Accounting for Uncertainty in Offset and Trading Programs

EPA Technical Memorandum

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Prepared by EPA Region III

CONTENTS

ABBREVIATIONS AND ACRONYMS

BMP	Best management practice
CBP	Chesapeake Bay Program
EPA	United States Environmental Protection Agency
MS4	Municipal separate storm sewer system
NPS	Nonpoint source
NPDES	National pollutant discharge elimination system
TMDL	Total maximum daily load
WIP	Watershed implementation plan
WSM	Watershed model
WWTP	Wastewater treatment plant

SCOPE

This technical memorandum addresses EPA's expectations for information the Chesapeake Bay jurisdictions[1] should incorporate when accounting for uncertainty when calculating credits for offsets and trading. Specifically, this technical memorandum identifies EPA's expectations for uncertainty in the Chesapeake Bay jurisdictions' offset and/or trading programs.

This technical memorandum is not official agency guidance and does not replace the EPA 2003 Trading Policy. Its purpose is to elaborate on EPA's expectations, set out in Appendix S and Section 10 of the Chesapeake Bay Total Maximum Daily Load (Bay TMDL), for the Bay jurisdictions' offset and/or trading programs. As stated in the Bay TMDL, the Bay jurisdictions' offset and/or trading programs are expected to be consistent with and supportive of the water quality goals of the Chesapeake Bay TMDL, including its allocations and assumptions and the common elements of Appendix S. This technical memorandum is applicable only in the Chesapeake Bay watershed and may be revised in the future.

EXECUTIVE SUMMARY

This technical memorandum addresses factors to consider when accounting for uncertainty in the calculation of credits used for offsets or trading in the Chesapeake Bay watershed. Uncertainty in trading or offsets comes from multiple sources, including meteorological factors and effectiveness of best management practices (BMP).

Meteorological factors can affect uncertainty through annual variation in precipitation, temperature, evapotranspiration, wind, solar radiation, dew point, and cloud cover, especially when the variance is high when compared to average conditions used in management models. The ability to accurately monitor pollutant loads from nonpoint or diffuse sources introduces uncertainty associated with implementation of BMPs. Evaluating BMP effectiveness, or the ability of a BMP to achieve pollutant reductions, includes consideration of operational conditions, implementation date, time to maturity, and natural variability. All of these may introduce elements of uncertainty.

An uncertainty ratio of 1:1 is acceptable for transactions between point sources that have a National Pollutant Discharge Elimination System (NPDES permit), i.e., a direct and representatively monitored source to a direct and representatively monitored source. EPA expects the Chesapeake Bay jurisdictions to accept no lower than a 1:1 uncertainty ratio.

Challenges exist in accurately measuring nonpoint source credit generation because of complexities and costs associated with assessing and monitoring pollutant load reductions from BMPs, especially when compared to the relatively straightforward measurement of loads from point sources. Therefore, offset and trading programs may be expected to apply higher uncertainty ratios to credit generation by nonpoint sources.

When an offset or trading transaction is conducted between a credit-generating nonpoint source and a credit-purchasing point source, EPA expects an uncertainty ratio of at least 2:1 to be used (e.g., 2 pounds of nitrogen reduction is equivalent to 1 pound of nitrogen pollution reduction credit), unless otherwise justified as

[1] The Bay jurisdictions are: Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia.

explained in this technical memorandum. When direct and representative monitoring of a nonpoint source is performed at a level similar to that performed at traditional NPDES point sources (i.e., wastewater treatment plants and industrial sources), and there is consistency in operation of the nonpoint source, an uncertainty ratio as low as 1:1 may be appropriate. In such cases, EPA expects jurisdictions to demonstrate that the lower ratio is justified and protective of water quality. Verification of practice implementation does not substitute for direct monitoring of pollutant loads.

A ratio of less than 2:1 may be appropriate for projects involving implementation of BMPs for land conservation that ensures permanent protection through a conservation easement or other instrument attached to the deed and where load reductions can be reliably determined.

The recommendations in this technical memorandum are consistent with the Bay TMDL, the Clean Water Act, implementing regulations, guidance, EPA's 2003 Water Quality Trading Policy,[2] and the 2007 Water Quality Trading Toolkit for NPDES Permit Writers.

INTRODUCTION

The 2010 Chesapeake Bay Total Maximum Daily Load (Bay TMDL) established limits (caps) on total nitrogen, phosphorus, and sediment loads into the Bay.[3] After 2010, any new or increased loads above those limits are expected to be offset by equal reductions of that pollutant by an existing source or sources. This applies to new or increased loads from existing sources (e.g., a wastewater treatment plant that adds additional subdivisions to its effluent intake) and new sources (e.g., new development that generates stormwater runoff). Credits can be used for offsetting purposes.

