwater BMPs were identified for the initial TMDL Action Plan submittal in 2016. The BMPs were inventoried by the USACE field crew in 2011. Inspections were again conducted in 2018, where an additional 11 BMPs were added to the inventory for a total of 23 BMPs. Table 4-2 shows the BMP Inventory Results and Table 4-3 shows the inspection results based on condition ratings. The location and type of BMPs are recorded for the BMPs in the BMP Access Database, which is discussed in Section 4-2.

TABLE 4-2 BMP INVENTORY RESULTS

BMP type	Number
Filtration	7
Infiltration	1
Manufactured	6
Miscellaneous	3
Ponds	6

TABLE 4-3 BMP INSPECTION RESULTS

Rating	Number
A	7
B	9
C	2
D	4
E	0

4.2 STORMWATER BMP DATABASE

The data collected from the field assessments was used to create the BMP Database. The BMP database serves as a tracking and record keeping tool, and can also be used to determine the pollutant reductions provided by implementing various BMPs. The BMP Database can be used to create a map of all BMP locations within the installation, by exporting a GIS shapefile. The database is in Microsoft Access format, with forms containing all the inspection results and a digital photograph of each BMP. Should the installation implement any additional stormwater BMPs, the database can be expanded so installation staff can use it to manage their stormwater program. A brief user's guide for the BMP Database is located in Appendix B. Additionally, all historical BMPs have been reported to DEQ.

5 ESTABLISHMENT OF BASELINE POLLUTANT LOADS

Knowledge of baseline (existing) loading conditions for TN, TP and TSS is needed to guide the facilities in their management and implementation of stormwater BMPs to meet the overall Chesapeake Bay TMDL pollution reduction requirements. The Chesapeake Bay Program Watershed Model (CBPWM) is at a macro-scale and typically does not have the level of detail in land use and installation boundary data as was collected in this study. Therefore, independent calculations of baseline pollutant loads, using the best data available, is needed to better understand the actual baseline pollutant contribution from these facilities and what level of improvements, if any, are needed to meet overall Chesapeake Bay TMDL goals.

5.1 METHODOLOGY

Tables provided in the Virginia TMDL Guidance were used to calculate pollutant load rates from JBM-HH (DEQ, 2014). This approach uses tables with established "Edge of Stream" (EOS) loading rates for pervious and impervious land uses in each of the four regional river basins within the Chesapeake Bay watershed – James River, Potomac River, Rappahannock River, and York River. The total existing acreage for each site is then input into the appropriate table and multiplied by the 2009 EOS loading rate to determine the estimated baseline loads.

5.2 RESULTS

JBM-HH is located within the Potomac River watershed. Baseline load rates from the 2009 CBPWM; acres served by JBM-HH's MS4 permit, which excludes the 5.92 acres on JBM-HH within industrial permit areas; and the estimated pollutant loads for JBM-HH based on the 2009 progress run rates are shown in **Error! Reference source not found.**

TABLE 5-1 BASELINE POLLUTANT LOADS

	Pollutant	Total Existing Acres Served by MS4 (06/30/09)	2009 EOS Rate (lbs/acre)	Estimated Total POC Load (lbs) Based on 2009 Progress Run
Regulated Urban Impervious	Nitrogen	127.27	16.86	2,145.77
Regulated Urban Pervious		111.88	10.07	1,126.63
Regulated Urban Impervious	Phosphorus	127.27	1.62	206.18
Regulated Urban Pervious		111.88	0.41	45.87
Regulated Urban Impervious	Suspended Solids	127.27	1,171.32	149,073.90
Regulated Urban Pervious		111.88	175.80	19,668.50

Table 2-b: Calculation Sheet for Estimating Existing Source Loads for the Potomac River (Based on Chesapeake Bay Program Watershed Model Phase 5.3.2) (DEQ, 2015).

