

COMMONWEALTH of VIRGINIA

Verification Quality Assurance Project Plan for Managing and Reporting BMP Data to the U.S. EPA - Chesapeake Bay Program Office

November 16, 2015 Submittal Draft

This document is subject to change based on EPA review.

Virginia Department of Environmental Quality
629 East Main Street
Richmond, VA 23219

Group A – Project Management
A1 – Title and Approval Sheet

Plan Coverage: This *Verification Quality Assurance Project Plan for Managing and Reporting BMP Data to the U.S. EPA - Chesapeake Bay Program Office* in combination with the DEQ Quality Management Plan and other quality assurance documents referenced herein reflects the overall Quality Assurance Program framework, verification protocols and management systems necessary to assure that data generated, acquired, aggregated and submitted by the Virginia Department of Environmental Quality (DEQ) are of acceptable quality to meet the needs of the United States Environmental Protection Agency’s Chesapeake Bay Program Office (EPA-CBPO) and are consistent with the Partnership’s approved Verification Principals.

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Questions or comments regarding this QAPP should be referred to James Davis-Martin.

A2 – Table of Contents and Verification Checklist

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Virginia BMP Verification Program Checklist

	BMP Verification Component	QAPP Section
1	BMP's Collected	
	Type (structural, management, annual, etc.)	Appendix 4, A6, D1
	BMP Funding/Cost shared (federal, state, NGO, non-cost shared)	
	Distinct state standards/specifications	
	Matching CBP BMP definition/efficiencies	
2	Method/System of Verification/Assessment	
	Description of methods/systems to be used	Appendix 3, D2
	Documentation of procedures used to verify BMPs	
	Instruction manual for system users	
3	Who will Complete the Verification	
	Qualification requirements	Appendix 3, D2,A8
	Training requirements	
	Certification requirements	
	CEU follow-up training requirements in the future	
4	Documentation of Verification Finding	
	Date of installation	Appendix 3, A6, A7, A9, C1 and D2
	Location (lat/long if applicable)	
	Level of reporting (watershed, HUC, county, site specific, etc.)	
	Units (number, acres, length, etc.) needed for NEIEN	
	Ownership (public, private)	
	Documentation:	
	Pictures	
	Worksheets	
	Electronic Tool	
	Aerial Photos	
	Maps	
	Other	
	Report Generator	
5	How Often Reviewed (Cycle of review)	
	1-2 years	Appendix 3, D2
	5 years	

Virginia BMP Verification Program Checklist

	BMP Verification Component	QAPP Section
	10 years	
	Other	
6	Independent Verification of Finding	
	Is this a requirement?	Appendix 3, D2
	Internal Independent	
	External Independent	
BMP Data Validation		
7	Quality Assurance/Spot Checking	
	Who-qualifications/training/certification	Appendix 3, A6, A7, B10.1, B10.2, B10.3, C1 and D2
	Method to select BMP for follow-up check	
	Method to select the number of BMPs to review	
	Other	
8	Data Entry of BMP Implementation	
	What is the system?	Appendix 3, B10.1, B10.2, B10.3, C1 and D2
	Who enters data (training/certification)?	
	Does the system connect to NEIEN?	
	System in place prevent double counting	
9	External Provided Data Validation Meeting CBP Partnership Guidance	
	Method to validate data	Appendix 3, B10.2, B10.3, C1 and D2
	Who will validate data (training/certification)?	
10	Historic Data Verification	
	System to re-certify or remove	Appendix 3, B10.3, C1, D1 and D2
	Who will verify historic data training/certification)?	
	Documentation of action	
BMP Performance		
11	Does state collect data to assess BMP Performance?	Appendix 3 and D2
	System used to collect BMP performance data?	
	Who collects BMP performance data?	
	Who analyses collected data and report to CBP?	

Source: Derived from Table 7 and Appendix Q in CBP 2014.

A3 – Distribution List

This document is being provided to the Verification Review panel for evaluation and comment and to the following personnel for review and approval.

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The final approved document will be posted to the DEQ [Chesapeake Bay](#) website.

A4 – Project / Task Organization

Pollution reduction tracking data is generated by a coordinated effort among DEQ and other agencies (see section [A6](#) for a complete list). The DEQ NPS Modeling Specialist is responsible for the receipt and preparation of the annual report through the National Environmental Information Exchange Network (NEIEN or EN) to EPA-CBPO and is the designated Project Manager. The DEQ Data Management Analyst assists the NPS Modeling Specialist in compiling and organizing the data by providing overall database expertise. The DEQ Chesapeake Bay Coordinator is the designated Project Quality Assurance Officer and will provide oversight and quality control during the data acquisition and reporting process. The

Chesapeake Bay Grants Administrator is responsible for ensuring all grant deliverables and requirements are met, including the requirement for this Quality Assurance Project Plan. The DEQ Quality Assurance Officer is in an independent unit from those generating the data. The Quality Assurance Officer is responsible for maintaining the official approved Quality Assurance Project Plan. Organization charts showing lines of authority and reporting responsibilities are provided in Appendix 1, [Tables 1](#) and [2](#).

A5 – Problem Definition and Background

In 2014, the Chesapeake Bay Program partnership approved the [Verification Framework](#) which defined verification as “the process through which agency partners ensure practices, treatments and technologies resulting in reductions of nitrogen, phosphorus and/or sediment pollutant loads are implemented and operating correctly” and adopted five principles to guide partners’ efforts as they build on existing local, state and federal practice tracking and reporting systems and make enhancements to their verification program.

Principle	Description
Practice Reporting	Affirms that verification is required for practices, treatments and technologies reported for nitrogen, phosphorus and/or sediment pollutant load reduction credit through the Bay Program. This principle also outlines general expectations for BMP verification protocols.
Scientific Rigor	Asserts that BMP verification should assure effective implementation through scientifically rigorous and defensible, professionally established and accepted sampling, inspection and certification protocols. Recognizes that BMP verification shall allow for varying methods of data collection that balance scientific rigor with cost-effectiveness and the significance of or priority placed upon the practice in achieving pollution reduction.
Public Confidence	Calls for BMP verification protocols to incorporate transparency in both the processes of verification and tracking and reporting of the underlying data. Recognizes that levels of transparency will vary depending upon source sector, acknowledging existing legal limitations and the need to respect individual confidentiality to ensure access to non-cost shared practice data.
Adaptive Management	Recognizes that advancements in practice reporting and scientific rigor, as described above, are integral to assuring desired long-term outcomes while reducing the uncertainty found in natural systems and human behaviors. Calls for BMP verification protocols to recognize existing funding and allow for reasonable levels of

	flexibility in the allocation or targeting of funds.
Sector Equity	Calls for each jurisdiction’s BMP verification program to strive to achieve equity in the measurement of functionality and effectiveness of implemented BMPs among and across the source sectors.

The Partnership agreed that the documentation of each jurisdiction’s BMP verification program would build directly upon their existing QAPP, a standing requirement for recipients of Chesapeake Bay Implementation Grants and Chesapeake Bay Regulatory and Accountability Grants. This document describes the various sources of data, the quality assurance measures taken to acquire and report that data, and the procedures DEQ uses to compile and assure data quality prior to submission to EPA-CBPO.

The Department of Environmental Quality (DEQ) is responsible for reporting annual nonpoint source (NPS) implementation activities, including a digital transfer of NPS Best Management Practice (BMP) information across all NPS sectors via the NEIEN. DEQ is also responsible for transmission of annual wastewater data directly to the EPA-CBPO. DEQ assumed responsibility for the NPS reporting in 2012. Prior to that, the responsibility was with the Department of Conservation and Recreation (DCR).

The EPA, in conjunction with other EN Partners, including the Chesapeake Bay Program partnership, has developed an NPS BMP eXtensible Markup Language (XML) schema that provides a standardized structure and format for the data reporting elements to be transmitted via the EN. An EN Node is in place at DEQ which enables a direct, digital transfer of the NPS information. The EPA-CBPO creates annual progress scenarios using the provided data. Scenario Builder and the Chesapeake Bay Watershed Model (WSM) are then used to estimate the anticipated reductions in nitrogen, phosphorus and sediment loadings to Chesapeake Bay and its tidal tributaries. The resulting information, model outputs, are used along with other lines of evidence to assess progress towards meeting the Chesapeake Bay Total Maximum Daily Load

(TMDL), as well as the goals outlined in Virginia's Watershed Implementation Plans and Two-year Milestones.

A6 – Project / Task Description

The project objectives are to fulfill EPA-CBPO's annual reporting requirements as outlined in the [Bay Grant Guidance](#) by supplying annual nutrient reduction implementation data for the period July 1 through June 30 of the reporting year. This data is provided to EPA-CBPO for inclusion in the annual watershed model progress evaluations on or before December 1 of each year or as otherwise stipulated in the grant documents. Until the Phase 6 version of the watershed model is available, DEQ reports annual BMP implementation only once, the year the practice is implemented. All non-annual BMPs are accumulated by EPA from data submitted in previous years for annual progress runs. When the [Verification Framework](#) is fully implemented, BMPs with no documented inspection, maintenance or spot checks to confirm continued function will be dropped from the BMP record at the end of their credit duration.

All reported BMPs are documented in the most recent version of the National Environmental Information Exchange Network (NEIEN) NPS BMP CBP Data Flow Appendix A (available at <http://webservices.chesapeakebay.net/schemas/>). DEQ will continue to work with EPA-CBPO to keep information in the Appendix up to date.

The following table lists potential sources of data that may be included in the data capture, aggregation, and reporting associated with this project along with a link to additional details on the programs that drive the implementation of those BMPs that may be reported by the source (see [Appendix 2](#) for a detailed data flow diagram).

Data Source	BMPs Provided	POC
Department of Environmental Quality	Urban Stormwater	Fred Cunningham
Department of Environmental Quality	Wastewater	Allan Brockenbrough
Department of Environmental Quality	Erosion & Sediment Control	Drew Hammond
Department of Environmental Quality	Manure Transport	Neil Zahradka
Department of Environmental Quality	319 Grant Projects	Nicole Sandberg
Department of Environmental Quality	SLAF/WQIF Grant Projects	Walter Gills
Department of Environmental Quality	Bay Grant Projects	Lara Kling
Department of Conservation & Recreation	Agriculture	Darryl Glover
Department of Conservation & Recreation	Agriculture Nutrient Management	Tim Sexton
Department of Conservation & Recreation	Manure Transport	Tim Sexton
Department of Conservation & Recreation	Urban Nutrient Management	Tim Sexton
Department of Conservation & Recreation	Feed and Manure Additives	Tim Sexton
Virginia Department of Health	Septic	Dwayne Roadcap
Department of Forestry	Forest Harvesting Practices	Greg Evans
Department of Mines, Minerals & Energy	Abandoned Mine Reclamation	Tom Bibb
Department of Mines, Minerals & Energy	Extractive Erosion & Sediment Control	Tom Bibb
Virginia Department of Agriculture and Consumer Services	Voluntary and Resource Improvement Agriculture	Darrell Marshall
Virginia Department of Transportation	Urban Stormwater	Roy Mills
Phase 1 MS4s (11 Local Governments)	Urban Stormwater	Jaime Bauer
Phase 2 MS4s (Regulated portions of Cities, Counties, Towns and Federal, State and Municipal Facilities)	Urban Stormwater	Jaime Bauer
Bay Act Localities (84 Cities, Counties and Towns)	Septic Pumpout, Erosion & Sediment Control, and Urban Stormwater	Joan Salvati
Local Governments (approximately 200 Cities, Counties and Towns)	Urban Stormwater	James Davis-Martin
Federal Facilities (approximately 200)	Any	James Davis-Martin
NRCS	Agriculture	Olivia Devereux
FSA	Agriculture	Olivia Devereux
Alliance for the Chesapeake Bay	Urban Stormwater (residential scale)	Nissa Dean
National Fish and Wildlife Foundation	Any	Jake Reilly

BMPs reported through this project have been determined to meet the Chesapeake Bay Program BMP definitions. The complete list of Bay Program BMPs, their definitions and information about how they are simulated in the WSM are available online in the documentation of the [Chesapeake Assessment and Scenario Tool](#). The subset of these BMPs that are commonly reported in Virginia can be found in [Appendix 4](#).