The Bay TMDL also contemplates the use of trading for existing sources to meet TMDL allocations. In principle, such activities may offer a more cost-effective way of meeting allocations, as those sources that can reduce their loads more cheaply can sell credits to those sources for which the same reduction would be more expensive.

Any water quality offset and/or trading programs the Bay jurisdictions develop are expected, under the Bay TMDL, to be consistent with the Clean Water Act,[4] its implementing regulations, EPA's 2003 Water Quality Trading Policy,[5] and the 2007 Water Quality Trading Toolkit for NPDES Permit Writers.[6]

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[2] United States Environmental Protection Agency, Water Quality Trading Policy (2003), available at http://www.epa.gov/owow/watershed/trading/finalpolicy2003.pdf. Last accessed 11/30/2013.
[3] Full text of the Bay TMDL is available at http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/tmdlexec.html. Last accessed 11/30/2013.
[4] Clean Water Act, 33 U.S.C. §§ 1251 et seq.
[5] United States Environmental Protection Agency, Water Quality Trading Policy (2003), available at http://www.epa.gov/owow/watershed/trading/finalpolicy2003.pdf. Last accessed 11/30/2013.
[6] United States Environmental Protection Agency, "Water Quality Trading Toolkit for Permit Writers," Updated June 2009. Available online at http://water.epa.gov/type/watersheds/trading/WQTToolkit.cfm. Last accessed 11/30/2013.

TRADING RATIOS IN OFFSETS AND TRADES

Trading ratios are commonly used in offset and trading programs to ensure that credits generated result in actual reductions of pollutant loads. Although trading programs use various types of trading ratios and different terms to describe them, the basic categories are delivery, location, equivalency, retirement, and uncertainty:

1. **Delivery factors** — account for the distance and unique watershed features (e.g., hydrologic conditions) that affect pollutant fate and transport between trading partners.
2. **Equivalency ratios** — account for trading different forms of the same pollutant or cross-pollutant trading.
3. **Retirement ratios** — set aside a portion of credits for improving water quality.
4. **Uncertainty ratios** — account for challenges in accurately measuring pollutant load reductions, especially for nonpoint sources, and the level of confidence in implementing BMPs. [7]

Accounting for uncertainty is the focus of this technical memorandum. The purpose of this technical memorandum is to address EPA's expectations for information the Chesapeake Bay jurisdictions should incorporate to account for uncertainty when credits are calculated for offsets and trading. These expectations should help ensure that total nitrogen, phosphorus, and sediments loads will decrease as a result of water quality trading.

The Bay jurisdictions' offset and/or trading programs may include trading ratios in addition to the expectations discussed herein, although any such additional components should be consistent with EPA's expectations in the Bay TMDL and technical memoranda related to water quality trading and offsets for the Chesapeake Bay.

CAUSES OF UNCERTAINTY

A number of factors may cause a BMP to produce lower than expected pollutant load reductions, including, but not limited to:

1. **Meteorological conditions** — differences in temperature, evapotranspiration, wind, solar radiation, dew point, cloud cover, precipitation timing and intensity produce variable effects on pollutant loads.
2. **BMP Effectiveness**
3. **Operational conditions** — variations in how a BMP is operated and maintained.
4. **Implementation date and time to maturity** — time between BMP implementation and realization of the estimated BMP control efficiency.
5. **Natural condition** — variation due to differences in heterogeneity in soils, topography, and management.
6. **Failed credit generation** — planned credits are not generated.

While this list is not intended to be exhaustive, it does represent the predominant causes of uncertainty. Each of these causes is addressed in greater detail in the sections below.

[7] See, e.g., Cynthia Morgan and Ann Wolverton, Water Quality Trading in the United States, Working Paper# 05-07 for the National Center for Environmental Economics, U.S. EPA, at 15-16 (June, 2005); World Resources Institute (WRI), Water Quality Trading Programs: An International Overview, at 9-11 (March 2009).

ACCOUNTING FOR LOAD ESTIMATION AND MEASUREMENT METHODS AND METEOROLOGICAL FACTORS IN POLLUTANT LOADS

Meteorological factors are significant sources of uncertainty that are unaccounted for and can impact pollutant loads in at least two ways: (1) hydrologic uncertainty and (2) monitored versus modeled (unmonitored) loads.

Hydrologic Uncertainty — The uncertainty ratio recommended in this technical memorandum is designed partially to account for the variability in loads and BMP effectiveness as a result of annual variation in meteorological factors. These factors include: precipitation, temperature, evapotranspiration, wind, solar radiation, dew point, and cloud cover.

