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# PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL PROTECTION

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QAPP Addendum

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## BMP VERIFICATION PROGRAM PLAN

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## Background:

### History and Purpose of Best Management Practice (BMP) Verification

The Chesapeake Bay Program (CBP) Partnership has called for transparency and sound scientific support in the verification of the best management practices that are implemented as part of the states' Watershed Implementation Plans (WIPs) and the Chesapeake Bay Total Maximum Daily Load (TMDL). To respond to this request, *Strengthening Verification of Best Management Practices Implemented in the Chesapeake Bay Watershed: A Basinwide Framework, Report and Documentation from the Chesapeake Bay Program Water Quality Goal Implementation Team's BMP Verification Committee* (Verification Framework) (Chesapeake Bay Program 2014), was developed. The Verification Framework served as a guide for the states to document the methodology for verification of Best Management Practice (BMP) installation, function, and continued effectiveness of practices over time. This verification would be included as part of every state's Quality Assurance Program Plan (QAPP). The BMP Verification Program Plan is an addendum to our Quality Assurance Program Plan (QAPP). The QAPP is required by the Environmental Protection Agency (EPA) Chesapeake Bay Program Office for data submission and progress reporting towards Pennsylvania's pollution reduction goals. Pennsylvania's QAPP was most recently updated by DEP and approved by EPA in 2018.

Verification is formally defined by the CBP partners 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." The CBP Partnership's Principals' Staff Committee formally adopted five verification principles in December 2012. These are described in Table 1.

**Table 1. Verification Principles adopted by the Principals' Staff Committee.**

<b>Principle</b>	<b>Description</b>
<b>Practice Reporting</b>	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.
<b>Scientific Rigor</b>	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.
<b>Public Confidence</b>	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.
<b>Adaptive Management</b>	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 limitations and allow for reasonable levels of flexibility in the allocation or targeting of funds.
<b>Sector Equity</b>	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.

Verification can happen in multiple ways as part of other activities; either through inspections, complaint investigations, permit approvals, County Conservation District plan reviews, voluntary surveys, or by image capture.

There are two key components to verification:

- 1) Initial Verification (at PROJECT COMPLETION)
- 2) Follow-up Verification (Re-Verification of EXISTING PRACTICES):

The time between initial and follow-up verification will depend mostly on the particular BMP's "lifespan" or time period during which "credit" for pollution reductions are counted for progress toward Pennsylvania's pollution reduction goals in the Bay model. Some practices are "annual" or "single-year" practices while others are considered "multi-year" practices. This time period is also referred to as a BMP's Credit Duration. The type of assessment used to verify a BMP depends on the BMP type and its Credit Duration.

There are three typical assessment methods:

- 1) Visual Assessment – Single Year
  - Short term (annual) practices

Example BMPs: Cover Crops, Conservation Tillage, Forest Harvesting
- 2) Visual Assessment – Multi-Year
  - Long term (cumulative) practices, often "Structural"

Example BMPs: Animal Waste Storage Systems, Bioswales, Tree Planting, Forested and Grassed Buffers

3) Non-visual Assessment:

- A practice that cannot typically be visually assessed because it is a type of management system or an enhanced approach, rather than a physical BMP.
- Can last a single season or multiple years

Example BMPs: Nutrient Management, Street Sweeping, Manure Transport

Alternative methods for data collection and assessment may be utilized. PADEP has been successful in using alternative BMP verification methods which allowed BMP reporting at less than 100% Visual Assessment (field verification) based on statistical assessment. These have been special projects to address specific data needs and to explore potential alternative methods that could be used with limited staffing resources. To date these efforts have been conducted in the Agriculture sector and are planned for use in the Urban Stormwater sector. Table 2 lists the alternative methods and projects PA has commissioned or plans to commission to accomplish verification.

**Table 2. BMP Verification Methodologies.**

Alternative Methodology	Project Name	Citation from Pennsylvania's Approved Quality Assurance Project Plan (QAPP) 2018
<b>Survey</b>	Capital Area RC&D Conservation Tillage Survey	p. 59 Appendix C, p. 90
	Capital Area RC&D Cover Crop Survey	p. 62 Appendix D, p. 94
	Penn State University Voluntary BMP Reporting Outreach	p. 64 Appendix F, p. 106
<b>Inspection</b>	Chesapeake Bay Agricultural Inspection Program	p. 66
	NPDES CAFO Inspections and Annual Reporting	p. 18
	Pennsylvania Agriculture Conservation Stewardship Program	p. 68
<b>Remote Sensing</b>	NRCS Remote Sensing (Potomac Pilot)	p. 65 Appendix G, p. 107
	Remote Sensing Using LiDAR (Request for Proposal)	N/A- Pending final development
	Forestry Remote Sensing Project	N/A- See Workplan
<b>Other Reporting</b>	Manure Treatment Technologies	p. 50
	Manure Transport Tracking Pilot	N/A- See Lancaster's County Action Plan
	CAFO Electronic Reporting	N/A- Pending final development
	MS4 Electronic Reporting	N/A- Pending final development
	PCSM and BMP reporting using ePermitting	N/A- Pending final development

## Incorporating the QAPP Addendum into the Phase 3 WIP

Pennsylvania's approved BMP Verification Program Plan (QAPP Addendum) of March 4, 2016 was revised to its current form as an outcome of several meetings with stakeholders from Pennsylvania's Agriculture, Urban Stormwater, and Forestry sectors. While Pennsylvania is committed to working with EPA and CBP to continue to implement and strengthen best management practice (BMP) verification activities that balance verification work and limited resources, this revised BMP Verification Program Plan (QAPP addendum) focuses on verification of our Phase 3 Watershed Implementation Plan (WIP) priority BMPs for control of nitrogen, phosphorous, and sediment in the Agriculture, Urban Stormwater and Forestry sectors. As part of the Phase 3 WIP planning process, Pennsylvania chose these priority BMPs for implementation and verification. Table 3 shows the priority BMPs by sector and color-coded verification methodologies. Some BMPs have more than one verification methodology.

The BMP Verification Program Plan (QAPP addendum) sets forth our current plan for verifying the priority BMPs in non-point source pollution sectors as identified in the Phase 3 WIP. The QAPP addendum consists of four sections – Agriculture, Forestry, Urban Stormwater, and Plan Implementation – covering the following information.

- 1) A background of each sector introduces the relative WIP priority initiatives in each sector.
- 2) The sector-specific inspector/verifier qualifications are listed. These are the requirements for verifying that priority BMPs are installed and functioning as designed.
- 3) A discussion of the WIP priority initiatives and the associated priority BMPs for implementation and verification as part of those initiatives. The BMPs are described using templates created by experts at the Chesapeake Bay Program Office and agreed upon by the 60+ experts who attended the BMP Verification Summit on August 30, 2018.
- 4) The plan implementation section outlines existing programs and new verification programs or methods that Pennsylvania will use to verify the priority BMPs.

The goal of Pennsylvania's BMP Verification Program Plan as described in this addendum creates a comprehensive, implementable program which verifies priority practices identified in the Phase 3 WIP are installed and operational and continue to provide the pollution reductions for the Chesapeake Bay Program model to accurately reflect Pennsylvania's progress towards improved local water quality and the restoration of the Chesapeake Bay. This addendum not only functions as a part of our data quality assurance, but also as an integral part of Pennsylvania's Phase 3 WIP. We include this addendum as an appendix to the Phase 3 WIP so that, as the Countywide Action Plans are implemented, and as needs and resource allocations change, this plan may be updated and amended to include other projects and proposals, and otherwise modified.

**Table 3. Priority BMPs and Verification Methodologies Matrix.**

Priority BMPs are shown by sector and color-coded verification methodologies. Some BMPs have more than one verification methodology.

WIP Priority BMPs for Verification	Agriculture	Manure Transport	Tillage Practices	Dairy Precision Feeding	Cover Crop (Traditional)	Nutrient Management - Core Nitrogen and Core Phosphorus	Soil Conservation and Water Quality Plans	Nutrient Management- Supplemental Nitrogen and Phosphorus	Animal Waste Management Systems	Agriculture
		Manure Treatment Technologies	Prescribed Grazing	Barnyard Runoff Controls and Loafing Lot Management	Cover Crop (Commodity)	Grassed Buffers- with and without Stream Fencing	Forested Buffers- with and without Stream Fencing	Stream Restoration	Wetland Restoration	
	Urban Stormwater	Dry Detention Ponds and Hydrodynamic Structures	Dry Extended Detention	Vegetated Open Channels	Performance Standards: Bioretention Practices	Performance Standards: Infiltration Practices	Wet Ponds and Wetlands	Urban Forest Buffers	Stream Restoration	Urban Stormwater
		Riparian Forest Buffers	Urban Forest Expansion/ Conservation Landscaping	Urban Tree Canopy Expansion	Ag Stream Restoration	Urban Stream Restoration	Wetland Creation	Wetland Restoration	Forestry	

<b>Approved Methodologies:</b>	
<span style="display: inline-block; width: 15px; height: 15px; background-color: yellow; border: 1px solid black;"></span> Survey	<span style="display: inline-block; width: 15px; height: 15px; background-color: #6699cc; border: 1px solid black;"></span> Remote Sensing using Aerial Imagery
<span style="display: inline-block; width: 15px; height: 15px; background-color: #ff9933; border: 1px solid black;"></span> Survey and/or Inspection	<span style="display: inline-block; width: 15px; height: 15px; background-color: #9933cc; border: 1px solid black;"></span> Remote Sensing using Aerial Imagery and/or Inspection
<span style="display: inline-block; width: 15px; height: 15px; background-color: #ff6633; border: 1px solid black;"></span> Inspection	<span style="display: inline-block; width: 15px; height: 15px; background-color: #99ccff; border: 1px solid black;"></span> Remote Sensing using Lidar
	<span style="display: inline-block; width: 15px; height: 15px; background-color: #ff99ff; border: 1px solid black;"></span> Remote Sensing using Lidar and/or Inspection

## Agriculture:

Agricultural operations are required to be compliant with Chapter 102 (Erosion and Sediment Control), Chapter 91 (Manure Management) and, when animal numbers and density reach a certain threshold, Chapter 92a (National Pollutant Discharge Elimination System ((NPDES) Permitting) and/or Chapter 83/Act 38 (Nutrient Management). Pennsylvania has three inspection programs relating to the compliance assurance of agricultural operations: NPDES Concentrated Animal Feeding Operations (CAFOs) are inspected at a minimum of 20% annually by Department of Environmental Protection (DEP) staff; Act 38 Concentrated Animal Operations (CAOs) are inspected annually by Conservation District and State Conservation Commission staff; and all other non-CAFO and non-CAO operations are inspected within the Chesapeake Bay Watershed at a rate of between 5-10% annually by Conservation District and DEP staff. The requirements for all operations include planning, record keeping, and implementing Best Management Practices, to include Nutrient and Manure Management, Barnyard Runoff Controls, Loafing Lot Management, Conservation/Agricultural Erosion and Sediment Control Plans and related practices.