Further information regarding the quality assurance, quality control, and management of these datasets can be found in sections [A.7](#), [B.9](#), [B.10](#), and [D](#) of this document.

A7 – Quality Objectives and Criteria

DEQ seeks to provide EPA-CBPO with the highest quality data possible and to ensure practices, treatments and technologies resulting in reductions of nitrogen, phosphorus and/or sediment pollutant loads are implemented and operating as intended through time. The intent of this section is to establish the expected minimum standards for data quality and verification for each class of BMPs. Because this project involves the aggregation of data from many diverse sources, DEQ does not have direct involvement or control over much of the original data collection and reporting. As such, data providers will need to document, and improve as necessary, their QA procedures. DEQ does anticipate many improvements to quality assurance actions during the BMP verification program development process and acknowledges that this document will experience many iterative changes in the coming years. In the interim, DEQ will work towards implementing a three-tiered data reporting system that will indicate the level of quality assurance and quality control (QA/QC) associated with a given data source. The first and lowest tier will be comprised of sources that have not provided any documentation to DEQ regarding QA/QC procedures. The second tier will include data sources that have some documented QA/QC procedures but not an approved QAPP/SOP; this tier may include, for example, regulatory programs that have established protocols for data collection and reporting. The third and final

tier will contain sources that have complete and approved QAPP/SOPs. The intent is to move each reporting source through the tiers over time, striving to have all data providers at tier three by 2018.

When DEQ receives data from any source, there are certain qualitative accuracy and completeness objectives that are implemented. All data is reviewed for completeness (required information is present or not) and appropriate formatting that can be readily transferred or modified to allow posting to the EN. If data sets are missing required information or are received in an unusable format, attempts are made to contact the data provider and explain what issues exist in the provided data that prohibit its use in the annual progress data exchange. Required information includes: dates of installation that coincide with the annual reporting window of June 30 through July 1 of the reporting year, correct information for BMPs such as proper units, and location information indicating that the implementation occurred within Virginia's Chesapeake Bay drainage. More detailed location information consistent with the functional capabilities of the models, such as Hydrologic Unit, City/County or latitude/longitude, will be used as the data is available and allowable. Examination for anomalous data is performed through comparison to previous years' reported data. For example, if millions of acres of BMPs are reported instead of typically thousands of acres, or if nothing is reported from a significant data source, efforts will be made to contact the data provider and confirm or revise the data in question.

Every attempt is made to contact missing data providers before internal deadlines lapse. If data is received after established deadlines and it is complete and formatted appropriately, every effort is made to include that information. DEQ continues to work to develop and refine

these qualitative accuracy and completeness procedures; updates will be provided in future iterations of the QAPP.

A8 – Special Training Certifications

DEQ does not anticipate any specialized training and certifications requirements for Verification. Training and certification for DEQ internal data are inherent to the regulatory programs from which the data is generated. Information on the training and certification requirements for these programs can be found by following the links in the table in [A6](#). Programmatic training and certification requirements for the external data providers described in [B10.2](#) are documented in their respective QAPP/SOPs. These can be accessed, where available, by following the links in the table in [D1](#).

To begin the public education process and communication of these verification expectations, DEQ will post this Verification Program Plan, once approved, conspicuously on their [Chesapeake Bay](#) website and provide a copy to all data providers. Additionally, EPA has committed to provide verification training (e.g., webinars, meetings) and support the development and distribution of outreach materials, in cooperation with other Bay Program partners.

A9 – Documentation of Records

Each data provider will need to maintain documentation of their own records. Because this project involves the aggregation of data from many diverse sources, DEQ does not have direct involvement or control over much of the original data collection, management, and reporting. When DEQ receives data from individual sources it reviews the data for completeness and format and ensures appropriate quality assurance and verification protocols are in place for the data provider. Copies of all data sets are stored on the NPS Modeling Specialist's computer

and backed up daily on external and network drives, creating a dual redundant backup of all reported information.

All processed data is sent to the DEQ Office of Information Services (OIS). OIS places all Excel files from the NPS Modeling Specialist and all XML instance files created from those Excel files onto a DEQ network drive. The Virginia Information Technology Agency (VITA) also backs up all network drives nightly on servers located at their secure facility in Chesterfield County. All data is retained in perpetuity.

DEQ anticipates developing a network database to store or link to all sources of data. This system will improve data accessibility, automate some quality assurance process, expedite conversion to XML and allow for management of BMP credit durations. The system would allow DEQ to notify data providers of BMPs approaching the end of their creditable life, and to solicit updates to those records demonstrating dates of any recent maintenance, inspections or spot checks.

Group B – Data Generation and Acquisition

B1 – Sampling Process Design (Experimental Design)

This section does not apply to this QAPP.

B2 – Sampling Methods

This section does not apply to this QAPP.

B3 – Sample Handling and Custody

This section does not apply to this QAPP.

B4 – Analytical Methods

This section does not apply to this QAPP.

B5 – Quality Control

This section does not apply to this QAPP.

B6 – Instrument / Equipment Testing, Inspection, and Maintenance

This section does not apply to this QAPP.

B7 – Instrument / Equipment Calibration and Frequency

This section does not apply to this QAPP.

B8 – Inspection / Acceptance of Supplies and Consumables

This section does not apply to this QAPP.

B9 – Non-direct Measurements

Current data submissions include three classes of BMPs derived from non-direct measurements, Feed and Manure Additives practices, Tillage practices and some Urban Nutrient Management.

The feed and manure additive BMPs include phytase for poultry and phytase for swine. These BMPs are collected and reported based on past cooperative agreements with integrators and the results of manure sampling indicating a change in phosphorus concentrations from a baseline.

Tillage practices, which include Conservation Tillage and High Residue, Minimum Soil Disturbance Tillage Management, are based on survey results from Conservation Technology Information Center (CTIC) historically and beginning in 2016 from a planned quinquennial, Virginia specific, transect tillage survey. The survey data is then supplemented with new implementation directly measured through implementation of cost-share practices. Row crop land in Virginia is being surveyed in 2015 and early 2016 to update existing rates of conservation tillage practice, which were last determined in 2004 or 2007 on a county by county basis by the

CTIC. The surveyors will be measuring the amount of residue they encounter and classifying it as <30% crop residue, 30-59%, or 60% and greater. These levels correspond with the Bay Program BMP definitions. It is believed that conservation tillage as a BMP has increased significantly since the 2004-2007 timeframe.

The surveys are being conducted in the manner in which the previous CTIC tillage surveys were, except that we are only recording 6 crop types being grown on the surveyed fields as opposed to the 23 or so crop types which CTIC recorded. Our statistical goal is to be 90% certain that our derived rates of conservation tillage per survey unit are within $\pm 5\%$ of what we is the actual on-the-ground rate. For our results to meet this statistical goal requires a minimum number of survey collection points, and that number is influenced by the estimate of the conservation tillage rate we expect to occur in each survey unit based on previous knowledge (the rate established from the 2004/2007 surveys). The surveys are planned to be updated every five years.

Urban nutrient management relies in part on non-directly measured information. DCR has for the past several years entered into cooperative agreements with urban lawn care companies where the company commits to following turf nutrient management standards on their contracted acreage without having to develop formal nutrient management plans for that land. These acres are reported as Urban Nutrient management just as if they had plans in place.

B10.1 – Data Management: DEQ Internal Data

DEQ internal program data is derived from regulatory requirements or grant programs. The regulatory programs include expectations of data quality assurance and the use of inspections and audits as a means for verifying them. The grant data is collected in accordance with grant guidance and contractual agreements. These agreements currently include some

quality assurance requirements. Moving forward, this language will be reevaluated to ensure the expectations for rigorous quality assurance and verification requirements are clear.

DEQ Program	BMP Types
Urban Stormwater (MS4, VSMP, Bay Act, Industrial Stormwater)	Urban Stormwater
VPDES Wastewater	Discharge Data
Erosion & Sediment Control	Erosion & Sediment Control
Land Application	Manure Transport
319 Grant Projects	Any
SLAF/WQIF Grant Projects	Urban Stormwater
Bay Grant Projects	Any

The internal data is stored in DEQ Agency network databases and documents as it is received. These databases are secured and backed up backed up daily on external and network drives, creating a dual redundant backup of all reported information. These data handling and backup procedures follow state information technology standards. The internal DEQ data for annual BMP reporting is drawn from these sources during the annual progress data collection process. The data is selected based on the date implemented based on the progress year established in the Chesapeake Bay Program progress. Quality assurance checks are conducted to identify and correct any data inconsistencies or outliers. The internal data then proceeds to follow the process described in section [B10.3](#).

B10.2 – Data Management: External Data

The table below provides a list of all external data sources that may provide data to DEQ for reporting to EPA-CBPO through NEIEN. The source organization and sector BMPs are indicated.

Data Source	BMPs Provided
Department of Conservation & Recreation	Agriculture
Department of Conservation & Recreation	Agriculture Nutrient Management
Department of Conservation & Recreation	Manure Transport
Department of Conservation & Recreation	Urban Nutrient Management

Department of Conservation & Recreation	Feed and Manure Additives
Virginia Department of Health	Septic
Department of Forestry	Forest Harvesting Practices
Department of Mines, Minerals & Energy	Abandoned Mine Reclamation
Department of Mines, Minerals & Energy	Extractive Erosion & Sediment Control
Virginia Department of Agriculture and Consumer Services	Voluntary and Resource Improvement Agriculture
Virginia Department of Transportation	Urban Stormwater
Phase 1 MS4s (11 Local Governments)	Urban Stormwater
Phase 2 MS4s (Regulated portions of Cities, Counties, Towns and Federal, State and Municipal Facilities)	Urban Stormwater
Bay Act Localities (84 Cities, Counties and Towns)	Septic Pumpout, Erosion & Sediment Control, and Urban Stormwater
Local Governments (approximately 200 Cities, Counties and Towns)	Urban Stormwater
Federal Facilities (approximately 200)	Any
NRCS	Agriculture
FSA	Agriculture
Alliance for the Chesapeake Bay	Urban Stormwater (residential scale)
National Fish and Wildlife Foundation	Any

When DEQ receives data from individual sources it reviews the data for completeness and format and ensures appropriate quality assurance and verification protocols are in place for the data provider. Copies of all data sets are stored on the NPS Modeling Specialist's computer and backed up daily on external and network drives, creating a dual redundant backup of all reported information.

DEQ has invested significant effort pursuing a 1619 Conservation Cooperator agreement with USDA. Unfortunately, the efforts have been unsuccessful to date. As a result, DEQ must rely on aggregated data provided through a USDA agreement with USGS. Absent detailed USDA data, the information cannot be examined for elimination of duplicate records with respect to DCR's Virginia Agricultural Cost-Share (VACS) BMP dataset. As such, the data fails to meet the Partnership's verification standards and must be excluded from the data

reporting. It is clear that USDA is a significant contributor to agricultural BMP implementation, that the exclusion of this data is not in the best interest of accurately simulating nutrient and sediment reductions to the Bay and the absence of historical USDA implementation data will adversely impact the calibration of the Phase 6 watershed model, but the Verification Framework is equally clear that unverified data should not be reported and is not eligible for credit.