The CBP Partnership's Watershed Model (WSM) does not use conservative values for estimating the amount of nutrients and sediments reaching the Chesapeake Bay, and thus contains no buffer to account for high variance from average conditions. The WSM is designed and intended as a management tool for representing consistent hydrologic conditions over a constant 10-year period (1991-2000). The WSM averages the effect of rainfall over the 10-year period, including all wet and dry weather as well as extreme events during the 1991-2000 period. Uncertainty can arise when the hydrologic conditions for a year in which credits are generated are different from the WSM 1991-2000 simulated average loads. An uncertainty ratio provides a buffer for cases in which hydrologic conditions are not average.

Monitored Versus Modeled (or Unmonitored) Loads — The uncertainty ratio recommended in this technical memorandum also is designed to address the difference between monitored and modeled loads. NPDES point sources are typically monitored for flows and concentrations. The municipal, state, and federal review of operations typically associated with a NPDES facility adds certainty to estimated load reductions and credit calculations. By contrast, it is often impractical or impossible to directly monitor loads from nonpoint source loads, and loads are most often modeled estimates that introduce additional uncertainties associated with the implementation of any particular BMP.

The amount of precipitation in a given year has a substantial impact on loads for all sources. Wastewater treatment plants (WWTPs) can develop relatively accurate credit calculations because loads are routinely monitored and measured. Loads from nonpoint sources (e.g., agriculture) and sources where the loads are generated from diffuse locations (e.g., stormwater) are not as readily monitored or measured making it difficult to develop accurate calculations.

BMP EFFECTIVENESS

BMP effectiveness values are an integral component of the CBP Watershed Model, and the resultant calculations are used in a variety of plans and assessments for the Chesapeake Bay watershed. BMP effectiveness values express the pollutant reduction achieved by implementing a particular BMP compared to the load that would have been delivered before BMP implementation.[8] The Bay jurisdictions' Watershed Implementation Plans

[8] For example, if a BMP is assigned an effectiveness value of 60% for nitrogen, then the nitrogen load from the modeled land use on which the BMP is applied is decreased by 60%, and 40% of what would have been delivered without the BMP reaches a local water body. This should not be confused with the delivery factor, which calculates how much of that 40% reaches the Chesapeake Bay.

(WIPs)[9] include BMP implementation and predicted loads based on the BMP effectiveness values established by the CBP partnership. The Bay jurisdictions also have developed two-year milestones that include various BMPs and levels of implementation to achieve target loads. Those milestones also use established BMP effectiveness values in predicting loads. In addition, through an annual review process, actual BMP implementation is reported to determine load reductions using the established BMP effectiveness values. This Annual Progress Review assesses each jurisdiction's progress toward the Bay TMDL goals. The WIPs, milestones, and Annual Progress Review all use approved BMPs and their established effectiveness values.

BMPs and their effectiveness values are established using a protocol[10] that requires involvement by experts and members of the CBP partnership.[11] As of December2013, the CBP partnership has approved over 200 BMPs for use in the Bay watershed and has established effectiveness values for nitrogen, sediment, and phosphorus for those BMPs, as applicable.

The process used to develop the CBP partnership BMP effectiveness values is designed to arrive at unbiased and realistic values. The CBP partnership approach references small watershed monitoring studies and is designed to remove unwarranted optimism in research values relative to real-world implementation by adjusting effectiveness values found in literature (commonly from well-managed research plots on experimental farms) to reflect operational conditions, implementation date, time to maturity, temporal effectiveness (i.e., seasonal variability in BMP effectiveness), and variation in natural conditions such as heterogeneity in soils and topography.[12]

The CBP partnership BMP effectiveness values vary across the Chesapeake Bay watershed for conditions such as implementation date, growth rate of crops, and physiographic region. These adjustments generate BMP effectiveness values that are unbiased and realistic but not necessarily conservative because they were established using realistic estimates for load reductions that do not reflect additional sources of uncertainty, especially hydrological variability and operation and maintenance over the lifetime of BMPs. The uncertainty ratio recommended in this technical memorandum is designed partially to account for those additional sources of uncertainty.

The Bay jurisdictions that currently have offset and/or trading programs (Maryland, Pennsylvania, and Virginia) use the CBP partnership BMP effectiveness values in their offset and/or trading programs. Those Bay jurisdictions also have accommodations for additional BMPs not approved by the CBP partnership. As described in

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[9] Phase II WIPs are accessible at http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/EnsuringResults.html?tab2=7.