6 ESTIMATED POLLUTANT LOAD REDUCTIONS

By 2028, JBMHH is prepared to meet their targeted pollutant load reduction. Table 6-1 summarizes the percent pollution reduction requirements for impervious and pervious landuse

TABLE 6-1 POLLUTION REDUCTION REQUIREMENTS

Pollutant	Regulated Acreage % Load Reduction Target	
	Impervious	Pervious
TN	9%	6%
TP	16%	7.25%
TSS	20%	8.75%

L2 scoping run reductions, presented in the Phase II WIP and enforced through the MS4 permit equate to a reduction of 9 percent of TN loads, 16 percent of TP loads, and 20 percent of TSS loads from impervious regulated acres, and 6 percent of TN loads, 7.25 percent of TP loads and 8.75 percent TSS loads beyond 2009 progress loads for pervious regulated acreage by the end of the third permit cycle. Virginia (VA) TMDL Guidance provides flexibility in the implementation of specific management technologies employed to meet the required reductions, while stipulating standards and/or objectives. MS4 operators will be able to adjust the levels of reduction between pervious and impervious land uses within their service area, provided the total load reduction for each pollutant is met.

Best Management Practices accepted as methods of reducing pollutant loads for TMDL requirements include: street sweeping, urban stream restoration, shoreline restoration, land use change, structural BMPs, urban nutrient management, and nutrient trade. Street Sweeping is credited based on lane miles swept per year. Permittees may receive credit for urban stream restoration, based on linear footage of restoration completed. The methodology under review is based on linear footage of shoreline restored and was used to calculate reductions in this report (Drescher, 2014). Conversion of land use from impervious to pervious or forest land may also receive POC reductions credits based on the acreage changed and type of change. Urban nutrient management plans developed for unregulated, public land smaller than one acre where nutrients are applied may be considered for credit, but have not yet been developed at JBM-HH. Permittees may also offset pollutant loads trading non-point source nutrients in accordance with Virginia Code (DEQ, 2015).

VA TMDL Guidance provided a table of CBP BMP load reduction efficiencies, which were used to calculate BMP pollutant removal rates.

2009 progress run estimated pollutant loads were applied to the load reduction targets to calculate pollutant load reductions required for each of the three permit cycles at JBM-HH, shown in Table 6-2.

TABLE 6-2 POLLUTANT REDUCTIONS REQUIRED FOR JBM-HH, BY PERMIT CYCLE

Pollutant	First Permit Cycle Reductions (lbs) 5% by 2018	Second Permit Cycle Reductions (lbs) 35% by 2023	Third Permit Cycle Reductions (lbs) 100% by 2028
TN	13.54	94.78	270.80
TP	1.38	9.66	27.60
TSS	1,576.48	11,035.36	31,529.60

Table 6-3 shows the "Calculation Sheet for Determining Total POC Reductions Required during the Permit Cycle for the Potomac River Basin" provided in the VA TMDL Guidance completed with total existing acres served by JBM-HH's MS4 permit for regulated urban impervious and pervious land uses and the resulting reduction required by applying the reduction loading rate provided in the fourth column (DEQ, 2015). *Permit cycle 1 goals were met; total POC reductions are seen in Table 6.3.*

TABLE 6-3 FIRST PERMIT CYCLE REDUCTIONS

Sub-source	Pollutant	Total Existing Acres Served by MS4 (06/30/09)	First Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)	Total Reduction Required First Permit Cycle (lbs/yr)**	Actual First Permit Cycle Total Achieved (lbs/yr) and % 2028 *
Regulated Urban Impervious	Nitrogen	127.27	0.08	10.18	48.30 (17.8%)
Regulated Urban Pervious		111.88	0.03	3.36	
Regulated Urban Impervious	Phosphorus	127.27	0.01	1.27	6.23 (22.6%)
Regulated Urban Pervious		111.88	0.001	0.11	
Regulated Urban Impervious	Total Suspended Solids	127.27	11.71	1,490.33	2,707.48 (8.6%)
Regulated Urban Pervious		111.88	0.77	86.15	

*BMPs awarded in 2016 and 2017 for construction and 2014 demolition
**Table 3b: Calculation Sheet for Determining Total POC Reductions Required During the Permit Cycle for the Potomac River Basin (*Based on Chesapeake Bay Program Watershed Model Phase 5.3.2)

6.1 FIRST PERMIT CYCLE PROGRESS

First Permit Cycle goals were met by awarding contracts for five new BMPs to be built, as well as demolishing building 406 in 2014, which converted the area from impervious surface to grass. Reduction totals from permit cycle one can be seen in table 6-4. Figure 6.1 shows the location of all BMPs to be implemented to meet the first permit cycle goals. VA TMDL Guidance provided a table of CBP BMP load reduction efficiencies, which were used to calculate BMP pollutant removal rates.