There are several possible solutions that could resolve this issue.

1. If the Verification Review Panel and EPA could authorize an exception from the verification requirements for the USDA data. DEQ could then submit the aggregated data in our NEIEN submission.
2. USDA could engage a third party to identify and eliminate duplicate records, then aggregate the data and provide the clean dataset to DEQ. This alternative would require USDA, or their third party contractor, to clearly document the duplicate record identification and removal process, as well as their data validation, verification and management procedures and submit that to DEQ as assurance that the process satisfies the Bay Program Verification principals.
3. USDA could provide DEQ the limited 1619 authority and detailed data needed to identify and eliminate duplicates.

B10.3 – Data Management: Reporting to EPA-CBPO

All internal and external data sources are queried or examined, for a given reporting year (July 1 – June 30), for BMP installations reportable to CBPO. This process includes the identification and elimination of potentially duplicative reporting and when the Verification Framework is fully implemented, a process for eliminating practices beyond their credit duration.

While many of the BMP data sources have the potential for duplicative reporting, the

largest risk for failing to identify such a duplicate record lies with agricultural BMPs that may be jointly cost-shared by the state program and USDA. Until such time that detailed USDA data can be shared with DEQ or another process is established to compare the state and USDA detailed records to account for duplicate reporting, DEQ will exclude all USDA data.

All processed data is sent to the DEQ Office of Information Services (OIS). The Excel files are combined with other tables in the DEQ Comprehensive Environmental Database System (CEDS) database to map BMP installations to the EN XML schema. The resulting XML file is transmitted to EPA via established protocols. The most recent guidance documents for EN data inputs are used for this work. The schemas, Appendix A, codes list and other guidance is available at <http://webservices.chesapeakebay.net/schemas/>.

OIS places all Excel files from the NPS Modeling Specialist and all XML instance files created from those Excel files onto a DEQ network drive. VITA backs up all network drives nightly on servers located at their secure facility in Chesterfield County. All data is retained in perpetuity.

DEQ is developing a network database to store or link to all sources of BMP data. This system will improve data accessibility, automate some quality assurance and data validation processes, expedite conversion to XML and allow for management of BMP credit durations. The system will allow DEQ to notify data providers of BMPs approaching the end of their creditable life, and to solicit updates to those records demonstrating dates of any recent maintenance, inspections or spot checks. The basic BMP upload, some initial QA/QC functions and an automated feedback procedure for data providers has been deployed for internal DEQ use. Additional functionality to translate BMP data for reporting through NEIEN will be completed in early December 2015. Our intent is to use the system to report 2015 Progress

replacing the procedures described in the preceding two paragraphs. Full deployment to all data providers for 2016 Progress is planned as are modifications to this QAPP to thoroughly document the new process.

Group C – Assessment and Oversight

C1 – Assessments and Response Actions

The quality objectives and criteria described in section [A7](#) and the data management procedures described in [B10](#), which collectively describe DEQ’s data validation procedures along with the verification procedures outlined in section [D](#) are used to evaluate the quality of internal and external data sets. If data sets are missing, incomplete, are received in an unusable format, or fail to meet the verification requirements for the appropriate BMP class, attempts are made to contact the data provider and explain what issues exist in the provided data that prohibit its use in the annual progress data exchange. Every attempt is made to resolve identified data issues before the reporting deadlines occur. In the event that data issues are not resolved, DEQ will exclude the data in question from the submitted dataset.

The historical record of BMPs will be evaluated annually to determine which BMPs are approaching the end of their credit duration. DEQ will notify data providers of BMPs approaching the end of their creditable life, and solicit updates to those records demonstrating dates of any recent maintenance, inspections or spot checks. When the Verification Framework is fully implemented, BMPs with no documented inspection, maintenance or spot check based, statistically derived BMP verification rate will be dropped from the BMP record at the end of their credit duration.

C2 – Reports to Management

This section does not apply to this QAPP.

Group D – Data Validation and Usability

D1 – Data Review, Verification, and Validation

The following table provides the list of potential internal and external providers of practices implemented within Virginia and which may be reported by DEQ for nutrient and sediment pollutant load reduction credit in accordance with the Chesapeake Bay Program Partnership’s [Verification Principals](#). Because DEQ is an aggregator of data from many diverse sources, DEQ does not have direct involvement or control over much of the original data collection and reporting. Therefore, the table includes a link to the originating organization’s internal quality assurance procedures (where available). Over the coming years, DEQ will work with data providers to document, and improve as necessary, their QA procedures. The QA procedures of the data providers is supplemented by the quality objectives and criteria described in section [A7](#) and the data management procedures described in [B10](#), which collectively describe DEQ’s data validation procedures. Data verification standards are outlined in section [D2](#). Any dataset that fails to meet these standards for validation and verification will, upon full implementation of the Verification Framework, result in exclusion of that data from the DEQ reporting of practices, treatments and technologies resulting in reductions of nitrogen, phosphorus and/or sediment pollutant loads in the Chesapeake Bay.

Data Source	BMPs Provided	QA Documentation Link
Department of Environmental Quality	Urban Stormwater	DEQ QAPP
Department of Environmental Quality	Wastewater	DEQ QAPP and Regulations
Department of Environmental Quality	Erosion & Sediment Control	DEQ QAPP
Department of Environmental Quality	Manure Transport	DEQ QAPP
Department of Environmental Quality	319 Grant Projects	DEQ QAPP
Department of Environmental Quality	SLAF/WQIF Grant Projects	DEQ QAPP
Department of Environmental Quality	Bay Grant Projects	DEQ QAPP
Department of Conservation & Recreation	Agriculture	DCR QAPP (Update Planned)
Department of Conservation & Recreation	Agriculture Nutrient Management	DCR QAPP (Update Planned)
Department of Conservation & Recreation	Manure Transport	DCR QAPP (Update Planned)
Department of Conservation & Recreation	Urban Nutrient Management	DCR QAPP (Update Planned)
Department of Conservation & Recreation	Feed and Manure Additives	DCR QAPP (Update Planned)
Virginia Department of Health	Septic	VDH QAPP (Planned)
Department of Forestry	Forest Harvesting Practices	DOF SOP
Department of Mines, Minerals & Energy	Abandoned Mine Reclamation	DMME SOP (Planned)
Department of Mines, Minerals & Energy	Extractive Erosion & Sediment Control	DMME SOP (Planned)
Virginia Department of Agriculture and Consumer Services	Voluntary and Resource Improvement Agriculture	VDACS SOP (Planned)
Virginia Department of Transportation	Urban Stormwater	VDOT SOP (Planned)
Phase 1 MS4s (11 Local Governments)	Regulated Urban Stormwater	Regulatory Guidance
Phase 2 MS4s (Regulated portions of Cities, Counties, Towns and Federal, State and Municipal Facilities)	Regulated Urban Stormwater	Regulatory Guidance
Bay Act Localities (84 Cities, Counties and Towns)	Septic Pumpout, Erosion & Sediment Control, and Urban Stormwater	Regulatory Guidance
Local Governments (approximately 200 Cities, Counties and Towns)	Urban Stormwater	SOPs (Planned)
Federal Facilities (approximately 200)	Any	SOPs (Planned)
NRCS	Agriculture	SOP (Planned)
FSA	Agriculture	SOP (Planned)
Alliance for the Chesapeake Bay	Urban Stormwater (residential scale)	SOP (Planned)
National Fish and Wildlife Foundation	Any	SOP (Planned)

D2 – Verification and Validation Methods

The table in Appendix 3, based on the Jurisdictional Verification Protocol Design Table from the Verification Framework document, outlines DEQs verification expectations for all practices, treatments and technologies reported for nitrogen, phosphorus and/or sediment pollutant load reduction credit through the Bay Program. The verification program design includes scientifically rigorous and defensible, professionally established and accepted methods to assure reported BMPs are in place and functioning prior to reporting and that function remains intact through time. Varying methods are used for different BMP groups based on the specific traits of that group and to ensure the cost-effectiveness of the program. While different BMP groups have different verification procedures or frequencies, the overall framework strives to achieve equity in the measurement of functionality and effectiveness of implemented BMPs among and across the source sectors.

One approach to grouping and assessing BMPs for verification, identified in the guidance, uses estimates of the potential nutrient and sediment reductions associated with BMPs based on Watershed Implementation Plans to stratify or prioritize practices. The guidance also provides a default sampling rate of 10% for re-inspecting the practices. The default sampling rate was intended as a placeholder, pending the development of scientifically defensible, statistical sampling protocols. While both of these approaches are included in the guidance, they do not represent the only viable approaches to designing a Verification Protocol. The verification framework specifically allows for jurisdictional flexibility in designing their verification protocols, as long as the five Verification Principals remain sound. Virginia has elected to group BMPs by sector, delivery program and risk rather than the default breakout and prioritization used in the guidance. Furthermore, Virginia has taken the time to develop a

statistically valid sampling approach for a number of BMPs. This approach has been reviewed by the Statistical Design Review Team (SDRT), an independent team of experts in statistical sample design, appointed by the Verification Review Panel. The SDRT has confirmed that Virginia's statistical sampling approach is valid and when implemented will produce results that have a minimum of 90% confidence \pm a 5% margin of error. In other words, when we evaluate a sample of the population, we will know that there is a 90% chance that the results are within 5% of the correct answer for the entire population. This confidence interval exceeds the expectations established in the guidance of 80% and serves as a strong example for the expected confidence other model inputs (e.g. Land use) should strive for.

Additional details relating to the statistical sampling and Virginia's overall approach to Verification can be found throughout the narrative of this document and is summarized in [Appendix 3](#). Additional details and calculations associated with the statistical sampling approach can be found in [Appendix 5](#).

The development of Verification Protocols is intended to be an iterative and adaptive process. The Verification Framework and Bay Grant Guidance calls for the quality Assurance Plans to be reviewed and updated annually, as needed. As new BMPs are approved, or implementation programs evolve, the document will be updated to reflect those changes. The same is true of the statistical sampling approach. The sample findings will guide future adaptation of the sampling approach, including potential re-stratification. Should a few BMP types or geographic areas show higher failure rates, the sampling approach will be adaptively adjusted. Should the sample data reveal increasing trends in BMP failure rates, that may indicate the need to reconsider the broader Verification approach. The key is that this approach begins to build a robust data collection capability that can, with great confidence, ensure reported

BMPs are functioning as intended through time as well as empower science based decision making and adaptation in the future

Agriculture

Verification procedures for BMPs in the agriculture sector are outlined in [Appendix 3, Table 1](#). The BMPs are subdivided into verification groups based on the type of practice (management, structural, annual, land conversion), program type (cost-share, voluntary, regulatory, cooperative), credit duration, and the risk for failure. Details of this grouping can be found in [Appendix 4, Table 1](#). result is nine verification groups, each with specific procedures for initial inspection, follow-up checks and lifespan/sunset provisions. Additionally, any agricultural BMPs required in CAFO/AFO permits are subject to compliance inspections associated with those programs. These regulatory compliance inspections are independent of and in addition to this verification protocol and will serve to add additional confidence in the BMPs installed on CAFO/AFO sites.

Onsite initial inspections are the standard for all but three of the agricultural verification groups. Tillage practice reporting will be based on a transect survey, described in section [B9](#) of this plan. The transect survey approach was reviewed by the SDRT and found to be sufficient for use in the Bay Program modeling system. Manure transport reporting will be based on weigh station tickets from manure haulers and transport records required in Poultry General Permit ([9VAC630](#)). Finally, reports of feed additives will come from a combination of cooperative agreements with the integrators that dictate feed composition for their animals and manure samples from growers for each integrator. The manure samples are typically taken at time of clean-out, permit renewal and annually for permitted operations. The manure sample phosphorus concentrations are compared to historical data preceding the addition of phytase to

the feed. These three classes of BMPs do not lend themselves to traditional onsite inspections to ensure implementation, but these alternate measures represent a reasonable approach to satisfying the Verification requirements.