[10] Protocol for Development, Review, and Approval of Loading and Effectiveness Estimates for Nutrient and Sediment Controls in the Chesapeake Bay Watershed Model. http://www.chesapeakebay.net/about/programs/watershed_implementation_plan_tools#1, last accessed 12/13/2013.

[11] The CBP is a unique regional partnership that includes Maryland, Pennsylvania, Virginia, the District of Columbia, the Chesapeake Bay Commission, EPA, federal agencies, and participating advisory groups. The headwater states of Delaware, New York, and West Virginia participate as full partners on issues related to water quality. Each of the CBP partners agrees to use its own resources to implement projects and activities that advance Bay and watershed restoration.

[12] See, e.g., Simpson and Weammert, 2009. Developing Best Management Practice Definitions and Effectiveness Estimates for Nitrogen, Phosphorus and Sediment in the Chesapeake Bay Watershed. Available at: http://archive.chesapeakebay.net/pubs/BMP_ASSESSMENT_REPORT.pdf. Last accessed 12/13/2013.

the technical memorandum on Components of Credit Calculation, EPA expects the Bay jurisdictions to generate credits (either for offset or trade purposes) using only those practices approved by the CBP partnership.

FAILED CREDIT GENERATION AND VERIFICATION

While failed credit generation is a cause for concern and may generate ambiguity and liability in credit transactions, EPA believes that use of an uncertainty ratio may not be the most appropriate way to account for credits that fail to be generated. Rather, failed credit generation should be managed as a verification issue or special conditions that might be applied to a permit. Ultimately, the permit holder is held accountable for meeting the requirements of its permit. Liability on the part of the credit generator may be handled using the expectation of Appendix S of the Bay TMDL regarding documentation of agreements between parties to the transaction.[13]

Verification is the process of ensuring that a BMP is implemented according to a standard. EPA expects the Bay jurisdictions to have a comprehensive system in place for credit verification through which BMPs are routinely evaluated to ensure that they are installed, performing and maintained as designed. Verification of BMP implementation is a critical component of trading and offset programs, but it does not address uncertainty due to the inability or impracticability to accurately monitor actual reductions in pollutant loads.

Some state offset or trading programs, as well as some third party credit brokers, have established a reserve ratio that may be used as an insurance pool for failed credit generation. The existence of a reserve ratio is not a substitute for an uncertainty ratio, which addresses uncertainty for reasons other than solely failed credit generation.

Verification is expected to be more fully addressed in a separate EPA technical memorandum.

EPA EXPECTATIONS FOR UNCERTAINTY RATIOS

To effectively use credits to meet TMDL load allocations, parties involved with credit transactions and authorities that oversee credit transactions must know, with as much certainty as possible, how many credits will be generated and that these credits are real and quantifiable. Because monitoring every BMP to quantify accurately the amount of credits generated is impractical, the use of an uncertainty ratio allows a buyer to purchase credits with greater certainty. Given that certainty is higher for traditional NPDES point sources (WWTP and industrial sources) and that certainty is lower for nonpoint sources, higher uncertainty ratios are expected to be applied to credits generated by nonpoint sources.

EPA expects the Bay jurisdictions to apply an uncertainty ratio of at least 1:1 to transactions involving credits generated by point sources since point sources are directly and representatively monitored in a regulatory context. Direct and representative sampling of point sources is required as part of the federal NPDES program, which helps to establish a level of certainty. In most cases, the NPDES program is administered by

[13] Appendix S of the TMDL, 8(h) at S-5 available at: http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/FinalBayTMDL/AppendixSOffsets_final.pdf, last accessed on 3/4/2013.

authorized states.[14] To assist Bay jurisdictions in ensuring that point sources are directly and representatively monitored, EPA plans to issue a separate technical memorandum to address representative sampling.

In a review of more than 20 water quality trading programs across the United States, EPA found that a 2:1 uncertainty ratio was most widely adopted, although uncertainty ratios as high as 4:1 were observed. EPA believes that 2:1 represents an uncertainty ratio that is adequately conservative and protective of water quality while not being unduly restrictive so as to discourage transactions. As the Bay jurisdictions gain additional experience from trading programs, the ratio may be reevaluated.

EPA expects the Bay jurisdictions to apply an uncertainty ratio of at least 2:1 to transactions involving credits generated by nonpoint sources, unless otherwise justified as explained in this technical memorandum. This ratio addresses uncertainty generated by assuming average hydrology, average BMP effectiveness over the lifespan of the BMP, and monitored vs. modeled loads. A ratio of at least 2:1 would also apply to credits generated in the context of stormwater.