TABLE 6-4 FIRST PERMIT CYCLE ESTIMATED POLLUTANT REDUCTION BY BMP

First Permit Cycle BMPs	TN Removed (lbs/yr)	TP Removed (lbs/yr)	TSS Removed (lbs/yr)	Fiscal Year Awarded
Special Events Area – Bio-retention and permeable pavement	15.84	2.18	921.4	FY16
Building 406 Demolition	15.07	1.61	747.94	FY17
Bio-swale near Sheridan Ave and Pershing Dr.	2.84	0.41	212.90	FY17
Permeable Pavement near Sheridan Ave and Pershing Dr.	2.11	0.30	179.62	FY17
Bioswale near the Fitness Center Parking Lot	2.63	0.38	165.10	FY17
Bio-retention – East Lot Island	8.71	1.19	423.44	FY17
Total Pollutant Removal	47.2	6.07	2,650.4	
2028 Polluntant Goal (lb)	270.80	27.60	31,529.60	
% 2028 Goal	17.4%	22.0%	8.4%	

FIGURE 6-1 FIRST PERMIT CYCLE BMPS UNDER CONSTRUCTION

7 PLAN FOR REMAINING 2028 POLLUTANT LOAD GOALS

In addition to structural BMPs, permittees may receive credit for land use change, urban nutrient management, nutrient trading and urban stream restoration. Any conversion of land use from urban impervious to pervious or to forest can receive credit for pollutant removal, as explained in the VA TMDL Guidance (DEQ, 2015). Urban nutrient management plans developed for unregulated, public land smaller than one acre where nutrients are applied may be considered for credit. Permittees may offset pollutant loads trading non-point source nutrients in accordance with Virginia Code. Permittees may also receive credit for urban stream restoration, based on the reduction of nutrients entering streams as a result of the restoration. This section looks at recommended BMPs to meet the remaining 2028 load reductions as outlined in Table 6-2.

7.1 STREET SWEEPING

Street sweeping estimates for TN and TP are based on the Qualifying Lanes Method detailed in the VA TMDL Guidance. TSS loading rates have not been adopted by VADEQ to date, therefore, the 2017 "Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices" approved by the Chesapeake Bay Expert Panel. Lane miles were calculated using GIS mapping of the facility. Expected pollutant reductions per year for three separate scenarios are shown in Table 7-1

TABLE 7-1 STREET SWEEPING REDUCTIONS

	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)
Regenerative/Vacuum ***Street*** Sweeping of ~ 16.5 acres every two weeks	30.82	4.80	13,006.70
% 2028	**11.4%**	**17.4%**	**41.3%**
Regenerative/Vacuum ***Parking Lot*** Sweeping of ~ 40.27 acres every two weeks	75.18	11.72	31,731.70
% 2028	**27.8%**	**42%**	**100.6%**
Regenerative/Vacuum ***Street and Parking Lot*** Sweeping every two weeks	106.00	16.52	44,738.40
% 2028	**39%**	**60%**	**141.9%**

7.2 ADDITIONAL PROPOSED BMPs

Millennium Vault Retrofit

The existing Millennium Stormwater Detention Vault is only used for volume control. The Millennium Vault is a good candidate for water quality retrofit. The proposed plan would be to incorporate proprietary filter cartridges either upstream or in the actual vault to pre-treat the first flush stormwater. The vault could also include a rainwater harvesting component to maximize water quality credits. Table 7.2 shows the removal estimate with and without rainwater harvesting and Figure 7-2 shows the location of the vault and associated drainage area.