Several alternative approaches are used for the follow-up inspections to ensure reported BMPs are still in place and functioning as intended. Annual practices typically do not have follow-up checks. Stratified random sampling will be used to spot check the BMPs in several verification groups as part of the follow-up inspection process. The statistical sample size calculations can be found in [Appendix 5](#).

Calculation of statistical sample size and confidence intervals requires some assumption or prior knowledge (data) of the size of the population and the anticipated pass/fail rate of the sample (response distribution). The existing Virginia Cost-Share Program has a strong database of all practices installed through the history of the program and documented results from past spot checks that have found a 97% compliance rate for practices within the contractual period. This data is included in [Appendix 6](#). It should be noted that failure to maintain BMPs during the contractual period also carries the potential for financial penalty to the producer. This requirement to repay cost-share funds if practices are not maintained serves as a significant deterrent to non-compliance. Additionally, cost-shared practices are designed and installed following strict standards and there is robust initial inspection (100% onsite initial verification) to ensure the practices, as built, meet those strict design standards. Even with the historical spot check data and these additional lines of evidence that reduce the probability of failure, to be conservative, the assumed pass/fail ratio used for this verification group is 85/15.

The next grouping includes those practices that were previously designed and installed in accordance with the strict standards of agricultural cost-share programs, but no longer have a

contractual maintenance requirement. Based on the robustness of the design, construction and initial verification these practices, they are assumed to have a relatively low rate of failure, but double that of practices within the contractual period. The sample size used for this verification group is calculated with the assumption of a 20% failure rate. However, due to the proximity of stream exclusion practices and the associated buffers to waterways with the potential for flooding that may adversely impact the practices, and the fact that farm operations could continue with minimal interruption after such a failure, these practices, within this verification group, are deemed to have a higher risk of failure. An assumed failure rate of 30% is used for sample size calculations for the stream exclusion practices and associated buffers that have no contractual requirement for maintenance.

The last verification grouping in the agricultural sector that uses statistical sampling for follow-up inspections includes all practices that meet the Bay Program approved definitions of Resource Improvement Practices. In general, these are BMPs that are similar to a cost-shared BMP, but do not meet the same design and construction standards. Despite this fact, these BMPs have been determined during the initial onsite inspection to be functioning and producing a resource improvement. Typically, these practices have been voluntarily installed at the producers' full expense. These practices have shorter credit durations in the modeling system which will result in the removal of the practice from the models unless a re-inspection is conducted. The high level of producer initiative and investment in the practices in this group lends itself to a high likelihood that the practices will be continually maintained. However, because of the uncertainty in the design and lack of contractual maintenance, the statistical sample for this group assumed a 40% failure rate. This group also separates out the stream

exclusion practices and associated buffers and assumes a higher failure rate of 50% for these practices. To date, Virginia has not reported any BMPs that would fall into this grouping.

These calculations and the resulting sampling design will be reevaluated triennially, incorporating the results obtained from the previous samples. The goal of the verification program is to strive for a 90% confidence level with a margin of error of $\pm 5\%$ for sample based follow-up inspections. This confidence interval exceeds the expectations established in the guidance of 80% and is in line with the expected confidence of other model inputs (e.g. Land use).

The Bay Program approved credit durations will be used as the basis for removing reported BMPs for all verification groups in the agricultural sector unless the practices are re-inspected to verify continued operation. DCR plans to conduct 100% re-inspections for all structural and land use change BMPs prior to the end of their credit duration. While this is encouraged for other providers of agricultural BMP data, it is not a requirement for satisfying the verification standard. For practices within their model credit duration, the information from the statistical sample based follow-up checks will be used to remove practices from the reporting record based on identified failure/abandonment rates in each BMP verification group.

Forestry

Verification procedures for BMPs in the Forest sector are outlined in [Appendix 3, Table 3](#). The two BMPs included in this sector can be found in [Appendix 4, Table 3](#). The forest harvesting BMP is an annual practice in the Bay Program modeling systems. This practice has initial inspections conducted by the Department of Forestry in accordance with the Virginia silvicultural law. Based on these inspection the Department of Forestry provides DEQ with data on the total acres of harvested forest in Virginia's Bay Watershed and the extend of that which was found to have forest harvesting practices in place and functioning. Because this practice is

and annual BMP in the modeling system, there is no requirement for follow-up inspections for the purpose of verification.

Reporting of the Forest Conservation BMP requires documentation of appropriate local ordinances requiring the preservation of trees when parcels are developed and the acres of forest conserved as a result. The extent of forest conservation must meet the Bay Program definition in order for the practice to be reportable. These ordinances remain in effect until changed or removed and areas of forest conserved under the ordinance would likely remain in perpetuity even if the ordinance were rescinded. The Bay Program credit duration for this practice of one year is inappropriate and this BMP should be treated as a permanent practice.

There are BMPs included in the agricultural and urban sectors that involve trees, such as riparian forest buffers, but these practices will be verified in accordance with the protocols specific to those sectors. The proposed site inspections for these forest related practices will include consideration of the common maintenance issues related to water quality for such practices (e.g. tree survival, channelization).

In addition to the verification protocols described in [Appendix 3](#), the Department of Forestry does have a memorandum of understanding with FSA, NRCS and DCR to provide technical assistance in support of Riparian Forest Buffer establishment projects. DOF's role is to provide a planting plan to include species selection, planting density, site preparation if needed (either mechanical, chemical, or both). During the planting operation or shortly thereafter, the DOF forester will perform a planting quality check to insure that the trees were planted according to the plan and correctly planted, including species size and type, planting density, installation of tree shelters and mats (if required) and appropriate competition control. Two years post planting, the DOF forester will again perform an inspection to check on planting survival, competition for planted seedlings and any maintenance that may be required. This

information is provided to the landowner as well as the agency that is providing the cost-share funding for the project, any planting failures would be required to be re-planted at that point. The agency that provided the cost-share (NRCS, FSA, DCR through SWCD's) would then be responsible to perform periodic spot checks for continued maintenance of the project through the contract period. DOF partners with those agencies to perform some of these spot checks as time allows. DOF has been involved through a technical service agreement to re-visit CRP/CREP Projects to insure adequate tree density for CREP Re-enrollment, this is likely to occur annually as projects come up for re-enrollment. In addition to the cost-share practices that fall under this MOU, planting quality inspection and survival inspection are standard operating procedure for all DOF buffer planting projects as well as hardwood open field planting projects in the Commonwealth.

Stream Restoration and Wetlands

Verification protocols for stream restoration and wetland practices are included in the appropriate source sector. Specifically, protocols for urban stream restoration and wet ponds/wetlands are included in the urban sector. Non-urban Stream Restoration, Stream Access Control (Stream Crossings) and agricultural wetland restoration are included in the agricultural sector protocols.

Stream restoration practices are a highly regulated activity, typically requiring permit coverage from both state and federal agencies. The oversight provided by these permitting programs is in addition to and strengthens the onsite verification protocols described in this document. Inspection checklists are commonly used as part of state regulatory inspections. Where appropriate, these tools will be adapted for use specifically for inspection of stream

restoration projects to ensure follow-up inspections consider both the continued presence of the structures as well as their function to control nutrient and sediment loads.

Practices reported as wet ponds/wetlands in the urban sector are typically designed to address the storm water flows and loads originating from the drainage area to the facility. These designs may or may not include wetlands as part of the functional design of the system. Where wetlands are part of the practice functional design, storm flows and inundation durations are factored into the wetland siting, species selections, planting densities and other design characteristics. Agricultural wetland restoration projects can be designed for different purposes. Some designs may focus on waterfowl habitat while others have a more water quality focus. When implemented through the Virginia Agricultural Cost-Share Program, the practice design and construction standards are specified in the [DCR Cost-Share manual](#). Shoreline management practice incorporating living shoreline techniques could also be seen as restoring or protecting wetlands. These practices will also follow the protocols of the sector, agriculture or urban, where the practice is implemented and reported. Follow-up inspections of wetland related practices will consider both the continued presence of the systems as well as their function to control nutrient and sediment loads.

Urban

Verification procedures for BMPs in the urban sector are outlined in [Appendix 3, Table 2](#). The BMPs are subdivided into verification groups based on the type of practice (management, structural, annual, land conversion), program type (cost-share, voluntary, regulatory, cooperative), credit duration, and the risk for failure. Details of this grouping can be found in

[Appendix 4, Table 2](#). The result is ten verification groups, each with specific procedures for initial inspection, follow-up checks and lifespan/sunset provisions.

Many of the BMPs implemented in the urban sector are required by permits or regulatory programs. These programs and permits include requirements for BMPs to be properly installed and maintained. Typically, this includes a requirement that a maintenance agreement be recorded with the parcel's land records. These regulatory programs also include compliance and enforcement processes that ensure the regulatory requirements are being followed. When program compliance inspections reveal BMPs that are not properly maintained, the permittees are typically given no more than 90 days to resolve the issues and provide documentation of such actions to the inspectors. Collectively, these procedures ensure the proper initial implementation and continued operation of the BMPs installed pursuant to these regulatory programs. As such, this class of BMPs is expected to be maintained in perpetuity. DEQ will continue its oversight of inspection and maintenance requirements for practices in urban regulated sector to ensure practices remain in place and functioning.

Onsite initial inspections are the standard for all but two of the urban verification groups. Street sweeping practice reporting will be based on weigh station reports indicating the date and weight of material collected or by vehicle logs documenting the area swept. The second practice without onsite initial inspection is the Urban Phosphorus Fertilizer Reduction practice. This credit is based on the established regulations prohibiting phosphorus in lawn maintenance fertilizer. Beginning with the progress data submission in December 2016, the preliminary default credit for this practice will be replaced with documented changes in non-agricultural fertilizer sales data for phosphorus. These two classes of BMPs do not lend themselves to traditional onsite inspections to ensure implementation, but these alternate measures represent a

reasonable approach to satisfying the Verification requirements. Only BMPs satisfying the Bay Program BMP definitions will be reported, even though regulatory programs may accept additional implementation information to satisfy their permitting requirements.

Several alternative approaches are used for the follow-up inspections to ensure reported BMPs are still in place and functioning as intended. Annual practices typically do not have follow-up checks. BMPs installed with no regulatory requirement represent a unique challenge. In the non-regulated urban sector BMP reporting is voluntary, as is BMP inspection. The protocol takes a practical approach, attempting to notify the BMP reporting source of the need for re-inspections as BMPs approach the end of their credit duration. The notification will recommend a re-inspection to verify continued performance and provide the procedures for reporting data documenting such re-inspections. Inspection updates provided by reporting sources will be used to update data records and extend credit life. If no updates are received, credit durations will require removal of the record from the reporting system.

Statistical sampling will be used to spot check the Urban Nutrient Management Plan and Urban Nutrient Management Certified Applicator groups. The statistical sample size calculations can be found in [Appendix 5](#). The sample size will be reevaluated at least triennially, incorporating the results obtained from the previous samples. The goal of the verification program is to strive for a 90% confidence level with a margin of error of $\pm 5\%$ for sample based follow-up inspections. In other words, when we evaluate a sample of the population, we will know that there is a 90% chance that the results are within 5% of the correct answer for the entire population. This confidence interval exceeds the expectations established in the guidance of 80% and serves as a strong example for the expected confidence other model inputs (e.g. Land use) should strive for.