Best Management Practices (BMPs) such as no-till or reduced till and cover crops are utilized by farms to reduce erosion and increase soil health and sustainability. These practices are currently verified by the transect survey methodology, which is performed by the Capital Resource Conservation and Development (Capital RC&D) and Conservation District staff annually. Rotational/Prescribed Grazing, Horse Pasture Management, or equivalent Resource Improvement Practice is verified via the Penn State Survey Methodology, Chesapeake Bay Ag Inspection Program or Natural Resource Conservation Service (NRCS) contracts. Animal Waste Management Systems (AWMS) are included in Nutrient Management Plans and verified either via the Nutrient Management Program, NPDES CAFO Program, Penn State Survey methodology, NRCS Remote Sensing, or NRCS contracts. Dairy Precision Feeding is utilized throughout the dairy industry, but with minimal accounting for the use of this practice. Manure Treatment Technologies, as they are reported, are certified and are verified to have generated credits via DEP's Nutrient Trading Program. Grassed and Forested Buffers are verified using the Penn State Survey and NRCS Remote Sensing methodology, Chesapeake Bay Ag Inspection Program, and funding sources (such as NRCS-Farm Service Agency (FSA), Growing Greener, DCNR, etc.). Stream and wetland restoration practices are typically reported and verified from the funding and/or implementing source (such as NRCS, US Fish and Wildlife Service (USFWS), Growing Greener, etc.). Refer to Table 3

### Inspector/Verifier Qualifications

Verifiers of these activities include federal (NRCS and FSA), state (DEP, DCNR, SCC, PDA), local (conservation districts), and third-party (Non-governmental organizations (NGOs) such as Chesapeake Bay Foundation, William Penn Foundation, Penn State, and private entities). It is expected that for each BMP type, the verifier(s) will have the

relevant training and experience with identifying the existence and visual indication of BMP function.

Typical training includes:

- Act 38 Nutrient Management Program – offers 11-13 days of training for certification. However, not all inspectors need to be certified in Act 38 and may attend some of the training days that are relevant to their field (i.e. DEP CAFO inspectors are not required to be Act 38 certified but are directed to attend the workshops and trainings). Additional nutrient management related workshops are supported by the program throughout the year. See PAPlants ([www.paplants.pa.gov/Index.aspx](http://www.paplants.pa.gov/Index.aspx)) for an up-to-date list of trainings and workshops.
- NRCS Conservation Planning – Federal staff and NRCS Technical Service Providers (TSPs) are provided web-based and in-person training for NRCS Conservation Planning certification. Conservation district staff are considered TSPs and may attend these trainings.
- Spring Agriculture Trainings – Three weeks of basic and advanced trainings are offered annually to federal and state staff as well as Technical Service Providers (TSPs) (conservation districts and some NGOs). These trainings are led by NRCS and SCC and include field exercises and assessments of resource concerns and identification of BMPs to address those concerns. “Basic” level training is provided to new staff. “Advanced” level training is split into two groups: agronomy and engineering. The advanced training runs concurrently, so more advanced staff may attend these trainings in concurrent years.
- Manure Management Planning Facilitator Trainings – Manure Management Planning trainings have been offered annually in-person by Penn State Extension and DEP for conservation district staff who provide planning assistance via workshops and one-on-one. This day-long training will be provided in web-based modules to conservation district staff and potentially others (consultants, NGOs, etc.).
- Inspection Program Standard Operating Procedures (SOPs) – The Chesapeake Bay Agriculture Inspection Program is led by DEP and executed by conservation districts and DEP regional offices. The SOP (BCW-INSP-018) provides guidance for inspection and collection of data. Training has been and will continue to be provided in web-based and in-person format.
- PA Agriculture Conservation Stewardship (PACS) Program – third-party verifiers are required to maintain Act 38 Nutrient Management Certification and participate in web-based and/or in-person training specific to on-site assessments and BMP verification.
- Data Management - Additional SOPs and instructions will be finalized and provided to staff. This guidance will specifically relate to data management using the PracticeKeeper geodatabase to track nutrient management and inspection outputs as well as BMPs. Training has been and will continue to be provided in web-based and in-person format.
- Additional guidance and trainings will be provided to staff as developed.

Each priority Agriculture BMP is listed, below, under the associated Agriculture WIP Priority Initiative (PI). Each BMP is identified by the BMP name used in the Chesapeake Bay Model and described using the template created by experts at the Chesapeake Bay Program Office.

## Priority Initiative 1: Agricultural Compliance

### Nutrient Management – Core Nitrogen and Core Phosphorus

BMP Type: Annual. Nutrient Management Plans (NMPs) are 3-year plans; Manure Management Plans (MMPs) are 3-year+ plans.

Program (Existing or New): Existing (Act 38 Nutrient Management Program; Chesapeake Bay Ag Inspection Program; Chapter 91 Manure Management Program); New (Pennsylvania Agriculture Conservation Stewardship Program (PACS)).

What factors can cause the BMP to fail? Annual Practice, relies on record-keeping and compliance with regulations (Act 38 and Chapter 91).

Who does the verification? Compliance Inspections performed by Conservation Districts (Act 38) and Conservation Districts and DEP (Chapter 91), Penn State Extension (Surveys), Qualified third-party verifiers for the PACS Program (Certified Commercial Planners- Ch. 91) NRCS 590.

How is it verified? On-farm assessments (Act 38, Chapter 91, PACS Program); Surveys

Do resources exist to support verification techniques? Yes, via PA Nutrient Management Program Funds and EPA Chesapeake Bay Regulatory Accountability Program (CBRAP).

How often does it have to be verified/re-verified? Inspections occur on the same operation once every year for CAOs and CAFOs (Act 38); once every 10 years for non-CAOs, non-CAFOs (Chapter 91). As this is an annual practice, a percentage of the total plan coverage would need to be inspected and reported. The rate of implementation would be assigned to the total known plan coverage.

What actions could help support better verification for the practice in PA the next few years? Building public and private technical assistance capacity for plan development and BMP implementation to ensure compliance with existing regulations.

## Manure Transport

BMP Type: Annual

Program (Existing or New): Existing (Act 38 – Nutrient Management Program; Act 49 – Commercial Manure Haulers and Brokers)

What factors can cause the BMP to fail? Annual Practice, relies on ability to obtain/review Nutrient Balance Sheets (NBS) and records.

Who does the verification? Pennsylvania Department of Agriculture (PDA)/State Conservation Commission (SCC) via Manure Hauler/Broker Program Inspections, Conservation Districts via NBS technical reviews, PSU survey

How is it verified? Records reviews/on-site hauler or broker inspections (mushroom industry on receiving end, survey method)

Do resources exist to support verification techniques? Limited, via Nutrient Management Program Fund.

How often does it have to be verified/re-verified? Annual practice would need to be reported on an annual basis

What actions could help support better verification for the practice in PA the next few years? Regular record submission to the Department of Agriculture from Brokers and Manure Haulers.

## Soil Conservation and Water Quality Plans (i.e. PA Ag E&S/Conservation Plans)

BMP Type: Annual

Program (Existing or New): Existing (Act 38 Nutrient Management Program; Chesapeake Bay Ag Inspection Program; Chapter 102 Erosion and Sedimentation Control); New (PA Ag Conservation Stewardship Program)

What factors can cause the BMP to fail? Annual Practice, relies on record-keeping and compliance with regulations (Act 38 and Chapter 102), verification for plan, not implementation of plan.

Who does the verification? Compliance Inspections performed by Conservation Districts (Act 38) and Conservation Districts and DEP (Ag Inspection Program). Penn State Extension (Surveys). Qualified third-party verifiers for the PACS Program, NRCS- check implementation.

How is it verified? On-farm assessments; Surveys

Do resources exist to support verification techniques? Yes, via PA Nutrient Management Program Funds and EPA Chesapeake Bay Regulatory Accountability Program (CBRAP)

How often does it have to be verified/re-verified? Inspections occur on the same operation once every year for CAOs and CAFOs (Act 38); once every 10 years for non-CAOs, non-CAFOs (Chapter 91 and 102)

What actions could help support better verification for the practice in PA the next few years? Building public and private capacity to ensure compliance with existing regulations and verify thousands of BMPs per year. Increase funding for BMP implementation and to ensure continued Operation and Maintenance (O&M). Incentivize reporting of implementation.

## **Barnyard Runoff Controls and Loafing Lot Management**

BMP Type: Multi-Year

Program (Existing or New): Existing (Chapter 91 and Chapter 102 – Animal Concentration Area/Animal Heavy Use Area Management; Act 38 – Nutrient Management Program, Chapter 92 - NPDES); New (PA Ag Conservation Stewardship Program)

What factors can cause the BMP to fail? Improper O&M and management of animals

Who does the verification? NRCS (EQIP); Conservation Districts and DEP via Act 38, NPDES CAFO, and Chesapeake Bay Ag Inspection Programs; Qualified third-party verifiers for the PACS Program, PSU Survey

How is it verified? Visual Assessment

Do resources exist to support verification techniques? Potentially. Visual Assessment would increase time necessary to perform an On-farm assessment or inspection.

How often does it have to be verified/re-verified? Once every 10 years. (Resource Improvements = once every 5 years)

What actions could help support better verification for the practice in PA the next few years? Building public and private capacity to ensure compliance with existing regulations and verify thousands of BMPs per year.

## Priority Initiative 2a: Soil Health: Residue Management

### Tillage Practices, to include Conservation Tillage and High Residue Management (No-till)

BMP Type: Annual

Program (Existing or New): Existing (Resource Enhancement and Protection-REAP; Transect Survey);

What factors can cause the BMP to fail? Annual Practice, relies on implementation that year, as well as weather/climate.

Who does the verification? Capital RC&D, along with the CDs, run the transect study program since 2014

How is it verified? Follow CBP/CTIC survey protocol, Farmer survey/question during inspection to add confidence to transect survey,

Do resources exist to support verification techniques? Yes, via the EPA Chesapeake Bay Regulatory Accountability Program funding.

How often does it have to be verified/re-verified? Annual practice would need to be reported on an annual basis

What actions could help support better verification for the practice in PA the next few years? Increase data set for lands known to practice conservation tillage/no-till.

## Priority Initiative 2b: Soil Health: Cover Crops

### Cover Crop – Traditional

BMP Type: Annual

Program (Existing or New): Existing (Transect Survey)

What factors can cause the BMP to fail? Annual Practice, relies on implementation that year, as well as weather/climate.

Who does the verification? Capital RC&D, along with the CDs, run the transect study program since 2014

How is it verified? Follow CBP/CTIC survey protocol

Do resources exist to support verification techniques? Yes, via the EPA Chesapeake Bay Regulatory Accountability Program funding.

How often does it have to be verified/re-verified? Annual practice would need to be reported on an annual basis

What actions could help support better verification for the practice in PA the next few years? Provide funding and support for continuation and development of additional methodologies for traditional cover crop data collection and reporting to ensure crediting of practices.