If a Bay jurisdiction can demonstrate factors that ameliorate the presumed 2:1 uncertainty ratio for credits generated by nonpoint sources, such as direct and representative monitoring of a nonpoint source performed at a level similar to that performed at traditional NPDES point sources as well as consistency in operation that approaches that of a traditional point source, EPA will work with the Bay jurisdiction to determine whether a ratio other than 2:1 would be appropriate.

EPA believes that a ratio of less than 2:1 may be appropriate for projects involving implementation of land conservation measures that ensure permanent protection through a conservation easement or other instrument attached to the deed and where load reductions can be reliably determined. Examples of land conservation measures may include, though are not limited to, reforested lands, vegetated buffers, and restored wetlands that are subject to perpetual easement and annual inspections.

Bay jurisdictions may determine whether to apply the uncertainty ratio at the point of credit generation or at the point of sale.

MONITORING INCENTIVE FOR DECREASING UNCERTAINTY

Where uncertainty can be decreased substantially through monitoring, the uncertainty ratio may also be decreased; although in no event should the ratio be lower than 1:1. Monitoring should meet the expectations described in EPA's forthcoming Representative Sampling technical memorandum that are applied to point sources.[15] These data should be provided to the permitting authority for review on a regular basis.

[14] NPDES regulatory information may be found here: http://cfpub.epa.gov/npdes/. Last visited 1/25/2013. For specific authorizations, see http://cfpub.epa.gov/npdes/statestats.cfm.
[15] Verification is expected to be more fully addressed in a forthcoming EPA technical memorandum

CONCLUSIONS - SUMMARY OF POLICY OBJECTIVES

To effectively use credits to meet TMDL load allocations, parties involved with credit transactions and authorities that oversee credit transactions must know, with as much certainty as possible, how many credits will be generated and that these credits are real and quantifiable. EPA expects the Bay jurisdictions to address uncertainty by employing an uncertainty ratio to offsets and trades.

The following represents EPA expectations related to the use of an uncertainty ratio as set out in this technical memorandum:

- EPA expects the Bay jurisdictions to apply an uncertainty ratio of at least 1:1 to transactions involving credits generated by point sources
- EPA expects the Bay jurisdictions to apply an uncertainty ratio of at least 2:1 to transactions involving credits generated by nonpoint sources, unless otherwise justified as explained below.
    - If a Bay jurisdiction can demonstrate factors that ameliorate the presumed 2:1 uncertainty ratio for credits generated by nonpoint sources, such as where direct and representative monitoring of a nonpoint source is performed at a level similar to that performed at traditional NPDES point sources and where consistency in operation approaches that of a traditional point source, EPA will work with the Bay jurisdiction to determine whether a ratio other than 2:1 would be appropriate. In such cases, EPA expects jurisdictions to demonstrate that the lower ratio is justified and protective of water quality.
    - Where uncertainty can be decreased substantially through monitoring, the uncertainty ratio may also be decreased; although in no event should the ratio be lower than 1:1. Monitoring should meet the expectations described in EPA's forthcoming Representative Sampling technical memorandum that are applied to point sources.[16] These data should be provided to the permitting authority for review on a regular basis. Where actual discharges do not match anticipated discharges, a "true-up" or reconciliation process should be employed. If a "true-up" is not possible, additional credits generated cannot be sold. If monitored discharges are greater than anticipated discharges, those anticipated credits have not been generated. If the converse is true, more credits may be sold.
    - A ratio of less than 2:1 may be appropriate for projects involving implementation of BMPs for land conservation that ensures permanent protection through a conservation easement or other instrument attached to the deed and where load reductions can be reliably determined.
- Bay jurisdictions may determine whether to apply the uncertainty ratio at the point of credit generation or at the point of sale.
- EPA expects that the Bay jurisdictions will use no less than a 1:1 uncertainty ratio when use of a 1:1 ratio is justified under the circumstances described in this technical memorandum.

The Bay jurisdictions' offset and/or trading programs may include trading ratios in addition to the expectations discussed herein, although any such additional components should be consistent with EPA's expectations in the Bay TMDL and technical memoranda related to water quality trading and offsets for the Chesapeake Bay.

[16] Verification is expected to be more fully addressed in a forthcoming EPA technical memorandum

The expectations in this technical memorandum are consistent with the Bay TMDL, the Clean Water Act, implementing regulations, guidance, EPA's 2003 Water Quality Trading Policy,[17] and the 2007 Water Quality Trading Toolkit for NPDES Permit Writers.

[17] United States Environmental Protection Agency, Water Quality Trading Policy (2003), available at http://www.epa.gov/owow/watershed/trading/finalpolicy2003.pdf. Last accessed 11/30/2013.