With the exception of BMPs installed pursuant to regulatory requirements, the Bay Program approved credit durations will be used as the basis for removing reported BMPs for all verification groups in the urban sector unless the practices are re-inspected to verify continued operation. Information from the sample based follow-up checks and regulatory compliance programs will also be used to remove practices from the reporting record based on identified failure/abandonment. BMPs found to have problems that are not returned to functionality within 90 days will be excluded from the reporting record. Only when full function is restored will those practices be added back to the reporting record.

Wastewater, Onsite, and Extractive

Verification procedures for BMPs in the Wastewater, Onsite, Forest and Extractive sectors are outlined in [Appendix 3, Table 3](#). The BMPs are subdivided into verification groups based on the sector, type of practice (management, structural, annual, land conversion), program type (cost-share, voluntary, regulatory, cooperative), credit duration, and the risk for failure. Details of this grouping can be found in [Appendix 4, Table 3](#). The wastewater sector is included in this section of Verification Protocol Design Table as well, although it is not typically thought of as a BMP. The result is seven verification groups, each with specific procedures for initial inspection, follow-up checks and lifespan/sunset provisions.

The first two verification groups are for the wastewater sector. Both the significant and non-significant wastewater groups are reported based on actual or estimated discharge data. This data is collected in accordance with the appropriate permits and follows the verification procedures established within those program regulations. DMR data collected pursuant to these regulations is transferred to EPA via the Integrated Compliance Information System (ICIS) data exchange.

For the remaining verification groups, onsite initial inspections are the standard. Many of the verification groups in the onsite and extraction sectors are annual practices which do not need any follow-up checks for the purpose of verification. For the remainder, follow-up inspections to ensure reported BMPs are still in place and functioning as intended are driven by the [onsite](#) or [extractive](#) program regulations.

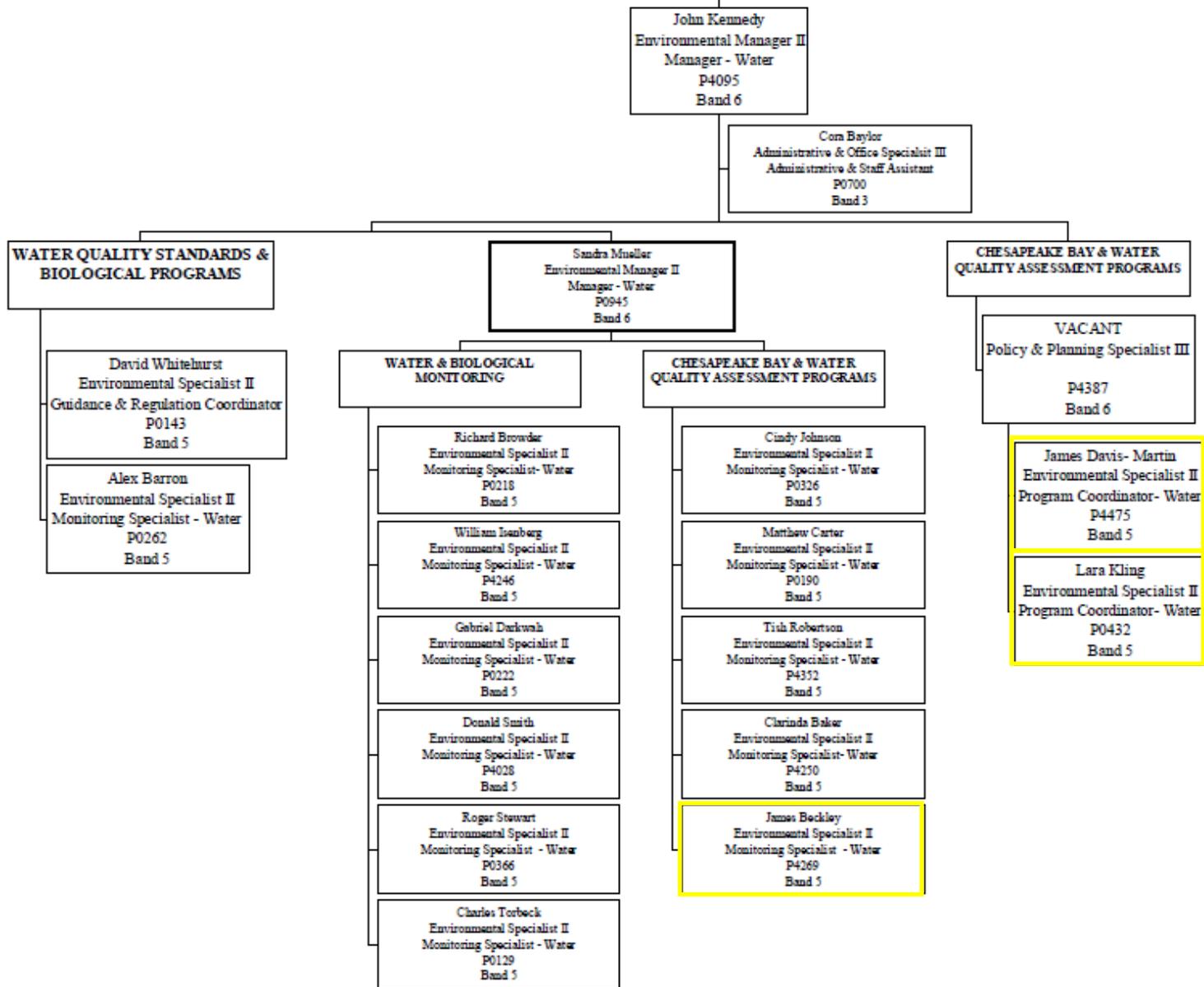
The Bay Program approved credit durations will be used as the basis for removing reported BMPs for most verification groups in the Wastewater, Onsite and Extractive sectors. However, the approved credit durations for the mine reclamation group is not appropriate. Mining sites that have been reclaimed have a very low probability of failure once established and verified through two growing seasons. As such this BMP should be treated as a permanent practice as opposed to the Bay Program credit duration of ten years. For the remaining verification groups, the Bay Program credit durations and information from the follow-up checks and regulatory compliance programs will be used to remove practices from the reporting record based on identified failure/abandonment.

Combined Sewer Overflows (CSOs) are not a BMP, but data regarding the regulated area draining to CSOs along with the frequency and estimated volumes of overflow events are used in the modeling system. Implementation and verification of actions to reduce the impact of CSOs follows the CSO Control Plans and applicable regulations. As CSO control projects are completed, the model data is updated through the Bay Program modeling team.

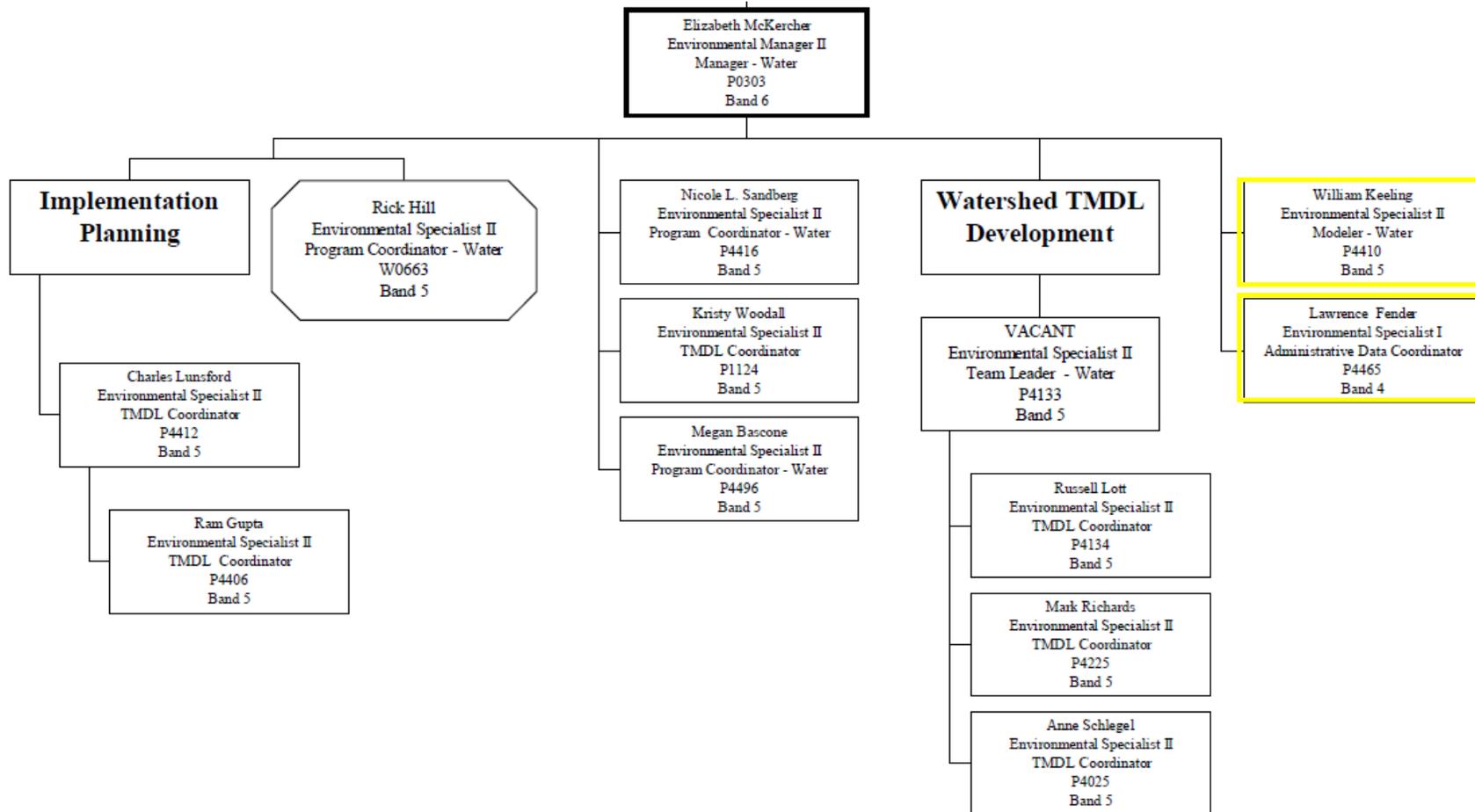
D3 – Reconciliation with User Requirements

This section does not apply to this QAPP.