## Cover Crop – Commodity

BMP Type: Annual

Program (Existing or New): Existing (Resource Enhancement and Protection – REAP)

What factors can cause the BMP to fail? Annual Practice, relies on implementation that year, as well as weather/climate.

Who does the verification? Capital RC&D, along with the CDs, run the transect study program since 2014

How is it verified? Follow CBP/CTIC survey protocol

Do resources exist to support verification techniques? Yes, via the EPA Chesapeake Bay Regulatory Accountability Program funding.

How often does it have to be verified/re-verified? Annual practice would need to be reported on an annual basis

What actions could help support better verification for the practice in PA the next few years? Provide funding and support for development of methodology for commodity cover crop data collection and reporting and ensure CBP approval of methodology.

## Priority Initiative 2c: Soil Health: Prescribed Grazing

### Rotational/Prescribed Grazing (to include Resource Improvement)

BMP Type: Annual

Program (Existing or New): Existing; New (PA Ag Conservation Stewardship Program)

What factors can cause the BMP to fail? Annual Practice, relies on implementation that year.

Who does the verification? NRCS (Grazing Plans); Conservation Districts and DEP via Act 38 and Chesapeake Bay Ag Inspection Programs; Qualified third-party verifiers for PACS Program

How is it verified? Review of Visual Inspection; Records Review, as applicable

Do resources exist to support verification techniques? Potentially. More data needs to be collected to understand the full universe of implementation.

How often does it have to be verified/re-verified? Annual practice would need to be reported on an annual basis

What actions could help support better verification for the practice in PA the next few years? Increase data set for lands known to practice rotational/prescribed grazing. Building public and private capacity to ensure compliance with existing regulations and verify thousands of BMPs per year.

## **Priority Initiative 3: Enhanced Nutrient Management**

### **Nutrient Management – Supplemental Nitrogen and Phosphorus**

BMP Type: Annual

Program (Existing or New): Existing (Act 38 Nutrient Management Program; Chesapeake Bay Ag Inspection Program); New (PA Ag Conservation Stewardship Program, 4-R Nutrient Stewardship)

What factors can cause the BMP to fail? Annual Practice, relies on record-keeping and voluntary implementation of “enhanced” Nutrient Management BMPs

Who does the verification? Penn State Extension (surveys); Qualified third-party verifiers for the PACS Program and other grant-funded programs (4R Nutrient Stewardship)

How is it verified? On-farm assessments and surveys

Do resources exist to support verification techniques? Potentially. Funding will need to be provided to ensure continued farm surveys and assessments.

How often does it have to be verified/re-verified? As this is an annual practice, a percentage of the total plan coverage would need to be inspected and reported. The rate of implementation would be assigned to the total known plan coverage.

What actions could help support better verification for the practice in PA the next few years? Increasing education and awareness of “enhanced” nutrient management practices; increasing incentives for adoption and reporting of enhanced practices

## Priority Initiative 4: Animal Waste Management Systems (AWMS)

### Animal Waste Management Systems

BMP Type: Multi-Year

Program (Existing or New): Existing (NRCS, PA Act 38, PA Chapter 91, Chapter 92a); New (PA Ag Conservation Stewardship Program)

What factors can cause the BMP to fail? Improper O&M

Who does the verification? NRCS (EQIP); Conservation Districts and DEP via Act 38, NPDES CAFO, and Chesapeake Bay Ag Inspection Programs; Penn State Extension (survey); Qualified third-party verifiers for the PACS Program

How is it verified? Visual Assessment / Survey w/ statistically valid QA/QC spot-check

Do resources exist to support verification techniques? Potentially. Visual Assessment would increase time necessary to perform the inspection.

How often does it have to be verified/re-verified? Once every 15 years. RI (Solid AWMS) = once every five years.

What actions could help support better verification for the practice in PA the next few years? Building public and private capacity to ensure compliance with existing regulations and verify thousands of BMPs per year.

## Priority Initiative 5: Dairy Precision Feeding

### Dairy Precision Feeding

BMP Type: Annual

Program (Existing or New): New

What factors can cause the BMP to fail? Management-based practice

Who does the verification? NRCS for cost-shared practices; Non-cost shared has historically not been reported/verified, Penn State, nutritionists, PDMP, Center for Dairy Excellence, self-reporting, New Bolton Large Animal Veterinary Center, veterinarians, Co-ops, Feed mills

How is it verified? Unknown, Survey- feed records

Do resources exist to support verification techniques? Limited

How often does it have to be verified/re-verified? Annual practice would need to be reported on an annual basis

What actions could help support better verification for the practice in PA the next few years? Better ability to collect information via co-ops, associations, etc.

## **Priority Initiative 6: Development of Integrated System for Excess Manure**

### **Manure Treatment Technologies**

BMP Type: Annual

Program (Existing or New): Nutrient Trading

What factors can cause the BMP to fail? Annual Practice, relies on ability to obtain/review records.

Who does the verification? DEP (Nutrient Trading Program)

How is it verified? Records review

Do resources exist to support verification techniques? Minimal resources to support verification techniques.

How often does it have to be verified/re-verified? Annual practice would need to be reported at minimum on an annual basis, but may be verified multiple times in a year

What actions could help support better verification for the practice in PA the next few years? Record submission from Brokers and Manure Haulers, record submissions from locations previously receiving manure (nutrient management/ag practices when received manure and now that they aren't receiving manure).

## **Priority Initiative 7: Enhanced Development of Forested and Grassed Buffers**

### **Grassed Buffers - with and without Stream Fencing (35+ feet width)**

BMP Type: Multi-Year

Program (Existing or New): Existing (Act 38, Chapter 91, Chapter 92); New (PA Ag Conservation Stewardship Program)

What factors can cause the BMP to fail? Improper O&M

Who does the verification? NRCS (cost-share); Conservation Districts and DEP via Act 38, NPDES CAFO, and Chesapeake Bay Ag Inspection Programs; Penn State Extension (survey); Qualified third-party verifiers for the PACS Program, NRCS

How is it verified? Visual Inspection / Survey w/ statistically valid QA/QC spot-check, remote sensing (timing critical)

Do resources exist to support verification techniques? Potentially. Visual Inspection would increase time necessary to perform the inspection.

How often does it have to be verified/re-verified? Once every 10 years. (Resource Improvement = once every 5 years)

What actions could help support better verification for the practice in PA the next few years? Building public and private capacity to ensure compliance with existing regulations and verify thousands of BMPs per year.

### **Forested Buffers - with and without Stream Fencing (35+ feet width)**

BMP Type: Multi-Year

Program (Existing or New): Existing (NRCS, PA DEP Growing Greener); New (PA DCNR Buffer Grants, PA Ag Conservation Stewardship Program (PACS))

What factors can cause the BMP to fail? Improper O&M

Who does the verification? NRCS (EQIP); Penn State Extension (survey); Qualified third-party verifiers for the ACS Program, DCNR Foresters, NRCS

How is it verified? Visual Inspection / Survey w/ statistically valid QA/QC spot-check remote sensing, DCNR-PracticeKeeper (soon), 10 Million Tree Project

Do resources exist to support verification techniques? Potentially. Visual Inspection would increase time necessary to perform the inspection.

How often does it have to be verified/re-verified? Once every 10 years. (Resource Improvement = once every 5 years)

What actions could help support better verification for the practice in PA the next few years? Building public and private capacity to ensure compliance with existing grant requirements and verify hundreds of acres of forest buffers per year.

## Urban Stormwater:

Depending on location, purpose, and design, the responsibility for the operation of and ensuring that Urban Stormwater BMPs are maintained can fall to several different entities:

### *1. Post Construction Stormwater Management (PCSM) in Municipal Separate Stormwater Systems (MS4s) Regulated Areas (Responsible Party—Owner and MS4)*

MS4s are required under Minimum Control Measure #5 of the MS4 permit to “ensure maintenance” of Chapter 102 Post-Construction Stormwater” (PCSM) BMPs. Since “ensure” is not defined, MS4s are expected to establish a process suited to their municipality. Some send out questionnaires to property owners and do physical inspections of non-responses. Some hire summer interns to do inspections of all BMPs or employ other variations. The number of Chapter 102 BMPs varies depending on the extent of development that has occurred since 2003. Some have a dozen, some have hundreds.

An initial challenge for many MS4s is developing the inventory. Despite the long-standing requirement, many MS4s failed to keep a record of Chapter 102 permits. County Conservation Districts can sometimes help. All MS4s should have an inventory of recent permits and should expand that inventory at every opportunity.

A second challenge is that while the existence of the BMPs has been recorded with land titles since 2003, it was not until 2010 that the Chapter 102 permit required an Operation & Maintenance (O&M) manual to also be attached. Therefore, the older permits require judgment regarding what O&M is required.

DEP MS4 inspections include a review of the PCSM inventory and the process to ensure O&M.

NOTE: The effort described above reflects the EPA-accepted 2018 MS4 permit. DEP cannot commit to changing the 2023-2028 MS4 permit prior to going through the public process but may consider changes recommended by the public for the 2023-2028 MS4 permit at that time. The verification frequency required by the Chesapeake Bay Program (CBP) is listed for each BMP below.

### *2. PCSM Outside MS4-Regulated Areas (Responsible Party—Permittee/Co-permittee and/or Owner)*

Section 102.8 requires that persons proposing a new earth disturbance activity (post November 19, 2010) that requires permit coverage under this chapter or another new DEP permit that requires compliance with this chapter shall be responsible to ensure that a written PCSM Plan is developed, implemented, operated and maintained.

Section 102.8(m) describes PCSM long-term operation and maintenance requirements, to include:

- The permittee or co-permittee shall be responsible for long-term operation and maintenance of PCSM BMPs unless a different person is identified in the notice of termination (NOT) and has agreed to long-term operation and maintenance of PCSM BMPs.
- For any property containing a PCSM BMP, the permittee or co-permittee shall record an instrument with the recorder of deeds which will assure disclosure of the PCSM BMP and the related obligations in the ordinary course of a title search of the subject property.
- A permittee or co-permittee that fails to transfer long-term operation and maintenance of the PCSM BMP or otherwise fails to comply with this requirement shall remain jointly and severally responsible with the landowner for long-term operation and maintenance of the PCSM BMPs located on the property.

The Chapter 102 inspection program requires that delegated conservation districts perform inspections throughout the active permit to inspect earth disturbance activities and at the time the NOT is submitted to ensure that PCSM BMPs were constructed and are functioning. Inspections are also performed in response to complaints. There is no continuous inspection program instituted for PCSM BMPs outside of MS4 regulated areas.

### *3. Pollutant Reduction Plans (PRP) / TMDL Plan BMPs in MS4-Regulated Areas (Responsible Party--MS4)*

The 2018 MS4 permit requires most MS4s to implement BMPs to reduce current pollutant (N, P and sediment) loads; the design requirement in most cases is a 10% sediment reduction, which must be completed within five years of permit issuance. Those BMPs must be reported as operational at the five-year date. Any BMPs which fail before that date must be replaced. DEP cannot commit to changing the 2023-2028 MS4 permit prior to going through the public process, but this plan assumes that MS4s will be expected to maintain the reductions from the 2018-2023 MS4 permit. Annual MS4 Status Reports require the date of the latest inspection of PRP/TMDL BMPs. O&M is therefore essential to successful MS4 permit compliance.