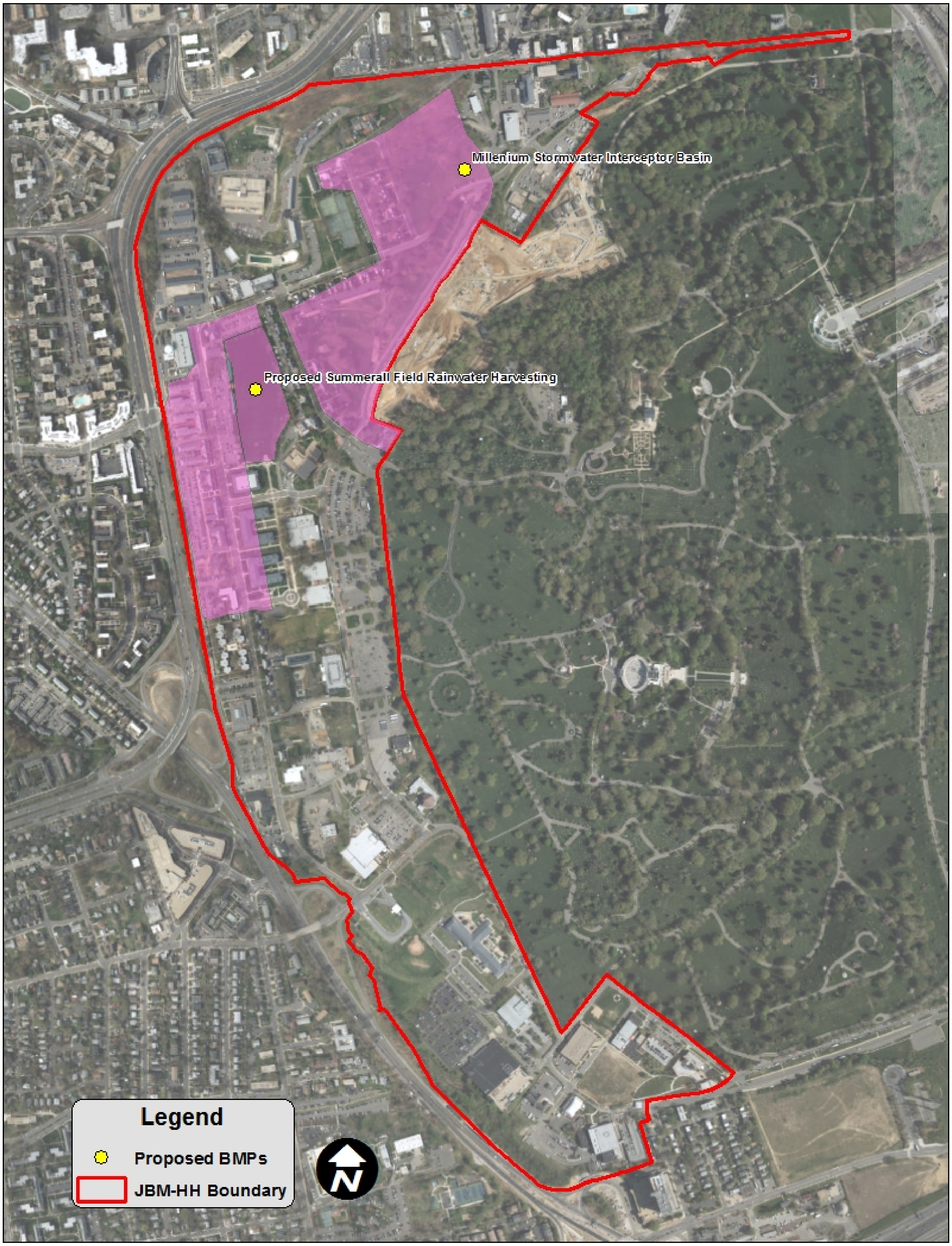
Summerall Field Rainwater Harvesting

The proposed BMP for Summerall Field is a relatively new take on rainwater harvesting. The field will be filled with sand that has a 29% void space. The profile will maintain a 4"-5" depth that is completely saturated in the bottom. Stormwater will be diverted to the sand bed profile and distributed through a 6"-8" dia. PVC "Header" with dozens of 2" pipe connections that extend into EPIC Chambers, followed by a 2" diameter pipe section to another EPIC chamber. The stormwater will be evenly distributed across the entire parade field. Underground detention vaults will be placed upstream of Summerall Field and will retain peak flow to maintain a slow release into the sand bed profile. Once the water enters the parade field it can only: 1) evaporate, 2) transpire through the growth of grass, or 3) discharge (after being filtered from moving through the sand bed) into an overflow pipe that will be connected to an existing storm drain pipe/system. Table 7.2 show the removal estimates for the proposed Summerall Field Rainwater Harvesting BMP and Figure 7-2 shows the location of the proposed BMP and associated drainage area