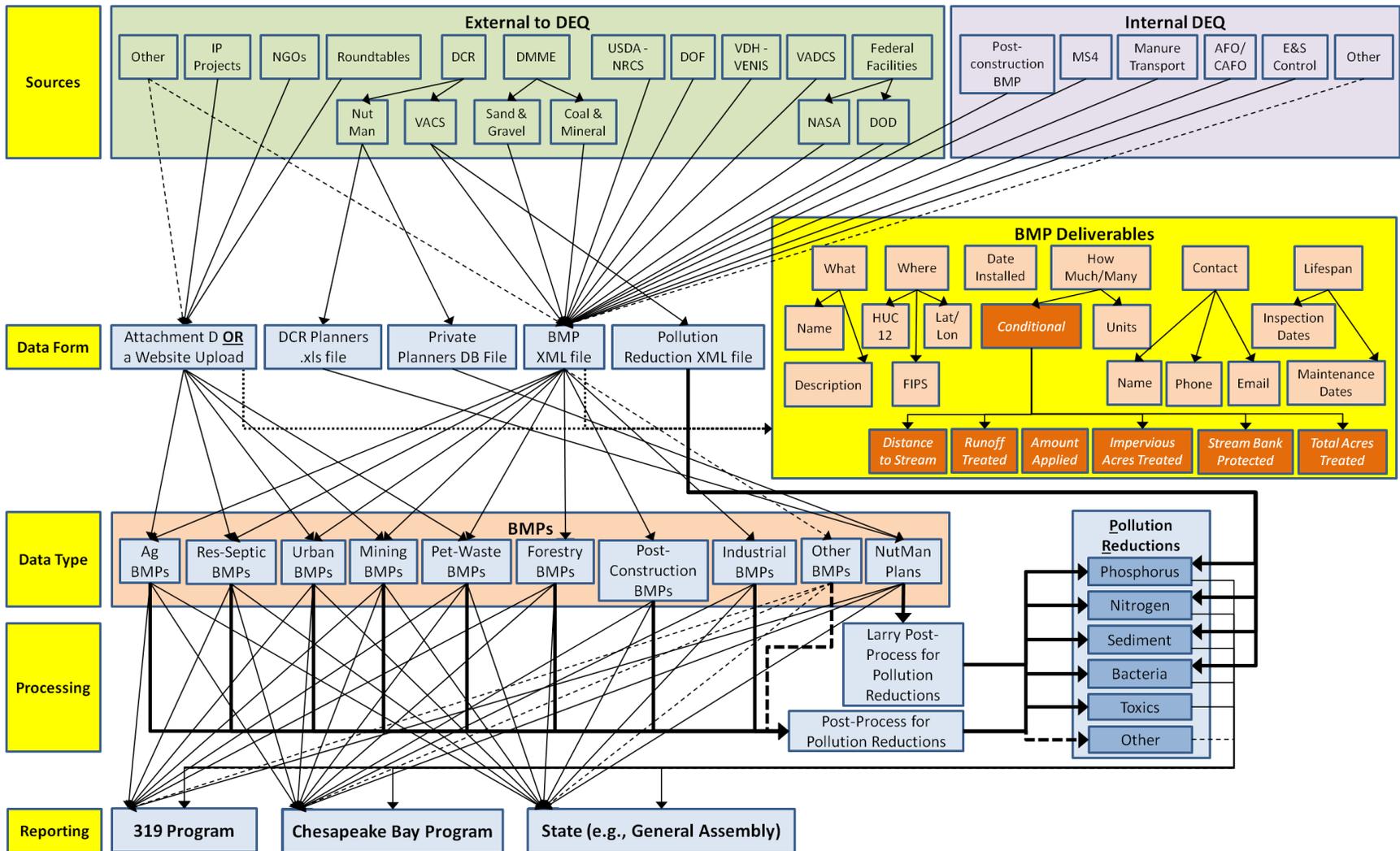
Appendix 1 - DEQ Organizational Chart
Table 1: Office of Ecology



**Appendix 1 - DEQ Organizational Chart
Table 2: Office of Water Quality Programs**



Appendix 2 - Internal and External Data Flow



Appendix 3 - Verification Protocol Design Table 1 - Agriculture

A. Sector	B. Data Grouping	C. BMP Type	D. Initial Inspection <i>(Is the BMP there?)</i>				E. Follow-up Check <i>(Is the BMP still there?)</i>			F. Lifespan/Sunset
			Method	Frequency	Who inspects	Documentation	Follow-up Inspection	Statistical Sub-sample	Response if Problem	<i>(Is the BMP no longer there?)</i>
A g r i c u l t u r e	State or Federal Cost-Share Cover Crops	Annual	Onsite	100% at planting	DCR, SWCD, NRCS	VACS Database, NRCS	Onsite	100% at establishment to ensure required cover is achieved	Practices that fail to establish sufficient cover are disallowed and not reported as cover crops	Annual
	Tillage Practices	Annual	Transect Survey	Quinquennial	DCR, SWCD or Certified Planner	VACS Database	N/A	N/A	N/A	Annual
	State or Federal Cost-Share In Contractual Period	All BMPs are Low Risk as determined by existing VACS spot check program.	Onsite	100%	DCR, SWCD, NRCS	VACS Database, NRCS	Onsite	Statistical sample of 2% per year 100% Re-inspection of structural and land use change practices one year prior to end of contract is encouraged.	Practices found not functioning as intended are issued a 60 day Corrective Action Agreement to restore BMP function. If CAA not completed, BMP is deemed failed in survey. Sample failure rate will be applied to group population to remove practices from the reporting record.	Per CBP approved Credit Duration Re-inspection regimen ensures practices are sampled during credit duration and encourages all practices be inspected prior to end of contractual period or Credit Duration to re-verify and extend.
	State or Federal Cost-Share Out of Contractual Period or Voluntary meets program design standards	Low Risk of Failure	Onsite	100%	DCR, SWCD, NRCS or Certified Planner	VACS Database	Onsite	Statistical sample of 2% per year 100% Re-inspection of structural and land use change practices one year prior to end of credit duration is encouraged.	Practices components found not functioning as intended are deemed failed in the survey. Sample failure rate will be applied to group population to remove practices from the reporting record.	Per CBP approved Credit Duration Re-inspection regimen ensures practices are sampled during credit duration and encourages all practices be inspected prior to end of contractual period or Credit Duration to re-verify and extend.
		Stream Exclusion and Associated Buffers	Onsite	100%	DCR, SWCD, NRCS or Certified Planner	VACS Database	Onsite	Statistical sample of 4% per year 100% Re-inspection of structural and land use change practices one year prior to end of credit duration is encouraged.	Practices components found not functioning as intended are deemed failed in the survey. Sample failure rate will be applied to group population to remove practices from the reporting record.	Per CBP approved Credit Duration Re-inspection regimen ensures practices are sampled during credit duration and encourages all practices be inspected prior to end of contractual period or Credit Duration to re-verify and extend.
	Voluntary Resource Improvement (Does not meet program design standards, but adequately provides the desired resource improvement)	Low Risk of Failure	Onsite Visual Indicators	100%	DCR, SWCD or Certified Planner	VACS Database	Onsite	Statistical sample of 5% per year 100% Re-inspection of structural and land use change practices one year prior to end of credit duration is encouraged.	Practices found not meeting the visual indicators are deemed failed in the survey. Sample failure rate will be applied to group population to remove practices from the reporting record.	Per CBP approved Credit Duration Re-inspection regimen ensures practices are sampled during credit duration and encourages all practices be inspected prior to end of contractual period or Credit Duration to re-verify and extend.
		Stream Exclusion and Associated Buffers	Onsite Visual Indicators	100%	DCR, SWCD or Certified Planner	VACS Database	Onsite	Statistical sample of 10% per year 100% Re-inspection of structural and land use change practices one year prior to end of credit duration is encouraged.	Practices found not meeting the visual indicators are deemed failed in the survey. Sample failure rate will be applied to group population to remove practices from the reporting record.	Per CBP approved Credit Duration Re-inspection regimen ensures practices are sampled during credit duration and encourages all practices be inspected prior to end of contractual period or Credit Duration to re-verify and extend.
	Manure Transport	Annual	Report with weight records	100%	DCR, DEQ	DCR and DEQ databases	N/A	N/A	N/A	Annual
	Feed Additives	Annual	Cooperative Agreement	100%	DCR	DCR databases	Manure/Litter Sampling required by permit and associated with Nutrient Management Plan development	Manure P concentrations are compared against pre-Phytase baseline data to calculate reductions.	Reported treatment levels are adjusted accordingly.	It is expected that this group of BMPs will be discontinued in the Phase 6 model.
	Nutrient Management Plans	Annual	Onsite Plan Development	100%	Certified Planner	NutMan Database	Onsite, Farmer interview, yield and fertilizer/manure application records evaluation	100% DCR and DCR Contractor Developed Plans at time of plan renewal or revision in 2016 to establish baseline data. Program design to be adjusted based on initial findings.	Frequency of sampled plan acres found to have not been implemented consistent with nutrient management planning standards will be used to discount implemented BMPs included in future reporting.	Currently, all practices within the plan effective dates are reported. Typical plan is effective for 3 years, but may be revised several times within that period. Reporting discount rate to be reassessed annually based on previous 3 years results
Resource Management Plans (with RMP Certificate)	Group	Onsite Implementation Certification	100%	Certified Planner, SWCD, DCR	VACS Database, RMP module	Triennial onsite compliance evaluation	100% Triennial	Practices found not functioning as intended are issued a 90 day Corrective Action Agreement to restore BMP function. If CAA not completed, RMP Certificate is revoked and BMP(s) removed from the reporting record.	BMPs associated with RMPs are tracked, reported and verified as described above for each BMP Grouping.	

Appendix 3-Verification Protocol Design Table 2 - Urban

A. Sector	B. Data Grouping	C. BMP Type	D. Initial Inspection <i>(Is the BMP there?)</i>				E. Follow-up Check <i>(Is the BMP still there?)</i>			F. Lifespan/Sunset <i>(Is the BMP no longer there?)</i>
			Method	Frequency	Who inspects	Documentation	Follow-up Inspection	Statistical Sub-sample	Response if Problem	
Urban	BMP installed pursuant to MS4 Permit requirement (does not include BMP installed to meet VSMP requirements under the Construction GP).	Group	Onsite	100%	Locality or Facility	Locality or Facility database, MS4 Annual Report/Bay TMDL Action Plan	MS4 conducts onsite inspections and maintenance per VPDES MS4 permit requirements. Annual for MS4 owned. Quinquennial for privately owned within MS4.	DEQ MS4 program conducts inspections, audits and review of annual reports to ensure compliance is maintained.	CAA, NOV or Consent Order	BMPs implemented in MS4s must be maintained in accordance with permit conditions. Non-MS4 owned BMPs have maintenance agreements with the BMP owners recorded with land records. As such, this class of BMPs is expected to be maintained in perpetuity and no sunsets will apply. Reported BMPs will be reduced to account for identified non-compliance with the above maintenance requirements.
	BMP installed pursuant to Bay Act requirement	Group	Onsite	100%	Bay Act Locality	Bay Act Locality records (site plans, inspection reports, maintenance agreements), Bay Act Annual Report	Locality conducts or requires documentation of owner inspection quinquennially.	DEQ Bay Act program conducts locality program evaluations and review of annual reports to ensure compliance is maintained.	CAA, NOV or Consent Order	BMPs implemented in Bay Act Localities must be maintained in accordance with permit conditions. BMP maintenance agreements with the BMP owners are recorded with land records. As such, this class of BMPs is expected to be maintained in perpetuity and no sunsets will apply. Reported BMPs will be reduced to account for identified non-compliance with the above maintenance requirements.
	BMP installed to meet VSMP requirements under the Construction GP	Group	Onsite	100%	VSMP Authority (Locality and DEQ)	CGPS Database	Locality conducts quinquennial inspections.	DEQ Construction GP program conducts inspections, locality program evaluation to ensure compliance is maintained.	CAA, NOV or Consent Order	BMPs implemented per VSMP regulations must be maintained in accordance with permit conditions. BMP maintenance agreements with the BMP owners are recorded with land records. As such, this class of BMPs is expected to be maintained in perpetuity and no sunsets will apply. Reported BMPs will be reduced to account for identified non-compliance with the above maintenance requirements.
	BMP installed with no regulatory requirement (e.g. more stringent local VSMP requirements, unregulated urbanized area choosing to install BMPs)	Low Risk of Failure	Onsite	100%	Locality or Facility	Locality or Facility database	Reporting source will be notified of BMPs approaching the end of their credit duration recommending a reinspection to verify continued performance.	N/A	Inspection updates provided by reporting sources will be used to update data records and extend credit life. If no updates are received, credit durations will require removal of the record from the reporting system.	Per CBP approved Credit Duration. If system is not inspected, maintained or is otherwise abandoned, it will be removed from the reporting record.
	Homeowner BMPs	Group	Onsite	100%	Locality, SWCD, PDC or NGO	SMART				
	Street Sweeping conducted outside of MS4 Permit	Annual	Report with weight records	100%	Locality, Facility, VDOT	Locality or Facility database	N/A	N/A	N/A	Annual
	Erosion and Sediment Control (during construction)	Annual	Onsite	100%	Locality, DEQ, Standard and Specs Holder	Locality database, DEQ CGPS database (> 1 acre), Standard & Specs Holder	N/A	N/A	N/A	Annual
	Urban Nutrient Management Plan	Annual	Onsite Plan Development	100%	Certified Planner, Certified Applicator	NutMan Database	Onsite compliance evaluation for acres under active plans	Statistical sample of 2% of acres with active plans each year conducted by certified plan developer. 50% of those will be joint evaluations by certified plan developer and DCR program staff.	Reduce reporting based on rates determined from sample.	Annual, plans typically written for 3-5 years
	Urban Nutrient Management Certified Applicator	Annual	Onsite Applicator	100%	Certified Applicator	VDACS Certified Applicator database	Compliance evaluation for certified applicators, including fertilizer records check	Statistical sample of 50% of companies to evaluate reported acres under management and fertilizer records, conducted by certified planner, DCR or VDACS program staff.	Reduce reporting based on rates determined from sample.	Annual
	Urban Phosphorus Fertilizer Reduction	Annual	State Fertilizer Sales Data	100%	State Regulatory Agency	VDACS Database	N/A	N/A	N/A	Annual