### *4. Voluntary BMPs Outside MS4-Regulated Areas*

Voluntary BMPs outside of MS4-regulated areas have been challenging to track and report, as there is no compliance metric to require these BMPs, which are most likely homeowner installed practices. As such, there is essentially no “responsible party” to ensure operation and maintenance. This tier of urban BMPs will not be a priority to collect, report, and verify.

## Inspector/Verifier Qualifications

Typically, the MS4 permittee is responsible for long-term verification of PCSM BMPs. These entities can either do the work themselves or hire contractors to do it.

- The MS4 permittee shall establish what local qualifications are needed to inspect and verify stormwater BMPs. In most cases, it can be done by individuals with some training in the visual indicators and local inspection procedures.
- The MS4 should have access to stormwater engineering expertise to handle the BMPs that are flagged in the field as failing. These facilities will require some further investigations on how to restore performance and resolve any dam hazard or public safety issues.
- DEP provides training to MS4s and County Conservation Districts.
  - 1) Chapter 102/NPDES Construction Spring Training – Two week-long trainings (basic and advanced) are offered annually and is led by DEP and PACD. These trainings are complemented by web-based training modules geared toward new staff. These trainings focus on plan review, permit approval, inspection, compliance, enforcement, referrals, and BMP visual inspection.
- MS4s and County Conservation District staff involved in inspecting stormwater BMPs are encouraged to take advantage of additional training materials and opportunities offered by other private and public sources.

For additional information, please reference the Chesapeake Stormwater Network (CSN) 2013, *Bioretention Illustrated: a visual guide for constructing, inspecting, maintaining and verifying the bioretention practice*. See appendices for guidance on visual indicators for infiltration, permeable pavement, grass swales, filter strips and other low impact design (LID) practices.

Each priority Urban Stormwater BMP is listed, below, under the associated Urban Stormwater WIP Priority Initiative (PI). Each BMP is identified by the BMP name used in the Chesapeake Bay Model and described using the template created by experts at the Chesapeake Bay Program Office.

## **Priority Initiative 1: Stormwater Management Controls**

### **Dry Detention Ponds and Hydrodynamic Structures**

BMP Type: Structural. Note that this category includes a wide range of BMPs (basins that temporarily store runoff, swirl concentrators, grit chambers, and others); what they have in common is limited pollutant capture (10% sediment). Verification practices will therefore vary.

What factors can cause the BMP to fail? BMP removed, soil compaction, overgrown with weeds, filled with sediment & trash, washed out.

Who does the verification? MS4, reported to DEP.

How is it verified? Field inspection, assessment of visual indicators (structural stability of embankments and inflow/outflow structures, vegetative conditions, sediment accumulation, ponding water)

Do resources exist to support verification techniques? Yes, original recorded design drawings for BMP are the primary resource for determining if an existing BMP is functioning as designed. Where original designed are unavailable, the PA BMP Manual provides guidance that can be used to determine if the functionality of the BMP meets a minimum standard.

How often does it have to verified/re-verified? Sufficient to “assure maintenance” in accordance with MS4 permit. CBP requirement is to verify at 10 years.

What actions could help support better verification for the practice in the next few years? More frequent DEP inspections of MS4s, BMP O&M training (physical training and improved website-based materials). A Request for Proposal is being developed to ascertain the validity and viability of using remote sensing technologies (with statistically valid QA/QC on-site checks) to verify these BMP types.

## Dry Extended Detention

BMP Type: Structural.

What factors can cause the BMP to fail? BMP removed, soil compaction, overgrown with weeds, filled with sediment & trash, washed out.

Who does the verification? MS4, reported to DEP.

How is it verified? Field inspection, assessment of visual indicators (structural stability of embankments and inflow/outflow structures, vegetative conditions, sediment accumulation, ponding water)

Do resources exist to support verification techniques? Yes, original recorded design drawings for BMP are the primary resource for determining if an existing BMP is functioning as designed. Where original designed are unavailable, the PA BMP Manual provides guidance that can be used to determine if the functionality of the BMP meets a minimum standard

How often does it have to verified/re-verified? Sufficient to “assure maintenance” in accordance with MS4 permit. CBP requirement is to verify at 10 years.

What actions could help support better verification for the practice in the next few years? More frequent DEP inspections of MS4s, BMP O&M training (physical training and improved website-based materials). A Request for Proposal is being developed to ascertain the validity and viability of using remote sensing technologies (with statistically valid QA/QC on-site checks) to verify these BMP types.

## Vegetated Open Channels

BMP Type: Structural.

What factors can cause the BMP to fail? BMP removed, overgrown vegetation, filled with sediment & trash, washed out.

Who does the verification? MS4, reported to DEP.

How is it verified? Field inspection, assessment of visual indicators (structural stability of embankments, vegetative conditions, impediments to drainage flow)

Do resources exist to support verification techniques? Yes, original recorded design drawings for BMP are the primary resource for determining if an existing BMP is functioning as designed. Where original designed are unavailable, the PA BMP Manual provides guidance that can be used to determine if the functionality of the BMP meets a minimum standard.

How often does it have to verified/re-verified? Sufficient to “assure maintenance” in accord with MS4 permit. CBP requirement is to verify at 10 years.

What actions could help support better verification for the practice in the next few years? More frequent DEP inspections of MS4s, BMP O&M training (physical training and improved website-based materials). A Request for Proposal is being developed to ascertain the validity and viability of using remote sensing technologies (with statistically valid QA/QC on-site checks) to verify these BMP types.

## Wet Ponds and Wetlands

BMP Type: Structural.

What factors can cause the BMP to fail? BMP removed, overgrown with weeds, filled with sediment & trash, washed out, sink hole)

Who does the verification? MS4, reported to DEP.

How is it verified? Field inspection, assessment of visual indicators (structural stability of embankments and inflow/outflow structures, vegetative conditions/invasive species, mosquito control)

Do resources exist to support verification techniques? Yes, original recorded design drawings for BMP are the primary resource for determining if an existing BMP is functioning as designed. Where original designed are unavailable, the PA BMP Manual provides guidance that can be used to determine if the functionality of the BMP meets a minimum standard.

How often does it have to verified/re-verified? Sufficient to “assure maintenance” in accord with MS4 permit. CBP requirement is to verify at 10 years.

What actions could help support better verification for the practice in the next few years? More frequent DEP inspections of MS4s, BMP O&M training (physical training and improved website-based materials). A Request for Proposal is being developed to ascertain the validity and viability of using remote sensing

technologies (with statistically valid QA/QC on-site checks) to verify these BMP types.

## Stream Restoration

BMP Type: Structural

What factors can cause the BMP to fail? Common reasons for BMP failure include poor design and/or construction, extreme storms, unexpected channel erosion, floodplain deposition.

Who does the verification? Usually an MS4 or land conservation agency that installed the stream restoration project is responsible for verification, although they often hire independent consultants to do the actual work.

How is it verified? Initial verification requires review of original design drawings/specifications and field inspection along the project reach. Follow-up inspections limited to field inspection and assessment using visual indicators (streambank conditions/erosion, riparian buffer condition, floodplain connection).

Do resources exist to support verification techniques? No. Standard guidance is not yet available, although a special group of the Urban Stormwater Work Group (USWG) is working on it and should have guidance ready later in 2019.

How often does it have to be verified/re-verified? Stream restoration projects need to be verified every 5 years after their original Chapter 105 construction permit expires. There is a gap after 5 years for further verification through existing regulatory requirements. Could Chapter 105 requirements be changed? Tie long-term monitoring reporting to funding sources??

What actions could help support better verification for the practice in PA the next few years? Some outreach and training on the forthcoming Bay-wide guidance would be helpful for the MS4 and practitioner community, after it is adapted for PA conditions. A Request for Proposal is being developed to ascertain the validity and viability of using remote sensing technologies (with statistically valid QA/QC on-site checks) to verify these BMP types.

## Urban Forest Buffers

BMP Type: Structural.

What factors can cause the BMP to fail? Trees die (from lack of and/or improper O&M, disease, drought, flooding, cutting, deer damage or other), or growth stunted by non-preferred vegetation in first 5 years. Stormwater cuts channels which limit infiltration and filtering expected through sheet flow. Lots of onsite maintenance in the first five years can avoid this.

Who does the verification? MS4s and through other grantee requirements

How is it verified? field inspection, visual indicators, remote sensing.

Do resources exist to support verification techniques? Yes, in MS4s.

How often does it have to be verified/re-verified? Sufficient to “assure maintenance” in accord with MS4 permit. CBP requirement is to verify at 15 years.

What actions could help support better verification for the practice in the next few years? BMP O&M training (physical training and improved website-based materials).

## Bioretention Practices

BMP Type: Structural

What factors can cause the BMP to fail? Common reasons for BMP failure include poor design, poor construction, sediment clogging, vegetative failure and surface ponding. Most bioretention practices have good longevity if they are regularly maintained.

Who does the verification? Usually the MS4 stormwater agency or conservation district that approved the stormwater retrofit plan is responsible for long-term verification, although they often may hire independent consultants to do the actual inspections.

How is it verified? Usually requires a field inspection at the project site that relies on simple visual indicators to determine the condition and pollutant removal function. Visual indicators to be assessed include structural stability of embankments and inflow/outflow structures, vegetative conditions (including presence of invasive species), and accumulated sediment. The practice needs to be inspected every 10 years to ensure it is still working and renew the pollutant reduction credit for another 10 years. It is helpful to have a copy of the original design, planting plan or an as-built construction drawing handy to compare the practice against.

Do resources exist to support verification techniques? Yes. Bioretention has become widely used in new and redevelopment projects in recent years. Projected to be used as a stormwater retrofit in the future (MS4 PRPs). Since bioretention is a runoff reduction practice, it has high nutrient and sediment reduction capability when designed to the criteria in the DEP stormwater manual. The original recorded design drawings for BMP are the primary resource for determining if an existing BMP is functioning as designed. Additionally, CSN (2013) has produced good resources to how to construct, inspect, maintain and verify bioretention practices that many large and small communities are using to meet the maintenance conditions of their MS4 permits.

How often does it have to be verified/re-verified? All stormwater practices, such as bioretention, that are built according to the sizing and design criteria outlined in the state’s stormwater performance standard, get pollutant reduction credit for 10

years, regardless of whether it is a retrofit or new practice to serve a new or development project.

What actions could help support better verification for the practice in PA the next few years? Good outreach and training materials on how to construct, inspect and maintain bioretention practices can be found on the CSN website ([www.chesapeakestormwater.net](http://www.chesapeakestormwater.net)), including webcasts, technical resources, inspection checklists and other guidance. Municipalities should also refer to the relevant sections of the PA DEP Stormwater Management Manual. A Request for Proposal is being developed to ascertain the validity and viability of using remote sensing technologies (with statistically valid QA/QC on-site checks) to verify these BMP types.