TABLE 7-2 PROPOSED BMP REDUCTIONS

	TN (lb/yr)	TP (lb/yr)	TSS (lb/yr)
Millennium Vault Retrofit without Rainwater Harvesting (Filter Cartridges only)	50.70	10.42	5,155.00
% 2028	**18.7%**	**37.8%**	**16.4%**
Millennium Vault Retrofit with Rainwater Harvesting	80.00	12.00	7,500.00
% 2028	**29.5%**	**43.5%**	**23.8%**
Summerall Field Rainwater Harvesting	293.10	28.16	20,362.70
% 2028	**108.2%**	**102.0%**	**64.6%**

FIGURE 7-1 PROPOSED BMPS



7.3 SUMMARY

The proposed BMPs outlined in this section are summarized in Table 7-3. A combination of these BMPs will satisfy the final 2028 TMDL Action Plan reduction goal. To meet the 2nd permit cycle 40% intermediate goal, it is recommended that a combination of street sweeping and either the Millennium Vault or Summerall field be implemented by 2023.

***TABLE 7-3 SUMMARY OF PROPOSED BMPS**

	BMP Pollution Reduction (lb/year)			Cumulative Percent of Total Goal		
AOI	**TN**	**TP**	**TSS**	**TN**	**TP**	**TSS**
Street Sweeping (Roads only)	30.82	4.80	13,006.70	**11.4%**	**17.4%**	**41.3%**
Street Sweeping (Parking Lots Only)	75.18	11.72	31,731.70	**27.8%**	**42%**	**100.6%**
Street Sweeping (Both Roads and Parking)	106.00	16.52	44,738.40	**39%**	**60%**	**141.9%**
Millennium Vault (Filter, no RWH)	50.70	10.42	5,155.00	**18.7%**	**37.8%**	**16.4%**
Millennium Vault (Filter, with RWH)	80.00	12.00	7,500.00	**29.5%**	**43.5%**	**23.8%**
Summerall Field	293.10	28.16	20,362.70	**108.2%**	**102%**	**64.6%**

*2028 Reduction Goals are 260.72 for TN, 36.31 for TP, and 31,535.77 for TSS

8 IMPLEMENTATION SCHEDULE AND COSTS

Schedule:

VA TMDL Guidance provides a timeline for when these pollutant load reductions must be implemented, as describe in Table 6.2.

In addition to the pollution reduction credits attributed to the Phase one implementation of 5 BMPS and building 401 Demolition, street sweeping, millennium vault, and drainage field are recommended to meet permit cycle two (2023) and three (2028) pollutant reduction goals. Table 8-1 provides a recommended schedule to meet the final 2028 TMDL Action Plan goals.

TABLE 8-1 RECOMMENDED SCHEDULE TO MEET ACTION PLAN REDUCTION GOALS

Pollutant	First Permit Cycle Reductions (lbs) 5% by 2018	Second Permit Cycle Reductions (lbs) 35% by 2023	Third Permit Cycle Reductions (lbs) 100% by 2028
TN	*13.54	**94.78	***270.80
TP	*1.38	**9.66	***27.60
TSS	*1,576.48	**11,035.36	***31,529.60

*First permit cycle reduction goals have been met. Construction contracts have been awarded for five BMPs that are currently either complete or under construction.
**Second permit cycle reductions goals will be met by implementing recommended BMPs outlined in Section 7.
*** Third permit cycle reductions goals will be met by implementing recommended BMPs outlined in Section 7.

Cost:

Virginia TMDL Guidance does not provide a tool for estimating BMP costs. Generalized, planning-level construction costs are provided for the proposed BMPs using the *Costs of Stormwater Management Practices in Maryland*. This table was developed using data from Virginia as well as Maryland, and based on impervious acre treated by the BMP (Hagan, 2011).

The total cost to implement BMPs to satisfy the first phase of the permit for JBM-HH was $2,995,239, excluding the cost of the building demolition.