Appendix 3 - Verification Protocol Design Table 3 - Wastewater, Onsite, Forest and Extractive

A. Sector	B. Data Grouping	C. BMP Type	D. Initial Inspection <i>(Is the BMP there?)</i>				E. Follow-up Check <i>(Is the BMP still there?)</i>			F. Lifespan/Sunset <i>(Is the BMP no longer there?)</i>
			Method	Frequency	Who inspects	Documentation	Follow-up Inspection	Statistical Sub-sample	Response if Problem	
			W a & s t O n e s w a t t e r	Significant Wastewater	Discharge Loads	VPDES significant facilities sample in accordance with the VPDES watershed general permit. All laboratory analysis are performed by laboratories certified under the Virginia Environmental Laboratory Accreditation Program (VELAP) administered by the Virginia Division of Consolidate Laboratory Services (DCLS), a National Environmental Laboratory Accreditation Conference (NELAC) recognized accreditation body. DEQ VPDES Inspectors verify monitoring protocols as part of regular compliance inspections.				
Non-Significant Wastewater	Discharge Load Estimates	Nutrient loads from nonsignificant facilities are estimates provided by DEQ using a percentage of the wasteload allocations included in the TMDL. Virginia is working on sampling protocols to help verify the reported nonsignificant loads.								
Pumpouts	Annual	Onsite Certified Entity		100%	Locality, Facility	Locality or Facility database	N/A	N/A	N/A	Annual
Connection to Sewer	Group	Onsite Certified Entity		100%	Locality, VDH, WWTP Operator	Multiple possible data sources	N/A	N/A	N/A	Per CBP approved Credit Duration.
AOSS including all nitrogen reducing systems	Group	Onsite Certified Entity, VDH		100%	VDH	VDH VENIS Database	Onsite Certified Entity	Annual Maintenance Required per regulation	Issues identified during annual maintenance inspection are typically repaired immediately. Failure to repair would result in condemnation and discontinued use.	Per CBP approved Credit Duration. If system is not maintained or is otherwise abandoned, it will be removed from the reporting record.
E F o r r e a s t i & v e	Forest Harvesting Practices	Annual	Onsite	100%	DOF Foresters	DOF Database	N/A	N/A	N/A	Per CBP approved Credit Duration. Harvested forest acres discounted based on identified non-compliance rate.
	E&S on Extractive	Annual	Onsite Regulatory Compliance Monitoring	100%	DMME	DMME Database	Onsite Regulatory Compliance Monitoring	Throughout active extractive period	NOV or Special Order or Notice of Non-compliance per 4-VAC 25.31	Per CBP approved Credit Duration. Active extractive acres discounted based on identified non-compliance rate.
	Forest Conservation	Based on local requirements mandating forest conservation on new development sites	Onsite	100%	Locality	Locality	N/A	N/A	N/A	Reporting of this BMP requires documentation of appropriate local ordinances requiring the preservation of trees when parcels are developed. Once established, the ordinance remain in effect until changed or removed and areas of forest conserved under the ordinance would likely remain in perpetuity. As such this BMP will be treated as a permanent practice.
	Mine Reclamation	Group	Onsite	100%	DMME	DMME Database	Onsite	Reclaimed sites are monitored for two growing seasons to ensure successful establishment of vegetation and BMP function.	Permits remain in force and associated surety bonds are held until DMME determines the reclamation was successful.	Reclaimed sites have a very low probability of failure once established and verified through two growing seasons. As such this BMP will be treated as a permanent practice.

**Appendix 4 Best Management Practices Verification Crosswalk
Table 1 - Agriculture**

<i>Agriculture Practices</i>	<i>BMP Short Name</i>	<i>BMP Long Name</i>	<i>Credit Duration</i>	<i>BMP Type</i>	<i>Data Source(s)</i>	<i>Program Type(s)</i>	<i>Verification Group</i>
Nutrient Application Management on Crop	EffNutMan	Tier 1 Crop Group Nutrient Application Management Efficiency Version	1	Annual Management	DCR	Cost Share/Voluntary/Regulatory	Agriculture Nutrient Management Plans
Decision Agriculture	EffNutManDecAg	Decision Agriculture Efficiency Version	1	Annual Management	DCR	Cost Share/Voluntary/Regulatory	
Enhanced Nutrient Application Management	EffNutManEnhance	Enhanced Nutrient Application Management Efficiency Version	1	Annual Management	DCR	Cost Share/Voluntary/Regulatory	
Nutrient Application Management on Pasture	EffNutMan (on pasture)	Tier 1 Crop Group Nutrient Application Management Efficiency Version	1	Annual Management	DCR	Cost Share/Voluntary/Regulatory	
Decision Agriculture Application on Pasture	EffNutManDecAg (on pasture)	Decision Agriculture Efficiency Version	1	Annual Management	DCR	Cost Share/Voluntary/Regulatory	
Enhanced Nutrient Application Management on Pasture	EffNutManEnhance (on pasture)	Enhanced Nutrient Application Management Efficiency Version	1	Annual Management	DCR	Cost Share/Voluntary/Regulatory	
Conservation-Till Specialty Crops	ConserveTillom	Conservation Till Without Nutrients	1	Annual Management	DCR	Survey	Tillage Practices

Agriculture Practices	BMP Short Name	BMP Long Name	Credit Duration	BMP Type	Data Source(s)	Program Type(s)	Verification Group
High Residue Tillage	HRTill	Continuous, High Residue, Minimum Soil Disturbance Tillage Management	1	Annual Management	DCR	Survey/Cost Share	Tillage Practices
Conservation Tillage including High Residue Tillage	ConserveTillTotAcres	Conservation Tillage - Total Acres	1	Management	DCR	Survey/Cost Share	
	ConserveTillom	Conservation Till Without Nutrients	1				
	HRTill	Continuous, High Residue, Minimum Soil Disturbance Tillage Management	1				
Cover Crop	(All Traditional Cover Crops)	(All Traditional Cover Crops)	1	Annual	DCR/USDA	Cost Share/Voluntary	State or Federal Cost-Share Cover Crops
Commodity Cover Crop	(All Commodity Cover Crops)	(All Commodity Cover Crops)	1	Annual	DCR/USDA	Cost Share/Voluntary	
Stream Access Control with Fencing	PastFence	Stream Access Control with Fencing	10	Structural	DCR/USDA	Cost Share/Voluntary	State or Federal Cost-Share In Contractual Period or Voluntary (meets program design standards) or State or Federal Cost-Share Out of Contractual Period
	GrassBufferstrp	Streamside Grass Buffers	10				
Forest Buffers on Fenced Pasture Corridor	ForestBuffersTrp	Streamside Forest Buffers	10 or 15	Land Conversion	DCR/USDA	Cost Share/Voluntary	
Grass Buffers on Fenced Pasture Corridor	GrassBufferstrp	Streamside Grass Buffers	10	Land Conversion	DCR/USDA	Cost Share/Voluntary	

Agriculture Practices	BMP Short Name	BMP Long Name	Credit Duration	BMP Type	Data Source(s)	Program Type(s)	Verification Group
Pasture Alternative Watering	OSWnoFence	Off Stream Watering Without Fencing	10	Structural	DCR/USDA	Cost Share/Voluntary	State or Federal Cost-Share In Contractual Period or Voluntary (meets program design standards) or State or Federal Cost-Share Out of Contractual Period
Prescribed Grazing	PrecRotGrazing	Prescribed Grazing	10	Management	DCR/USDA	Cost Share/Voluntary	
	UpPrecIntRotGraze	Precision Intensive Rotational Grazing	10				
Horse Pasture Management	HorsePasMan	Horse Pasture Management	10	Management	DCR/USDA	Cost Share/Voluntary	
Forest Buffers	ForestBuffers	Forest Buffers	10 or 15	Land Conversion	DCR/USDA	Cost Share/Voluntary	
	ForestBuffNarrow	Narrow Forest Buffer	10 or 15				
Wetland Restoration	WetlandRestore	Wetland Restoration	15	Land Conversion	DCR/USDA	Cost Share/Voluntary	
	WetlandRestoreTrp	Streamside Wetland Restoration	15				
Land Retirement	LandRetireHyo	Land Retirement to hay without nutrients (HEL)	10	Land Conversion	DCR/USDA	Cost Share/Voluntary	
	LandRetirePas	Land Retirement to pasture (HEL)	10				
Grass Buffers	GrassBuffers	Grass Buffers	10	Land Conversion	DCR/USDA	Cost Share/Voluntary	
	GrassBuffNarrow	Narrow Grass Buffer	10				
Tree Planting	TreePlant	Tree Planting	10 or 15	Land Conversion	DCR/USDA	Cost Share/Voluntary	
Conservation Plans	ConPlan	Soil Conservation and Water Quality Plans		Management	DCR/USDA	Cost Share/Voluntary	
Water Control Structures	WaterContStruc	Water Control Structures	10	Structural	DCR/USDA	Cost Share/Voluntary	
NonUrban Stream Restoration	NonUrbStrmRest	Non Urban Stream Restoration	10	Structural	DCR/USDA	Cost Share/Voluntary	
NonUrban Shoreline Erosion Control	ShoreAg	Shoreline Erosion Control on Agriculture and Forest Lands	10	Structural	DCR/USDA	Cost Share/Voluntary	

Agriculture Practices	BMP Short Name	BMP Long Name	Credit Duration	BMP Type	Data Source(s)	Program Type(s)	Verification Group
Livestock Waste Management Systems	AWMS (Livestock)	Animal Waste Management System	15	Structural	DCR/USDA	Cost Share/Voluntary	State or Federal Cost-Share In Contractual Period or Voluntary (meets program design standards) or State or Federal Cost-Share Out of Contractual Period
Poultry Waste Management Systems	AWMS (Poultry)	Animal Waste Management System	15	Structural	DCR/USDA	Cost Share/Voluntary	
Livestock Mortality Composting	MortalityComp (Livestock)	Mortality Composting	15	Structural	DCR/USDA	Cost Share/Voluntary	
Poultry Mortality Composting	MortalityComp (Poultry)	Mortality Composting	15	Structural	DCR/USDA	Cost Share/Voluntary	
Barnyard Runoff Control	BarnRunoffCont	Barnyard Runoff Control	5	Structural/Management	DCR/USDA	Cost Share/Voluntary	
Loafing Lot Management	LoafLot	Loafing Lot Management	10	Management	DCR/USDA	Cost Share/Voluntary	
Manure Transport Outside CBWS	ManureTransport (Outside)	Manure Transport	1	Annual	DEQ/DCR	Cost Share/Voluntary/Regulatory	Manure Transport
Manure Transport Within CBWS	ManureTransport (Inside)	Manure Transport	1	Annual	DEQ/DCR	Cost Share/Voluntary/Regulatory	
Poultry Phytase	PoultryPhytase	Poultry Phytase	1	Annual	DCR	Cooperative	Feed or Manure Additives
Swine Phytase	SwinePhytase	Swine Phytase	1	Annual	DCR	Cooperative	