## Infiltration Practices

BMP Type: Structural<sup>1</sup>

<sup>1</sup> Note: this guidance also applies to other LID practices such as permeable pavement, grass swales, filter strips and rooftop disconnection (see CSN, 2013).

What factors can cause the BMP to fail? Common reasons for infiltration failure include poor design or soil testing, construction compaction, failed pre-treatment, clogging by sediment, sinkholes or surface ponding. Most infiltration practices have good longevity if they are located on suitable soils and are regularly maintained.

Who does the verification? Usually the MS4 stormwater agency or conservation district that approved the stormwater retrofit plan is responsible for long-term verification, although they often may hire independent consultants to do the actual inspections.

How is it verified? Usually requires a field inspection at the project site that relies on simple visual indicators to determine the condition and pollutant removal function. Visual indicators to be assessed include of the structural stability of embankments and inflow/outflow structures, vegetative conditions, accumulated sediment, and ponding water. The practice needs to be inspected every 10 years to ensure it is still working and renew the pollutant reduction credit for another 10 years. It is helpful to have a copy of the original design or an as-built construction drawing handy to compare the practice against

Do resources exist to support verification techniques? Yes. Infiltration is a preferred approach to stormwater design in PA and has become widely used in new and redevelopment projects in recent years. Infiltration practices can be an effective stormwater retrofit where soils permit for PA MS4's implementing PRPs. Since infiltration is a runoff reduction practice, it has high nutrient and sediment reduction capability when designed to the criteria in the DEP stormwater manual. The original recorded design drawings for BMP are the primary resource for determining if an existing BMP is functioning as designed. Additionally, Appendix

B-4 Of CSN (2013) has good resources to how to construct, inspect, maintain and verify infiltration practices. Many large and small communities rely on these visual indicators to inspect infiltration practices.

How often does it have to verified/re-verified? All stormwater practices, such as infiltration, that are built according to the sizing and design criteria outlined in the state's stormwater performance standard, get pollutant reduction credit for 10 years, regardless of whether it is a retrofit or new practice to serve a new or development project.

What actions could help support better verification for the practice in PA the next few years? Good outreach and training materials on how to construct, inspect and maintain infiltration and other LID practices can be found on the CSN website ([www.chesapeakestormwater.net](http://www.chesapeakestormwater.net)), including webcasts, technical resources, inspection checklists and other guidance. Municipalities should also refer to the relevant sections of the PA DEP Stormwater Management Manual. A Request for Proposal is being developed to ascertain the validity and viability of using remote sensing technologies (with statistically valid QA/QC on-site checks) to verify these BMP types.

## Forestry:

Forestry practices consist of BMPs that reduce both Urban and Agricultural runoff. BMPs that include tree planting, native meadow establishment, wetland establishment, etc. are cost-effective for improving water quality while also providing significant wildlife habitat benefits. Riparian forest buffers and upland tree plantings on both agricultural and developed lands also provide significant human health and social benefits in addition to water quality benefits, while reducing flooding impacts.

Currently, most Forestry-associated BMPs have been verified through field inspections, visual indicators, or surveys. Moving towards a more comprehensive verification process via remote sensing will save time, money, and resources and yield more complete data. Newly implemented buffers will be tracked by DEP and DCNR primarily through PracticeKeeper, which will assist the future remote sensing verification process. Below, each BMP is identified, along with the Priority Initiative (PI) within the preliminary Forestry Workgroup recommendations for the Phase 3 WIP and a brief overview of the verification requirements.

### Inspector/Verifier Qualifications

Inspectors should be familiar with the BMPs outlined in the Forestry PIs, and how to identify these practices on the landscape via remote sensing technologies.

For any field-inspection verification necessary, inspectors/verifiers should have a basic knowledge of Forestry BMPs, especially including riparian forest buffers, basic native tree identification skills, and basic invasive plant and insect identification skills.

Each priority Forestry BMP is listed, below, under the associated Forestry WIP Priority Initiative (PI). Each BMP is identified by the BMP name used in the Chesapeake Bay Model and described using the template created by experts at the Chesapeake Bay Program Office.

## Priority Initiative 1: Forested Riparian Buffers

### Riparian Forest Buffers

BMP Name: Riparian Buffers (Urban Riparian Forest Buffers, Ag Riparian Forest Buffers, Ag Riparian Grass Buffers)

BMP Type: Multi-Year

Program (Existing or New): Existing (NRCS, PA DEP Growing Greener); New (PA DCNR Buffer Grants, Ag Conservation Stewardship Program, TreeVitalize Urban Riparian Buffers, etc.).

What factors can cause the BMP to fail? Improper O&M, Natural Disaster (i.e. flooding shortly after installation, drought, etc.), Invasive Species.

Who does the verification? USDA, DEP, DCNR, PSU, MS4 communities, etc.

How is it verified? remote sensing, field inspection, visual indicators, PSU survey w/ statistically valid QA/QC spot-check, etc.

Do resources exist to support verification techniques? Potentially/in some areas. MS4 communities have resources to verify urban forest buffers if utilized within PRPs, DCNR grants will utilize Service Foresters and Buffer Technicians. USDA verifies all buffers, forest and grass, installed with USDA funding.

How often does it have to be verified/re-verified? Ag: Once every 10 years. (Resource Improvement = once every 5 years). Urban: sufficient to “assure maintenance” in accord with MS4 permit- CBP requirement is to verify at 15 years.

What actions could help support better verification for the practice in the next few years? Development of remote sensing verification process/partnership with USDA to verify all buffers through remote sensing.

## Priority Initiative 2: Tree Canopy

### Urban Tree Canopy Expansion

BMP Name: Tree Planting (Urban Tree Canopy Expansion)

BMP Type: Multi-Year

Program (Existing or New): Existing (Treevitalize)

What factors can cause the BMP to fail? Improper O&M, Natural Disaster (i.e. drought).

Who does the verification? DCNR, PSU, MS4 communities, etc.

How is it verified? remote sensing, field inspection, visual indicators.

Do resources exist to support verification techniques? Potentially/in some areas. MS4 communities have resources to verify urban tree canopy expansion if utilized within PRPs, TreeVitalize grants will utilize Service Foresters and Penn State Extension foresters.

How often does it have to be verified/re-verified? Once every 10 years.

What actions could help support better verification for the practice in the next few years? Development of remote sensing verification process in PA.

## Priority Initiative 3: Turf Conversion (Woods and Pollinator Habitat)

### Urban Forest Expansion/Conservation Landscaping

BMP Name: Turf Conversion (Urban Forest Expansion; Conservation Landscaping)

BMP Type: Multi-Year

Program (Existing or New): Existing (TreeVitalize, DCNR); New (PA DCNR seeking to launch new lawn/turf conversion initiative.

What factors can cause the BMP to fail? Improper O&M, Natural Disaster (i.e. flooding shortly after installation, drought, etc.), Invasive Species.

Who does the verification? DEP, DCNR, PSU, MS4 communities, etc.

How is it verified? remote sensing, field inspection, visual indicators

Do resources exist to support verification techniques? Potentially/in some areas. MS4 communities have resources to verify urban practices if utilized within PRPs, DCNR grants will utilize existing staff to assist with verification.

How often does it have to be verified/re-verified? Once every 15 years. (Resource Improvement = once every 5 years)

What actions could help support better verification for the practice in the next few years? Development of remote sensing verification process in PA.

## Priority Initiative 5: Stream and Wetland Restoration

### Ag Stream Restoration

BMP Type: Multi-Year

Program (Existing or New): Existing (DEP, USDA, federal grants, etc.)

What factors can cause the BMP to fail? Improper O&M, Natural Disaster (i.e. major flood events).

Who does the verification? DEP, USDA

How is it verified? remote sensing, field inspection, visual indicators

Do resources exist to support verification techniques? Potentially/in some areas. MS4 communities have resources to verify urban practices if utilized within PRPs, USDA verifies practices installed with USDA funding.

How often does it have to be verified/re-verified? Once every 10 years.

What actions could help support better verification for the practice in the next few years? Development of remote sensing verification process in PA.

## Urban Stream Restoration

BMP Type: Multi-Year

Program (Existing or New): Existing (DEP, USDA, federal grants, etc.)

What factors can cause the BMP to fail? Improper O&M, Natural Disaster (i.e. major flood events).

Who does the verification? DEP, USDA

How is it verified? remote sensing, field inspection, visual indicators

Do resources exist to support verification techniques? Potentially/in some areas. MS4 communities have resources to verify urban practices if utilized within PRPs, USDA verifies practices installed with USDA funding.

How often does it have to verified/re-verified? Once every 5 years.

What actions could help support better verification for the practice in the next few years? Development of remote sensing verification process in PA.

## Wetland Creation

BMP Type: Multi-Year

Program (Existing or New): Existing (DEP, USDA, federal grants, etc.)

What factors can cause the BMP to fail? Improper O&M, Natural Disaster (i.e. major flood events).

Who does the verification? DEP, USDA

How is it verified? remote sensing, field inspection, visual indicators

Do resources exist to support verification techniques? Potentially/in some areas. MS4 communities have resources to verify urban practices if utilized within PRPs, USDA verifies practices installed with USDA funding.

How often does it have to verified/re-verified? Once every 15 years.

What actions could help support better verification for the practice in the next few years? Development of remote sensing verification process in PA.

## Wetland Restoration

BMP Type: Multi-Year

Program (Existing or New): Existing (DEP, USDA, federal grants, etc.)

What factors can cause the BMP to fail? Improper O&M, Natural Disaster (i.e. major flood events).

Who does the verification? DEP, USDA

How is it verified? remote sensing, field inspection, visual indicators

Do resources exist to support verification techniques? Potentially/in some areas. MS4 communities have resources to verify urban practices if utilized within PRPs, USDA verifies practices installed with USDA funding.

How often does it have to be verified/re-verified? Once every 15 years.

What actions could help support better verification for the practice in the next few years? Development of remote sensing verification process in PA.

## Plan Implementation:

Below is Pennsylvania's Verification Plan moving forward to verify the priority practices described above as identified in the Phase 3 WIP. The major source of funding for the core activities of this Verification Plan is the EPA Chesapeake Bay Regulatory and Accountability Program (CBRAP) grant.

### Programs and Projects – Agriculture

#### **Chesapeake Bay Agricultural Inspection Program**

Pennsylvania's Chesapeake Bay Agricultural Inspection Program (CBAIP) is a phased regulatory farm inspection program implemented by DEP and participating County Conservation Districts to track Manure Management Plans (MMPs), Agriculture E&S plans, NMPs, and other BMPs in place. This program uses PracticeKeeper software to document planning and inspections. Pennsylvania is initially looking at plan completeness but will expand to plan implementation in the future.