Costs for street sweeping, millennium vault, and Summerall field are all currently unknown and will be updated once design is initiated.

Several variables to be explored in later phases of the study can greatly affect the cost to implement a BMP, such as utility placement, regional specific permits, and unexploded ordinance surveys, type of contract, acquisition strategy, and real property. With further investigation, these areas of interest can be prioritized based on the cost of logistics to construct the BMPs and divert stormwater to them.

9 CONCLUSIONS

The purpose of this study is to provide technical data pertaining to the Chesapeake Bay TMDL Action Plan for JBM-HH. This was executed by locating, inventorying, and assessing the condition of existing stormwater BMPs, quantifying source loads for TN, TP, and TSS within the installation boundary and identifying opportunities to reduce pollutant loads to the Chesapeake Bay.

The results of this investigation conclude that approximately 3,272.40 lbs of TN, 252.05 lbs of TP and 168,742.40 lbs of TSS are loaded into waterways from JBM-HH per year, based on 2009 land use data. JBM-HH must reduce their nutrient loads by 260.72 lbs of TN, 36.31 lbs of TP and 31,535.77 lbs of TSS by the end of the third MS4 permit cycle in 2028. Permit cycle one successfully met the pollutant reduction goals by implementing five stormwater BMPs and demolition of building and converting to pervious. If Street sweeping of roads, a filter is added to the Millennium Vault, and Summerall Field Rainwater Harvesting are implemented (or some combination of the three), JBMHH will exceed their pollutant reduction goals by 2028. The cost to implement the proposed structural BMPs proposed to meet these requirements is unknown and will require a more in depth engineering and cost analysis.

JBM-HH will release the Action Plan information to the public on or around 1 August 2018. It will be available for comment for 30 days, and will be accessible by phone or email request. The "public," as defined by JBM-HH's MS4 Program Plan is "the resident and employee population within the fence line of the facility" (JBM-HH, 2013). Therefore, the Action Plan will only be released via installation media outlets, including the weekly newspaper, the Pentagram, and the installation Facebook page.

A BMP database was created to store and organize data collected from the BMP inventory conducted as a part of this study; it also provides the installation with a tool to track L2 reduction progress and generate annual progress reports.

APPENDIX A

ORIGINAL TMDL ACTION PLAN (2015)

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
NORTHERN REGIONAL OFFICE
13901 Crown Court, Woodbridge, Virginia 22193
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Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

Thomas A. Faha
Regional Director

July 26, 2016

By Email (richard.p.lafreniere2.civ@mail.mil)

Mr. Richard P. LaFreniere
Chief, Environmental Management Division
Acting Chief, Business Operations and Integration Division
Directorate of Public Works
Joint Base Myer-Henderson Hall
111 Stewart Road, Bldg 321
Fort Myer, VA 22211-1199

Re: Virginia Pollutant Discharge Elimination System (VPDES) MS4 Registration No. VAR040068
Joint Base Myer – Henderson Hall
Local Total Maximum Daily Load (TMDL) Action Plan Approval

Dear Mr. Richard LaFreniere:

The Virginia Department of Environmental Quality (DEQ) received the following revised Local TMDL Action Plan for the above-referenced registration number on July 18, 2016, and addresses comments provided by DEQ in a comment letter dated July 13, 2016. The plan was originally submitted to DEQ on June 29, 2016, in accordance with the Compliance Agreement dated February 10, 2016. The plan was developed in accordance with Section I.B of the General VPDES Permit for Discharges of Stormwater from Small MS4s.

The following Local TMDL Action Plan is approved and is an enforceable part of the MS4 Program Plan:

- PCB TMDL Action Plan for Fort Myer & Henderson Hall Installations, Fort Myer, Virginia, identified as Appendix C.1 of the MS4 Program Plan, submitted under cover letter dated July 18, 2016

Please note any future modifications to an approved Local TMDL Action Plan shall be made in accordance with the Program Plan Modification Section of the MS4 General Permit (Section II.F).

Please contact Sarah Marsala at (703) 583-3898 or sarah.marsala@deq.virginia.gov, or me at (703) 583-3843, bryant.thomas@deq.virginia.gov, if you have any questions regarding this approval.

Respectfully,

Bryant Thomas
Water Permits and Planning Manager

//skm