<i>Agriculture Practices</i>	<i>BMP Short Name</i>	<i>BMP Long Name</i>	<i>Credit Duration</i>	<i>BMP Type</i>	<i>Data Source(s)</i>	<i>Program Type(s)</i>	<i>Verification Group</i>
Resource Improvement BMPs	(All RI Practices)	(All RI Practices)	3-10	Structural/Management	DCR/VDACS	Voluntary	Voluntary Resource Improvement (Does not meet program design standards, but adequately provides the desired resource improvement)

**Appendix 4 Best Management Practices Verification Crosswalk
Table 2 - Urban**

Urban Practices	BMP Short Name	BMP Long Name	Credit Duration	BMP Type	Data Source(s)	Program Type(s)	Verification Group
Wet Ponds & Wetlands	WetPondWetland	Wet Ponds and Wetlands	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	BMP installed pursuant to MS4 Permit requirement or BMP installed pursuant to Bay Act requirement or BMP installed to meet VSMP requirements under the Construction GP or BMP installed with no regulatory requirement
Dry Ponds	DryPonds	Dry Detention Ponds and Hydrodynamic Structures	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
Extended Dry Ponds	ExtDryPonds	Dry Extended Detention Ponds	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
Infiltration Practices	Infiltration	Urban Infiltration Practices w/o Sand, Veg. - A/B soils, no underdrain	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
	InfiltWithSV	Urban Infiltration Practices w/ Sand, Veg. - A/B soils, no underdrain	10				
Filtering Practices	Filter	Urban Filtering Practices	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
BioRetention	BioRet	Bioretention - with underdrain with AB Soils	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
	BioRetNoUDAB	Bioretention/raingardens - A/B soils, no underdrain	10				
	BioRetUDAB	Bioretention/raingardens - A/B soils, underdrain	10				
	BioRetUDCD	Bioretention/raingardens - C/D soils, underdrain	10				
BioSwale	BioSwale	Bioswale	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
Permeable Pavement	PermPavNoSV	Permeable Pavement - no sandveg with underdrain with AB soils	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
	PermPavNoSVNoUDAB	Permeable Pavement w/o Sand, Veg. - A/B soils, no underdrain	10				

Urban Practices	BMP Short Name	BMP Long Name	Credit Duration	BMP Type	Data Source(s)	Program Type(s)	Verification Group
Permeable Pavement	PermPavNoSVUDAB	Permeable Pavement w/o Sand, Veg. - A/B soils, underdrain	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	BMP installed pursuant to MS4 Permit requirement or BMP installed pursuant to Bay Act requirement or BMP installed to meet VSMP requirements under the Construction GP
	PermPavNoSVUDCD	Permeable Pavement w/o Sand, Veg. - C/D soils, underdrain	10				
	PermPavSVNoUDAB	Permeable Pavement w/ Sand, Veg. - A/B soils, no underdrain	10				
	PermPavSVUDAB	Permeable Pavement w/ Sand, Veg. - A/B soils, underdrain	10				
	PermPavSVUDCD	Permeable Pavement w/ Sand, Veg. - C/D soils, underdrain	10				
	PermPavWSV	Permeable Pavement - with sandveg with underdrain with AB soils	10				
Vegetated Open Channel	VegOpChan	Vegetated Open Channels - no underdrain with AB soils	10	Structural	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
	VegOpChanNoUDAB	Vegetated Open Channels - A/B soils, no underdrain	10				
	VegOpChanNoUDCD	Vegetated Open Channels - C/D soils, no underdrain	10				
Urban Stream Restoration	UrbStrmRest	Urban Stream Restoration	10	Structural	Locality	Cost Share/ Voluntary/Regulatory	or
Urban Shoreline Erosion Control	ShoreUrb	Shoreline Erosion Control on Urban Land	10	Structural	Locality/DCR	Voluntary/Regulatory	BMP installed with no regulatory requirement
Impervious Surface & Urban Growth Reduction	ImpSurRed	Impervious Surface Reduction	10	Land Conversion	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
Urban Forest Buffers	ForestBufUrban	Urban Forest Buffers	10	Land Conversion	Locality/DEQ	Cost Share/ Voluntary/Regulatory	
Urban Tree Planting	UrbanTreePlant	Urban Tree Planting	10	Land Conversion	Locality/DEQ	Cost Share/ Voluntary/Regulatory	

Urban Practices	BMP Short Name	BMP Long Name	Credit Duration	BMP Type	Data Source(s)	Program Type(s)	Verification Group
Street Sweeping	StreetSweepLbs	Street Sweeping Pounds	1	Annual	Locality	Voluntary/Regulatory	BMP installed pursuant to MS4 Permit requirement or Street Sweeping conducted outside of MS4 Permit
	StreetSweepLbs25x	Street Sweeping 25 times a year-lbs	1				
	StreetSweep	Street Sweeping 25 times a year-acres (formerly called Street Sweeping Mechanical Monthly)	1				
Erosion and Sediment Control	EandS1	Erosion and Sediment Control Level 1	1	Management	Locality/DEQ	Regulatory	Erosion and Sediment Control (during construction)
	EandS2	Erosion and Sediment Control Level 2	1				
	EandS3	Erosion and Sediment Control Level 3	1				
Urban Nutrient Management	UrbanNMPlan	Urban Nutrient Management Plan	1	Management	DCR	Cooperative/Regulatory/ Cost Share/Voluntary	Urban Nutrient Management Plan or Urban Nutrient Management Certified Applicator
	UrbanNMPlanHR	Urban Nutrient Management Plan High Risk Lawn	1				
	UrbanNMPlanLR	Urban Nutrient Management Plan Low Risk Lawn	1				
	UrbanNutMan	TBD	1				
Urban Phosphorus Fertilizer Reduction	UrbanPLegislation	Urban Phosphorus Legislation	1	Annual	VDACS	Regulatory	Urban Phosphorus Fertilizer Reduction
Homeowner BMPs	(All Homeowner Practices)	(All Homeowner Practices)	5/1	Structural/ Management	Locality/ SWCD/ Alliance/	Voluntary	Homeowner BMPs

**Appendix 4 Best Management Practices Verification Crosswalk
Table 3 - Onsite, Forestry and Extractive**

Onsite Practices	BMP Short Name	BMP Long Name	Credit Duration	BMP Type	Data Source(s)	Program Type(s)	Verification Group
Septic Connections	SepticConnect	Septic Connection	100	Structural	VDH	Voluntary/Regulatory	Connection to Sewer
Septic Denitrification	septicdecon	50% Denitrification Units with Conventional In Situ	10	Structural	VDH	Voluntary/Regulatory	AOSS including all nitrogen reducing systems
	septicdeenhance	50% Denitrification Units with Enhanced In Situ	10				
	SepticDenitrify	Septic Denitrification	10				
	septicseffenhance	Septic Effluent with Enhanced In Situ	10				
	septicseccon	Secondary Treatment with Conventional InSitu	10				
	septicsecenhance	Secondary Treatment with Enhanced In Situ	10				
Septic Pumping	SepticPump	Septic Pumping	1	Annual	Locality/VDH	Voluntary/Regulatory	Pumpouts
Forest Harvesting Practices	ForHarvestBMP	Forest Harvesting Practices	1	Management	DOF	Regulatory	Forest Harvesting Practices
Forest Conservation Act	ForestCon	Forest Conservation	1	Management	Locality	Regulatory	Forest Conservation
Extractive Erosion and Sediment Control	EandSext	Erosion and Sediment Control on Extractive, excess applied to all other pervious urban	1	Annual	DMME	Regulatory	E&S on Extractive

Onsite Practices	BMP Short Name	BMP Long Name	Credit Duration	BMP Type	Data Source(s)	Program Type(s)	Verification Group
Abandoned Mine Reclamation	AbanMineRec	Abandoned Mine Reclamation	10	Land Conversion	DMME	Regulatory	Mine Reclamation

Appendix 5 - Stratified Random Sampling Calculations

Sector	Data Grouping	BMP Type	Number of Practices	Response Distribution	Verification Sample	Resulting Confidence and Error
A g r i c u l t u r e	State or Federal Cost-Share In Contractual Period	All BMPs are Low Risk as determined by existing VACS spot check program.	17,318	Assumed 85/15 pass/fail	2% = 346	90% ± 3.13
	State or Federal Cost-Share Out of Contractual Period or Voluntary meets program design standards	Low Risk of Failure	10,022	Assumed 80/20 pass/fail	2% = 200	90% ± 4.61
		Stream Exclusion and Associated Buffers	3,599	Assumed 70/30 pass/fail	4% = 216	90% ± 4.97
	Voluntary Resource Improvement (Does not meet program design standards, but adequately provides the desired resource improvement)	Low Risk of Failure	0	Assumed 60/40 pass/fail	5%	TBD
		Stream Exclusion and Associated Buffers	0	Assumed 50/50 pass/fail	10%	TBD
U r b a n	Urban Nutrient Management Plan	Annual	15,000	Assumed 50/50 pass/fail	2% = 300	90% ± 4.70
	Urban Nutrient Management Certified Applicator	Annual	300	Assumed 50/50 pass/fail	50% = 150	90% ± 4.76

The sample size and confidence interval calculations in this table were developed using the following website:

<http://www.raosoft.com/samplesize.html>

These calculations have been evaluated and confirmed to be accurate by the Statistical Design Review Team.

Appendix 6 – Historical BMP Failure Rates from DCR Spot Checks (1998-2015)

Practice Name	Total Number of BMPs	Number of Spot Checks (Cumulative)	Number of Inactive or Destroyed BMPs (Cumulative)	Percent of Spot Checks where BMP Destroyed (Failure Rate)
Stream Exclusion With Grazing Land Management	8,994	2,358	37	1.57%
Continuous High Residue Minimal Soil Disturbance Tillage System	3,789	577	6	1.04%
Long Term Vegetative Cover on Cropland	3,554	796	41	5.15%
Aforestation of erodible crop and pastureland	1,270	443	17	3.84%
Alternative Water System	1,149	420	4	0.95%
Animal waste control facilities	940	354	5	1.41%
Streambank protection (fencing)	784	187	8	4.28%
Grass filter strips	489	62	1	1.61%
Livestock Exclusion with Riparian Buffers for TMDL Imp.	427	95	1	1.05%
Sod waterway	385	148	1	0.68%
Stream Exclusion - Maintenance Practice	372	45	7	15.56%
Composter Facilities	291	118	3	2.54%
Woodland buffer filter area	191	81	3	3.70%
Farm Road or Heavy animal Travel lane Stabilization	135	48	1	2.08%
Livestock Exclusion with Reduced Setback	78	12	1	8.33%
Stream Protection - TMDL	70	22	1	4.55%
Livestock Exclusion with Reduced Setback for TMDL Imp.	53	18	1	5.56%
Totals:	22,971	5,784	138	2.39%