Pennsylvania recently completed modifications to the Standard Operating Procedure (SOP) (Version 1.2) for the CBAIP (SOP No BCW-INSP-018) to address the following:

- The Chesapeake Bay Program Partnership's Nutrient Management Best Management Practice panel report for the five elements to address core nitrogen requirements.
- The specific approach to compliance with DEP's regulatory requirements.
- How inspectors are assessing farms to determine if plans are administratively complete.
- The qualifications and training requirements for inspectors.

The SOP was effective July 1, 2018 and describes the procedures by which DEP and participating County Conservation Districts will conduct initial and follow-up Inspections of agricultural operations within the Chesapeake Bay watershed to ensure compliance with agricultural planning requirements found in the Pennsylvania Clean Streams Law and regulations promulgated thereunder and can be found at the following link:

[http://files.dep.state.pa.us/Water/BNPNSM/AgriculturalOperations/AgriculturalCompliance/Final\\_SOP\\_Cheseapeake\\_Bay\\_Agricultural\\_Inspection\\_Program.pdf](http://files.dep.state.pa.us/Water/BNPNSM/AgriculturalOperations/AgriculturalCompliance/Final_SOP_Cheseapeake_Bay_Agricultural_Inspection_Program.pdf).

The agricultural compliance annual summary for 2016-2017, as well as related webinars, and a sample inspection checklist can be found on DEP's website at the link below:

[www.dep.pa.gov/Business/Water/CleanWater/AgriculturalOperations/Pages/Agricultural-Compliance.aspx](http://www.dep.pa.gov/Business/Water/CleanWater/AgriculturalOperations/Pages/Agricultural-Compliance.aspx).

Additional revisions to the BCW-INSP-018 as well as additional Standard Operating Procedures (SOPs) for data management will continue to be developed and incorporated as documented into the verification strategy.

*BMPs captured:*

**Nutrient Management, Soil Conservation and Water Quality Plans, Animal Waste Management Systems, Manure Treatment Technologies, Prescribed Grazing, Barnyard Runoff Controls and Loafing Lot Management, Grassed Buffers- with and without Stream Fencing, Forested Buffers- with and without Stream Fencing, and other Ag BMPs.**

## **NPDES Concentrated Animal Feeding Operations (CAFO) Inspections and Annual Reporting**

As part of Pennsylvania's Compliance Monitoring Strategy (CMS), DEP is obligated to inspect 20% of permitted CAFO's annually and perform an administrative review of all annual reports. DEP performs these functions and reports outputs to the EPA ICIS.

*BMPs captured:*

**Nutrient Management, Soil Conservation and Water Quality Plans, Animal Waste Management Systems, Manure Treatment Technologies, Prescribed Grazing, Barnyard Runoff Controls and Loafing Lot Management, Grassed Buffers- with and without Stream Fencing, Forested Buffers- with and without Stream Fencing, and other Ag BMPs.**

## **Pennsylvania Agriculture Conservation Stewardship Program (PACS)**

PACS is a conceptual voluntary program designed to recognize and provide certain benefits to Pennsylvania farmers who step forward to document their environmental stewardship. The program focuses on ensuring farmers meet Pennsylvania environmental regulatory compliance (soil conservation and manure management) along with the utilization of practices that demonstrate the farmer's conservation stewardship addressing all resource concerns on the farm.

The program relies on third party entities to perform environmental assessments of farms applying for recognition, with the oversight of the local county conservation district or other designated entity to administer and provide assessment of program applications.

For conservation districts that choose to support the implementation of this program, the conservation district will provide on-farm inspections on at least 10% of the farms submitting PACS program applications to the conservation district for consideration. These inspections will be considered as counting towards the county's Chesapeake Bay agriculture initial inspection goal if the farm has not been previously accounted for in the inspection program, the farm is not a prior identified Confined Animal Operation (CAO)

or Confined Animal Feeding Operation (CAFO) with an approved nutrient management plan, and the inspection is performed consistent with the with Standard Operating Procedure No. BCW-INSP-018, *Chesapeake Bay Agricultural Inspection Program.*, including the completion of the required inspection report and the record keeping and compliance follow up. For every 10 applications received by participating conservation districts, there will be a minimum of one on-farm inspection completed. This language is included in the Technician Agreement.

The scope of work for this program would be covered within the Ag Inspection SOP here:

[http://files.dep.state.pa.us/Water/BNPNSM/AgriculturalOperations/AgriculturalCompliance/Final\\_SOP\\_Chesapeake\\_Bay\\_Agricultural\\_Inspection\\_Program.pdf](http://files.dep.state.pa.us/Water/BNPNSM/AgriculturalOperations/AgriculturalCompliance/Final_SOP_Chesapeake_Bay_Agricultural_Inspection_Program.pdf).

This is currently a pilot program in a few counties.

*BMPS captured:*

**Nutrient Management, Soil Conservation and Water Quality Plans, Animal Waste Management Systems, Manure Treatment Technologies, Prescribed Grazing, Barnyard Runoff Controls and Loafing Lot Management, Grassed Buffers- with and without Stream Fencing, Forested Buffers- with and without Stream Fencing and other Ag BMPs.**

## **Capital Area Resource Conservation & Development (RC&D) Conservation Tillage Survey**

Cropland residue transect survey procedures used by the Pennsylvania Chesapeake Bay Counties Survey were adapted from those developed by the Conservation Technology Information Center (CTIC) and detailed by the National Crop Residue Management Survey on their website, [www.ctic.org/CRM](http://www.ctic.org/CRM). Survey procedures are described in "Revised & Simplified Cropland Roadside Transect Survey: Procedures for Using the Cropland Roadside Transect Survey for Obtaining Tillage/Crop Residue Data," available online at [https://efotg.sc.egov.usda.gov/references/Delete/2003-10-06/nb\\_450\\_2\\_2\\_a1%5B1%5D.pdf](https://efotg.sc.egov.usda.gov/references/Delete/2003-10-06/nb_450_2_2_a1%5B1%5D.pdf). According to this document, "When conducted properly, this cropland transect survey procedure provides a high degree of confidence in the data summaries. Users can have 90% or more confidence in the accuracy of the results". The Chesapeake Bay Counties Survey uses CTIC procedures and data collection standards with the goal of collecting data that can be authenticated and published by CTIC.

In addition to working within CTIC guidelines, quality assurance and quality control components are detailed below.

**Survey Routes** - Routes were developed for each county using the CTIC procedures and were adapted to a hilly geography. Each county survey route was developed by a

local county agriculture technician with route development guidance adapted from CTIC guidelines. The routes will be reused for each future resurvey.

**Survey Teams and Qualifications** – County survey teams are staffed by three individuals; two of whom work in multiple counties to achieve greater consistency of process between counties. Each team includes one county agriculture agency staffer (from the county to be surveyed), one consulting technician and one data entry technician, with the consulting and data entry technicians staffing multiple counties. A description of each observation (identification of the growing crop and estimation of the percentage of residue cover) is made by the consulting technicians. Qualifications for this position include extensive experience as an agricultural professional working with crop land. The Data Entry Technician qualifications include experience with mapping and GIS data. The county agricultural agency member is typically from the conservation district and is selected for their knowledge of agriculture in the surveyed county.

**Training** – The training was developed by the survey organizer, Capital RC&D, in collaboration with a technical consultant, Joel Myers. A one-day training is required for the entire survey team. Training includes an overview of the entire survey process and review of multiple in-field examples of crop residue. The training is supported by multiple photo guides and written survey procedures. Training may be modified and expanded depending upon the experience of the consulting technicians. In-field post-training testing of the consulting technicians is done during the first week of the survey by the technical consultant and documented for quality assurance. Evaluation of the data entry technicians is also conducted by the technical consultant and documented. This training was shown to be effective for the 2012/2013 tillage survey.

**Data Collection and Entry** – Survey data is entered electronically during the survey using an Excel-based data entry sheet with drop-down data selection on a tablet computer. The data entry technicians are responsible for locating and confirming each data point, using GPS and entry of the observation information for each data point into the data entry sheet. The GPS waypoints are pre-loaded and appear on screen in a map of the survey route. The pre-entered points were visited in previous surveys. The location of the survey vehicle is tracked on the tablet GPS and shown on the map. With this system the data points can be found easily and entered with minimal data entry error.

**Independent Verification of Data** – Independent verification of the data collected by each survey technician is conducted by the technical consultant during the first two weeks of the survey. Ten-percent of the crop observations of each technician is visited and documented. Review of the verification documents is performed by Capital RC&D and results of that review are reported to the technical consultant and the survey technician team. Any concerns are appropriately addressed to ensure data reliability.

**External Validation of Data** – Data summaries are developed from the collected data for each county and entered in the CTIC data collection system. CTIC authenticates and publishes the residue data on an annual basis.

**Chesapeake Bay Program Partnership Agricultural Workgroup Approval:** This methodology was approved by the Chesapeake Bay Program Partnership. The final approval can be found here:

[https://www.chesapeakebay.net/channel\\_files/24633/agwg\\_draft\\_call\\_summary\\_121516\\_2.pdf](https://www.chesapeakebay.net/channel_files/24633/agwg_draft_call_summary_121516_2.pdf).

*BMPs Captured:*

**Tillage Practices**

## Capital Area RC&D Cover Crop Survey

Cover crop transect survey procedures were developed with the technical expertise of a project team consisting of four former NRCS technical staff and reviewed by Mark Dubin, the Chesapeake Bay Program *Cover Crop Expert Panel* Coordinator. The project team considered important variables identified in the Chesapeake Bay Program's "Cover Crop Expert Panel Draft Report" to determine observable cover crop attributes that impact nitrogen reduction. The first survey was implemented in five counties to test if these attributes could be reliably collected using a transect survey method. These attributes included cover crop species, estimated date of planting, density of the planted crop, planting method and occurrence of fall application of manure.

The transect survey route for each county was created using procedures adapted from a method developed and tested by the Conservation Technology Information Center (CTIC) and detailed as the National Crop Residue Management Survey on their website, [www.ctic.org/CRM](http://www.ctic.org/CRM). The cover crop transect survey route and observation points were determined and used by a transect survey of crop residue carried out during 2012 and 2013. Routes were developed for each county using the CTIC procedures adapted to the regional road layout in Pennsylvania

Information collected by the 2015 cover crop survey teams included attributes required to characterize cover cropping for the Chesapeake Bay Model and provide data useful for ag agency understanding of current practices. They include, harvested crop, cover crop species, planting method, cover crop density, estimated days from planting (based on cover crop height), and manure application.

**Survey Team Duties and Qualifications** – County survey teams are staffed by three individuals, two of whom survey multiple counties to achieve greater consistency between counties. Each team includes:

- 1) County Agriculture Agency Staffer to drive the team along the survey route. This person is selected for their knowledge of agriculture in the surveyed county.
- 2) The Consulting Technician surveys multiple counties each year and provides the description of each observation (harvested crop, cover crop, planting method, cover crop density, estimated days from planting and manure application). The primary

qualification for this position is extensive experience as an agricultural professional working with agronomic crops.

- 3) The Data Entry Technician also works in multiple counties each year. The technician guides the team along the survey route, identifies each pre-determined observation point and enters the cover crop data determined by the consulting technician. Qualification required for this position includes experience with mapping and GIS data.

**Training** – Training was developed by the survey organizer, Capital RC&D, in collaboration with a technical consultant, Joel Myers. A half-day training was required for the consulting technicians and data entry technicians and an hour-long training was provided to the county agency staff. Training included an overview of the entire survey process and review of multiple in-field cover crop examples. The training is supported by photos and written survey procedures. Training may be modified and expanded depending upon the experience of the consulting technicians.

**Data Collection and Entry** – Survey data is entered electronically during the survey using an Excel-based data entry sheet with drop-down data options. Data entry techs use a laptop computer with county-specific data sheets and ArcGIS maps with the survey route and points identified. The data entry technicians are responsible for locating and confirming each pre-established data point, using ArcGIS and a GPS device. At each observation point, observation information is entered into the Excel-based data entry sheet. The GPS waypoints are pre-loaded and appear on screen in a map of the survey route. The location of the survey vehicle is tracked on the GPS and shown on the map. With this system, the data points can be found easily and entered with minimal data entry error.

Following the five county survey effort, a post-survey discussion including all participants did not identify areas of significant concern regarding field identification of cover crop establishment date and estimation of cover crop density however, distinguishing between annual rye and small winter grains – particularly when the plants are very small is difficult. The group discussed the cost/benefit of taking the time to decide between those crops using a magnifying glass or other method that would result in significantly increasing the time needed to complete the survey. The consensus of the group was that sacrificing the determination of exact species (of winter grain/rye) to a default species grouping was a necessary sacrifice. The default crop species or group will be the species that has a lower nutrient impact on the model. When exact species of winter grain or rye is easily identified it will be recorded.

**Internal Independent Verification of Data** – Independent verification of the data collected by each survey technician is performed in the spring when the cover crop points are revisited to determine if the cover was harvested or burned down. Ten-percent of the crop observations of each technician are visited by an independent quality control technician and documented. Review of the verification documents are performed by Capital RC&D and results of that review reported to the technical

consultant and the survey technician team. Any concerns are appropriately addressed to ensure data reliability.

**Chesapeake Bay Program Partnership Agricultural Workgroup Approval:** This methodology was approved by the Chesapeake Bay Program Partnership. The final approval can be found here:

[https://www.chesapeakebay.net/channel\\_files/24633/agwg\\_draft\\_call\\_summary\\_112116.pdf](https://www.chesapeakebay.net/channel_files/24633/agwg_draft_call_summary_112116.pdf).

*BMPs captured:*

**Cover Crop (Traditional)**

## **Penn State University Voluntary BMP Reporting Outreach**

The Penn State University Agricultural Voluntary BMP Reporting outreach is an effort to allow producers to voluntarily report BMPs implemented on their operations through paper or web-based forms. The survey was mailed to approximately 20,000 farmers in late January 2016, with returns accepted until the end of April 2016. A total of 6,782 were completed and returned. The reporting was comprised of agricultural BMPs installed without cost-share including structural and management action BMPs. (Structural BMPs reported as Resource Improvement (RI) Practices without known design specifications (shorter Credit Duration than BMPs meeting Federal/State Cost Share standards)).

The final report (December 15, 2016) is available at the link below:

<http://files.dep.state.pa.us/Water/ChesapeakeBayOffice/Farm%20Survey%20Report%20Final%20121516.pdf>.

Future producer surveys will use the revised TetraTech recommendations contained within the report at the link below:

[https://www.chesapeakebay.net/channel\\_files/25874/producer\\_survey\\_recommendation\\_report\\_2018-02-14.pdf](https://www.chesapeakebay.net/channel_files/25874/producer_survey_recommendation_report_2018-02-14.pdf).

Options are being explored on how to continue this survey using these approved protocols on a regular basis.

*BMPs Captured:*

**Nutrient Management, Animal Waste Management Systems, Barnyard Runoff Controls, Soil Conservation and Water Quality Plans, Grassed Buffers- with and without Stream Fencing, Forested Buffers- with and without Stream Fencing**

## **Manure Transport Tracking Pilot – Lancaster County**

Currently, information on manure transport is collected from Nutrient Balance Sheet quarterly activity reports submitted by County Conservation Districts to the SCC. These

reports include information on the amounts, as well as the “sources” and “destinations”, of the manure within, and outside of, the county and the Chesapeake Bay Watershed. One of the priority initiatives in Lancaster County’s Countywide Action Plan is to initiate better documentation of current manure transport practices. This will define an accurate baseline and provide a way of measuring future progress. Depending on the success of this pilot, expanding the protocols developed to other counties in the watershed will be explored.

*BMPs Captured:*  
**Manure Transport**

## **Manure Treatment Technologies**

These technologies are treatment and site specific. Certification of a manure treatment technology involves administrative completeness and technical reviews of a certification request that must include a detailed description of the technology process, all inputs and outputs of nutrients, the calculation methodology, and a verification plan detailing exactly what information will be provided to verify that the facility has generated credits.

Verification involves administrative completeness and technical reviews of the verification request to ensure that the facility has followed its verification plan and correctly calculated the credits generated.

If the technology involves wastewater treatment and a discharge or manure storage (depends on the type of manure and whether the thresholds under 91.36(a) are exceeded), then an NPDES or WQM permit may be required. Depending on the technology and any volatilized emissions, an air quality permit may be required (e.g., thermochemical – we have one of these facilities that has generated credits and needs an air quality permit). There may also be waste permits required depending on the process and what byproducts or waste are produced.

*BMPs Captured:*  
**Manure Treatment Technology**

## **NRCS Remote Sensing (Potomac Pilot)**

NRCS and DEP’s Remote Sensing proof of concept effort to determine if aerial imagery could be used to identify and inventory BMPs was carried out in the five counties of the Potomac River Basin by analyzing grids within the study area. A total of 28 NRCS conservation practices were targeted for identification in the pilot project. The list of practices was based on BMPs that could be detected remotely. Field verification was used to assess accuracy. Five percent of farms in Somerset, Bedford, Fulton and Adams County were visited while ten percent of the farms were visited in Franklin County. Field verification methods were established based on the agreed scope of work by NRCS, DEP, and EPA. The CBP’s Agriculture Workgroup approved only a limited number of practices (limited population size) based on specific remote sensing

statistical standards for accuracy developed by a contractor for the Chesapeake Bay Program Partnership Agriculture Workgroup.

The final report (December 13, 2016) is available at the link below:

[https://www.chesapeakebay.net/channel\\_files/24633/assessment\\_of\\_pilot\\_remote\\_sensing\\_12-13-2016.pdf](https://www.chesapeakebay.net/channel_files/24633/assessment_of_pilot_remote_sensing_12-13-2016.pdf).

*BMPs Captured:*

**Forest Buffers, Prescribed Grazing, Access Control, Fencing, and Mortality Composters.**

## **CAFO Electronic Reporting**

Pennsylvania will be developing an electronic reporting form for CAFO Annual Reporting in order to meet EPA's Electronic Reporting Rule requirements. Part of the existing annual report includes self-reporting of BMPs that had been implemented during the reporting year. DEP intends to utilize this information either to report directly (i.e. manure storage facility) or to verify industry trends (i.e. species of cover crop).

*BMPs Captured:*

**All Ag BMPs, but focus is on the following: Animal Waste Management Systems, Manure Treatment Technology, Nutrient Management – Supplemental N and P, Cover Crop (Commodity), Dairy Precision Feeding**

## **Programs and Projects – Urban Stormwater**

### **MS4 Electronic Reporting**

Pennsylvania is developing an electronic reporting system for MS4 Annual Reports. The system is being developed in phases and will eventually collect all information needed to comply with the eReporting Rule for MS4 program reports. MS4s will report their inventories of PCSM BMPs and new BMPs implemented under Pollutant Reduction Plans and TMDL Plans, which will be validated against other sources of PCSM BMP data for submission to EPA for use in the Chesapeake Bay Model.

*BMPs Captured:*

**Dry Detention Ponds and Hydrodynamic Structures, Dry Extended Detention, Vegetated Open Channels, Performance Standards: Infiltration Practices, Performance Standards: Bioretention Practices, Wet Ponds and Wetlands, Stream Restoration**

### **PCSM and BMP reporting using ePermitting**

With the design of the new ePermitting system, the following will be possible:

- The identification of the Drainage Area List where the BMP is located. This will allow better identification of which BMPs are in the Chesapeake Bay watershed
- The identification of locational data of the BMPs. This will allow the more accurate location of the PCSM BMPs for future inspection/verification. Currently the locational data is not captured as part of the permit but is captured as part of the NOT.
- The capturing of more accurate data on the single BMPs. Currently only the volume and acres treated is captured for each BMP type as part of the permit, not each individual BMP. The number of each type of BMP and the total volume and acreage treated by these BMPs is captured as part of the NOT.
- For inspection/verification, the final plans will be available immediately. Currently, the plans are only in hard copy format at the District office, Regional Office, or State Archive.

#### *BMPs Captured:*

**Dry Detention Ponds and Hydrodynamic Structures, Dry Extended Detention, Vegetated Open Channels, Performance Standards: Infiltration Practices, Performance Standards: Bioretention Practices, Wet Ponds and Wetlands**

### **Remote Sensing Using LiDAR**

DEP proposes to implement a pilot project to determine the feasibility of using Lidar imagery, potentially in combination with aerial imagery, to identify and catalogue the existence of storm water retention structures and other BMPs installed in the Tier 1 and Tier 2 counties identified in Pennsylvania's Phase 3 WIP. The project will be completed in two tasks:

- 1) Using a known dataset, with verified information obtained from one or more participating municipalities, will validate the use of LiDAR for the purposes of stormwater BMP feature identification and designed to locate BMPs with an 80% confidence level
- 2) Using protocols for on-site verification developed for this project, a full-scale analysis based on the results from step 1 will include 10% ground verification to
  - a) verify that our database of known Chapter 102 stormwater BMPs exist on the terrain and are functioning as designed and
  - b) capture locational information of other stormwater BMPs which were previously unaccounted for in the reporting.

Depending on resources and the lessons learned from this pilot, the program protocols may then be applied to the remaining counties in the watershed.

Intended outcomes of this project include:

- Identified features and locations for development of the MS4 inventories.
- Verified existence of known Chapter 102 permit and PCSM related BMPs and associated locational information.
- Identified orphan or unknown stormwater features for further investigation

- Identified wetland and stream restoration opportunities. Will require a certain percentage of ground truthing by the contractor
- Targeted areas for retro-fit opportunities at the state or municipal level.

**Qualifications** – Eligible entities should have experience dealing with mapping and geospatial data with the ability to run statistical analyses. Eligible entities must have knowledge of stormwater best management practices and training in the visual indicators and local inspection procedures.

**Note:** Given the level of accuracy of available lidar data, is it anticipated that results of the Remote Sensing project will be limited to locating BMPs with substantial changes in topography (detention ponds, infiltration ponds, large-scale swales). However, there may be newer technologies with more accuracy than traditional lidar that are capable of sensing smaller changes in topography. In this case, additional BMPs (smaller swales, bioretention practices, shallow basins, infiltration trenches) may also be located during the Remote Sensing project.

**Reference:**

Chesapeake Bay Program Water Quality Goal Implementation Team BMP Verification Committee (October, 2014). Strengthening Verification of Best Management Practices Implemented in the Chesapeake Bay Watershed: A Basinwide Framework. Appendix B: Urban Stormwater BMP Verification Guidance, Part 5: Guidance for Verification of Semi-Regulated BMPs.

*BMPs existing which we hope to identify:*

**Stream Restoration, Wetland Restoration, Dry Detention Ponds and Hydrodynamic Structures, Dry Extended Detention, Vegetated Open Channels, Performance Standards: Infiltration Practices, Performance Standards: Bioretention Practices, Ag Stream Restoration, Urban Stream Restoration, Wetland Creation**

*Restoration opportunities we hope to highlight:*

**Stream Restoration, Wetland Restoration, locations with legacy sediment**

## Programs and Projects – Forestry

### **Forestry Remote Sensing Project**

As part of the Chesapeake Bay Phase 6 Watershed Model development, Chesapeake Conservancy and others completed land cover mapping for the entire watershed. This mapping included an assessment of land cover and assignment of land use to define the acreages of land use within each land-river segment in the model. Additionally, aerial imagery was used to map and identify buffered and unbuffered stream reaches in the watershed. This work was completed through the Chesapeake Bay Land Use Workgroup. The workgroup has committed to repeating this mapping effort in 5 to 7 years to establish updated land use in the model and assess the progress of buffer implementation over this period. While other local mapping efforts may additionally be

completed during this period, the Chesapeake Conservancy's work for the Land Use Workgroup is expected to serve as a primary data source for Pennsylvania land use change and buffer assessment going forward. For more information, please see the Chesapeake Conservancy Workplan for project period June 21, 2018- June 20, 2019.

#### *BMPs Captured:*

Urban Forest Buffers, Riparian Forest Buffers, Grassed Buffers-with and without Stream Fencing, Forested Buffers-with and without Stream Fencing, Wet Ponds and Wetlands, Urban Forest Expansion/Conservation Landscaping, Urban Tree Canopy Expansion, Land Conservation

## **Chesapeake Bay Foundation Keystone 10 Million Trees**

The verification plan we are using for riparian buffers and tree canopy initiatives are very similar and rely heavily on our partners to ensure projects are implemented and reported properly.

Priority Initiative 1: Forested Riparian Buffer

BMP Name: Forested riparian buffer

There are Existing and New programs that are included in this BMP type; some BMPs will be funded through multiple sources that could include Existing and/or New programs. The list of Existing and New programs is evolving during the course of the K10 campaign.

- Existing – CREP, Growing Greener, other funding sources
- New – Programs not associated with funding sources listed in “Existing”.

What factors can cause the BMP to fail?

Natural disasters, invasive species, improper plantings and/or maintenance, deliberate removal (by landowner or other).

Who performs the verification?

CBF staff and trained CBF partners are the main verifying agents. Depending on the program type additional verification process may be required (e.g., CREP).

How is it verified?

The planting is verified when the partner submits planting event information after the planting event has occurred, which can include attaching planting images, changing project status to complete, and additional notes. Partners typically have knowledgeable staff who are familiar with how to implement a successful tree planting event and all partners have been trained on how to use our Tree Tracker tool to submit their implementation information. CBF staff verify the planting prior to reporting submissions using remote sensing, spatial indicators, tree density, and partner communications and education. Sites that are reported as this BMP type need to be located within the riparian corridor of a waterway and be a minimum of 35 feet from the top of bank. The tree density of the planting has to be at least 100 trees/acre. A planting site must meet both the tree density and distance from waterway criteria to be verified as a forested riparian buffer. As part of the tree request form that partners submit for each of their planting events, they can submit their planting event as a riparian buffer BMP and these sites are

then verified by calculating the tree density. If a site has any discrepancies it is marked for follow-up with the partner organization that completed the planting.

As the K10 program progresses we will be incorporating long-term verification techniques that include using remote sensing to determine the health of past planting sites. This can only be implemented approximately 5 years post-planting once the plantings “canopy out” and this technique would be most successful for planting sites with a high density of trees.

Do resources exist to support verification techniques? Yes – CBF staff, trained partners, and CBF GIS staff.

How often does it have to be verified / re-verified? Currently once, at installation.

What actions could help support better verification for the practice in the next few years?

A maintenance platform on which partners are trained to monitor planting sites, linked to live weather data. This would assist CBF staff in notifying partners when their planting sites may be/have been compromised due to flooding or other factors.

Priority Initiative 2: Forested Riparian Buffer—Narrow

In certain situations, including but not limited to landscape restrictions and landowner preferences, inhibit the planting of a minimum 35’ buffer. In these circumstances, the K10 campaign seeks to accommodate partner and landowners in planting trees in the riparian coordinator. This is facilitated primarily through private funding sources.

What factors can cause the BMP to fail?

Natural disasters, invasive species, improper plantings and/or maintenance, deliberate removal (by landowner or other).

Who performs the verification?

CBF staff and trained CBF partners are the main verifying agents. Depending on the program type additional verification process may be required (e.g., CREP).

How is it verified?

The planting is verified when the partner submits planting event information after the planting event has occurred, which can include attaching planting images, changing project status to complete, and additional notes. Partners typically have knowledgeable staff who are familiar with how to implement a successful tree planting event and all partners have been trained on how to use our Tree Tracker tool to submit their implementation information. CBF staff verify the planting prior to reporting submissions using remote sensing, spatial indicators, tree density, and partner communications. Sites that are reported as this BMP type need to be located within the riparian corridor of a waterway and be a width of 10 to 35 feet from the top of bank. The tree density of the planting must be at least 100 trees/acre. A planting site must meet both the tree density and distance from waterway criteria to be verified as a narrow forested riparian buffer. As part of the tree request form that partners submit for each of their planting events, they can submit their planting event as a riparian buffer BMP and these sites are then verified by calculating the tree density. If a site has any discrepancies it is marked for follow-up with the partner organization that completed the planting.

As the K10 program progresses we will be incorporating long-term verification techniques that include using remote sensing to determine the health of past planting sites. This can only be implemented approximately 5 years post-planting once the plantings “canopy out” and this technique would be most successful for planting sites with a high density of trees.

Do resources exist to support verification techniques? Yes – CBF staff, trained partners, and CBF GIS staff.

How often does it have to be verified / re-verified? Currently once, at installation.

What actions could help support better verification for the practice in the next few years?

A maintenance platform on which partners are trained to monitor planting sites, linked to live weather data. This would assist CBF staff in notifying partners when their planting sites may be/have been compromised due to flooding or other factors.

Priority Initiative 3: Tree Canopy

BMP Name: Upland Planting (Urban or Rural/Agriculture)

There are Existing and New programs that are included in this BMP type; some BMPs will be funded through multiple sources that could Existing and/or New programs. The list of Existing and New programs is evolving during the course of the K10 campaign.

- Existing – CREP, Growing Greener, TreeVitalize
- New – Programs not associated with funding sources listed in “Existing”.

What factors can cause the BMP to fail?

Natural disasters, invasive species, improper plantings and/or maintenance, deliberate removal (by landowner or other).

Who performs the verification?

CBF staff and trained CBF partners are the main verifying agents. Depending on the program type additional verification process may be required (e.g., CREP).

How is it verified?

The planting is verified when the partner submits planting event information after the planting event has occurred, which can include attaching planting images, changing project status to complete, and additional notes. Partners typically have knowledgeable staff who are familiar with how to implement a successful tree planting event and all partners have been trained on how to use our Tree Tracker tool to submit their implementation information. CBF staff verify the planting prior to reporting submissions using remote sensing, spatial indicators, tree density, and partner communications.

Sites that are reported as Upland Plantings need to be designated as “urban” or “rural/agriculture”; to verify this designation CBF staff use land cover data (e.g., Chesapeake Conservancy), aerial imagery, and slope data to determine whether the water that would drain to the tree planting site is coming from impervious surface (urban) or other (rural/ag). Staff also consider the presence of stormwater infrastructure as an indicator of an urban designation. Sites with minimal impervious and/or stormwater infrastructure are considered “rural/agriculture”. Sites that are reported as Urban Plantings are located in highly dense impervious areas. If a site has any discrepancies it is marked for follow-up with the partner organization that completed the planting.

As the K10 program progresses we will be incorporating long-term verification techniques that include using remote sensing to determine the health of past planting sites. This can only be implemented approximately 5 years post-planting once the plantings “canopy out” and this technique would be most successful for planting sites with a high density of trees.

Do resources exist to support verification techniques? Yes – CBF staff, trained partners, and CBF GIS staff.

How often does it have to be verified / re-verified? Currently once, at installation.

What actions could help support better verification for the practice in the next few years?

A maintenance platform on which partners are trained to monitor planting sites, linked to live weather data. This would assist CBF staff in notifying partners when their planting sites may be/have been compromised due to flooding or other factors.

There are Existing and New programs that are included in this BMP type; some BMPs will be funded through multiple sources that could Existing and/or New programs. The list of Existing and New programs is evolving during the course of the K10 campaign.

- Existing – TreeVitalize
- New – Programs not associated with funding sources listed in “Existing”.

What factors can cause the BMP to fail?

Natural disasters, invasive species, improper plantings and/or maintenance, deliberate removal (by landowner or other).

Who performs the verification?

CBF staff and trained CBF partners are the main verifying agents. Depending on the program type additional verification process may be required (e.g., CREP).

How is it verified?

The planting is verified when the partner submits planting event information after the planting event has occurred, which can include attaching planting images, changing project status to complete, and additional notes. Partners typically have knowledgeable staff who are familiar with how to implement a successful tree planting event and all partners have been trained on how to use our Tree Tracker tool to submit their implementation information. CBF staff verify the planting prior to reporting submissions using remote sensing, spatial indicators, and partner communications.

Sites that are reported as Urban Tree Canopy Expansion are verified by CBF staff use land cover data (e.g., Chesapeake Conservancy) and arial imagery to confirm that the tree planting occurred in an urban area that is not part of a riparian forest buffer or structural BMP and is not planted in a contiguous area. If a site has any discrepancies it is marked for follow-up with the partner organization that completed the planting.

As the K10 program progresses we will be incorporating long-term verification techniques that include using remote sensing to determine the health of past planting sites. This can only be implemented approximately 5 years post-planting once the plantings “canopy out” and this technique would be most successful for planting sites with a high density of trees.

Do resources exist to support verification techniques? Yes – CBF staff, trained partners, and CBF GIS staff.

How often does it have to be verified / re-verified? Currently once, at installation.

What actions could help support better verification for the practice in the next few years?

A maintenance platform on which partners are trained to monitor planting sites, linked to live weather data. This would assist CBF staff in notifying partners when their planting sites may be/have been compromised due to flooding or other factors.